College of Agricultural Economics, Rural Sociology and Extension (CAERSE)
Michael Okpara University of Agriculture,
UMUDIKE, ABIA STATE, NIGERIA

FOOD SECURITY & CLIMATE CHANGE: NIGERIA'S CONTEMPORARY SOCIO-POLITICAL & TECHNOLOGICAL ENVIRONMENT

PROCEEDINGS

OF MAIDEN INTERNATIONAL CONFERENCE

held at Anyim Pius Anyim Auditorium
on 14-16 May, 2025

EDITORS

J.C. Onwumere, J.B. Simonyan,
N.M. Agwu, C.U. Nwaobiala,
U.A. Kalu, & L.D.N. Nnadozie

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Food Security & Climate Change:
Nigeria's Contemporary Socio-Political & Technological Environment

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Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria

held 14-16 May 2025, at Anyim Pius Anyim Auditorium, MOUAU

E D I T O R S
J.C. Onwumere, J.B. Simonyan, N.M. Agwu,
C.U. Nwaobiala, U.A. Kalu, & L.D.N. Nnadozie

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DEAN'S ADDRESS

A Welcome Address delivered by the Dean, College of Agricultural Economics, Rural Sociology and Extension (CAERSE), Michael Okpara University of Agriculture, Umudike Abia State Nigeria Professor Nnanna Mba Agwu on the Occasion of Opening Ceremony of the Maiden International Conference this day, Thursday 15th May, 2025

PROTOCOL.

I am so excited today as we gather here for the opening ceremony of the maiden edition of the College of Agricultural Economics, Rural Sociology and Extension (CAERSE) conference tagged 'CAERSE 2025'. Let me welcome our Chairman, the keynote speaker, the distinguished speaker, Prof. Galina Astratova, who will be speaking to us all the way from the Ural Federal University, Yekaterinburg, Russia, the lead paper presenter and all participants to this conference. I want to thank our dear Vice-Chancellor, Prof. Maduebibisi Ofo Iwe, *CFS* and his management team for providing the enabling environment for this kind of engagement to thrive.

I most sincerely thank the Almighty God for HIS mercies and enablement to be here today and talking about this conference. May HIS name alone be praised!!!

An academic conference as this is an event for researchers to present and discuss their scholarly works. It provides an important channel for exchange of information between researchers. Participating in academic conferences also helps in learning in terms of presentation skills and academic habits, receiving feedback from peers for one's own research, engagement in informal communication with peers about work opportunities and collaborations, as well as getting an overview of current research in one or more disciplines.

However, academic conferences are not just about knowledge dissemination, idea exchange, and collaboration among scholars, researchers, and professionals. They can transform host destinations beyond their educational purposes, sparking a wave of economic, social, and cultural growth. These events significantly impact host destinations, enhancing their reputation and attractiveness and of course bring change in host institutions. While networking among colleagues is assured, intercultural dialogue, tolerance and inclusivity is promoted, overall, attendees understanding is also enriched.

Bearing all these benefits in mind, I made up my mind on assumption of office as the Dean of CAERSE to kick start annual conferences in line with our mandate and contemporary issues bothering our areas of specialization, Nigeria's agricultural and socio-economic development as well as international demands which I know is long overdue as the first college established in the University.

The theme of the conference 'Food Security and Climate Change: Nigeria's Contemporary Socio-political and Technological Environment' is considered appropriate at this time given the effect of climate change around the world, particularly ours as a developing nation and in line with the sustainable development goals of the United Nations.

According to World Bank projections for a very high emissions scenario, Nigeria is likely to experience a significant rise in temperatures, reaching between 2.9 °C and 5.7 °C by the year 2100. The country ranks 157th out of 187 in the University of Notre Dame Global Adaptation Initiative (ND-GAIN) 2022 ranking index. This ranking rates a country's vulnerability to climate change in combination with its readiness to improve resilience to climate change. Again, the World Bank, had noted that around 78% of Nigeria's land area is devoted to agriculture, the majority of which is rain-fed (with less than 1% irrigated) and carried out by small-scale farmers using traditional methods.

In addition, its varied geography exposes it to many extreme weather phenomena which may lead to serious disruptions.

However, the issue is more than just environmental; it is deeply socio-political. Our clime is characterized with large inequalities, poor governance, inconsistent policies, poor coordination and inadequate resources which has exacerbated the factors leading to climate change and its mitigation. Given all of these, there is no better time than now for researchers to brain storm on ways to handle these challenges associated with climate change and hence our theme.

For the researchers who are presenting their works today, we are assuring you that the outcome of these will not end here. Our own journal which will soon be up will certainly absorb the good ones. These moves no doubt will boost the image of the college and our university and also help our younger academics among other benefits. This is part of the vision behind this conference.

The Chairman, Vice – Chancellor, our guest speakers, other special guests and participants, on behalf of the entire staff and students of the college, I warmly welcome you all once again to this historic event for CAERSE and wish us all a very fruitful conference session.

Thank you and remain blessed.

Prof. Nnanna Mba Agwu
Dean, College of Agricultural Economics, Rural Sociology and Extension (CAERSE)
Michael Okpara University of Agriculture, Umudike Abia State Nigeria

VICE-CHANCELLOR'S ADDRESS

Address of the Vice Chancellor on the Occasion of the Opening Ceremony of the Maiden International Conference of the College of Agricultural Economics, Rural Sociology and Extension (CAERSE), Michael Okpara University of Agriculture, Umudike Abia State Nigeria, Holding on Thursday 15th May, 2025 at Senator Anyim Pius Anyim Auditorium, MOUAU

PROTOCOL

It gives me special joy to witness yet another College-based international conference in our dear University MOUAU.

The conference with the theme "Food security and climate change: Nigeria's contemporary socio-political and technological environment" is an intellectual platform to showcase, limelight and enhance our research breakthroughs and collectively create a direction for more research efforts and opportunities. As a platform to pool ideas from a wide range of researchers, inventors, policy makers, public and private inventors, it is my hope and desire that the output from this conference will expand the frontiers of knowledge with cutting-edge approaches and remedies that will sufficiently address the many challenges of food security and climate change in many developing economies and beyond.

The narrations on food security and climate change appear to be more consequential for most developing countries in view of the numerous challenges bedeviling and obstructing meaningful growth and development in these parts of the globe. Therefore, the onus lies more on the intellectuals to fashion out workable methodologies, strategies, practices and ideologies necessary for mitigations as well as strengthening resilience and sustainable production systems. This remains an ever-present challenge for the knowledge society.

The focus of my administration is to continuously provide the enabling environment for meaningful academic exercises that are problem–solving, thought-provoking and result- oriented. This, we hope will engage our researchers and intellectuals as well as throw-up the challenges that we desire to address as a knowledge-based institution whose mandate is hovers around the emancipation of the society through smart agriculture, food sufficiency, employment generation, poverty reduction and enhancement of the living standard of the people.

Therefore, as the conference kicks off in our institution, I heartily congratulate the Dean, the entire staff and students of CAERSE, and earnestly believe that the conference will herald a new beginning in our desire to re-direct our research efforts to realistically addressing the challenges of the society. I, on behalf of the Management, Staff and students of MOUAU welcome all participants in the conference and wish you all a happy and rewarding time in MOUAU.

Thank you.

Prof. M. O. Iwe, *CFS*
Vice-Chancellor, Michael Okpara University of Agriculture, Umudike Abia State Nigeria

KEYNOTE ADDRESS

Ensuring Food Security in the Midst of Climate Change: A Panacea for Nigerian Economic Development. Keynote Address Delivered by Dr Cliff Agbaeze, *FCIB*, on the Occasion of the Maiden Edition of the College of Agricultural Economics, Rural Sociology and Extension (CAERSE) of the Michael Okpara University of Agriculture, Umudike on Thursday, May 15, 2025

PROTOCOL

I am truly delighted and honoured to participate in this maiden Conference of the College of Agricultural Economics, Rural Sociology and Extension (CAERSE), Michael Okpara University of Agriculture, Umudike and I must commend the Dean and his team for making this happen. As many of you already know, this is a homecoming for me both as a product of this esteemed college and a faculty board member of the University. I am happy to observe that this University, thanks to the able leadership of the VC, has consistently extended hands of collaboration with the present Abia State Government and it is my belief that this renewed partnership would foster a sustainable framework for agricultural development both in the State and beyond.

2. The theme of the Conference, "Food Security and Climate Change: Nigeria's Contemporary Socio-Political and Technological Environment" captures crucial factors underlying the agricultural development of the country. We would be living in self-denial if we neglect the impact of climate change on food production. The proven solution however, has relied heavily on technology that is driven by astuteness in administration and governance.
3. No doubt, such administrative sagacity is being exemplified today by the hosting of this conference and this gives eloquent credence to the pragmatic leadership of the Vice Chancellor of MOUAU, Professor Maduebibisi Ofo Iwe, and the Dean of CAERSE, Professor Nnanna Agwu. They have provided an ideal environment to showcase excellence, innovation and collaboration. These are important factors for driving scholarship in the contemporary period and the technology required to combat climate change effects and achieve food security anchors on these factors.
4. The call extended to me to deliver a keynote address at this conference on the topic, "Ensuring Food Security in the midst of Climate Change: A Panacea for Nigerian Economic Development" is an affirmation of the imperative of collaboration, research and education in our efforts at addressing the climate change challenge.
5. According to FAO(2002), food security is defined as the condition in which all people at all times have physical, social and economic access to sufficient food which meets their dietary needs and food preferences for an active and healthy life. The definition brings in perspective the wider concept of poverty because in the real sense, it is only "income" poverty that would really deny people the ability to acquire or purchase food when production fails. This is the reason poverty is mostly tagged the main cause of hunger, and the duo of hunger and poverty had attracted a prime place in both the old Millennium Development Goals (MDGs), and the ongoing Sustainable Development Goals (SDGs). It is equally important to draw our attention to the evolving concept of nutrition security in the food security definition. Climate change on the other hand, refers to the long-term shifts in average weather patterns, such as temperature and rainfall, over decades or more.
6. The challenge for food security given the wide and varied incidences of climate change is daunting. Climate change brought back the dispelled illusion of the Malthusian trap especially in developing countries. For instance, food insecurity increases by 5-20 percentage points following each drought or flood in Sub-Saharan Africa as reported by the World Meteorological Organization. Notably, such fears were initially conquered by agricultural productivity successes linked with the Green Revolution (GR) or the Third Agricultural Revolution of the late 1960s to 1980s powered, essentially by the Ford and Rockefeller Foundations. Unfortunately and maybe, paradoxically, the success stories of GR have been eroded by, and in some cases, triggered climate-related extreme events. Four facets of climate change linked with the breakdown of the food systems include global

warming, flooding, extreme and irregular rainfall and drought. Also, the heavy use of chemical fertilizers and pesticides resulted in water pollution, soil degradation, and loss of biodiversity which were/are the unintended consequences of the Green Revolution.

7. The impact of climate change on food security can be holistically linked with the outlined facets or attributes of climate change. This is evident in agricultural productivity decline, food price variability, and loss of biodiversity. Much of these effects are disproportionately borne by the poor regions like sub-Saharan Africa, India and other third World regions.
8. Climate change mitigation and adaptation strategies are essential elements of a food security framework. Climate-Smart-Agriculture (CSA), a pack of mitigation and adaptation strategies is recommended to reduce the impact of climate change. The trio of mitigation, adaptation and resilience are considered the three pillars of response to a climate change indicator as captured at the 23rd annual Conference of the Parties (COP23) to the United Nations Framework Convention on Climate Change (UNFCCC) held in the Republic of Fiji. The World Bank pioneered thematic surveys on Climate Smart Agriculture across developing countries where the states of Bornu, Adamawa and Yobe are presently representative locations in Nigeria. Succinctly, these three locations in Nigeria have demonstrated high level of awareness of climate change and clear-cut adaptation and mitigation efforts by the farmers. Climate change mitigation financing has been recommended given the findings that show finance as a major constraint. Accordingly, the World Bank Group has delivered $83billion in climate finance for developing countries between 2016 and 2023.
9. Recently, at COP26 in Glasgow, the World Bank Group's new Climate Change Action Plan, 2021 – 2025, which integrates climate change and development as the guiding pillar, launched a diagnostic tool tagged the Country Climate and Development Report (CCDR) as a built-in evaluation kit. This is a comprehensive superstructure for countries to derive feasible mitigation strategies in line with its development objectives. The realization of the UN Sustainable Development Goals would directly or indirectly be influenced by climate change. Evidence showed that climate change affects the poor mostly and its effect on induced migration is expected to increase. Both micro and macro data on development indicators could henceforth be x-rayed under climate change indicators using the CCDR toolkit. The alignment of climate change with development cannot be overemphasized as evidences abound on how climate change can erode economic incentives.
10. The ripples of economic shocks that emanate from various sources including climate change elements and the macro economy are quite diverse. It offers an opportunity to strengthen resilience. A resilient system is expected to reduce vulnerability to food insecurity. Regrettably, the Nigerian agricultural system is predominantly small-holder, rain-fed, and grossly rudimentary. Obviously, these features cannot pass the resilience test both with respect to climate and socioeconomic changes. There are huge antecedent repercussions in the form of loss in productivity, decline in output, price distortions and further aggravation of the climate change indicators.
11. Given the seemingly inevitable scenarios of climate change, it behoves systems and economies to adopt/adapt coping mechanisms, develop mitigants and build resilience. This is part of the Paris Agreement negotiated at COP21 where parties, among other things, agreed to establish specific actions and targets for reducing greenhouse gases emissions, mitigating, and adapting to the effects of climate change and financing mitigation and adaptation efforts in developing countries.
12. To summarize, ensuring food security in the midst of climate change entails:
    a) Implementation of sustainable agricultural practices and technologies: implementing conservation agriculture and agro-forestry increases resistance to climate change by fostering soil health, water retention and biodiversity. Water utilization is optimized by utilizing cutting-edge technology like remote sensing and precision watering. Reduction in the use of chemical materials and promotion of organic, regenerative agriculture will help in soil conservation and reduction in environmental degradation.
    b) Prioritizing climate-smart policies and investments: financial services, such as credit and insurance, research on and investing in climate-resistant crop types,

breeding programs and agro ecological methods all help ensure resilient food production.

c) Improving food storage and distribution: building warehouses, silos and cold storage facilities, in addition to efficient transportation and logistics systems, will lower post-harvest losses, guarantee food availability, eliminate food waste, satisfy demand and combat food insecurity.
d) Developing climate-resilient livestock production and manure management: Effective feeding, adequate manure management, methane collection systems, sustainable management techniques and the promotion of climate-resilient animal breeds increase livestock productivity and decreases methane emissions - a major greenhouse gas.
e) Improving early warning systems and climate information: Developing early warning systems and enhancing meteorological data gathering enable farmers to react to extreme weather occurrences proactively.
f) Promoting sustainable and nutritious food consumption: Encouraging local sourcing, mindful purchasing and reducing food waste can boost nutrition and environmental sustainability.
g) Collaboration and knowledge sharing

13. In Abia State, we feel a deep sense of responsibility to the course of food security. The Executive Governor, His Excellency, Dr Alex C. Otti, OFR, is passionate about executing planned agricultural policies and projects that balance the intractable objectives of growth and environmental protection. In this regard, we have based our agricultural projects on feasibility criteria that ensure environmental and social impact assessments meet acceptable thresholds. The philosophy behind such pathway of planned development is sustainability.
14. Continuous training and capacity-building programs for farmers on new technologies, including precision agriculture, irrigation systems, and crop management techniques are integral part of our agricultural development strategy. This will enable our farmers to increase productivity, reduce costs, and improve the quality of their produce.
15. Our Government has also initiated compliance efforts to ensure that our agricultural products and practices align with international standards. Part of these efforts entails the State's forestry and agricultural products (rubber, lumber, cocoa, palm oil, etc) will satisfy the deforestation-free standards, guaranteeing sustained and increased access to EU and other markets and safeguarding important sources of income.
16. We are also working to ensure complete traceability and legality of commodities to meet international standards. Farmers and producers throughout the state are being mapped, counted, and verified through reliable land use and land cover systems and trained on focused areas such as EUDR regulations, environmental sustainability, social safeguards, and human rights principles to ensure they are better equipped to execute and oversee compliance with international standards.

    These efforts and initiatives will help in mitigating the effects of climate change on food production and security and preserve farmers' incomes.

17. Finally, permit me to once again thank the organizers of this conference for the honour granted me as the government's representative to deliver the maiden keynote address of the conference. I pledge the State Government's support to the course of food security of our nation. The uphill task of surmounting the marauding elements of climate change and all other sources of socio-economic shocks will not deter us. We will conquer food insecurity.

Thank you
Dr Cliff Agbaeze, FCIB
Hon. Commissioner for Agriculture, Abia State

COMMUNIQUE

Communique of the Maiden International Conference of the College of Agricultural Economics, Rural Sociology and Extension (CAERSE), held 14 – 16th May, 2025 at Anyim Pius Anyim Auditorium, Michael Okpara University of Agriculture, Umudike, Abia State Nigeria

PREAMBLE

The maiden International conference of the College of Agricultural Economics, Rural Sociology and Extension (CAERSE) took place from the 14 – 16th May, 2025 at Anyim Pius Anyim Hall. The Theme of this International Conference was; *Food Security and Climate Change: Nigeria's Contemporary Socio-political and Technological Environment.* The International Conference was attended by group of stakeholders consisting of; the Vice Chancellor, Michael Okpara University of Agriculture Umudike, Prof. Maduebibisi Ofo Iwe represented by Deputy Vie Chancellor (Academic), Prof. N. E. Obasi, the Deputy Vice Chancellor (Administration), Prof. U. N. Akanwa, University Bursar, represented by Mr. Uchechukwu Eme (Director, Expenditure & Control, Pension & Payroll), Deans of Colleges and Heads of Departments in the University. Other dignitaries were; Chairman of the event, Pastor Dr. Okey Ihemanma, Permanent Secretary, Ministry of Industries Abia State, Nigeria, Dr. Cliff Agbaeze FCIB, Hon. Commissioner, Ministry of Agriculture, Abia State, Nigeria, who served as the Keynote Speaker, Distinguished Professor, Galina Vladironvna Astratova from Ural Federal University (Boris Yeltsin) Federal University, Russia who was the Distinguished Speaker and Dr. B.C. Okoye, Assistant Director, National Root Crops Research Institute, Umudike Abia State who served as the Plenary Speaker. Policy makers, Scientists, Foreign researchers, former Post-graduate and undergraduate students of the College, post and undergraduate students of the college, Public Servants, and the University Community at large.

The Dean, CAERSE Prof. Nnanna Mba Agwu in his opening remarks noted that the Conference theme was considered appropriate at this time, when the effect of Climate Change around the World, particularly in developing countries has posed a threat to household food security. He stated that it is also in line with the Sustainable Development Goals (SDGs) of the United Nations. He therefore called for increased collaboration among researchers and other stake holders to develop sustainable responses to food insecurity driven by climate change. He assured the researchers and scholars that well -articulated papers presented during the Conference shall be published in the College Journal.

The Keynote Address titled: *Ensuring Food Security in the Midst of Climate Change: A Panacea for Nigerian Economic Development* was delivered by Dr. Cliff Agbaeze, FCIB, the Hon. Commissioner, Ministry of Agriculture, Abia State. The key note speaker in his paper emphasized that conference theme is an affirmation of the imperative of collaboration, research and education in our efforts at addressing the climate change challenge as its effect is the main cause of hunger, poverty and food security had attracted a prime place in both the old Millennium Development Goals (MDGs), and the ongoing Sustainable Development Goals (SDGs). The challenge for food security given the wide and varied incidences of climate change is daunting. He highlighted that global warming, flooding, extreme and irregular rainfall, drought, heavy use of chemical fertilizers and pesticides are linked with the breakdown of the food systems. The impact of climate change on food security can be holistically linked with agricultural productivity decline, food price variability, and loss of biodiversity. Much of these effects are disproportionately borne by the developing nations such as Nigeria, which mitigated by employing climate change mitigation and adaptation strategies as essential elements of a food security framework.

The speaker recommended that measures to ensure food security in the midst of climate change entail:

- Implementation of sustainable agricultural practices and technologies: implementing conservation agriculture and agro-forestry.
- Improving food storage and distribution: building warehouses, silos and cold storage facilities, in addition to efficient transportation and logistics systems, will lower post-harvest

losses, guarantee food availability, eliminate food waste, satisfy demand and combat food insecurity.

- ❖ Developing climate-resilient livestock production and manure management:
- ❖ Improving early warning systems and climate information.
- ❖ Promoting sustainable and nutritious food consumption.
- ❖ Collaboration and knowledge sharing
- ❖ Continuous training and capacity-building programmes for farmers on new technologies, including precision agriculture, irrigation systems, and crop management techniques are integral part of our agricultural development strategy.

Distinguished Speakers' Presentation

The Paper titled: *Geopolitical Pressures and State Policy Responses in Improving the Agro-Industrial Complex for Russian and Nigerian Food Security was* presented via a recorded video by Distinguished Professor, Galina Vladironvna Astratova from Ural Federal University (Boris Yeltsin) Federal University Russia. In her paper, she stressed that from the first half of 2022 there was a catastrophic escalation of geopolitical pressure, instability and a full-scale aggravation of the global situation, that led to drastic changes in the global financial and economic system, which was expected to affect the Russian financial system leading to the destruction of number of the agricultural and industrial complex, which ensures the country's food security. The sanctions imposed by the Government of Russia on these sectors proved ineffective, as a result of government support for both the agrarian industries as whole and specific subjects of the agricultural complex.

These sanctions affected Russian economy due to several factors such as; adequacy of the purpose of sanctions to the task set by the initiator State; strength and complexity of sanctions; duration of sanctions (short-term or long-term); number of initiator countries (unilateral or multilateral sanctions); the political regime of the "target country" (democratic or dictatorial); internal consolidation of the population of the "target of sanctions" country.sufficiency of support for the country of the "target of sanctions" by the allied countries; the strength of the threat of weakening external relations with other countries for both the State and the target country. In this circumstance, that issue of increasing the effectiveness of government support responses in the face of sanctions is becoming relevant by identifying ways to further develop the agro-industrial complex as the most important sector of national innovative development and economic growth.

In Russia, considerable attention has always been paid to the problem of ensuring food security, especially in the context of public administration of the agro–industrial complex and the development of agrarian policy. This was achieved through prioritization of national project in the development of agriculture in 2005 and 2006; and the Doctrine of Food Security of the Russian Federation in 2020. In the context of sanctions reprisals and the destruction of the balance of the global food market, a number of positive changes in business conditions have occurred in the Russian agricultural sector, in the areas of state support for agriculture, increase in the number of support programmes (preferential loans, grants (Agrostartaps, Agrotourism, etc.), tax preferences, targeted subsidies, etc.), changes in the structure of the agro-industrial complex market in the demand for Russian products has increased both inside Russia and abroad; import substitution and the growth of its own agricultural products, but also the transformation of the Russian agricultural sector into a guarantor of global food security and increase in the volume of agricultural exports in 2023 that amounted to $ 37.6 billion), which made it possible to realize the transition from the import substitution model to the export-oriented model of agriculture;

The speaker highlighted the lessons of agricultural financing and technology innovations adopted in Russia to could be replicated to improve Agricultural Security in Nigeria to include;

- ❖ Increased Support Programmes: Expanded individual agricultural business support through preferential loans, grants, tax preferences.
- ❖ Market Transformation: Changed agro-industrial complex market structure to increase domestic product demand
- ❖ Quality and Competitiveness Focus: Enhanced product quality, competitiveness, and technological integration and;
- ❖ Transition to Digital Economy: Increasing digitalization of agricultural management

Recommendations

Data-driven grants, loans and tax preferences to actors agricultural sector

- ❖ Secure agricultural value chains with protected corridors from production zones to markets
- ❖ Deploy Digital Agriculture Strategy (2020-2030) solutions to monitor farm assets in insecure regions.
- ❖ Support formalized community defense groups with training and oversight, modeled after successful CJTF intervention

Plenary Speakers' Presentation

The Plenary Paper Address Titled: *Mitigating the Effects of Climate Change by Smallholder Farmers in a Challenging Economy: A Case of Nigeria* -was delivered by Dr. B.C. Okoye, an Assistant Director, National Root Crops Research Institute, Umudike Abia State.

The plenary speaker noted that agriculture accounts for 25% of Nigeria's Gross Domestic Product (GDP); employs more than 60% of the labour force thereby farmers are faced with threats of climate change such as; erratic rainfall, flooding in southern Nigeria, rising temperature affecting livestock and pest outbreaks (fall armyworm, taro blight) resulting to economic hardship. In the year 2022, floods destroyed 450,000 hectares of farmland which led to rising insecurity and inflation, threatening smallholder farmers who produce 80% of food in Nigeria. The impact of socio-economic factors on food security could be traced to 25 million Nigerians that were faced with hunger in the year 2023, less than 10% of farmers do not have access to irrigation facilities, 62% incur debt to recover post-disasters and rise in rural-urban migration affecting labour availability.

The Agricultural Promotion Policy (APP) (2016–2020) introduced by the Federal Government to address the challenge of food security had limited impact on farmers as only 12% accessed credit, despite the policy's focus on input support and finance. In the same vein, policy's climate adaptation components were particularly neglected, with many farmers unaware of its existence NATIP (2022–2027) and digital tools, climate-risk assessments, seed support, development and dissemination of varieties. He noted that these policies were affected by underfunding were only less than 2% of the budget was allocated to agriculture in previous years, compared to 128% in 2025 as the country's allocation is still low when compared with other African countries. Other challenges were; the policy fragmentation between the federal/state levels, gender-blind design, with women's productivity still limited and poor extension service delivery. In order to curb the menace of climate change there is need for farmers to engage in resilient crop diversification such as; drought-tolerant, pest resistance, flexible harvest, fast-maturing, nutrient, low water needs and nitrogen-fixing crop varieties. He advocated for institutional support for under-utilized crops by introducing improved varieties and role of technology on climate smart agriculture to the establishment of cooperative marketing/market clusters, use weather apps, mobile advisory services, insurance and hedging, good agronomic practices, diversification of enterprise, farm insurance-against theft, fire etc., Government pricing policy- Price support and household off-farm employment. The paper recommended the promotion of intercropping and nutrition-sensitive agriculture, integration of Climate-Smart Agriculture practices into all state-level plans, expanding digital extension platforms, funding of Research and Development for drought-resistant varieties and reformation land rights and support women-led agribusiness.

Recommendations

The Conference proffered the following recommendations:

a) The integration of climate-Smart Agricultural practices as a mitigation and adaptive mechanism at the farm, local Government, State and National level to curb the menace of Climate change.
b) Provision of rural infrastructure in the rural areas such as roads, electricity and communication networks for farmers to be aware of the early signs of climate variation
c) Reduction of airtime tariff charges by telecommunication operators to assist the rural dwellers access information on climate change resilience and best adaptive options to employ on their farms

d) Strengthening the extension arms of the Agricultural Development Programmes (ADPs) and Research Institute's on the training of farmers on the application and use of *Apps* for information on improved resilience to climate change.
e) Encouraging farmers to belong to digital extension platforms in order to access vital information on climate change as it affects their agricultural production activities.
f) Deployment of forest guards to protect women who engage in farming as a livelihood against bandits who terrorize and rape them
g) Development of high yielding crop varieties, drought tolerant, peat and disease resistance varieties that will withstand the effects of climate change.
h) Increase in State and Federal Government budget allocation on Agriculture, Science and technology sectors.
i) A critical review of the Reform land rights to encourage women participates actively in agriculture and agribusinesses related ventures.
j) There should be investment in the coordination of climate finance initiatives among stakeholders
k) Empowerment of women and youth in agricultural activities and scaling up of successful pilot programmes.
l) Adopting the Russian model for agricultural financing and technology innovations ensuring sustainable food security in Nigeria.

CONCLUSION

The maiden International conference of College of Agricultural Economics, Rural Sociology and Extension (CAERSE) emphasized the urgent need for engaging adaptive measures to mitigate the effect of climate change at farm, State and Federal government levels. The conferences advocated for an e-extension system to enable stakeholders' access research–proven climate- smart agricultural practices four effective utilization by farmers. Since livelihood of the rural dwellers depend on agriculture, there is need to enact innovative solutions that will increase their agricultural productivity. The major stakeholders in the agricultural sector were encouraged to collaborate with foreign partners, share knowledge, adopting sustainable recommended agricultural practices that are targeted to increasing productivity and attaining food security.

Dr. C.U. Nwaobiala
Secretary, Scientific/Technical Subcommittee

Prof. J.B. Simonyan
Chairperson, Conference Organizing Committee

Dated 15th May, 2025

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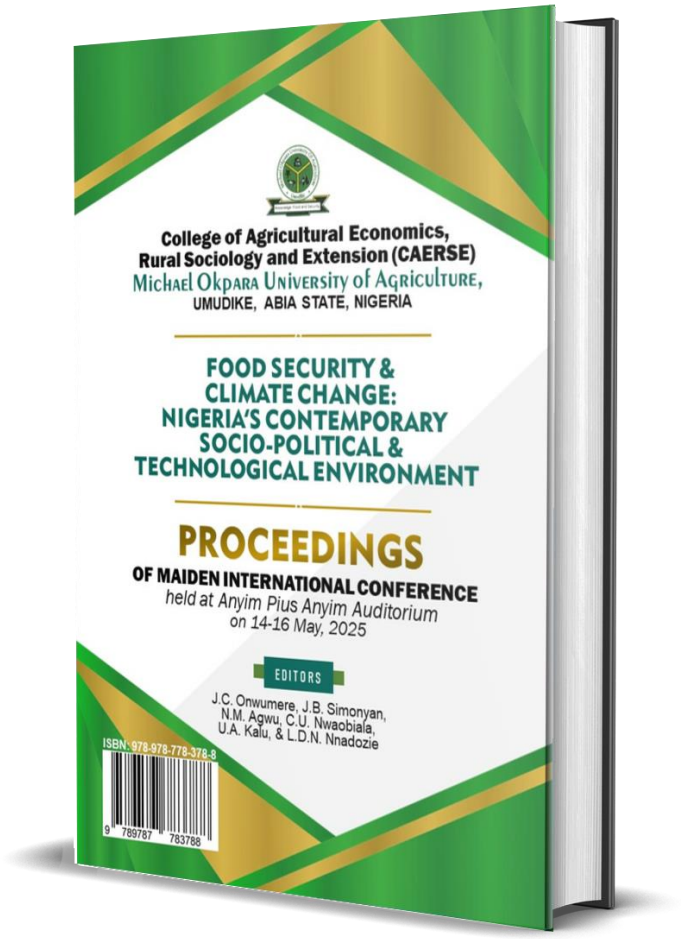
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Michael Okpara University of Agriculture,
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NIGERIA'S CONTEMPORARY
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PLENARY

LEAD PAPER

Mitigating the Effects of Climate Change by Smallholder Farmers in a Challenging Economy: A Case of Nigeria

Paper presented

by

Okoye, Benjamin C
National Root Crops Research Institute, Umudike

at the maiden Conference of the
College of Agricultural Economics, Rural Sociology and Extension,
Michael Okpara University of Agriculture, Umudike, 14-16th May 2025

NRCRI

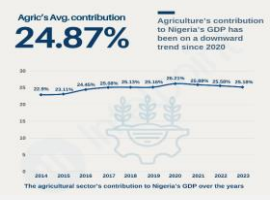
Overview

- Climate change severely affects Nigerian smallholder farmers.
- Over 90% of agriculture is rain-fed, high vulnerability.
- Economic instability worsens impacts.
- Solutions: crop diversification, digital tools, cooperatives ,and inclusive policies.

NRCRI

Introduction

- Agriculture = 25% of Nigeria's GDP; employs 60%+ of the labour force
- Farmers face dual threats: climate change + economic hardship
- 2022 floods destroyed 450,000 ha of farmland.
- Rising insecurity and inflation undermine resilience.
- Threatening smallholder farmers who produce 80% of food in Nigeria



Nigeria's Agricultural Contribution to GDP (2010–2023)
(Source: NBS, 2022)

NRCRI

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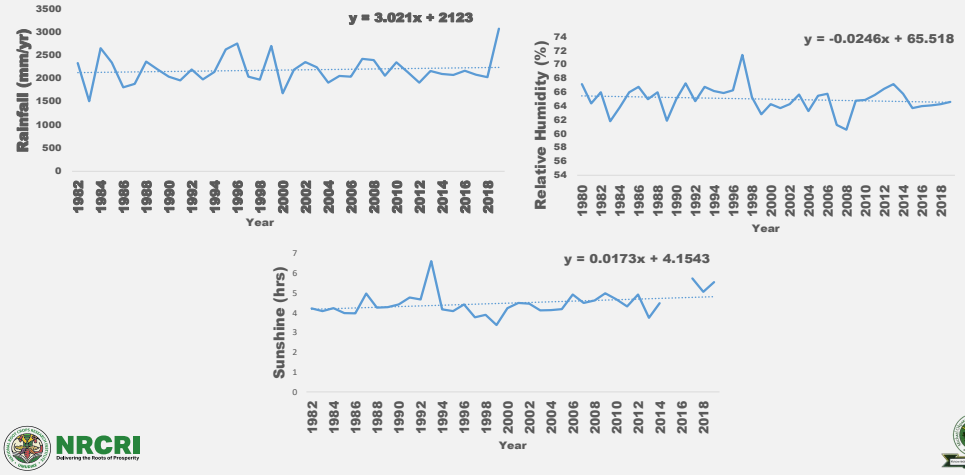
Variations in Selected Climatic Variables: Umudike, 1980-2019

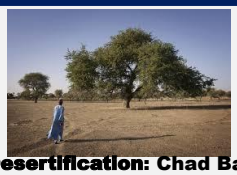


NRCRI

Climate Challenges Facing Smallholder Farmers

- **Erratic rainfall and drought** (e.g., Lake Chad shrinkage)
- **Flooding** in southern Nigeria
- **Rising temperatures** affect livestock/poultry
- **Pest outbreaks** (e.g., fall armyworm, taro blight)

Images: Lake Chad, flooded farmland, armyworm



Desertification: Chad Basin

Flooding in Southern Nigeria

Incidence of Taro Blight

Fall Armyworm Incidence

NRCRI

Socioeconomic and Food Security Impacts

- 25 million Nigerians face hunger (2023)
- 80% of food comes from smallholders
- <10% have irrigation access
- 62% incur debt to recover post-disasters
- Rural-urban migration is rising

NRCRI

Recent Policy Response – Past and Present

Agricultural Promotion Policy

APP (2016–2020): Limited impact; only 12% accessed credit, despite the policy's focus on input support and finance. The policy's climate adaptation components were particularly neglected, with many farmers unaware of its existence

NATIP (2022–2027): Digital tools, climate-risk assessments, seed support. Development and dissemination of varieties, GAP etc. https://www.neep.gov.ng/

•**Renewed Hope Agenda**: Focus on value chain, youth employment etc

NRCRI

Challenges with Policy Implementation

•Underfunding: Only less than 2% of the budget was allocated to agriculture in previous years, compared to 128% in 2025. However, the country's allocation is still low when compared with other African countries

•Policy fragmentation between the federal/state levels

•Gender-blind design, with women's productivity still limited

•Poor extension service delivery.

NRCRI

Resilient Crop Diversification

•**Cassava**: drought-tolerant, pest resistance, flexible harvest

•**Yam**: drought tolerant, cultural importance, long storage

•**Sweet Potato (OFSP)**: fast-maturing, nutrient-rich

•**Millet & Sorghum**: low water needs, drought hardy

•**Cowpea**: nitrogen-fixing, fills seasonal hunger gap

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Institutional Support for Underutilized Crops

•NRCRI, IITA are introducing improved varieties.
•Gaps:
- Some other underutilized crops like Taro/Cocoyam, Bambara nut etc. are under-researched.
- Limited seed supply for of these crops, slow progress in genomic breeding.

Needed Actions:
•Need to expand NATIP crop list
•PPPs with Universities, Research Institutions, and CGIAR centres
•Input subsidies for farmers etc.

NRCRI

Role of Technology and Climate-Smart Agriculture

- Cooperative marketing/Market clusters
- Weather apps, mobile advisory services etc
- No-till, mulching, crop rotation
- Insurance and hedging
- Good Agronomic Practices
- Diversification of enterprise
- Development of market clusters
- Formal Insurance- against theft, fire etc
- Staggered Planting
- Vertical integration
- Selling products at different points in time
- Hedging (forward contracting)
- Government Pricing Policy- Price support

Household off-farm employment

NRCRI

Percentage distribution of coping and adaptation strategies adopted by men and women in response to climatic/environmental stressors

	Benue		Osun		Abia	
Environmental/Climate Pests and Disease	M	W	M	W	M	W
Growing disease-resistant crops	3	10	6	7	8	18
Growing underground RTCs	17	33	9	-	9	21
Relatively low farm size	6	7	6	-	4	3
Selective crop cultivation	6	20	11	7	17	15
Sowing less	14	13	6	-	4	8
Migrating	3	7	6	-	8	5
Growing crops in upland case of flash floods	8	10	6	-	4	13
Use of chemicals	**86**	**70**	**74**	**74**	**38**	**26**

Olaosebikan, O.; Bello, A.; Utoblo, O.; Okoye, B.; Olutegbe, N.; Garner, E.; Teeken, B.; Bryan, E.; Forsythe, L.; Cole, S.; Kulakow, P.; Egesi, C.; Tufan, H. and Madu, T (2023). **Stressors and Resilience within the Cassava Value Chain in Nigeria: Preferred Cassava Variety Traits and Response Strategies of Men and Women to Inform Breeding**. *Sustainability*, *15*, 7837. https://doi.org/10.3390/ su15107837

NRCRI

Erosion: Coping Strategies

	Benue		Osun		Abia	
Erosion	M	W	M	W	M	W
Growing underground RTCs	14	23	-	-	21	8
Relatively low farm size	6	3	-	-	-	3
Selective crop cultivation	14	17	-	-	-	3
Sowing less	3	13	-	-	-	3
Migrating	8	10	-	-	-	3
Growing crops in upland cases of flash floods	17	3	-	-	8	10

NRCRI

Nutrient Depletion: Coping Strategies

	Benue		Osun		Abia	
Nutrient depletion	M	W	M	W	M	W
Relatively low farm size	8	13	-	-	-	3
Selective crop cultivation	11	33	11	7	-	8
Sowing less	11	7	-	-	-	5
Applying fertilizer	50	30	43	30	-	23
Applying manure	14	10	14	19	-	26

NRCRI

Droughts: Coping Strategies

	Benue		Osun		Abia	
Droughts	M	W	M	W	M	W
Growing crops tolerance to droughts (Cassava etc)	31	33	54	44	4	13
Growing underground RTCs	19	37	20	22	4	18
Relatively low farm size	6	7	6	3	4	3
Selective crop cultivation	17	20	23	15	4	8

High Temperature: Coping Strategies

	Benue		Osun		Abia	
High temperature	M	W	M	W	M	W
Growing crops tolerant to high temperatures	14	20	3	4	17	15
Growing underground RTCs	25	30	-	4	38	33
Relatively low farm size	3	17	-	4	-	3
Selective crop cultivation	3	13	-	4	-	18
Sowing less	8	3	-	4	4	5
Migrating	3	17	-	4	4	3
Growing crops in upland cases of flash floods	6	3	-	4	4	13

NRCRI

Percentage distribution of respondents by cassava traits, which enhance resilience to "environmental/climatic stressors" among male and female cassava producers in Nigeria

	Benue		Osun		Abia	
Environmental/Climatic Stress	**M (%)**	**W (%)**	**M (%)**	**W (%)**	**M (%)**	**W (%)**
Tolerance to pests and diseases	78	73	89	93	75	74
Survives in a water-logged area	44	50	40	41	21	36
In-ground storability	69	73	57	70	92	90
Thrives on low-nutrient soil	86	70	91	89	79	90
Tolerance to dry spells	83	87	91	93	75	80
Short duration/early bulking	56	60	80	78	75	67
M = Men, W = Women						

NRCRI

Strengthening Cooperatives, Gender & Youth Inclusion

- **Cooperatives**: RIFAN raised rice output by 1.5M MT
- **Youth**: Drudgery; Hello Tractor's leasing model helps 50k+ farmers
- **Gender**:
  - Women lose 30% more post-disaster income
  - More women are engaged in processing
  - Access to land and seed is limited

NRCRI

Recommendations

- Promote intercropping and nutrition-sensitive agriculture
- Integrate CSA into all state-level plans
- Expand digital extension platforms
- Fund R&D for drought-resistant varieties
- Reform land rights and support women-led agribusinesses

NRCRI

Conclusion

- Nigeria's smallholder farmers face a precarious climate-economic situation
- Crop diversification, technology adoption, and inclusive governance are key
- Urgent need for investment, coordination, and climate finance
- Empower women and youth, and scale up successful pilot programmes.

NRCRI

Thank You for Listening

NRCRI

GUEST PAPER

Уральский федеральный университет

GEOPOLITICAL PRESSURES AND STATE POLICY RESPONSES IN IMPROVING THE AGRO-INDUSTRIAL COMPLEX FOR RUSSIAN AND NIGERIAN FOOD SECURITY

- **Speaker:**
- **Astratova Galina V..**
- **Dr. (Dr.) Economics. Ph.D. Techniques. Professor.**
- **Honorary Worker of Higher Professional Education of the Russian Federation;**
- **corresponding member of Academies of Management in Education and culture ;**
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- **Member of European Association of International Education (EAIE).**
- **Founder of the scientific school "Theory. Methodology and Practice of Marketing and Marketing Research" (Decision of the Presidium of the Russian Academy of Natural Sciences. No. 17 dated October 02. 2013)**

1. GEOPOLITICAL PRESSURES

- Since 2014. in response to the annexation of Crimea to the Russian Federation, Russia has been at the epicenter of sanctions pressure from the countries of the Euro-Atlantic, or the "collective West."
- From the first half of 2022 there is a catastrophic escalation of geopolitical pressure, instability and a full-scale aggravation of the global situation.
- A drastic changes took place in the global financial and economic system, which was supposed to bring down the Russian financial system and lead to the destruction of a number of its industries that are important for the national economy.
- Among such industries, we consider it necessary to single out the **agricultural and industrial complex,** which ensures the country's **food security**.

Effectiveness of sanctions

- **As our research has shown** (Astratova et al., 2022; Astratova et al., 2024). **which was confirmed by the results of research by other authors** (Bengraf et al., 2024; Grinberg et al., 2021; Lavrikova et al., 2022). **sanctions proved ineffective**.
- **This happened as a result of government support** for both:
  - **Agrarian industry** as a whole
  - and **specific subjects of the agricultural complex** (Rezvyakova, Lilenko 2022; Serebryakova, Zemskova 2018; Ushachev et al., 2025).

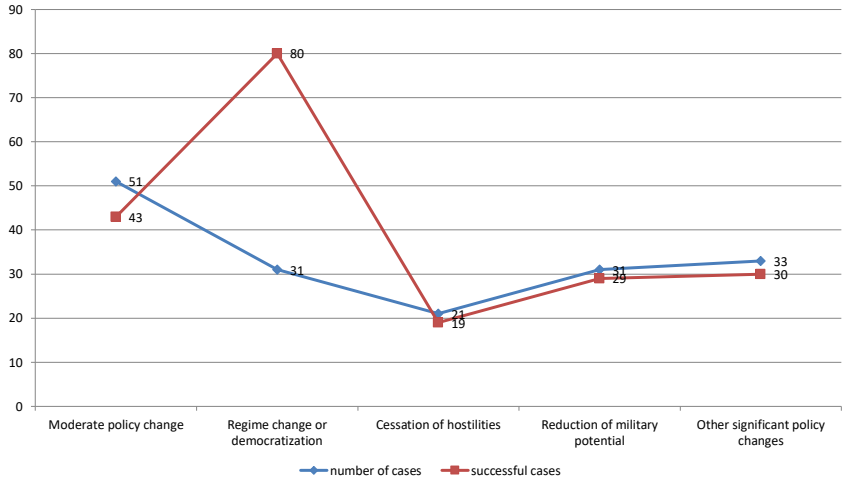

Figure 1. **The percentage of successful implementation of sanctions, depending on the goals set,** was obtained by the authors as a result of an expert survey in 2022-2024.

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The list of factors affecting the country's economy as a result of sanctions

- 1. Adequacy of the purpose of sanctions to the task set by the initiator State;
- 2. The general nature of sanctions (strength and complexity of sanctions);
- 3. Duration of sanctions (short-term or long-term);
- 4. Number of initiator countries (unilateral or multilateral sanctions);
- 5. The political regime of the "target country" (democratic or dictatorial);
- 6. Sufficiency of sanctions support by the countries-allies of the initiator state;
- 7. Internal consolidation of the population of the "target of sanctions" country.
- 8. Sufficiency of support for the country of the "target of sanctions" by the allied countries.
- 9. The strength of the threat of weakening external relations with other countries for both the initiator State and the target country.
- 10. The likelihood of potential damage to national economic interests for both the initiator State and the target country

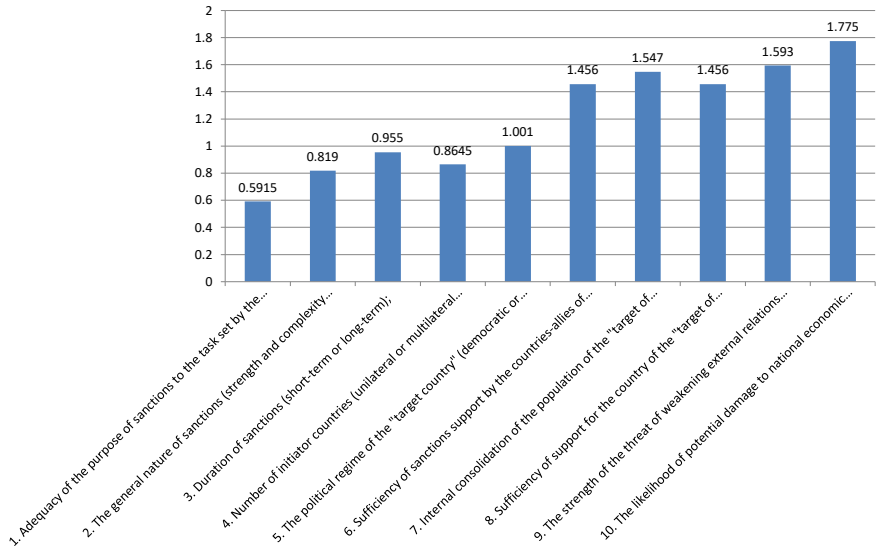

Figure 2. **The ranking system of assessment of factors influencing the development of the Russian economy, in points,** Source: compiled by the authors on the basis of mathematical processing of expert estimates for 2022-2024.

It follows from Fig. 2 that

- **the strongest influence in Russia,** according to available data, is exerted, in descending order, by such factors as:
  - 1. **The likelihood of potential damage to national economic interests for both the initiator State and the target country**;
  - 2. **The strength of the threat of weakening foreign relations with other countries for both the state that initiated the sanctions and the country that is the target of the sanct**ions;
  - 3. **Duration of sanctions (short-term or long-term).**
- The weakest influence is exerted by such a factor as
  - "The adequacy of the purpose of sanctions to the task set by the initiator state."

In these circumstances.

- the **issue of increasing the effectiveness of government support responses in the face of sanctions is becoming relevant**.
  - as well as **identifying ways to further develop the agro-industrial complex**
  - as the most important sector of the national economy **in the context of ensuring further innovative development and economic growth**.

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2. STATE POLICY RESPONSES IN IMPROVING THE AGRO-INDUSTRIAL COMPLEX FOR RUSSIAN FOOD SECURITY

- Considerable attention has always been paid to the problem of ensuring food security in Russia, **especially in the context of public administration of the agro–industrial complex and the development of agrarian policy**.
- Among the most important documents are the following:
  - 1. **The priority national project** "Development of agriculture" (2005).
  - 2. **The Federal Law** "On the development of agriculture" (2006).
  - 3. **The Doctrine of Food Security** of the Russian Federation (2020).

The level of self-sufficiency in agricultural products in Russia

Product Name	% of the plan	+/ – percentage points from the indicators of the Food Doctrine	The level of self-sufficiency
Sugar	108.5	+ 18.5	Super- sufficient
Vegetable oil	227.9	+2.5	Super- sufficient
Fish and fish products	165.6	+1.9	Super- sufficient
Potatoes	97.0	+ 2.0	Critical
Vegetables and melons	89.4%	– 0.6	Critical
Fruits and berries	46.7	–13.3	Weak
Seeds of the main agricultural crops of domestic breeding	62.5	–12.5	Weak
Food salts	64.5	– 19.6	Weak
Seed	170.5	+ 180	Super- sufficient
Meat and meat products	101.5	+16.5	Super- sufficient
Milk and dairy product	86.7	– 3.3	Critical

In the context of sanctions reprisals and the destruction of the balance of the global food market, a number of positive changes in business conditions have occurred in the Russian agricultural sector:

- **The role of state support for agriculture has significantly increased** during the implementation of the State Program for the Development of Agriculture;
- **The number of support programs for individual agricultural business entities has increased**, including preferential loans, grants (Agrostartaps, Agrotourism, etc.), tax preferences, targeted subsidies, etc.;
- **The structure of the agro-industrial complex market has ch**anged and the demand for Russian products has increased both inside Russia and abroad;
- **There has been not only import substitution and the growth of its own agricultural products**, but also the transformation of the Russian agricultural sector into a guarantor of global food security;
- **The quality and competitiveness of Russian agricultural products (crop production, seed production, animal husbandry, etc.) has increased**, the volume of agricultural exports has increased (in 2023 it amounted to $ 37.6 billion), which made it possible to realize the transition from the import substitution model to the export-oriented model of agriculture; etc.

3. Security-Focused Lessons Nigeria Can Learn From Russia to Improve Food Security

Table 1: Creating Security-Focused Agricultural Zones

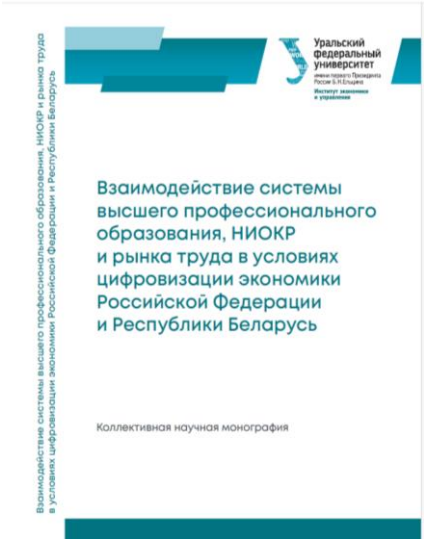
Russian Model Success Factors	Current Nigerian Challenges	Recommended Implementation for Nigeria
Government Prioritization: Food security as national priority through comprehensive policy documents (Development of Agriculture project, Federal Law on Agriculture Development, Food Security Doctrine)	**Fragmented agricultural security policies with limited integration between security and agricultural sectors**	**Develop an integrated National Agricultural Security Framework that combines food security and physical security elements**
Rapid Response to Sanctions: Transformed 2014 sanctions challenges into agricultural opportunities	**Reactive rather than proactive responses to insurgency impacts on agriculture**	**Establish Protected Agricultural Zones with enhanced security presence in areas affected by Boko Haram/ISWAP**
Robust Financial Support: Significant state agricultural funding creating resilience against geopolitical pressures	**Inadequate funding for agricultural security initiatives**	**Develop specialized Agricultural Security Task Forces with dedicated budget allocation**
Internal Consolidation: Strong population support for agricultural self-sufficiency	**Herder-farmer conflicts claimed ~1,300 lives in first half of 2018; displaced ~300,000 people**	**Implement community-based Early Warning Systems using mobile technology to alert about potential attacks**

4. Agricultural Financing and Technology Innovations: Lessons Nigeria Can Learn From Russia to Improve Agricultural Security

Table 2: Agricultural Financing and Technology Innovations

Russian Model Success Factors	Current Nigerian Challenges	Recommended Implementation for Nigeria
Increased Support Programs: Expanded individual agricultural business support through preferential loans, grants, tax preferences	Anchor Borrowers Program (ABP) implementation challenges: late input arrival, inadequate extension services, side-selling	**Data-driven grants, loans and tax preferences to actors agricultural sector**
Market Transformation: Changed agro-industrial complex market structure to increase domestic product demand	Underdeveloped agricultural value chains in conflict zones	**Secure agricultural value chains with protected corridors from production zones to markets**
Quality and Competitiveness Focus: Enhanced product quality, competitiveness, and technological integration	Limited technology adoption in agricultural security	**Deploy Digital Agriculture Strategy (2020-2030) solutions to monitor farm assets in insecure regions**
Transition to Digital Economy: Increasing digitalization of agricultural management	Lack of digital knowledge and infrastructure	**Support formalized community defense groups with training and oversight, modeled after successful CJTF intervention**

The questions discussed in more detail can be found in our collective monograph:



- **Interaction of the higher professional education system, R&D and the labor market in the context of digitalization of the economy of the Russian Federation and the Republic of Belarus**: collective scientific monograph/ **Astratova G.V**., Astapovich O.G., Afanasyev M.S., Bekshaev A.A., Belaykhun Markos, Bengraf S.V., Britvina I.B., Vlasov M.V., Goncharova N.V., Gorbyleva Z.M., Daineko L.V., Dedekind V.M., Dostanko O.N., Dyachkova A.V., Zhelezka B.A., Zhdanovich O.V., Zhuravleva N.M., Zaitseva V. N., Izmailov A.M., Laptev V. M., Larionova V. A., Lisin I. V., Mickevich V.V., Mikhaleva T.N., Novgorodtseva A.N., **Onwusiribe N. Chigorizim** , Rubo O.P., Savchuk G.A., Samosyuk E.V., Silin V. N., Simchenko N.A., Sinitsyn E. V., Stelmakh E.V., Tararishkina L.I.., Tolmachev A.V., Troshina V.E., Kharitonovich S.N., Khokhlova N.Jr., Shamardina I. A., Yanovskaya A.A. / **under total and scientific editorship by Prof. G.B. Astratova**; Ural Federal University. Yekaterinburg: Azhur Publishing House. **2024**. – 274 pp.

A new one book will be published soon:

OPTIMIZING SOCIO-ECONOMIC SYSTEMS IN THE UNION STATE OF RUSSIA AND BELARUS: R & D, HIGHER EDUCATION, AND LABOR MARKETS IN THE DIGITAL ECONOMY

Collective Scientific Monograph

Galina V. Astratova
Maxim V. Vlasov
Chigozirim Ndubuisi Onwusiribe, *et al*

BENTHAM SCIENCE

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The research, the results of which are included in this monograph, was carried out with the financial support of the Russian Science Foundation (2022 Competition "Conducting fundamental scientific research and exploratory scientific research by small individual scientific groups) on the topic: "Mechanisms for the development of complex socio-economic systems in new economic conditions: The Union State of Russia and Belarus; the research sector; higher education and the labor market in the digital economy".

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CAERSE
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Food Security & Climate Change: Nigeria's Contemporary Socio-Political & Technological Environment

Paper Code: CC25001

Productivity and Profitability of Garden Eggs Farming among Farmers in Isiala Ngwa South Local Government Area of Abia State, Nigeria

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ABSTRACT
Garden eggs are significant source of income for many smallholder farmers and contribute substantially to food security. Improving the productivity level will increase the profitability as well as its sustainability as a high value crop. This study investigates the productivity and profitability of garden eggs (Solanum melongena) farming in Isiala Ngwa South Local Government Area, Abia State, Nigeria. A multistage sampling procedure were used to select 120 garden eggs farmers used for the study. Data were collected through the aid of well-structured questionnaire. Methods of data analysis employed include descriptive statistics, total factor productivity (TFP) index, net return analysis, and ordinary least squares (OLS) regression. The findings showed that most (66.7%) of the garden egg farmers were male, with an average age of 42.8 years. The majority (94.2) were married and had 6-12 years of farming experience, with a mean household size of 4.7 and average monthly income of ₦180,833. Additionally, most farmers were members of cooperatives and had regular access to extension services. Further findings showed an average TFP of 1.919, indicating that farmers generate ₦1.92 in output for every ₦1 invested in inputs. The net profit per hectare is ₦144,739, demonstrating the economic viability of garden egg farming in the area. OLS regression results identified cost of seed, cost of herbicides, education, farming experience at 1% respectively, monthly income (10%), and access to extension contact (5%) as significant determinants of profitability of garden eggs production. The study recommends improving farmers' access to cheap herbicides and strengthening extension services to improve productivity and profitability of the farming communities.

Keywords: Productivity, Profitability, garden eggs farmers, Isiala Ngwa South

INTRODUCTION
Garden egg (Solanum melongena), a commonly grown vegetable in Nigeria, is crucial for household nutrition, generating income, and ensuring food security (Adeoye *et al.,* 2021). It serves as a vital part of traditional diets and is an essential cash crop for smallholder farmers. Nigeria ranks among the top producers of garden egg in Africa, with an estimated annual output exceeding 1.2 million metric tons, making a significant contribution to the vegetable sector (Food and Agriculture Organization (FAO, 2023). In Abia State, especially in the Isiala Ngwa region, garden egg farming has become increasingly popular due to its suitability for the local climate, strong market demand, and relatively short production cycle (Okpara *et al.,* 2022).

The cultivation of garden eggs (Solanum melongena) holds the promise of becoming a lucrative venture; however, smallholder farmers in the Isiala Ngwa South Local Government Area (LGA) of Abia State encounter considerable obstacles that hinder its productivity. Many farmers view garden eggs cultivation as a risky endeavor because of production difficulties, which deters them from committing their limited resources to the growth. The main challenges faced include insufficient storage facilities, restricted access to funding, high expenses for chemical fertilizers, significant post-harvest losses, inadequate soil fertility, and frequent pest and disease outbreaks (Onu et al., 2016). The attendants' effect of the production challenges includes low productivity rates, production inefficiencies, and decreased profitability, subsequently restricting the role of garden eggs farming in enhancing household income and contributing to local food security.

Although previous researches (Onu et al., 2016; Abayomi et al., 2017; Mangan *et al.,* 2017; Oreoritse, 2022; Ibe et al., 2022) have investigated different dimensions of garden eggs cultivation across various regions, there is a lack of empirical data concerning productivity and profitability of garden eggs farmers in Isiala Ngwa South LGA. With the rising demand for garden eggs and their significance in local diets and markets, it is essential to evaluate the productivity, cost and returns, and factors impacting its profitability in this region. This study addressed this knowledge gap.

METHODOLOGY

The research was carried out in Isiala Ngwa South Local Government Area (LGA), located in Abia State, Nigeria, which has an estimated population of 199,000 and a density of 395 individuals per square kilometer (NPC, 2022). A multistage sampling approach was employed, with Isiala Ngwa South intentionally selected due to its significant involvement in garden egg farming. Three communities were randomly selected, subsequently leading to the choice of five villages within each community, and a total of eight farmers from each village, resulting in 120 respondents overall. Data collection was accomplished using structured questionnaire, and analyzed using descriptive statistics, total factor productivity, net return analysis, and ordinary least squares (OLS) regression.

The Total Factor Productivity (TFP) is specified as:

$$\text{TFP} = \frac{Y}{\sum P_i X_i} \quad (1)$$

Where,
TFP = total factor productivity,
Y = Output of garden egg
P_i = unit price of i^{th} variable input and
x_i = quantity of i^{th} variable input.

From cost theory,

$$\text{AVC} = \frac{TVC}{Y} \quad (2)$$

Where AVC = Average variable cost in naira (N).
Therefore,

$$\text{TFP} = \frac{Y}{TVC} = \frac{1}{AVC}$$

As such, TFP is the inverse of the AVC

The interpretation of TFP index are as follows as used by Folorunso and Bayo (2020);

Index	Interpretation
(< 0.1)	Sub-optimal
(1.0 –1.09)	Optimal
(≥ 1.10)	Super-optimal

The net return model is defined as the difference between the total revenue (TR) and total cost (TC). It is specified thus:

$$NR = TR - TC \quad (3)$$

Total cost is the addition of the entire variable cost (VC) and fixed cost (FC) items;

$$TC = TVC + TFC \quad (4)$$

Total revenue is the total amount of money that a farmer received from the sale of garden eggs crop;

$$TR = \Sigma P_x Q_x \quad (5)$$

Where; P_x = price garden eggs crop sold (₦)
Q_x= Quantity of garden eggs crop sold (kg)

$$GP = TR - TVC \quad (6)$$

$$R/N = \frac{GP}{TC} \quad (7)$$

$$\text{Gross Ratio (GR)} = TC/TR \quad (8)$$

GP = Gross profit (₦)
R/N = Return per naira invested

The generalized OLS model is given as follows;

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + e_i \quad (9)$$

Where,
Y = Profit (₦)
X_1 = Cost of Seeds (₦)
X_2 = Cost of Herbicide (₦)
X_3 = Cost of Labour (₦)
X_4 = Farm size (Ha)
X_5= Household size (numbers)
X_6 =Age (years)
X_7 Education (years),
X_8 = Monthly Income (₦),
X_9 = Farming experience (years),
X_{10} = Extension contacts (Number)
e_i = Error term
β_0 = coefficients
β_1- β_{11} = parameters estimated

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Garden Eggs Farmers in Isiala Ngwa South Abia State, Nigeria

Table 1 showed the socio-economic characteristics of garden eggs farmers in Isiala Ngwa. The study reveals that 66.7% of the farmers are male, reflecting the demanding nature of garden eggs farming, this is consistent with the report obtained by Ibe et al. (2022). With an average age of 42.8 years, most farmers are in their productive middle age, enhancing their resource management (Barau et al., 2020; Chah et al. 2019). Marital status analysis shows that 94.2% are married, signifying the importance of taking up responsibilities and availability of family labour in reducing costs, as also noted by Chah et al. (2019). In terms of education, 66.7% of farmers have 6–12 years of schooling, with an average of 9.2 years, which can improve their ability to adopt innovative farming practices, as supported by Adeosun et al. (2022). The average household size of 4.7 persons indicates sufficient labour availability, supporting findings by Ibe *et al.* (2022). Additionally, farmers' average monthly income of ₦180,833.3, above the national minimum wage, supports the adoption of new technologies (Adeosun *et al.,* 2022). With an average of 6.7 years of farming experience, the farmers possess significant expertise, aligning with Abiodun *et al. (*2019). However, 73.3% of the garden eggs farmers in the study area lack access to credit, a barrier due to collateral and risk concerns, truncated Barau *et al.* (2020). While 52.5% have access to extension services, the limited coverage remains a challenge (Ibe et *al*., 2022). Addressing these constraints is crucial to improving productivity in the area and Nigeria at large.

Table 1: Socioeconomic Characteristics of Garden Eggs Farmers in Isiala Ngwa South Abia State

Variables	Frequency (N =120)	Percentage (100%)
Gender		
Male	**80**	66.7
Female	40	33.3
Age		
Below 40	47	39.2
40-60	70	58.3
Above 60	3	2.5
Mean age 42.8		
Marital Status		
Single	2	1.7
Married	113	94.2
Divorced	3	2.5
Widower	2	1.6
Years of Education		
Mean= 9.2		
6-12	115	66.7
Above 12	3	18.3
Below 6	2	15
Household Size		
Below 4	**33**	27.5
4 – 6	**71**	59.2
Above	**16**	13.3
Mean household size 4.7		
Monthly income		
Below ₦100,000	8	6.7
₦100,000 - ₦300,000	94	78.3
Above ₦300,000	18	15.0
Mean = ₦ 180,833.3		
Cooperative Membership		
Yes	8	6.7
No	112	93.3
Access to Extension		
Yes	63	52.5
No	57	47.5
Farming Experience		
Below 5	30	25.00
5 - 10	79	65.83
Above 10	**11**	**9.20**
Mean = 6.7 years		
Access to Credit		
Yes	32	26.7
No	88	73.3
Access to Extension Service		
Yes	63	52.5
No	57	47.5
Land Acquisition		
Owned	06	5.0
Rent/leased	31	25.8
Inherited	14	11.7
Family	69	57.5
Farm size		
Below 0 .5 Size (ha)	78	65.0
0.5 – 0.9 size (ha)	27	22.5
1 – 5 sizes (ha)	15	12.5
Mean (0.7 ha)		

Source: Field Survey, 2024

As indicated in Table 1, majority (57.5%) of the garden eggs farmers in the study area cultivated family land, 25.8% rented land, 11.7% inherited it, and 5.0% owned the land cultivated for the production of garden eggs in the study area. This aligns with the prevalence of communal land

tenure structures, which may limit long-term investments in land developments (FMARD, 2024). Analysis of the farm size of the farmers shows that, most (65.0%) farmers cultivated less than 0.5 hectares, while 22.5% farmed between 0.5ha and 0.9ha, and 12.5% had farm sizes between 1ha and 5ha. The average farm size was 0.7 hectares, indicating predominance of small-scale production, consistent with Barau et al. (2020)

Productivity

The result on the productivity of garden egg farmers in Isiala Ngwa LGA of Abia State is presented in Table 2.

Table 2: Total Factor Productivity (TFP) of Garden Egg Production.

	Total Value Product (₦)	Input Cost (₦)	TFP
Mean	309,441.67	159280.42	1.919062
Minimum	90000	68500	0.6742
Maximum	1025000	380050	3.9035

Source: Field Survey data, 2024

The result in Table 2 shows the mean, minimum and maximum values of the TFP of garden egg cultivation in Isiala Ngwa South, Abia State, highlighting notable discrepancies in productivity levels among farmers. The mean TFP of 1.919 indicates that, on average, farmers obtain ₦1.92 in output value for each ₦1 spent on inputs, suggesting a relatively efficient production system (Fare et al., 2018). However, the lowest recorded TFP of 0.6742 points to certain farmers facing inefficiencies, likely a result of challenges such as restricted access to quality inputs, inadequate farm management techniques, or unfavorable environmental conditions (Ibe et al., 2022). In contrast, the highest TFP of 3.9035 shows that some farmers attain high levels of efficiency, potentially due to superior agronomic practices, enhanced input usage, or economies of scale (Ogunniyi *et al.,* 2020).

Cost and Returns Result

The cost and return, hence profitability of garden eggs production in the study area is presented in Table 3.

Table 3: Cost and Return and Profitability of garden egg production in the study area

Variable Cost	Amount (₦)/ha	Percentage
Seed	7,537	4.7
Labour	63,958	40.2
Rents	19,019	11.9
Herbicides	11,293	7.1
Fertilizers	55,104	34.6
Transportation	2,369	1.5
Total Variable Cost (TVC)	159,280	
Depreciation	5,422	
Total Fixed Cost	5,422	
Total Cost	164,702	
Returns		
Sales	309,442	
Total Returns	309,442	
Gross margin	150,162	
Net Profit	144,739	

Source: Field Survey data, 2024

The result on the cost and return analysis for garden egg farming revealed a total variable cost of ₦159,280 per hectare yearly, with fixed costs amounting to ₦5,422, amounting to a total cost of ₦164,702 per hectare. The primary cost components were labour (40.2%) and fertilizers (34.6%), reflecting trends identified by Onu *et al.* (2016), who noted that labour made up the largest portion of costs (57.6%). With total revenue of ₦309,442 per hectare, farmers earned a gross margin of ₦150,162 and a net profit of ₦144,739, which indicates that garden eggs farming is a profitable enterprise in the study area. These results support previous studies, such as those by Onu *et al.* (2016), which indicated profitability in garden egg farming (₦113,658 per hectare). Access to

inputs, including fertilizers and labor-saving technologies, could enhance returns, encouraging rural economic growth (Adebayo & Daramola, 2018; Ogunniyi *et al.,* 2020).

Determinants of Profitability of Garden Egg Production

The Ordinary Least Squares (OLS) regression model result is presented in Table 4. Double log functional form was chosen as the lead equation with the coefficient of determination of 0.6607. The result in Table 4 shows that 66.07 % of the variation in the net profit of garden eggs farmers can be explained by the explanatory variables included in the model. The F-statistic was statistically significant at the 1% probability level, suggesting a well-fitted model.

Table 4: OLS Regression Result of Determinants of Profitability of Garden Eggs in the Study Area

Variable	Coefficient	Standard error	T -Value
Constant	2.56	0.19176	13.350^{xxx}
Seed	0.004	0.00043	9.304 ^{xxx}
Farm size	0.454	0.21943	2.069 ^{x}
Labour	-0.30	-0.05703	-5.260 ^{xxx}
Herbicides	12.83`3	1.80274	7.12 ^{xxx}
Age	0.31	0.02607	11.89 ^{xxx}
Farming Experience	0.08	0.02694	2.97 ^{xxx}
Education	0.01	0.00123	8.12 ^{xxx}
Income	47`52.96	21601.68	2.20 ^{x}
Household size	0.390	0.07457	5.26 ^{xxx}
No of Extension contact	0.21704	0.8466	2.56 ^{xx}
R^2	0.6607		
Adjusted R^2	0.6395		
F - Statistic	31.15		
No of Respondents	120		

Source: Field survey 2024, ***, **, * significant at 1%, 5% and 10% respectively

All the explanatory variables included in the model significantly determined the level of net profit obtained by the garden eggs farmers studied. The cost of herbicide had a significant effect on the net profit of garden egg production, with 12.83 increase in net profit for every unit of herbicide cost increase. This finding challenges the common belief that higher herbicide costs would reduce net profits. Given the crop's high socio-cultural and nutritional value, farmers may raise the price of garden eggs more than proportionally to herbicide cost increases (Ibe *et al.,* 2022). This is in contrasts with earlier research by Ibe *et al*. (2022), which found that agrochemical use reduced garden egg profitability. The coefficient of labour is significantly signed at 1% level and negatively correlated with the net profit of garden egg. This suggests that as the cost of labour increases the farmers' level of net income declines.

Monthly income also positively influenced net profit at 10% level of significant, with a unit increase in income causing a 2.20 rise in net profit of garden egg farming by ₦47,152.96. This suggests that higher income enables farmers to make more investments in garden egg farming, thereby increasing yield and profitability. This aligns with the study of Adebayo and Daramola (2018), who posited the positive link between income and farm investment. Also, access to extension service showed a considerable positive effect on profitability of garden eggs production in the study area, where an increase of one unit in extension service access raised net yield by 0.217 unit. This implies that increase in the farmers extension contact help them to adopt innovations and technologies that lead to garden egg productivity and profit maximization as well. This result is consistent with Adeyemo and Olayemi (2020), who established that regular extension contact offers farmers with critical production and marketing information, improving farm productivity and financial effects.

CONCLUSION AND RECOMMENDATIONS

The study concludes that garden egg production in Isiala Ngwa South LGA is profitable, with an average TFP of 1.919 and a net profit of ₦144,739 per hectare. Nevertheless, the observed variability in TFP among farmers points to differences in production. The following recommendations are made:

- Strengthening extension services can provide farmers with up-to-date agronomic practices, leading to improved farm management and increased productivity.

- Implementing financial programs to support farmers can alleviate constraints related to input purchases, thereby enhancing production capacity
- Training farmers on the judicious use of herbicides can optimize weed control, potentially increasing yields and profitability.

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Adoption of Cowpea Production Technologies among Farmers in Dekina Local Government of Kogi State, Nigeria

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ABSTRACT
The study analysed adoption of cowpea production technologies among farmers in Dekina Local Government Area of Kogi State, Nigeria. Data for the study were obtained from 150 respondents selected through multi-stage random sampling. Data for the study were analyzed using descriptive statistics and Logit regression analyses. Results revealed that majority of the respondents were males (94.7) and married (92%) and fell within the age bracket of 50 years and below (84%). The factors that influenced the level of adoption of cowpea production technologies were education level, level of income and access to credit were found to be significant (p≤ 0.01% each. With respect to sources of information, it was found that friends and relations, and personal experience were found to be the main source of information used by farmers. Constraints to adoption of cowpea production technologies were found to be mostly due to lack of inputs, mechanized services, finance, storage facilities and lack of adequate dissemination of information. Based on the finding of this study, the researcher recommended that, there is a need for re-organizing and intensification of extension services in order to improve their effort towards information dissemination. Also, loans should be made available to farmers so as to enable them procure farm inputs and mechanized services.

INTRODUCTION
Cowpea is known by other names such as black eye beans, china beans, black eye pea and marble beans and the Igala people call it egwa. It is very important in the socio-cultural and religious life of the people of Kogi State. Among the Okun people of Kabba it is essential in the Oro celebration. The making and eating of bean cake is prohibited a week before the festival in honour of the gods to whom it will soon be offered. In Dekina beans and other grains are often offered to the gods and ancestors, sacrifices are not complete without them. This is to tell us that cowpea has a place of honour among crops in the life of Kogi people. In order to meet the demand of cowpea by the inhabitants, technology has to be used in its production.

Adoption is a decision made by an individual or group to use an innovation in a continuous manner (Orisakwe and Agomuo, 2011). Technology is the systematic application of scientific or other organized body of knowledge to practical purposes (Orisakwe and Agomuo, 2011). This includes new ideas, inventions, innovations, techniques, methods and materials. The importance of technology to agricultural development especially in less developed countries is widely recognized. This is predicted on the observed impact of technology and its potential and actual contribution to the development of agriculture. In developing countries like Nigeria where a greater proportion of

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the population live in rural areas, agricultural technology could provide a potential means of increasing production and subsequently raising income of the farmers as well as their standard of living (Yindau,2014) cited in (Bashir, et.al., 2018). Cowpea (*vigna unguiculata (L) walp*) is a leguminous crop grown mainly in the savanna regions of the tropics and subtropics of Africa, Asia and South America (Sani *et al*., 2014). Being a drought tolerant and warm weather crop cowpea is well adapted to the drier region of the tropics where other food legumes do not perform well. It is of major importance to the livelihoods of millions of people in less developed countries of the tropics, particularly in Asia and Africa. From its production, rural families derive food, animal feed and income (IITA, 2009). Cowpea is also one of the most importance economic crops in the tropics for the fact that all of its parts are useful for human consumption and for the provision of livestock feed. The crop tolerates drought and performs well in a wide variety of soil. Similarly, the bacteria in the root nodules contribute to soil fertility through fixation of nitrogen in the soil and production of organic matter (Tijjani *et al.*, 2015).

Therefore, the objective of this study is to: Describe the socio-economic characteristics of the cowpea farmers; determine the factors that influenced adoption of cowpea production technologies among the farmers; and identify cowpea production technologies available to the farmers;

METHODOLOGY

The Study Area

The study area is Dekina Local Government Area of Kogi State. It is one of the nine local government areas in Kogi East senatorial District. It has a population of 66,801 out of which 31,839 are males and 34,962 are females. About 4,356 of the population are between 7 and 14 years of age and 18,141 are between 15 and 49 years (Omale 2004.).

The study area is predominantly rural in nature. Streams like Okura, Ofu, and Itemie serve as the major sources of household water in the area. The major crops produced are yam, cassava, maize, cowpea and Bambara nut. Tree crops include oil palm, citrus, mango, and cashew. The climate is tropical with a mean temperature of about 30^0c during the hottest period of January to April. The mean temperature during the coldest period of December to January is about 21^0c. The area is generally cool during the rainy season, with a mean annual rainfall of between 1500mm and 1800mm. The rainfall is seasonal with most of it between April and October. This pattern of rainfall dictates the farming season. There are two seasons in a year, the early season is from April to August and the second season from August to October (aA Nigeria 2024).

Analytical Techniques

Sources of Data and Sampling Procedure

Data for the study were collected with the use of a structured questionnaire. The populations for the study were cowpea farmers in Dekina Local Government Area of Kogi State. In this study, Multi-stage random sampling technique was adopted in the selection of respondents. In the first stage, the three districts in the study area were purposively selected. This includes Biraidu, Dekina and Okura. In the second stage 5 villages were randomly selected from each of the districts giving 15 villages all together. These are from Dekina, Odo-ate, Odu-ofomu, Ogane-nigu, Iyale and Oloba; from Biraidu, we have Araba salifu, Emewe-efopa, Abocho etiaja, Ogbabede and Biraidu-abocho; from Okura we selected Itama, Okura sawmill, Ochaja, Agala-ate, and Abejukolo-egume. In the third stage, snow ball technique was used to select 10 respondents from each of the selected villages. In all 150 respondents were selected for the study.

The data were analyzed with descriptive statistics using frequency, percentages and mean scores for objectives I, and III, while objectives II was analyzed using logit multiple regression. {Software used in the analysis was special package for social science (SPSS)}.

$$\text{Mean } X = \Sigma fn$$

Where;

X= Mean score Σ= Summation F = frequency of response mode n = likert nominal value Nr = number of response. The decision rule that served as basis for acceptance or rejection was determined thus; Decision rule (DR) of 3- point rating scale = (3 + 2 + 1)/3 = 2.0. The rating scale was used to

determine the problem encountered by the farmers in the study area. A 3-point rating scale was used as follows, very severe 3, severe 2, not severe 1. To determine the cutoff point, a class interval of 0.05 was used to determine the upper limit of the mean. The upper limit 2.0 + 0.05 = 2.05 The lower limit 2.0 – 0.05 = 1.95 Therefore responses with mean score X up to the above 2.00 were regarded as good while those mean score X below 1.95 were regarded as not so strong or good. Regression model is the situation in which dependent variable (P) is predicted from two or more independent variables. It is used to determine the contributions of independent variables to the dependent variables. To determine the magnitude of each cowpea technology in explaining the variation in total adoption, the total adoption scores of the respondents were regressed on the adoption scores for various cowpea technologies. The order in which the technology was selected gives valuable information on the contribution of each technology in explaining the differences in total adoption of the farmers. This is why regression model were used in this study to analyze the factors that influence adoption of cowpea production technologies.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

Age distribution of the Respondents

Result of the study in Table 1 show that the average age of the respondents was 45 years. The implication of these findings is that a moderate proportion of the respondents belong to the young and middle-aged group. This is an advantage since they are supposed to be physically able and more mentally alert in learning new technologies than the older farmers. This finding is similar to that of Sani *et al;* (2014) as the obtained a similar result among cowpea farmers in Bichi Local Government Area of Kano State. Majority of the respondents (94.7%) were male, this implies cowpea production is dominated by male in the study. However, majority (92%) of the respondents were married which is an indication that family labour could be available for cowpea farmers in the study area. The result indicates that most of the respondents (56.67%) had not acquired formal education. They cannot easily understand and adopt innovations. This finding is in agreement with that of Onweremadu and Mathew (2007), and Sani *et al.,* (2014). The result shows that majority (88%) of the respondents cultivates 0.10 – 5.99 hectares as this finding differs from the finding of Agwu and Anyanwu, (1996) cited in Agwu (2004) that, cowpea farmers in south eastern Nigeria cultivated not more than 1.5 hectares. This is an advantage for adoption of modern cowpea production technologies.

Result show that a good proportion (56.8%) of the respondents' household were between 6 – 20 members. This finding related to Sani *et al*; (2014) who reported 8 persons as an average household size in the adoption of dual purpose cowpea production. Households provide ready source of labour on the farm, this is an indication of why farmers tend to take more than one wife. A good proportion (53.9%) of the respondents had 6-15 years of farming experience, this indicate that farmers were experienced enough to be able to understand the technologies and adopt it. This also implies that majority of the cowpea farmers had long period of farming experience and therefore would be conversant with constraints to increased cowpea production. This could increase their level of acceptance of new ideas as a means of overcoming their production constraints and hence could serve as an advantage for increased cowpea production.

However, all (100%) respondents indicated they had no contact with the extension agents but adopt the practice on their own or with the help of fellow farmers. This poor ratio farmers contact with extension agents negates the theoretical role extension agencies supposed to play in technology diffusion and adoption Tijjani *et al.,* (2015) which may be due to inadequacy or insufficient logistics for the extension worker to reach the farmer or incompetency of the personnel to be conversant with technical aspect of the technology.

Table 1: Socioeconomic characteristics of the respondents

Socio-economic variables	Frequency	Percentage
Age(Years)		
20-29	28	18.7
30-39	69	46.0
40-49	29	19.3
50-59	17	11.3
>60	7	4.7
Gender		
Male	142	94.7
Female	8	5.3
Marital Status		
Married	138	92.0
Single	8	5.3
Widow(er)	4	2.7
Divorce	-	-
Educational Level		
No formal Education	85	56.67
Primary Education	25	16.7
Secondary Education	33	22.0
Tertiary Education	7	4.6
Farm Size		
0.1-5.99	132	88.0
5-9.99	7	4.67
10-15.99	7	4.67
16-20	2	1.33
>20	2	1.33
Years of Farming Experience		
1-5	18	37.8
6-10	47	43.2
11-15	35	10.7
16-20	18	4.1
>20	32	4.1
Access to Extension Service		
Yes	0	0
No	150	100

Source: Filed Survey, 2017

Cowpea Production Technologies

The percentage of the adoption rate of the eleven-cowpea production technologies among farmers are presented in Table 2, highest (99.3%) adoption percentage was recorded for land preparation. This is not surprising as it is well known that, the yields of cowpea varieties are generally decreases without proper land clearing and cultivation procedures. Hence, the high level of adoption associated with this technology implies that farmers in the study area were aware of the fact that without proper land preparation in their cowpea farms they cannot make good economic gains. Recommended spacing and planting date and storage techniques recorded 98.7% and 97.3% respectively while used of herbicide for weed control and seed rate recorded 95.3% and 90.7% respectively. For mechanize farming use of tractor for land preparation and pesticide to control pest on cowpea farms recorded.2.6% and 96% respectively. Field practices showed that farmers in this area cultivate their farm lands manually often achieving this through cooperative farming. Furthermore, fertilizer application and seed treatment recorded 5.3% and 36% respectively. The low adoption 8% recorded for improves seed may be associated to the low level of awareness of the technology among the respondents

Table 2: Cowpea production technologies (n = 150)

Technologies	Frequencies	Percentage	Ranking
Land preparation	149	99.3	1
Spacing and Planting Date	148	98.7	2
Storage	146	97.3	3
Pesticide	144	96	4
Herbicide	143	95.3	5
Seed rate	136	90.7	6
Harvesting	102	68.0	7
Seed Treatment	54	36.0	8
Improved seed	12	8.0	9
Fertilizer application	8	5.3	10
Mechanized farming	4	2.6	11

Source: Filed Survey, 2017.

Logit multiple Regression of Some Variables Influencing Adoption of Cowpea Production Technologies among Farmers in the Study Area

The factors influencing the adoption of cowpea production technologies were evaluated using multiple (Logit) regression analysis where four functional forms were tried and linear function gave the best fit. The result is presented in table 4 which revealed that the coefficient of multiple determinations (R2) was 0.79 implying that about 79% of the variations in the adoption of cowpea production technologies were explained by variables in the models. Z value was statistically significant at 1% which also showed model fit.

The coefficient for age was positive and statistically significant at 1%. The positive coefficient of age means that there is direct relationship between adoption of cowpea production technologies and age of the farmers. Age is said to be primarily latent characteristics in adoption decisions. However, there is contention on the direction of the effect of age on adoption. Age was found to positively influence adoption of cowpea. The farmers' age can increase or decrease the probability of adopting cowpea production technologies. The coefficient of gender was negative and not statistically significant. This implies that gender is not a factor influencing adoption of cowpea production technologies in the study area. This agrees with the appriori expectation that irrespective of one gender he or she could adopt cowpea production technologies. There was a positive significant relationship between marital status and adoption of cowpea production technologies in the study area. This could be explained for the fact that, married farmers have more responsibilities to catered for their families which could stimulate them to adopt the new technologies in order to enhance their farm yield. The coefficient of household size was positive and statistically significant at 1% level. This agrees with the appriori expectation, that the large household size could supply cheap family labour which positively enhances adoption of cowpea production technologies in the study area. The coefficient of educational level was also found to be positive and statistically significant at 1%. The positive coefficient of educational status means that there is a direct relationship between adoption of cowpea production technologies and educational status, whereby as educational status increased adoption level also increased among farmers. This agreed with appriori expectation that the higher the educational level the higher the level of adoption. Low level of education of the farmers is inimical to the adoption of innovation especially for technologies that are complex. The coefficient in farm size was positive and statistically significant at 1% level. The positive coefficient implies a direct relationship that as farm size increases, adoption of cowpea production technologies increase and vice-versa. In other word, the larger the farm size the higher the potential of adoption, these agree with the appriori expectation that large farmers adopt improved technologies at a faster rate than small .farmers. It will be difficult to used mechanized farming system on small and fragmented individual farms. Small scale farmers live at subsistence level and are usually financially disadvantaged. These financial constraints may discourage them from adopting improved technologies. The table also revealed that years of farming experience was found to be important in influencing the likelihood of adoption of cowpea production technologies. The variables were found to be statistically significant at 1% level and positively related with likelihood of adoption. Most farmers fear trying improved technology because they do not have previous experience in applying the new technology and due the possible risk of failure. Years of farming experience could enable the farmers to have courage in adopting the technology as it confirmed appriori expectation. However, the studies of Ajala (1992) and Ikini *et al*; (1998) cited in

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Agwu (2004) show that age, farming experience and organizational participation significantly influenced adoption. The difference might be the type of technologies studied among other factors. Furthermore, this result conformed to the findings of Salau *et al*; (2010) who reported in their study of assessing adoption level of diffused light storage technology among Irish potato farmers in Jos South Local Government Area of Plateau State. The logistic regression result showed that farmer's age, education, income and farm size are significant determinants of adoption. Similarly, Isibor and Ugwumba (2014) applied logistic regression model in their study on adoption of oil palm production technologies in Ihiala Local Government of Anambra State, Nigeria. The found out that farm size, educational level and annual farm income were positively significant.

CONCLUSION AND RECOMMENDATIONS

The study discovered that the variables that determines cowpea technology adoption in the study area include age, marital status, educational level, farm size, and farming experience.

Based on the findings of this study, the following recommendations were put forward:
i. The extension agents should use the group approach in extension service delivery and identify farmers that should be taught the technical skill involved in the cowpea production technologies. In this way a large number of farmers would be reached at the same time. These farmers would in turn teach these technologies to other farmers in the area.

ii. The poor economic condition of the farmers occasioned by lack of funds to carryout necessary farm activities associated with cowpea production technologies, among other variables, was major constraints to the production capacity of the farmer were handicapped in this area. Thus, even though the issue of provision of credit is an intractable problem in Nigeria agriculture, it is suggested that a realistic policy on provision of credit to cowpea farmers in particular be put in place. The Government may have to revisit this issue. Once this is done, the credit facilities must be accompanied with supervision and advice from the disbursing agency to ensure their proper utilization for increase cowpea production.

iii. Farmers should be encouraged to participate actively in farmers/social organization and co-operative societies in order to strengthen their group action, since such organization act as effective channels for extension contact with larger number of farmers. It also creates opportunity for participatory interaction of farmers with extension organization further more. Co-operative societies help in providing marketing facilities for the mutual benefit of the famers.

iv. Loans should be made available to farmers so as to enable them procure farm inputs and mechanized services for improved agricultural production. Farm inputs such as fertilizers, chemicals and improved seeds should be made available to farmers at subsidized rate before the onset of rainy season by government.

v. Modern storage facilities should be introduced to farmers in order to reduce post-harvest loss as a result of pest attack.

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Assessment of the Effects of Climate Change Mitigation Practices among Arable Crop Farmers in Ideato North Local Government Area, Imo State, Nigeria

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ABSTRACT
The study assessed the effects of climate change mitigation practices among arable crop farmers in Ideato North LGA, Imo State, Nigeria. The specific objectives of the study were to identify the socio-economic characteristics of the respondents; ascertain the adaptive and mitigating measures used by farmers; ascertain the perceived effect of climate change. Purposive and multi-staged random sampling techniques were used to select a sample size of 64 respondents who are involved in arable crop production and affected by climate change. Data were collected with a structured questionnaire, and analysed using descriptive and inferential statistics (tobith regression analysis). Results show that majority of the respondents were female, over 50% of the farmers were married, majority of the farmers acquired primary education. The result revealed that regular weeding X=4.57, use of water channels X=4.45, use of organic manure X=4.46 were the major adaptive measures used. In the perceived effects, the result revealed that destruction of wild life X=4.56, drying of streams early X=4.44 affected the farmers. The tobith regression estimate of the influence of socioeconomic characteristics of the knowledge of climate change, the chi-square value of 6.48.464 confirms the fitness and it is statistically significant at 1% level which affirms the significant relation of the dependent and independent variable. For socio-economic of climate change adaptive mitigation, the chi-square value of 807.945 confirms the fitness and significant at 1% level and the variables are positively related. The study therefore concludes that the famers were conversant with adaptive mitigation of the climate change and thereby has derived means to cope with the climate change. The study therefore recommend that efforts should be shown by governments, NGOs, individuals to acquaint and educate famers on how they will cope more on the climate change related issue.
Keywords: Effects, Climate Change Mitigation, Farmers

INTRODUCTION
Climate change has intensified the frequency and severity of extreme weather events, such as droughts, floods, storms, and heat waves, posing significant challenges to farmers worldwide (Ekweanya, Anyanwu, Odoh and Ifenkwe, 2021). In response, farmers are adopting various strategies to mitigate risks, enhance preparedness, and adapt to changing environmental conditions (Ifeanyi-Obi and Iwuagwu, 2022). Farmers play a central role in managing agricultural risks and adapting to climate variability. Their knowledge, experience, and adaptive capacity are essential for devising effective strategies to cope with climate change-related disasters. Climate change-related disasters encompass a wide range of extreme weather events and environmental

phenomena that are exacerbated or influenced by global climate change. These disasters pose significant threats to human well-being, infrastructure, ecosystems, and économies, with profound implications for sustainable development, social equity, and planetary health (Rodriguez, and Smith 2023). Understanding the nature, causes, impacts, and responses to climate change- related disasters is crucial for enhancing resilience, mitigating risks, and promoting adaptive strategies at local, national, and global scales. Farmer-led preparedness encompasses a holistic and proactive approach to managing climate change-related risks and uncertainties in agriculture Ifeanyi-Obi, Issa, (2022), AFDB, 2021). It was also, noted that Nigeria specifically ought to be concerned by climate change because of the country's high vulnerability due to its long (800km) coastline that is prone to sea-level rise and the risk of fierce storms. In addition, almost 2/3 of Nigeria's land cover is prone to drought and desertification. Its water resources are under threat which will affect energy sources (like the Kainji and Shiroro dam). Moreover, rain-fed agriculture practiced and fishing activities from which 2/3 of the Nigerian population depend primarily on foods and livelihoods are also under serious threat besides the high population pressures of 140 million people surviving on the physical environment through various activities within an area of 923,000 square kilometers (IPCC 2017; NEST 2022). To approach the issue appropriately, one must take into account local communities' understanding of climate change, since they perceive climate as having a strong spiritual, emotional, and physical dimension. It is therefore assumed that these communities have an inborn, adaptive knowledge from which to draw and survive in high-stress ecological and socio-economic conditions. Thus, the human response is critical to understanding and estimating the effects of climate change on production and food supply for ease of adaptation. Accounting for these adaptations and adjustments is necessary in order to estimate climate change mitigations and responses.

Although the agricultural sector is being transformed by commercialization at the small, medium and large-scale enterprise levels, the country is still faced with a number of constraints. According to International Food Policy Research Institute (IFPRI) (2018), the constraints include poor agricultural pricing and low fertilizer use, low access to agricultural credit, land tenure insecurity and land degradation, poverty and gender issues, low and unstable investment in agricultural research as well as poor market access and marketing efficiency. In addition to these, climate and weather parameters have consistently been changing. Climate refers to the average or typical weather conditions observed over a long period of time (usually over 30 years) for a given area (Spencer, 2019). The classical period is 30 years as defined by the World Metrological Organization (WMO). Climate encompasses the statistics of temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric partial count and other metrological elemental measurement in a given region. On the other hand, climate change is a significant and lasting change in the statistical distribution of weather patterns over period ranging from decades to millions of years (World Bank (2021). Climate change and Agriculture are inter-related processes, both of which take place on a global scale. Global warming is projected to have significant impacts on conditions affecting Agriculture. These conditions include temperature, carbon dioxide, glacial run off, precipitation and their interactions are of significant importance. These changes in climate have had negative effects on agriculture over the years with arable crops not left out. Between 2016 and 2023, world grain production has stabilized over 1.8 billion tones. From 2018 to 2023, grain stocks have been dropping, resulting in a global grain harvest that was short of consumption by 93 million of tons in 2003 (World Bank, 2021). There has also been a reduction in harvest of these crops.

It has been predicted that the resultant increase in temperature due to climate change will accelerate physiological development resulting in hastened maturation and reduced yield (Bassey, C.E., 2023). It is also a well-known fact that the occurrence of moisture stress resulting from drought, during flowering, pollination and grain filling is harmful to most arable crops. Growing seasons are expected to become shorter as temperature increases e.g. rice yield starts decreasing at over 340c. It has also been noted that food production in Africa could half by 2030 (IPCC, 2021). Furthermore, extreme weather events (climate change) such as thunder storm, flood, heavy rainfall and heavy wind are detrimental to agricultural activities in crops, livestock and humans. These often lead to failure of crops and incidence of pests and diseases due to migration in response to climate change and variations. Nigeria is an Agrarian Economy with 75% small farmers accounting for the nation's agricultural output (Bello, 2023). Most of these farmers depend solely on the natural weather conditions for production and therefore need effective adaptive and mitigating measures

to cope with these changes. The Imo state ADP and intervention programmes like National Fadama Development Project (NFDP), National Programme for Food Security (NPFS) and NGOs are in place to deliver extension services to farmers in all aspects of agriculture. However, it could not be categorically stated that they disseminate climate change adaptation and mitigation practices/information to farmers particularly on arable crops. Hence, this study is conducted to assess the climate mitigation practices among arable crop farmers in Ideato North LGA, Imo State, Nigeria. Specifically the specific objectives were to:

(i) describe the socio-economic characteristics of arable crop farmers in the study area;
(ii) ascertain the adaptive and mitigating measures used by farmers on climate change;
(iii) ascertain the perceived effects of climate change by farmers;

Hypothesis

HO_1: There is no significant relationship between respondent socio-economic characteristics and the perceived effect of climate change.

METHODOLOGY

The study was conducted in Ideato North Local Government Area of Imo state. It is one of the twenty-seven local government areas that made up Imo state. It was initially established in 1976 as Ideato Local Government, but was later sub-divided into Ideato North and Ideato South. In terms of education, they have advanced educated personnel in virtually all fields of endeavour. That is why some of them are civil servants and self- employed. Some of the areas are characterized by inadequate and deteriorated road walkways, unregulated building patterns, poor sanitation, noise pollution and overcrowding as a result of human migration. Ideato North local government area is located within the Orlu agricultural zone of Imo State. It is located on longitude 5o 48'21.89" N and latitude of 7o 08' 20.62" E. It has an area of 88km2 and had a population of 159,879 at the 2006 census. The people of the area are known for their crafts, apprenticeship, and farming. They produce cash crops such as oil palm, raffia palm, groundnut, cotton, cocoa, rubber. The food crops grown in large quantities include cassava, cocoyam, breadfruits, yam, maize, melon, and trifoliate yam. The population for this study comprised of arable crop farmers in Ideato North LGA, Imo State, Nigeria. Multi-stage sampling procedure were used to select arable crop farmers. Firstly, four (4) communities were purposively selected because of the farming activities in the area. Secondly, a random sampling procedure was used to select two (2) villages from the communities under study making a total of eight (villages).

Thirdly, in this stage, eight (8) arable crop farmers were randomly selected from each of the villages, giving a total 64 respondents. Data for this study were collected from primary and secondary sources. The primary source of data was mainly the use of a structured questionnaire which was designed to elicit information on an assessment of climate change mitigation practices among arable crop farmers in Ideato North LGA, Imo State, Nigeria. The secondary source of data collections were textbooks, journals and scholarly materials. Data for this study were analysed using descriptive and inferential statistics. Specifically, objectives 1,2,3, was analysed using descriptive statistics such as frequency, mean counts, percentages and likert type rating scale. The hypothesis was analysed using Tobit analysis.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

The result revealed that majority of the respondent were female against the male counterparts which is an indication that females were more involved in farming activities. The result from the bar chart reveals that majority of the farmers were married which means that have families who are much involved in farming activities in the study area. The implication of this result is that married ones are considered to be more responsible to take any rational decision as it affects climate change. Ekweanya, et.al (2021) noted that married farmers with their household are usually better off to adopt labor intensive farming activities, thereby leading to increased output. The result reveled that majority of the respondents had at least primary school education, followed by the secondary school education, whereas the respondents with no formal education and tertiary education were low, which is an indication that the more knowledge they have helped them to be aware of the climate change and how they can be able to adapt effectively to climate change. The implication of

this result is that educated farmers will have more knowledge about climate change, and it is in consonant with the findings of Oladebo, (2023) that educated farmers facilitates understanding, accepting and participating in innovations that will yield positive things. The result indicates that majority according to the pie chart were aware of the climate change mitigation in the area. This is an indication that due to their educational level, they were able to have the knowledge of the climate change in the area. The more educated they become, the more knowledge they have on climate change mitigation.

Adaptive and mitigating measure used by farmers
The result revealed that regular weeding to avoid breed of insects pest were x=4.53, the use of water channels as draining system x=4.45, use of organic manure x=4.40, breeding of drought and heat resistant crop varieties x=4.39 were the major adaptive measures the farmers used to cope with the climate change, although that all other variables were high which is an indication that the farmers had some adaptive measures to cope with the climate change mitigation.

In the mitigation measures, the table revealed that proper conservation of seed x= 4.23, avoidance of deforestation/ trees felling's x=4.27, reduced the use of generators for electrification x=4.27 and afforestation x=4.08 were the major mitigating measures used by the farmers to cope with the climate change mitigation in the area, which means that they were all aware and were ready to find solutions on the climate change.

Perceived effects of climate change by farmers
The result revealed that destruction of wildlife x=4.56, drying of streams early x=4.46, reduced production cycle x=4.44, shift in time of planting x=4.41, reduction in farm income due to reduced yield x=4.39, premature ripening of fruit x=4.36, reduction in the fish production x=4.20, loss of pastures x=4.31etc were the major factors seen as the perceived effect of climate change by farmers. Through the perceived effect, the farmers were able to cope with the climate change since the grand mean = 4.32 was achieved which is an indication that the farmers were aware of the climate change mitigation.

The result on Table shows the Tobith regression estimate of the influence of socioeconomic characteristics on the use of climate change adaptive mitigation strategies in the study area. The Chi-square value of 807.945 confirms the fitness of the model used and is statistically significant at 1% alpha which affirms the significant relationship the dependent and the predictor variables. The coefficient of age (0.029) was statistically significant at 1% level of probability and positively related. This implies that increase in age of the farmers will increase their intensity of the use of climate change adaptive and mitigation strategies in the study area. The coefficient of farming experience (0.017) was statistically significant at 1% level of probability and positively related. This implies that increase in the farmers experience will result to a corresponding increase in the use of climate change adaptive and mitigation strategies in the study area. The coefficient of income (3.771E-5) was statistically significant at 5% level of probability and positively related. This implies that increase in the farmer's income will result to a corresponding increase in the use of climate change adaptive and mitigation strategies in the study area. The hypothesis which stated that there is no significant relationship between farmer's socio-economic characteristics and the use of climate change adaptive and mitigation strategies in the study area was therefore rejected at 5% alpha level and concluded otherwise.

CONCLUSION AND RECOMMENDATIONS

Climate change is knocking on our door and efforts should be geared towards limiting its effect on agricultural performance. The study assessed the climate change mitigation practices among arable crop farmers in Ideato North LGA, Imo State, Nigeria. The result revealed that majority of the famers were female, and they acquire primary education. Regular weeding to avoid breed of insects pest were x=4.53, the use of water channels as draining system, use of organic manure, breeding of drought and heat resistant crop varieties, were the major adaptive measures the farmers used to cope with the climate change. Proper conservation of seed, avoidance of deforestation/ trees felling's, reduced the use of generators for electrification and afforestation, destruction of wildlife, drying of streams early, reduced production cycle, shift in time of planting, reduction in farm income

due to reduced yield, premature ripening of fruit, reduction in the fish production, loss of pastures etc were the major factors seen as the perceived effect of climate change by farmers.

The coefficient of age (0.029) was statistically significant at 1% level of probability and positively related. This implies that increase in age of the farmers will increase their intensity of the use of climate change adaptive and mitigation strategies in the study area. The coefficient of farming experience (0.017) was statistically significant at 1% level of probability and positively related. This implies that increase in the farmers experience will result to a corresponding increase in the use of climate change adaptive and mitigation strategies in the study area.

The study therefore recommends among others that:

i. Efforts should be shown by governments, NGOs, individuals to acquaint and educate famers on how they will cope more on the climate change related issue.
ii. Government agencies should provide information regarding climate change scenarios, seasonal variability, and the impacts of climate change so that farmers can make decisions instructed about the best mitigation and adaption measures available
iii. Government should available improved seedlings at affordable prices or subsidize prices as this has been known as one of the management techniques towards mitigating climate change effects

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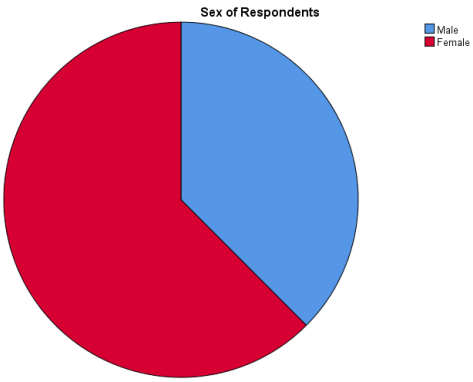
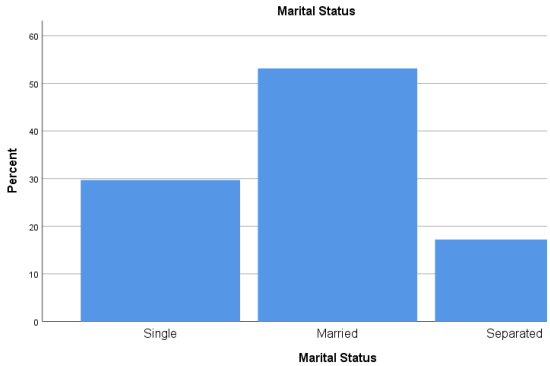
SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS:

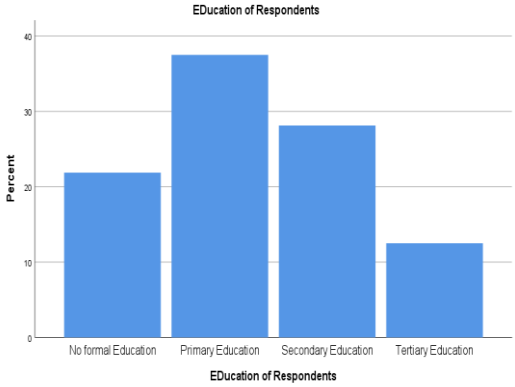
Frequency Distribution of Respondents according to their sex



Frequency Distribution of Respondents according to their Marital Status



Frequency Distribution of Respondents according to their Education level



Frequency Distribution of Respondents according to their awareness of climate change

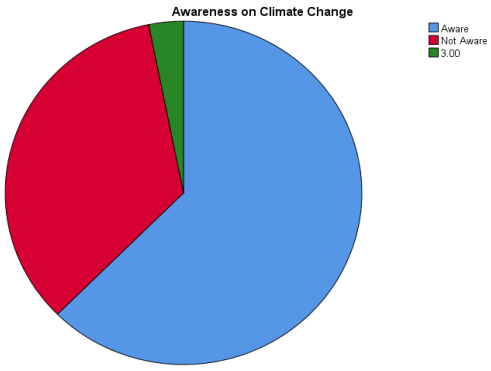


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Table 1: Mean frequency distribution of respondents according to Farmers Adaptive and mitigating measure used by farmers

Identified Adaptive and mitigation strategies	SA (5)	A (4)	UN (3)	DA (2)	SD (1)	Sum	SD	Mean
Adaptive								
Cli Crop rotation	24(120)	29(116)	10(30)	0(2)	0(0)	268	0.753	4.19
Use of water channels as draining system	35(175)	23((92)	6	0(0)	0(0)	285	0.665	4.45
Use of organic manure	35(175)	21(84)	7(21)	1(2)	0(0)	282	0.750	4.40
Planting of cover crops	26(130)	23(92)	15*45)	0(0)	0(0)	267	0.788	4.17
Mixed cropping practices	30(150)	26(104)	5(15)	0(0)	0(0)	275	0.810	4.30
Planting of pest and disease resistant crops	27(135)	24(96)	11(33)	1(2)	1(1)	272	0.817	4.25
Mulching	27(135)	27(108)	9(27)	0(0)	1(1)	276	0.731	4.31
Regular weeding to avoid breed of some insect pest	40(200)	15(60)	4(12)	3(6)	2(2)	290	0.854	4.53
Breeding of drought and heat resistant crop varieties	31(155)	21(84)	11	1(2)	0(0)	281	0.657	4.39
Conserving of soil moisture through appropriate tillage operation.	21(105)	28(112)	4(12)	10(20)	1(1)	274	0.806	4.28
Use of improved varieties	33(165)	20(80)	11(33)	0(0)	0(0)	255	1.046	3.98
Diversify income sources	20(100)	32(	9(27)	3(6)	0(0)	278	0.760	4.34
Mitigating								
Afforestation	32(160)	24(96)	5(15)	3(6)	0(0)	261	0.802	4.08
Proper conservation of seeds	27(135)	21(84)	14(42)	0(0)	2(2)	277	0.818	4.32
Avoidance of deforestation/tree felling	29(145)	23(92)	12(36)	0(0)	0(0)	273	0.840	4.27
Reduced the use of generators for electrification	29(145)	23(92)	12(36)	0(0)	0(0)	273	0.761	4.27
Grand mean								**4.28**
Benchmark								**3.00**

Source; Field survey data, 2024. SA (Strongly agree), A (Agree), UN (Undecided), D (Disagree), SD (Strongly Disagree)

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Table 2: Mean frequency distribution of respondents according to Perceived effects of climate change by farmers

Perceived effects	SA (5)	A (4)	UN (3)	DA (2)	SD (1)	Sum	SD	Mean
Decreased soil	24(120)	27(108)	11(33)	2(4)	0(0)	265	0.814	**4.14**
Premature ripening of fruit	30(150)	27(108)	7(21)	0(0)	0(0)	279	0.675	**4.36**
Reduced production cycle	36(180)	20(80)	8(24)	0(0)	0(0)	284	0.710	**4.44**
Prolonged production	29(145)	26(104)	8(24)	0(0)	0(0)	279	0.721	**4.36**
Yield reduction	26(130)	31(124)	6(18)	1(2)	0(0)	274	0.700	**4.28**
Reduction in farm income due to reduced yield	31(155)	22(88)	8(24)	1(2)	2(2)	281	0.809	**4.39**
Reduction in storage quality	23(115)	27(108)	11(33)	2(4)	1(1)	266	0.840	**4.16**
Destruction of wild life	41(205)	19(76)	3(9)	1(2)	0(0)	292	0.664	**4.56**
Streams drying up	26(130)	30(120)	4(12)	0(0)	4(4)	286	0.712	**4.46**
Reduction in fish production	30(150)	18(72)	15(45)	1(2)	0(0)	269	0.858	**4.20**
Reduction in farm size	34(72)	19(76)	8(24)	3(6)	0(0)	276	0.871	**4.31**
Loss of pastures	30(150)	24(96)	10(30)	0(0)	0(0)	276	0.732	**4.31**
Change timing of rain	27(135)	27(108)	8(24)	2(4)	0(0)	271	0.792	**4.23**
Shift in time of planting	33(165)	22(88)	5(15)	2(4)	2(2)	278	0.796	**4.41**
Erratic rain reduces crop yields	29(145)	23(92)	10(30)	2(4)	0(0)	271	0.831	**4.23**
Grand mean								**4.32**
Benchmark mean								**3.00**

Source; Field survey data, 2024. SA (Strongly agree), A (Agree), UN (Undecided), D (Disagree), SD (Strongly Disagree)

HO_2: There is no significant relationship between farmer's socio-economic characteristics and their perceived of climate change adaptive mitigation strategies in the study area.

Table 3: Tobith regression estimate of the influence of socioeconomic characteristics on use of climate change adaption strategies the study area.

Parameters	Estimate	Std. Error	t- value
Gender	.558	.502	1.237
Age	.029	.023	7.606***
Education	-.166	.254	.430
Marital Status	.141	.363	.152
Household size	-.091	.128	.501
Farming experience	.017	.031	3.316***
Income	3.771E-5	2.721E-5	1.921**
Information Source	.279	.316	.780
Awareness	.080	.397	.040
Climate	-.162	.875	.034
-2 Log Likelihood	*306.251*		
Cox and Snell	0.219		
Chi-Square	*807.945****		

Source: STATA, RA Result from Field Survey. Key: * Significance at 10%, ** Significance at 5%, *** Significance at 1% ***, + = Lead Equation and the values in bracket are the t-value.

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Effects of Climate Change on Tuber Crops Yield in Nigeria: An Autoregressive Distributed Lag Model Approach

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ABSTRACT
The study analyzed the long and short run effects of climate change on tuber crops yield in Nigeria. This study adopted a longitudinal documentary survey design that made use of time series data spanning from the year 1981-2021. Data on the variables for the study were collected from the National Bureau of Statistics (NBS), NIMET and Food and Agriculture Organization (FAO). Data for this study were analyzed using Augmented Dickey Fuller (ADF) test, Philips-Perron (PP) test and Autoregressive distributed lag model (ARDL). The result of the Augmented Dickey Fuller (ADF) test for unit root indicated that all the variables were found to be integrated of order one and became stationary on first differencing. The result of the Bound test indicated that there exist co-integration among the variables. The result of the ARDL indicated that relative humidity (11.896587), rainfall (3.732268) and temperature (16.490249) were positively related to cassava yield in the long run. Similarly, relative humidity (15.231227) and rainfall (2.715363) were positively related to yam yield while temperature (-5.464341) was negatively related to yam yield in the long run. Furthermore, rainfall (18.636236) was positively related to potatoes yield while relative humidity (-47.842327) and temperature (-81.56372) were negatively related to potatoes yield in the long run. The study concluded that climate change significantly influences tuber crops yield. The study therefore recommended that there should be more investment in research and development to create and distribute crop varieties that are resistant to high temperatures, particularly for yam and potatoes, which are negatively impacted by temperature increases.
Keywords: Tuber, Yield, Climate, Change, Effects

INTRODUCTION
The agricultural sector plays a significant role in the economy of Nigeria and other developing countries. Its contribution as at the first quarter of 2021 to the Gross Domestic Product (GDP) in Nigeria is 22.35%. According to Ajetomobi and Abiodun (2010), the sector is a source of raw materials used in many industries and serves as a source of foreign exchange earnings for Nigeria. Most rural dwellers depend on this sector for their source of livelihood. It is also the major source of employment for about 60% of the population in Nigeria.Despite the many enthralling reasons for encouraging the production of tuber crops, there are also many challenges associated with its production which could result in poor yield. Some of such challenges according to Udemezue and Nnabuife (2017) are unimproved planting materials, pest and disease attack, poor soil fertility and climatic conditions such as drought and rainfall.

IITA (2015) posited that although root and tuber crops have shown tremendous growth over the past three decades relative to other crops, virtually all production increases have resulted from increasing the land area planted and not significant yield increases. The crops are plagued by

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various factors such as climate change, diseases and pests attack and low yielding varieties and this has constrained yield improvement and produce quality (Ochoche *et al.*, 2022).

Climate is an important resource to crop production in Nigeria especially in the rainforest zone of Nigeria as farmers depend largely on rain for agriculture (Onyeneke and Madukwe, 2010). Today, climate change and food insecurity are twin devils that have been identified as urgent world problems. This is because food security which is mainly from agriculture is threatened by the emergence of climate variability as agriculture serves as one of the sensitive sectors to this threat. Over 60% of the Nigerian populace depends so much on agriculturally related activities for sustenance and crop production takes significant aspect of agricultural related activities in Nigeria.

Several studies (Oguntoyinbo, 1986; Ayoade, 2002; Ayoade, 2004 and Cicek and Turkogu, 2005) have shown that climatic parameters such as rainfall, humidity, sunshine, temperature and evaporation are closely interconnected in their influence on crops. Climate change affects agricultural production directly by altering the crop growth and production environment (e.g., temperature and precipitation) and indirectly by influencing total crop production, market supply, and demand conditions (Acharya, 2018).

Okogbenin *et al*. (2013) reported that root and tuber crops usually experienced greater yield loss when drought occurred. However, cassava accumulates abscisic acid during the early phase of water deficit, and this results in the formation of small leaves and limited formation of new leaves but this can quickly return to normal within as little as one day after watering, resuming normal growth. When drought lasts for over an extended period, a low yield would be experienced.

Climate change anomalies such as decline in annual rainfall, higher temperatures and humidity are detrimental to crop germination and yield, resulting in little or no harvest at the end of the season. Rainfall provides most of the needed water for agriculture in the tropics where because of relative high temperature throughout the year, the rate of evaporation is consistently high. To ensure the growth of crops over most parts of the tropics, the growing season unlike in the temperate region is determined by the availability of rainfall. Tuber crops depend very much on rainfall as the size of tuber is enhanced by the availability of soil water. Consequently, it is paramount to study the relationship between climate change and tuber crops yield in the face of looming food insecurity in Nigeria.

METHODOLOGY

Study Area

The study area is Nigeria. Nigeria with a projected population of 210.87 million in 2021 (NBS, 2021) and a total geographical area of 923,768 square kilometers is located between latitudes 4° N and 14° N and longitudes 2°2' and 14° 30' East. The nation is bordered in the north by the Republic of Niger and Chad, in the south by Atlantic Ocean, in the east and west by Republic of Cameroon and Benin respectively.

Nigeria has five main vegetation belts; these are the Mangrove forest, Savannah grassland, Equatorial forest, Semi desert, Guinean savannah. The country has a wide range of climatic conditions but as a tropical country, it is generally hot and humid. The specific location is of advantage in terms of environmental diversity, culture, cultivation and human practices; thus, the country is blessed with favourable climatic conditions which is good for almost all the food crops. The agricultural sector is particularly important in terms of its employment generation and its contribution to Gross Domestic Product (GDP) and export earnings. Administratively, Nigeria has 36 states with six geopolitical zones and FCT Abuja. These are South-East, South-South, South-West, North-East, North-West and North-Central.

Methods of Data Collection and Analytic Technique

The study used time series data spanning from 1981 to 2020. Data on rainfall and temperature were collected from the National Bureau of Statistics (NBS), data on humidity were collected from NIMET, data on tuber yields were collected from the records of Food and Agriculture Organization (FAO). Data for this study were analyzed using Augmented Dickey-Fuller (ADF) test, Philips-Perron (PP) test and Autoregressive distributed lag model (ARDL).

Model Specification
Unit Root Test
The Augmented Dickey Fuller (ADF) test for the presence of unit root (evidence of non-stationarity) was employed. The advantage of the method lies on its robustness to handle both first order and higher order auto regressive processes.

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \beta Y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta Y_{t-i} + \varepsilon_1 \quad (1)$$

Where Y is cassava yield or yam yield or potatoes yield or rainfall or temperature or humidity or food security as the case may be; α_0 is the constant; α_1 is the coefficient of the trend series; p is the lag order of the autoregressive process; Y_{t-i} is the lag value of order one of Y_t and ε_1 is the error term. Δ is the change operator; t represents the variable time and u_t is the white noise error.

The null hypothesis that σ = 0 means existence of a unit root in Y_t or that the time series is non-stationary. The decision rule is that if the computed ADF statistics is greater than the critical at the specified level of significance, then the hull hypothesis of unit root is accepted otherwise it is rejected.

Autoregressive Distributed Lag (ARDL) model
The Autoregressive Distributed Lag (ARDL) bounds testing approach was developed by Pesaran and Shin (1999) and Pesaran, Shin and Smith (2001) to ascertain the long-run relationship variables. The mathematical representation of the ARDL approach is as follows:

$$\Delta CY_t = \beta_O + \beta_1 \sum_{i=1}^{n} \Delta CY_{t-i} + \beta_2 \sum_{i=0}^{n} \Delta YY_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta PY_{t-i} + \beta_4 \sum_{i=0}^{n} \Delta H_{t-i} + \beta_5 \sum_{i=0}^{n} \Delta T_{t-i} + \beta_6 \sum_{i=0}^{n} \Delta R_{t-i} + \beta_7 CY_{t-i} + \beta_8 YY_{t-i} + \beta_9 YPY_{t-i} + \beta_{10} T_{t-i} + \beta_{11} R_{t-i} + \beta_{12} H + \xi_{1t} \quad (2)$$

$$\Delta YY_t = \beta_O + \beta_1 \sum_{i=1}^{n} \Delta YY_{t-i} + \beta_2 \sum_{i=0}^{n} \Delta CY_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta PY_{t-i} + \beta_4 \sum_{i=0}^{n} \Delta H_{t-i} + \beta_5 \sum_{i=0}^{n} \Delta T_{t-i} + \beta_6 \sum_{i=0}^{n} \Delta R_{t-i} + \beta_7 CY_{t-i} + \beta_8 YY_{t-i} + \beta_9 YPY_{t-i} + \beta_{10} T_{t-i} + \beta_{11} R_{t-i} + \beta_{12} H + \xi_{1t} \quad (3)$$

$$\Delta PY_t = \beta_O + \beta_1 \sum_{i=1}^{n} \Delta PY_{t-i} + \beta_2 \sum_{i=0}^{n} \Delta YY_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta CY_{t-i} + \beta_4 \sum_{i=0}^{n} \Delta H_{t-i} + \beta_5 \sum_{i=0}^{n} \Delta T_{t-i} + \beta_6 \sum_{i=0}^{n} \Delta R_{t-i} + \beta_7 CY_{t-i} + \beta_8 YY_{t-i} + \beta_9 YPY_{t-i} + \beta_{10} T_{t-i} + \beta_{11} R_{t-i} + \beta_{12} H + \xi_{1t} \quad (4)$$

Where Δ represents change. t is the time trend and εt is white noise error term. The parameters β_1, β_2, β_3, β_4, β_5, β_6 are the short run parameters while β_7, β_8, β_9, β_{10}, β_{11} and β_{12} are the long-run elasticities of the variables cassava, yam, potatoes yields, rainfall, temperature and humidity respectively. CY = Cassava yield; PY = Potatoes yield; YY = Yam yield; R = Rainfall; T = Temperature H = Humidity.

In order to investigate the short-run relationship between the variables, the error correction model based on the ARDL approach is alternatively represented as follows:

$$\Delta CY_t = \gamma_O + \gamma_1 \sum_{i=1}^{n} \Delta CY_{t-i} + \gamma_2 \sum_{i=0}^{n} \Delta YY_{t-i} + \gamma_3 \sum_{i=0}^{n} \Delta PY_{t-i} + \gamma_4 \sum_{i=0}^{n} \Delta T_{t-i} + \gamma_5 \sum_{i=0}^{n} \Delta R_{t-i} + \gamma_6 \sum_{i=0}^{n} \Delta H_{t-i} + \gamma_7 ECT + \xi_{1t} \quad (5)$$

$$\Delta YY_t = \gamma_O + \gamma_1 \sum_{i=1}^{n} \Delta YY_{t-i} + \gamma_2 \sum_{i=0}^{n} \Delta CY_{t-i} + \gamma_3 \sum_{i=0}^{n} \Delta PY_{t-i} + \gamma_4 \sum_{i=0}^{n} \Delta T_{t-i} + \gamma_5 \sum_{i=0}^{n} \Delta R_{t-i} + \gamma_6 \sum_{i=0}^{n} \Delta H_{t-i} + \gamma_7 ECT + \xi_{1t} \quad (6)$$

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$$\Delta PY_t = \gamma_O + \gamma_1 \sum_{i=1}^{n} \Delta PY_{t-i} + \gamma_2 \sum_{i=0}^{n} \Delta YY_{t-i} + \gamma_3 \sum_{i=0}^{n} \Delta CY_{t-i} + \gamma_4 \sum_{i=0}^{n} \Delta T_{t-i} + \gamma_5 \sum_{i=0}^{n} \Delta R_{t-i} + \gamma_6 \sum_{i=0}^{n} \Delta H_{t-i} + \gamma_7 ECT + \xi_{1t} \quad (7)$$

Where ECM (-1) term is a lagged value of the residual of model in which the long-term relationship is obtained. ECM (-1) is the speed of adjustment parameter which is expected to be negative. The lags are selected using the Akaike information criteria (AIC).

RESULTS AND DISCUSSION

Unit root test

The Augmented Dickey Fuller (ADF) test and Philips-Perron (PP) test for unit root were employed to test whether a variable is stationary and determine the order of integration of the variable (Table 4). Decision was made based on the outcome of the Augmented Dickey Fuller (ADF) and Philips-Perron (PP) tests as the results obtained were the same using both tests. The result indicated that all the variables (rainfall, temperature, humidity, cassava yield, yam yield and potatoes yield) were found to be integrated of order one and became stationary on first differencing. This indicates that the variables exhibit random walk (unit roots) or the future values of these variables do not converge from their past values.

Table 4: Result of ADF and PP Tests

Variables	Augmented Dickey-Fuller Test				Phillips – Perron Test				Decision
	ADF stat	Prob.	Critical value @ 1%	Order	PP Stat	Prob.	Critical value @ 1%	Order	
Cassa yield	-7.7157***	0.0000	-3.6104	Δ I(1)	-8.0771	0.0000***	-3.6104	Δ I(1)	Stationary
Yam yield	-8.2184***	0.0000	-3.6104	Δ I(1)	-8.4441	0.0000***	-3.6104	Δ I(1)	Stationary
Potat yield	-6.7528***	0.0000	-3.6104	Δ I(1)	-6.7403	0.0000***	-3.6104	Δ I(1)	Stationary
Rainfall	-4.6639***	0.0005	-3.6056	Δ I(1)	-4.6639	0.0005***	-3.6056	Δ I(1)	Stationary
Temperature	-8.5498***	0.0000	-3.6104	Δ I(1)	-11.9635	0.0000***	-3.6104	Δ I(1)	Stationary
Humidity	-5.6941***	0.0000	-3.6210	Δ I(1)	-13.5973	0.0000***	-3.6104	Δ I(1)	Stationary

Source: Data Analysis, 2023. Δ = difference operator. *** significant at 1% (P < 0.01) level of significance

Bounds Test for Long Run Relationship between Climate Change and Tuber Crops Yield

In the first step of the ARDL analysis, the presence of long-run relationships was tested as stated in the methodology. Bounds test was used to determine whether a linear combination of non-stationary variables is stationary. According to Kwiatkowski *et al.* (1992), regressing a non-stationary series on another non-stationary series yields spurious regression, but if a linear combination of the series is stationary, the variables are said to be cointegrated and the regression is no longer spurious. The result of the bounds test for cassava yield (Table 2) shows that the computed F-statistics 5.689 is greater than the upper bound critical value, 3.67 at 0.05 level. Therefore, cointegration exists among the variables. This implies that a long run relationship exists among cassava yield, temperature, humidity and rainfall.

Similarly, the result of the bounds test for yam yield (Table 2) shows that the computed F-statistics 6.812 is greater than the upper bound critical value, 3.67 at 0.05 level. Therefore, cointegration exists among the variables. This implies that a long run relationship exists among yam yield, temperature, humidity and rainfall.

Finally, the result of the bounds test for potatoes yield (Table 2) shows that the computed F-statistics 3.802 is greater than the upper bound critical value, 3.67 at 0.05 level. Therefore, cointegration exists among the variables. This implies that a long run relationship exists among potatoes yield, temperature, humidity and rainfall.

Therefore, the null hypothesis which stipulated that there is no long run relationship between climate change and tuber crops yield is hereby rejected. This is in line with the work of Chikezie *et*

al. (2015) who posited that there exists existence of one co-integrating vector or a long run relationship between climate change variables and cassava and yam yield. Similarly, Larbi *et al.* (2016) reported the existence of long-term equilibrium relationships between climate change variables and tuber crops yield (cassava and yam).

Table 2: Bounds Test for Co-integration between Climate Change and Cassava, Yam and Potatoes Yield

Crop	Test ststistics	Value	Sigificace (%)	1(0)	1(1)
Cassava	**F**	5.689	10	2.26	3.35
	K	3	5	2.62	3.79
			2.5	2.96	4.18
			1	3.41	4.68
Yam	**F**	6.812	10	2.26	3.35
	K	3	5	2.62	3.79
			2.5	2.96	4.18
			1	3.41	4.68
Potatoes	**F**	3.802	10	2.26	3.23
	K	3	5	2.45	3.61
			2.5	2.75	3.99
			1	3.15	4.43

Source: Data Analysis, 2023.

Effect of Climate Change on Cassava Yield in the Short and Long Run

Consequent upon the existence of cointegration among the variables, indicating the existence of a long run relationship among the variables, the conditional error correction model based on the ARDL approach was estimated (Table 3). The model shows the short run and long run effects of climate change on cassava yield in Nigeria.

The result of the ARDL as shown in Table 3 indicated that in the long run, the coefficient of relative humidity (11.896587) was positive and statistically significant at 5% probability level. This implies that a unit increase in relative humidity will increase cassava yield by 11.896587 units in the long run *ceteris paribus*. More so, the coefficient of rainfall (3.732268) was positive and statistically significant at 1% probability level. This implies that a unit increase in rainfall will increase cassava yield by 3.732268 units in the long run *ceteris paribus*. Similarly, the coefficient of temperature (16.490249) was positive and statistically significant at 5% probability level. This implies that a unit increase in temperature will increase cassava yield by 16.490249 units in the long run *ceteris paribus*. Therefore, the null hypothesis which stipulated that climate change has no significant effect on the yield of tuber crops in Nigeria in the long run is hereby rejected. Akpenpuun and Busari (2013) studied the impact of climate on the yield of major tuber crops in Kwara State and concluded that climate has a strong linear correlation with yam and cassava.

The short run result indicated that the conditional error correction term or speed of adjustment, ECM (-1) is negative (-0.596143) and statistically significant. The result implies that 59.61% of the deviation from the long run equilibrium position is corrected within the year. This indicate a quick speed of adjustment (that is, the speed at which the deviation from long run equilibrium is adjusted quickly where 0.596143 of the disequilibrium is removed immediately in each period).

The result of the ARDL as shown in Table 3 indicated that in a short run, the coefficients of relative humidity (2.715363) and (3.056022) were positive and statistically significant at 5% probability level during the first and third lagged periods respectively. This implies that a unit increase in relative humidity will increase cassava yield by 2.715363 and 3.056022 units respectively *ceteris paribus*. This finding is at variance with Chikezie *et al.* (2015) who observed that temperature and humidity have negative relationship with cassava output in southern east Nigeria.

Similarly, the coefficient of rainfall (0.684853) was positive and statistically significant at 5% probability level during the first lagged period. This implies that a unit increase in rainfall will increase cassava yield by 0.684853 units in the short run *ceteris paribus*. This is consistent with the findings by Larbi *et al.* (2016) who reported that output of cassava is significantly affected by rainfall.

Table 3: Long and Short Run Effects of Climate Change on Cassava Yield

Short-run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
LNCASS_YIELD(-1)	0.181142	0.196345	0.92257	0.3708
LNCASS_YIELD(-2)	0.222715	0.167166	1.332297	0.2027
LNHUMIDITY	0.679231	1.063745	0.638528	0.5328
LNHUMIDITY(-1)	2.715363	1.07859	2.517512**	0.0237
LNHUMIDITY(-2)	0.641457	1.205675	0.532031	0.6025
LNHUMIDITY(-3)	3.056022	1.339513	2.281442**	0.0375
LNRAINFALL	-0.377423	0.294986	-1.279461	0.2202
LNRAINFALL(-1)	0.684853	0.264469	2.589542**	0.0205
LNRAINFALL(-2)	-0.295926	0.232942	-1.270387	0.2233
LNRAINFALL(-3)	-0.395209	0.233239	-1.694437	0.1108
LNRAINFALL(-4)	-0.471556	0.285353	-1.652532	0.1192
LNTEMP	-0.05025	2.081735	-0.024139	0.9811
LNTEMP(-1)	-1.529497	1.97008	-0.776363	0.4496
LNTEMP(-2)	1.16757	1.723987	0.67725	0.5086
LNTEMP(-3)	3.165633	1.488331	2.126968**	0.0504
LNTEMP(-4)	3.917605	1.650938	2.372957**	0.0314
CointEq(-1)	-0.596143	0.179749	-3.31654***	0.0047
R-squared	0.894535	Mean dep. var	2.295473	
Adjusted R-squared	0.746885	S.D. dep. Var	0.178786	
S.E. of regression	0.089948	AI criterion	-1.692845	
Sum squared resid	0.12136	Sch criterion	-0.735002	
Log likelihood	53.31763	HQ criterion	-1.35516	
F-statistic	6.058461	DW stat	2.429296	
Prob(F-statistic)	0.000419***			
Long Run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LNHUMIDITY	11.896587	4.8828	2.436427**	0.0278
LNRAINFALL	3.732268	0.969473	3.849791***	0.0016
LNTEMP	16.490249	6.956637	2.370434**	0.0316
C	30.014459	30.262113	0.991816	0.337

Source: Data Analysis, 2023. *significant at 10%, **significant at 5%, ***significant at 1% respectively

Cassava thrives in warm climates with well-distributed rainfall. An increase in temperature within the optimal range and adequate rainfall can promote vegetative growth, root development, and overall yield of cassava plants. Adequate moisture availability during the growing season is particularly crucial for cassava, as water stress can severely limit growth and yield.

Furthermore, the coefficients of temperature (3.165633) and (3.917605) were positive and statistically significant at 5% probability level during the third and fourth lagged periods respectively. This implies that a unit increase in temperature will increase cassava yield by 3.165633 and 3.917605 units respectively *ceteris paribus*. Therefore, the null hypothesis which stipulated that climate change has no significant effect on the yield of tuber crops in Nigeria in the short run is hereby rejected. The results suggest that cassava can grow in areas with high to moderate temperatures, relative humidity and rainfall in both the long and short run.

Effect of Climate Change on Yam Yield in the Short and Long Run

The result of the ARDL as shown in Table 4 indicated that in the long run, the coefficient of relative humidity (15.231227) was positive and statistically significant at 1% probability level. This implies that a unit increase in relative humidity will increase yam yield by 15.231227 units in the long run *ceteris paribus*. High relative humidity slows down transpiration, allowing yam plants to maintain adequate water uptake and reduce water stress, especially during dry periods. This can promote healthier plant growth and higher yields (Cirelli, Nimmo & Chater, 2014) thereby contributing to the food security of the nation.

More so, the coefficient of rainfall (2.715363) was positive and statistically significant at 5% probability level. This implies that a unit increase in rainfall will increase yam yield by 2.715363 units in the long run *ceteris paribus*. Therefore, the null hypothesis which stipulated that climate change has no significant effect on the yield of tuber crops in Nigeria in the long run is hereby rejected.

Furthermore, the coefficient of temperature (-5.464341) was negative and not statistically significant at any convectional probability level. This implies that a unit increase in temperature will not have a significant effect on yam yield in the long run *ceteris paribus*. This finding is in line with Chikezie *et al.* (2015) who observed that temperature have negative relationship with yam output in southern east Nigeria.

The short run result indicated that the conditional error correction term or speed of adjustment, ECM (-1) is negative (-0.522574) and statistically significant. The result implies that 52.25% of the deviation from the long run equilibrium position is corrected within the year. This indicate a quick speed of adjustment (that is, the speed at which the deviation from long run equilibrium is adjusted quickly where -0.522574 of the disequilibrium is removed immediately in each period).

The result of the ARDL as shown in Table 4 indicated that in a short run, the coefficients of relative humidity (2.088204), (2.197807) and (2.061079) were positive and statistically significant at 5% and 1% probability level during the base year, second and third lagged periods respectively. This implies that a unit increase in relative humidity will increase yam yield by 2.088204, 2.1978073 and 2.061079 units respectively *ceteris paribus*.

Table 4: Long and Short Run Effects of Climate Change on Yam Yield

Short-run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
LNYAM_YIELD(-1)	0.255183	0.188943	1.350578	0.1906
LNYAM_YIELD(-2)	0.006825	0.180721	0.037768	0.9702
LNYAM_YIELD(-3)	0.215418	0.151881	1.418329	0.1701
LNHUMIDITY	2.088204	1.068376	1.95456*	0.0635
LNHUMIDITY(-1)	0.107458	1.131195	0.094995	0.9252
LNHUMIDITY(-2)	2.197807	1.082989	2.029389**	0.0507
LNHUMIDITY(-3)	2.061079	1.0761	1.915324*	0.0685
LNHUMIDITY(-4)	1.504896	1.185952	1.268935	0.2177
LNRAINFALL	0.893049	0.239263	3.732491***	0.0012
LNTEMP	-2.855522	1.629923	-1.751937*	0.0937
LNTEMP(-1)	0.222715	0.167166	1.332297	0.1812
LNTEMP(-2)	0.679231	1.063745	0.638528	0.9778
CointEq(-1)	-0.522574	0.106655	-4.899678***	0.0001
R-squared	0.884217	Mean dep. Var	2.245011	
Adjusted R-squared	0.810536	S.D. dep. Var	0.204869	
S.E. of regression	0.089174	AI criterion	-1.705518	
Sum squared resid	0.174944	Sch criterion	-1.052443	
Log likelihood	46.55208	HQ criterion	-1.475278	
F-statistic	12.00072	DW stat	2.197503	
Prob(F-statistic)	0.00000***			
Long Run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LNHUMIDITY	15.231227	5.139431	2.963602***	0.0072
LNRAINFALL	2.715363	1.07859	2.517512**	0.0237
LNTEMP	-5.464341	3.238226	-1.687449	0.1056
C	-46.615621	25.14785	-1.853662*	0.0772

Source: Data Analysis, 2023. *significant at 10%, **significant at 5%, ***significant at 1% respectively

Similarly, the coefficient of rainfall (0.893049) was positive and statistically significant at 1% probability level during the first lagged period. This implies that a unit increase in rainfall will increase yam yield by 0.893049 units in the short run *ceteris paribus*. This is consistent with the findings by Larbi *et al.* (2016) who reported that yam yield is affected positively by rainfall. Yam also thrives in warm climates with well-distributed rainfall, therefore an increase in rainfall within the optimal range can promote vigorous vegetative growth and tuber development in yam plants thereby leading to an increased yam yield. This also leads to food security.

Furthermore, the coefficient of temperature (-2.855522) was negative and statistically significant at 10% probability level during the base year. This implies that a unit increase in temperature will

decrease yam yield by 2.855522 units in the short run *ceteris paribus*. Therefore, the null hypothesis which stipulated that climate change has no significant effect on the yield of tuber crops in Nigeria in the short run is hereby rejected. This suggests that yam can grow in areas with high to moderate relative humidity and rainfall in both the long and short run, but not in areas with high temperature for both the long and short run.

Effect of Climate Change on Potatoes Yield in the Short and Long Run

The result of the ARDL as shown in Table 5 indicated that in a long run, the coefficient of relative humidity (-47.842327) was negative and statistically significant at 1% probability level. This implies that a unit increase in relative humidity will decrease potatoes yield by 47.842327 units in the long run *ceteris paribus*. More so, the coefficient of rainfall (18.636236) was positive and statistically significant at 5% probability level. This implies that a unit increase in rainfall will increase potatoes yield by 18.636236 units in the long run *ceteris paribus*. This is consistent with the reports of IITA (2015) which enthused that a temperate climate, and generally dependable rains make for near ideal growing conditions for potato.

Furthermore, the coefficient of temperature (-81.56372) was negative and statistically significant at 1% probability level. This implies that a unit increase in temperature will decrease potatoes yield by 81.56372 units in the long run *ceteris paribus*. This will have an adverse effect on food security. Therefore, the null hypothesis which stipulated that climate change has no significant effect on the yield of tuber crops in Nigeria in the long run is hereby rejected. Ayanlade *et al*. (2010) posited that climate change anomalies such as decline in annual rainfall, higher temperatures and humidity are detrimental to crop germination and yield, resulting in little or no harvest at the end of the season.

The short run result indicated that the conditional error correction term or speed of adjustment, ECM (-1) is negative (-0.043596) and statistically significant at 5% probability level. The result implies that 4.36% of the deviation from the long run equilibrium position is corrected within the year. This indicates a slow speed of adjustment (that is, the speed at which the deviation from long run equilibrium is adjusted where -0.043596 of the disequilibrium is removed immediately in each period).

The result of the ARDL as shown in Table 5 indicated that in a short run, the coefficient of relative humidity (2.085712) was positive and not statistically significant at any convectional probability level. This implies that a unit increase in relative humidity will not have a significant effect on potatoes yield in the study run *ceteris paribus*.

More so, the coefficient of rainfall (0.859077) was positive and statistically significant at 1% probability level during the third lagged period. This implies that a unit increase in rainfall will increase potatoes yield by 0.859077 units in the short run *ceteris paribus*. Tuber crops depend very much on rainfall as the size of tuber is enhanced by the availability of soil water (Buduka *et al.*, 2015).

Furthermore, the coefficient of temperature (-4.279375) was negative and statistically significant at 10% probability level during the first lagged period. This implies that a unit increase in temperature will decrease potatoes yield by 4.279375 units in the short run *ceteris paribus*. Therefore, the null hypothesis which stipulated that climate change has no significant effect on the yield of tuber crops in Nigeria in the short run is hereby rejected. This suggests that potatoes can grow in areas of moderate temperature and rainfall, but not in areas of high rainfall and high temperature in the long and short run. High temperatures during the growing season can reduce tuber formation, decrease photosynthesis, and increase water stress, ultimately leading to lower yields. Irregular rainfall patterns, droughts, or excessive rainfall can affect soil moisture levels, leading to water stress, poor tuber development, and increased susceptibility to pests and diseases, all of which can reduce yields and hamper food security.

Table 5: Long and Short Run Effects of Climate Change on Potatoes Yield

Short-run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
LNPOTA_YIELD(-1)	1.043596	0.110642	9.432216***	0.0000
LNHUMIDITY	2.085712	1.394959	1.495178	0.1479
LNRAINFALL	-0.398844	0.326662	-1.220968	0.2348
LNRAINFALL(-1)	-0.51378	0.315812	-1.626854	0.1168
LNRAINFALL(-2)	0.482001	0.297327	1.621114	0.1181
LNRAINFALL(-3)	0.859077	0.291802	2.944039***	0.0071
LNRAINFALL(-4)	0.477243	0.351061	1.359432	0.1866
LNTEMP	4.322326	2.471183	1.649092	0.1193
LNTEMP(-1)	-4.279375	2.293821	-1.86561*	0.0744
LNTEMP(-2)	-1.224677	2.056624	-0.59548	0.5571
LNTEMP(-3)	1.509974	1.913555	0.789094	0.4378
LNTEMP(-4)	3.227567	1.93473	1.668226	0.1083
CointEq(-1)	-0.043596	0.110642	-2.394025**	0.0221
R-squared	0.903032	Mean dep. var	1.446273	
Adjusted R-squared	0.854547	S.D. dep. var	0.326936	
S.E. of regression	0.124688	Al criterion	-1.056172	
Sum squared resid	0.373128	Sch criterion	-0.490174	
Log likelihood	32.53918	HQ criterion	-0.856631	
F-statistic	18.62528	DW stat	1.742143	
Prob(F-statistic)	0.00000***			
Long Run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LNHUMIDITY	-47.842327	114.792467	-4.416772***	0.0005
LNRAINFALL	18.636236	50.851887	2.366481**	0.0228
LNTEMP	-81.56372	155.294019	-3.525221***	0.0042
C	348.371611	718.269425	0.485015	0.6321

Source: Data Analysis, 2023. *significant at 10%, **significant at 5%, ***significant at 1% respectively

CONCLUSION AND RECOMMENDATIONS

The study empirically analyzed the long and short run effects of climate change on tuber crops yield in Nigeria. Climate change makes the weather more erratic globally, alters weather conditions and thus has direct, biophysical effects on tuber crops production. The innate advantages and climate resilience of root and tuber crops to climate extremes and unpredictable variations are essential in addressing the food security situation in Nigeria in view of the emerging food crisis and the on-going changes and rising food prices. The study concludes that climate change variables (temperature, rainfall and relative humidity) significantly influence tuber crops yield positively both in the short and long run. Also, tuber crops yield responds positively to producer prices both in the short and long run. These results underscore the critical role that climatic factors play in determining crop yields. Overall, this study highlights the necessity of integrating climate considerations into agricultural practices and policies to ensure sustainable crop production and food security.

The study therefore recommended that:

i. There should be more investment in research and development to create and distribute crop varieties that are resistant to high temperatures, particularly for yam and potatoes, which are negatively impacted by temperature increases.
ii. Improved irrigation systems should be provided to ensure consistent water supply, especially during periods of low rainfall. This can help stabilize yields for cassava, yam, and potatoes, which all benefit from adequate rainfall.
iii. Farmers should adopt the use of water conservation techniques such as rainwater harvesting, drip irrigation, and mulching to optimize the use of available water resources and maintain soil moisture levels.
iv. Policy makers should promote agricultural practices that enhance resilience to climatic variations, such as agroforestry, intercropping, and crop rotation. These practices can help maintain soil health and improve water retention.

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Natural Resources-Induced Communal Crises and Food Crop Production in Konshisha LGA, Benue State Nigeria

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ABSTRACT
The study assessed the fluctuations in food crop yields due to displacement, destruction of farmlands, and insecurity caused by conflicts over use of natural resources in Konshisha Local Government Area of Benue State. Simple random sampling technique was used in selecting 120 crop farmers. Primary data were collected through structured questionnaire and the objectives were analyzed using descriptive statistics (mean, frequency, percentages) and inferential statistics (t-test). The result showed that majority (71.7%) of crop farmers were male and their mean household size was 8 with most (78.3%) being married. The result further revealed that many (43.3%) of crop farmers had primary education with mean average farm income of N221,083.33 and mean non-average farm income of N48,433.33. Most farmers (58.3%) has a farm size of ≤3.00 hectares with major (75.8%) source of land ownership being inheritance. The result revealed boundaries dispute to be the major (mean=4.00) cause of communal crises. Result of the study shows that reduction of output of selected crops after communal crises was significant at 1% and 5% except cassava output. Also the study reports the most hit intensity of communal crises on farmer's productivity to be destruction of Agricultural produce with a mean scores of 3.50. Furthermore, interruption in the education of children was the major (mean of 3.82) challenge confronting farmers after communal crises. Conclusion from the study is that communal crises have a significant effect on food crop production in the study area as shown by the t-test. The study recommends that clear land tenure policies should be implemented to prevent disputes over land ownership and usage. Also, sustainable resource-sharing agreements should be established among conflicting groups to promote peaceful coexistence.
Keywords: Natural resources, crises, food production

INTRODUCTION
Conflicts within communities are frequently caused by or made worse by competition over limited resources, especially land and water. Concomitant with community strife has been a distortion of the country's growth possibilities. In other words, Nigeria has systemic shortcomings as a result of the severe impact on both people and material resources. In most sub-Saharan African countries, land-related issues are becoming a bigger danger to rural economic activities like agriculture (Yamano and Deininger, 2005, Deininger and Castagini, 2006). At a time when agricultural yields are stagnating or even dropping for several nations in the area, the occurrence of these disputes is increasing (Ofuaku and Isife (2009).

Therefore, it is clear that land tenure security becomes essential in achieving this aim as governments struggle to improve technology adoption and reform the agriculture sector's performance to fulfil the high and rising demand for food. To reduce the possibility of war, most

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African nations still lack strong institutions managing land, such as those that safeguard property rights, mediate disputes, and uphold contracts (Fred Mensah, 1999). Land disputes have sparked worries about potential food insecurity and high rates of poverty in the impacted regions due to population pressure and consequent land shortage (Deininger and Castagnini, 2006). Land conflicts also had an impact on social capital and crop portfolio selection, with less cash crops. Furthermore, there is a chance that localised land disputes might escalate into extensive civil wars, endangering national security (Andre and Plateau, 1998).

Thus, several studies have connected land conflicts to the absence or weakness of formal land institutions as well as the inadequacy of the existing systems of customary land tenure in resolving disputes (Fred Mensah, 1999). Usually seen from an integrated viewpoint, land is essential and serves as a significant source of their identity. Original occupants, as seen in many African nations, resist the transfer of customarily held family and community land to outsiders by engaging in acts of sabotage, looting, burning, and theft of new landholders' property and crops. Tensions and resentment are stoked by immigration, which can result in open violence and land communal crises.

Conversely, migrations that occur across communities include the blending of tribes with differing internal land systems and values. This results in the dissolution of already-existing informal institutions, which cause problems in host communities when there are no official institutions. In fact, host communities have suffered for years, according to Fred-Mensha (1999); Nigerian agricultural growth has received more emphasis. Examples of initiatives that demonstrate this focus include the Agricultural Development Programme (ADP), the Green Revolution (GR), Operation Feed the Nation (OFN), and many more.

The broad objective of the study was to ascertain the effect of communal crisis on agricultural productivity in Konshisha local government area of Benue state. Specifically, the study described the socio-economic characteristics of farmers in the study area; identified the causes of communal crises in the study area; determined the output levels of selected crops before and after communal crises; assessed the perceived intensity of communal crises on Farmers productivity; and ascertained the challenges confronting farmers after communal crises.

METHODOLOGY

The study Area

The study was carried out in Konshisha local government area of Benue state, Nigeria. Konshisha LGA has 11 council Wards namely; Mbaikyase, Mbatem, Ikyurav/Mbatwer, Mbayegh/Mbaikyegh, Mbatsen, Iwarnyam, Mbavaa, Mbanor, Mbatser/Mbagusa, Mbake and Mbawar council Ward's with a population of about 225,672 (NPC, 2006) and an area of 1,673km^2,it is located on a level land in the North East of Benue state lying between longitude 8° 400 East and latitude 6° 551 and 7° 231 North.

The inhabitants of Konshisha are predominantly Tiv and engaged in agricultural activities as a major occupation, they grow wide range of crops ranging from staple grains like maize, rice, groundnuts, soybeans, yam, sweet potatoes, cassava and orange orchard. They as well engaged in other activities such as trading and some are civil servants.

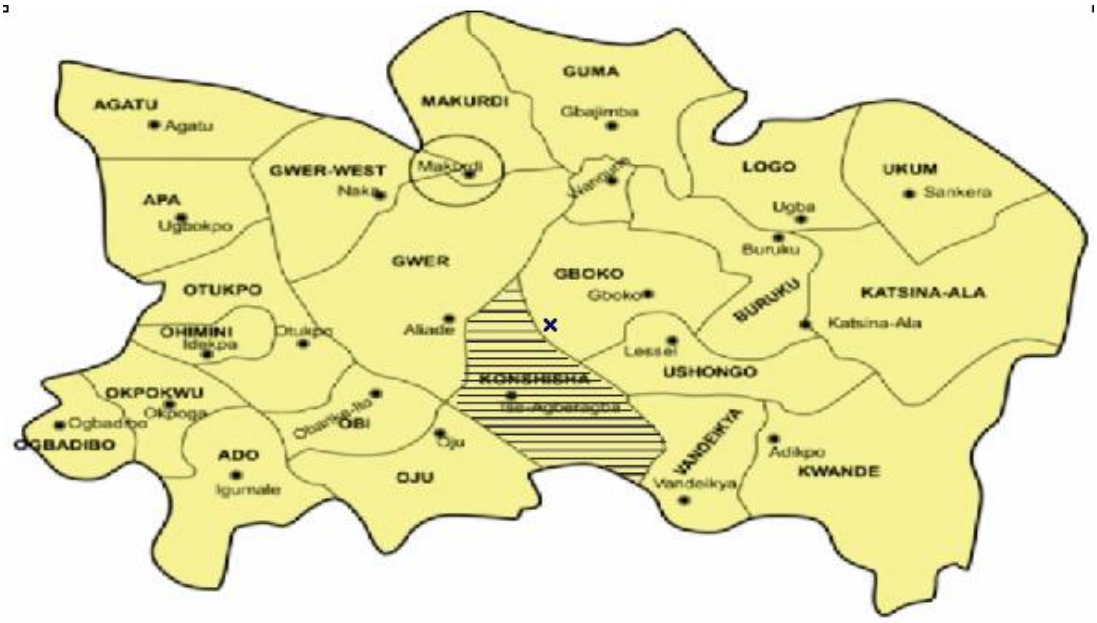

Figure 1: Map of Benue state showing the study Area Source: Google 02/2020

The population of this study consists of all crop farmers inKonshisha local government area.The sample for the study was 120 respondents obtained using simple random sampling technique to select crop Farmers from six wards which have experienced crisis frequently. Data for this study were collected from primary source using structured questionnaire.

Model Specification
T-test

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{S^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$S^2 = \frac{\sum_{i=1}^{n_1}(\bar{x}_1 - x_2)^2 + \sum_{j=1}^{n_2}(x_j - \bar{x}_2)}{n_1 + n_2 - 2}$$

Where,
$\bar{x}_1$=1st mean of output before communal crisis
$\bar{x}_2$=2nd mean of output after communal crisis
S^2=pooled variance of both output before communal crisis and after communal crisis
$n_1 + n_2$=sample size from both output before communal crisis and after communal crisis
t=student test
$n_1 + n_2 - 2$df

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Crop Farmers

The result of socio-economic characteristics of crop farmers in Konshisha local government area is presented in Table 1.The result showed that majority (71.7%) of the crop farmers were male. The high percentage involvement of men could be explained by the dictates of prevailing culture. Men have numerous rights, responsibilities and privileges. They own land, pass same to their heir's and have opportunities of using it for collateral Chikaire *et al* (2016).

As shown in the research, age of the crop farmers from 21-60 was 81.7% with the mean age of 45.34. This result implies that most of the farmers are within their active and productive age and can protect their land against Invaders. Ofuaku and Itsie (2009) reported that most farmers were in the age bracket taken to be relatively young and receptive to innovations and confronting challenges. Adebayo and Olaniyi (2008) also reported mean age of 42 years for farmers indicated a stronger labour force.

On household size, 26.7% size of less than or equal to four, 54.2% had 5-8 family members while 19.2% had between 9-12 family members. The mean household size was 6.32. Large household

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size could entail more family labour therefore occupying more land for farm work. The study further showed that majority (78.3%) of the crop farmers were married men and women. This implies that married people engaged in farming in the study area more than unmarried people.

From the table 6.7% had no formal education, 43.3% attained primary education, and 29.2% attained secondary education while 20.8% attained tertiary education. This implies that most farmers surveyed were literate. This had great benefits of modern education in terms of production, processing and marketing method. Adisa (2012) explain that enlightened persons are quickly able to understand the negative implications of conflicts on social and economic lives.

Also the average farm income of farmers less or equal to 250000 was 70.8%, 250001-500000 was at 29.2%. The mean of the average farm income was #221083.33.The result further showed the average non-farm income of farmers ranged of 50000 was at 65.8% while from 50001-100000 was at 31.7% with the mean average income of #48433.33. This mean the respondents were predominantly sole dependence on farming in the study area.

Result further revealed that farm size of farmers in the study area showed that farmers who had less or equal to 3.00 hectares were 58.3%, 26.7% had 3.01-6.00 hectares, 6.01-9.00 hectares had 7.5% while 7.5% had 9.01 hectares of land and above. The average farm size was 3.9042, this result showed that majority of the farmers do not have large scale of farmland, an indication that majority of the farmers in the study area will struggle to own farmland. This small size of farm land trigger communal crises because as farmers continue to give birth, their farm land becomes inadequate per head making farmers to contest for farm land leading to communal crises.

According to the research, 2.5% of respondents had less than six years of experience, 18.3% had 7-12 years of experience, 25% had 13-18 years of experience while 54.2% had farming experience of 19 years and above. The respondents farming experience mean was 22.78. This implies that majority of the farmers have high years of farming experience and this will have a positive effect on their level of performance and observation on the farm.

Inheritance system of land tenure system is the major (75.8%) source of land for farming activities in the study area, followed by gift (13.3%) and leasehold ownership (10.8%). The source of land acquisition for farming activities do affect the type of crop cultivated, scale of farming enterprises and mechanization of farming activities.

Table 1: Socioeconomic Characteristics of Crop Farmers (n=120)

Variable	Frequency	Percent	Mean
Sex			
Female	34	28.3	
Male	86	71.7	
Age		45.34	45.34
≤20	3	2.5	
21-40	44	36.7	
41-60	54	45	
>60	19	15.8	
Household size			6
≤ 4	32	26.7	
5-8	65	54.2	
9-12	23	19.2	
Marital Status			
single	26	21.7	
Married	94	78.3	
Education			
No school at all	8	6.7	
Primary school	52	43.3	
Secondary school	35	29.2	
Tertiary	25	20.8	
Average farm income			221083
≤250000	85	70.8	
250001-500000	35	29.2	
Average Non-Farm income			
50000	79	65.8	48433.33
50001-100000	38	31.7	
>100000	3	2.5	
Farm Size			3.9042
≤3.00	70	58.3	
3.01-6.00	32	26.7	
6.01-9.00	9	7.5	
>9	9	7.5	
Farming Experience			22.78
≤6	3	2.5	
12-Jul	22	18.3	
13-18	30	25	
>18	65	54.2	
Land Ownership			
Inheritance	91	75.8	
Leasehold	13	10.8	
Gift	16	13.3	

Souce: Filed Survey, 2020

Causes of Communal Crises

Table 2 shows causes of communal crises in the study area. The cut off mean score from the 4-point liker scale was 2.5. This implies that any factor with a mean score from 2.5 and above was considered a serious cause of communal crises. The result showed that land dispute having a mean score (3.93) above the cut off mean score of 2.5 was adjudged to be a serious cause of communal crisis. This result is in agreement with the findings of Aule (2015) that causes of communal crises in the Tiv nation in Benue State Nigeria had to do with the struggle for farmlands and the exploitation of land related resources.

The result also showed that contested claims to land had score of 3.12 which is a serious cause of communal crises. This is in line with the findings of Chikaire *et al,* (2016) that most verdict from land litigation rather generated communal crises. Resource inequalities as a cause of communal crises had the mean of 2.93. Adam Smith's "postulated that due to population explosion resources will be depleted, this depletion of natural resources" give rise to competition which can possibly cause conflict among farmers.

According to the findings, boundaries dispute is the major cause of communal crises in the study area with the mean scores of 4.00. According to Utov (2000) cause of communal clashes in Tiv land is rooted in internal instability of boundaries among the ethics group such as Jukun who are border neighbours to the Tiv. This entails that boundaries dispute had been a lingering issue that needs to be addressed in the study area.

Encroachment into farmland recorded the mean scores of 3.64, due to population growth and scarcity of farmland farmers encroached into others land which caused conflict. Scarcity of farmland showed the mean scores of 3.24 which indicated that land scarcity was a serious cause of communal crises in the study area. Adisa (2012) reported that land scarcity had been a serious problem between farmers and herder's crises.

The results further revealed that envy (*iyuhe*) is a serious cause (mean score =3.29) of communal crises in the study area. Jibo (1994) reported that, the basis for so much of the intra-personal and communal clashes, as well as under development of Tiv land is *Iyuhe* (envy) which, to many observers is prevalent in Tiv society to an unprecedented level.

Population pressure had agreement score of 3.05 as affirmation of causes of conflict among farmers respectively. Globally the population had been increasing yearly while farmland remain the same, this makes family struggle to occupy farmland thereby crossing boundaries which induced conflict.

According to the findings struggle for chieftaincy position is a serious cause of communal crises in the study area with the mean scores of 2.68. These findings agreed with that of Chikaire*et al*, (2016) which reported that most of the communal crises in South East were caused by Ezeship tussles.

Table 2: Descriptive Statistics of Causes of Communal Crises

Causes	Minimum	Maximum	Mean	Std. Deviation	one-sample t-test
Boundaries dispute	4	4	4.00	.000	7.46*
Encroachment into farmland	3	4	3.64	.482	25.97*
Scarcity of farmland	2	4	3.24	.550	14.77*
Contested claims to land	1	4	3.12	.505	-7.86*
Inequality in use of water & Forest	1	4	2.93	.624	13.37*
Population pressure	1	4	3.05	.633	14.13*
Market ownership	1	3	2.02	.673	9.51*
Envy	2	4	3.29	.614	44.99*
Struggle for political position	1	4	2.14	.677	-5.79*
Struggle for Chieftaincy position	1	4	2.68	.608	3.30*

*= significant at 1% level. Cut-off mean score (test value) = 2.5

Impact of Communal crisis on output of selected crops

The impact of Communal crisis on output of crops was measured using 'before and after' approach to impact analyses as presented in table 3. The result showed that, output of yam before crises was more than output after crises as shown by mean difference of 4009.822kg and t-test of 2.416, which was significant at 5% level. This implies that the output of yam after conflict was significantly lower than that before communal crises. This result agreed with that of Kughur *et al* (2017), which reported that quantity of crops produced before crises were higher or encouraging but after the crises the quantity of selected crops produced and their respective value were low. These could be because of refusal of the yam farmers to go to farm for fear of the unknown.

Output of rice before crises was high while output decreased after communal crises as reported by a mean difference of 389.792kg and a significant t-testof 2.534 at 5%. The study further reported the output of soya beans before crises to be higher than output after crises, with the mean difference of 244.208kg and t-test of 2.161 significant at 5%. These could be due to recruitment of young men into militias therefore taken labour away from agriculture, Chikaire et al (2016).

Maize output before had been reported in table 3 to be higher in yield before crises with the mean scores of 71.314kg and T-test 0f 7.349 but seriously decreased after communal crises; these could be because farmers no longer had the required inputs.

The result also showed that, the output of groundnut before crises was higher but declined after communal crises. The mean difference was 173.613kg and T-test of 3.881, these result corroborate with Uyang *et al* (2013) which reported that there were always differences in food production between war and peaceful years and their contribution to agricultural production.

The findings reported the output of cassava before crises not to be significantly greater than after crises like other crops. The mean difference of 887.538kg with t-test of 1.870. This could be the fact that cassava stems cannot be easily destroyed like yam sett and other crops. Also it could be that the Farmers been cautious of what to feed on after crises engaged into massive cassava cultivation which can be easily maintained.

Table 3 reported orange output before crises was reported to be higher while output after crises was lower as shown by the mean difference of 2031.153kg and T-test of 3.009. A significant decreased in yield had been recorded after communal crises because orange is a perennial crop and cannot be easily replaced after destruction. Chikaire *et al* (2016) asserted that during and after crises, there will be reduction in consumer demand, spoilage of produce and increase in transportation cost.

The result reported the output of guinea corn before communal crises to be higher than after communal crises, with the mean difference of 376.975kg and T-test of 2.607. Bearing the risk of being attacked in mind, the farming populations tend to flee, decline or stop farming causing decreased in output after crises.This report is in agreement with that of Chikaire *et al* (2016) which reported that there was a decreased in agricultural output after conflict. Sambe *et al*, (2013) reported that production of crops and rearing of livestock is the main economic activity of the people in Nigeria, therefore communal conflicts have serious implications on food production system.

Table 3: Output Level of Selected Crops before and after Crises

Output of crops(kg)	Minimum	Maximum	Mean	Std. Deviation	t-test
Yam before crises	0	115000	4502.38	18140.566	
Yam after crises	0	3000	492.56	529.572	2.41**
Rice before crises	0	15000	578.15	1914.617	
Rice after crises	0	2000	188.36	266.036	2.53*
Soya bean before crises	0	10000	337.84	1283.594	
Soya bean after crises	0	500	93.64	107.156	2.16**
Maize before crises	0	2000	199.41	268.768	
Maize after crises	0	2000	128.09	255.679	7.34*
Groundnut before crises	0	3010	333.03	541.532	
Groundnut after crises	0	500	159.42	115.208	3.88*
Cassava before crises	0	45000	1353.87	5859.163	
Cassava after crises	0	5000	466.33	900.290	1.87
Citrus before crises	0	96000	4243.00	14038.584	
Citrus after crises	0	42000	2211.85	7099.760	3.00*
Guinea corn before crises	0	10200	552.32	1689.316	
Guinea corn after crises	0	1000	175.35	180.708	2.60*

*, ** = significant at 1% and 5% levels respectively. Source: Field survey, 2020

Perceived effects of Communal Crises on Farmers

The result on perceived intensity of communal crises on farmer's productivity is presented in table 4. The cut off mean score on a 4-point likert scale was 2.5. All the variables with mean score of 2.5 and above were considered having high negative effect on farmer's productivity in the study area. The result showed the scarcity of farm input to be at a mean of 3.44, this result entails there was serious scarcity of inputs like seedlings due to the destruction of crops and associated farm implement. These scarcity of farm input increased starts-up in non-agricultural activities, Deininger (2003).

Social insecurity was reported to be on the increased with a mean of 3.06. This is because in conflict situations people live in perpetual fear and the security structures are overwhelmed. This result is in agreement with Rock more (2011) who reported that violence increases uncertainty and risks promoting insecurity.

Also migration of labour was reported with a mean of 3.42, these result revealed that several people left due to communal crises and never returned for fear of similar conflict situations. The result of the study further revealed that inadequate food for family with a mean of 3.02 was identified as a resultant effect of communal crises in the study area. These indicated that due to the intensity of the crises on farmers they no longer produced enough even for the family. Bozzoli and Bruck (2009) reported that in Mozambique, three years after the cease fire, household were still practicing many of their war time coping strategies, making them not to farm freely.

Table 4, revealed that destruction of stored product in the study area was serious with the mean scores of 3.37. These high destruction of stored product is a clear indication that farmers suffer more any where communal conflict is experienced, these result support the findings of Fews-NET (2005) which reported destruction of barns, stores, residence and household items in Nigeria.

The result reported displacement of the people with the mean scores of 3.45. The respondents in the study area witness intense displacement of dwellers during and after communal crises as shown by the result, this displacement make farmers not to meet up with their productive needs. These results are in agreement with that of Victor *et al* (2015) which reported displacement of people during conflict to be a serious factor affecting agricultural activities.

Result in the study further showed destruction of agricultural produce to be high with a mean score of 3.50, which indicates that it a serious factor farmer's face during and after crises. The result reported loss of lives to be high with a mean score of 2.78. These study revealed that Farmers in the study area loss their lives during and after communal crises as a result of attack. This study does not conflict the findings of Spelten, (1995) which reported that attacked on villages during communal conflict leads to death of many people.

Table 4: Perceived Effects of Communal Crises on Farmers Productivity

Intensity of communal crises	Minimum	Maximum	Mean	Std. Deviation
Scarcity of farm input	2	4	3.44*	0.547
Social insecurity	1	4	3.06*	0.639
Migration of labour	1	4	3.42*	0.904
Inadequate food for family	2	4	3.02*	0.622
Expected returns on assets	1	4	1.96	0.947
Destruction of stored product	1	4	3.37*	0.798
Displacement of people	1	4	3.45*	0.708
Destruction of Agricultural produce	1	4	3.50*	0.71
Investment decisions	1	4	1.87	0.958
Loss of lives	1	4	2.78*	0.704
Broken marriages	1	4	2.46	0.819

Source: field survey, 2020. Cut off mean score = 2.5 *factors above cut off mean

CONCLUSION AND RECOMMENDATIONS

The study on Natural resources-induced communal crises and food crop production highlighted the significant impact of conflicts on agricultural activities. Communal crises, are often fueled by disputes over natural resources especially land and water resources, ethnicity, or political differences, disrupt farming activities, displace farmers, and lead to food insecurity. These conflicts reduce agricultural productivity by limiting access to farmland, destroying crops, and discouraging investment in farming.

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Based on the findings of the research on, the following recommendations are suggested to mitigate the impact of natural resources-induced conflicts on food production:

i. Government agencies, traditional leaders, and community stakeholders should establish dialogue and mediation mechanisms to prevent and resolve communal conflicts.
ii. Early warning systems should be developed to detect and address tensions before they escalate into crises.

iii. Clear land tenure policies should be implemented to prevent disputes over land ownership and usage.
iv. Sustainable resource-sharing agreements should be established among conflicting groups to promote peaceful coexistence.
v. Training programs should be introduced to equip farmers with alternative income-generating skills to reduce dependence on natural resources in crisis-prone areas.

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Determinants of Profitability of Plantain Marketing in Port-Harcourt Local Government Area of River State, Rivers State, Nigeria

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ABSTRACT
Plantain contributes significantly to Nigeria's Agricultural Gross Domestic Product (AGDP), and commercial production of plantain has been found to be both technically and economically feasible in Rivers State. As a result of its commercial production, an efficient marketing system is crucial. The study was designed on determinants of profitability of plantain marketing in Port-Harcourt, Rivers State, Nigeria. Specifically, the examined the socio-economic characteristics of the plantain marketers, estimate the cost and returns of plantain marketing in the Study Area and estimated the determinants of profitability of plantain marketing in the area. A multistage random sampling technique was adopted to select 60 respondents which represent the sample size. Well-structured questionnaires were used to collect information from the respondents. The data collected were analyzed using both descriptive statistical tools such as percentage, mean and percentage and inferential statistics such multiple regression model were used to analyze. A review of the socioeconomic characteristics indicates that 68.3% of the Plantain marketers in Port-Harcourt were female while 18.3 percent of them were male with mean age of the Plantain marketers was 41 years with majority. Majority (61.7%) of the Plantain marketers in the study area were married, with mean household size was 5 persons. About 95.0% of the Plantain marketers in the study area were literate possessing divers' formal educational levels ranging from primary school education to tertiary education. On average the marketers had spent about 7 years in marketing. Majority (80%) of the marketers belongs to marketers' association. The value of Return per naira invested was 1.287 while the gross profit realized was ₦ 49,622.37 per month, Multiple Regression result on determinants of profitability of plantain marketing in the area shows that coefficient of labour cost ($p<0.01$) and Transport cost ($p<0.01$) were significant and negatively related to the profit of the plantain marketers, while coefficient of Household size ($p<0.1$), experience ($p<0.05$) and education ($p<0.01$) were significant and positive variables influencing the profit of the Plantain marketers in the area. The government should put up favourable credit policies that would encourage plantain marketers to take loans for their business expansion, also there is a need for the provision of basic marketing facilities such as basic infrastructures and credit to enhance profit of plantain marketing positively. Plantain marketers should be influenced to join or form cooperative societies to help handle some of their issues.

Keywords: Determinants, profitability, plantain marketing, Port-Harcourt, Rivers State, Nigeria

INTRODUCTION

Efficient marketing systems are vitally important for any economy under all conditions and at every stage in its development (Chouhan *et al*., 2018). As marketing channels used by marketers to sell the outputs of their production play important roles in their productivity (Jara-Rojas *et al*., 2018). This perhaps is due to the specific nature (perishability and level of processing) of agricultural production and its products, in particular, complex transportation and storage problems require a greater number of intermediaries in their movement from producers to consumers (Petković and Užar, 2020). So, the ultimate aim of the producer, which is to get rewards, irrespective of the channels used to market the products that are targeted at turning potential customers into profitable customers is achieved, this is one of the key roles of marketing channels (Kotler and Keller, 2016). Lack of knowledge on the marketing of some crops such as plantain and their products partly leads to the inherent poor agricultural commodity marketing in Nigeria. Hence, there is a need for efficient marketing channels and systems.

The plantain (*Musa paradiciaca*) is a member of the Musaseae family that originated in Southeast Asia. The plantain is a tall (3-10 m) plant with a conical false trunk created by the leaf sheaths of its spirally arranged 1.5 to 3 m long and 0.5 m wide leaves. Plantain is one of the main sources of carbohydrates in humid tropical Africa, according to the International Institute of Tropical Agriculture (IITA, 2020), as it comprises around 35 percent starch, 0.2 to 0.5 percent fats, 1.2 percent protein, and 0.8 percent ash. It is high in minerals, especially iron, and contains many vitamins, including A, B, and C. It is low in protein and fat, but high in minerals, particularly iron. It's also cholesterol-free, high in fiber, and low in sodium. Plantain is useful in the treatment of a variety of diseases, according to Akinbola and Aturamu (2021), including cardio-vascular and kidney disorders, dehydration in infants and diabetic patients, arthritis, and gastrointestinal ulcers. Again, its economic importance cannot be over-emphasized in terms of food security, job creation along its value chain, and source of livelihoods to many rural households (Akinbola and Aturamu, 2021).

Nigeria is a major producer and consumer of plantains in Africa, and is among the top 20 plantain-producing countries in the world, according to the Food and Agriculture Organization (2019). Plantains are the world's fourth most important food crop, after rice, wheat, and maize, according to the International Institute for Tropical Agriculture (IITA, 2020). It is a vital staple food crop for both rural and urban areas, and it is strategically positioned for rapid food production in Nigeria. Nigeria is one of the main producers of plantain in West Africa, according to (IITA, 2020), with an annual production of about 2.74 million metric tons. In Rivers State, plantain is often grown as backyard crops or intercrop with other food crops such as yams, cassava, vegetables etc. Despite the importance of plantain as a staple food in Nigeria, the producers (marketer) are still faced with numerous problems such as inadequate credit; non-availability of complimentary inputs in the right quantity and quality, under developed marketing system, and poor and inadequate infrastructural facilities for production.

Port-Harcourt, Plantain is well consumed in and thus has a large market, especially in the city centres and semiurban areas such as Oil mill market and Mile one market, in itself has large market centres, operating daily or every four days. The marketing of plantain provides means of livelihood for many households in the area, hence, its decentralization, as both wholesalers and retailers purchase their commodities directly from the producers (Obetta, 2015). In urban centers, the wholesalers sell to the retailers who in turn resell smaller quantities to the ultimate consumers (Ukwuaba *et al*., 2022). Therefore, venturing into plantain enterprise holds promising potentials, however, there is a little study to back up marketing of plantain within Port-Harcourt, as the relatively little attention given to plantain in this study area focused on its production technology (characterization, correlation, path analysis and selection indices of Musa genotypes under different conditions). Increasing output (production) without correspondingly increasing marketing may bring about resource wastage and as such, people may continue to wallow in poverty and food insecurity (UNEP, 2020).

METHODOLOGY

The study was carried out in Port Harcourt City Local Government Area of River state, Nigeria. The area lies between latitude of 4^0 .45/ and 4^0 .75/ North and longitudes East 7^0 50/ and 8^0 0 /. The area is bounded on the North and East by Obio/Akpo and Oyigbo Local Government Area on the West. The Atlantic Ocean forms the southern boundary. It has a land mass of 360km^2.The people in the area are mostly civil servants and marketers. The population of the metropolitan area of Port Harcourt is almost twice its urban area population with a 2015 United Nations estimate of

2,344,000. The local government area covers 260 km^2. A multistage sampling method was used to select respondents and markets in the study area. Purposive sampling was use for selection of the market. In the first stage two (2) major markets in the area were purposively selected for the study. They are Oil Mill Market and Mile one Market. The markets were chosen because they are the market with the highest concentration of plantain marketing activities. They served as a meeting point for urban and rural plantain marketers. The second stage involve a random selection of thirty (30) plantain marketers from each market to give a total number of 60 marketers for the study.

Model Specification
Cost and Returns Analysis
Total cost (TC) = Variable cost (VC) + fixed cost (FC) (1)
Total Revenue (TR) = Price per bunch x number of bunches sold
Gross Margin = Total Revenue – Variable Cost
Net Return = Gross Margin – Fixed Cost

Ordinary least Square Regression
OLS to analyze the determinants of profitability of plantain marketing in the area was analyzed using multiple regression model.
Implicitly the function is stated thus
$Y= f (X_1 X_2 X_3 X_4 X_5 X_6 X_7, X_8, , X_9, X_{10}, X_{11} e_I)$ (2)

Explicitly the function is stated thus
$Y= \beta_0+ \beta_I X_1+ \beta_2 X_2+ \beta_3 X_3 + \beta_4 X_4+ \beta_5 X_5 +\beta_6 X_6 + \beta_7 X_7 \ldots + \beta_{11} X_{11}$ (3)

Where;
Y= Profitability (Measured in Naira)
X_1 =Selling price (Naira)
X_2 = Labour cost (Naira)
X_3 = Rent (Naira)
X_4 = Transport cost (Naira)
X_5 = Age of respondent (Years)
X_6 = House hold Size (Actual number of household members)
X_7 = Purchase cost (Naira)
X_8 = Years of Plantain marketing experience (Years)
X_9 = Source of capital (Dummy)
X_{10} = Storage Cost (Naira)
X_{11} = Level of Education (Years of Schooling)

RESULTS AND DISCUSSION

The result shows that 68.3% of the Plantain marketers in Port-Harcourt were female while 18.3 percent of them were male. This is because female take greater responsibilities for Plantain marketing and enhanced economic contributions to family. Using this information, it could be deduced that female participation in marketing of Plantain was high in the area. This is in conformity with the findings of other related studies. Ukwuaba et al., (2022) noted that plantain production is dominated by men, but then, women play a key role in processing and marketing or perhaps, because women generally prefer self-employment to either working for other people, private organizations or even the government, thus showed that females dominated the plantain business in their study on Unravelling the Drivers of Plantain Marketing. Similar to another study and this can be attributed to the believe of the people in the study area that Plantain marketing is the duty or work of female while male participate in production.

Table 1 shows that the mean age of the Plantain marketers was 41 years with majority. This is an indication that the Plantain marketers in the study area were mostly middle aged that was within the active productive work force. Ukwuaba et al., (2022) noted obtained an average age of 40 years and indicated that most (75%) of the respondents were relatively young marketers, who fall within the active years of service (less than 50 years), are tireless, energetic, willing to take risks, full of vigour and can go through the rigours of marketing, thus conforming to findings in a related study. This is in support of (Oladejo and Sanusi, 2011) who reported that most of the people involved in marketing activities were young persons who are vibrant and energetic with a significant market influence. This has implication on Plantain marketing because of the ability of this segment of the

population to effectively withstand the rigours, strain and stress involved in Plantain marketing. Middle aged Plantain marketers within the active productive work force can effectively shoulder the rigours and tedium involve in Plantain marketing.

Table 1: Distribution of the plantain marketers (N = 60)

Gender	Frequency	Percentage
Female	41	68.3
Male	19	31.7
Age (years)		
20-29	7	13.33
30-39	20	33.33
40-49	15	25.00
50-59	12	20.00
60 -69	5	8.33
Mean	**40.95**	
Marital Status		
Single	15	25.0
Married	37	61.7
Widowed	6	10.0
Divorced	2	3.3
Total	**60**	**100.00**
Household Size		
1-4	34	56.7
5-8	22	36.7
9-12	4	6.7
Mean	**5**	
Experience		
1-5	**18**	**30.00**
6-10	**28**	**46.67**
11-15	**9**	**15.00**
16-20	**5**	**8.33**
Mean	**8**	
Membership status		
Member	12	20.0
Non member	48	80.0
Total	**60**	**100.0**

Source: Field Survey Data, 2024

Table 1 shows that majority (61.7%) of the Plantain marketers in the study area were married while 25% of them were single. Also, 10% and 3.3% of them were widowed and divorced respectively. This implies that a greater percentage of the population had family members. The dominance of the married people in marketing in the area may be attributed to the fact that married people are more settled as it relates to giving appropriates attention to Plantain marketing operations. The Table showed that the majority (80%) of the respondents were married. This explains why they tend to respond favorably to risk in terms of economies of scale, as the couple may combine their resources to increase output which in turn increases their income. The result agrees with the findings of (Korir, 2011) who reported that married individual had greater involvement in agricultural marketing could be as a result of high labour requirement in which they use members of their family as labour force. Also, about 50.8% of the processors purchased directly from local farmers, 45.0% purchased from plantain depot in the market, and 4.2% purchased from the bulk market. This therefore implies that the married class was more involved in Plantain marketing.

Table 1 shows that majority (56.7%) of the Plantain marketers had household sizes of between 1 and 4 persons. The mean household size was 5 persons. This result indicates that the Plantain marketers in the study area had moderate family sizes. It has been shown in the past, that household sizes provide enough labour for Plantain marketing. This suggest that the families are averagely normal families within the government recognized family size of 6 persons, which includes father, mother and four children as noted by Ukwuaba et al., (2022). This is an indication that the families are moderate and not over-laden or overburdened with responsibilities since they are within the officially recommended family size.

Table 1 revealed a good proportion of the respondent 95.0% of the Plantain marketers in the study area were literate possessing divers' formal educational levels ranging from primary school

education to tertiary education. This is in consonance with findings from a similar study (Nzeh, 2023). Having, at least, basic education could imply better adoption of new ideas and knowledge which will help in taking decisions to improve marketing as well as strategies. Possession of literacy (ability to read and write) enable the Plantain marketers to better utilize effectively and efficiently whatever available resources in the area and curtail frivolous spending. As expected, higher education would enhance improved technology adoption hence increased marketers' income (Haruna et al., 2012).

Table 1 shows that on average the marketers had spent about 7 years in marketing. This shows that majority of the respondents had gained reasonable experience. This implies that most of the respondents have been marketing plantain long enough to offer reasonable verifiable information about the business. Marketers would count more on their marketing experiences for improved output rather than educational attainment. This tallies with the finding of [Onubuogu and Onyeneke, 2012] that experience in agribusiness enhances output performance. Experience determines his ability to make effective decisions and it is expected to influence marketing efficiencies because of accumulation of skills. The implication of this is that they are equipped to overcome their marketing challenges to a considerable extent (Ademola and Olujide 2014).

Majority (80%) of the marketers belongs to marketers' association while the rest (20%) were not. The implies that an overwhelming majority of the Plantain marketers in Port-Harcourt belong to marketing union, which may help the marketers get adequate information on Plantain marketing and other benefit that may be obtainable from a union. The marketers join cooperatives in order to fend off low pricing and collectively tackle other problem facing the business as noted by Nnadi *et al.,* (2013).

Table 2: Cost and return analysis from the Plantain marketers per month

Items	Average values (₦)
Selling price (per bunch)	6,950.00
Quality sold (month)	32.00
Total return/revenue	222,400.00
Variable cost	
Purchase price/bunch	5,200.00
Quality sold (month)	32.00
Total Purchase price	166,400.00
Transportation cost	3,850.00
Rent	1,050.00
Other market charges	1,477.63
Total variable cost	172,777.63
Gross profit	49,622.37
Fixed cost	
Depreciated value of marketing items	1,569.67
Total fixed cost	1,569.67
Total cost	174,347.30
Net return (profit)	**48,052.70**

Source: Field survey data, 2024

The result in Table 2 shows that purchase cost of Plantain was the highest fraction of the entire marketing costs. The average purchase cost was ₦5, 200.00 per bunch and total cost for 32 bunch per month was ₦166, 400.00 which accounted for 96.3% of total cost, while the selling price per bunch was 6,950.00, and total selling price for 32 bunch was ₦ 222,400.00. This implies that marketing margin was 25.17% per bunch of plantain sold per month. The average total variable cost of marketing was ₦174,347.30 while the gross profit was ₦ 49,622.37, the gross profit indicate that the plantain marketers were successfully making gain over and above its costs, this implies that respondents can re-invest their returns back into their plantain marketing activities the findings is akin with findings of Adejo et al., (2021).

Profit maximization is the main objective of any business and every marketers want to maximize net returns or profit from variable inputs, the table thus shows that plantain marketing is a high income generating business as net return was ₦ 48,052.70 of an average marker per month. The net marketing returns of plantain sold per month indicated that plantain enterprise was viable and the marketers are making a reasonable amount of profit. The findings of this study correspond with Ukwuaba et al., (2022) who obtained an average quantities of plantain sold per month by the

marketers as 63 bunches and the mean monthly marketing returns made by the marketers was positive. The positive net return is an indication that participation in plantain marketing is very much profitable and viable. This is in line with the findings of Jatto et al., (2021) who obtained positive net returns in their studies.

Table 3: Estimate of effect of credit on the profitability of plantain marketing

Variables	Linear	Exponential+	Semi log	Double log
Intercept	906.8395	0.176297	4727.855	0.967258
	(50.19)***	(35.14)***	(33.85)***	(63.73)***
Intercept	1759.666	7.299154	29630.97	9.689134
	(2.06)**	(30.70)***	(2.71)***	(8.16)***
Amount of Loan (X_1)	4.18004	0.0020191	-29.67531	0.0272717
	(1.13)	(2.97)***	(-0.16)	(1.37)
Interest rate (X_2)	22.73899	0.0318618	-405.948	-.0007742
	(0.55)	(2.80)***	(-3.10)***	(-0.05)
Purchase cost (X_3)	-.0889495	0.0000131	-3613.997	-.2645114
	(-1.65)	(0.88)	(-3.32)***	(-2.24)**
Quantity (X_4)	1759.666	7.299154	29630.97	9.689134
	(2.06)**	(30.70)***	(2.71)***	(8.16)***
Transportation (X_5)	-.1842248	-.0000764	383.845	-.0093258
	(-3.07)***	(-4.59)***	(3.57)***	(-0.80)
Experience (X_6)	-.1028147	1.19E-06	-234.4441	-.0291554
	(-2.51)**	(0.10)	(-1.67)*	(-1.91)*
Labour cost (X_7)	-.0634168	1.19E-06	-95.11358	-.0188704
	(-0.28)	(0.02)	(-0.90)	(-1.65)*
Levies (X_8)	0.0507428	-.0000348	432.6649	0.01499
	(0.84)	(-2.07)**	(4.04)***	(1.29)
Storage cost (X_9)	-.3946309	-.0000942	-32.81845	-.0110972
	(-1.80)*	(-1.55)	(-0.31)	(-0.96)
R^2	0.9652	0.9306	0.9297	0.9785
R^{-2}	0.9624	0.9249	0.9239	0.9768
F-ratio	339.34***	163.94***	161.61***	556.56***

Source: Field survey (2024).+ means lead equation, ***, **, *significant at 1%, 5% and 10%, respectively.

The exponential functional form was chosen as the lead equation. The choice of the lead equation was based on the number of significant variables, the magnitude of the coefficient of multiple determination (R^2), the conformity of signs borne by the variable to with *a priori* expectation as well as the significance F-ratio. The coefficient of multiple determination was 0.9306 which implies that 93.06% of the variation in the plantain enterprise net-returns was explained by the explanatory variables included in the model. The result shows that performance was positively related to amount of credit, interest rate, quantity, while transportation and levies were negative and significant variable that influence the performance of plantain enterprise. Amount of credit was significant and positively related to performance, this is in line with a prior expectation because increase in amount of loan is expected to increases the income of the enterprise, expands the business and enables the enterprise to acquire technologies; it also enables the enterprise to procure inputs and hire labour for enhanced performance. Having access to credit contributed positively to a production efficiency, enhance production input which will in turn lead to increased performance. Also the coefficient of interest was significant at 1% level of significance and positively related to the net return of the plantain marketers in the study area. This is in line with a prior expectation. This shows that increase in interest rate will increase the performance, this is so because interest rate increase as a result of increase in amount of credit granted. Quantity of plantain was significant at 1% and positively related to the net return of plantain enterprise. This implies that an increase in number of plantain will leads to an increase in return from the enterprise. Furthermore, the coefficient of transportation and levies were statistically significant at 1% and 5% respectively, this implies that increase in the cost of any of these variables will lead to decrease in net return and vice versa.

CONCLUSION AND RECOMMENDATION

Marketing is an important aspect of the agricultural value chain and it ensures that agricultural products reach the consumers in the place, time and form needed by the end-users. Plantain marketing is a major source of livelihood in southern Nigeria. Marketing of plantain was profitable and viable in the study area. It was concluded that labour cost ($p<0.01$) and Transport cost ($p<0.01$) were significant and negatively related to the profit of the plantain marketers, while coefficient of

Household size ($p<0.1$), experience ($p<0.05$) and education ($p<0.01$) were significant and positive variables influencing the profit of the Plantain marketers in the area. There is a need for the provision of basic marketing facilities such as basic infrastructures and credit to enhance profit of plantain marketing positively. Plantain marketers should be influenced to join or form cooperative societies to help handle some of their issues.

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Determinants of Risk Attitudes of Retail Fruit Vendors in Abia State, Nigeria

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ABSTRACT
Risk attitudes are crucial in determining how entrepreneurs make decisions, especially in a sector like retail fruit vending, where market conditions can be unpredictable and often volatile. In the context of developing economies, such as Nigeria, understanding these factors is essential for creating policies that support small-scale businesses and improve their resilience to risks. Retail fruit vendors often face challenges such as fluctuating prices, supply chain disruptions, and limited access to resources. The study investigates the determinants of risk attitudes of retail fruit vendors in Abia State, Nigeria. Multi-stage sampling techniques was adopted in selecting 72 respondents that was used for the study. The study's findings reveal that a significant portion of the fruit marketers in Abia State are women (56.7%), with men making up 43.3% of the market. The average age of the vendors was 46 years, and most (70%) were married, with an average household size of four individuals. Additionally, 86.7% of respondents were literate, with varying levels of formal education ranging from primary to tertiary education. Risk preferences among the vendors were varied, with 55% classified as risk-preferring and 26.67% as risk-averse. Using an ordered probit regression model, the study reveal that age ($p<0.01$), household size ($p<0.1$), educational status ($p<0.01$), scale of operations ($p<0.01$), experience ($p<0.01$), distance to market ($p<0.01$), amount of credit ($p<0.01$), and value of processing ($p<0.01$) all play significant roles in determining the vendors' approach to risk. Based on the findings of this study, several recommendations can help improve the risk management strategies of retail fruit vendors in Abia State and enhance the sustainability of their businesses. Access to credit plays a significant role in shaping risk attitudes, so it is essential for policymakers and financial institutions to offer tailored financial support to fruit vendors, particularly those with limited resources. Low-interest loans, microfinance options, and flexible repayment terms could empower vendors to manage risks related to price fluctuations and operational challenges more effectively.

Keywords: Determinants, Risk Attitudes, Retail fruit, Vendors, Abia Atate, Nigeria

INTRODUCTION
Risk is a day to day incident that affects the achievement of set goals and is studied in various disciplines to serve as control measures for preventing negative consequences which in this case is food insecurity (Wasiu and Burhan, 2018). According to Agbayekhai (2010) Risks that affect agriculture can be broadly grouped as; systemic/correlated risks and idiosyncratic/independent risks. Systemic risks include production risks (farming practice, weather, pests, etc.), price risks, and political risks (export bans, price caps, debt write offs, etc.). Non-agricultural risks known as idiosyncratic risk are made up of personal risks which affect the entrepreneur, proprietor and or manager of the farm business. Risk pooling and insurance arrangements are more likely to offer protections against idiosyncratic risks rather than systematic risks.

Risk will arise from the unpredictable nature of agricultural product prices. According to Fausayana et al., (2018), this situation arises as a result of speculation sellers who tend to get big profits and marketing chain. This risk has to be controlled otherwise there was problem in the supply of materials/resources that could resulted to financial losses (Zsidisin, *et al* ., 2008). Risk on fruit is found at the stage of marketing, but the experience of marketers will reduce the risk on marketing (Fausayana *et al.,* 2018).

Fruits vendors are prone to risk due perishability associated with the products; the high perishable nature of fruit, lack of storage facilities, mechanical injuries due to improper handling, packaging, transportation, and microbial infection, are the major reasons for post-harvest loss in fruits. Post-harvest losses in developing countries can range from 15 percent up to 50 percent (Asfaw *et al*., 2022). Attitude toward risk could influence entrepreneurs' decisions to access financing and training. Fruit marketing decision-making is influenced by risk, which has an inadvertent effect on their demand for credit.

Marketing risks are prevalent throughout the world and they are particularly burdensome in developing countries. Risk, which is regarded as the chance of falling below a critical (i.e., minimum, disastrous or subsistence) income level, plays a vital role in the farmers'/maketers and their marketing decisions related to choices and levels of inputs and outputs (Lawrence *et al.*, 2018).

Attitudes towards risk, is referred to as risk preferences, are considered of major importance in farmers' and marketers decision-making behaviour in situations that includes risk and uncertainty (Fausayana *et al.,* 2018). Although market vary widely with respect to enterprise mix, financial situation, and other business and household characteristics, many sources of risk are common to all farmers, ranging from price and yield risk to personal injury or poor health. These personal risks common to all in one form or the other transcend to the marketing aspect of the produce, when there is low yield, there was low supply and hence increase in prices thus low demand for produce, For example, falling prices resulting from large worldwide production could have devastating consequences for local farm incomes (Phoebe *et al*., 2018).

Risk attitudes can be categorized into risk-averse, risk-seeking / lovers and risk-neutral which represent a working definition of risk attitude (Murray-Webster and Hillson 2008). Risk-averse people are those who are highly uncomfortable with the uncertain outcome; this may guide them to sacrifice expected profit to avoid risk. They are willing to accept a lower average income to avoid or reduce threats (Murray-Webster and Hillson 2008). Risk seekers are quite interested with uncertainties, and they do not have a desire to avoid or reduce threats. They perceive risk as a profitable chance and thus, they seek to pursue the venture and accept losses to take their chances (Murray-Webster and Hillson 2008). Between the two extremes attitudes, there exist have risk-neutral individuals who are uncomfortable with uncertainty in the long term; therefore, they are able to take whatever necessary short-term activates to gain a certain long-term outcome (Lawrence *et al*., 2018).

However, the risk attitude of fruit vendors could influence their demand for credit in order to boost their fruit marketing and side influencing the microcredit demand, risk attitude of fruit vendors could also influence their investment capacity of fruit vendors. Fruit vendors taking risk to increase their level of investment would lead to demanding for more credit which will translate into higher profitability from any given level of investment. Given the plethora of research currently taking place, this study therefore aims to contribute to the understanding of determinants of risk attitudes of fruit vendors in Abia State, Nigeria.

METHODOLOGY

The study was conducted in Abia State. The state was created out of Imo state in August, 1991. The State has a land mass of 700 square km with 17 Local Government Areas. The state lies between longitudes 7^{o} 23/ and 8^{0} 02/ East of Greenwich meridian and latitudes 5^{o} 49/ and 6^{o} 12/ North of the equator. Abia State is bounded on the east by the Cross River and Akwa Ibom Sates, on the north by Ebonyi and Enugu States, on the West by Imo State and on the South by Rivers State. Abia consists of three agricultural zones, namely; Aba, Umuahia and Ohafia. The population of Abia State is 2,833,999, comprising, 1,434,193 males and 1,399,806 females. This population consists of people in all walks of life with about 65 percent of them engaging in agriculture (NBS, 2020). The annual rainfall ranges from 2000-2500m while the temperature ranges from 22^{0}C to 35^{0}C. The

area is characterized by a tropical wet climate (April to October), and dry climate (November to March). The major occupation of the people is farming, although farming is done at subsistence level. The state is endowed with a rich fertile soil that supports the growth of the crops; such as yam, cassava, cocoyam, melon, maize, oil palm, garden egg, cocoa, to mention but a few. Poultry, goat, pigs and sheep are the major livestock kept. The rivers in the area support a wide range of irrigation farming and fishing, while its green vegetation also supports livestock farming. There are also numerous forest reserves in different areas useful for a wide range of forestry activities to support the livelihood of the rural people. Multi-stage sampling techniques was adopted in selecting 72 respondents that was used for the study. Data for this study were collected from primary sources. Structured questionnaire and oral interview was used in getting primary data. Data were collected

To examine and classify the retail fruit vendors according to risk attitude was achieved using descriptive statistics. To obtain the mean score, a four-point rating scale of Strongly Agree (SA)=4; Agree(A)=3; Disagree (DA)=2; and Strongly Disagree (SD)=1 was used. Each of the fruit vendors will rank his/her response to the questions on risk aversion from four (indicating high acceptance) to one (indicating low acceptance). Respondents was provided with a set of questions which are related to their risk attitude and was used to classify the risk attitude of the fruit vendors with the value {1,2,...J} for J, take a positive integer. The mean response of each fruit marketing entrepreneur was determined and used to classify their risk attitude in line with Oparinde, Amos, Aturamu and Daramola (2018) as follows: 1.00 - 2.49 = Risk-averse, 2.50 – 3.00 = Risk neutral and 3.01 - 4.00 = Risk-taking.

Ordered Probit model
The determinants of risk attitudes of fruit vendors in the study area was analysed using ordered Probit regression analysis. The ordered Probit model for this study is specified as follows:

$$Q_{i=0,1,\ldots,j} = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + e \quad (1)$$

Where;
Q_i = Risk attitude of fruit vendors (where i is stance for Risk Averse = 1, Risk Neutral = 2, and Risk Taking = 3)
X_1 = Age in years
X_2 = Marital Status (1=Married, 0=Not married)
X_3 = Household size (number of persons)
X_4 = Educational status in years spent in school
X_5 = Experience in years
X_6 = Scale of operations (Small scale =1; Otherwise =0)
X_7 = Cooperative Membership (1= Yes, 0= No)
X_8 = Distance to market (km)
X_9 = Amount of credit obtained in Naira
X_{10} = Average selling price of product (fruit) in Naira
β_i = Parameters to be estimated
e = Error terms

RESULTS AND DISCUSSION

The result shows that 56.7 percent of the fruit marketers in Abia State were female while 43.3 percent of them were male. This is because female take greater responsibilities for fruit marketing and enhanced economic contributions to family. Using this information, it could be deduce that females participate more in the marketing of fruit. This can be attributed to the believe of the people in the study area that fruit marketing is the duty or work of female. The concur with findings of (Wasiu and Burhan, 2018).

Table 1: Socioeconomic of retail fruit vendors in in the study area

Gender	Frequency	Percentage
Female	34	56.7
Male	26	43.3
Age (years)		
20-29	6	10.0
30-39	13	21.7
40-49	19	31.7
50-59	15	25.0
60 -69	6	10.0
70-79	1	1.7
Mean	**46**	
Marital Status		
Single	7	11.7
Married	42	70.0
Widowed	8	13.3
Divorced	3	5.0
Household Size		
1-4	45	75.00
5-8	11	18.3
9-12	4	6.7
Mean	**4**	
Educational Level		
No formal Education	8	13.3
Primary Education	28	46.7
Secondary Education	17	11.7
Tertiary Education	7	11.7
1-5	33	55.00
6-10	20	33.33
11-15	4	6.7
16-20	3	5.00
Mean	**6**	
Membership status	**Frequency**	**Percentage**
Member	49	81.7
Non member	11	18.3
Total	**60**	**100.0**

Source: Field survey (2024)

Table 1 shows that the mean age of the fruit marketers was 46 years with majority (31.7%) within the age range of 40 and 49 years. This is an indication that the fruit marketers in the study area were mostly middle aged that were within the active productive work force. This has implication on fruit marketing because of the ability of this segment of the population to effectively withstand the rigours, strain and stress involved in fruit marketing. Middle aged fruit marketers within the active productive work force can effectively shoulder the rigours and tedium involve in fruit marketing (Agbayekhai, 2010).

Table 1 shows that majority (70.0%) of the fruit marketers in the study area were married while 11.7% of them were single. Also, 13.3% and 5.0% of them were widowed and divorced respectively. This therefore implies that the married class was more involved in marketing because of the need to supplement the family's means of livelihood. Asfaw, *et al*., (2016) who noted that marriage should create a conducive environment for good citizenship training, development of personal integrity and entrepreneurship. This implies that a greater percentage of the population had family members. The dominance of the married people in marketing in the area may be attributed to the fact that married people are more settled as it relates to giving appropriates attention to fruit and marketing operations.

Table 1 shows that majority (75.0%) of the fruit marketers had household sizes of between 1 and 4 persons. The mean household size was 4 persons. This result indicates that the fruit marketers in the study area had moderate family sizes. It has been shown in the past that household sizes provide enough labour for fruit marketing. The economic implication is that household members provides the marketers with family labour and reduce cost of marketing and increase their revenue. This conforms to Asfaw, *et al*., (2016), that a relatively large household size may likely enhance family labour supply in the market.

Table 1 shows a good proportion of the respondent 86.7% of the fruit marketers in the study area were literate possessing divers' formal educational levels ranging from primary school education to tertiary education. Possession of literacy (ability to read and write) enable the fruit marketers to better utilize effectively and efficiently whatever available resources in the area and curtail frivolous spending. As expected, higher education would enhance improved technology adoption hence increased marketers income (Asfaw *et al*., 2022).

Majority (81.7%) of the marketers belongs to marketer's association while the rest (18.3%) were not. The marketers join cooperatives in order to fend off low pricing and collectively tackle other problem facing the business. The implies that an overwhelming majority of the fruit marketers in Abia State belong to marketing union, which may help the marketers get adequate information on fruit marketing and other benefit that may be obtainable from a union.

Table 2: Distribution of retail fruit vendors by risk preferences

Category	Risk aversion index	Frequency	Percentage
Risk Preferring	2.51 – 5.00	33	55.00
Risk neutral	2.5	11	18.33
Risk Averse	1.00 – 2.49	16	26.67
Total		**60**	**100.0**

Source: Computed from field survey (2024)

Table 2 reveals that some 55 percent of the retail fruit vendors in the study area have positive risk coefficients (2.51 – 5.00) and were therefore categorized as risk preferring. This result corroborates the inference with findings of Lim et al., (2010). Risk preferring attach more utility to the potential of additional wealth without considering the risk elements of the investment. For earning a given wealth (or return) they are prepared to assume higher risk. The individual under this is characterized as more adventures, some, with a preference for more risky agribusiness ventures (Lawrence et al., 2018). This group of processing will select the alternatives with some probability of higher outcome. In order to get this higher income, this person must also accept a probability of a lower outcome compared to the risk averters. The investor likely has a greater risk bearing ability and therefore is less concerned with the increased probability of a lower outcome and primarily focuses on the higher outcome potential. The wealthy investors are more risk preferring (Lim et al., 2010). They can afford to accept higher risk in seeking higher returns, they prefer volatile industries where they take risk and exploit opportunities coming their ways and hence have wider choice of strategies. Risk referrers due to the selection of vigorously offensive strategies, their value innovation, core competence and competitive edge are very highly compensated in returns.

About 26.67% of smallholder retail fruit vendors were risk averse. The implication of this findings is that the retail fruit vendors will sacrifice some level of expected return in order to reduce possibility of a loss; investors have a low risk bearing ability, risk bearing of the investor is directly related to liquidity and solvency measures of the firm. This confirm with the findings of Ayinde, (2008). Thus the business situation would be such that a large income loss would seriously disrupt or end the business investment. The implication is that for a given wealth (or return), they prefer less risk to more risk. The behavior of investor reflects the risk aversion, with poorer investors accepting lower returns exchange for lower risk to smooth their consumption. In this case, choice of alternative is small and hence growth rates are also slower. The risk adverse investors are satisfied with lower returns and always wanting to play safe rather than engaging in risky ventures with higher returns. Risk averters are cautious individuals who prefer less risky sources of income or investments. They will sacrifice some amount of income to reduce the probability of low income or losses; this implies that they will forego some possible gains to reduce the probability of losses. This is referred to as his "risk premium" and it increases with the degree of risk aversion. Averting risk does not mean that the individual was not at risk; instead he must be compensated for taking risks by receiving a return that is greater than what would be received if the outcome of an action choice were certain. Furthermore, about 18.33% of the sample respondent are risk indifferent/neutral. This confirm with findings of Ayinde, (2008). The implication of this findings is that the retail fruit vendors will have acceptable levels of risk bearing ability such that large losses are not of concern but at the same time achieving the highest outcome is not the focus either. Their attitude to risk and consequent return (wealth) are indifference. The implication is that they are not interested to less or more risk for a given wealth (or return). The investor will select the alternative with the highest expected Outcome (return) regardless of the probability associated with potential gains or losses.

Table 3: Ordered Probit Regression Result on determinants of risk attitudes

			Marginal Effects (dy/dx)		
Variables	Coefficients	z-value	Risk-Preferred	Risk-Neutral	Risk-Averse
X_1 = Age	0.1664	5.33***	0.0873***	-0.0369***	0.0669***
X_2 = Marital Status	-0.0028	-0.21	-0.3962	-0.0013	-0.00171
X_3 = Household size	0.0539	1.71*	0.0741*	-0.0118*	0.04551*
X_4 = Educational status	0.0693	3.42***	0.0239***	-0.0055***	0.01509***
X_5 = Experience	0.6657	5.09***	0.1687***	-0.0407***	0.1429***
X_6 = Scale of operations	0.6766	5.83***	-0.5316***	0.02316***	0.04801***
X_7 = Cooperative	0.8242	0.556	0.8962	0.0072	0.00679
X_8 = Distance	-0.2009	-5.68***	-0.0553***	0.0301***	-0.02969***
X_9 = Amount of credit	0.0000	3.28***	-0.0108***	0.0007***	0.00029***
X_{10} = Selling price	0.0009	5.48***	0.0629***	-0.0179***	0.04179***
Cut 1	-3.4402				
Cut 2	-0.3310				
LR $\chi^2(9)$	168.22				
Prob> chi^2	0.0000				
Pseudo R^2	0.45516				
log likelihood	-102.1314				
Number of observation	60				

Source: Field Survey, 2024 *, **, *** denotes 10%, 5% and 1% significant respectively

The result value of chi-square was 168.22, significant at 1% level, Pseudo R^2 was 45.16% and log likelihood was -102.13, this shows strong explanatory power of the model. The eight (8) out of ten variables are significantly factors influencing the retail fruit vendors attitude towards risks in fruit vendor in the study area. The coefficient of the ordered probit regression model revealed that the respondents' age, household size, educational status, scale of operations, experience, distance, amount of credit and value of processing were significantly factors influencing the retail fruit vendors attitude towards risks in fruit vendor in the study area.

The respondents' age was positively correlated with retail fruit vendors' risk aversion ($P < 0.1$). The results of the marginal effects for each group of risk attitudes, including the risk-preferred, risk-neutral, and risk-averse retail fruit vendors (Table 3) shows that the coefficient of age was significant at 1% the risk-preferred group, if age decreases by one unit, the probability of retail fruit vendors switching from the risk-preferred group to the risk-neutral group increases by 8.73%, while the other factors are constant ($P < 0.1$). For the groups of retail fruit vendors with a risk-averse attitude, if age decreases by one unit, the probability of switching from a group with a risk-averse attitude to a group with a risk-neutral attitude increases by 6.69% ($P < 0.1$). For the group of retail fruit vendors with a risk-neutral attitude, when other factors remain unchanged, if age increases by one unit, the probability of retail fruit vendors switching from the group with a risk-neutral attitude to the group with high risk aversion decreased by 3.67 % ($P < 0.1$). The study results were consistent with those of Luke (2011) and Korir (2011). Hence, the probability that retail fruit vendors will change their attitude from risk averse to risk neutral will increase when they are younger, if all of the other factors remain unchanged. This might be explained by the fact that younger retail fruit vendors might have a higher motivation to earn a higher income. Hence, they might accept the challenges of investing in risky processing activities, compared to older retail fruit vendors.

The coefficient of household size was positive and significant at 10%. This implies that increase in the household size will increase retail fruit vendors preference and attitude towards risks. The implication of this result is that with an increase in the household size of the retail fruit vendors, their preference for risk tends to increase. The results of the marginal effects shows that, if household size increases by one unit, the probability of retail fruit vendors switching from the risk-preferred group to the risk-neutral group increases by 7.41%, while the other factors are constant ($P < 0.1$). For the groups of retail fruit vendors with a risk-averse attitude, if household size decreases by one unit, the probability of switching from a group with a risk-averse attitude to a group with a risk-neutral attitude decreases by 4.45% ($P < 0.1$). For the group of retail fruit vendors with a risk-neutral attitude, when other factors remain unchanged, if household size increases by one unit, the probability of retail fruit vendors switching from the group with a risk-neutral attitude to the group with high risk aversion increased by 11.8 % ($P < 0.1$). The study results were consistent with (Lim et al., 2010). In contrast, Alderman (2008) indicated the opposite results, such that the characteristics of the household size did not affect retail fruit vendors' risk attitudes.

The coefficient of education was significant at 1%. The results of the marginal effects shows that, if years spent in school decreases by one unit, the probability of retail fruit vendors switching from the risk-preferred group to the risk-neutral group increases by 2.4%, while the other factors are constant ($P < 0.1$). For the groups of retail fruit vendors with a risk-averse attitude, if household size decreases by one unit, the probability of switching from a group with a risk-averse attitude to a group with a risk-neutral attitude increases by 1.5% ($P < 0.1$). For the group of retail fruit vendors with a risk-neutral attitude, when other factors remain unchanged, if household size increases by one unit, the probability of retail fruit vendors switching from the group with a risk-neutral attitude to the group with high risk aversion decreased by 0.5 % ($P < 0.1$). Better education has the effect of enabling marketer's access and conceptualizes information on improved marketing methods and other related issues capable of enhancing their risk attitude. Lim et al., (2010) noted that educational level was a positive and significant ($p \leq 0.05$) factors.

The coefficient of scale of operations was significant at 1%. The results of the marginal effects shows that, if scale of operations increases by one unit, the probability of retail fruit vendors switching from the risk-preferred group to the risk-neutral group decreases by 53.2%, while the other factors are constant ($P < 0.1$). For the groups of retail fruit vendors with a risk-averse attitude, if scale of operations decreases by one unit, the probability of switching from a group with a risk-averse attitude to a group with a risk-neutral attitude increases by 4.8% ($P < 0.1$). For the group of retail fruit vendors with a risk-neutral attitude, when other factors remain unchanged, if scale of operations decreases by one unit, the probability of retail fruit vendors switching from the group with a risk-neutral attitude to the group with high risk aversion increased by 2.3 % ($P < 0.1$). However, the results of this study indicate that the probability of changing a farmer's attitude from risk averse to risk neutral and risk preferred increases when the scale of operations is reduced by one unit. This means that the higher the scale of operations that retail fruit vendors have, the higher their risk aversion.

Similarly, the result on experience shows that if the number of years spent in processing decreases by one unit, the probability that retail fruit vendors switched from a risk-preferred to a risk-neutral group increases by 16.9 %, all factors held constant. If experience decreases by one unit, the probability of switching from a group with a risk-averse attitude to a group with a risk-neutral attitude increases by 14.3% ($P < 0.1$). For the group of retail fruit vendors with a risk-neutral attitude, when other factors remain unchanged, if experience increases by one unit, the probability of retail fruit vendors switching from the group with a risk-neutral attitude to the group with high risk aversion decreased by 4.1 % ($P < 0.1$). The study results were consistent with Lim *et al*. (2010).

The ordered probit regression results also demonstrated that an increase in the distance, the probability that they will switch from the risk-averse group to the group with a neutral risk attitude decreases by 5.53%, respectively ($P < 0.1$). If distance increases by one unit, the probability that retail fruit vendors will switch from a group with a risk-averse attitude to a group with a neutral risk attitude decreases by 2.97 % ($P < 0.1$)., while for the group of retail fruit vendors with a risk-neutral attitude, when other factors remain unchanged, if distance decrease by one unit, the probability of retail fruit vendors switching from the group with a risk-neutral attitude to the group with high risk aversion increased by 3.0 % ($P < 0.1$).

Regarding the amount of credit, the coefficient was positive related to risk attitude, if the amount of credit used in processing increases by one unit, the probability that retail fruit vendors switched from a risk-preferred to a risk-neutral group decreases by 1.08 %, all factors held constant. If amount of credit decreases by one unit, the probability of switching from a group with a risk-averse attitude to a group with a risk-neutral attitude increases by 0.7% ($P < 0.1$), while for the group of retail fruit vendors with a risk-neutral attitude, when other factors remain unchanged, if amount of credit decrease by one unit, the probability of retail fruit vendors switching from the group with a risk-neutral attitude to the group with high risk aversion increased by 0.7 % ($P < 0.1$). The results of this study were consistent with those of Abdul et al. (2017); Lim et al., 2010; etc. These results can be explained by

the fact that loans increase additional costs and create a financial burden on retail fruit vendors. Therefore, retail fruit vendors who are willing to use loans for processing might be considered risk preferred. This suggests that accessibility to credits with a reasonable interest rate might enhance retail fruit vendors' willingness to accept a higher probability of risk. This, then, might help retail fruit vendors gain higher profitability projects, which might contain higher potential risks.

The result from the marginal effect shows that a decrease in average selling price of fruit by one unit will increase the probability that retail fruit vendors switch from a risk-preferred to a risk-neutral group by 6.3 % ($P < 0.1$). Meanwhile, the higher the average selling price of fruit, the higher the probability of the farmer switching to the risk-neutral group decreases by 1.8 %, all factors held constant ($P < 0.1$). This result is consistent with Wencong *et al*. (2006). This suggests that increase in selling price of product might create changes in the risk aversion attitudes of retail fruit vendors

CONCLUSION AND RECOMMENDATIONS

In conclusion, this study on the determinants of risk attitudes among retail fruit vendors in Abia State, Nigeria, found that age, household size, educational status, scale of operations, experience, distance to market, access to credit, and the value of processing are significant factors influencing vendors' attitudes toward risk in the study area. Based on these findings, it is recommended that the government provide targeted credit facilities to fruit vendors to help them acquire necessary processing resources, particularly labor, which is a major constraint. Additionally, access to modern technologies and tools should be facilitated to enhance their operations and reduce vulnerabilities to market uncertainties. These measures would support the long-term sustainability and growth of fruit vendors in the region.

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Assessment of Farmers' Awareness, Attitude and Constraints to Cocoa Agroforestry Systems in Ikwuano Local Government Area of Abia State, Nigeria

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ABSTRACT
This study analyzed farmers' awareness, attitude and constraints to cocoa agroforestry systems in Ikwuano Local Government Area of Abia State, Nigeria. Specifically; it identified sources of information on cocoa agroforestry systems; assessed farmers' awareness; ascertained attitude of farmers and examined constraints to the cocoa agroforestry systems in the study area. Multistage random sampling procedure was used to select ninety (90) cocoa farmers. Data for the study were collected through a structured questionnaire and results analyzed using descriptive statistics such as; frequency counts, mean scores and percentages. The result showed that all (100.0%) farmers sourced information on cocoa agroforestry systems from Research Institutes and Agricultural Development Programme/Ministry of Agriculture, extension agents (98.9%), agricultural workshop (97.8%) and fellow cocoa farmers (81.1%). More so, majority (95.0%) and 93.3% were aware of Cocoa-Agroforestry with Fruit Trees and Alley Cropping with Timber Trees respectively. Again, farmers had positive attitude ($\bar{x}$=2.4) and were highly constrained ($\bar{x}$=2.4) in the utilization cocoa agroforestry systems in the study area. The study concluded that famers were aware of cocoa agroforestry systems, had positive attitude and high constraints in the study area. The study recommended introduction farmers to other agroforestry based climate change adaptation technologies, investment in extension education and access to credit facilities in order to enhanced cocoa production in the study area.

Keywords: Awareness, Attitude, Constraints, Cocoa Agroforestry, Systems

INTRODUCTION
Cocoa *(Theoboma cacao)* is an important tree crop cultivated worldwide (Orimogunje et al., 2019). In Africa, it is majorly grown in Ivory Coast, Ghana, Cameroun and Nigeria 2018, up to 5.3 million metric tons of dry cocoa. African countries cocoa production is estimated to be about 25% cocoa beans produced worldwide (International Cocoa Organization's (ICCO) (2023)). In order to intensify the production, several cocoa production systems such s cocoa under tree has being integrated reduce the use of agrochemicals in plantation worldwide (Shahbandeh, (2021). Cocoa production in Nigeria are constrained by pest and disease infestations such as mirids *(Sahlbergella singularis),* 17% loss due to cocoa pod borer *(Charalomastrictigrapha)* as the major losses occurred from the black pod disease caused by *Phytophthora megakarya,* range from 30-90% in the country (Herbwisdom., 2015) and improper fermentation practices which accounted to about 25-30% losses in yield leading to poor quality of cocoa beans. Oluwalade *et al*., (2013) affirmed that most

cocoa farms were established more than forty years ago and those who produce cocoa are experienced old small scale and migrant farmers that cultivate less than one hectare of farm land without employing improved cocoa production technologies on their farms. Oseni *et al*., 2018; Adetarami *et al*., 2020 in their studies found that cocoa cultivation in Nigeria is predominantly undertaken on small-scale farms, which covers less than.

Agroforestry systems integrates timber, fruit and other trees with cocoa trees to sustain cocoa production by adapting to climate change effects, increased yield, biodiversity conversation, nutrient recycling, increase in food security, soil chemical and physical properties, reduction of disease and pest infestation and provision of additional income for the farmer [8, 13], [7, 17] by buffering climatic extremes and blocking direct radiation [7, 18]. Cocoa Research Institute of Nigeria (CRIN), (2017) and Sustainable Tree Crop Programme (STCP) (2008) identified Shade Grown Cocoa, Alley Cropping with Timber Trees, Cocoa-Plantain Intercropping, Cocoa-Agroforestry with Fruit Trees, Live Fencing with Cocoa, Cocoa-Grains Intercropping: and Cocoa-Rubber as Cocoa Agroforestry Systems practiced by farmers in Nigeria.

Many programmes were developed to ameliorate the reduction in quality of Nigeria's cocoa beans in the world market such is the Sustainable Tree Crop Programme (STCP) of International Institute of Tropical Agriculture (IITA) commenced the implementation of a Farmer Field School (FFS) in selected cocoa producing communities on a pilot basis in 2001. The approaches include; farming system research (FSR), small plot adoption techniques (SPAT), conventional agricultural extension system, (CAES), community type extension approach, integrated agricultural extension approach, training and visit extension approach (T&V), unified agricultural extension system among others, geared towards increasing yield of cocoa by the application of good management practices (Sustainable Tree Crop Programme (STCP) 2006); Odoemenam *et al*., 2020; Nwaobiala, 2014). Farmer Field School was the step taken to ameliorate these setbacks in cocoa production in Abia State and other cocoa producing States of the nation (Abia State Cocoa National Day Bulletin 2009). From the foregoing, it seems that there is paucity of information and not certain whether farmers were aware, their attitude and constraints to cocoa agroforestry systems in the study area. The study was undertaken to assess awareness, attitude and constraints to cocoa agroforestry systems among farmers in Ikwuano Local Government Area of Abia State, Nigeria.

In view of the above assertions this paper sought to provide answers to the following research questions.

i. Where do farmer's source information on cocoa agroforestry systems?
ii. Are cocoa farmers aware of cocoa agroforestry systems?
iii. What are the attitude of farmers towards cocoa agroforestry systems and
iv. What are the constraints to cocoa agroforestry systems by farmers in the study area?

The specific objectives were to:

i. identify sources of information on cocoa agroforestry systems;
ii. assess awareness of cocoa agroforestry systems by farmers;
iii. ascertain attitude of farmers towards cocoa agroforestry systems ; and
iv. examine constraints to cocoa agroforestry systems by farmers in the study area.

METHODOLOGY

Study Area and Description

The study was conducted in Ikwuano Local Government Area of Abia State, Southeast Nigeria. The Local Government Area was created on the 27th day of August 1991 from the defunct Ikwuano/Umuahia Local Government Area. The Local Government has its headquarters in the town of Isiala Oboro which lies between the Latitudes 5° 24'N and 5° 30'N of the Equator and between the Longitudes of 5° 32''N and 5° 37'N of the Greenwich meridian. It borders Umuahia North and Bende to its North, Umuahia South and Isiala-Ngwa North to its West, Ini to the East and Obot-Akara to the South.

According to the Federal Republic of Nigeria, the projected population growth of Ikwuano at 2.6% from 2006 population figure is 55,405 people (National Population Commission (NPC), 2022). It has notably landmarks include; Michael Okpara University of Agriculture Umudike and National Root Crops Research Institute Umudike. Ikwuano Local Government Area occupies total areas of 281 square meters and has an average temperature of 28°C. The cocoa producing communities are ten

(10) namely; Amauro, Amawom, Ekebedi, Iberenta, Nkalunta, Ibere, Ihim, Nyinla, Iyialu and Umuariga Oboro (Abia State Cocoa National Day Bulletin 2019).

Measurement of Variables

Awareness of respondents about cocoa agroforestry system attributes

The levels of awareness of cocoa agroforestry systems in the study area was operationalized by asking the farmers to indicate whether they were aware of the seven (7) stated agroforestry systems with response options of "Yes" and otherwise "No"..

Attitude of respondents towards cocoa agroforestry system attributes

This was measured and rated on a 4-point Likert rating scale of; Strongly Agree=4, Agree= 4, Disagree= 2, Strongly Disagree = 1. Based on the eleven (11) perception item statements, respondents mean scores were computed for each perception statement by adding the weights of 4+3+2+1 = 10/4=2.5. Mean score greater than or equals 2.5 implied positive and otherwise, negative attitude of the cocoa agroforestry systems.

Constraints to the utilization of cocoa agroforestry systems

This was measured and rated on a 3- point Likert rating scale of; Severe = 3, mild = 2 and not severe =1. A midpoint was thus; 3+2+1 = 6/3 =2.0. The following decision rules were adopted. Mean scores between; 1.0 -1.49 = low constraint, 1.5-1.99 = moderate constraint; and above 2.0 = high constraint.

Sampling Procedure and Sample Size

The study adopted purposive and simple random sampling technique. Purposively all the ten communities producing cocoa namely Amauro, Amawom, Ekebedi, Iberenta, Nkalunta, Ibere, Ihim, Nyinla, Iyialu and Umuariga Oboro were selected for the study because the intensity in cocoa cultivation and production in the State. From the communities, simple random sampling technique was employed to select nine (9) cocoa farmers each to give a sample size of ninety (90) cocoa farmers tused in the study. Data for the study were analyzed using descriptive statistics such as; frequency counts, percentages and mean scores.

RESULTS AND DISCUSSION

Sources of Information about Cocoa Agroforestry Systems

The result in Figure 1 shows the awareness about cocoa agroforestry systems in the study area. The result revealed that all (100.0%) of farmers sourced information on cocoa from Research Institutes and ADP/Ministry of Agriculture each. Also, majority (98.9%) and 97.8% sourced from extension agents and agricultural workshop respectively, as against 81.1% that sourced from fellow cocoa farmers. However most (65.6%) of them sourced information from cocoa trainings, 23.3% from personal observations, 5.6% from printed materials while few (2.2%) and 1.1% from radio and television programmes respectively.

The result suggest that the location of Cocoa Research Institute Nigeria sub-station and involvement of cocoa farmers in Farmer Field School programmes may have facilitated farmers' sourcing of cocoa agroforestry systems in the Local Government Area of the State. Research Institutes are considered to be a legitimate avenue in transmitting and providing information on various production technologies as it affects the commodity to be sourced (Nwachukwu and Nwaobiala, 2020; Odoemenam *et al*., 2020).

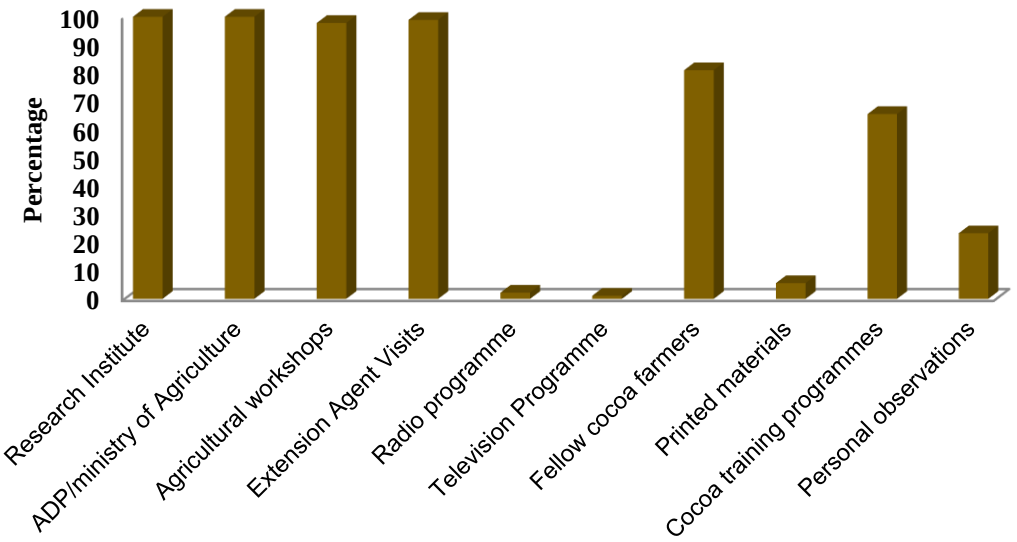

Figure 1: Farmers' sources of information about cocoa agroforestry systems

Awareness of Farmers about Cocoa Agroforestry Systems

The result in Figure 2 shows the awareness about cocoa agroforestry systems in the study area. The result indicates that all (100.0%) the farmers were aware of Cocoa-Plantain Intercropping. However, majority (95.0%) and 93.3% were aware of Cocoa-Agroforestry with Fruit Trees, and Alley Cropping with Timber Trees respectively. Again, half (50.0%), a moderate proportion (48.9%) of the farmers was aware of Shade Grown Cocoa and Cocoa-Grains Intercropping respectively. More so, few (6.7%) and 5.6% of cocoa farmers were aware of Cocoa-Rubber Agroforestry and Live Fencing with Cocoa systems.

The result suggest that majority of cocoa farmers were aware of Cocoa-Agroforestry intercropped with Fruit Trees and Alley Cropping with Timber Trees. Nwaobiala *et al*., (2024, Amadi *et al*., (2023), Ogunyemi *et al*., (2022) in their studies found that farmers' awareness of agricultural production technologies have shown to facilitate its adoption and utilization of extended to them, thereby guaranteeing confidence and efforts of farmers by the extension worker during training sessions.

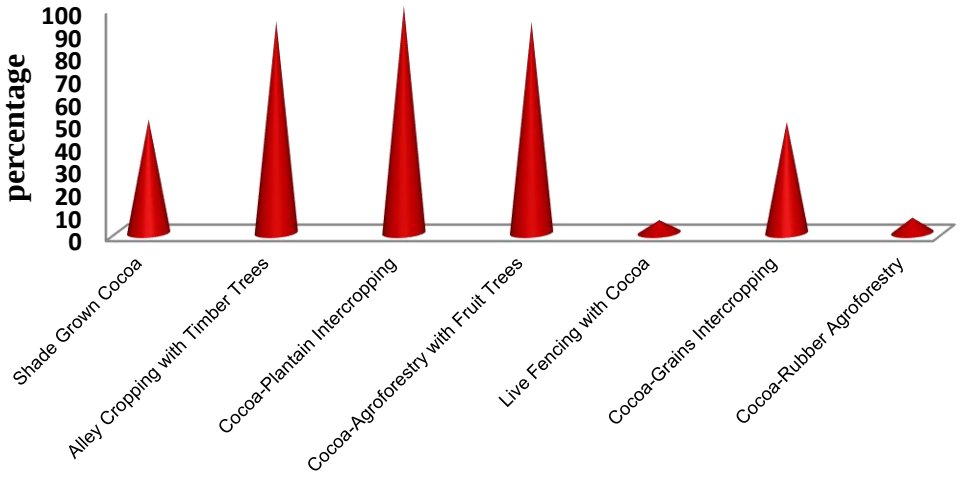

Figure 2: Farmers' awareness of cocoa agroforestry systems

Attitude of Farmers towards Cocoa Agroforestry Systems

The result in Figure 3 shows the attitude of farmers towards cocoa agroforestry systems in the study area. The result showed that cocoa farmers had attitude that cocoa agroforestry systems enhances

farmers income Enhances farmers income ($\bar{x}$=3.5), adaptation to cocoa plantations ($\bar{x}$=3.0), soil nutrient conservation ($\bar{x}$=2.8), environmentally friendly ($\bar{x}$=2.8), increase in cocoa output ($\bar{x}$=2.7), assured availability of variety of crops all year ($\bar{x}$=2.7), permits and allows crop mixture ($\bar{x}$=2.6), help to check soil erosion and flooding ($\bar{x}$=2.6), helps in climate change mitigation ($\bar{x}$=2.6), reduces disease incidence and pest infestation ($\bar{x}$=2.5) and act as wind breaks to cocoa trees ($\bar{x}$=1.7).

The grand mean attitudinal score of 2.4 indicate that cocoa farmers had positive attitude of cocoa agroforestry system in the study area. The result is in consistent with the findings of Mustapha *et al*., (2023); Oluwalade *et al*., (2023); Kekong, (2023), Ijigbade *et al*., (2023), as they reported that technology characteristics or attributes as perceived by farmers facilitates its adoption and utilization in the long run.

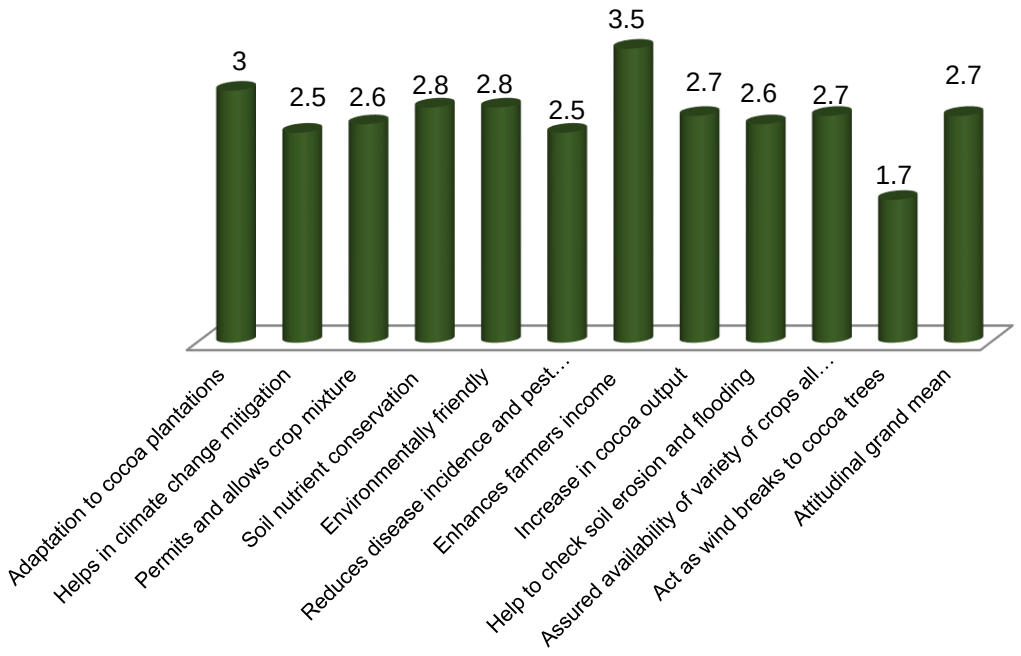

Figure 3: Attitudinal mean scores of farmers towards cocoa agroforestry systems

Constraints of Cocoa Agroforestry Systems by Farmers

The result in Figure 4 shows the constraints of cocoa agroforestry systems by farmers in the study area. The result indicate that cocoa farmers were highly constrained by inadequate cocoa seedlings ($\bar{x}$=3.0), complicated systems ($\bar{x}$=2.9) and lack of funds ($\bar{x}$=2.5). However, they were constrained by poor extension support and lack of technical know-how with mean ratings of 2.4 each, also pest and disease problems and non- access to credit with 2.1 each. The farmers had moderate constraints ($\bar{x}$=1.9).to cocoa agroforestry systems due to poor road network.

The grand mean constraint score of 2.4 affirmed that cocoa farmers were highly constrained in cocoa agroforestry systems in the study area. Muhammad *et al*., (2023), Nwaoiala and Uduma, (2023), Oluwalade *et al*., (2023) affirmed that most of these identified constraints affected utilization of agricultural crops especially cocoa in Nigeria.

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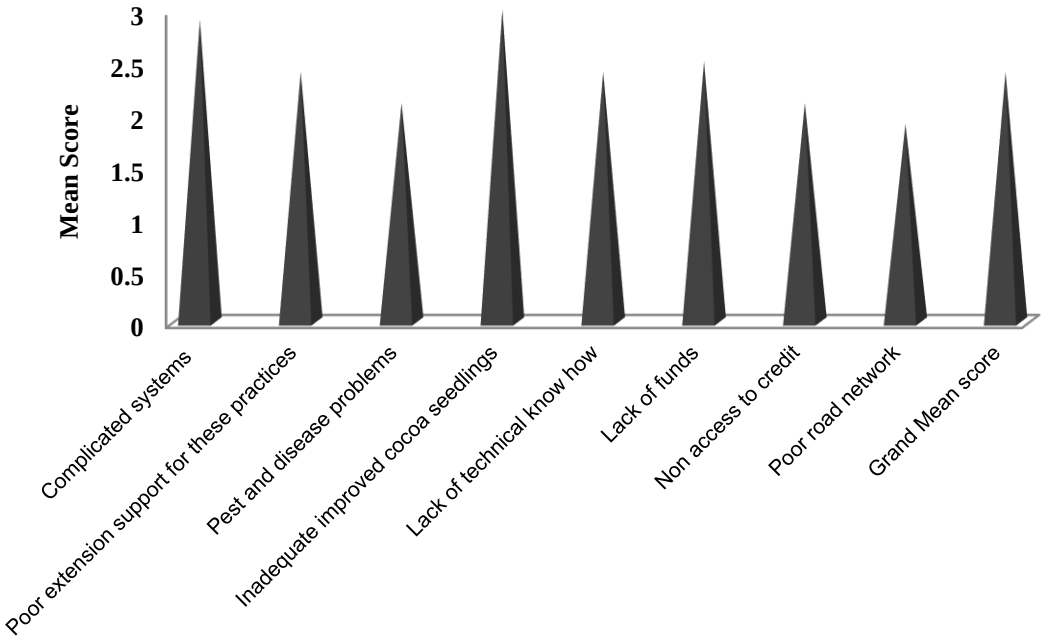

Figure 4: Constraints to cocoa agroforestry systems by farmers

CONCLUSION AND RECOMMENDATIONS

The study concluded that farmers were aware were aware of cocoa agroforestry systems, had positive attitude and high constraints highly constrained by inadequate cocoa seedlings, complicated systems, lack of funds poor extension support and lack of technical know-how pest and disease problems and non- access to credit.in the study area. The study recommended that cocoa farmers should be use agroforestry based climate change adaptation strategies, strengthening of extension education and access to credit facilities for increased cocoa agro-forestry practices.

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Paper Code: CC25009

Evaluation of Farmers' Proficiency in Utilizing Organic Products to Combat Cucumber Mosaic Virus Disease in Okra in Abia State, Nigeria

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ABSTRACT

Strengthening the extension services and providing timely and context-specific information through innovation platforms can contribute to building resilience in regenerative agriculture and nature-based agri-production systems. Thus the study evaluated farmers' proficiency in utilizing organic products to combat cucumber mosaic virus disease in okra in Abia State, Nigeria" Specifically, the study ascertained farmers awareness and intensity of incidence of CMV, identified organic extracts and products used by farmers in the control of CMV, examined level and determinants of farmer's proficiency and constraints limiting farmers use of organic products on the control of CMV in okra. Multi-stage sampling procedure was employed in the selection of 150 respondents from two out of three Agricultural zones in Abia State Nigeria. Structured questionnaire was used to obtain relevant data for the study which was analyzed using simple descriptive statistics such as frequency counts, percentages, means as well as Z-test and OLS regression model. Results show that Majority (71%) of the farmers demonstrated basic understanding of organic products and their potential for disease control. Certain organic products (plants ($\bar{x}$ = 3.4) and non-plant ($\bar{x}$ = 3.0) extracts) were found to be more popular and widely used among farmers due to their effectiveness and availability. High level of proficiency in the use of Azadirachta indica (neem) ($\bar{x}$ = 3.60) than Zingiber officinale (ginger) ($\bar{x}$ = 3.05), Allium sativum (garlic), ($\bar{x}$ = 2.69) and Jathropha leave extract ($\bar{x}$ = 2.55) respectively were recorded. Coefficients for educational qualification (10%), extension contact (1%), participated in trainings (1%) are significant variables directly influencing the level of proficiency. The study therefore calls for empowering the farmers through access to informal education, trainings and contact with extension services to substantially increase access to information on organic farming practices, and/or pest and disease control as best control strategy ultimately leading to improved yields and livelihoods in the agricultural sector.

Keywords: Organic Products, Cucumber Mosaic Virus Disease, Okra

INTRODUCTION

In recent years, organic farming has gained substantial popularity owing to its multifaceted benefits in terms of economics, nutrition, and medicine. This approach carries minimal risk factors, places a strong emphasis on genetic and physical diversity, optimizes the use of local resources, and promotes environmental health. It has garnered recognition and support from a range of organizations, including international development agencies, governmental bodies, and non-governmental entities (IFOAM, 2020). Organic agricultural practices offer a solution to address issues related to poor soil quality and severely degraded soils. The traditional approach of harnessing our resources and technology to meet the ever-growing global demand for food production is commendable. However, it is vital to acknowledge the long-term adverse impacts of

certain technologies on the environment and soil. For instance, the widespread use of chemical fertilizers, in addition to its high cost, tends to render the soil acidic and, when runoff contaminates water bodies, poses a threat to aquatic ecosystems and human health (Hurtado-Barroso et al., 2019; Khan et al., 2020).

Furthermore, the demand for food production that is free from diseases and chemical residues has been steadily increasing worldwide, even in the face of challenges associated with organic crop cultivation. Organic crops, in general, are considered more natural and involve fewer or no synthetic pesticides or fertilizers. The desire for healthier and environmentally-friendly food options has been a driving force behind the growing popularity of organic farming practices (Abdulraheem et al., 2022). Okra (*Abelmoschus esculentus L. Moench*) is a versatile crop with the potential to yield abundantly without the use of chemicals, is a notable example. It belongs to the Malvaceae family and is widely cultivated in tropical regions for its edible fruits. Okra is not only a source of dietary calories but also provides essential nutrients, including vitamins A, B, and C, as well as proteins, carbohydrates, fats, and various minerals.

In Africa, particularly in Nigeria, Ghana, and Burkina Faso, there is a significant diversity of okra production. It ranks as the second most important vegetable crop in West Africa, following tomatoes (Zandjanakou-Tachin et al., 2021). In 2019, global okra production covered vast acreage and yielded millions of tons, with Nigeria being one of the largest producers (FAOSTAT, 2020). The production and consumption of okra in Nigeria have seen remarkable growth in recent years, surpassing the growth rates of other key crops like cassava and maize. However, the success of okra cultivation relies heavily on factors such as soil fertility and cultural practices, as well as the ability to manage abiotic and biotic factors affecting production.

One notable biotic challenge in okra production is the prevalence of plant viruses, with cucumber Mosaic Virus (CMV) being a major concern. This virus, which spreads through insect vectors, causes severe damage to okra crops and results in significant economic losses. These losses, ranging from 10% to 100%, have a direct impact on food security (Fudzagbo and Abdulraheem, 2020). Cucumber mosaic virus of okra (CMV) is a member of the Tymovirus group, and its symptoms include a characteristic yellow mosaic pattern on leaves, ultimately affecting yield. Farmers have employed various measures to address the CMV issue, including planting resistant cultivars, weed management, integrated pest management, and the use of organic products to prevent and control viral diseases. The effectiveness of these measures depends on farmers' proficiency in implementing organic methods for disease prevention and control. Understanding the level of knowledge and proficiency among farmers in this regard is essential for designing effective strategies to manage CMV and enhance okra production sustainably.

Farmer's proficiency in utilizing organic products plays a crucial role in sustainable agriculture and effective disease management. Proficiency refers to the level of skill, knowledge, and capability a farmer possesses in using organic products, techniques, and practices to enhance crop growth, productivity, disease resistance and climate resilience (UNDP 2022). In the context of organic farming, proficiency extends to understanding the principles of organic agriculture, utilizing organic inputs effectively, and implementing environmentally friendly practices. Proficiency starts with a solid understanding of organic farming principles, including the use of natural fertilizers, pest control, soil health management, and sustainable agricultural practices. Farmers need to be aware of the benefits of organic products and how they can positively impact crop health, soil fertility, and the ecosystem as a whole. It also involves hands-on skills in applying organic products, such as compost, organic fertilizers, biopesticides, and beneficial microorganisms. Farmers should know when and how to use these products effectively to improve crop yield, reduce pests, and enhance overall plant health.

Proficient farmers are adaptable and open to adopting new organic farming techniques and products as they evolve. They demonstrate an ability to innovate and incorporate sustainable farming practices into their existing agricultural methods, ensuring continual improvement in their proficiency levels (europa.eu, 2022). The farmers are skilled in managing diseases using organic approaches (Ekwe and Umeh, 2019). They understand the specific organic products that are effective in preventing, controlling, or mitigating various plant diseases. This knowledge helps them address disease challenges sustainably and reduce reliance on synthetic chemicals.

The study assessed farmers' proficiency in utilizing organic products to combat cucumber mosaic virus disease in okra in Abia State. Specifically, the study ascertained farmers experience of intensity of incidence of CMV in okra in the study area, identified organic extracts and products used by farmers in the control of the diseases, ascertained level of farmers' proficiency in the use of selected organic products on the control of CMV and identified constraints militating against Okra farmers in the use of organic products in the control of cucumber mosaic virus.

METHODOLOGY

This study was conducted in Abia State of Nigeria. Abia State with Umuahia as its capital has seventeen (17) Local Government Areas, three senatorial zones namely, Abia South, Abia Central and Abia North and many communities. It is one of the five states in the South East geo-political Zone of Nigeria. The total land area of Abia state is 4,900 Km^2 (Wikipedia, 2021). The State has a population density of 580 persons per square kilometer and a population of 3,727,300 persons. Historically, Abia was carved out of the former Imo State in 1991. It lies between latitude4°45' and 06°07' N and longitude 07°00' and 08°10' East of the equator (NBS, 2020). The climate is tropical and humid with minimal rainfall ranges of 2000mm to2500mm. The population of the study comprises of all the Okra crop producing farmers in Abia State, Nigeria. A simple random sample procedure was used to select 150 okra producers for the study.

This involved selection of one block from each zone, two circles from each block and 25 okra farmers from each circle. Questionnaire administration was employed in collecting data from the farmers while descriptive statistics (namely frequency counts, percentages, mean) and Ordinary Least Square regression analysis were used to analyze the data obtained.

farmers experience of intensity of incidence of CMV in okra farm was captured using a six-point rating scale using Very High (VL) = 6, High (H) =5, Moderate (M) =4, Low (L) =3, Very Low (VL) = 2, and None (N) =1, a midpoint of 3.50 was obtained implying that mean scores equal to or higher than 3.50 indicates high intensity of incidence of CMV while mean score of less than 3.50 indicates low intensity of incidences of CMV. Organic extracts and products used by farmers in the control of the disease were captured descriptively with frequency and percentage. Level of farmers' proficiency in the use of selected organic products was captured using a four-point Likert-type scale of High proficiency HP =4, Moderate Proficiency MP =3, Low proficiency LP =2 and No proficiency NP =1 with a midpoint of 2.50. The decision rule is that mean scores of 2.50 and above imply that they are positive and in affirmative to having proficiency needed for utilization and application of the organic product while factors with mean score of less than 2.5 are negative and rarely have the needed proficiency for the organic product being measured. Constraints militating against Okra farmers in the use of organic products in the control of CMV were captured using a five-point Likert scale of SA= Strongly Agree (5), A= Agree (4), U= Undecided (3), D= Disagree (2), SD= Strongly Disagree (1). Based on the weights assigned, a midpoint of 3.00 was obtained. The decision rule is that a mean score of 3.00 and above indicates agreement with the statement while a mean score of less than 3.00 posits disagreement with the statement.

The model specification for the Least Square regression analysis is implicitly stated as follows:

Linear Function

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11}.....X_n + ei \quad (1)$$

Semi – log function

$$Y = L_nb_0 + b_1L_nx_1 + b_2L_nx_2 + b_3L_nx_3 + b_4L_nx_4 + b_5L_nx_5 + b_6L_nx_6 + b_7L_nx_7 + b_8L_nx_8 + b_9L_nx_9 + b_{10}L_nx_{10} + b_{11}L_nx_{11} + ei \quad (2)$$

Exponential function

$$LnY = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + ei \quad (3)$$

Cobb Douglas Function

$$LnY = L_nb_0 + b_1L_nx_1 + b_2L_nx_2 + b_3L_nx_3 + b_4L_nx_4 + b_5L_nx_5 + b_6L_nx_6 + b_7L_nx_7 + b_8L_nx_8 + b_9L_nx_9 + b_{10}L_nx_{10} + b_{11}L_nx_{11} + ei \quad (4)$$

Y = farmers' level of proficiency (provided by the mean score of 4 point weighing scale).
X_1 = Age (years)
X_2 = Education (years)
X_3 = Farming experience (years)
X_4 = Farm size (hectare)
X_5 = Sex (Male =1, Female – 0)
X_6 = Access to land (hectares)
X_7 = Cooperative membership (yes =1, No = 0)
X_8 = Extension visit (Number of times)
X_9 = participated in trainings on organic agriculture standards (yes=1, no=0)
X_{10} = easy access to organic planting resources (yes=1, no=0)
X_{11} = Access to improved seed varieties (Yes=1, No =0)
ei = error term

RESULTS AND DISCUSSION

Intensity of incidence of CMV in the study area

The incidence of CMV in the study area, as depicted in Table 1, revealed notable intensity. Farmers reported high incidences of yellow, white, or green stripe/spores on leaves (5.35), CMW (5.64), and OYVMV (5.68), all surpassing the acceptable mean of 3.50. This indicates the considerable prevalence of these viruses among the local farming community. This aligns with prior findings by Salaudeen et al. (2018), which observed severe CMV infection in okra plants in a similar region of Nigeria. Consistent with Asare-Bediako et al. (2018) and Amiteye et al. (2021), the study also noted high incidences of OYVMV and Okra mosaic virus. In contrast, leaf curl (3.20), damping off (3.16), and powdery mildew (3.21) were less frequently experienced, scoring below the acceptable mean of 3.50.

Table 1: Level of Intensity of incidence of OKMV in the study area

Viruses of okra	VH	H	M	L	VL	N	T	M
Yellow, white or green stripes/spores on leaves	68(408)	66(330)	16(64)	0(0)	0(0)	0(0)	802	5.35
CMV Okra mosaic virus	100(600)	48(240)	0(0)	2(6)	0(0)	0(0)	846	5.64
OYVMV	116(696)	26(130)	4(16)	2(6)	2(4)	0(0)	852	5.68
Leaf curl	0(0)	4(20)	52(208)	66(198)	26(52)	2(2)	480	3.20
Damping off	0(0)	6(30)	42(168)	74(222)	26(52)	2(2)	474	3.16
Powdery Mildew	2(12)	2(10)	60(240)	56(168)	22(44)	8(8)	482	3.21
Grand mean								**4.37**

Source: Field survey, 2023. Values in parenthesis are the lickert frequency values
Very High (VL) = 6, High (H) =5, Moderate (M) =4, Low (L) =3, Very Low (VL) = 2, None (N) =1.
Acceptance mean = 3.5 and above

Identification of organic extracts and products used by farmers in the control of the diseases

The study's findings on the organic extracts and products used for CMV control, as presented in Table 2, indicate a notable preference for Azadirachta indica (neem) among the majority of respondents (81.30%). Zingiber officinale (ginger) follows at 56.00%, with Jathropha Leaf (41.30%), Allium sativum (garlic) (40.00%), and Alliumcepa L (onion) (21.30%) also noted. Neem extracts are widely recognized for their efficacy in controlling various insect pests and viral diseases, including CMV, making them a popular choice in vegetable farming, particularly in developing regions like sub-Saharan Africa (Akama et al., 2023). Additionally, the use of plant extracts from locally available materials, such as neem, ginger, and jatropha leaf, is considered an environmentally friendly and cost-effective approach for pest and viral disease control in crops (Adhikari et al., 2020).

Furthermore, regarding non-plant extracts, the study identified a high usage of ash (92.00%), surpassing organic boosters/fertilizers (58.70%) and urea (17.30%). This preference for ash as a non-plant extract may be attributed to its accessibility and effectiveness in the context of organic farming practices. The study revealed that most farmers (98.70% and 92.00%) utilized regular weeding and rouging as planting/management controls for CMV, followed by improved seed use (86.70%), planting timing (69.30%), proper spacing (68.00%), and mixed cropping (49.30%). Abdulraheem et al. (2022) also emphasized the significance of weeding in preventing viral diseases in okra, underscoring the importance of proper cultural practices. They noted that weed infestation and erroneous practices like contaminated tools and seeds exacerbate crop vulnerability to pests, heightening the risk of CMV infection.

Table 2: Organic extracts and products used by farmers in the control of OKMV

Control	Used	Not Used
Plant extracts		
Azadirachta indica (neem)	122(81.30)	28(18.70)
Allium sativum (garlic)	60(40.00)	90(60.00)
Zingiber officinale (ginger)	84(56.00)	66(44.00)
Alliumcepa L (onion)	32(21.30	118(78.70)
Jathropha Leaf	62(41.30)	88(58.70)
Non-plant extract		
Ash	138(92.00)	12(8.00)
Urea	26(17.30)	124(82.70)
Organic booster/fertilizer	88(58.70)	62(41.30)
Planting/management control		
Wedding regularly	148(98.70)	2(1.30)
Improved seeds	130(86.70)	20(12.30)
Proper Spacing	102(68.00)	48(32.00)
Time of planting	104(69.30)	46(30.70)
Mixed cropping	74(49.30)	76(50.70)
Rogue out	138(92.00)	12(8.00)

Source: Field survey, 2023. Values in parenthesis are the percentage values

Level of farmer's proficiency in the use of selected organic products on the control of okra mosaic virus (CMV)

Table 3 outlines the proficiency levels of farmers in employing selected organic products for controlling CMV. Notably, farmers displayed high proficiency in the use of Azadirachta indica (neem), Zingiber officinale (ginger), Allium sativum (garlic), and Jathropha leaf extract with mean scores of 3.60, 3.05, 2.69, and 2.55, respectively. This aligns with a growing trend towards using organic substances, where farmers demonstrate significant proficiency in application methods for pest and virus control. Adhikari et al. (2020) also highlighted farmers' expertise in utilizing these organic substances. Farmers' high proficiency is attributed to their experience with various viral diseases affecting okra during its growth and development, with CMV and OYVMV being the most significant and prevalent. As Carvalho et al. (2022) noted, farmers are seeking alternatives to toxic substances in agriculture, leading to a focus on the effectiveness of plant extracts.

However, there remains low proficiency among respondents in using Alliumcepa L (onion) (1.79), possibly due to limited awareness and knowledge regarding its application for controlling CMV. Bilqees et al. (2020) reported the successful use of various plant extracts, including garlic and neem, to manage CMV and its vector. Ali et al. (2018) demonstrated that Allium sativum extracts, while known to farmers, were less effective compared to salicylic acid and Azadirachta indica against the vector. These findings emphasize the need to expand knowledge and proficiency in the utilization of a wider range of organic products. This paucity of knowledge in the effectiveness and method of applications of other varieties of organic products has limited the farmers to constant use of the indicated few thereby causing scarcity, higher cost of input as well as compromise of organic standards among organic practitioners.

Furthermore, the findings also indicated high proficiency in using non-plant extracts, particularly ash (3.56) and organic booster/fertilizer (2.95), while proficiency in using urea was notably low (1.73). Adeyemo et al. (2022) supported the study's observations, noting farmers' extensive knowledge of wood ash's role in enhancing soil quality and combating viral diseases in okra and other crops in South Western Nigeria's degraded alfisols.

Among the assessed management controls, farmers displayed the highest proficiency in regular weeding (3.79), followed by rouging out infected plants (3.69), use of improved seeds (3.00), proper spacing (2.61), and timing of planting (2.59). This suggests that farmers possessed sufficient proficiency to understand that regular weeding and proper farm sanitation can reduce CMV incidence. In line with these findings, Abdulraheem et al. (2021) reported that regularly weeded farms had the lowest viral infection incidence and severity. Planet Natural Research Center (2023) emphasized that infected soil, seeds, containers, and plant cuttings contribute to virus spread, further endorsing the importance of improved seeds, proper spacing, and planting time in reducing CMV incidence.

Table 3: Level of farmer's proficiency in the use of selected organic products on the control of okra mosaic virus (OkMV)

Products	HP	MP	LP	NP	Total	Mean
Plant extracts						
Azadirachta indica (neem),	120(480)	1442)	2(4)	14(14)	540	**3.60**
Allium sativum (garlic),	68(272)	24(72)	2(4)	56(56)	404	**2.69**
Zingiber officinale (ginger)	56(224)	46(138)	48(96)	0(0)	458	**3.05**
Alliumcepa L (onion)	24(96)	22(66)	2(4)	102(102)	268	1.79
Jathropha leave extract	18(72)	46(138)	86(172)	0(0)	382	**2.55**
Non-plant extract						
Ash	96(384)	42(126)	12(24)	0(0)	534	**3.56**
Urea	20(80)	24(72)	2(4)	104(104)	260	1.73
Organic booster/fertilizer	36(144)	70(210)	44(88)	0(0)	442	**2.95**
Management control						
Wedding regularly	122(488)	24(72)	4(8)	0(0)	568	**3.79**
Use of Improved seeds	56(224)	66(198)	0(0)	28(28)	450	**3.00**
Proper Spacing	30(120)	76(228)	0(0)	44(44)	392	**2.61**
Time of planting	28(112)	76(228)	2(4)	44(44)	388	**2.59**
Inter cropping	32(128)	36(108)	12(24)	70(70)	330	2.20
Rogue out the infected	118(472)	18(54)	14(28)	0(0)	554	**3.69**

Source: Field survey, 2023. Values in parenthesis are the weighted frequency values. High proficiency HP = 4, Moderate Proficiency MP = 3, Low proficiency LP =2 and None proficiency NP =1 Acceptable mean =2.50

Constraints militating against Okra farmers in the use of organic products in the control of okra mosaic virus (CMV)

The study presented the results on constraints militating against okra farmers in the use of organic products in the control of cucumber mosaic virus (MV) in the Table 4 The results showed that high cost of labour (4.88), high cost of organic materials (4.72), unavailability of farm input (4.61), procedure difficult to understand (4.51), fear (4.15), and lack of access to credit facilities (4.02), and non-availability of technologies (3.79) had mean scores above the acceptable mean of 3.0, and therefore were major constraints militating against okra farers in the use of organic products to control CMV.

Tikon et al. (2023) in line with the findings noted that organic farmers faced high cost of organic farming, scarcity of organic inputs, low technical know-how on applications of organic inputs and standards, poor premium market outlet, poor storage facilities and inadequate consumer information, which constrains the for effective participation and control of pest and diseases such as CMV.

Table 4: Constraints militating against Okra farmers in the use of Organic Products in the control of okra mosaic virus (OkMV) in the study area

Constraints	SA	A	U	SD	D	T	M
Lack of awareness/information	10(50)	8(60)	20(60)	74(148)	38(38)	328	2.17
High cost of organic materials	120(600)	24(96)	2(6)	2(4)	2(2)	708	**4.72***
Long time in preparation	16(80)	30(120)	2(6)	46(92)	56(56)	354	2.36
Long time to effect on the plant	0(0)	16(64)	4(12)	58(116)	72(72)	264	1.76
Long time to effect on the plant	0(0)	12(48)	4(12)	66(132)	68(68)	260	1.73
Lack of Financial Support	8(40)	40(160)	14(42)	56(112)	32(32)	386	2.57
Unavailability of farm input	104(520)	40(160)	2(6)	2(4)	2(2)	692	**4.61***
Cultural beliefs	12(60)	118(472)	4(12)	8(16)	8(8)	568	**3.79***
Environmental factors	4(20)	14(56)	84(252)	24(48)	24(24)	400	2.67
Non-availability of technologies	12(60)	98(392)	24(72)	6(12)	10(10)	546	**3.64***
Fear	60(300)	70(280)	4(12)	14(28)	2(2)	622	**4.15***
Poor knowledge of Subject Matter	2(10)	36(144)	36(108)	42(84)	34(34)	380	2.53
Lack of access to credit facilities	22(110)	118(472)	6(18)	0(0)	4(4)	604	**4.02***
High cost of labour	132(660)	18(72)	0(0)	0(0)	0(0)	732	**4.88***
Procedures difficult to understand	118(590)	14(56)	0(0)	12(24)	6(6)	676	**4.51***
Difficulty in applying technology	10(50)	6(24)	0(0)	76(152)	58(58)	284	1.89
Lack of technical support	16(80)	8(32)	2(4)	70(140)	54(54)	312	2.08

Source: Field Survey, 2023. Figures in Parentheses are the weighted frequencies. SA= Strongly Agree, A= Agree, U= Undecided, D= Disagree, SD= Strongly Disagree. *S= Significant, NS= Non significant. Acceptable mean =3.00

BACK TO CONTENTS

Relationship between selected socio-economic characteristics of the farmers and their level proficiency in the use of organic products to control CMV

The study depicted the results of OLS regression estimates of influence of selected socio-economic characteristics on the level of proficiency of organic control of CMV in Table 5. The study showed that among the four functional forms estimated, the exponential was chosen as the lead equation based on a high R^2 value, number of significant factors and agreement with a priori expectations. The F-value was highly significant at 1% level indicating a regression of best fit. The R^2 value of 0.5501 indicated that 55.01% of the variability in level of proficiency was explained by the independent variables, meaning that the combined effects of all independent variables (namely, age, sex, marital status, educational status, monthly income, working experience, household size, extension contact**,** participation in training and access to organic planting resources) in the model were responsible for 55.01 percent of the variations in the use of digital tools. Four factors (namely, educational status (2.08), extension contact (4.39), participation in training on organic standard (5.45) and access to organic planting resources (2.32) were statistically significant in effecting farmers' proficiency in utilizing organic products to combat cucumber mosaic virus disease in okra. This implies that okra farmers who are more educated, have regular contact with extension agents, participate in trainings on organic standards and have access to organic planting are more likely to have higher proficiency in utilizing organic products to combat cucumber mosaic virus disease.

These findings are similar with earlier research conducted by Ucha et al. (2018), highlighting the importance of improving farmers' educational attainment through formal and informal educational programs to enhance okra production and CMV control. Uche et al. (2018) in agreement also reported that extension services guide farmers on how to enhance capacity in organic farming operations and their quality of life by effectively using natural resources, which overlaps with the principles of organic farming.

Table 5: OLS Regression Estimates of influence of selected socio-economic characteristics on the level of proficiency of organic control of CMV

Variables	P	Linear	Exponential +	Double Log	Semi-Log
Constant	B0	4.0218	1.6348	1.5759	2.6191
		(1.46)	(7.06)***	(4.51)***	(0.63)
Age	X1	-0.0323	-0.0017	-0.3391	-0.3634
		(-1.07)	(-0.68)	(-0.54)	(1.99)*
Education status	X2	0.5029	**0.0559**	0.0650	-0.2431
		(1.58)	**(2.08)***	(2.41)*	(-0.44)
Farming experience	X3	-0.0009	-0.0039	-0.0409	-0.2431
		(-0.01)	(-0.51)	(-0.88)	(-0.44)
Farm size	X4	0.0703	0.0087	0.009	0.0653
		(0.43)	(0.63)	(0.55)	(0.35)
Sex	X5	0.0120	0.0042	0.0271	0.2666
		(0.02)	(0.07)	(0.46)	(0.39)
Access to land	X6	0.5223	0.0424	0.0585	0.6871
		(0.74)	(0.71)	(0.96)	(0.95)
Membership of cooperation	X7	-0.4279	-0.0287	0.0400	0.4222
		(-0.36)	(-0.29)	(0.39)	(0.35)
Extension contact	X8	0.3086	**0.0289**	0.2289	2.4006
		(3.94)***	**(4.39)*** **	(3.74)***	(3.31)**
Participated in trainings on organic agric. standards	X9	4.1600	**0.3817**	0.3844	4.2003
		(5.00)***	**(5.45)*** **	(5.38)***	(4.96)***
Access to organic planting resources	X_{10}	2.1965	**0.1788**	-0.1976	-2.4560
		(1.94)*	**(2.48)***	(-1.61)	(-1.69)*
Access to improved seed varieties	X_{11}	3.8869	**0.2983**	0.2638	3.6864
		(2.54)*	**(2.320)***	(1.97)*	(2.32)*
F-cal		8.63	10.19	9.14	7.71
R-squared		0.5093	0.5501	0.5233	0.4822
Adj R-squared		0.4618	0.5059	0.4770	0.4326

Source: field survey, 2023. Figures in parenthesis are t-values. *, ** and *** are significant at 10%, 5% and 1% level of probability respectively. + lead equation

CONCLUSION AND RECOMMENDATIONS

Enhancing farmers' proficiency is the key in maximizing the benefits of utilization of organic products to control CMV in the context of okra farming. These findings emphasized the need to recognize and address key socio-economic variables affecting the use of organic products to control CMV among

farmers as this could positively impact effective utilization. Promoting collaboration between researchers, extension agents, and farmers can facilitate the adoption of regenerative agriculture and nature-based agri-production practices, ultimately leading to improved yields and livelihoods in the agricultural sector. Recommendations are: Strengthening the extension services**,** organic Training and enhancing access to farm resources and organic inputs.

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Expository Analysis of Utilization of Improved (Taro) Cocoyam Production Technologies Among Farmers in Abia State, Nigeria

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ABSTRACT
Cocoyam is one of the major subsistent crops that plays an important role in the lives of many Nigerians as a food security crops and it has become an important component of rural development because of cocoyam rebirth programme embraced upon by NRCRI. This study examined utilization of improved cocoyam production technologies among farmers in Abia State, Nigeria. Specifically the study ascertained cocoyam technologies that had been transferred to farmers; identified source (s) of information on cocoyam production technologies to farmers; assessed the level of utilization of cocoyam production technologies by farmers in the study area; and ascertained the socio-economic factors that significantly influence utilization of improved technologies on cocoyam production in Abia State, Nigeria. Multi-stage random sampling technique was used to select 90 taro (cocoyam) farmer. Objectives were achieved using simple descriptive statistics and O L S multiple regression the model. The results shows that the main technology transfer were 25g set of cocoyam (80%), Time of planting (May -June) (68.89%), Crop mixture (Arable Cropping) (64.44%), use of manure (56.67%) and weed control (56.67%). NRCRI (70%), Market place (65.56%), Health center (52.22%) and radio (52.22%) were the dominant sources of information for taro (cocoyam) farming technology in the area. Result on level of utilization of cocoyam farming technologies revealed that 25g set of taro (cocoyam) ($\bar{X}$= 2.878), use of mulching materials has mean of ($\bar{X}$= 2.822); Time of planting (May -June) ($\bar{X}$= 2.8) and spacing adopted (100cm × 50cm) " ($\bar{X}$=2.6) have high level of level of utilization of cocoyam storage techniques by farmers in the study area. OLS estimate on socio-economic factors influencing utilization of improved cocoyam technology Shows that positive relationship exists between education attainment, farmer experience, household size and labour while there is an inverse relationship between Farm sizes of the farmers. The study therefore recommended that an awareness creation in the use of the various technologies by extension would be a necessary step towards increased cultivation and production of cocoyam.

Keywords: Utilization, improved cocoyam, Production technologies, farmers, Abia State,

INTRODUCTION
Agriculture is the mainstay of the economy of most countries in the region hence it contributes substantially to export earnings and employs majority of total labour force (FAO, 2021). Within the sector, crop production (e.g Taro) remained the fastest growing subsector at 3.64% followed by forestry, livestock and fishery which grew by 3.31%, 1.61% and 1.34% respectively. Agriculture is the dominant sector in the economy of Nigeria which plays a major role in the economy and it contributes about 21.91 percent to Nigeria's GDP (FAOSTAT, 2021). The agricultural sector has been performing very noteworthy roles in providing food and income to majority of people in the

rural areas of Sub-Saharan Africa, including Nigeria. The sector in recent years has contributed significantly to improved economic growth performance in Nigeria (Anyiam *et al*., 2023).

One of such crop that has improved the economic growth performance in Nigeria is Taro (Cocoyam). Taro (Cocoyam) is grown in the tropical regions of the world especially in Africa, where it is cultivated for food (Food and Agricultural Organization, (FAO), 2015). The food crop which is mainly grown in the rural communities across Africa by subsistent farmers is highly valued among other tuber and root crops consumed among different households, the high cost of production is mainly due to the high labour requirement during cultivation amid the use of indigenous planting materials, application of total weed controls as well as limited value addition have led to a general decline of the cocoyam subsector (Boakye-Achampong, *et al*. 2017).

Colocasia originated in South East Asia and was introduced to Africa through Egypt and has been known for over 2,500 years. It then spread across the east coast of Africa and across the continent to West Africa (Otekunrin *et al*, 2021). *Xanthosoma* originated in tropical America and was introduced to West Africa by Indian missionaries (Anyiam *et al*., 2023). Taro (Cocoyam) as a tuber crop is intensively cultivated and consumed by resource poor families in South Eastern and South Southern parts of Nigeria (Shiyam; Obiefuna; Ofoh; Okoh and Uko, 2015), the leaves are often used as wraps for foods in some parts of African and Asia; the crop most times is grown as ornamentals (Mikami and Tsutsui, 2019). Cocoyam leaves are nutritious spinach-like vegetable which gives a lot of minerals, vitamins (A and C), and thiamine (Sharma *et al*., 2020). There are two main species commonly cultivated in Nigeria the species are *Xanthosoma* called Tannia and *colocasia* called Taro (Otekunrin, *et al*., 2021).

According to Olatunji and Nwakor, (2015) there were at least 16 categories of root and tuber crops technologies that the NRCRI had developed. Some of these include, improved cassava varieties, improved sweet potato varieties, improved yam varieties, value addition, and improved taro (cocoyam) production. Taro (Cocoyam) (colocasia sp. and xanthosoma sp.) is an important food security crop grown mostly by women in the South-Eastern, South Southern and South-Western Nigeria (Ikwelle Bauchi, Madukwe and Onwubiya, 2003). The National Root Crops Research Institute (NRCRI), Umudike had promoted colocasia and Xanthosoma varieties of Taro (cocoyam) with the following cultivars or species: *cocoindia* (NCe 001), *edge ofe* green (NCe 002), *ede ofe* purple (NCe 003), *ede giant* (NCe 004) *ede upong* (NCe 005), *ede ghana* (NCe 006), *ede ocha* (NXS 001), *ede Uhie* (NXS 002) and *ede okorokoro* (NXS 003) (Olatunji and Nwakor, 2015). It was expected that these technologies would be transferred from the research station to the end users that is, the farmers) via the extension service. The goal of achieving agricultural transformation would be a mirage if developed technologies remain in the research stations. One way of achieving the goal of food security is to have an effective, well-conceived, well-planned and well-executed system of technology transfer. In order to have expected impact on national development, improved technologies must be made available to those in the production systems (That is, the farmers). Transfer of technology is usually the responsibility of the agricultural extension service (Olatunji et al., 2015).

Based on this the National Root Crop Research Institute (NRCRI) Umudike which had the national mandate to research into root and tuber crops developed some processing technologies to reduce the perishability of the products and add value to these crops. The essence is to ensure that these crops can be put to wider uses in the home, for income generation and probably for export purposes. To this effect, groups and individuals all over Nigeria appreciated this development and requested to be trained in those technologies.

Cocoyam (*Xanthosoma sagittifolium)* is among the world's six most important root and tuber crops (FAO, 2012). It is pantropical and has been domesticated in most communities in Oceania, Africa, and Asia and providing sustenance for over 400 million people (Anyiam et al., 2023). Africa is the major producer with West and Central Africa, notably, Nigeria, Ghana, and Cameroon contributing to over 60% of the total African production. Thus, the importance of cocoyam to regional food security cannot be overstated, In spite of its high productivity, levels and better storability compared to other tropical root and tuber crops, *Xanthosoma sagittifolium* has been marginalized in agricultural policies and research interventions on root and tuber crops. It remains an underexploited food resource, with a reported decline of production levels (Onyeka, 2014).The challenge of underutilization is exacerbated by the existing confusion in improved technology on

cocoyam production which limits researchers in exploiting data from one area of indigene to another (Anyiam et al., 2023).

Combination of factors like farmers' socio-economic and socio-cultural characteristics were observed to exert influence on different ways of technology utilization (Onyeka, 2021). Risks involved in technologies were considered to determine farmers' opinion to use them or not. It is therefore, of opinion that those technologies which have risk characteristics when compared to their traditional alternative or practices were utilized faster than technologies with low relative risk (Nwaobiala et al., 2014). Information and innovation which are intended to improve agricultural production should be disseminated to farmers (male and female) and ultimately meet their need. However, variations exist on relevant production technologies needed by farmers; lack of adequate access to extension service, low knowledge and skills in performing various farm operations have been impediments to increased agricultural production (). Farmers have been by and large rejected by existing extension system, receiving about 5-7% of extension service due to their limited control over assets and decision making that are evident in agricultural institutions).

Technology adoption by farmers is an essential pre-requisite for the economic prosperity in Nigeria (Otekunrin *et al*., 2021). However, in recent years, individual farmers have started to adopt and use the improved technologies including machineries and planting of improved seed varieties. However, many farmers show different attitudes towards the adoption of these agricultural technologies and this has greatly affected the availability of food in the economy. To further corroborate many other research, this study will specifically;

i. ascertain Taro (cocoyam) technologies that had been transferred to farmers in Abia State.
ii. identify source (s) of information on cocoyam production technologies to farmers;
iii. assess the level of utilization of taro (cocoyam) production technologies by farmers in the study area; and
iv. ascertain the socio-economic factors that significantly influence utilization of improved technologies on taro (cocoyam) production in Abia State, Nigeria.

METHODOLOGY

The study was carried out in Abia State. Abia State is one of the 36 states of Nigeria and lies in the south eastern of Nigeria with Ariaria international market, Aba as its capital and largest city. Aba is a city and in the southeast of Nigeria and the main trading center in Abia State. Upon the creation of Abia state in 1991, Aba was divided into two local government's areas namely; Aba south and Aba North. Aba south is the main city center and the heartbeat of Abia State, south-east Nigeria. It is located on the Aba River. Aba is made up many villages such as; Umuokpoji Aba, Eziukwu-Aba, Obuda-Aba, Aba Ukwu and other villages from Ohazu merged due to administrative convenience. Aba was established by the Ngwa clan of Igbo People of Nigeria as a market town and then later a military post was placed there by the British colonial administration in 1901. It lies along the west bank of the Aba River, and is at the intersection of roads leading to Port Harcourt, Owerri, Umuahia, Ikot Ekpene, and Ikot Abasi. The city became a collecting point for agricultural products following the British made railway running through it to Port Harcourt. Aba is a major urban settlement and commercial center in a region that is surrounded by small villages and towns. Multi-stage random sampling technique was used to select 90 taro cocoyam farmer, used as respondent for the study. Data for this study were collected from primary sources. Objectives i, ii and iii were achieved using simple descriptive statistics while **iv** was tested using the O L S multiple regression the model

Model Specification

O L S multiple regression the model for socio-economic factors that significantly influence utilization of improved technologies on cocoyam production in Abia State, Nigeria is implicitly specified as:

$$Y = f\,(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, e) \quad (1)$$

Where;

Y = utilization of improved technology on cocoyam (Number of improved technologies utilized)
X_1 = Sex (male 1, female 0)
X_2 = Age of the farmers (years)
X_3 = Education attainment (number of years in school)
X_4 = Farmer experience (number of years)

X_5 = Household size (number of persons)
X_6 = Access to credit (₦)
X_7 = Extension contact (number of visitations)
X_8 = Farm size (hectare)
X_9 = Labour (man days)
e = error term

RESULTS AND DISCUSSION

Table 1: Farmers' awareness of cocoyam farming technologies

Cocoyam Farming Technologies	*Frequency	Percentage
25g sett of Taro (cocoyam)	72	80.00
Time of planting (May -June)	62	68.89
Spacing adopted (100cm × 50cm)	44	48.89
Use of mulching materials	25	27.78
Fertilizer (NPK 20:10:10)	36	40.00
Planting depth (10 cm)	17	18.89
Pest control	10	11.11
Weed control	51	56.67
Crop mixture (Tree Cropping)	11	12.22
Crop mixture (Arable Cropping)	58	64.44
Use of manure	51	56.67
Side dressing application	13	14.44
Harvesting (8-12 months)	32	35.56

Source: Field survey; 2024. *multiple responses recorded

Table 1 shows that the main technology transfer were 25g sett of Taro (cocoyam) (80%), Time of planting (May -June) (68.89%), Crop mixture (Arable Cropping) (64.44%), use of manure (56.67%) and weed control (56.67%) as they were ranked 1st, 2nd, 3rd, 4th and 5th respectively. Efforts are needed to effectively disseminate the remaining two technologies whose transfer was found to be at low. It has been shown that an effective system of technology transfer is capable of bringing about sharp increases in agricultural productivity (Nzeakor *et al*., 2020).

Furthermore 11 out of the 13 technologies on cocoyam production (representing 84.62%) were transferred to farmers in the study area. It is commendable that much of the cocoyam technologies has been transferred to farmers in Abia State. This may be an indication that the Research/ Extension/Farmer/Input Agencies linkage was effective in the State. Agricultural Extension has been described as the kingpin in the process of technology generation, technology transfer and technology utilization (Okezie *et al*., 2021).

Table 2: Sources of information on cocoyam farming technologies

Source	Frequency*	Percentage
Radio	47	52.22
Television	25	27.78
Newspaper / magazines	17	18.89
Health centre	47	52.22
Spouses	30	33.33
Friends	29	32.22
Market place	59	65.56
NRCRI	63	70.00

Source: Field survey (2024). Multiple responses recorded

A critical look at the result in Table 2 shows that NRCRI (70%), Market place (65.56%), Health centre (52.22%) and radio (52.22%) were the dominant sources of information for cocoyam farming technology in the area. Giving farmers access to a variety of information sources, which are accessible, affordable, relevant and reliable is the ultimate aim of providing agricultural (Aphunu and Agwu, 2014). Interpersonal communication is more robust with built-in feedback mechanism. It is however instructive to note that the farmers never indicated any of the electronic media (Radio, Television Internet) as sources of information. Findings also corroborate this fact that the internet and library are still an elitist communication media for most people. The implication of this is that stakeholders in the provision of agricultural information need to do more in the a real of information delivery and dissemination to cocoyam farmers.

Table 3: Level of Utilization of Cocoyam Farming Technologies

Technologies	Always	Sometimes	Never	Mean	Std. Dev.	Remark
25g sett of cocoyam	81	7	2	2.878	0.4786	Accepted
Time of planting (May -June)	75	12	3	2.800	0.3691	Accepted
Spacing adopted(100cm × 50cm)	58	28	4	2.600	0.3250	Accepted
Use of mulching materials	76	12	2	2.822	0.1763	Accepted
Fertilizer (NPK 20:10:10)	31	50	9	2.244	0.6237	Accepted
Planting depth (10 cm)	33	53	4	2.322	0.5574	Accepted
Pest control	18	61	11	2.078	0.5654	Accepted
Weed control	50	36	4	2.511	0.5853	Accepted
Crop mixture (Tree Cropping)	4	3	83	1.122	0.2881	Rejected
Crop mixture (Arable Cropping)	28	45	17	2.122	0.7004	Accepted
Use of manure	22	49	19	2.033	0.6779	Accepted
Side dressing application	5	12	73	1.244	0.5469	Rejected
Harvesting (8-12 months)	33	39	18	2.167	0.7382	Accepted
Grand mean				**2.226**		

Source: Field Survey, 2024. Decision mean ≥ 2.0

From the result eleven (11) of the variables in the table were accepted by the mean range used for decision which is 2.0 and above. 25g sett of cocoyam has on the average the highest mean ($\bar{X}$= 2.878) i.e. the farmers indicated strong agreement to the statement; this was followed by "Use of mulching materials has mean of ($\bar{X}$= 2.822); this was followed by "Time of planting (May -June)" has mean of ($\bar{X}$= 2.8); this was followed by "Spacing adopted (100cm × 50cm) " ($\bar{X}$=2.6). Others are shown on the table. Also from the table two items were rejected since is less than 2.0, which were Crop mixture (Tree Cropping) and Side dressing application. Furthermore, the clustered mean was 2.226 which was accepted, this therefore implies that there is high level of level of utilization of cocoyam storage techniques by farmers in the study area.

Table 4 shows the results of ordinary least square regression (OLS) the model (linear, exponential, semi-log and double-log) were tried. The choice of appropriate functional form for this study was made based on the economic, statistical and econometric criteria. Based on the criteria stated above the linear functional form was chosen as the lead equation. From the linear functional form result, R^2 value of 0.724 implies that the specified explanatory variables explained about 96.6% of the total variables in profit. The F-statistic of 28.333 which is statistically significant at 1% probability level, indicate that the equation has goodness of fit.

The five out of nine variables significantly influenced the level of utilization of cocoyam farming technologies. The Table shows that positive relationship exists between education attainment, farmer experience, household size and labour. This implies that as more of these variables are employed, there will be an increase in level of utilization of cocoyam farming technologies. The result also shows that there is an inverse relationship between Farm size of the farmers.

Education and farmers experience were positive and significantly influence level of utilization of cocoyam farming technologies at 5% and 1% level respectively. This showed that an increase in one year of education and years spent in farming increase the level of utilization some particular technologies for cocoyam farmers in the study area. The implication of this result is that more years of formal education and stay in farming will help cocoyam farmers to increase their literacy level and this is an asset as the farmers would be exposed to many information sources, embrace innovations such as improve farming technologies. This corroborate with conformity with a- priori expectation that the level of education of the farmers enhances their knowledge, technical and managerial efficiency and the findings of Okute (2017) where he reported that the educational level of farmers is expected to increase level utilization.

The coefficient of household size was positive and significant at 5%. This implies that increase in the household size will lead to increase in level of utilization of cocoyam farming technologies. This connect with finding of Nzeakor *et al*., (2021) where they obtained a positive relationship between household size and level of utilization of new innovation.

Table 4: Socio-economic factors influencing utilization of improved cocoyam technology

Variables	+Linear	Exponential	Semi log	Double log
Intercept	110083.6	5.599027	-19095.61	-1.925356
	(1.55)	(11.37)***	(-0.11)	(-8.41)**
Sex	0.0454642	3.28e-07	31092.77	0.0598499
	(1.10)	(1.14)	(5.20)***	(7.35)***
Age of the farmers	6805.75	0.5813647	1.247883	2.87e-06
	(1.43)	(17.55)	(1.58)	(2.67)***
Education attainment	0.097208	3.28e-07	42739.53	0.8308869
	(2.52)**	(1.23)	(1.58)	(22.56)***
Farmer experience	0.2402157	5.22e-06	49136.12	0.0954723
	(4.55)***	(14.23)***	(1.92)**	(2.74)***
Household size	0.4003172	3.02e-06	-2373.839	-0.0151381
	(2.65)***	(2.87)***	(-0.30)	(-1.38)
Farm size	-0.0898305	3.38e-07	-45090.88	-0.0202486
	(-3.01)***	(1.63)***	(-4.62)***	(-1.52)
Labour	90644.12	0.1732413	463944.8	0.9494328
	(72.76)***	(20.01)***	(44.60)***	(66.99)***
Access to credit	2568.89	0.031459	34058.04	0.0140612
	(0.91)	(1.60)*	(3.49)***	(1.06)
Extension contact	0.1027072	7.18e-07	9609.037	0.0149972
	(0.74)	(0.75)	(1.07)	(1.23)
R^2	0.724	0.612	0.711	0.691
R^{-2}	0.698	0.576	0.683	0.661
F-ratio	28.333***	17.015***	25.083***	22.808***

Source: field survey (2024) + lead equation, *** Significant at 1%, ** Significant at 5%,*significant at 10%.

The coefficient of labour was positive and statistically significant at 1% level. This implies that an increase in number of workers in the farm, increases the level of utilization of cocoyam farming technologies. The plausible reason may be that more workers in the farm is significant enough to carry out major operation in the farm and enhance farmers' confidence in the level of utilization of cocoyam farming technologies hence as labour increases the probability of level of utilization of cocoyam farming technologies increase.

Furthermore, the coefficient of farm size was significant 1% and negatively related. This implies that increase in the farm size will lead to decrease in level of utilization of cocoyam farming technologies in the area.

CONCLUSION AND RECOMMENDATIONS

Based on this finding it can be concluded that there is high level of utilization of cocoyam production technology in Abia State, Nigeria which is attributed to opulence of technical information on improved cocoyam production technology in the area among the cocoyam farmers studied. Also education attainment, farmer experience, household size, labour and farm size of the farmers has significant influence on level of utilization of cocoyam production technology by farmers in the study area.

The study makes the following recommendations:

i. Awareness creation in the use of the various technologies by extension would be a necessary step towards increased cultivation and production of cocoyam.
ii. The study also revealed that education and farming experience were positive. The result therefore calls for policies aimed at provision of free education ~~esp~~ecially to the girl – child and encourage those who are experience to study the production and increase utilization of cocoyam technologies.
iii. The Agricultural Extension Service should invigorate efforts at transferring the two cocoyam technologies which the study noted had not been effectively transferred to the end-users (farmers)

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Involvement of Women in Cocoa Post-Harvest Activities in Umuahia Agricultural Zone, Abia State, Nigeria

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ABSTRACT
This study investigated Involvement of Women in cocoa post-harvest activities in Umuahia Agricultural Zone, Abia State, Nigeria. A multi-staged sampling technique was employed in the sampling of 80 plantain processors that took part in the survey. A set of questionnaires was used to get responses from the women. Both descriptive and inferential statistics were used to analyze the data. Findings from the study showed that the mean age of the women was 44 years with a mean household size of 5 persons and mean years of experience in cocoa post-harvest activity was 9 years. Furthermore, the women are mainly involved in Marketing (100.00%), Gathering of pods (98.75%), Breaking of pods (97.5%), Drying (97.5%), Storage (95.00%) and fermentation of beans (91.25) with a grand mean of 2.88 indicating a high level of involvement in cocoa post-harvest activities. The Regression analysis indicated that significant relationship exists between the socio-economic characteristics of the women and their level of involvement in cocoa post-harvest activities. The study concluded that there's high level of involvement of the women in cocoa postharvest activities in the study area and therefore recommended that Government and other donor agencies should assist the young women to access credit facilities from financial institutions to enable them expand their cocoa farming enterprise, earn more income and ensure food security for their households.
Keywords: Women farmers, Cocoa, Post-harvest, Involvement)

INTRODUCTION
Cocoa (*Theobroma Cacoa*) is largely produced in Nigeria and Nigeria is the fourth leading exporter of cocoa in the world, after Cote d'Ivoire, Indonesia and Ghana. The four major West African cocoa producers, the Ivory Coast, Ghana, Nigeria and Cameroon, together account for about two-thirds of world cocoa production. Nigeria is the fourth producer of cocoa in Africa after Cote d'Ivoire, Ghana and Cameroon. Cocoa export is the main agricultural export in Nigeria accounting for only 0.3% of the agricultural GDP (World Cocoa Conference, 2019).

According to Ukoha, and Agu-Aguiyi (2016), cocoa is produced in fourteen States of Nigeria with a total planted area of 640, 000 hectares. These are Abia, Adamawa, Akwa Ibom, Cross River, Delta, Edo, Ekiti, Kogi, Kwara, Ogun, Ondo, Osun, Oyo and Taraba States where over 200,000 rural households in the 14 states depend on cocoa mainly for their cash income.

Mbeine (2019) added that post-harvest management refers to how agricultural commodities and products are handled systematically after harvesting. Post-harvest process begins immediately after a cocoa is taken from the field and ends with its consumption. Post-harvest operations include washing and cleaning, fermentation, drying, storage, grading, packaging, transportation, processing, and marketing.

Abia state is a home of cocoa, and has over 80, 000 hectares of its land under cultivation of cocoa with current annual production exceeding 25, 000 metric tonnes. The major cocoa producing Local Government Areas are Ikwuano, Bende and Umuahia North (Ukoha, and Agu-Aguiyi, 2016).

Post-harvest procedures in cocoa farming are indispensable and important because of the attendant benefits. Post-harvest activities in cocoa farming helps to extend shelf and storage life of cocoa, improves taste and appearance and protects commodities from animals and pests (Oluyole et al, 2020). Adetunji et al (2019) noted that cocoa post-harvest activities can contribute to food security mainly through the reduction of losses and waste.

Olowolaju (2014) noted that women are mainly involved in gathering of pods, breaking of the pod, fermentation, drying among other things involved in postharvest activities. However, the activities of these women are well under-reported in literature and little or no work has been done in this area especially in the study area to ascertain the significant relationship between the socio-economic characteristics of these women and the level in which they are involved in the cocoa post-harvest activities. Most often the male folks are very much projected more than the females, not only in cocoa production but also in postharvest activities.

Hence, for proper documentation, planning and implementation of women empowerment programmes by Government and other Development agencies, this study tends to provide empirical data on the various cocoa post-harvest activities the women get involved in and their level of involvement in those activities to boost household income and ensure food security in the study area.

Objectives of the study
Specifically, the study:

i. described the socio-economic characteristics of the women in the study area;
ii. ascertain cocoa post-harvest activities the women are involved in; and
iii. determine the level of involvement of women in cocoa post-harvest activities in the study area

Hypothesis
HO: There is no significant relationship between the socio-economic characteristics of the women and their level of involvement in cocoa post-harvest activities

METHODOLOGY

Study Area

The study was carried out in Umuahia Agricultural Zone, Abia State, Nigeria. Umuahia is the capital of Abia state located in the South East geo-political zone of Nigeria. The choice of the study area is informed by the notable position of the area in cocoa production. Umuahia is situated within the geographical locations of latitudes $5^{0}\,6^{1}$N - $5^{0}\,24_{1}$N of the equator and longitudes $7^{0}\,18^{1}$ E – $7^{0}\,54^{1}$ E of the Greenwich.

The Zone comprises of five Local Government Areas (LGAs) namely: Umuahia North, Umuahia South, Ikwuano, Isiala Ngwa North and Isiala Ngwa South has a population of 426,803 with a land mass of 423462 square kilometer. Major crops produce in Umuahia Agricultural Zone includes Cocoa, maize, yam, plantain, rice, vegetable, melon, beans etc.

Population of the Study

The population for the study consisted of all women cocoa farmers in Umuahia Agricultural Zone, Abia State, Nigeria.

Sample and Sampling Procedure

Multi-Stage sampling technique was used in selecting the sample size. In the first stage, two Local Government Areas (LGAs) in Umuahia agricultural zone were purposively selected because of their high involvement in cocoa production. The LGAs selected included Umuahia North and Ikwuano LGAs. In the second stage, two autonomous communities from each of the LGAs making a total of four autonomous communities were selected while at the third stage, two villages from each of the communities were selected, bringing it to a total of eight villages. Finally, at the fourth stage, ten

farmers from each village were randomly selected to get a sample size of eighty women for the study.

Method of Data Collection

The study made use of Primary data that were collected with the aid of structured questionnaire. in line with the objectives of the study.

Method of Data Analysis

Objective 1: describe the socio-economic characteristics of the women in the study area
This was realized using frequency distribution, means and percentages.
Objective 2: ascertain cocoa post-harvest activities the women are involved in the study area
This was a Yes/No response question to ascertain the post-harvest activities; it was realized using frequency distribution, means and percentages.
Objective 3: determine the level of involvement of women in cocoa post-harvest activities;
a 4-point Likert type scale of Always, Sometimes, Rarely, and Never was assigned scores of 4, 3, 2 and 1 and was used to analyze objective 3. The mean cut off point was 2.50 that is 4+ 3+ 2 + 1 = (10/2) = 2.50. Any mean response below 2.50 was considered as an activity with low level of involvement of women in cocoa post-harvest activities while above 2.50 was adjudged otherwise.

Test of Hypothesis

The hypothesis which states that there is no significant relationship between the socio- economic characteristics of the women and their level of involvement in cocoa post-harvest activities was tested using multiple regression model. The model is specified explicitly as follows:

Linear function

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + ei \quad (1)$$

Exponential function

$$LnY = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + ei \quad (2)$$

Semi log function

$$Y = Ln\beta_0+\beta_1 logX_1+\beta_2 logX_2+\beta_3 logX_3+\beta_4 logX_4+\beta_5 logX_5+\beta_6 logX_6+\beta_7 logX_7+\beta_8 logX_8 + ei \quad (3)$$

Double Log function

$$LnY=Ln\beta_0+\beta_1 LnX_1+\beta_2 LnX_2+\beta_3 LnX_3+\beta_4 LnX_4+\beta_5 LnX_5+\beta_6 LnX_6+\beta_7 LnX_7+\beta_8 LnX_8 + ei \quad (4)$$

Where;

Y = level of involvement in cocoa post-harvest activities (Mean Scores)
X_1 = Age (Years)
X_2 = Marital status (married = 1, otherwise = 0)
X_3 = Cocoa processing experience
X_4 = Farm Income (naira)
X_5 = Education (years of schooling)
X_6 = Extension contact (Number of times or frequency of visits
X_7 = Cooperative membership (years)
X_8 = Household size
β_0 = Intercept
ei = Error term

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

Result presented in Table 1 showed that the mean age of the women in the study area was approximately 44 years. This implies that majority of the women were in their productive years, where their energies could be harnessed and utilized for cocoa postharvest activities. The findings of this study are in line with that of Ukoha and Nzeakor (2020) that the women involved in agro processing activities in Umuahia were between 41 to 50 years. Age has been described as an important factor that influences the level of involvement in post-harvest activities in agriculture.

About 61.3% of the women were married and their mean household size was 5 persons. This agreed with the findings of Osarenren, Ejuetueyin and Eweka (2016) that most cocoa farmers were married

and could effectively take crucial decisions jointly with their spouses. Large household size may provide most of the labour needed for cocoa production in order to reduce the cost expended in hiring labourers, thereby leading to increased productivity(Kanu, 2020).

Table 1: Distribution of the women according to their socio-economic characteristics (n = 80)

Variables	Frequencies	Percentages	Means
Age			
≤29	5	6.25	
30 – 39	29	36.25	
40 – 49	31	38.75	
50 and above	15	18.75	**43.8**
Level of Education			
No formal education	9	11.25	
Primary education	16	20	
Secondary education	51	63.75	
Tertiary education	4	5	
Marital status			
Divorced	6	7.5	
Single	3	3.8	
Married	49	61.3	
Widowed	13	16.3	
Separated	9	11.3	
Household size			
1 – 3	15	18.75	
4-6	53	66.25	
7-9	9	11.25	
≥ 9	3	3.75	**5**
Years of experience			
1 – 3	28	35	
4- 6	24	30	
7 – 9	23	28.75	
≥ 9	5	6.25	**8.5**
Access to credit			
No	45	56.3	
Yes	35	43.8	
Cooperative societies			
No	62	77.5	
Yes	18	22.5	
Extension Contact			
Once a week	0	0	
Fortnightly	3	3.8	
Bi-monthly	22	27.5	
Monthly	19	23.8	
None at all	36	45.0	

Source: Field Survey, 2023

Furthermore, the mean years of experience of the women was approximately 9 years, less than 45% of the women had access to credit and less than 23% of the women belonged to Cooperative societies. Active participation in Cooperative activities no doubt impact positively on productivity. Nmeregini, Onuekwusi and Ekweanya (2020) opined that membership to cooperative will positively influence the involvement of farmers in agricultural activities.

Also, the findings showed that a greater percentage (63.75%) of the women had secondary education, indicating that there is an appreciable level of education in the study area. The extent of education received by farmers account so much in understanding and adopting recommended practices. This is similar to the findings of Ukoha and Nzeakor (2020) that only 6.67% of women involved in postharvest activities in Umuahia Agricultural Zone, Abia State had no formal education.

For extension contacts, about 55% of the women had contacts with extension in various times. Odoemelam Onuekwusi and Alaocha (2016), observed that extension contact is expected to have a positive influence on farmers' investment decisions on agricultural technologies.

Cocoa post-harvest activities that the women are involved in

Table 2: Distribution of women based on the cocoa post-harvest activities they are involved in (n = 80)

Post-harvest activities	Frequency	Percentage
Gathering of pods	79	98.75
Breaking of pods	78	97.50
Fermentation of cocoa beans	73	91.25
Drying of beans	78	97.50
Cleaning and bagging of beans	70	87.50
Grading	56	70.00
Storage	76	95.00
Transportation of cocoa beans	56	70.00
Marketing of dried beans	80	100.00

Source: Field Survey, 2023. Multiple responses recorded

Findings in Table 2 showed that the post-harvest activities the women are involved in, include: Marketing (100.00%), Gathering of pods (98.75%), Breaking of pods (97.5%), Drying (97.5%), Storage (95.00%), fermentation of beans (91.25), Cleaning and bagging (87.5%), Transportation (70.00%) and Grading (70.00%). This implies that the women were fully involved at every stage of the cocoa post-harvest activities. This corroborates the finding of Osarenren, Ejuetueyin and Eweka (2016) that in cocoa production, the role of the women is often confined to post harvesting handling which include fermentation and drying.

Level of Involvement of Women in Cocoa Post-Harvest Activities

Table 3: Level of involvement of women in cocoa post-harvest activities n = 80

Variables	Always (4)	Sometimes (3)	Rarely (2)	Never (1)	Total	Mean
Gathering of pods	68(272)	1(3)	10(20)	1(1)	296	3.70
Breaking of pods	54(216)	3(9)	21(42)	2(2)	268	3.36
Fermentation	8(32)	54(162)	5(10)	13(13)	217	2.71
Drying	54(216)	16(48)	9(18)	1(1)	283	3.50
Cleaning and bagging	2(8)	44(132)	22(44)	12(12)	196	2.45
Grading	8(32)	16(48)	27(54)	29(29)	163	2.03
Storage	12(48)	48(144)	11(22)	9(9)	223	2.78
Transportation	4(16)	17(51)	15(30)	44(44)	141	1.76
Marketing	60(240)	12(36)	6(12)	2(2)	290	3.62
Grand mean						**2.88**

Source: Field Survey, 2023. Mean Score ≥ 2.50 = High Level of involvement; Mean Score ≤ 2.50 = Low level of involvement

Table 3 showed the level of involvement of women in cocoa post-harvest activities. The areas with high level of involvement are: gathering of pods ($\bar{x}$=3.70), marketing ($\bar{x}$=3.62), drying ($\bar{x}$=3.50), breaking of pods ($\bar{x}$=3.36), storage ($\bar{x}$=2.78) and fermentation ($\bar{x}$=2.71) while cleaning and bagging ($\bar{x}$=2.45), grading ($\bar{x}$=2.03), transportation ($\bar{x}$=1.76) have mean scores lower than the bench mark mean of 2.50. This could be as a result of some of the activities being more strenuous and more time consuming for the women to fully carry out. Also, possession of the resources and the necessary equipment involved could be other contributory factors. The overall result from the Table showed that the grand mean score ($\bar{x}$ = 2.88) was above the benchmark mean indicating high level of the women's involvement in cocoa post-harvest activities.

The four functional forms of the multiple regression model were tried and the exponential model was selected as the lead equation due to the significant F-value of 17.71 at P<0.05 which shows the overall significance of the regression line and a high R^2 value of 0.72 which implies that 72% of the total variation in the dependent variable was accounted for by the explanatory variables.

The coefficient of age (-4.16)*** was significant at 1% and negatively related to level of involvement of women in cocoa post-harvest activities. This implies that the higher the age, the lower the level of involvement of women in coco post-harvest activities. This finding agrees with that of Ukoha and Nzeakor (2020) that young age provides women farmers with energies which could be harnessed and utilized for productive ventures in post-harvest activities.

Table 4: Regression Estimates of the relationship between the Socio- Economic Characteristics of the Women and their Level of Involvement in Cocoa Post-Harvest activities

Variable	Linear	Exponential+	Cob Douglass	Semi Log
(Constant)	3.033(15.17)	1.131(21.49)	1.151(8.06)	3.118(5.77)
Age	0.013(4.09)***	-0.003(4.16)***	0.097(2.22)**	-0.362(2.19)**
Marital status	0.017(1.37)	0.004(1.38)	-0.002(-0.43)	-0.006(-0.43)
Level of education	0.016(0.87)	0.4(0.83)	-0.008(-1.30)	-0.030(-1.27)
Family size	-0.045(-1.56)	-0.012(-1.627)	-0.107(-3.18)***	-0.398(-3.14)***
Years in processing of cocoa	-0.029(-2.33)**	0.8(2.31)**	-0.036(-2.18)**	-0.136(-2.12)**
Credit access	0.065(2.08)**	0.118(2.150)**	0.023(2.26)**	-0.086(2.22)**
Farmers' cooperative	-0.021(-0.46)	0.006(0.48)	-0.032(-2.35)**	-0.119(-2.33)**
Extension contact	0.022(1.00)	0.006(0.98)	0.024(3.79)***	0.090(3.81)***
R^2	0.71	0.72	0.54	0.54
R^2 Adjusted	0.67	0.67	0.48	0.48
F- Value	17.32	17.71	9.37	9.24

Source: Computed from Field survey, 2023. Key: ** and *** is significant at 5% and 1% level of probability respectively. + = Lead Equation and the values in bracket are the t-values.

The coefficient of farming experience (2.31)** was significant at 5% and positively related to level of involvement of women in cocoa post-harvest activities. This implies that the higher the years of experience, the higher the involvement of women in cocoa post-harvest activities. According to Ogunsola, Oseni and Bankole (2020), the farming experience of cocoa farmers is expected to have a positive impact on their production level.

The coefficient of access to credit (2.15)**was significant at 5% and positively related to level of involvement of women in cocoa post-harvest activities. This implies that women with high level of access to credit will have high level of involvement in cocoa post-harvest activities. Access to credit can increase farmers' liquidity which may encourage them to invest more in cocoa postharvest activities.

CONCLUSION AND RECOMMENDATIONS

Women's involvement in cocoa post-harvest activities can contribute to household income and food security in the society. The post-harvest activities the women are involved in, in the study area included: gathering of pods, breaking of pods, fermentation, drying, cleaning and bagging, grading, storage, transportation and marketing of beans. The study concluded that the women are highly involved in cocoa post-harvest activities in the study area.

Therefore, the study recommends that non-governmental organizations and other Donor Agencies in collaboration with the Government should assist the young women access credit facilities from financial institutions to enable them expand their cocoa farming enterprise, earn more income and ensure food security for their households.

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Food Security Status and Economic Efficiency of Noiler Producing Households in Abia State, Nigeria

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ABSTRACT
The food security and nutritional status of the most vulnerable population groups is likely to deteriorate further due to the health and socio-economic impacts of the COVID-19 pandemic WHO (2021). It further estimated that between 720 and 811 million people went hungry in 2020. A multistage random sampling technique was adopted in selecting 120 respondents. A well-structured questionnaire was used to collect information from the respondents. The economic efficiency of the respondents was analysed using Tobit regression model Data Envelopment Analysis and the food security status was analysed using food security index. The result of data analysis revealed that extension visits, stock size and feed were the significant factors influencing the economic efficiency of the Noiler households. Forty-one of the Noiler farmers recorded economic efficiency of between 70-100% and are said to be economic efficiency. The study area could be regarded as food insecure given the fact that majority of the rural households (63.3%) were food insecure while 36.7% were food secure. There is need to develop agricultural extension services and the inclusion of more farmers under such training programs to enhance efficiency and production level of the farmers also, government should monitor and support feed mills that can produce feeds of the required quality for the industry and at reduced cost.

INTRODUCTION
Food security has always been a major problem and a global challenge. The food security and nutritional status of the most vulnerable population groups is likely to deteriorate further due to the health and socio-economic impacts of the COVID-19 pandemic WHO (2021). The Food and Agriculture Organization (FAO, 2004) defined food security as "food that is always available for everyone to eat, supported by the fact that they have access to it; and that it is nutritionally adequate in quantity, quality and variety, that must be accepted in culture. On the other hand, food insecurity is the lack of food security that results from the lack of those situations at different levels, for example, at the domestic, regional and national levels to a stage called "hunger". Globally, due to the lack of food security, the number of malnourished people has increased worldwide (FAO, 2010). Increasing the food security and income levels of farmers is possible by increasing the efficiency and productivity of agricultural enterprises (Ogundari, 2014).

The effort to eradicate hunger, food insecurity, and other forms of malnutrition has been the topic of many studies Xie et al., (2021). Nevertheless, despite recent advances in these areas, many nations, particularly in developing countries like Sub-Saharan Africa, still face significant food insecurity challenges Cheteni, Khamfula, and Mah (2020).

United Nations agencies have documented rising levels of severe hunger in the world, affecting 820 million people. More than two billion people suffer "moderate or severe" food insecurity. During the

same period, the world is experiencing what Reuters called a "global grains glut," with surplus agricultural commodities piled up outside grain silos rotting for want of buyers, Wise (2019).

The United Nations (2005) estimates more than 100 million children fewer than 5 are malnourished and underweight, with about 98 percent of these estimates living in developing countries, including Nigeria. Especially in Nigeria, with a population of over 160 million, over 70 percent of the population is malnourished and suffers from poverty (Murdock, 2012).

Although food security is a problem, Gavrilova (2020) opined that the biggest challenges in providing food to the Nigerian population are not only food shortages but also unbalanced diets that lead to many health problems.

According to the International Crisis Group (2017; 2018), adding products of animal origin to the diet would help compensate for the lack of animal proteins and balance the protein and energy balance, the violation of which leads to an decrease in immunity and the development of anemia and other diseases in children. The poultry subsector is the fastest source of meat and its production method is the least dangerous and complex compared to other livestock enterprises. Increasing poultry production is therefore one of the surest and fastest ways to close the gap in animal protein consumption between developing countries and developed countries in the world Haruna *et.al*. (2002).

According to Ayoola (2015) protein deficiency is reflected in the number of eggs Nigerians consume every year. He emphasized that Nigerians consume 70 eggs per person per year while developed countries like China have 370 eggs per person per year. Bridging this gap in protein consumption seems insurmountable given the current financial and technological limitations of our livestock industry. Zuberu et al. (2015) reported that poultry meat production as one of the most important sub-sectors of agriculture is an important supplier of zoologically valuable proteins, lipids and vitamins.

Despite the fact that Nigeria's agricultural sector employs over 60 percent of Nigeria's agricultural workforce (IFAD, 2014); the country has not met the recently set Millennium Development Goal (MDG) of reducing hunger in the country by 50 percent. The proportion of underweight children under the age of five only decreased from 35.7% in 1990 to 25.5% in 2014, which is 7.6% below the Millennium Development Goal of 17.85% (Nigeria Millennium Development Goal End Point Report, 2015). Figures from the 2016 Central Bank of Nigeria (CBN) Statistical Bulletin showed that the share of agriculture in Nigeria's Gross Domestic Product (GDP) has steadily declined from 37.5 percent in 2002 to 21.2 percent in 2016.

Economic efficiency means choosing the best combination for a given level of output, which is determined by both output and input prices. Oparinde and Daramola, (2014), reported that a number of factors affect the extent of farmers' market participation such as farmer's age, poor delivery route, lack of market knowledge, quantity, membership in farmers' union, failure to meet standard, experience and improved agricultural practices, which significantly affected the share sold in the market. Protein energy malnutrition (PEM) is still a major public health problem in developing countries (Muller and Krawinkel, 2005).

Amo Farm Sieberer Hatchery Limited came up with the idea of Noiler birds to curb poverty and malnutrition among rural people, especially women and youth. Noiler bird, a word formed by combining the two words "Nigerian" and "Broiler", they are bred for two purposes; their eggs and meat. Noiler birds are cheap, hardy and easy to handle and produce four times more eggs than chickens in most rural areas of Nigeria. Female Noiler birds produce 160 eggs in their lifetime, after which they are sold for meat (Runsewe, 2019). Male birds mature to eating weight faster than local birds, which takes longer. Broiler weighs about 1.8kg in 6weeks, a male Noiler matures to a table weight of 2.0-2.5 kg in 14 weeks; a domestic chicken gains 1.5 kg in 10 months under the same conditions (Runsewe, 2019).

Agricultural households need to be efficient during production in other to make profit. To this effect, the household food insecurity can be overcome either by strengthening the household's resources or by enhancing their control and management of these resources, Ibrahim and Bello (2009). This

forms the basis for this research to analyse the food security status and economic efficiency of Noiler producing households in Abia state of Nigeria.

METHODOLOGY

The Study was conducted in Abia State. According to National population commission and National bureau of statistics, Abia state is about 3,727,347 people in 2016. According to Nigerian Investment promotion commission (NIPC), (2021) "Abia" is an acronym formed from the initial letters of four groups of people, namely: Aba, Bende, Isuikwuato and Afikpo. These constituted the major groups in the state at its creation. At the country's independence in 1960, Abia State nicknamed the God's Own State was part of the then Eastern Region but was carved out from Imo State on 27 August 1991.

Abia state comprises of 17 Local Government Areas (L.G.As) which are divided into three agricultural zones namely: Aba, Ohafia, Umuahia. Farmers who were involved in Noiler farming were the target population for this study.

A multistage random sampling technique was adopted in selecting the respondents for the study. In the first stage, all three Agricultural zones were used which are Abia South (Aba), Abia Central (Umuahia) and Abia North (Ohafia).

The second stage involved the purposive selection of two (2) Local Government areas from each of the agricultural zones. The Local Government chosen were Aba South and Osisioma in Abia south zone, In Abia central zone; Umuahia North and Umuahia South while that of Ohafia zone were Bende and Isiukwato. The six (6) Local Government areas were selected based on the availability of Noiler farmers.

In the third stage, a random selection of four (4) communities from each of the Local Government Areas was done making it a total of 24 communities.

In the last stage, five (5) Noiler households were randomly selected from each of the selected communities, giving a total of 120 respondents. Relevant data were then collected from these respondents using a well-structured questionnaire.

To determine the factors affecting to economic efficiency, the Tobit model was used. The Tobit regression model is specified as:

$$Vj = \beta Zij + e \quad (1)$$

$$Vj = Vj \text{ if } Vj > 0$$

$$Vj = 0 \text{ if } Vj \leq 0$$

$$j = 1 - - - n$$

Vj* = Limited or censured dependent variable. It is the measure of severity of economic efficiency. It is defined as:

$$(K-Yj) / K \quad (2)$$

Where K = threshold level;
Yj = jth household's economic efficiency;
β = Parameter estimates;
Bij = Vector of the explanatory variables.
e= error term
The following variables affecting economic efficiency were fitted into the Tobit model:
X1 = Age (Years)
X2 = Education (years spent in school)
X3 = Labour (Man-day)
X4 = Extension (Number of contact)
X5 = Stock size (Number)
X6 = Farming experience (Years)
X7 = Feed (Kg)

While food Security index was estimated as follows;

$$Fi = \frac{\text{Per capita monthly food expenditure for the } i^{th} \text{ household}}{2/3 \text{ means per capita monthly food expenditure of all households}} \quad (3)$$

Where;
Fi = Food security index.
When Fi ≥ 1 it implies that the i^{th} Noiler farmer is food secure
When Fi < 1, it implies that the i^{th} Noiler farmer is food insecure.

RESULTS AND DISCUSSION

Economic Efficiency

Tobit model was employed to determine the factors associated with economic efficiency. The model was used because the estimated regression coefficients were censored variables having values between 0 and 1. The result showed chi-square significant at 1% level (28.73) showing strong explanatory power of the model. Economic efficiency was influenced by extension visit, stock size and feed as shown in the table 1.

The economic efficiency index measure was regressed on farmers' age, labour, education, stock size, experience and quantity of feed. The result reveals that the estimated coefficients were significant and positive for extension, stock size and feed. A positive sign of an estimated coefficient parameter implies that an increase in the associated variable will lead to an increase in economic efficiency of Noiler farmers in the study area. A negative and significant relationship existed between experience and economic efficiency, and a negative sign of an estimated coefficient parameter implies that an increase in the associated variable it would lead to a decrease in the economic efficiency of the farmer.

The result in Table 1 shows that extension contact was positive and significant at 5% level. This implies that increase in numbers of contact with extension agents increases the level of economic efficiency of the Noiler farmers in the area. This finding is in-line with the *a priori* expectation and findings of (Elias *et al.,* 2014; Dinar *et al.,* 2007; Anik and Salam, 2017) were they noted that agricultural extension service positively and substantially influences farmers' economic efficiency. The implication of this finding is that a number of farm visits of the agricultural officers play a vital role in enhancing the farmers' economic efficiency. This result is also akin to the previous findings by Adem and Gebregziabher (2014), Elias *et al.* (2014) and Dinar *et al.* (2007) which reveal that there is the potentiality to promote economic efficiency of farmers through the agricultural extension services.

The coefficient of Stock size was significant at 5% and positively related to economic efficiency, this implies that economic efficiency increases with increase in stock size. The implication of this result is the need for farmers to increase their capacities of stocking so as to improved efficiency and maximum production of Noilers. The positive and significance levels of flock size have also been reported by Ezeh *et al.* (2012); Olorunwa (2016); Pakage *et al.* (2014).

The coefficient of experience was significant and negative related at 5%. This is in-line with the findings of Athukorala *et al*. (2017) who noted that years of farming experience have a negative association with the economic efficiency of farmers, whereas previous studies conducted by Afrin *et al.* (2017) and Rahman *et al.* (2012) found an affirmative association between them.

There is a significant and positive relationship between feed and economic efficiency. This implies that increase in the quantity of feed it will lead to increase in economic efficiency. Olorunwa (2016) estimated economic efficiency and reported quantity of feed influenced economic efficiency. According to Hadi *et al.* (2018) feed intake positively and significantly affected broiler economic efficiency.

Distribution of Economic Efficiency

The frequency distribution of economic efficiency of farmers in the study area was presented in Table 2. It indicates that the values of efficiency obtained lies between 0 and 1. This implies that all the Noiler households were operating below the frontier. Thus the results of Data Envelopment Analysis reveal substantial inefficiencies in Noiler production in Abia State. The estimated mean value of economic efficiencies was 0.562. This implies that the Noiler farmers were 56.2% economically efficient in production.

Economic efficiency shows minimum, maximum and mean were 0.008, 0.954 and 0.562, this implies in the short run, there is a hope for increasing Noiler production by 44% by adopting the technology and techniques used by most efficient enterprise as to reduce inefficiency and increase

economic efficiency in Noiler production in the study area. The result also reveals that 45% of Noiler enterprise had an efficiency index less than 50% while 14% had between 50% and 69%. About 41% of the Noiler farmers recorded economic efficiency of 70-100%. Noiler households who scored 70% and above are said to be economic efficient; hence, only 41 of the farmers could be said to be economically efficient in Noiler production in the study area. The efficiency of the sampled enterprise is less than one (i.e.100%) which indicates that all the enterprises are producing below the maximum efficiency frontier. This confirm with the assertion of Edet *et al*, (2019) as shown in the Table 2.

Food Security Status among Farming Household

The distribution of the respondents based on their food security status is presented in Table 3. The respondents were then classified into food secure and insecure households. A food secured household is, therefore, when Fi ≥ 1 it implies that the i^{th} farmer is food secure, but when Fi < 1. This implies that the i^{th} individual is food insecure. Households are said to have attained food security level when the per capita monthly food expenditure fall above or is equal to two-third of the mean monthly per capita food expenditure. On the other hand, a food insecure household is that whose per capita monthly food expenditure fell below two-third of the mean monthly per capita food expenditure.

The study area could be regarded as food insecure given the fact that majority of the rural households (63.3%) were not able to meet the per capita monthly food expenditure since it was less than two-third of the mean monthly per capita food expenditure while (36.7%) were food secure.

According to Ahmadi *et al.,* (2021), Food security is considered a pivotal factor for the sustainable development of communities. More specifically, it is of paramount importance in developing countries, even though future predictions point to a slow-down in agricultural productivity and a food-gap mainly in areas across Africa and Asia which are having ongoing food security issues. The problem of food insecurity is expected to worsen due to, among others, rapid population growth and other emerging challenges such as climate change and rising demand for biofuels.

The household food security theory includes, in its concept, the dimension of food accessibility of the households and the individuals within the household. This accessibility to food, according to Franken-berger and McCaston (1998), is called entitlement. Following closely the idea of Sen's Food Entitlement theory, Franken-berger and McCaston (1998) defined entitlement as the set of income and resource bundles over which a household can secure its livelihood. Securing this livelihood ensures that the whole set of well-being of the household is put into consideration, and not just its food needs. Most of the respondents were food insecure as shown in the Table 3.

CONCLUSION AND RECOMMEDNATIONS

Food security is vital in both urban and rural areas, but an important determinant in the success rate largely depends on how efficient the resources were used. Based on the findings of the study, it could be concluded that the level of economic efficiency has effect on food security status of the Noiler farmers. Extension visit, stock size, quantity of feeds was all significant factors influencing the economic efficiency of Noiler producing households. Indicating that farmers should be educated and sensitized on essential farm management practices. Furthermore, there is need to develop agricultural extension service methods and the inclusion of more farmers under such training programs to enhance efficiency and production level of the farmers. Lastly, since the coefficient of feed was positive and significantly influences efficiency, it is recommended that government should monitor and support feed mills that can produce feeds of the required quality for the industry and at reduced cost; it will encourage more smallholder Noiler farmers.

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Table 1: Tobit regression model result on the determinants of economic efficiencies

Variables	Coefficients	Std. Error	z-value
Age of farmer	0.0010593	0.0012999	-0.81
Education	0.0032538	0.0023872	1.36
Labour	0.0021232	0.002562	-0.83
Extension visit	0.0126858	0.004762	2.66**
Stock size	2.03e-06	8.36e-07	2.43**
Experience	0.0021046	0.0010626	-1.98**
Feed	0.0005062	0.0002002	2.53**
Constant	0.4434527	0.1098556	4.04***
LR chi2	28.73***		
Prob> chi2	0.0002		
Pseudo R2	0.2324		
log likelihood	76.181972		
Number of observations	120		

Source: Field Survey, 2021 *, **, *** denotes 10%, 5% and 1% significant respectively

Table 2. Economic efficiency distribution among Noiler farmers in Abia State, Nigeria

Efficiency index	Economic efficiency	Freq (%)
0.10-0.19	8	6.7
0.20-0.29	8	6.7
0.30-0.39	33	27.5
0.40-0.49	5	4.2
0.50-0.59	8	6.7
0.60-0.69	9	7.5
0.70-0.79	14	11.7
0.80-0.89	33	27.5
0.90-1.00	2	1.7
Min	0.008	
Max	0.954	
Mean	0.562	
Total	120	100.0

Source: Field Survey Data, 2021

Table 3: Distribution of the respondents based on Food security status

FSS	Freq	Percentage %
Food insecurity	**76**	**63.3**
Food secure	**44**	**36.7**
Total	120	100.0

Source: Field survey, 2021.

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Effects of Input Costs on Egg Production Among Poultry Farmers in Ikwuano Local Government Area, Abia State Nigeria

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ABSTRACT
The study estimated the effects of input costs on the egg production among poultry farmers in Ikwuano Local Government Area, Abia State Nigeria. The specific objectives described the socioeconomic characteristic of the farmers in the study area; identified the various poultry inputs, its associated costs incurred by the poultry farmers and estimated the effects of cost of input on egg output among the farmers. Multistage random sampling technique was used in selection of eighty (80) poultry egg farmers. Structured questionnaire were administered to the farmers in the study area. Data collected were analyzed using descriptive statistical tools and ordinary least square regression model. The results showed that the farmers had mean age of 46 years with mean household size of 5 persons. The farmers attended at least secondary school. Had mean monthly income of N48000. The variables that influence the egg output included; number of pullets (1%), cost of feed (1%), cost of drugs (5%), fuel (1%), rent (1%) and labour (1%). Recommendations include poultry farmers' use of improve high-laying efficiency breeds with better feed conversion rates. Farmers can formulate on-farm feed using locally available ingredients such as cassava peels, soybean meal, palm kernel cake and fish meal as substitute for feed and reduce reliance on commercial feed. Poultry farmers can establish cooperative feed purchasing groups to buy feed in bulk at discounted prices.

Keywords: poultry input costs, poultry farmers, egg production and Ikwuano Local

INTRODUCTION
Egg production is a significant aspect of poultry farming in Nigeria including Abia State, contributing to food security, employment, and economic development (Inyang, *et al*., 2023). Poultry farming, particularly layer production, is a vital source of protein through egg consumption, which is essential for nutritional health. The demand for eggs has been increasing due to population growth, urbanization and rising awareness of the nutritional benefits of eggs. However, several factors influence the efficiency, available and sustainability of egg production in the state.

Egg production involves the use of good layers stock for the purpose of table egg production. The eggs are sold off-fresh to the public, while the spent layers are culled off from the farm. Poultry are good converters of feeds to eggs and meat within a short period of time (Ebraheem *et al.,* 2012). The nutritive value of poultry eggs rank second to cow milk. Eggs provide essential dietary supplements such as fat and water soluble vitamins like B_{12} and chlorine. It is also rich source of minerals like phosphorus, zinc, iron and magnesium (Nega, 2020). Apart from providing employment and a livelihood to thousands of people, it also provides a remarkably high quality nutritious food. The egg is a complete protein with excellent quality; one egg gives 6g of protein (Ebraheem *et al.,* 2012; Rafed, *et al*., (2024). Egg white protein has a biological value of 100, the

highest biological value of any single food protein (FAO, 2019). Therefore, consumption of eggs has been linked to improved cognitive development and overall health outcomes (Kritz-Silverstein and Bettencourt 2023).

Depending on the farm-size, eggs production can be the main source of family income or can provide income and gainful employment to farmers throughout the year. Not all eggs produced are however, directly consumed some are further used for production of vaccines and antibodies (Ezeano *et al.*, 2019). Augmenting the production of laying chickens is an important objective in helping to meet the nutritional needs of the growing population in Nigeria. Eggs are palatable and generally acceptable and this acceptability cuts across nearly all cultural and religious boundaries in Nigeria. Furthermore, layers are adaptable to various climates and altitudes. Poultry rising can often be combined with other types of farming and offers the possibility to raise extra revenue for farmers.

Egg production in Ikwuano Local Government Area (LGA) of Abia State, Nigeria, is a significant agricultural activity with various socio-economic implications. The farmers supply eggs to households, food vendors, hotels and markets, thereby playing a crucial role in the local economy. However, despite the growing demand, egg production faces several challenges, including high costs of poultry feed, inadequate veterinary services, disease outbreaks, poor farm management practices, and limited access to finance and extension services. However, the poultry industry in Nigeria, as well as other developing countries of African, is continually characterized by low production levels (Okoli, 2002). According to Lukanov *et al*., (2015) poor input in egg production affect production, these inputs include feeding cost, medication, cost of labour, water consumption as used by poultry farmers among other factors are responsible for the low production. Researches have been conducted on egg production, marketing, technical efficiency and productivity in the study area, hence this research is aimed at bridging the gap in the area of input costs associated with egg production.

The broad objective of the study is to estimate the effects of input costs on the egg production among poultry farmers in Ikwuano L.G.A, Abia State. Nigeria. The specific objectives are to;

i. describe the socioeconomic characteristic of the farmers in the study area;
ii. estimate the effects of cost of input on egg output among the farmers.

The research hypothesis tested was;

H_1: Costs of poultry inputs have no significant influence on egg output among poultry farmers in the study area.

METHODOLOGY

The study was carried out in Ikwuano Local Government Area (LGA) of Abia State, Nigeria. Ikwuano Local Government Area was created out of the defunct Umuahia LGA in 1991 and has its headquarters at Isiala Oboro. It shares a common boundary with Ini Local Government Area of Akwa Ibom and Umuahia North. Ikwuano LGA is made up of four clans namely Oboro, Ibere, Oloko and Ariam and 18 villages. The L.G.A is located between latitudes 5^0 24/ N and $5^0$30/ N of the equator and longitudes 7° 32' E and 30 37: E of the Greenwich Meridian. Ikwuano L.G.A has a population of 180,600 people which comprise of 92,300 males and Female 88,300 Nigeria Bureau of Statistics (NBS, 2016).

The climate is tropical and humid all the year round. There are usually two seasons, rainy season ranges from March to October. The dry season occurs from November to February. The mean annual rainfall ranges from 2000mm to 2500mm with the southern areas receiving more than the northern areas. The temperature ranges between 22°C minimum to 31°C (Maximum). The vegetation is predominantly lowland rainforest. Major occupation of the people is farming. The major food crops grown are cassava, yam, melon, vegetable, three-leaf yam and cowpea. Some important cash crops grown in Ikwuano LGA are oil palm and cocoa, while animals reared are goats, sheep, pigs and poultry.

Sampling Technique

Multi-stage random sampling technique was used in choosing the poultry egg farmers. In the first stage, all the historic clans were selected from the Local Government Area. In the second stage, two villages from each clan were purposively selected based on concentration of layer farmers in the villages, making it 8 villages namely Ihim, Isiala, Amizi, Ahaba, Ndieke, Ndiorie, Umudike and

Amaoba. In the third stage, layer farmers were identified who operate layers farms in the area, through the poultry farmers association. Fourth stage, a random selection of 10 egg production farmers from each village, given a total of 80 farmers were used for this study.

Data collection

Data were collected with the use of structured questionnaire which were administered to farmers in the study area. The questionnaire were designed to capture the socio-economic characteristics such age, experience, level of education, household size of the farmers in the study area, the various poultry inputs and its associated costs incurred by the poultry farmers.

Method of Data Analysis

Objectives i was analyzed using descriptive statistical tools such as frequency, percentage and mean. Objective ii was be realized using ordinary least regression model expressed as follows;

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})$

Where;

Y = Quantity of egg produced (Naira/kg)
X_1 = Number of pullets (Number)
X_2 = Cost of feed (Naira)
X_3 = Cost of labour (Naira)
X_4 = Cost of drugs/Vaccine (Naira)
X_5 = Cost of water consumption (in naira)
X_6 = Amount of wood shavings (Naira)
X_7 = Depreciated value of items used in the poultry farm (Naira)
X_8 = Rent for building (Naira)
X_9 = Fuel cost (Naira)
X_{10} = Cost of transportation (Naira)

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Farmers

Table 1 showed that the mean age of the farmers was 46 years which indicate active working age. The implication of this age bracket on output is increase output and income. Majority (68%) of the respondents in the study area were males, while 32% were female. The mean household size was 5 persons. The mean farming experience was 8 years. The result has some positive implications on increased output because according to Michael *et al.,* (2022). Years of farming experience of a farmer contributed to his ability to manage his holding efficiently. Thus, the higher the experience of a farmer, the higher the adoption rate of new technology will be. Mean number of years spent in school was 10 years. This suggest that majority of the farmers in the study area are lettered. The result implies that most of them can read and can therefore handle their farming activities and challenges with very minimum assistance since education has a way of improving the performance of farmers in their farming activities (Onyemekihian *et al*., 2023).

Table 1 indicated that 55% of poultry farmers in the study area are members of cooperative societies while 45% are non-members. Mean monthly income was 48,000. Mean values of 94 crates of eggs are produced monthly. Table 1 also showed that 92% of the poultry farmers in the study area have no access to any form of credit facility while only 8% are have obtained one level of credit or the other. This implies that majority are operating on self-funding basis.

Determinant of the Effects of Input on Egg Outputs

The regression estimates of the effect of inputs on egg output in the study area is presented in Table 2. The semi-log regression function was chosen as the lead equation based on the value of R^2 (coefficient of multiple determination), F-ratio, the number of significant variables and the conformity of regression coefficient with *apriori* expectation. The R^2 value 0.869 means that 86.90% of the total variation observed in the dependent variable was accounted for by the changes in the explanatory variables included in the model. The F-ratio of 36.87 signifies that the model was statistically significant at 1% level, implying that the model was of good fit, that variables included in the model were correct. The variables that influence the egg output included; number of pullets (1%), cost of feed (1%), cost of drugs (5%), fuel (1%), rent (1%) and labour (1%).

The finding reveals that the coefficient of number of pullet (2.26) was positive and statistically significant at 1%. This implies that there is a direct relationship between number of pullets and egg output. The higher the number of birds/pullets, the efficient of stock size had a positive and significant association with output.

The coefficients of cost of feed (-4.02) have a negative sign and is significant at 1% showing a negative relationship with output of egg. This implies that a unit increase in the cost of feed will result to a decrease in quantity of feed obtained for consumption thereby leading to a reduction in egg production. This is in line with the findings of Abdulrahman *et al.,* (2022).

The coefficient of drugs (2.32) was positive and significant at 5% level which implies that effective management, which includes ensuring birds receive timely and high-quality veterinary care which enhance the egg output. The coefficient of quality of wood shaving (3.03) was positive and statistically significant at 1%. This implies that level of quality beddings provided for the pullets will enhance egg output.

The finding shows that cost of fuel (-5.66) has a negative coefficient and significant at 1%. This implies that there is a negative relationship between the light and output. The egg production is associated with the length and intensity of the light received by the bird daily. In other words, an increase in the cost of fuel, which leads to a reduction in light provided, will have a negative effect on the pullet and it leads to decrease in the egg production.

The coefficient of labour (-5.57) is negative and significant at 1%. This suggests that additional labour does not contribute positively to egg production. This could be due to inefficiencies in labour utilization, overstaffing, or other factors that reduce productivity despite increased labour input (Girei, *et al.,* 2018).

The coefficient of cost of equipment (-4.04) was negative and statistically significant at 1%; implying that increased in depreciation in value of items used in the poultry farm and will bring about decrease in egg output. Altahat *et al.,* (2012), opined that high depreciation cost reflects aging infrastructure, reduced operational efficiency, and higher maintenance costs.
Also, the coefficient of the cost of rent (-4.06) was negative and significant at 1%. The implication is that, the increase in rent will result to a reduction in space thereby reducing the number of pullets and feed purchased which will surely lead to a decrease in egg output.

CONCLUSION AND RECOMMENDATIONS

This study concludes that the major poultry input whose cost affect egg production in the study area include number of pullets, cost of feed, cost of drugs, cost of fuel, rent, cost of labour and cost of equipment. Recommendations to optimize production and reduce costs offered include, optimizing the number of birds through the use of improve breed selection by choosing high-laying efficiency breeds with better feed conversion rates. To reduce cost of feed, farmers can formulate on-farm feed using locally available ingredients such as cassava peels, soybean meal, palm kernel cake and fish meal as substitute for feed and reduce reliance on commercial feed. Poultry farmers can establish cooperative feed purchasing groups to buy feed in bulk at discounted prices. Routine vaccination programs and probiotic use to enhance bird immunity naturally should be adhered to in order to reduce unnecessary cost veterinary care. Use of alternative energy sources such as solar panels for lighting and biogas from poultry waste can reduce fuel dependence. Adopting vertical farming techniques like battery cage systems to maximize space. Workers can be trained to handle multiple tasks efficiently, reducing the need for excess labour.

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Table 1: Socioeconomic Characteristics of the Farmers

Variable	Freqency	Percentage (%)	Mean
Age			
30 -39	13	16	**46**
40 – 49	38	47	
50 – 59	26	33	
60 and above	3	4	
Gender			
Male	54	68	
Female	26	32	
Marital Status			
Single	8	10	
Married	72	90	
Household Size			
1 – 3	27	34	**5**
4 – 6	47	58	
7 and above	6	8	
Years of Experience in Poultry Farming			
1 – 5	27	34	**8**
6 – 10	44	55	
11 and above	9	11	
Years Spent in School			
0 – 6	19	24	**10**
7 -12	32	40	
13 – 16	39	36	
Monthly Egg Production in Crates			
1 – 100	44	56	**94**
101 -200	29	36	
201 and above	7	8	
Monthly Farm Income			
10000 – 30000	16	20	**48000**
31000 – 50000	30	37	
51000 – 70000	19	24	
71000 and above	15	19	
Cooperative Membership			
Yes	44	55	
No	36	45	
Access to Credit			
Yes	6	8	
No	74	92	

Source: Field Survey Data, 2023. Total number of respondents = 80

Table 2: Estimates of the effect of inputs on egg output

Variables	Linear	Semi-log +	Double log	Exponential
Intercept	3172.459	9.594	8.3458	-860690.7
	(5.70)***	(19.08)***	(3.20)***	(-4.42)***
X_1= Number of pullets	508.34	0.857	0.232	203.75
	(2.46)**	(2.26)***	(2.19)**	(2.51)**
X_2= Cost of Feed	-7572.78	-0.153	-0.1557	28615.27
	(-4.80)***	(-4.02)***	(-0.34)	(2.31)**
X_3= Cost of Labour	3.995	0.7395	0.5309	-1036.952
	(4.66)***	(-5.57)***	(2.56)**	(-2.56)**
X_4= Amount of Drug Intake	85.65	0.789	0.3042	93973.41
	(3.21)***	(2.32)**	(2.56)**	(2.11)**
X_5= Cost of Water	51900.04	0.0019	0.1814	66156.05
	(3.35)***	(0.06)	(0.08)	(0.80)*
X_6= Wood Shaving	0.715	4.05e-06	0.1804	14982.78
	(1.41)	(3.03)***	(2.87)**	(1.22)*
X_7 = Cost of equipment	-5.457	-0.0000499	-0.4153	-10444.91
	(-11.70)**	(-4.04)***	(-13.29)***	(-1.72)*
X_8 = Cost of Rent	0.157	-1.497	-0.0871	-34778.29
	(0.73)***	(-4.06)***	(-1.86)***	(-3.82)***
X_9 = Cost of Fuel	4048.92	0.165	-0.00003	69454
	(3.69)**	(-5.66)***	(-2.58)**	(2.69)***
X_{10} = Cost of Transportation	3172.46	-0132	0.967	33751.24
	(5.70)***	(-1.57)	(0.50)	(0.89)
R^2	0.7510	0. 869	0.6958	0.6383
R^{-2}	0.7143	0.7769	0.6595	0.5851
F-ratio	26.84***	36.87***	20.60***	15.71***

Source: Field Survey (2023) + lead equation, *** Significant at 1%, ** Significant at 5%*significant at 10%. The regression coefficients (β) in parenthesis

Effect of Microcredit on the Household Food Security Status of Market Women in Benin City, Edo State, Nigeria

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ABSTRACT

The study examined the Effect Of Microcredit On The Household Food Security Status of Market Women In Edo State, Nigeria. 120 respondents were sampled using a two-stage sampling procedure involving purposive and simple random sampling technique. Data were analysed using frequency count, percentage, logit regression and t-test. 76.7% of the respondents were in their active years, mean household size was 5, mean marketing experience for the beneficiaries and non-beneficiaries is 13 and 14 while 87% were once married. 95.8% sourced their capita from their personal saving. Also respondents having access to food to micro credit were 3 times likely to experience food security than the respondents having no access. The major constraint were inadequate government policies ($\bar{X} = 3.3750$), untimely release of credit ($\bar{X} = 3.250$), personal belief ($\bar{X} = 3.1500$), and high interest rate ($\bar{X} = 3.3583$). it was concluded that access to micro credit facilities improves the household food security status of the market women appreciably. it was recommended that marketers should endeavour to utilize the wide acceptance from banks to obtain credit to invest in their marketing activities thus influencing their food security status appreciably

Keywords: Micro Credit, Food Security, Market Women, Edo State, Nigeria

INTRODUCTION

It is widely accepted all over the world that food is one of the basic physiological needs of man, and is necessary for a healthy and productive life, which can only be achieved through quantitative and qualitative food intake. Food security has many definitions. The 1996 World Food Summit defined food security as a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 1996). Attaining food security implies availability of nutritionally adequate and safe food, individual household's accessibility to nutritional food to meet their needs, and ability of the body to utilise essential dietary nutrients (Barrett, 2010; Maxwell & Frankenberger, 1995; Smith, El Obeid, & Jensen, 2000). Food security attainment is a prerequisite for economic development (World Bank, 2007) and many development practitioners and national governments continue to place food security attainment at the centre of their development goals and objectives, yet the Food and Agricultural organization in 2015 estimated that more than 800 million people worldwide were undernourished in terms of dietary energy intake, while micronutrient malnutrition affected 2 million people (FAO, IFAD, & WFP, 2015).

In developing countries such as Nigeria the issue of food security is particularly serious. The United Nations and the FAO estimated that one in eight people were suffering from chronic undernourishment between the year 2010 and 2012 (Ukpe, 2016). One important aspect of the wealth of any nation is in the ability to make food available for her citizens. In Nigeria, the percentage

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of food secure households was reported to be 18% in 1986 and over 40% in 2005(Sanusi *et al.,*2006).In recent times the issue of food security has become a major area of concern in Nigeria due to its ever increasing population which is not commensurate with food production. Food security actually depends on whether households can afford to buy food given the prices and their income and their ability to produce enough food to cater for their food needs. Under recent conditions of rising food prices, high cost of living accompanied by low per capita, many households are unable to access quality food. However food insecurity in Nigeria is identified to be prevalent amongst women and children. Women play a central role in the home as producers of food, managers of natural resources, entrepreneurs and caretakers of the household. Empirical evidence shows that women in developing countries play a crucial role in ensuring household food security (Quisumbing *et al.,* 1995). Studies have shown that microcredit have reached women in diverse socio-economic environment, and provided them with a better purchasing power and enabled them to invest money in small scale businesses such as the processing, sale and marketing of agricultural products. According to Latifee (2003), it creates opportunities for self-employment and liberates them from the clutches of poverty, they are able to generate income, educate their children and participate in household decision-making. Additionally microcredit improves the household capability of women by enhancing "human capital" through providing better nutrition, education, skill improvement and health improvement. Most studies have revealed that women require financial services to carry out their activities more efficiently and ensure food security in their households and it is evident that microcredit can serve as a useful tool to achieving this. The specific objectives of the study is to:

1. determine the socioeconomic characteristic of the respondents
2. examine the effect of microcredit on the household food security

Hypothesis testing
H0: That there is no significant difference in the mean daily expenditure between the micro credit beneficiaries and non-beneficiaries
H1: That there is significant difference in the mean daily expenditure between the micro credit beneficiaries and non-beneficiaries

METHODOLOGY

Study Area and Scope of study

The study was carried out in Benin City in Edo State Nigeria. Benin City lies within longitudes 05 °04′ and 06° 43′ E and latitudes 05° 44′ and 07° 34′ N. It is bounded in the North by Kogi State,in the South by Delta State, in the West by Ondo State and in the East by Kogi and Anambra States. Benin City is the capital of Edo State. The local Government areas in the ever expanding Benin are Oredo, Egor Ikpoba-okha, Uhunwonde and Ovia North East bordering the University of Benin. It has a population of 3,218,332 by the 2006 population census figure. It has a mean annual rainfall of about 1400 mm with vegetation mainly rainforest. The dwellers in this study area are predominantly Christians who are mainly farmers and also engage in other non-farming activities as their source of living.

Sampling Technique

The study employed a multi-stage sampling procedure involving purposive and simple random sampling techniques. The first stage involved the purposive selection of four (4) Local Government Areas (LGAs) namely, Egor, Ikpoba Okha, Oredo and Ovia South East. These LGAs were purposively selected because of the prevalence of micro credit institutions in the area. The second stage involved the random selection of 80 women that had access to microcredit from the microcredit institutions in the selected LGA's and (40) women who had no access to microcredits. Twenty (20) women beneficiaries of the microcredit were selected at random from each of the four (4) LGAs and (10) non-beneficiaries from each of the four LGA's giving a total of one hundred and twenty (120) respondents in all for the study.

Data Collection

The data was sourced from a combination of primary and secondary sources. Primary data was collected using structured questionnaire which was administered to respondents. The direct face to face administration of questionnaire was the best approach to data collection and this was used in this study. This method was ideal because the study involved collecting data from women who may not be literate.

Data Analysis

Descriptive statistics such as frequency tables, mean and percentages was used to analyse the socio-economic characteristics of the respondents in the Study Area. The volume of credit accessed by the respondents was realized using frequency, percentages, and means. The effects of microcredit on the household food security status of respondents in the Study Area was analysed using the student t-test and the Logit regression model. This model was chosen because of the dichotomous variables. The model is stated as follows:

$$Log(P_i) = Log\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_1 \quad (1)$$

logit (P) = probability of being food secure, P/(P/1-P) which is simply the odd ratio in favour of food secure (food secure=1, food insecure=0), 1-P = the probability of not being food secure
β_0 = constant
β_1 = estimated coefficient of micro credit
X_1 = beneficiaries of micro credit

Constraints in accessing microcredit was realized using the 5 point likert type scale. Respondents' perceived constraints in accessing micro credit was measured by asking respondents to rate from a list of constraints as very serious rated 5, serious rated 4, moderately serious 3, least serious rated 2 and not serious rated 1. The bench mark was the mean of the assigned scores which is:

$$\text{Mean Score} = \frac{5+4+3+2+1}{5} = 3$$

An average score $\geq$ 3 connotes a serious constraint while those < 3 were regarded as not serious.

Hypothesis testing

The stated hypothesis was tested using a t-test. The formula is given below:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{n}}} \quad (2)$$

Where;
t = t–statistic
$\bar{X}_1$ = mean per capital expenditure on food for respondents who are beneficiaries of micro credit
$\bar{X}_2$ = mean per capital expenditure on food for respondents who are non-beneficiaries of micro credit
S^2_1 and S^2_2 = their respective mean variances
n = number of respondents

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Market Women in the Study Area

Distribution of Respondents Based On Age

From Table 3.1, the results showed that 30% of microcredit beneficiaries were within the age range of 51 years and above and 40% of non-beneficiaries were less than 36 years of age. The mean age of the Market Women was 45 years for beneficiaries and 41 years for non -beneficiaries. The pooled sample as a whole, approximately 76.7% of the respondents were in their active years. Age has been found to determine how active and productive a marketer would be, which implies that majority of the respondents in the region were energetic and still able to work which confirms the result of a study done by Okurut and Bategeka (2005), who noted that age bracket between 30 – 50 years is called the "Working age", and that when the head of a household is of working age, the likelihood of moving out of poverty and food insecurity is high.

Distribution of Respondents Based on Household Size

The result in Table 4.1 showed that 70% of beneficiaries and 65% of non-beneficiaries had a household size of 4-6 persons and, the mean household size is 5 for beneficiaries and non-beneficiaries respectively. The mean household size in the study area was approximately 5 persons. The household is not large, which could also indicate a low supply of labour to the family enterprise. Household size is important because, decrease or increase in household size, decreases or

increases the number of consumers, thereby reducing or putting pressure on household resources particularly food. Furthermore, households with high dependency ratio are particularly prone to food insecurity (Ibok, 2012).

Distribution of Respondents Based on Marketing Experience
According to Table 3.1, 51.30% of beneficiaries and 42.50% of non-beneficiaries have spent 6-15 years in marketing and, the mean marketing experience did not vary widely between beneficiaries and non-beneficiaries. The mean marketing experience was 13 years for beneficiaries and 14 years for non-beneficiaries. Results show that the marketing experience of the respondents in the surveyed area varied widely, with a minimum of 1 year and a maximum of 44 years. The mean marketing experience in the study area is 8 years. This shows that households in the region had considerable experience in marketing.

Level of education of respondents.
The result in Table 4.1 shows that majority (91.2% and 87.5% of beneficiaries and non-beneficiaries respectively) of the respondents acquired one form of formal education or the other. A higher proportion (50% and 45% of beneficiaries and non-beneficiaries respectively) had secondary education. The pooled results shows that 90% of the respondents had formal education. The level of education could determine the level of opportunities available to improve livelihood strategies, enhance food security and reduce the level of poverty. High education status of the respondents will enable them acquire knowledge and skills, for budgeting, saving, adoption of innovations and using resources. (Esturk and Oren, 2014).

Distribution of respondents based on Marital Status
Table 3.1 shows that a high percentage of respondents (82.5% beneficiaries and 70% of the non-beneficiaries) were married. However, a cursory look at Table 3.1 shows that on the average, about 87.5% of the respondents were once married, while only 12.5 % has never been married.

Distribution of Respondents Based on Major Occupation
The result as presented in Table 3.1 shows that majority 80% of the beneficiaries and non-beneficiaries had marketing as their major occupation. Only 1% of the beneficiaries were into farming. The pooled result also shows that majority (80%) of the respondents were marketers.

Source of Finance
Table 3.1 unveiled the source of finance of the respondents. 95.8% of the respondents financed the business by from their personal savings. This implied that majority of the respondents were able to fund their business in addition to the loan or credit from any of the microcredit institutions while 3.45 of these respondents however, source for fund through cash gift and the remaining 0.8% obtained assistance from cooperative banks to finance their business.

Distribution of Respondents Based on the Volume of Credit
The results as presented in Table 3.2 shows that a higher percentage 48.4% of the beneficiaries has access to loan between 50000 to 100000 naira. While only 3.8% of the beneficiaries collected credit that is above 200000 naira. The mean volume of credit accessed by the Market Women was ₦56000

Effect of micro credit on Household food security status
The result as presented in Table 3.3 shows that micro credit has a significant effect on the market women food security status. The results showed that respondents without access to micro credit were 3.09 times likely to experience more food insecurity than the respondents having no access to microcredit. This might be due to the fact that having access to micro credit will increase capital for their business which will ultimately increase their net income and expenditure on food.

Hypothesis testing
The results presented on Table 3.4 shows the mean difference in the daily expenditure on food of the food marketers household that are beneficiaries of micro credit and those that are non-beneficiaries of micro credit was ($\bar{x} = 70.2$, t = 3.71) showed that it was statistically significant at 1%. The implication in this is that micro credit has played a significant role in improving the food security status of the respondents in the Study Area.

Constraints Faced by Respondents in accessing microcredit

The result presented on Table 3.5 revealed the constraint faced by the respondents in their marketing activities in the Study Area. The constraints with mean value above 3.00 indicated the serious constraint faced by the marketers in securing their food with the aid of credit facilities. From the result presented on Table 3.5. The serious constraint were inadequate government policies ($\bar{X} = 3.3750$), untimely release of credit ($\bar{X} = 3.250$), personal belief ($\bar{X} = 3.1500$), and high interest rate ($\bar{X} = 3.3583$). This finding is in agreement with the findings of Oruonye and Musa (2012) and Umoh (2006) which stated that high interest rate as a major constraint in accessing microcredit.

CONCLUSION AND RECOMMENDATIONS

Based on the findings from the study, it was concluded that access to micro credit facilities improves the household food security status of the Market Women appreciably in the Study Area. As a result, it was recommended that marketers should endeavour to utilize the wide acceptance from banks to obtain credit to invest in their marketing activities, thus, influencing their food security status appreciably. Also, microcredit policies that will help to improve the food security status of Market Women such as Lift Above Poverty should be implemented by government and directed towards favouring the female gender thereby improving the household food security status of Market Women.

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Table 1: Socio Economic Characteristics of Market Women in the Study Area

	Beneficiaries		Non beneficiaries		Pooled	
	Frequency (n = 80)	Percent (100%)	Frequency (n = 40)	Percent (100%)	Frequency (n = 120)	Percent (100%)
Age						
≤ 35 yrs	16	20	16	40	32	26.7
36 – 40 yrs	10	12.5	8	20	18	15
41 – 45 yrs	17	21.3	4	10	21	17.5
46 – 50 yrs	13	16.3	8	20	21	17.5
≥ 51 yrs	24	30	4	10	28	23.3
Mean	**45**		**41**		**43**	
Household size						
≤ 3	10	12.5	7	17.5	17	14.2
4 – 6	56	70	26	65	82	68.3
7 – 9	13	16.3	7	17.5	20	16.7
≥ 10	1	1.3	0	0	1	0.8
Mean	**5**		**5**	**12.5**	**5**	
Marketing experience						
≤ 5yrs	24	30	19	47.5	43	35.8
6 – 10 yrs	26	32.5	15	37.5	41	34.2
11 – 15 yrs	15	18.8	2	5	17	14.2
16 – 20 yrs	11	13.8	2	5	13	10.8
≥ 21 yrs	4	5	2	5	6	5
Mean	**10**		**8**		**9**	
Educational level						
No formal	7	8.8	5	12.5	12	10
Primary education	12	15	7	17.5	19	15.8
Secondary education	40	50	18	45	58	48.3
Tertiary education	21	26.3	10	25	31	25.8
Educational level of household head						
Primary education	10	12.5	11	27.5	21	17.5
SSCE	36	45	16	40	52	43.3
NCE/OND/Nursing	5	6.3	2	5	7	5.8
B.Sc/HND	29	36.3	10	25	39	32.5
MSc.			1	2.5	1	0.8
Marital status						
Single	7	8.8	8	20	15	12.5
Married	66	82.5	28	70	94	78.3
Divorced	3	3.8	2	5	5	4.2
Widowed	3	3.8	2	5	5	4.2
Widower	1	1.3	0	0	1	0.8
Major occupation						
Marketer	64	80	32	80	96	80
Civil servant	9	11.3	4	10	13	10.8
Farming	1	1.3	0	0	1	0.8
Working in private company	4	5	1	2.5	5	4.2
Others	2	2.5	3	7.5	5	4.2
Source of finance						
Personal saving	76	95.0	39	97.5	115	95.8
Cash gift	3	3.8	1	2.5	4	3.4
Cooperative loan	1	1.3	0	0.0	1	0.8

Source: Field Survey, 2022

Table 2: Volume of credit accessed

Volume	Frequency	Percent	Mean
≤50000	3	3.8	
50001 – 100000	39	48.8	
100001 – 150000	33	41.3	56000
150001 – 200000	2	2.5	
≥ 200000	3	3.8	
Total	**80**	**100.0**	
Mean	**56000**		

Source: Field Survey, 2022

Table 3: Effect of Micro Credit on Household Food Security Status

Food security status	Odd ratio	Coefficient	Std. Err.	Z	P>(z)
Micro credit	3.09	1.1299	0.4020	2.81	0.05
Constant	0.6	-0.5108	0.3266	-1.56	0.118

Log likelihood= -78.26 LR chi (1) = 8.20 Prob > chi2 = 0.0042. Source: Field Survey, 2022

Table 4: Hypothesis testing

	N	Mean	Std. Deviation	t -ratio
Beneficiaries of micro credit	80	231.34	11.8245	3.71
Non beneficiaries of micro credit	40	161.06	12.4608	

Source: Field Survey, 2022

Table 5: Constraints Faced by Respondents in Accessing Micro Credit

Constraints	Mean	Std. Deviation
Difficult to access microcredit	2.8917	1.16530
High interest rate	3.3583*	.84809
Insufficient credit	2.7333	1.01859
Irregular interest	2.9250	1.12394
Government policies	3.3750*	.98785
Personal belief	3.1500*	1.27583
Untimely release of credit	3.250*	1.03358
No collateral	2.6583	1.24682

*Serious Constraints. Source: Field Survey, 2022

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Nigerian Food Security, Nutrition and Governance Trend (2015-2025): Implications for Agricultural Development and Policy

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ABSTRACT

Trend analysis was conducted over a decade (2015-2025) on Nigerian food security, nutrition and governance. Empirical time series data were collected on agriculture share of the annual Nigeria's budgetary allocations, agriculture GDP share, malnutrition percentage rates, human development index, and consumer price index (CPI) or food products price inflation rates. Data collected were analysed by use of trend statistical analysis. The results implicated the following: the percentage annual national agriculture budget allocation increased from 0.88 in 2015 to 3.61 in 2019 but sharply decreased to 1.11 and 1.26 in 2024 and 2025 respectively. Data revealed that agriculture percentage share of the Gross Domestic Product (GDP) declined gradually from 25.13 in 2018, up from 23.11 in 2o15 and down to 20.50 in 2024. Nigeria 's Human Development Index (HDI) which increased from 0.527 in 2015 to 0.548 in 2021 where it stagnated till 2023 with life expectancy in years at 53.1 in 2015 which rose to 54.7 in 2021 but speedily declined to 52.7 in 2022. The mean schooling years of 6.0 in 2015 rose to 7.2 years in 2022 with gross national income (GNI) per capita (PPP in $) of $5,433 in 2015 which decreased to $4,790 in 2022. Nigeria's malnutrition percent rate of stunting or chronic malnutrition was 32.9 in 2015 which increased to 33.1 in 2016 and stagnated at31.5 since 2018 to 2020 for children under 5 years. For the wasting or acute malnutrition category, it was 7.9 in 2015 and rose up to 8.5 in 2024 while under nourishment which stood at 11.5 percent in 2015 sharply increased to 16.5 in 2024. In the same trend, food price percentage rate of 10.76 in 2015 sky rocked to 26.08 in 2024 while the consumer price index (CPI) of 8.50 % quadrupled to 33.69 % in 2024. The trend analysis in all sectors, showed that despite continued efforts by the federal government from 1972 to 2024, Nigeria has not achieved food self sufficiency. The researchers therefore, concluded that despite several Nigerian government efforts to revamp agriculture, food security and nutrition have not been achieved. Based on the findings and conclusion, the authors recommended that Nigeria can get it right by funding agriculture adequately up to 10 percent of annual national budget to position the sector for growth, employment generation, meet domestic food demand (adequate nutrition), generation of foreign exchange through exports promotion to increase life expectancy and per capita income. Adequate funding, monitoring and evaluation of all agricultural projects for efficiency and increased productivity is hereby recommended.

Keywords: Nigeria's Food Security, Nutrition and Governance, Agricultural Development and Policy implications

INTRODUCTION

Sustainable Development Goal number 2 of the United Nations (UN, 2015) sought to halve or reduce by 50% in 2015 and attain a zero hunger status by 2030 globally. However, five years to the target year of 2030, Nigeria is still battling with food insecurity, malnutrition, and poverty or low

Human Development Index (HDI) amidst high food price index or Consumer Price Index (CPI) (AFDB, 2023). These are despite various agricultural initiatives, programmes, and strategies by the federal government aimed at food security, wealth creation, and improved living standards of the teeming Nigerian populace (NESG, 2024; World Bank, 2023).

According to Nigerian Economic Summit Group (NESG, 2024), Nigeria's food crisis has reached unprecedented levels with an inflation rate of 28.9% in December 2023, pushing 14 million Nigerians into poverty. The inflation rate rose to 35.41% in January 2024. These were as a result of foreign exchange restrictions, border closures, and insecurity in North East, North Central, and North West. Also, the World Food Programme (WFP, 2024) reported that food-insecure Nigerians have increased from 28 million pre-COVID-19 to over 100 million in first quarter 2024. Further, WFP (2024) stated that about 26.5 million people across Nigeria face acute hunger as at June–August 2024, thus an increase on the figure of 18.6 million people facing food shortage at the fourth quarter of 2023.

NBS (2024) reported that cost of food in Nigeria increased by 61% from 25.25% in the second quarter of 2023 to a high percentage of 40–66% in the second quarter of 2024, which has resulted in a steady increase in the cost of living. This unarguably has pushed low-income households more into poverty and food scarcity. The WFP (2024) also asserted that crisis in the North East displaced about 2.2 million Nigerians and forced another 4.4 million into food insecurity in Borno, Adamawa, and Yobe States.

North Eastern Nigeria conflicts resulted in severe altercation and encumbered food production, access, and utilization. The increasing violent insurgency occasioned by Boko Haram resulted in general displacement of farmers, with over 2.3 million people stampeded into fleeing their homes (UNICEF, 2023). The resulting scenario is a decline in food production and increasing food prices. Other variables are drought and flooding which have seriously affected agricultural activities and food productivity, leading to high food prices and inaccessibility (NESG, 2024).

United States Agency for International Development (USAID, 2021) observed that 37% of Nigerian children under 5 years of age are severely malnourished, and this shows a Global Acute Malnutrition (GAM) of 14%. Malnutrition does not only retard children's physical growth but also has a long-term impact on their cognitive development and general well-being. Many Nigerian adults and elderly are also at risk of food insecurity. This is because as families' income and resources dwindle and decline, the aged can be faced with inadequate access to nutritious food, causing malnutrition and associated health issues with high mortalities (MOUAU, 2024; ARCN, 2024; Adekule, Akinode, Shittu, and Momoh, 2020).

Nigerian government has implemented several agricultural programmes, initiatives, and strategies over the years aimed at achieving food self-sufficiency and increasing agricultural productivity from 1972 to date. Some of these include:

- National Accelerated Food Production Programme (NAFPP, 1972) with objectives to provide subsidy in inputs such as fertilizers, seeds, especially in crops like maize, rice, and cassava.
- The World Bank-supported Agricultural Development Projects (ADPs, 1974) targeted at improved rural infrastructure and extension services for farmer productivity, which took off in Bauchi and Kano, later spread to all states.
- Operation Feed the Nation (OFN, 1976) aimed at mass participation in farming at urban, rural, and school areas for food self-sufficiency.
- River Basin Development Authority (RBDAs, 1976) targeted harnessing water resources for irrigation to increase all-year-round farming, e.g., Niger, Hadeja Jama.
- The Green Revolution (GR, 1979) was designed to expand mechanization, seeds, increased investment but was poorly implemented (ARCN, 2024; NBS, 2025).
- In 1986, Directorate of Food, Roads and Rural Infrastructure (DFRRI, 1986) had objectives of rural development with roads, water supply, and agriculture productivity.
- Better Life Programme for Rural Women (BLP, 1987) aimed at providing agricultural training and resources to improve livelihood across Nigerian communities.
- In 1989, Peoples Bank of Nigeria (PBN, 1989) was established to provide agricultural schemes and microcredits to smallholders for increased productivity.
- National Agricultural Land Development Authority (NALDA, 1992) targeted agricultural land development and allocation to increase and encourage large-scale farming.

- National Economic Empowerment and Development Strategy (NEEDS, 1999) aimed at the promotion of agribusiness and rural development.
- Presidential Initiative on Agriculture (PIA, 2002) was launched to improve specific crops like cassava, maize, and rice for exports.
- In 2002, the National Special Programme on Food Security (NSPFS, 2002), FAO-supported, aimed at food security through farmers' training and technology adoption.
- Fadama Development Project in phases (FDP, 2003) had objectives to support small-scale irrigation, wetland farming focusing on reduction of poverty by high productivity.
- Agricultural Transformation Agenda (ATA, 2011) was to modernize agriculture, increase job creation, and food security.
- Nigerian Incentive-Based Risk Sharing for Agricultural Lending (NIRSAL, 2011) focused on de-risking agricultural lending from financial institutions with import reduction and high-value chain development under the Growth Enhancement Support Scheme (GESS).
- CBN Anchor Borrowers Programme (ABP, 2015) focused on increasing loans and farm inputs to smallholders especially rice and maize.
- This was followed by Agricultural Promotion Policy (APP, 2016), the Green Alternative, aimed to build on ATA through promoting private sector investment, productivity, and food security.
- The Green Imperative Programme (GIP, 2019) targeted the supply of 10,000 tractors and promotion of mechanization over a 10-year span with Brazilian support of $1.1 billion.
- Other initiatives include:
- Zero Reject Initiative (ZRI, 2020) aimed at improving export quality, increasing standards, and reducing rejection of Nigeria's agricultural processing and exports.
- Presidential Economic Diversification Initiative (PEDI, 2020) focused on agriculture as a diversification tool, agricultural processing, and exports.
- National Agricultural Technology and Innovation Policy (NATIP, 2021) focused on technology adoption, climate resilience, and value chain development.
- National Agricultural Development Fund (NADF, 2023) targeted mobilization of N1 trillion by 2030 for agricultural research, mechanization, and credit.
- Nigeria Farmers Soil Health Card Scheme (NFSHCS, 2024) aimed at establishing soil testing laboratories to increase farmers' output and soil management.
- Temporary ban on import duties for agricultural commodities (2024) targeted removing duties on key imports to reduce food inflation and increase local food production.

National Bureau of Statistics (NBS, several years; 2024; Q1 2025; AFDB, 2024; Adebayo, 2010; Adebayo & Ojo, 2012) have reported a decline in agricultural percentage share of the GDP from 25.08% and 25.13% in 2017 and 2018 respectively to 20.50% in 2024.

Nigeria's Human Development Index (HDI) slowly increased from 0.527 in 2015 to 0.548 in 2022 with very low progress or seemingly stagnation at 0.550 in 2024. This made Nigeria remain in the low HDI as little benefits were quickly eroded by a high poverty rate of 38.9%, inequality, and conflicts (World Bank, 2023).
Also, Nigeria's life expectancy rate rose from 53.1 in 2015 to 54.7 in 2021 and sharply declined to 52.7 in 2022, while the GNI per capita (PPP), which was $5,433 in 2015, nosedived to $4,790 in 2022. The mean years of schooling increased from 6.0 in 2015 to 7.2 in 2022 due to economic hardship and insecurity, with very low gain in health and education (HDI – Global Hunger Index, 2024; WFP, 2024).

Overall, Nigeria's malnutrition percentage has been between 31–33 since 2015 for stunting (chronic malnutrition, children under 5 years), wasting stagnated between 8.0–9.5, while undernourishment deteriorated from 11.5% in 2015 to 16.5% in 2024 (WFP, 2025; GHI, 2024; UNICEF, 2024). In the same vein, Nigeria's food price inflation percentage rose from 10.76 in 2015 to a high index of 26.08 in 2024 (NBS, 2024; UNICEF, 2024).
The above empirical data show an ugly trend for Nigeria. There was also a sharp decline in the national budgetary allocation to agriculture from 3.61% in 2019 to 1.26% in 2024. This is in sharp contrast to the African Union's (AU) Maputo 2003 and Malabo 2014 declarations (which Nigeria was a signatory to) that national budget to agriculture should be 10% and above to help ensure food security and sustainable development (AGOA, 2021; WAAPP, 2010 & 2025).

Thus, Nigeria's budgetary allocations over the decade (2015–2025) have been below the recommended 10% benchmark (AFDB, 2023; AGOA, 2021). This reflects a big gap between policy intent and actual investment in the agricultural sector.

The food price inflation percentage rate or Consumer Price Index (CPI) for the period under review has shown a worsening trend, rising from 10.7 in 2015 to 26.08 in 2024 (WFP, 2024; World Bank, 2024; Global Hunger Index – GHI, 2023).

Based on the escalating economic hardship, dwindling per capita income, malnutrition, and decline in the share of agriculture in gross domestic product (GDP), this paper aims at analysing the trend of Nigerian food security, nutrition, and governance, and the implications for agricultural development and policy.

National Bureau of Statistics (NBS, several years, & 2024, Q1.2025 ;AFDB, 2024; Adebayo ,2010; Adebayo & Ojo, 2012) have reported a decline in agricultural percentage share of the GDP from 25.08 and 25.13 in 2017 and 2018 respectively to 20.50 in 2024. Nigeria's human development index (HDI) slowly increased from 0.527 in 2015 to 0.548 in 2022 with a very low progress or seemingly stagnation at 0.550 in 2024. This made Nigeria remain in the low Human Development Index as little benefits were quickly eroded by high poverty rate of 38.9%, inequality and conflicts(World Bank,2023).

Also, Nigeria's life expectancy rate in years rose from 53.1 in 2015 to 54.7 in 2021 and sharply declined to 52.7 in 2022 while the GNI per capita (PPP) which was $5,433 in 2015 nosedived to $4,790 in 2022. The mean schooling years of 6.0 in 2015 sky rocked to 7.2 in 2022 due to economic hardship, insecurity with very low gain in health and education (HDI- Global Hunger Index, 2024; WFP, 2024).

Overall, Nigeria's malnutrition percentage has been between 31-33 since 2015 for stunting or chronic malnutrition (children under 5years), wasting stagnated between 8.0 -9.5 while under nourishment deteriorated from 11,5% in 2015 to 16.5% in 2024 (WFP,2025; GHI.2024; UNICEF, 2024). In the same vein, Nigeria's food price inflation percentage rate rose from 10,76 in 2015 to a high index of 26.08 in 2024(NBS,2024; UNNICEF , 2024). The above empirical data have shown an ugly trend for Nigeria. There was also a sharp decline in the national budgetary allocation to agriculture from 3.61percent in 2019 to 1.26 percent in 2024. This is in a sharp contrast to the African Union's (AU) Maputo 2003 and Malabo 2014 declaration (which Nigeria was a signatory) that national budget to agriculture should be 10 percent and above for Africa to help in food security sustainable development (AGOA, 2021; WAAP, 2010 & 2025).

Thus, Nigeria's budgetary allocations over the decade(2015-2025) has been below the recommended 10 percent bench mark (AFDB,2023; AGOA,2021). This reflect a big gap between policy intent and actual investment in agricultural sector. The food price inflation percentage rate or consumer price index (CPI) for the period under review has shown worsening index as it rose from 10.7 in 2015 to 26.08 in 2024(WFP, 2024; World Bank, 2024; Global Hunger Index- GHI, 2023).
Based on the escalating economic hardship, dwindling per capita income, malnutrition and decline in the share of agriculture percentage of gross domestic product (GDP), this paper aims at analysing trend of Nigerian food security, nutrition and governance , and the implications for agricultural development and policy.

Problem Statement

Nigeria ranked 96th position out of 113 in the Global Food Security Index in 2018 with 38 percent poverty. Thus, making food availability, accessibility and utilization one of the major challenges in Nigeria (https://vcdpnigeria.org accessed February 12th, 2025). The African Union had Maputo 2003 and Malabo 2014 declarations where African member states pledged to allocate at least 10 percent of their national budget to agriculture. Nigeria's budgetary allocations to agriculture over the years (2015–2025) have been between 1–3 percent, reflecting a very big gap between policy intent and actual investment (AGOA, 2021; AFDB, 2024; WAAPP, 2021). AFDB (2024) and NBS (2025) reported that Nigeria's agricultural percentage share of GDP declined from 25.13 in 2018 to 20.50 in 2024. World Bank (2023) observed that Nigeria's Human Development Index grew very slowly with 0.527 in 2015 and 0.548 in 2022, which placed Nigeria in the low human development category. The GNI per capita income declined from $5,433 in 2015 to $4,790 in 2022.

Global Hunger Index (2024) reported that malnutrition has been one major challenge for Nigeria with stunting rate of 32 percent since 2015, wasting stagnated at an average of 8.25 percent, while undernourishment deteriorated from 2015 figure of 11.5 to 16.5 percent in 2024 (UNICEF, 2024). Nigeria's inflation rate did not fare better either, according to NBS (2024), it increased from 10.76 percent in 2015 to a galloping rate of 26.08 in 2024. The empirical evidence from the review so far has shown that Nigeria is not yet out of the woods as the agriculture share of national budget and GDP are dwindling downwards, with high food price inflation rate, lower life expectancy due to low Human Development Index and increasing malnutrition index and prevalence across Nigerian states. Thus, necessitating this study for immediate solutions.

Research Objectives

The broad objective of the study is to evaluate food security, nutrition and governance in Nigeria for a decade (2015–2025); while the specific objectives are to:

a) Determine the national budget to agricultural sector in the period under review.
b) Examine the agricultural Gross Domestic Product share in Nigeria (2015–2025).
c) Describe some of the agricultural initiatives, strategies and programmes between 2015 and 2025 targeted at Nigeria food self-sufficiency.
d) Evaluate the Nigerian Human Development Index in the period under review.
e) Verify the malnutrition and food price inflation rates in Nigeria (2015–2025) for implications on agricultural development and policy.

METHODOLOGY

Time series data from 2015 to 2025 were aggregated on Nigeria's budgetary allocation to agriculture, agriculture share of the GDP, Human Development Index, malnutrition percentage rate, food price inflation percentage rate (CPI) (Adebayo, 2010), and government agricultural initiatives, strategies and programmes will be collated, sequenced and analysed. Trend analysis was employed to show the trends of the variables and explored the influence on Nigeria's food security, nutrition and governance with the implications for agricultural development and policy.

RESULTS AND DISCUSSION

Despite several government agricultural initiatives, strategies and development programmes, it is not yet Uhuru in achieving food self-sufficiency in Nigeria for the decade under review on research objective (iii). The data in Table 1 showed that the agricultural share of the national annual budget increased in 2015 from 0.88 to 3.61 percent in 2019, and snowballed to 1.26 percent in 2024. The allocation fell below the recommended 10 percent African Union's benchmark. The gross continuous shortfalls in annual agricultural budgets have serious implications for agricultural mechanization, low productivity, food security and nutrition in Nigeria dealt with research objective (i). The findings concerned with the principles concurred with low agricultural budgets that are consequent upon low financing, poor mechanization and low sustainable support for innovative farming strategies earlier reported by West African Agricultural Productivity Programme (WAAPP, 2021).

Data acquired in Table 2 have shown the trends on agriculture share of GDP from 2015 to 2025 which answered objective (ii). The share of agriculture percentage rose from 23.11 percent in 2015 to 25.13 in 2018 and nose-dived to 20.50% in 2024. This reflected a faster growth rate in the service sector (ICT and finance) due to insecurity challenges in agricultural sector, climate change and low agricultural productivity. The findings agreed with AFDB (2023) forecast that above all, the agricultural sector in Nigeria faces challenges of low productivity.

Table 3 showed data on the Nigerian Human Development Index (HDI) on research objective (iv) which indicated that our HDI increased slightly slowly from 0.527 in 2015 to 0.548 in 2022, with a very low Human Development Index and high poverty rate of 38.9 percent, inequality and conflicts. In 2015, Nigeria was placed 152 out of 188 countries and 163 out of 191 nations in 2021.

Life expectancy in 2015 which was 53.1 rose to 54.7 years in 2019 but decreased to 52.7 years in 2022 while the Gross National Income (GNI) per capita or Purchase Power Parity (PPP) in dollars which was $5,433 in 2015 dovetailed to a lower level of $4,770 in 2022 with no statistical data for the years 2023–Q1 2025. The mean schooling years which was 6.0 in 2015 skyrocketed to 7.2 years in 2022 due to economic hardships, insecurity with very low gains in health and education

eroded away. The HDI findings are in concordance with World Bank (2023) report and the observations of Global Hunger Index (2024).

Nigeria's malnutrition prevalence percentages were as shown in Table 4 and dealt with objective (v). The prevalence rate of stunting or chronic malnutrition of 32.9 percent in 2015 increased to 33.0 percent in 2017 and stagnated at 32.0 in 2024. However, wasting or acute malnutrition increased from 7.9% in 2015 to 8.5% in 2024 for children under 5 years, while undernourished increased from 11.5 percent in 2015 to 16.5 percent in 2024. This also showed that about 2.0 million children are under severe malnutrition while 18 million children are projected to be in acute food shortage and this is most glaring in food production areas in Northern Nigeria with insecurity and banditry. The findings are in concordance and agreed with earlier studies by UNICEF (2022), WHO (2024), Global Hunger Index (2023), World Bank joint estimates for several years with WFP (2025) and UNICEF (2025).

Table 5 were the inflation percentage rates in Nigeria from 2015 to 2024 for research objective (v). The data showed a sharp increase in the rate of inflation from 10.76% in 2015 to 26.08% in 2024. The Consumer Price Index of 33.69% in April 2024 sprang up from 8.50% in 2015. These findings are in accord with previous observations of NBS (2023) and Global Hunger Index (2024).

CONCLUSION AND RECOMMENDATIONS

Based on the findings, all has not been well with the reviewed variables of growth and development reflecting inadequate food security, nutrition and inefficient governance. The researchers therefore, concluded that despite several Nigerian government efforts to revamp agriculture, food security and nutrition have not been achieved.

It is recommended that Nigeria can get it right by funding agriculture adequately to position the sector for growth, employment generation, meet domestic food demand, and generation of foreign exchange through exports promotion. It is interesting that the Federal Government's increment funding of agriculture is an improvement over those of the last two years but should be up to 10 percent of national annual budget to increase life expectancy and per capita income. Adequate funding, monitoring and evaluation of all agricultural projects for efficiency and increased productivity is hereby recommended.

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28. Notes on Annual GDP per Capita (PPP in 2017 Int. $) – globalnutritionreport.org

Table 1: Agriculture Share of the National Budget (2015–2025)

Year	Total Budget (₦ Trillion)	Agric. Allocation (₦ Billion)	Agric. Share (%)	Agric. Programmes / Initiatives & Strategies
2015	4.49	39.53	0.88	Agricultural Transformation Agenda (ATA)
2016	6.06	75.86	1.25	Agricultural Promotion Policy (APP)
2017	7.44	135.40	1.82	Economic Recovery & Growth Plan (ERGP)
2018	9.12	203.90	2.23	Anchor Borrowers Programme (ABP)
2019	8.92	322.00	3.61	Anchor Borrowers Programme (ABP)
2020	10.59	160.00	1.51	COVID-19 Health & Economic Relief
2021	13.59	215.00	1.58	National Agricultural Technology & Innovation Policy (NATIP)
2022	17.13	283.00	1.65	NATIP
2023	21.83	228.40	1.11	
2024	28.80	362.91	1.26	37% HQ-focused, low field impact
2025*	47.90*	826.50* (Est.)	1.70* (Target)	Targeted mechanization & food security

Table 2: Agriculture Share of Gross Domestic Product – GDP (2015–2025)

Year	Percentage Share (%)	Remarks & Milestones
2015	23.11	Agric is main driver of GDP despite low mechanization & insecurity.
2016	24.43	Same with fall in oil prices.
2017	25.08	Push by Agricultural Promotion Policy (APP).
2018	25.13	Despite flooding & conflicts in key agric zones.
2019	22.04	Share declined as service sector grew faster.
2020	24.14	Lockdown & supply chain disruptions.
2021	23.36	2.13% attributed to maize, rice & cassava.
2022	22.85	Insecurity, flooding & climate change impacts.
2023	21.07	Persistent insecurity & high input costs.
2024	20.50	AFDB forecasts & recommends more agricultural funding.
2025*	21.00* (Estimate)	Need for improved security & agriculture investment.

Sources: AFDB (2025); NBS (2024 & Q1 2025)

Table 3: Nigeria Human Development Index – HDI (2015–2025)

Year	HDI Rate	Ranking	Life Expectancy (yrs)	Mean Schooling Years	GNI per Capita (PPP $)
2015	0.527	152/188 nations	53.1	6.0	5,433
2016	0.530	152 (same)	–	–	–
2017	0.532	157	53.9	–	–
2018	0.534	158	–	–	–
2019	0.539	161 (same)	54.3	6.1	5,135
2020	0.539	–	–	–	–
2021	0.535	163/191	54.7	–	–
2022	0.548	–	52.7	7.2	4,790
2023	0.548	–	–	–	–
2024*	0.548–0.555*	Stagnation	–	–	–
2025*	0.555–0.560*	–	–	–	–

Sources: World Bank (2023); NBS (various years)

Table 4: Nigeria – Malnutrition Percentage Rate (2015–2025 Q1)

Year	Stunting/Chronic Mal. (>5)	Wasting/Acute Mal. (>5)	Undernourishment (%)
2015	32.9	7.9	11.5
2016	33.1	7.2	12.0
2017	33.0	7.4	12.5
2018	31.5	7.0	13.1
2019	31.5	6.8	13.4
2020	31.5	7.0	14.0
2021	31.5	7.1	14.6
2022	31.5	7.3	15.0
2023	31–32	7.5–8.0	15.5
2024	32.0	8.5	16.5
2025*	32.5*	9.5*	17.5*

Sources: Global Hunger Index (GHI 2015 & 2024); UNICEF; World Bank; Joint Malnutrition Estimates

Table 5: Inflation Percentage Rate in Nigeria (2015–2025)

Year	Inflation Rate (%)	Nominal Percentage Increase (%)	Consumer Price Index (CPI)
2015	10.76	–	8.50
2016	18.36	8.40	x
2017	16.52	-1.84	x
2018	14.80	-1.72	x
2019	–	–	x
2020	–	–	x
2021	–	–	x
2022	23.72	8.92	x
2023	24.05	1.67	x
2024	26.08	2.03	33.69
2025	–	–	x

Source: NBS. https://www.nigeriastat.gov.ng (Accessed March 20, 2025)

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Comparative Analysis of Broiler Chicken Welfare Using Alternative Bedding Materials to Wood Shavings

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ABSTRACT
The poultry industry's environmental footprint and animal welfare are pressing concerns in the face of climate change and food security challenges. This study investigates the welfare of broiler chickens raised on alternative bedding materials, specifically coconut husk and palm pressed fiber, compared to traditional wood shavings. A total of 90 day-old broiler chicks were randomly assigned to three treatment groups, each with 30 birds, and further divided into three replicates. The birds were reared in deep litter houses containing the respective bedding materials for six weeks. Welfare parameters, including dust-bathing frequency, breast blister incidence, and foot pad lesions, were monitored and recorded. The results showed that birds on wood shavings exhibited the highest frequency of dust-bathing behavior (60.7%), followed by palm pressed fiber (56.7%) and coconut husk (43.7%). Notably, no breast blisters were observed in any of the treatment groups. However, the incidence of foot pad lesions statistically, was significantly lower in birds on coconut husk and palm pressed fiber (0%) compared to those on wood shavings (25%). These findings suggest that coconut husk and palm pressed fiber are suitable alternatives to wood shavings for promoting improved welfare outcomes for broiler chickens, particularly in reducing foot pad lesions.
Keywords: alternative bedding materials, broiler chicken welfare, coconut husk, palm pressed fiber

INTRODUCTION
The poultry industry faces pressing challenges in balancing animal welfare, productivity, and environmental sustainability. Bedding materials play a critical role in maintaining a healthy and comfortable environment for broiler chickens. However, traditional bedding materials like wood shavings, straw, and sawdust have significant environmental drawbacks, including contributing to deforestation and climate change (Melecio *et al.,* 2020; Ozturk *et al*., 2022). As the world grapples with the urgent need to mitigate climate change and ensure food security, exploring sustainable alternatives to conventional bedding materials is essential. In this context, identifying environmentally friendly bedding options can help reduce the poultry industry's ecological footprint while promoting animal welfare and productivity.

This study investigates the welfare of broiler chickens raised on alternative bedding materials, specifically coconut husk and palm pressed fiber, compared to traditional wood shavings. By exploring these sustainable alternatives, this research aims to contribute to a more environmentally conscious and food-secure poultry production system.

METHODOLOGY

Experimental Location

The study was conducted at the Poultry Unit of the Teaching and Research Farm, College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

Experimental Design and Birds' Management

Ninety day-old broiler chicks were procured from a reputable source in Umuahia, Abia State. The poultry house was thoroughly cleaned and disinfected before the birds' arrival. The chicks were weighed and randomly assigned into three treatment groups based on bedding materials: T1 (wood shavings, control), T2 (palm pressed fiber), and T3 (coconut husk). Each treatment consisted of 30 birds, divided into three replicates of 10 birds each. The birds were reared in deep litter houses containing the respective bedding materials for six weeks. All birds received starter diet (ME 2800 kcal/kg, CP 22.00%) and finisher diet (ME 3200 kcal/kg, CP 20.00%) *ad libitum*, along with water. Vaccinations against Newcastle disease (days 5 and 24) and infectious bursal disease (days 10 and 20) were administered.

Data Collection

The effects of alternative bedding materials on the welfare of broiler chickens were investigated, with a focus on dust-bathing behavior, breast blisters, and foot pad lesions. Dust-bathing behavior was monitored three times a week at 5-minute intervals per replicate from weeks 1- 6. Breast blisters and foot pad lesions were assessed weekly, with lesions scored as follows: 0 (no lesion), 1 (modest/slightly lesion), and 2 (considerable/pronounced lesion). All data generated were expressed as percentages of the total birds per replicate and the mean values were presented in bar charts with error bars generated using Microsoft Office Excel 2016.

RESULTS AND DISCUSSION

Dust-Bathing Behavior

Figure 1 shows the frequency of dust-bathing behavior in broiler chickens raised on different bedding materials. The results indicate that birds on wood shavings exhibited the highest frequency of dust-bathing behavior (60.7%), followed by palm pressed fiber (56.7%) and coconut husk (43.7%). This suggests that wood shavings provide an optimal environment for dust-bathing, likely due to their fine-particle texture and dryness (Villagrá *et al.,* 2020). The lower frequency of dust-bathing behavior in birds on coconut husk may be attributed to its coarser texture, which may reduce the birds' ability to effectively toss and work the material through their feathers.

Breast Blisters

Figure 2 shows the effect of litter material on the occurrence of breast blisters in broiler chickens. Notably, no breast blisters were observed in 100% of birds across all treatment groups, including wood shavings, coconut husk, and palm pressed fiber. This finding is consistent with the report by Oke *et al.* (2021), which highlighted the significance of bedding material in preventing breast pad lesions. The absence of breast blisters in this study suggests that all three bedding materials provided adequate moisture absorption and comfort, thereby reducing the risk of lesion development.

Foot Pad Lesions

Figure 3 depicts the effect of bedding materials on the occurrence of foot pad lesions in broiler chickens. The results show that 75% of birds on wood shavings had no foot pad lesions, while 25% had mild lesions. In contrast, all birds (100%) on coconut husk and palm pressed fiber showed no occurrence of foot pad lesions. This finding is in agreement with Shini *et al.* (2021), who reported that alternative bedding materials like rice husks and coconut coir may reduce the incidence of footpad dermatitis and hock burns. The complete absence of foot pad lesions in birds on coconut husk and palm pressed fiber suggests that these materials provide superior comfort and protection for the birds' feet, likely due to their ability to maintain a dry and comfortable environment.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that coconut husk and palm pressed fiber are suitable alternatives to wood shavings for broiler chicken bedding, promoting improved welfare outcomes by reducing foot pad lesions and providing adequate comfort. Furthermore, the use of coconut husk and palm pressed fiber may offer

economic and environmental benefits, through agro-waste recycling and contributing towards the development of a more sustainable, humane and environmentally-conscious broiler production system.

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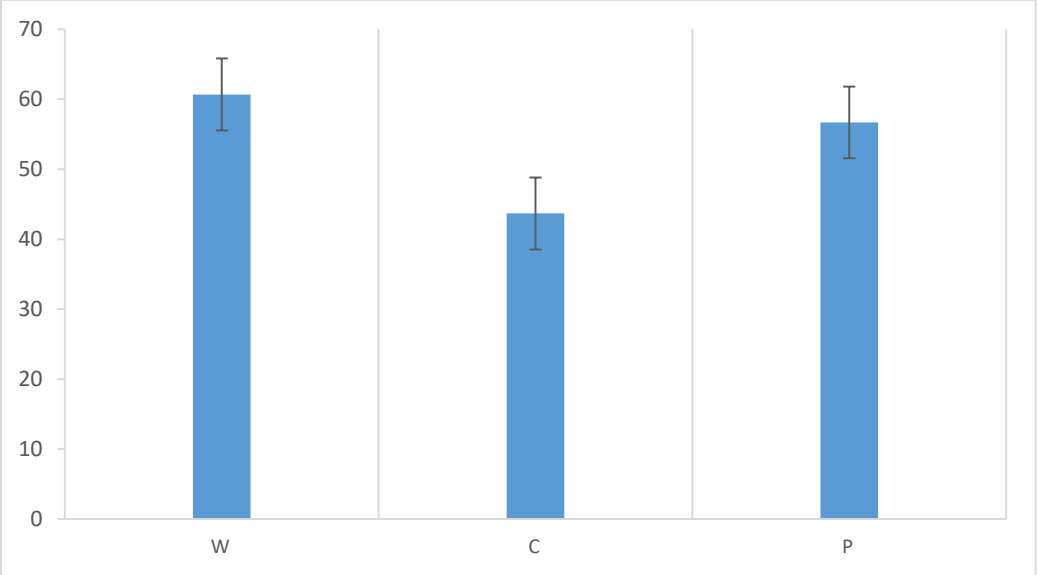

Figure 1: Effect of bedding material on dust bathing behavior of broiler chickens
W= wood shaving; C= coconut husk; P= palm pressed fibre

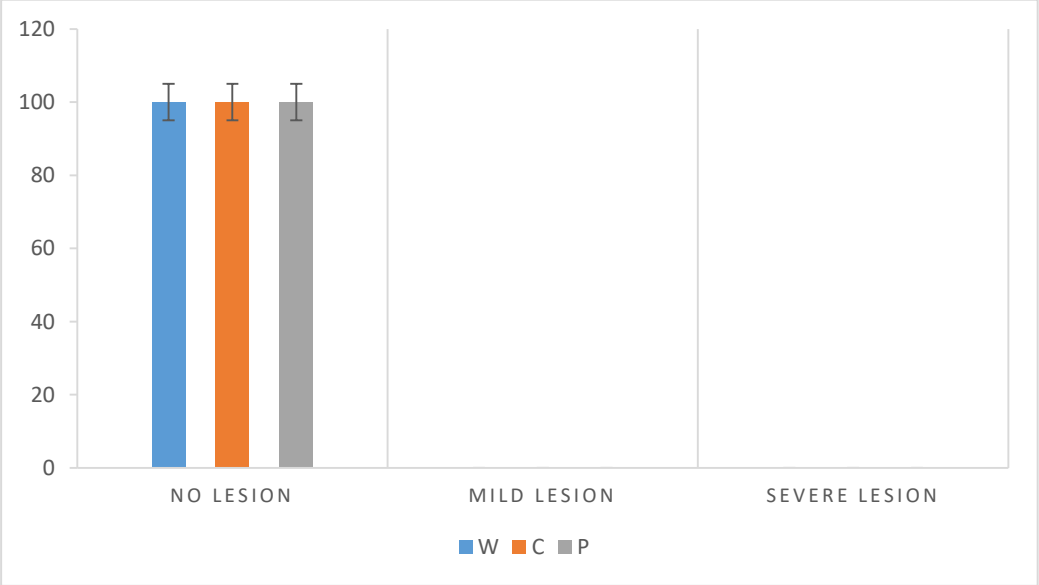

Figure 2: Effect of bedding material on breast blisters of broiler chickens
W= wood shaving; C= coconut husk; P= palm pressed fibre

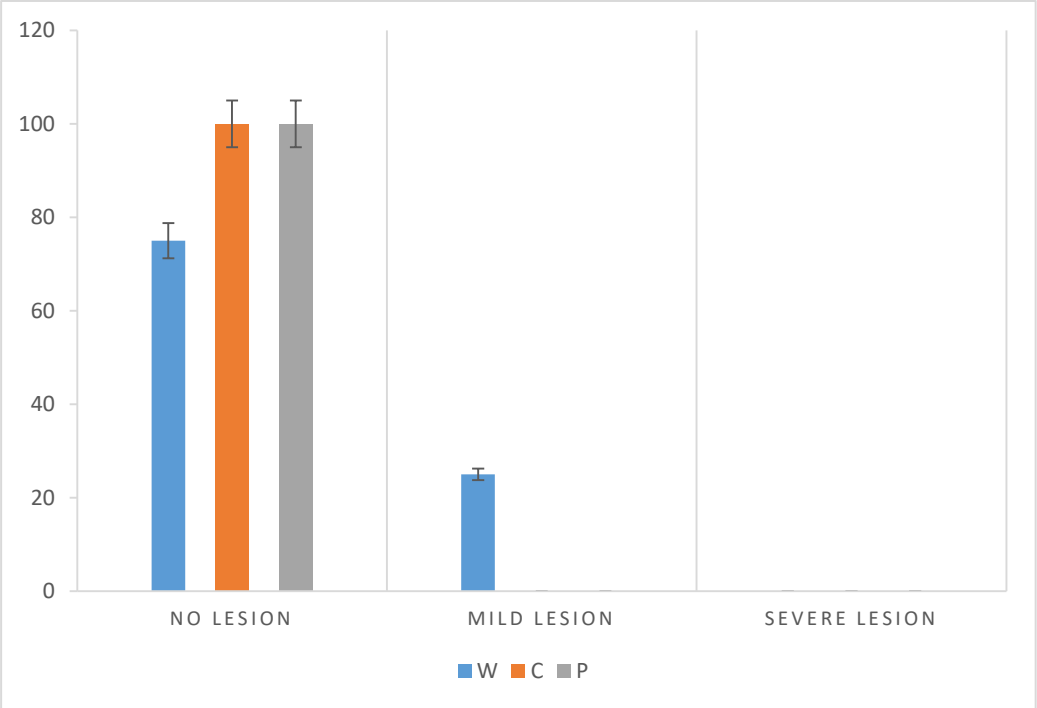

Figure 3: Effect of bedding material on foot pad lesions of broiler chickens
W= wood shaving; C= coconut husk; P= palm pressed fibre

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Determinants of the Income of Catfish Producers and Processors in Umuahia Agricultural Zone of Abia State, Nigeria

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ABSTRACT
The study examined the determinants of the income of catfish producers and processors in Umuahia Agricultural zone of Abia State, Nigeria. The study utilized primary data. Purposive and random sampling techniques were used to select 160 Catfish value chain actors (Producers and Processors) who constituted the respondents for the study. Data for the study were collected using a structured questionnaire. The results showed that the business was profitable. The result showed a net return of ₦73,013.37 from catfish produced and sold by the producers. The result showed that an average catfish processor had a net return of ₦31,452.81 The significant variables that influenced the net income of catfish producers were age, quantity of fingerlings, quantity of feed, pond size, householdsize, educational level, fishing experience, cooperative membership and labour. For the catfish processors, the significant variables that influenced their net return were age, marital status, household size, educational level, processing experience, cooperative membership. The study recommends that government and development agencies should assist catfish value chain actors in attaining by providing physical and marketing infrastructure. The significant variable that influenced the net income of the producers and marketers should be taken into consideration in policy issues.

Keywords: Determinant, Catfish, producer, processor

INTRODUCTION
Catfish farming constitutes the essential backbone of aquaculture in Nigeria. Therefore, the hope of fish supply in Nigeria hangs on sustainable catfish farming (Adewunmi *et al*, 2020). Catfish belongs to the family of *Claridae* and comprises the most commonly reared fishes in Nigeria because of its uniqueness. Catfish is very important in Africa, it has great culture potential in both tropical and sub-tropical environments. The economic importance of catfish is enhanced by their hardiness and adaptability to adverse environmental conditions, tolerance to high density, resistance to diseases, fast growth rate, capability to reproduce under captivity and their ability to thrive well on cheap feed. Common species of catfish reared in Nigeria aquaculture include: *Clarias gariepinus, Heterobranchus bidosalis, Heteroclaries longifilis and Clarias niarodigitatus* (Kaliba *et al.*, 2016). The estimated value of catfish production in Nigeria was around USD 2.6 billion in 2021. (Food and Agricultural Organizaton, FAO, 2021). In terms of Gross Domestic Product (GDP), the fishery sub-sector has recorded the fastest growth rate as it contributes 5.4 percent in agriculture to the Gross Domestic Product ((Food and Agricultural Organizaton, FAO 2020). Therefore, the fishery sector represents a major food source, which is invaluable for protein supply and industrial needs.

Catfish can be consumed fresh as harvested or more value can also be added to catfish so as to improve its quality, shelf-life, nutritional value etc. The processing and preservation of catfish is of utmost importance since catfish is highly susceptible to deterioration immediately after harvest and to prevent economic losses (Okonta and Ekelemu, 2015). Immediately fish dies a number of

physiological and microbial deterioration set in which invariably degrades the quality of catfish. It will become unfit for human consumption within one day of capture, except it is subjected to some forms of processing or perservation (value addition). Even after the fish has been processed, particularly if traditional methods have been used, the fish is still subject to many forms of degradation and spoilage. Hence, catfish being a highly perishable commodity needs to be preserved to avoid post harvest spoilage through drying, smoking and so on. Therefore value addition to catfish is fundamental. The catfish producers are naturally at the lowest level of value chain while the processors are immediately after them. Thus, the marketing interactions between the producers and processor is pronounced in the value chain.

Catfish value chain actors can earn higher benefits as more values are added to the fresh cafish. The value chain analysis has become an increasingly important framework for examining changes in the commodities line and comparative advantage among actors in a particular industry (Ezike, 2015).

Specific objective of this study was to examine the determinants of income of catfish prpducers and processors in Abia state, Nigeria

METHODOLOGY

The Study Area

The study was carried out in Umuahia Agricultural Zone of Abia State, Nigeria. Abia State has a land area of 7,677.20 square kilometers, with a population of 4,143,100 people (NBS,2022). Umuahia Agricultural zone comprises of the following Local Government Areas: Ikwuano; Umuahia North; Umuahia South; Isiala Ngwa North; Isiala Ngwa South.

Sampling Procedure

Multistage sampling technique comprising purposive and random sampling procedures were employed in selecting the respondents for the study. Firstly, Umuahia agricultural zone was purposively selected for the study due to high level of catfish value activities in the zone. Secondly, two (2) Local Government areas (Ikwuano and Umuahia North) were purposively selected from agricultural zones selected for the study based on their interest and engagement in catfish farming and marketing. Thirdly, four (4) communities were purposively selected from each of the 2 Local Government Areas based on the intensity of catfish farming marketing giving a total of eight (8) communities. Lastly, 10 catfish producers, 10 processors were sampled making a total of 80 producers and 80 processors for the study

Analytical Technique

The Net Return analysis used to achieve the objective was specified in line with Adedeji, (2013)
Net Return was expressed as:

$$NR = TR - TC \quad (1)$$

Where,
NR = Net Return of catfish value actors in Naira.
TC = Total Cost. Total cost of catfish in naira incurred by catfish actors.
Total Revenue = Total Revenue. It is the total cash received by value chain actors. It includes returns from sales of fresh catfish, value added to catfish and catfish products sales in Naira.

Multiple regression model for the determinants of catfish producers' net return was expressed thus:

$$Y_1 = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12}, X_{13},) \quad (2)$$

Where,
Y_1= Net Return of the producers (₦)
X_1 = Age of farmers (Years)
X_2 = Fingerlings (Number)
X_3 = Quantity of feed (Kg)
X_4 = Pond size (m^2)
X_5 = Marital status (married =1, others = 0)
X_6 = Household Size (Number of persons in the household)
X_7 = Level of education in years
X_8 = Experience in years

X_9 = Cooperative membership (1= member, 0= non member)
X_{10} = Credit amount (₦)
X_{11} = Labour input (₦)
X_{12} = cost of medication (₦)
X_{13} = Depreciation cost (₦)

Multiple regression model for the determinants of catfish processors' net return was expressed thus:

$$Y_2 = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_{10}, X_{11}, X_{12} X_{13}) \quad (3)$$

Where,
Y_2 = Net return for catfish processors (₦)
X_1 = Age of Marketer (Years)
X_2 = Marital status(married =1, others =0)
X_3 = Household Size (Number of persons in the household)
X_4 = Level of education in years
X_5 = Processing experience in years
X_6 = Cooperative membership (1 =membership,0= non-membership)
X_7 = Credit amount (₦)
X_8 = Purchase price (₦)
X_9 = Transportation cost (₦)
X_{10} = Sex (male =1, female= 0)
X_{11} = Selling price (₦)
X_{12} = Storage cost (₦)
X_{13} = Depreciation (₦)

RESULTS AND DISCUSSION

Table 1.0 shows the cost and returns of the catfish producers and processors. The result shows a positive net return for the two categories of respondents indicating that the business was profitable (Obasi and Kalu, 2015). The catfish producers posted higher levels of net return compared to the processors ₦72,013.37 and ₦31,452.81 respectively). This is however at variance with the expectation that as more value is added to the commodity, higher net return will be recorded. The may be as a result of higher volume of business transacted by the producers relative to the processors.

Table 1: Mean monthly cost and returns for the major catfish value chain actors

Items	Producers Amount (₦)	Processors Amount (₦)
Variable Cost (₦)		
Fingerlings (120) at ₦100	12,000	
Fish feeds	100,000	
Pond management	10,655.56	
Netting	46,000.20	
Medication	10,600.00	
Water	2,540	
Electricity	9,984.87	
Average fresh catfish purchased price/kg		3,000
Average number of kg purchased		50
Purchase cost for the number bought		150,000
Average smoke catfish purchased price /kg		
Average number of kg purchased		
Value of smoked fish purchased		
Labour/Security	10,560.65	
Firewood		15,400
Charcoal		12000
Kerosene		20,000
Transportation	14,210.00	10,500.01
Storage	15,440	17,000
Market association dues		
Loading and offloading		
Total Variable Cost (Tvc)	***223,198.80***	***222,071.23***
Fixed Cost (₦)		
Rent (N)	2,400.78	

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Items	Producers Amount (₦)	Processors Amount (₦)
Depreciation on assets	75,19.22	5,274.33
Interest on loan	13,48.61	1,201.63
Total Fixed Cost (FC) (₦)	**18,787.83**	**6,475.96**
Total Cost (TC) (₦)	**241,986.63**	**228,547.19**
Revenue		
Quantity of catfish harvested (kg)	105	
Selling price per kg of fresh catfish (N)	3,000	
Value of catfish produced/harvested	315,000	
Quantity of fresh catfish processed/smoked (kg)		50
Selling price per kg of catfish processed/smoked		4,500
Value of catfish processed/smoked		270,000
Quantity of fresh catfish sold (kg)		
Selling price per kg of catfish sold (N)		
Value of fresh catfish sold		
Quantity of smoked catfish sold (kg)		
Selling price per kg of smoked catfish sold (N)		
Value of smoked catfish sold (N)		
TOTAL REVENUE	315000	270000
NET REVENUE (₦)	73,013.37	31,452.81

Source: Field Survey Data, 2024

Determinants of Net Returns of Catfish Producers in the Study Area

The determinants of the net returns of catfish producers in Abia State Nigeria are presented in Table 2. The double log functional form was chosen as the lead equation. The choice of the lead equation was based on the number of significant variables, the magnitude of the coefficient of multiple determinations (R^2), the conformity of variables to *a priori* expectation as well as the significance level of the F-ratio. The coefficient of multiple determination (R^2) was 0.776 implying that 77.6% of the total variations in the net returns of catfish farming in the study area was accounted for by the explanatory variables in the model while the remaining 22.4% was unaccounted for, due to error of estimation or omitted variables not captured in the model.

Specifically, the coefficient of age (0.245) was negative and significant at 1.0% probability level. This shows that an increase in age of the catfish farmers would stir up decrease in net returns. The magnitude of the decrease in net returns level as a result of a unit change in the age of catfish farmers is 0.25%. This is in conformity with *a priori* expectation. This indicates that younger fish farming household in the study are still economically active and are better endowed with strength and zest which are essential attributes for a successful farming business. They have age advantage and c an effectively manage their farming business wisely in such a manner that will help them have good returns from their catfish farming business that will help them cater for their needs and those of their families and relatives. These groups of farmers should be able to cope with any stress involved in catfish farming business so as to enhance their productivity and net returns. This also has a lot of positive implications as the able bodied middle aged farmers can cope better with the daily challenges of the enterprise and readily accept new innovations.

The coefficients of fingerlings quantity, feed quantity and pond size were positively related to net returns and were all significant at 1% probability. These results imply that as the number of fingerlings increased, the net returns of catfish farmers increased and vice versa. The size of the pond will determine the quantity of water needed and the number of fingerlings stocked and consequently, the amount of profit made. This conforms to a priori expectation. The net returns is a direct function of the level of use of fingerlings. Quantity of feeds being directly related to net returns of catfish farmers implied that as quantity of feeds increased the net returns of the catfish farmers increased and vice versa. Pond size was also positively (directly) related to the net returns of catfish farmers. This conforms to a priori expectation given the land scarcity and the high population densities in the study area which make access to land for the establishment of pond expensive. Simonyan, et al., (2011) reported that farm size was significant and positively related to output. This is also supported by the studies of Ibekwe et al., (2010). According to this reports, the larger the farm size the greater the output of the farmers, ceteris paribus. A large farm size in this case, pond size will probably confer economics of scale on the farm business and lead to an increase in net returns. Land is a critical constraint to agricultural production in the study area and net returns will most likely increase as the farm (pond) size increases.

Table 2: Factors affecting the value addition/net returns of catfish farmers producers

Variables	Linear	Exponential	Double-Log+⁺	Semi-log
Constant	10688.261	5.216	3.109	-107562.180
	(1.4650)	(16.238)***	(11.942)***	(1.0211)
Age	-118.752	-0.001	0.245	2316.169
	(91-0.553)	(-2.128)**	(-3.712)***	(0.380)
Quantity of fingerlings	836.9349	.0006698	1.264688	1325160
	(16.03)**	(5.85)***	(6.64)***	(4.55)***
Feed quantity	2.332	0.331	15.541	15.541
	(1.228)*	(0.960)**	(2.829)***	(2.829)***
Pond size	-120.461	0.018	1.899	-1561.218
	(-2.131)**	(-0.582)	(3.103)***	(-2.128)**
Marital Status	590.116	-0.119	0.888	1501.214
	(0.062)	(-0.034)	(2.621)	(0.201)
Household size	-875.260	-0.047	0.203	-3196.770
	(-2.863) ***	(-2.917) ***	(3.554)***	(-2.670)**
Educational level	414.234	0.027	0.152	1748.074
	(1.156)	(1.445)	(3.102)***	(0.720)
Fishing experience	-256011	-0.018	0.639	-2401.668
	(-0.563)	(-0.766)	(3.635) ***	(-1.322)
Cooperative membership	13147.10	0.042	0.766	20126.221
	(1.241)	(2.215)**	(2.302)**	(1.321)
Credit amount	78079.89	0.027	0.152	1748.074
	(3.014)	(1.445)	(1.102)	(0.720)
Labour	-31186.65	-0.175	0.101	-12182.724
	(-0.4211)	(-1.884)**	(1.721)***	(-2.104)***
Medication	210.65	0.109	0.045	10991.942
	(0.153)	(0.414)	(1.110)	(0.686)
Depreciation	4110.131	0.078	0.021	3212.328
	(0.182)	(2.417)**	(1.321)	(0.813)
R^2	0.645	0.739	0.776	0.611
Adjusted R^2	0.529	0.716	0.716	0.602
F-statistic	20.714***	21.800***	75.210***	16.780***

Source: Field survey, 2024. ***, ** and * represents 1%, 5% and 10% levels of significance respectively. + = lead equation. Values in parentheses are t-ratios. N = 80

Furthermore, the result showed that the coefficient of household size (0.203) was positively signed and significant ($p<0.01$). This indicates the availability of cheap labour, which could lower the overall cost of catfish production, resulting in an increase in the individual farmer's net returns.

The coefficient of education in agreement with *a priori* expectation was positive and significant at 1% alpha level. Obasi *et al*. (2020) opined that education plays a vital role in making farm decisions such as purchase of inputs, resource allocation, timeliness of cultural practices and prices setting. This is not surprising given that education allows farmers to thrive in their farming activities, particularly in terms of farm management - decision making, planning, organizing, directing, coordinating, credit assessment, credit use, and product distribution.

Literacy (ability to read and write) would also enable the farmers to better utilize effectively and efficiently available resources in the area for farm businesses which would improve their productivity. As expected, higher education could enhance improved business ideas, skills, innovation and managerial ability for business sustainability. This finding is homologous with those of Nwibo and Okorie (2013) who studied determinants of Entrepreneurship Among Agribusiness Investors in South-East, Nigeria and found out that as an individual increases his educational attainment, his managerial ability for business sustainability also increases implying that education is a veritable tool in farm management.

The coefficient of fishing experience (0.639) is also positively signed and significant at 1% alpha level. This result is in line with *a priori* expectation. Farming experience aids in the combination and allocation of farming resources, farm management decisions, and forecasting the expected success of a farming business, particularly when the hazardous character of the farming business is considered. The longer the years of fishing experience a farmer has, the more practical expertise he will have in dealing with the challenges that come with fish farming. This result is in consonance with those of Obasi *et al*., (2020) who submitted that farming experience is crucial to the overall management of the farm activities and it has been hypothesized to be highly related to the welfare

and productivity of the farmers. Resource control and allocation (which improve with experience) are major activities that determine farm output and productivity. This result is also similar to that of Iheke and Nwaru (2014) who submitted that smallholder farmers rely heavily on their agricultural expertise to improve net returns. Farming expertise is also useful in developing ideas and implementing improved farming practices that would result in increased investment, output, and income creation. This finding is analogous with those of Mejeha *et al*., (1998) who found that farming experience can provide insight into a farmer's managerial abilities, knowledge and competence that would lead to increased profit.

Labour was positively related to the net returns of catfish farmers and significant at 10%. This implies that as availability and quantity of labour increased, net returns of catfish farmers increased and vice versa. Agricultural production in the study area is subsistence oriented and labour intensive. Labour use on the farm will increase as the level of use of other inputs increased. As a result net returns will increase. Similar positive relationships between labour and output were reported by Obasi *et al,* (2020).

The membership of cooperative society had direct relationship with the dependent variable and significant at 5% probability level. This could be as a result of the fact that membership of cooperatives offers members some advantages which among other things include borrowing money from the union and expanding their scale of operation, which will lead to higher returns.

Determinants of Net Returns of Catfish Processors

The factors influencing the net returns among catfish processors in Abia State Nigeria are presented in Table 3.0. The double log functional form was chosen as the lead equation. The choice of the lead equation was based on the number of significant variables, the magnitude of the coefficient of multiple determinations (R^2), the conformity of variables to *a priori* expectation as well as the significance level of the F-ratio. The coefficient of multiple determination (R^2) was 0.839 which implies that 83.9% of the total variations in the value addition/net returns in the study was accounted for by the explanatory variables in the model while the remaining 16.1% was unaccounted for, due to error of estimation or omitted variables not captured in the model. Age, marital status, household size, educational level, processing experience, membership of cooperative, purchase price, transportation cost and selling price were significant variables that influenced the net returns of catfish processors in the study area.

The coefficient of age of the processors (-1.003) was negatively signed and significant at 1% alpha level implying a negative relationship of age of the processors with net return. This result suggests that the younger catfish processors had higher net returns than those who are older. This fact is likely be as a result of the fact that the younger catfish processors are more enterprising and could afford to take more risks than the elderly ones considering the nature of the processing business. Nwibo *et al.,* (2011) supported this result as they were of the opinion that advancement in age has a negative effect on business ventures.

The coefficient of marital status (0.888) was positively signed and statistically significant at 5% risk level. This result implies positive relationship of marital status with net returns of the processors. This result is suggestive of the fact that net returns is higher for married catfish processors than those who are single. In other words, being married as a catfish processor increases net returns than not being married.

The coefficient of household size (1.201) was significant at 5% and had a positive relationship with net returns of the processors. This implies that as the household size of the processors increases, their net returns also increases. Increase in household size is certainly of immense advantage to the processor since the household members could assist in the processing activities. Larger household size in this case, is likely to increase the scale of processing activities and as a result net returns increases. This result is similar to the one obtained by Bedemo, *et al*., (2013) who reported that household composition has a significant effect of on farm and off-farm activities.

Table 3: Determinants of net returns of catfish processors

Variables	Linear	Exponential	Double-Log+⁺	Semi-log
Constant	110412.4	3.999	8.164	-621100.423
	(6.016)***	(9.612)***	(2.910)***	(-3.261)***
Age	-200.611	-0.426	-1.003	-21222.210
	(-2.999)***	(-1.926)**	(-3.492)***	(-2.201)**
Marital Status	590.116	-0.119	0.888	1501.214
	(0.062)	(-0.034)	(2.321)**	(0.201)
Household size	4439.830	0.018	1.201	19842.132
	(2.110)**	(1.163)	(2.411)**	(1.703)*
Educational level	202.444	0.292	1.425	1956.620
	(3.210)***	(2.292)**	(3.641)***	(1.999)**
Processing experience	494.172	0.201	1.723	2821.324
	(2.104)**	(2.009)**	(2.136)**	(1.823)*
Cooperative membership	13147.10	0.042	0.766	20126.221
	(1.241)	(2.215)**	(2.302)**	(1.321)
Credit amount	-11514.30	-0.041	0.174	-12345.261
	(-1.181)	(-1.001)	(3.721)***	(-2.062)**
Purchase price	-120.461	0.018	-1.899	-1561.218
	(-2.131)**	(-0.582)	(-3.103)***	(-2.128)**
Transportation cost	-204.563	-0.075	-0.141	-32682.724
	(-2.122)**	(-1.984)**	(-3.521)***	(-2.144)***
Sex	210.65	0.109	0.045	10991.942
	(0.153)	(0.414)	(1.110)	(0.686)
Selling price	120.174	0.072	1.341	114291.210
	(1.993)**	(0.912)	(4.221)***	(1.321)
Storage cost	1921.004	0.111	-0.018	-7114.610
	(0.142)	(0.204)	(-1.312)	(-0.173)
Depreciation	4110.131	0.078	0.021	3212.328
	(0.182)	(2.417)**	(1.321)	(0.813)
R^2	0.745	0.739	0.839	0.718
Adjusted R^2	0.729	0.716	0.816	0.702
F-statistic	30.715***	28.870***	45.216***	26.700***

Source: Field survey, 2024. ***, ** and * represents 1%, 5% and 10% levels of significance respectively. + = lead equation. Values in parentheses are t-ratios. N = 80

The coefficient of education (1.425) was significant at 1% and positively related to the net returns of the processors. This result implies that as the educational level of the processors increases by one year, their net returns increases by N1.425 and vice versa. Processors, who acquired more education, had more net returns. Learning enables the learner to become more objective in decision-making and enhances the processors' abilities to adjust to modern processing innovations and techniques.

The coefficient of processing experience (1.723) was positively signed and is statistically significant at 5% alpha level. This is in line with *a priori* expectation that experience gained over the years would enable processors to allocate scarce resources efficiently. This will also enable them to minimize cost which by extension will maximize net returns.

The coefficient of membership of cooperative (0.766) was positive and significant at 5% level of probability. This suggests that those catfish processors who belong to cooperative tend to have high net returns than others who do not belong to cooperatives. This could be explained by the fact that membership of cooperatives offers members some advantages which among other things include borrowing money from the union and expanding their scale of operation, which will lead to higher returns.

Processors' access to credit (credit amount) gave a positive coefficient (0.174) and was highly significant at 1.0% alpha level, indicating that an increase in processors' credit amount would increase net returns. The sign identity of this variable makes sense for this study and conforms to *a priori* expectation. Access to credit has been identified as an important factor in farm and off-farm businesses and useful in funding transaction cost for processing activities. It also regarded as one of the key elements in raising productivity and income.

The coefficient of purchase price (-1.899) was negatively signed and is statistically significant at 1% probability level. This means that as purchase price increases by N1, net returns of the processors'

decreases by N1.899 and vice versa. Increase in purchase price leads to higher cost per unit of the commodity, hence decrease in net returns.

The coefficient of transportation cost (-0.141) was negatively signed and significant at 1% risk level. This implies that increase in transportation cost decreases the processors' net returns Increase in transportation cost would mean more expenses for the processors thereby leading to a decrease in net returns. The coefficient value of selling price (1.341) was positive and significant at 1% probability level. This suggests that net returns was higher when selling price increased. This implies that as selling price increases, net returns on catfish processing also increases and vice versa.

CONCLUSION AND RECOMMENDATIONS

The study showed that the business was profitable with the catfish producers posting higher levels of net return relative to the processors. The significant variables that influenced the net income of catfish producers were .Age, quantity of fingerlings, quantity of feed, pond size, householdsize, educational level, fishing experience, cooperative membership and labour. For the catfish processors, the significant variable that influenced their net return were Age, marital status, household size, educational level, processing experience, cooperative membership, credit amount, purchase price, transport cost and selling price.

From the findings of this study, it is recommended that:

i. The significant variables that influenced the income of the catfish producers and processors should be taken into consideration for policy issues by government and non-governmental organizations
ii. There should be improvement in physical and marketing infrastructure by government in order to reduce cost incured by the catfish value chain actors.while the value chain actors should form cooperatives for mutual assistance and enhancement of their operations.

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Socioeconomic Determinants of Women's Involvement in the Processing of Plantain Products in Southern Senatorial Zone of Abia State, Nigeria

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ABSTRACT
This study analysed socio-economic determinants women's involvement in the processing of plantain products in Southern Senatorial Zone of Abia State, Nigeria. A multi-stage sampling procedure was employed in the sampling of eighty (80) plantain processors that were involved in the survey. Structured questionnaire was used to get responses from the women. Both descriptive and inferential statistics (multiple regression) analysis were used to analyze the data. Findings from the study showed that the mean age of the women was 40 years with a mean household size of 6 persons and mean years of experience in processing of 8 years, having a mean monthly income of ₦131,125.00. Furthermore, the women have high access to raw materials for processing of plantain products with a grand mean of 3.1 and were high involvement in processing with grand mean score of 2.53. in plantain processing. The women had server constraints in processing plantain products with a grand mean of 2.50. Multiple regression analysis showed that there was significant relationship between the socio-economic characteristics of the women and their level of involvement in processing plantain into products. The study concluded that the involvement of women in the processing of plantain products is not high due to the constraints they face and therefore recommended that more of the women should actively participate in cooperative societies to assist them raise soft loans to boost their enterprise, earn more income.

Keywords: Socio-economic, determinants, women processors, plantain products

INTRODUCTION
In Nigeria, plantain is produced in large quantities in Edo, Delta, Ogun, and Ondo States. Other producing states are River State, Cross River, Imo, Plateau, Kogi, Abia and Enugu. Plantain is important in the diet of many Nigerian families, it is normally eaten in convenient form like "dodo" (fried ripe pulp), chip (fried unripe pulp) and as plantain flour which has an advantage over other starchy foods because it contains protein, mineral & vitamins (Amah, et al, 2020). Medicinally plantain can be used to cure some ailment like sore throat, tonsillitis, diarrhea and vomiting, due to its high nutrients, plantain is used in the production of soymusa, which can be used in the treatment of Kwashiorkor (Amah et al., 2019).

Women constitute the backbone of any nation and the prosperity of the nation lies majorly upon them. They play essential and tremendous roles because they are resourceful and innovative not only in the informal but also in the formal sector. Patel and Anthonio (2015), stated that women help their husbands in decision-making and also assist them financially to enhance in processing of

plantain products. Extension provides rural women the opportunity to participate in trainings that will enable them understand the processing technologies in order to contribute to the health and well-being of their families Ukoha and Okonkwo, 2017).

Processed plantain products can ensure food availability, accessibility as well as making food affordable due to increased income from the enterprise. This of course will help the women to have their households to be food secured. It is of note that processing plantain into various products have become lucrative ventures in recent times due to increasing demand for plantain products in the World (Bhuiyan *et al*., 2020).

Despite the economic potentials inherent in the plantain processing into various products as an enterprise, it seems that the women that are involved in plantain processing products in Abia South zone of Abia State are not much, and the processed products are primarily subsistent, processed mainly for the traditional food market.

In view of the above, it is therefore necessary to investigate the women's level of access to raw materials for processing plantain products, their level of involvement and the challenges they face in processing the plantain products that influence their active involvement in the enterprise.
Specifically, the objectives of the study were to:

i. describe the socio-economic characteristics of the women in the study area;
ii. ascertain their level of access to raw materials for processing;
iii. identify different types of plantain products that the women are involved in processing;
iv. determine the level of involvement of the respondents in plantain processing; and
v. ascertain the constraints faced by the women in processing their plantain products

METHODOLOGY

Study Area

The study was carried out in Abia South zone of Abia State. It is a senatorial zone/district in Abia State, comprising of the entire geographical areas, located in the tropical rain forest zone which favours the processing of plantain products. Abia State lies within approximately latitudes 40 40′ and 60 14′ north, and longitudes 70 10′ and 80 east. The state shares common boundaries to the north with Ebonyi State; to the south and southwest with Rivers State; and to the east and southeast with Cross River and Akwa Ibom States respectively. To the west is Imo State, and to the northwest is Anambra State. The state covers an area of about 5,243.7sq. km which is approximately 5.8 per cent of the total land area of Nigeria. About 2.4million people in the zone are very entrepreneurial in nature.

Sampling Technique and Sample Size

Multi stage sampling technique was adopted for this study. In the 1st stage, purposive sampling was employed to select four Local Government Areas (LGAs) in Abia South Zone out of Six LGAs in the Zone namely: Aba South, Aba North, Osisioma Ngwa and Ukwa East LGAs. In the 2nd stage, two Communities were also selected purposively from each of the four Local Government Areas due to the predominance of plantain business in the area making a total of eight (8) communities. These were Aba North LGA – Osusu and Umuokoji; Aba south LGA- Aba- Ukwu and Umunisi; Osisioma LGA – Uratta and Umunneise; while for Ukwa East LGA – Ohuru Ala- and Ukwu were selected. Thirdly, ten (10) women plantain processors in each of the 8 communities that were selected, bringing the sample size to a total of eighty plantain processors that participated in the study.

Method of Data Analysis

Data for the study were collected through the use of questionnaire and Objectives i, ii and iii were analyzed using descriptive statistics such as frequency counts, percentages and means while objective iv was realized using a 4-point likert type of rating scale namely: most often = 4, often =3, sometimes = 2 and never = 1. The bench mark was obtained thus: 4+3+2+1 = 10, divided by 4 to give 2.50 mean score. This implies that any mean score responses less than the bench mark of 2.50 were adjudged to be low, between 2.51 and 2.70 were said to be moderate while from 2.71 and 2.90 were adjudged to be high level of involvement in plantain processing. Also objective v was realized using a 4-point likert type of rating scale namely: Strongly Agree = 4, Agree = 3, Disagree = 2 and Strongly Disagree = 1. The bench mark was obtained thus: 4+3+2+1 = 10, divided by 4 to give 2.5 mean score This implies that any mean score responses less than the bench mark of 2.50 were adjudged to be less, between 2.51 and 2.70 were said to be moderate while from 2.71 and

2.90 were adjudged to be high severe constraints limiting the women from getting much more involved in plantain processing enterprise.

Test of Hypothesis

H0: There is no significant relationship between the socio-economic characteristics of the women and their level of involvement in processing plantain into products will be tested using Ordinary Least Square Regression Model. The four functional forms of OLS is explicitly specified thus:

Linear function

$$Y=ß+ß+x_1+ß_2x_2+...ß_nx_nci \quad (1)$$

Exponential function

$$\text{Log } Y= ß + ß_1 + x_1+ß_2x_2 +...ß_nx_n+ci \quad (2)$$

Semi-log function

$$B_o + ß_1 \ln x_i +ß_2\ln x_2 +...ß_n\ln x_n + ci \quad (3)$$

Cobb Douglas function

$$\text{Log } Y= ß_o + ß_1 \ln x_i + ß_2\ln x_2 +... ß_n \ln x_n + ci \quad (4)$$

The model is specified implicitly thus:

$$Y = f (X_1, X_2, X_3, X_4, X_5, X_6, X_9, X_{10}, X_{11}) + ei \quad (5)$$

Where;

Y = Level of involvement of women in plantain processing (mean score)
X_1 = Age (Number of years)
X_2 = Education status (years spend in school)
X_3 = Marital Status (Married = 1, otherwise = 0)
X_4 = Household size (Number of persons living and eating from the same pot)
X_5 = Years of plantain processing experience (years)
X_6 = Frequency of contact with extension (Always=3, Sometimes= 2, Never=1)
X_7 = membership participation in corporative organization (Always=3, Sometimes=2 &Never =1)
X_8 =Quantity of plantain products processed monthly (in kg)
X_9 = Access to credit (1=Yes; 0=No)
X_{10} = Monthly income (in naira)

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents in the study area

The results in Table 1 showed that majority (60%) of the women were married with a mean age of 40 years indicating that the women were still in their active and productive years. This finding on age agrees with that of Ukoha and Nzeakor (2020) that age affects the rate of farmer's utilization of innovation, which in turn affects household productivity and livelihood improvement strategies. The processors had mean household size of 6 persons, which implies that the women have a fairly large size, although having a large household size may provide most of the labour needed for the processing of plantain products, reducing the cost expended in hiring labourers and leading to increased productivity (Kanu, 2020), however, large household size means more mouth to feed thereby putting pressure on the family income. Majority (89%) of the women were educated in the study area, which is an advantage in the processing business. According to Ifenkwe and Izuogu (2015), education and training enhance farmers' productivity and innovativeness. The women had years of processing experience of eight years. Years of experience is an important factor determining both the productivity and the production level in any enterprise (Ogunsola, Oseni and Bankole, 2020). Majority (85%) of the women had contact with extension once in a month while most (61%) of them belonged to one cooperative society or the other. The absence of extension contact or low extension contact will negatively affect technology utilization among other extension services Ukoha, Agu-Aguiyi, and Onwukwe (2020). Furthermore, the respondents had a mean monthly income of ₦131,125.00 ndicating that plantain processing as an enterprise contributed immensely to the women's income.

Level of Access to Raw Materials for Processing into products
The result of the level of access to raw materials for processing by the women in the study area is presented in Table 2. The result showed that the women have high access to the raw materials for processing in the study area with a grand mean of 3.1. Similarly, Unripe plantain ($\bar{x}$ = 3.4) and Ripe Plantain ($\bar{x}$ = 2.8) were greatly accessed by the women for their processing activities in the study. This could be attributed to the fact that most farmers used to harvest their plantain at the unripe state and quickly make it available to the processors to avoid spoilage and loss.

Types of processed plantain products the women are involved in
The result of the distribution of the types of processed plantain products the women are involved in, is presented in Table 3. It showed that, apart from Plantain ash for potash (15.0%), and Flour (37.5%), most of the other types of plantain products processed were; Roasted plantain (83.8%), Fried (82.5%) and Chips (81.3%) by the women in the study area. The women are therefore more involved in the processing of roasted plantain, fried plantain and plantain chips. This finding is in agreement with that of Evans et al., (2020), and Mogaj and Mogaji (2020) that plantain can be processed into various products.

Level of Involvement of women in plantain processing
Table 4 shows the level of involvement of the women in plantain processing in the study area. A grand mean of 2.53, above the benchmark mean of 2.50 was recorded indicating that the women are moderately involved in the processing of plantain in the study area. However, the individual means of Milling into Flour ($\overline{x}$=2.50), Peeling and roasting ($\overline{x}$=2.68), peeling, slicing and Frying of chips ($\overline{x}$=2.64) were moderate while Packaging of products (2.96) recorded high involvement of the women, indicating that they were the activities in processing of plantain that the women are actively involved in. This collaborates the finding of Ukoha and Okonkwo (2017), that majority of the women in Nigeria are involved in small scale enterprises as a way of solving problem of unemployment in the country thereby contributing their quota to national development.

Constraints faced by women in processing plantain products
Result presented in Table 4 is that of the constraints faced by the women plantain processors in their enterprise. The result revealed a grand mean of 2.50 indicative of the overall severity of the constraints they face in their enterprise. Furthermore, the mean of cost of processing equipment ($\overline{x}$=2.60), Transportation ($\overline{x}$=2.80), Finance ($\overline{x}$=2.88), and Lack of training program ($\overline{x}$=2.50) were much more severe than the rest of the constraints listed in this study. Therefore, any attempt to address the concern of lack of equipment, transportation, finance and training needs will improve the activities of the plantain processors.

Hypothesis Testing
HO: There is no significant relationship between the socio-economic characteristics of the respondents and the level of participation of the women in processing plantain into products. Table 4 is the result of the test of significant relationship between socioeconomic characteristics and level of participation in plantain processing. The four functional forms of the multiple regression model were tried and the Linear model selected as the lead equation due to the highest number of significant variables and a significant F-value of 16.131 at P<0.05 which shows the overall significance of the regression line and a high R^2 value of 0.642 which implies that 64.2% of the total variation in the dependent variable was accounted for by the explanatory variables. The coefficient of marital status (3.411***) was significant and positive. This implies that being in marriage contributes to the level of involvement in plantain processing as the individual works to improve household income.

Furthermore, at P<0.05, Age (4.173***) was significant and positively related to the women's involvement in plantain processing. The implication of the result is that the more advanced the respondents are, the more their drive for innovations that will create value for their enterprise. The coefficient of Household size (2.106**) was significant and positively related to the women's involvement in plantain processing. This implies that the higher the household size the more likely the women will draw from family labour to support the enterprise. The coefficient of Level of Education (5.001***) was significant and positively related to the women's involvement in plantain processing. The implication of the result is that the more advanced in learning an individual is, the more likely she will be open to new innovations on the processing of plantain products. The coefficient of income (5.110***) was significant and positively related to the women's involvement

in plantain processing. The implication of the result is that the more income the farmers receive, the more they are encouraged to invest in improving their earnings from the enterprise. Also, the coefficient of years of processing experience (2.194**) was significant and positively related to the women's involvement in plantain processing. The implication of the result is that the more experienced they are, the more likely they would have learnt strategies for improved performance in the plantain processing business. The study therefore rejects the null hypothesis that states that at P<0.05, there is a no significant relationship between socio-economic characteristics such as Marital status, Age, Household size, Level of formal education, income, years of processing experience with the level of the women's involvement in plantain processing.

CONCLUSION AND RECOMMENDATIONS

The study concludes that the level of women's involvement in the processing of plantain into products were high. Also socio-economic characteristics of the women such as; marital status, age, household size, education, income and years of processing experience influenced their involvement in processing of plantain. The study therefore recommended that more of the women plantain processors need to belong and participate actively in cooperative societies to assist them raise soft loans to boost their enterprise, earn more income and thereby ensure food security for their households.

Table 1: Distribution of Respondents based on their socio-economic characteristics

Variables	Frequency	Percentage	Mean
Marital Status			
Married	48	60.0	
Single	32	40.0	
Age (years)			
≤ 30	5	6.25	
31-40	23	28.75	
41-50	32	40.00	39.5 ≈ 40
≥51	20	25.00	
Household size (numbers)			
1-4	14	17.5	
5-8	52	65.0	6
9 and above	14	17.5	
Educational level (years)			
No formal education	9	11.3	
Primary Education	34	42.5	
Secondary Education	34	42.5	
Tertiary education	3	3.8	
Years of Experience			
≤5	20	25.0	
6 – 10	46	57.5	7.8 ≈ 8
≥11	14	17.5	
Frequency of Extension Contact			
Once in two weeks	2	2.5	
Once in a month	10	12.5	
Once after many months	68	85.0	
Estimated Monthly Income (₦)			
≤50,000	3	3.75	
50100 – 100,000	33	41.25	
100,100 – 150,000	22	27.5	131, 125.00
150,100 – 200,000	20	25	
≤200,100	2	2.5	
Cooperative Membership/Social Organization (numbers)			
Non-members	61	76.3	
Members	19	23.8	

Source: Field Survey Data, 20

Table 2: Distribution of Respondents based on Level of Access to Raw Materials for Processing

Raw materials for processing	Most often	Often	Sometimes	Never	∑*fx*	Mean ∑*fx/n*	Decision
Unripe Plantain	41(51.3)	30(37.5)	9(11.3)	0(0.0)	272	3.4	High
Ripe plantain	17(21.3)	37(46.3)	21(26.3)	5(6.3)	226	2.8	High
Grand Mean						**3.1**	High

Source: Field Survey Data, 2023

Table 3: Distribution based on types of processed plantain products women are involved in

Variables	Frequency	Percentage*
Chips	65	81.3
Flour	30	37.5
Roasted plantain	67	83.8
Fried	66	82.5
Plantain ash for (potash)	12	15.0

Source: Field Survey Data, 2023. *Multiple Responses Recorded

Table 4: Distribution based on Level of involvement of women in processing plantain products

Variables	Most often	Often	Sometimes	Never	∑*fx*	Mean ∑*fx/n*	Decision
Harvesting	26(32.5)	11(13.8)	7(8.8)	36(45.0)	187	2.34	Low
Sorting and Cleaning	18(22.5)	22(27.5)	7(8.8)	33(41.3)	185	2.31	Low
Milling into Flour	23(28.8)	21(26.3)	8(10.0)	28(35.0)	199	2.50	High
Plantain ash for (potash)	14(17.5)	26(32.5)	11(13.8)	29(36.3)	185	2.31	Low
Peeling and roasting	15(18.8)	35(43.8)	19(23.8)	11(13.8)	214	2.68	High
Peeling, Slicing and Frying of chips	12(15.0)	37(46.3)	21(26.3)	10(12.5)	211	2.64	High
Packaging of products	25(31.3)	35(43.8)	12(15.0)	8(10.0)	237	2.96	High
Grand Mean						**2.53**	**High**

Source: Field Survey, 2023. Values in parentheses are nominal Likert values multiplied by frequencies

Table 4: Distribution based on constraints faced by women in processing plantain products

Constraints	Strongly agree	Agree	Disagree	Strongly disagree	∑*fx*	Mean ∑*fx/n*	Decision
Cost of processing equipment	16(20.0)	33(41.3)	14(17.5)	17(21.3)	208	2.60	High
Transportation	23(28.8)	29(36.3)	17(21.3)	11(13.8)	224	2.80	High
Finance	21(26.3)	31(38.8)	25(31.3)	3(3.8)	230	2.88	High
Lack of training program	13(16.3)	20(25.0)	40(50.0)	7(8.8)	199	2.50	High
Not a member of cooperative society	10(12.5)	17(21.3)	41(51.3)	12(15.0)	185	2.31	Low
Fix price of the products	10(12.5)	12(15.0)	46(57.5)	12(15.0)	180	2.25	Low
Reconcile sales and purchase record to identify profit and loss	9(11.3)	19(23.8)	44(55.0)	8(10.0)	189	2.36	Low
Grading	11(13.8)	17(21.3)	44(55.0)	8(10.0)	191	2.39	Low
The ability to calculate time of plantain season	10(12.5)	24(30.0)	37(46.3)	9(11.3)	195	2.44	Low
Grand Mean						**2.50**	

Source: Field Survey, 2023. Values in parentheses are nominal Likert values multiplied by frequencies

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Table 4: Ordinary Least Square Regression Results of the Relationship between the socio-economic characteristics of the respondents and their level of involvement in plantain processing

Variables	Linear+	Semi-log	Exponential	Double-log
Constant	0.821	3.119	5.316	4.321
	(9.954)***	(7.466)**	(9.908)***	(15.925)***
Marital Status	0.005	-0.611	-0.001	-0.100
	(3.411)***	(2.852)**	(-2.456)*	(-2.861)**
Age	0.003	0.436	0.133	0.425
	(4.173)***	(2.554)**	(2.189)**	(3.222)***
Household Size	0.001	-0.263	-0.133	0.003
	(2.106)**	(-2.102)**	(-2.164)**	(-2.016)**
Level of Education	0.000	0.004	0.006	0.020
	(5.001)***	(1.999)**	(1.971)**	(2.210)**
Income	0.020	0.041	0.020	0.019
	(5.110)***	(3.597)***	(3.157)***	(2.832)**
Years of processing experience	0.043	-0.081	-0.094	0.172
	(2.194)**	(-1.950)**	(-1.092)	(1.042)
Extension Contacts	-0.002	0.003	0.005	0.012
	(-1.391)	(1.190)	(1.709)*	(1.603)
Cooperative Membership	0.043	-0.081	-0.094	0.172
	(1.634)	(-1.450)	(-1.092)	(1.042)
R^2	0.642	0.617	0.519	0.553
Adj. R^2	0.524	0.507	0.416	0.442
F-statistic	16.131***	12.220**	11.007***	11.311***

Source: Computed from field survey data, 2023. ** = significant at 5% and *** = significant at 1%
H_0 rejected at 5% level

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Determinants of Profitability among Rural Poultry Entrepreneurs in Imo State, Nigeria

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ABSTRACT
The study examined the determinants of profitability among rural poultry entrepreneurs in Imo State, Nigeria. Using a regression analysis approach, the study identified key factors influencing profitability, including farming experience, credit access, cooperative membership, market distance, bird prices, extension services, and farm size. The results showed that farming experience, credit access, price of birds, and farm size positively affected profit of the rural poultry farmers, and were significant at 1%, while Cooperative membership and extension services also affected the entrepreneurial' profit positively but significant at 5% and 10% respectively. Conversely, distance to the market negatively affects profit, highlighting transportation costs as a critical barrier. The study also identified major constraints, including high transportation costs (88.33%), high feed costs (85%), and labor expenses (58.33%), which significantly hindered productivity. The findings emphasized the need for improved infrastructure, targeted financial interventions, and enhanced veterinary and extension services. The study therefore recommends increased investment in rural road networks to reduce transportation costs, the development of poultry-specific credit schemes with flexible repayment structures, and the expansion of veterinary and extension services to improve disease management and productivity. Addressing these challenges through policy interventions and strategic investments will enhance the sustainability and profitability of rural poultry enterprises, contributing to economic growth and improved livelihoods in rural communities.
Keywords: Poultry, Profitability, Rural, Entrepreneurs, determinants, Constraints.

INTRODUCTION
A major factor in the economic growth of the majority of African nations is agriculture. Nigeria's agriculture sector employs around two-thirds of the country's workforce (approximately 60%), generates 88% of non-oil profits, and contributes more than 40% of the GDP (Osai, et al., 2023). A growth in the production of animal-based products worldwide, particularly from chicken, has resulted from the global food basket issue, which is primarily caused by an inadequate supply of animal protein (FAO, 2010). Poultry farming is the domestication of birds like chickens, ducks, quails, turkeys, and geese with the goal of raising them for meat and eggs as well as using their byproducts, like feathers and feces, as natural, unprocessed materials in industries (Stiles, 2017). Poultry production has grown to be a significant part of Nigerian agriculture, according to Ezeibe et al. (2014), because it serves as a legitimate source of consistent revenue in addition to providing the population with meat and eggs. It is currently among the best protein sources for humans. Since poultry meat and eggs are now crucial in filling the gap in Nigeria's protein supply, many Nigerians have recently become interested in raising poultry due to the high nutritional value and significant financial potential (Erdaw, et al., 2022). The demand for poultry products is expanding as a result of factors such population expansion, changing lifestyles, altering eating habits, rapid urbanization, rising per capita income, and improved knowledge of health care. Because of the consistent flow of

money in the Imo State rural economy throughout the year, this sector has a promising future. Imo State's food grain output and productivity, especially for cereals, have already saturated and there is limited room for growth, hence people are turning to side jobs like chicken farming. At the same time, diversification of agriculture through related businesses like poultry farming has gained additional relevance for resolving the state's agrarian problem due to the limited scope of further addition to the net area sown and the enormous amount of debt. Farmers who embrace poultry farming will be able to supply the rising demand for poultry meat while also escaping the debt trap. Starting and succeeding in the poultry industry demands farming experience. According to Nwaobiala et al. (2018), higher productivity in poultry production is based on farmers' quality farming experience. Effective skill training also boosts productivity in any firm or career choice, according to Bandura, (2023). The majority of poultry business owners are inexperienced in managing a poultry farm. These call into doubt both the poultry entrepreneurs' profitability and degree of efficiency. The external environment of the poultry industry is made up of sociocultural, economic, and environmental factors (Nwobodo, et al., 2023). Rural poultry farm owners face challenges that reduce their output, profitability, and efficiency. This issue affects the efficiency and profitability of rural poultry entrepreneurs and differs amongst these businesses (Ashagidigbi et al., 2011). Because profit is a motivating factor for people to start a business, there is an urgent need for a thorough investigation to critically analyze the profitability determinants among the rural poultry entrepreneurs in Imo State, Nigeria. Additionally, the study should offer some practical insights for policy makers, researchers, and practitioners in the poultry business.

METHODOLOGY

Study Area

The study was conducted in Imo State of Nigeria. Imo state lies between latitudes 05^0 48'N and 06° 08' of the equator and longitudes 06° 14'E and 07° 2' E of the Greenwich meridian. Imo State covers an area of about 5,067.20 km^2 with a population of about 3, 934, 899 (NPC, 2006) and population density of about 725km^2. The State derives its name from the Imo River, which takes its course from the Okigwe/Awka upland. Imo State is divided into three Agricultural Zones, namely: Owerri Zone, Orlu Zone and Okigwe agricultural zones. Administratively, the State has twenty-seven (27) Local Government Areas (LGAs). It is bordered on the east by Abia State, on the west by Delta State and River Niger, on the north by Anambra and Ebonyi States and on the south by River State. The State has an average annual temperature of 28°C, an average annual relative humidity of 80%, average annual rainfall of 1800 to 2500mm and an altitude of about 100m above sea level (Imo-ADP, 2013). The weather and environmental conditions of the state favors the production of poultry as it is not too hot or too cold (Oladeebo, 2008; Olayemi, 1998; and Olaitan, 2006). Hotel business is one of the leading businesses in the state; thus, creating market for poultry product. And also, it enjoys proximity to many of the neighboring states' metropolitan markets including; Aba, Uyo, Enugu, Onitsha, Abakiliki, and Port Harcourt.

Sampling Procedures

The study made use of multi-stage sampling techniques in selecting the 120 respondents needed for the study. The first stage involved all the three (3) agricultural zones in Imo State. They are Owerri, Orlu, and Okigwe agricultural zones. In the second stage, two (2) Local Government Areas were purposively selected from each of the agricultural zones, the Local Government Areas selected were Aboh Mbaise, and Ngor-Okpala for Owerri agricultural zone, Isu, and Orsu for Orlu agricultural zone, and Isiala Mbano, and Ihitte Uboma for Okigwe agricultural zone, giving a total of six (6) L.G.As. These places were selected due to the intensity of poultry production in the area. In the third stage, two (2) communities were randomly selected from each of the Local Government Areas, giving a total of twelve (12) communities. In the fourth stage, a random sample of ten (10) poultry entrepreneurs were selected, giving a total of one hundred and twenty (120) respondents which constituted the sample size for the study.

Data Collection Technique

The study employed the use of only primary data. The primary data was collected through the use of pre-tested and well- structured questionnaire administered to the selected rural poultry entrepreneurs. Preliminary visits were made to the study areas before the commencement of the actual data collection. This paved way for the pre-testing of research instruments for successful data collection. The research instrument (questionnaire) was found useful at the end of the fieldwork and was used for the analysis. Data collection was in the year 2024. Some of the entrepreneurs were reluctant to accept and fill the questionnaire for reasons as some thought they were giving out vital

personal information to an outsider and for other personal reasons, but with the help of the enumerators from there, these problems were resolved. The questionnaire for this study was designed to collect a wide range of information from the respondents such as the factors affecting their profitability, as well as the challenges they are facing in the poultry business.

Analytical Framework

The data was analyzed using descriptive and inferential statistical tools. Multiple regression analysis was used for the determinants of profitability of the entrepreneurs, while the entrepreneurs' constraints were analyzed using descriptive statistics.

Model Specifications

The models were specified as follows:

Determinants of Market Orientation

$$Y = (X_1, X_2, X_3, X_4 \ldots X_{12}) \quad (1)$$

Y = Net Return (₦)

Where in equation (1): X_1 = age (years), X_2= experience (in years), X_3 = sex of entrepreneur (male = 1, female = 0), X_4 = credit access (₦), X_5= household size (number), X_6= membership of cooperative society (years), X_7= Distance to market (km), $X_{8=}$ price of birds (₦), X_9 = cost of feed (₦), X_{10} = cost of inputs (₦), X_{11} = contact with extension service (number of visits), X_{12} = farm size (number of birds).

RESULTS AND DISCUSSION

Determinants of Profit

The result in table 1 showed that the linear functional form was chosen as the lead equation based on statistical and econometric criteria such as the magnitude of the coefficient of multiple determination (R^2), number of significant variables, conformity with a priori expectation of the signs in the coefficients of the variables, and overall significance of the functional form (F-ratio). The F-ratio (45.14) was significant at 1% which attests to the overall significance of the regression result. The R^2 value (0.9249) of the lead equation showed that 92.49% of the variations observed in profitability of the rural poultry entrepreneurs were accounted for by the explanatory variables included in the model.

Farming experience had a positive coefficient with the output of the poultry entrepreneurs hence it is statistically significant at 1% level of probability for the rural entrepreneurs. Entrepreneurs with higher years of farming experience knows the problems involved in poultry production and are in a better position to overcome them to improve on the yield than those that had little farming experience. The result is in line with the findings of Baliyan, *et al.,* 2017 who reported that entrepreneurs with more years of farming experience would be more efficient, have better knowledge of climatic conditions and market situation and are thus, expected to run a more profitable and efficient enterprise. Also, to support the findings of Esiobu *et al*., (2014) and Onubuogu *et al*., (2014) who asserted that previous experience in agribusiness enable entrepreneurs to set realistic time and cost targets, allocate, combine, utilize resources efficiently and effectively, identify production and marketing risks.

The coefficient of credit access is significant at 1% and positively related to the profit for the rural entrepreneurs; it implies that the higher the amount of credit received by the poultry entrepreneurs, the greater the profit made. Credit enables the entrepreneurs to grant them access to market information and farm inputs which leads to higher output and hence profit. The coefficient of Membership of cooperation is significant at 2% and positively related to profit for rural entrepreneurs. The result supports the findings of Esiobu *et al*., (2014) who reported that membership of cooperative help agribusiness entrepreneurs.

The coefficient of distance to the market is significant at 1% and negatively related to profit for the rural poultry entrepreneurs, it implies that the greater the distance from the farm to the market imply less the profit. Longer distance implies higher transport cost which reduces profit. As a result, entrepreneurs who have a long distance to travel to the nearest town, and from the farm to the market, and who have high farm transportation costs, are more un-likely to participate in the market. Akidi, *et al.,* 2018 have reported that infrastructure such as roads play an influential role in

determining market participation levels. Poor infrastructure also increases poultry farm transportation costs per km. Poor transportation costs also reduce when entrepreneurs are located close to markets and have access to a good road network.

The price of birds is significant at 1% and positively related to profit for the poultry rural entrepreneurs. It implies that the higher the price of the mature birds the higher the profit made. Contact with extension workers is significant at 10% and are positively related to profit. It implies that increase in contact with extension workers increases profit. Source of information is gotten from agents who lead to increase in output. Chukwu (2013) and Onubuogu and Esiobu (2014) reported that extension contact is the channel through which agricultural innovations and information are passed to entrepreneurs for improvement in their standard of living and production; hence increment in their profit. Farm size is significant at 1% and positively related to profit. It implies that it is expected that entrepreneurs with large farm size would realize more yield/output than their counterparts with less farm size. Birhanu, *et al.,* 2021 reported that large farm size increases livestock entrepreneur's productivity, improves their technical, allocative and resource-use efficiency.

Constraints Associated With the Rural Poultry Entrepreneurs

The result in table 2 presents the key challenges (constraints) encountered by rural poultry entrepreneurs. The most significant constraints include high transport cost (88.33%), high feed costs (85%), and high labor costs (58.33%). These findings are in tandem with common issues in the poultry sector, particularly in rural areas where infrastructure and resource access are often limited.

High transportation cost (88.33%) ranked as the most severe constraint. This is a critical challenge in rural areas where poor road infrastructure, long distances to markets and high fuel prices increase logistics expenses. Poor transportation systems significantly hinder the profitability of poultry farmers by raising production costs and limiting market access, claim Olawumi et al. (2020). The high price of poultry feed (85%) is still another significant issue. 60–70% of the expenses associated with raising poultry are related to feed (Afodu et al., 2024). This problem is exacerbated by import dependence, supply chain interruptions, and growing grain prices. Recent research has proposed sustainable solutions, including alternate feed sources (e.g., insect protein, agro-industrial by-products) (Bist, et al., 2024). Poultry management's high labor cost (58.33%) and rural-to-urban migration cause labor shortages and raise costs in rural regions (Adeyonu, et al., 2021). Even if automation and mechanization are practical answers, they are nevertheless expensive and out of reach for the majority of rural poultry entrepreneurs.

Lack of veterinary services (36.67%) and disease outbreaks (53.33%); Farmers are seriously threatened by poultry diseases like Gumboro disease, Newcastle disease, and Avian Influenza. The issue is made worse by restricted access to veterinary care. In order to reduce disease risks, studies by Robertson, (2020) highlight the significance of biosecurity protocols, immunization campaigns, and extension services. High Input Costs: In addition to feed, other inputs including medications, immunizations, and equipment continue to be costly. The effect of inflation and changes in foreign exchange on input costs in developing nations is highlighted in a report by Mottet, et al. (2017). Limited access to financial services due to poor credit availability (51.67%) hinders rural poultry farmers' ability to grow their businesses. This is consistent with research by Esiobu, et al. (2014), who noted that strict loan conditions result from financial institutions' frequent perception of poultry farming as high-risk. Poor market access, a lack of extension services, and insufficient government support are among the other challenges (35%) that are commonly reported in rural poultry production (Ibrahim et al., 2023).

The challenges that rural poultry entrepreneurs encounter have a substantial impact on their profitability and production. Policy changes, infrastructural upgrades, and financial access are all necessary to address these issues. Improving disease control and veterinary services is also crucial to improving the sustainability of poultry farming.

CONCLUSION AND RECOMMENDATIONS

The results of this study show that among rural poultry entrepreneurs' profitability is significantly influenced by farming experience, cooperative membership, financing availability, market distance, bird pricing, extension services, and farm size. While cooperative membership, farming experience,

and access to credit all have positive effects on profit, distance to markets has the opposite effect. Furthermore, considerable output is hampered by high labor expenses, inadequate veterinary services, diseases, and the high cost of feed and transportation. Rural livelihoods will eventually improve as a result of addressing these issues through focused policy interventions, infrastructure development, and easier access to financial and technical assistance. This will increase the sustainability and profitability of rural poultry entrepreneurs.

Recommendations

1. **Investment in Rural Infrastructure and Market Accessibility**: The construction of market infrastructure and rural road networks should be given top priority by policymakers in order to lower transportation costs and increase market participation. To improve market efficiency, public-private partnerships can help build decentralized poultry marketplaces and logistics hubs.
2. **Expansion of Financial Support Mechanisms**: Poultry-specific credit plans with adjustable payback periods should be created by financial institutions and agricultural development initiatives. This will increase business owners' capacity to make investments in high-quality inputs, grow their operations, and boost productivity. Enhancing the financial literacy of poultry farmers will also maximize the use of credit.
3. **Strengthening Veterinary and Extension Services**: The expansion of trained staff and the establishment of mobile veterinary units are two ways that government organizations and other stakeholders can improve access to veterinary care and extension services. Also, implementing regular training programs on biosecurity, disease prevention, and better management techniques will increase productivity and reduce production risks.

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Table 1: Distribution of Rural Poultry Entrepreneurs by determinants of profitability

Variable	Rural Coefficient	t-ratio
Intercept	5.995	2.31**
Age (X_1)	2.876	0.74
Farming experience (X_2)	18.795	3.66***
Sex (X_3)	9.118	0.67
Credit access (X_4)	5.409	5.13***
Household size (X_5)	17.454	0.81
Mem. of cooperative (X_6)	2.751	3.16**
Distance to mkt. (X_7)	-3.894	-7.01***
Price of birds (X_8)	3.275	4.53***
Cost of feed (X_9)	-7.364	-0.92
Cost of input (X_{10})	.0777	0.03
Contact ext. workers (X_{11})	4.570	3.33*
Farm size (X_{12})	33.770	10.47***
R^2		0.9249
Adjusted R^2		0.9044
F-ratio		45.14***

Source: computed from survey data, 2024. *** = significant at 1%; ** = significant at 5%; and * = significant at 10%

Table 2: Distribution of Rural Poultry Entrepreneurs by Constraints Faced

Constraints	Rural Frequency (%)
High cost of labor	70(58.33)
High cost of feed	102(85)
Diseases	64(53.33)
Lack of veterinary services	44(36.67)
High transport cost	106(88.33)
High input cost	54(45)
Poor access to credit	62(51.67)
Others	42(35)

Source: computed from survey data, 2024. N/B: The figures in parenthesis are percentages.

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Comparative Analysis of the Impact of Adoption of Improved Sweetpotato Technologies on the Socioeconomic Status of Women Farmers in Akwaibom and Anambra States, Nigeria

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ABSTRACT
*Sweetpotato is well known for sustained security, improved nutrition and income generation and having distributed the vines to many households in Nigeria, especially, women farmers, the need to find out the level of adoption and the extent the adoption has impacted on the socio-economic status of the women became imperative. A multistage random sampling procedure was used to select a sample of 100 sweetpotato women farmers (50 from Akwalbom state and 50 from Anambra state). Data were collected using structured questionnaire and focus group discussion (FGD). The data was analyzed using both descriptive and inferential statistics. The level of adoption of sweetpotato technologies was low in Akwalbom while that of Anambra was moderately high. The result shows that the technologies, mostly TIS 8164 and UMUSPO 1/OFSP had more positive impact on the livelihood of the women farmers in Anambra than their counterparts in Akwalbom, especially in the area of increased availability of food, good health nutrition and paying of children school fees. From the z-test result, in Akwalbom, mean income before adoption of improved sweetpotato technologies was ₦21,480 while mean income after adoption of improved sweetpotato technologies was ₦45,000.00. There was sweetpotato income difference of ₦23, 520.00 with Z-test value of (20.4890***), while in Anambra, the result shows that the mean income before adoption of improved sweetpotato technologies by women farmers was ₦44,580 and the mean income after adoption of improved sweetpotato technologies was ₦92,720.00. There was sweetpotato income difference of ₦48, 140.00 with z-test value of (15.1344***). In conclusion, the grand mean result was not encouraging but the individual mean of few of the technologies indicated high adoption, and as a result the mean income difference is moderately high but not also encouraging. On that note, the need for more awareness creation on the technologies, dissemination of sweetpotato vines, conducting training on value-addition of the technologies to boost adoption, enhance the quality and productivity of sweetpotato as well as enhance the soci0-economic status of the women farmers is highly needed.*

Keywords: Adoption, Impact, Sweetpotato, Socio-economic Status, Women Farmers, Comparative Analysis

INTRODUCTION
In Nigeria, women are very much involved into agricultural practices especially in the area of root and tuber crops, such as sweetpotato. Assessing the impact of adoption of improved sweetpotato technologies for their expected performance on the socio-economic status of farmers particularly women farmers is a pre-requisite and basis for the suitability of new varieties in Nigeria. Sweetpotato (*Ipomoea batata (L) Lam*) is an important tropical staple and nutritious food crop, belonging to the morning-glory family known as *convolulaceae.* It is an important food security crop in Nigeria and Africa at large (Anyaegbunam *et al*., 2019). The potential of sweetpotato as the fourth most

produced food crop in Nigeria after cassava and yam in terms of production and hectare (FAOSTAT, 2015; HarvestPlus, 2016) cannot be overemphasized. It is an herbaceous plant generally with trailing stems and extremities. The stems are called vines, and exudates are present in all parts of the plant. Sweetpotato is diverse with many species having different flesh colours, skin colours, textual properties and nutritional qualities. It is excellent potential for the development of new products and new genotypes to fit various demands of different consumer groups. In biochemical composition, sweet potato is a rich crop. (Afuape *et al*, 2011). Most varieties contain proteins of high nutritive value, high in carbohydrates and vitamin, and can produce more edible energy per hectare per day than wheat, rice or cassava (Afuape *et al*, 2015). The orange-fleshed sweetpotato of has the highest β-carotene content among the five leading root and tuber crops- cassava, yam, cocoyam, sweet potato and potato and it is also noted for its richness in minerals (Ca, Mg, K, Fe, Zn and Na). Sweetpotato has moved up from the minor crop status it used to occupy to an enviable position of being the fourth most important root and tuber crop in the world (Afuape *et al*, 2015). According to Nwankwo *et al*., (2022), sweetpotato is cultivated as annual crop due to its capacity to produce storage root at a shorter period of 3.5 to 4 months unlike cassava a root crop and yam a tuber crop that matures in 10 and 7 months respectively depending on the variety. It is a rich source of proteins, minerals and vitamins for human nutrition. Sweetpotato technologies studied are TIS 8164, X.Igbariam, UMU SPO 1/OFSP, UMU SPO 3/OFSP, UMU SPO 4/OFSP, sweetpotato flour and sweetpoato value-added products such as, chips, confectionaries (bread, cake, biscuits, chin-chin, doughnut, buns, puff-puff, crisps and OFSP juice drink (Amadi *et al*., 2018; NRCRI, 2021; NRCRI, 2023).

Currently, sweetpotato is being produced and utilized in various forms in the world today and having trained and disseminated the technologies to farmers, the need to find out the extent the adopted crop has positively impacted on the socio-economic status of the women cultivars came up. The objectives of the study were; to determine the level of adoption of improved sweetpotato technologies; to determine the extent to which the technologies positively impacted on the socio-economic status of women farmers in the study area; to access the level of farm income before and after the adoption of the technologies by women farmers and; to identify constraints to adoption.

METHODOLOGY

The study was conducted in Akwalbom and Anambra States, Nigeria. A multistage sampling procedure was used in selecting the sample for this study. In the first stage one agricultural zone each were purposively selected from each state. This is because sweetpotato technologies have been disseminated in those areas. The second stage involved the selection of two (2) blocks each from each of the agricultural zone, making it four (4) blocks. The third stage involved the random sampling of one (1) circle from each of the blocks, totaling four (4) circles altogether. Twenty-five (25) women sweetpotato farmers were randomly selected from the list of the farmers in the area, making it a total number of 100 women sweetpotato farmers for the study. Data were collected using structured questionnaires and was analyzed using descriptive and inferential statistics such as frequencies, percentages; mean count of 3 point (the points were adopt and still using = 3, adopt and stopped = 2, never adopt = 1. In using the 3 point rating type, a mid-point was obtained by adding 3, 2 and 1 which gave 6 and when divided by 3 gave a mean score of 2.0. For the purpose of decision, any mean score response above the upper limit was adjusted to indicate high and moderate adoption, while any mean score responses lower than the upper limit was viewed as low adoption of sweetpotato technologies). More so, mean count of 5 point likert scale was also used (the point were very much = 5, much = 4, moderate = 3, low = 2, very low = 1. In using the 5 point rating scale, a mid-point was obtained by adding 5, 4, 3, 2 and 1 which gave 15 and when divided by 5 gave a mean score of 3.0. For the purpose of decision making, any mean score response above the upper limit was adjusted to indicate much impact, while any mean score responses lower than the upper limit was viewed as low impact of adoption of sweetpoato technologies), respectively and z-test. The models specification for Z-test is thus;

$$Z = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Where z = calculated value of difference between means
$\bar{x}$ = Mean income of women farmers in naira before adopting the technologies
$\bar{x}$= Mean income of women farmers in naira after adopting the technologies

n_1= Sample size of respondents before adopting the technologies
n_2=Sample size of respondents after adopting the technologies
σ_1^2=Standard deviation of respondents before adopting the technologies
σ_2^2= Standard deviation of respondents after adopting the technologies.

RESULTS AND DISCUSSION

Level of adoption of improved sweetpotato technologies

Table 1 shows the mean scores distribution of the level of adoption of sweetpotato technologies in the study area. The overall level of adoption of sweetpotato technologies in Akwalbom was low ($\bar{x}$ =1.89) and lower than the decision mean cut-off of 2.0 with only TIS 8164 and UMUSPO1 having a high mean score of ($\bar{x}$ =3.00) and ($\bar{x}$ =2.66), while the overall level of adoption of sweetpotato in Anambra was moderately high ($\bar{x}$ =2.13) and higher than the decision mean cut-off of 2.0 with TIS 8164, UMUSPO1 and X-Igbariam having a high mean score of ($\bar{x}$ =2.36), ($\bar{x}$ =2.34) and ($\bar{x}$ =2.24). The results recorded high adoption of sweetpotato technologies in Anambra and a low adoption level in Akwalbom among the women farmers. The implication of the results of the adoption level in the study implied that adopters adopted the technology because of the impact on their socio-economic status while inadequate information could be the reason for poor adoption of sweetpotato in the study area. This finding is in accordance with the report of Abdoulaye *et al,* (2014) in Amadi *et al,* (2020) who stated that several factors could drive the adoption process.

Table 1: Level of adoption of improved cassava and sweetpotato technologies

AKWAIBOM STATE			ANAMBRA STATE		
Sweetpotato Technologies	**Mean**	**Remark**	**Sweetpotato Technologies**	**Mean**	**Remark**
TIS 8164	3.0	High	TIS 8164	2.36	High
X-Igbariam	1.0	Low	X-Igbariam	2.34	High
UMU SPO 1/OFSP	2.66	High	UMU SPO 1/OFSP	2.24	Moderate
UMU SPO 3/OFSP	1.86	Low	UMU SPO 3/OFSP	2.0	Moderate
UMU SPO 4/OFSP	1.86	Low	UMU SPO 4/OFSP	2.0	Moderate
Sweetpotato flour	1.0	Low	Sweetpotato flour	1.89	Low
Value-added products (chips, cake, etc).	1.88	Low	Value-added products (chips, cake, etc).	2.11	Moderate
Grand mean	**1.89**	**Low**	**Grand mean**	**2.13**	

Source: field survey, 2024; 2.25 and above – High adoption; 2.00 -2.24 – Moderately high; below 2.00 – Low adoption.

Extent to which sweetpotato technologies positively impacted on the socio-economic status of women farmers in Akwalbom and Anambra states, Nigeria

Table 2 shows that majority of the selected improved sweetpotato technologies had positive impact on the socio-economic status of the women farmers in Akwalbom, mostly TIS 8164 and UMUSPO 1/OFSP, especially in the area of increased availability of food (3.36), good health and nutrition (3.36), increased sweetpotato farmland (3.08) and paying of children school fees (3.02), though with a grand mean of 2.88 which is lower than the decision mean cut off of 3.00. The implication is that the poor result could be as a result of unavailability of improved sweetpotato vines and lack of information. Similarly, that of Anambra state shows that all the technologies except sweetpotato flour had positive impact on the socio-economic status of the women farmers in Anambra, especially in the area of increased availability of food (4.84), income generation (3.68), increased sweetpotato farmland (3.44), acquired new properties (kitchen equipment) (3.38), paying of children school fees (3.31), good health and nutrition (3.24), wedging of poverty and employment for households (3.0) respectively, with a grand mean of 3.48 which is greater than the decision mean cut off of 3.00. The implication is that high adoption of improved varieties brings about improvement in the socio-economic status of adopters. This finding agrees with the report of Ironkwe *et al*., (2012) in Amadi *et al.,* (2024) that farmers adopt those technologies that have high impact on their socio-economic status.

Table 2: Distribution of the women according to the extent the cassava technologies positively impacted on their socio-economic status

	AKWAIBOM STATE		ANAMBRA STATE	
Variables	**Mean**	**Remarks**	**Mean**	**Remarks**
Good health & nutrition	3.36	Much	3.24	Much
Wedging of poverty	2.9	Low	3.0	Much
Income Generation(money)	2.98	Low	3.68	Very much
Acquired new property	2.4	Very low	3.38	Much
Employment for household	2.44	Very low	3.0	Much
Increased availability of food	3.36	Much	4.84	Very much
Children school fees	3.02	Much	3.31	Much
Increased sweetpotato farmland	3.08	Much	3.44	Much
Grand mean	**2.88**		**3.48**	

Source: field survey, 2024; 3.5 and above -Very much; 3.2 -3.49 – Much; 3.0 -3.19 - Moderate, 2.5 – 2.99 – Low; 2.49 and below - Very low.

Z-test showing the difference in income of sweetpotato technologies in and Akwalbom Anambra States

Table 3a shows that Z-test statistic shows significant difference (P< 0.01) in income of sweetpotato women farmers before and after adoption of sweetpotato technologies in Akwalbom State, Nigeria. From the result, mean income before adoption of improved sweetpotato technologies was ₦21,480 while mean income after adoption of improved sweetpotato technologies was ₦45,000.00. There was sweetpotato income difference of ₦23, 520.00 with Z-test value of (20.4890***). This implies that improved sweetpotato technologies increased women farmers' income. In Table 3b, the result shows that the mean income before adoption of improved sweetpotato technologies by women farmers in Anambra state was ₦44,580 while mean income after adoption of improved sweetpotato technologies was ₦92,720.00. There was sweetpotato income difference of ₦48, 140.00 with z-test value of (15.1344***). This implies that the adoption also increased women farmers' income in Anambra. The finding of this study is in line with Onwusiribe *et al*. (2022) that adoption of improved crop varieties increased farmers income which in turn improves the capacity to adopt other agricultural innovations as they have the necessary capital to start the innovation.

Table 3: Z-test showing the difference in farm income of women farmers before and after adopting sweetpotato technologies in Akwalbom and Anambra states, Nigeria

Table 3a

Variable	Individual Mean	Mean Difference	Standard Err.	Z-Value	Sig
AKWAIBOM WOMEN FARMERS:					
Income before adopting cassava technologies	**21, 480.00**		1424.061		
		23, 520.00	**1147.932**	20.4890***	**0.000**
Income after adopting cassava technologies	45, 000.00		**1761.261**		

Table 3b

ANAMBRA WOMEN FARMERS: Income before adopting Sweetpotato technologies	44.580.00		**2051.598**		
		48, 140.00	**3180.826**	15.1344***	**0.000**
Income after adopting Sweetpotato technologies	92,720.00		**2430.762**		

Source: Field Survey data, 2024. ***significant at 1.0%

Constraints to the adoption of Sweetpotato technologies

The results revealed that almost all the possible constraints investigated in the study were serious constraints to adoption of sweetpotato technologies by women farmers. In Akwalbom, high cost of labour (70%), high cost of planting materials (66%), unavailability of vines, inadequate information and inadequate knowledge on value addition products (64%) respectively, were the most serious constraints to adoption of sweetpoato technologies. Similarly, insecurity (76%), high cost of labour (70%) and lack of credit facility (62%) were the most serious constraints to adoption of improved sweetpoato technologies in Anambra state. The implication is that these factors are more or less retrogressive to the total adoption goal of improved technologies. This finding is in line with Onyeneke *et al*., (2018) who reported that reality of new hybrid varieties and its improved farming

system, sometimes introduces certain difficulties for smallholder farmers to adopt due to inadequate fund and credit facilities.

Table 4: Constraints to the adoption of Sweetpotato technologies

	AKWAIBOM STATE			ANAMBRA STATE		
Variables	**Frequency**	**Percentage**	**Rank**	**Frequency**	**Percentage**	**Rank**
Unavailability of sweetpotato vines	32	64.00	3rd	30	60.00	4th
High cost of planting materials	33	66.00	2nd	30	60.00	4th
Marketing problems	16	32.00	7th	15	30.00	6th
High cost of labour	35	70.00	1st	35	70.00	2nd
Lack of credit facility	30	60.00	4th	31	62.00	3rd
Inadequate information	32	64.00	3rd	30	60.00	4th
Inadequate knowledge on value addition products	32	64.00	3rd	26	52.00	5th
Insecurity	20	40.00	5th	38	76.00	1st

Source: Field Survey data, 2024

CONCLUSION AND RECOMMENDATIONS

Considering the role women play in agricultural production in Nigeria, it is quite obvious that adoption of improved sweetpotato technologies and benefit from the crops business in a sustained and effective manner will impact positively to the socio-economic status of women. The study concluded that the grand mean result was not encouraging but the individual mean of few of the technologies indicated high adoption, and as a result the mean income difference is moderately high but not also encouraging. The study also concluded that high adoption of improved sweetpotato technologies brings about improvement in the socio-economic status of adopters, especially in the area of increased availability of food, good health and nutrition, increased sweetpotao farmland, paying of children school fees, income generation, acquired new properties (kitchen equipment), wedging of poverty and employment. Comparatively, women adopters in Anambra state had more positive impact of adoption of the technologies than their counterparts in Akwaibom state. On that note, the need for more awareness creation on the technologies, dissemination of sweetpotato vines, conducting training on value-addition of the technologies to boost adoption, enhance the quality and productivity of sweetpotato as well as enhance the socio-economic status of the women farmers is highly needed.

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Investment Decisions and Market Linkages of Cassava-based SMES in Abia State

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ABSTRACT
The study assessed the investment decisions and market linkages of cassava-based SMEs in Abia State, Nigeria. The objectives of the study are to; identify the types of investments made by cassava-based SME's in maintaining market linkages in the study area and estimate the factors influencing investment decisions in the market linkages of cassava-based SMEs in the study area. Data was collected using a well-structured questionnaire which was administered to the respondents. Objective (i) was analyzed using descriptive statistics like percentages, frequencies and mean while Objective (ii) was analyzed using ordinary least square regression (OLS). The study showed that infrastructure, financial investments, building partnerships and collaborations, technology, marketing and promotion and training and capacity building were types of investments made by cassava-based SME's in maintaining market linkages while income, technology, membership of cooperative society, quantity of cassava product produced and selling price of produce were the significant factors influencing investment in the market linkages of cassava-based SMEs. Income, membership of cooperative, quantity of cassava product produced and selling price were positive and significant at 5% probability level while access to modern technology was positive and significant at 1% probability level. In conclusion, the study highlights the importance of investment decisions and market linkages of cassava-based SMEs and the need for targeted interventions to enhance their resilience and competitiveness. It is therefore recommended that cassava-based SMEs should focus on adopting, integrating and leveraging technology to strengthen their market presence, improve operations and make informed investment decisions.

Keywords: Investment, Market linkages, Cassava, SME

INTRODUCTION
Cassava (Manihot esculenta crantz) is a tropical root crop which belongs to the family of Euphorbiaceae (McCallum *et al*., 2017). It is a staple crop in Nigeria and Abia State is one of the major cassava producing state in the country. It also contributes to food security due to its ability to survive in poor soil conditions and has long-term underground storage (Amelework *et al*., 2021). As a promising commodity, it is a staple food similar to rice and corn for ensuring food security (Rahayu *et al*., 2021). It is produced in all the six geographical zone in Nigeria and widely consumed as garri and fufu.

Cassava is grown by 98% of smallholder crop farmers in Abia State, which means that most of the state's entrepreneur relies heavily on the crop (Onya *et al.,* 2016). The cassava industry in Abia State is dominated by small and medium enterprises (SMEs), which play a crucial role in the state's economy. Small and medium enterprise operating in this sector often engage with multiple

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stakeholders from farmers to processors, distributors and consumers. These linkages are crucial for the sustainable growth of cassava-based Small and Medium Enterprises.

Market linkages refer to the relationships and connections that exist among various actors within a market system that enable the flow of goods, services, information and resources (Quader *et al*., 2023). In the context of cassava-based SMEs in Abia State, it is the connection that exists among the various actors within the cassava value chain. Market linkages are critical for accessing markets, securing finance and obtaining technical assistance. These linkages are critical for the functioning of markets and play a crucial role in determining how efficiently resources are allocated, how value is created and how economic activities are coordinated. It also provides insights into the dynamics of a market and helps identify opportunities and challenges. SMEs are finding it increasingly difficult to maintain profitability. A key factor contributing to this problem is the lack of adequate market linkages (Mitchell, 2023).Therefore market linkages are critical for the survival and growth of cassava-based SMEs thus the need for investment.

Investing in the market linkages of cassava-based Small and Medium Enterprises (SMEs) involves allocating financial resources strategically to enhance the efficiency, sustainability and overall performance of the business within the cassava value chain. Investment has been shown to be a two-step process that is decision of whether or not to invest and how much to invest (Mutinda *et al*., 2020). Investment decisions involved in market linkages include decisions on production, processing, marketing and financing. Analyzing factors influencing investment decisions facing small and medium scale enterprise in maintaining market linkages is essential to good planning in agricultural production, processing and innovation.

Despite the importance of market linkages and investment decisions for cassava-based SMEs in Abia State, there is a lack of research on this topic therefore it is important to fill the research gap by exploring the investment decisions involved in market linkages of cassava-based SMEs in Abia State.

Objectives of the Study

The specific objectives of the study are;

(i) identify the types of investments made by cassava-based SME's in maintaining market linkages in the study area;
(ii) estimate the factors influencing investment decisions in the market linkages among cassava-based SME's in the study area.

METHODOLOGY

Study Area

The study was carried out in Abia State, Nigeria. Umuahia is the capital of Abia State and has 17 local Government Areas (LGAs) which are ; Aba North, Aba South, OsisiomaNgwa, ObiomaNgwa North, Ukwa East, Ukwa West, Ugwunagbo, Isuiukwuato, Ohafia, Bende, Arochukwu, Umunneochi, Umuahia North, Umuahia-South, Ikwuano, IsialaNgwa North and IsialaNgwa South. Abia state has three agricultural zone namely; Umuahia, Ohaofia and Aba agricultural zones. It is between longitude 7^0 23' and 8^0 02'East of Greenwich Meridian and latitudes 5^0 47' and 6^0 12'North of Equator. The state has an estimated population of 4,143,100 people, (NPC, 2022) Agriculture is the major occupation of Abians though there are other sources of livelihood in the area such as fashion designing, hair dressing, trading, civil service, teaching, catering and transportation.

The major crops grown in the state include maize, plantain, cassava, fruits, and vegetables. There are many small and medium size agribusiness enterprises in Abia state that are involved in the processing of these agricultural commodities into different products of value for local consumption and export in which cassava based SMEs' is involved. These firms are playing a vital role in the economic development of the state. There are agricultural based research institutes in Abia State namely; National Root Crops Research Institute, Umudike, Land Resources Ahieke and National Cereals Research Institute Amakama, Umuahia. In addition, Michael Okpara University of Agriculture Umudike is situated in the state. These institutions' existence has boosted the state's agricultural industry and allied businesses.

Sampling Technique

The sampling procedure that was used in the study involved multi stage sampling technique. Initially, two agricultural zones namely Aba and Umuahia Agricultural zone were purposefully selected from the three Agricultural zones in the State (Aba, Umuahia and Ohaofia). These zones were purposely selected because of the intensity of cassava farming and cultivation in the area. In the second stage, two Local Government Areas were randomly chosen from each of the two selected agricultural zones. The local government area includes; Osisioma ngwa and Aba South for Aba Agricultural zone, Ikwuano and Umuahia South for Umuahia Agricultural zone. In the third stage, three communities were randomly chosen from each of the four Local Government Areas resulting in twelve communities. These communities includes;Odeukwu,Amasato and Amator for Osisioma ngwa L.G.A, Aba ukwu,Nnetu and Umuagbai for Aba South L.G.A, Amaoba,Umudike and Ikemba for Ikwuano L.G.A and Ahiaukwu,Ubakala and Amakama for Umuahia South L.G.A. Finally, ten cassava based SMES were purposively selected from each community and this gave a total of one hundred and twenty (120) respondents.

Data Collection and Analysis

Descriptive statistics such as frequencies, percentages and mean was used to identify the types of investments made by cassava-based SME's in maintaining market linkages in the study area while ordinary least square regression model (OLS) was used to estimate the factors influencing investment decisions in the market linkages of cassava-based SMEs in the study area.

Model Specification
OLS Multiple Regression Model
This model is specified explicitly as:

$$Y=\beta o+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+ei \quad (1)$$

Where;
Y= Investment Decisions ($\epsilon f(x)$)
$\epsilon f(x)$ =individual mean
X_1 =experience (years)
X_2 = income (Naira)
X_3 = technology (traditional=1, modern= 0)
X_4 = labour (number of workers)
X_5 = membership of cooperative society (Yes=1, No= 0)
X_6 = access to credit (Yes=1, No= 0)
X_7 = distance to market (km)
X_8 = access to information (Yes=1, No=0)
X_9 =total produce of cassava (kg)
X_{10} =selling price (Naira)
β_i = the parameter
e_i = the error term

RESULTS AND DISCUSSION

Types of Investment Made by Cassava-Based Smes in Maintaining Market Linkages

Table 1 shows the types of investments made by cassava-based SME's in maintaining market linkages in the study area. The result in Table 1 showed the types of investments made by cassava-based SMEs in maintaining market linkages and the dominant investments made by cassava-based SMEs is infrastructure (60.15%) with a mean value of ₦208113 indicating that cassava based SMEs priotize physical assets like storage, transportation and equipment followed by financial investments (23.41%) with a mean value of ₦35775 and then building partnerships and collaborations (5.84%) with mean value of ₦107000. Technology (8.44%), marketing and promotion (2.1%) and training and capacity building (0.02%) accounts for mean value of ₦31591, ₦13482 and ₦415 respectively of the types of investments made by cassava-based SME's in maintaining market linkages. Infrastructure is the major investment made because cassava-based SMEs depend heavily on physical infrastructure like storage facilities, processing equipment, and transportation to ensure product quality, reduce post-harvest losses and access markets efficient. This addresses challenges in storage, transportation, and processing thereby ensuring smooth market linkages.

Table 1: Distributions of Respondents According to Types of Investments Decision made by Cassava-based SME's in maintaining Market Linkages in the Study Area

Investment type	*F (%)	$\sum f(x)$	$\bar{x}$ (₦)	Std. Deviation	Share in total investment
Infrastructure	53(44.17)	11030000	208113.21	305052.370	0.6015(60.15)
Technology	49(40.83)	1548000	31591.84	14654.235	0.0844 (8.44)
Training and capacity building	13(10.83)	5400	415.38	293.956	0.0002 (0.02)
Marketing and promotion	29(24.17)	391000	13482.76	8283.463	0.0213 (2.13)
Building partnerships and collaborations	10 (8.33)	1070000	107000.00	52079.000	0.0584 (5.84)
Financial investments	120(100.0)	4293000	35775.00	9669.724	0.2341(23.41)
Total investment/ grand mean		18337400	66063.03		

Source: Computed from field survey, 2024. * = multiple responses

The respondents prioritize these types of investments because they directly address the most pressing challenges in maintaining market linkages. Oluwafemi *et al*. (2018); Oseni *et al*. (2017) stated that limited transportation facilities, and poorly developed storage systems elevate transportation costs and increase post-harvest losses thus disrupting effective market linkages.

Factors Influencing Investment Decisions in the Market linkages Of Cassava-Based Smes

The factors influencing investment decisions in the market linkages of cassava-based SMEs in the study area are presented in Table 2. Exponential function was chosen as the lead equation among the four functional regression forms. This was based on the magnitude of the R^2 value, F-ratio value and the number of significant variables. From table 4.7, the R^2 value of 0.734 shows that 73.4% of the variations in market linkage investment were explained by the independent variables. The F-ratio value of 10.997 which was highly significant at 1% probability level shows that the model has a good fit.

From Table 2, the significant factors influencing investment in the market linkages of cassava-based SMEs were income, technology, membership of cooperative society, quantity of cassava product produced and selling price of produce.

The co-efficient of income (3.434E-006) was positive and significant at 5% probability level. This implies that a unit increase in income will result in an increase in investment decision. This is in line with apriori expectation. Investment decision most often rely on the availability of income, hence an increase in income will most likely serve as a booster to making investment decisions. This is in accordance with Oskam *et al*. (2009) as cited in Okeke *et al*. (2022) who stated that a firm is more likely to invest if it has higher revenue and more wealth. Similarly, Simtowe (2010) revealed that increase in the level of income facilitate the mobilization of productive resources and hence, level of investment.

The co-efficient of technology (0.439) was positive and significant at 1% probability level. This implies that a unit increase to access to modern technology will lead to an increase in investment decisions in the market linkages of cassava- based SMEs. This is strong evidence that the availability and use of modern technology can increase the impact of linkage on investment decisions. Tschirley *et al*. (2015) noted that technology enhances transparency, traceability, and real-time data sharing, leading to reduced inefficiencies and improved decision-making.

The co-efficient of membership of cooperative society (0.546) was positive and significant at 5% probability level. This implies that investment decisions in the market linkages of cassava- based SMEs increases as the membership of cooperative society increases. If the cassava based SME belongs to a cooperative society; it is more likely to invest in market linkages of cassava-based products. Kehinde and Aboaba (2016) revealed that cooperatives help their members to increase their working capital through the loan they provide and thereby positively influencing their investment decision This is in conformity with Mossie *et al*. (2020) who noted that the positive effect of membership in local cooperatives on the decision can be attributed to the good information exchange platform of these cooperatives in enabling other actors in the chain to share experiences to increase production and marketing decisions.

Table 2: Regression Estimates of Factors Influencing Investment Decisions in the Market Linkages of Cassava-based SME's in the Study Area

Variables	Linear	+Exponential	Semi log	Double log
Constant	303027.271	9.344	2554363.689	1.525
	(2.270)**	(11.539)***	(2.489)**	(2.441)**
Years of experience	-173.845	-0.004	-3587.176	-0.116
	(-0.042)	(- 0.286)	(0.076)	(-0.733)
Income	1.128	3.434E-006	121323.605	0.447
	(2.396)**	(2.149)**	(1.392)	(1.524)
Technology	67487.621	0.439	117120.577	0.810
	(2.783)***	(3.421)***	(2.622)***	(3.330)***
Labour	17447.763	0.012	65168.235	0.106
	(0.833)	(0.163)	(1.062)	(0.515)
Membership to	122689.598	0.546	117586.512	0.534
cooperative society	(1.585)	(2.078)**	(1.525)	(2.057)**
Access to credit	11296.532	0.248	36548.221	0.323
	(0.110)	(0.710)	(0.357)	(0.936)
Distance to market	24530.277	0.061	100469.506	0.215
	(1.559)	(1.140)	(0.885)	(0.563)
Access to information	-30325.067	-0.109	-44847.860	-0.166
	(-0.583)	(-0.620)	(-0.853)	(-0.940)
Quantity of cassava	382.580	0.001	58518.791	0.241
product produced	(2.676)***	(2.367)**	(2.480)**	(2.587)***
Selling price of	80.731	4.341E-005	82863.607	0.317
produce	(2.506)**	(2.367)**	(2.711)***	(2.808)***
R	0.691	0.764	0.657	0.752
R2	0.665	0.734	0.632	0.729
F-ratio	9.963***	10.997***	9.594***	10.801***

Source: Computed from field survey data, 2024. Key: ***, ** and * = significant at 1%, 5% and 10% respectively. + = Lead Equation and the values in parenthesis are the t-values.

The co-efficient of quantity of cassava product produced (0.001) was positive and significant at 5% probability level. This implies that a unit increase in the quantity of cassava product produced will lead to an increase in the investment decisions of market linkages of cassava- based SMEs.

The co-efficient of selling price of produce (4.341E-005) was positive and significant at 5% probability level. This implies that a unit increase in the selling price of cassava-based produce will result to an increase in investment decisions. The assumption is that the higher the price, there will be greater income and also higher propensity for investment decision. This is in congruent with the finding of Nwibo and Mbam (2013) who noted that increase in the revenue will bring about increase in their savings and investment capacity as this will result in surplus that will be saved and invested after consumption expenditure has been made.

CONCLUSION AND RECOMMENDATIONS

The study on the investment decisions and market linkages among cassava based SME's in Abia State, Nigeria revealed that infrastructure, financial investments, building partnerships and collaborations, technology, marketing and promotion and training and capacity building were types of investments made by cassava-based SME's in maintaining market linkages and that income, technology, membership of cooperative society, quantity of cassava product produced and selling price of produce were the significant factors influencing investment in the market linkages of cassava-based SMEs. In conclusion, the study highlights the importance of investment decisions and market linkages of cassava-based SMEs and the need for targeted interventions to enhance their resilience and competitiveness.

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Effect of Gender Dynamics on the Poverty Status of Smallholder Contract Rice Farmers in Kano State, Nigeria

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ABSTRACT
This study examined the gender dynamics on the poverty status of contract rice farmers in Kano State, Nigeria. A multistage sampling procedure was used to select 176 smallholder contract rice farmers and 176 non-contract farmers from 3 predominant rice farming Local Government Areas of Kano state. Data was collected using a structured questionnaire and analyzed with descriptive statistics and the Foster Greer-Thorbecke index. Results show the majority (72.12%) of adult male farmers are between the ages of 35-43 years. A fairly proportion (43.70%) of the female adult farmers obtained secondary education, a good proportion (56.82%) of the youths had no form of education, while others attained different levels of education. The poverty index result revealed that about few (11%) of the adult male contract rice farming households were poor compared to 37% of non-contract farmers, most (61%) of adult female non-contract farmers were poor, and majority (77%) of them were in severe poverty when compared to about 23% of contract rice farmers. Based on the results of this study, it was concluded that the poverty level was high, particularly among adult females in both contract and non-contract farmers. Thus, it is recommended that efforts and relevant policies should be formulated by relevant stakeholders, including government and non-governmental organizations towards providing relevant interventions that will improve the welfare, and living standard of women farmers.

Keywords: Effect, gender dynamics. Contract farmers, poverty, rice farmers

INTRODUCTION
Contract farming is a major agrarian practice that has been widely applied in developed and developing countries at different times for improved coordination and performance of agricultural production, and its markets and for addressing different types of marketing failure. According to the Food and Agricultural Organization of the United Nations, FAO (2021), contract farming is an agricultural production carried out according to an agreement between farmers and a buyer that places conditions on the production and marketing of the commodity. It typically involves an agribusiness to provide quality inputs, a set of extension and other agricultural services, and, or, credit to individual or farmers' groups. Contract farming (often referred to as an out-grower scheme) is an important component of many current public-private partnerships (PPPs) in developing countries. Such schemes appeal to farmers because the company often provides inputs and technical services, and as a result, opens up new markets for produce, increases farming income, and provides new technology thereby improving the farmer's livelihoods (FAO, 2019).

Gender differences in contract farming in Nigeria have become significant in recent years. There is no denying the significant and dominant role that women and youths play in addressing the issues of agricultural productivity and household well-being. Even though adult females and youths make up about half of the agricultural labour force in Nigeria, adult males are more frequently the target

of loans, extension services, farm credit, and other forms of intervention (Awotona *et, al.* 2022). In addition to having little control over their resources, adult female and young farmers are also less likely to adopt modern inputs and technologies, have low harvest yields, and face barriers to capital acquisition (both human and material). These disparities based on gender also affect financial resources and incentives, which in turn undermine their capacity to add to and partake in economic growth, and influence intra-household resource allocation, land productivity, and welfare levels.

According to Mona, S.C (2023), if both genders have the same access to productive resources and use the same level of inputs, this could increase yields on their farms which would in turn raise total agricultural output, and result in a reduced number of impoverished people. Therefore, closing the gender gap in access to and use of productive resources and services can improve agricultural productivity and efficiency, with important additional benefits through raising the incomes of adult male, adult female, and youth farmers, which will invariably increase the availability of food, thus increasing the level of household wellbeing. Therefore, this paper was designed to examine the gender dynamics in contract farming, and also its effects on the poverty status of smallholder rice farmers in Kano State, Nigeria.

METHODOLOGY

The study was conducted in Kano state, specifically the Kano River Irrigation Project (KRIP), situated within Kura LGA, BunkureLGA, and Garun Mallam LGA. The KRIP is a vast irrigation scheme within the Sudan savannah zone of Nigeria, it was originally planned to irrigate a gross irrigable area of 25,606ha comprising two main canals of west branch and east branch canal, but only about 13,280ha was fully developed and being utilized for irrigation as of 2015 (KNARDA, 2019). KRIP lies between latitude 80º 30' E to 90º 40'E and longitude 11° 30' N to 12º 03'N, the project area receives about 660 mm mean of annual rainfall between May and September, the rest of the year is dry, with temperatures varying from 18ºC to 36ºC (Country coordinate, 2022). Farming is the main occupation of the people, with emphasis on the crops grown which include maize, rice, sorghum and a variety of vegetables. Livestock is also important in the economy of the project area, which includes cattle, sheep, goats, and poultry.

Multi-stage sampling procedure was used to select samples for the study. The sampling procedure was carried out in stages. Stage one involved a purposive selection of three LGAs; Kura, Bunkure, and Garun Mallam LGAs. The LGAs were selected based on predominant rice production. In the second stage, two communities were randomly selected in each of the three LGAs, making a total of six communities. In the third stage, the Raosoft sample size calculator (available at www.raosoft.com) was used to determine the sample size (176) from the sample frame (5289) of contract rice farmers population of the selected communities consisting of all genders, which was further decomposed using the African Youth Charter Classification (youths, 18-35yrs, adult >35yrs) during the analysis. The sample size (176) of the contract farmers was proportionately distributed based on the share number of contract farmers within the community. Another set of 176 non-contract rice farmers were also randomly selected from the same LGAs earlier sampled, to have a basis for comparison. Primary data was used for the study, it was collected using scheduled interviews with the assistance of trained enumerators. Descriptive statistics and the Foster Greer-Thorbecke index were used in the analysis of the assembled data

RESULTS AND DISCUSSION

The gender dynamics of the respondents in the data showed that for the adult, the majority (72.12%) of the male respondents are between the ages of 35-43 years, while the adult females from the same age bracket are about 59.50%. For the youths, 61.54% of them are between the ages of 26-34%. With a pooled mean value of 38 years, it implies that the majority of the farmers are economically active, strong, agile, and have the requisite strength to participate in farming activities and will respond to any intervention aimed at improving their general well-being.

Further results in Table 2 show that for adults, 87.95% and 97.10% of male and female farmers surveyed respectively were married, with only about 18.8% of the youth farmers being married. This high rate of marriage in the study area indicates a high degree of responsibility among the respondents, which is important in making rational decisions. This high percentage of married farmers was in line with the findings of Tanko (2019) which shows over 65% of rice farmers in the Kadawa rice cluster of Kano State Nigeria were married.

Furthermore, results also showed that 43.70% of the female adults obtained secondary education, 56.82% of the youths had a non-formal form of education, while others attained different levels of education across the categories of respondents. This finding was similar to that of Jatto *et al.* (2021), who reported that education has a positive and significant impact on farmers' poverty status. Thus, literacy level will greatly influence the decision-making and adoption of innovation by farmers, which might invariably decrease the level of poverty among smallholder farmers.

The World Bank's per capita income of the dollar-per-day approach ($2.15/pay) to the computation of poverty measures was adopted. Thus, according to the World Bank 2017 PPP (purchasing power parity), the $2.15/pay was equivalent to a discounted figure of ₦563 per day of HH expenditure of farmers. This resulted in the poverty line being set at $2.15 (₦563) at the time of the study as shown in Table 3. According to the pooled data FGT index, about 19% of the contract farming population is poor, while it was a little higher for the non-contract farming population which stood at about 42%. Poverty severity (P_2) and the poverty gap index (P_1) were 0.47 and 0.23 for contract farmers, while it was 0.77 and 0.56 for non-contract farmers respectively. This suggests that about 77% of the non-contract farmer's households are in severe poverty and that the impoverished home for contract farmers and non-contract farmers in the study area needs about 23% (₦129.5) and 56% (₦315.3) of the poverty line in other not to be define as poor.

By decomposing the analysis further, results in Table 4 revealed that about 11% of the adult male contract rice farming population were poor compared to the 37% of non-contract farmers. 61% of adult female non-contract farmers were poor, and about 77% of them were in severe poverty when compared to just about 23% of the contract rice farmers of the same gender. Furthermore, about 45% of the youth non-contract farming population are poor as indicated in the result, and they need about 39% (₦219.6) of the poverty line so as not to be termed as being poor. Generally, the results revealed that the female rice farmers in the study area were considered poorer in contrast to the adult and youth farmers respectively. This finding is contrary to that of Ogundipe *et al*. (2019) and Ibitola *et. al,* (2019) who both reported a poverty incidence to be higher for male-headed households as against the female-headed households

CONCLUSION AND RECOMMENDATIONS

Based on the results of this study, it was concluded that the poverty level among the respondents was high, particularly for adult female and youth farmers. Thus, it is recommended that efforts and relevant policies should be formulated by relevant stakeholders, including government and non-governmental organizations towards providing relevant interventions that will improve the welfare, and living standard of farmers, and also the provision of gender-sensitive labour-saving devices that will reduce the poverty level of farmers.

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Table 1: Summary of sampling size

LGA	Community	Contract farmers Sample Frame	Sample size	Non-contract farmers Sample size
Kura	Bugau	1650	55	55
	Karfi	875	29	29
Bunkure	Lautaye	455	15	15
	Tsambaki	272	9	9
Garun Mallam	Kadawa	1267	42	42
	Chiromawa	770	26	26
Total		**5289**	**176**	**176**

Source: Field Survey, 2024

Table 2: Decomposition of socioeconomic characteristics of rice farmers based on gender

Age (years)	Adult		Youths (%)
	Male (%)	Female (%)	
18-25	0.00	0.00	38.46
26-34	0.00	0.00	61.54
35-43	72.12	59.50	0.00
44-52	14.10	20.50	0.00
≥53	13.78	20.00	0.00
Marital status			
Single	0.00	2.90	78.40
Married	87.95	97.10	18.06
Widowed	6.98	0.00	3.54
Seprated	5.07	0.00	0.00
Household size			
1-3	0.00	3.40	90.20
4-6	42.60	67.21	9.80
7-9	50.00	29.39	0.00
10≥	7.40	0.00	0.00
Educational level			
Non-formal education	46.30	45.40	56.82
Primary education	36.84	43.70	31.07
Secondary education	16.56	10.90	10.31
Tertiary education	0.30	0.00	1.80
Primary occupation			
Crop production	58.80	34.50	27.90
Livestock rearing	7.40	51.70	52.50
Petty trading	6.80	13.80	4.40
Civil servant	0.50	0.00	0.00
Artisan	26.50	0.00	15.20
Farm size			
<1ha	32.40	84.50	63.45
1-2ha	60.82	15.50	14.10
≥3	6.78	0.00	22.45

Source: Field Survey, 2024

Table 3: Pooled poverty status of the respondents

Variables	Contract farmers	Non-contract farmers
Poverty line (₦)	₦563	₦563
Poverty headcount	0.19	0.42
Poverty gap	0.23	0.56
Poverty severity	0.47	0.77

Source: Field Survey, 2024

Table 4: Decomposition of poverty status of rice farmers based on gender

Variables	Contract farmers			Non-contract farmers		
	Adult Male	Female	Youth's	Adult Male	Female	Youth's
Headcount ratio	0.11	0.24	0.33	0.37	0.45	0.61
Poverty gap	0.27	0.48	0.31	0.38	0.55	0.39
Poverty severity	0.13	0.23	0.23	0.45	0.77	0.47
Poverty line (₦)	₦563	₦563	₦563	₦563	₦563	₦563

Source: Field Survey, 2024

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Climate-Smart Agriculture: A Concept for Increased Arable Crop Production

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ABSTRACT
Despite the idea of Climate-Smart Agriculture (CSA) is relatively new in Nigeria and is still developing, many of the techniques that comprise CSA are already in place and were given to farmers as a way to address different production issues. A deeper comprehension of CSA practices among Nigerian farmers will help policymakers create suitable measures to address the danger posed by climate change to sustainable food production. These studies clearly demonstrate the existence of climate change and its substantial effects on agricultural output. While studies have demonstrated that farmers have implemented a variety of adaptation measures to combat the effects of climate change, little is known regarding the extent to which farmers are adopting these strategies among arable crop framers. The review of the relevant literature would provide baseline data to help policymakers make decisions when developing effective programs to lessen the negative effects of climate change generally and on policies aimed at boosting Nigeria's productivity, resilience, and emissions reductions in particular.
Keywords: Climate-smart Agriculture, practices, concept, arable crop, production

INTRODUCTION
Concept of Climate-Smart Agriculture
One strategy that has been promoted as the "holy grail" of agricultural development is climate-smart agriculture (CSA) (Naess, 2011). According to this concept, agriculture is essential for mitigating and adapting to climate change (Wollenberg et al., 2011; Beddington et al., 2012). The acronym SMART, which stands for specific, measurable, achievable, dependable, and timely, is the source of the term "climate-smart agriculture" (McCarthy et al., 2012). CSA calls for new farming practices, including behavior changes, the replacement of customs, and occasionally the revival of old ones. It often demands different types of labour, physical inputs, and financial support for successful implementation. Research shows that men and women differ in their capacity to adjust to climatic shocks and longer-term climate change due to disparities in decision-making, access to resources, and entitlements; these disparities are further compounded by social and gender differences. According to Nwaobiala et al. (2024a), CSA frequently entails sustained investment in and commitment to better land management.

Climate-smart agriculture (CSA) is a method of agriculture that reduces/removes greenhouse gases (mitigation), increases productivity and resilience (adaptation), and enhances the achievement of national food security and development goals (FAO, 2010; Giller, 2014). Any CSA approach is based on three main pillars: reducing and/or removing greenhouse gas emissions; adapting and building resilience to climate change; and increasing agricultural productivity and incomes in a sustainable manner. Agriculture is deemed “climate-smart” when it accomplishes these three objectives (Olorunfemi et al., 2020; Ifeanyi-Obi and Henri-Ukoha, 2022: Uduma and Nwaobiala,

2024). The objectives of Climate-Smart Agriculture (CSA), an integrative approach to addressing these interconnected issues of food security and climate change, is to reduce greenhouse gas emissions from agriculture (including crops, livestock, and fisheries); adapt and build resilience of agricultural and food security systems to climate change at multiple levels; and sustainably increase agricultural productivity to support equitable increases in farm incomes, food security, and development.

Climate Smart Agriculture aims to take into account national and local specificities and priorities while examining these three objectives collectively at many levels, from local to global, and at various scales, from farm to landscape. The idea behind this is that farming should require a large financial investment, particularly in the development of technologies that can help farmers adapt to climate change, the transition of farmers from existing practices to new, climate-aware ones, and the encouragement of farmers to reduce or stop using practices that increase greenhouse gas emissions. Solutions under Climate-Smart Agriculture usually include new crop varieties or methods for improving soil and food output. One of CSA's exciting benefits is its capacity to sequester carbon and use carbon finance in the process, which can serve as a significant motivator for farmers to embrace CSA and sustainable production processes (World Bank, 2021).

Effect of Climate Change on Arable Crop Production

According to the 2015 climate change index by the global risk analytics business, Nigeria is ranked among the top ten (10) most vulnerable nations in the world (Ogunjinmi and Ogunjinmi, 2022). A climate change department was established by the Nigerian Ministry of Environment with the goal of advancing the federal government's plan to mitigate and adapt to the consequences of climate change. Providing leadership in fostering the proper adaptive culture and assisting with research, education, and awareness are just a few of their mandates. Agriculture has been the main focus of Nigeria's efforts to diversify its economy under the current leadership, but this sector is particularly vulnerable to climate change. Climate change impacts the production of arable crops through a variety of effects, including sudden changes in the weather, a lack of rainfall, soil degradation, flooding, and excessive heat (Anugwu, Agbo, and Agwu 2021; Nwaobiala et al., 2024b). The climate and the fertility of the soil are two major natural environmental factors that influence the amounts of arable crop output. Therefore, in order to enhance crop production and meet growing populations, farmers who raise arable crops in rural areas must increase their climate change adaptation tactics. The extensive body of research on this topic shows that the harm resulting from climate change affects both livestock farming and the production of arable crops. In actuality, climate change has an impact on various aspects of agriculture, leading to decreases in employment, profitability, and productivity. These show up as more extreme weather conditions, like erratic rainfall patterns, rising temperatures, sea level rise, delayed beginning of rainfall, early retreat of rainfall, drought floods, extended dry seasons, and elevated salt of ground water. These have resulted in a longer growing season, crop redistribution, soil infertility, insect pest invasion, water scarcity, and a decrease in agricultural output (Adeloye and Sotomi, 2013). In the Nigerian economy, yam and cassava are significant crops for both food and industry. Therefore, a thorough evaluation of how climate change is affecting the nation's yam and cassava producers' economic efficiency and production may be essential to meeting future demand. Increased pests and diseases, increased erosion, excessive flooding, plant death from severe drought drying up our local streams, soils that are harder to till than usual, poor and unpredictable crop yields, and delayed planting times due to rainfall patterns are all consequences of climate change on arable farming (Ekanem, Ekerete, and Umoh, 2020).

Climate-Smart Agricultural Practices

Numerous agricultural technologies and practices, including minimum tillage, various crop establishment techniques, nutrient and irrigation management, and residue incorporation, can increase crop yields, decrease greenhouse gas (GHG) emissions from agricultural activities, and improve the efficiency of water and nutrient use (Aggarwal, Arun Khatri-Chhetri, and Vyas, 2017). According to Chandra Alvin, Karen E. McNamara, and Paul Dargusch (2018), farmers can additionally lessen the effects of climate change and variability by using crop/livestock insurance, rainwater collecting, enhanced seed use, and ICT-based agro-advisories. Mulching, cover crops, conservation agriculture, agroforestry, integrated crop and animal management, better water management, and more are all examples of climate-smart agriculture.

Conservation Agriculture

The Food and Agriculture Organization (FAO) (2017), Conservation Agriculture (CA) is a method of managing agro-ecosystems for better and sustained productivity, higher profits, and food security while protecting and improving the environment and resource base. Three linked principles define CA, which are as follows:

a. Continuous minimum mechanical soil disturbance
b. Permanent organic soil cover
c. Diversification of crop species grown in sequences with/or associations.

Crop production is the primary objective of agriculture; therefore CA necessitates adjustments to weed and pest management. Plowing the soil and burning plant waste are mostly seen as essential for phyto-sanitary reasons, which include controlling weeds, pests, and diseases. To manage weeds and pests in a system with less mechanical tillage based on mulch cover and biological tillage, substitutes must be created. It becomes essential to use integrated pest management. In order to accomplish this, crop rotation is a crucial component.

Advantages of Conservation Agriculture

• It offers an incredibly sustainable production method that preserves and improves natural resources while expanding the diversity of soil biota, fauna, and flora (including wild life) in agricultural production systems without compromising high production yields. Because CA relies on biological processes to function, it improves agricultural production systems' biodiversity both at the macro and micro levels.

• No-till fields absorb CO2, and conservation farming, when implemented globally, may significantly reduce air pollution in general and global warming in particular. Eventually, farmers that use this method can receive carbon credits as compensation.

• The most energy-intensive farming practice is soil tillage, which contributes to air pollution in mechanized agriculture. Compared to conventional cropping, farmers can save 30 to 40% on time, labor, and fossil fuels by not tilling the soil in robotic agriculture.

• The extremely high water penetration capacity of CA soils greatly reduces surface runoff and, consequently, soil erosion. This promotes groundwater resources and improves surface water quality by lowering pollutants from soil erosion. After a few years of conservation farming, it has been noted that natural springs that had dried up for a long time have begun to flow once more in numerous places. It is yet unclear how widespread adoption of conservation farming might affect water balances around the world.

• Conservation agriculture produces yields that are comparable to those associated with modern intensive agriculture, but in a sustainable manner. Over time, yields typically rise while yield variances decline.

Conservation farming is primarily appealing to farmers because it lowers production costs, labor costs, and time, especially during periods of high demand like planting and land preparation. In mechanized systems, it also lowers long-term investment and maintenance costs for machinery.

Disadvantages of Conservation Agriculture

Short-term drawbacks could include the high upfront expenses of specialist planting equipment and the entirely new dynamics of a conservation farming system, which call for a farmer to have strong management skills and go through a learning process. Extensive global experience with conservation farming has demonstrated that it does not pose a single challenge to a farmer, but rather a variety of issues that can all be addressed (FAO, 2017).

Crop Rotation and Integrated Pest Management

Crop rotation maximizes the physical and chemical interactions between various plants species while breaking the infection link between succeeding crops. In the initial years, synthetic chemical pesticides—especially herbicides—are unavoidable, but they must be applied carefully to minimize their detrimental effects on soil life. The use of synthetic pesticides and mineral fertilizers tends to decrease to a level below that of the original "conventional" farming system to the extent that a new balance between the organisms of the farm-ecosystem, pests and beneficial organisms, crops and weeds, is established and the farmer learns to manage the cropping system. An vital source of plant nutrients and the potential for soil improvement are destroyed when crop and weed leftovers are burned. Crop rotation and integrated pest management techniques can more effectively accomplish the phyto-sanitary goals of burning and ploughing.

Integrated Crop and Livestock Management

The integration of livestock and crop production systems enhances both sectors' environmental sustainability and diversity (FAO, 2017). Simultaneously, it offers chances to boost farming's total productivity and profitability. Because specialized livestock production techniques have issues with both economic and environmental sustainability, this would lessen the demand for them. In order to minimize the negative effects of intensive farming and protect the environment, an integrated farming system uses a variety of resource-saving techniques to achieve high and sustained production levels and acceptable profits, according to the International Fund for Agricultural Development. The following are the outcomes of an integrated farming system: (a) reduces erosion; (b) higher crop yields, soil biological activity, and nutrient recycling; (c) increased land usage, increasing revenues; and (d) the potential to decrease poverty and malnutrition and improve environmental sustainability.

Advantages of Integrated Crop and Livestock Management

Crops and livestock are produced in a coordinated framework in an integrated system (Van Keulen and Schiere, 2004). One component's waste products are used as a resource by the other. Manure, for instance, is utilized to boost agricultural yields; crop leftovers and byproducts are fed to animals, augmenting frequently insufficient feed supplies, thereby improving animal productivity and nutrition. Animals are essential to the operation of the farm because they produce livestock products (meat, milk, eggs, wool, and hides) and can be quickly turned into cash when needed. They also convert plant energy into work that is useful, such as plowing, transporting, and water lifting for irrigation, as well as logging, milling, road construction, marketing, and other activities that increase soil fertility;

- By improving physical, chemical, and biological soil recovery, it enhances and preserves soils' potential for production. The collection and relocation of nutrients by animals greatly increases crop yields and soil fertility.
- Grain crops can be produced in four to six months, and pasture creation following cropping is quick and affordable, making it efficient, quick, and economically viable.
- By lowering production costs, it contributes to higher earnings. When artificial fertilizers become pricey due to growing petroleum prices, poor farmers might use fertilizer from livestock operations.
- It increases the amount of organic matter and biological aeration, which in turn increases the soil's capacity to store water.
- It offers a variety of revenue streams, ensuring protection from changes in trade, prices, and climate fluctuations.

Constraints to Integrated Crop and Livestock Management

- Crop residue often has low protein and digestible nutritional qualities. Although it is technically possible to improve the absorption and digestibility of agricultural residues through physical and chemical treatments, impoverished small farmers cannot afford the necessary equipment and chemicals due to their high cost or limited availability (Food and Agriculture Organization).
- Crop residues are primarily soil regenerators, but too often they are either disregarded or misapplied.
- Intensive recycling can cause nutrient losses.
- The cost and energy requirements for production and transportation, as well as the surpluses lost to the environment, will all continue to be high if manure nitrogen utilization efficiencies are not increased or used correctly.
- Farmers prefer to use chemical fertilizer instead of manure because it acts faster and is easier to use.
- Resource investments are required to improve intake and digestibility of crop residues.

Adoption of Climate Smart Agricultural Practices

Food consumption is rising as a result of dietary changes and the world's expanding population, according to the Food and Agriculture Organization (FAO, 2020a). As crop yields level off in many regions of the world, ocean health deteriorates, and natural resources—such as soils, water, and biodiversity—are overextended, production is finding it difficult to keep up. The detrimental effects of climate change are already being felt, as evidenced by rising temperatures, more frequent extreme weather events, invasive crops and pests, changing agro-ecosystem boundaries, and weather variability. Climate change is decreasing the nutritional value of main cereals, crop yields,

and livestock output on farms. To sustain existing yields and enhance production and food quality to satisfy demand, significant adaptation investments will be needed. Also, the issue is reversed. In order to accomplish climate goals and lessen environmental stress, it is imperative that food loss and waste be addressed (IPCC, 2020).

"Climate change" is defined by the Intergovernmental Panel on Climate Change (IPCC) (2019) as a shift in the climate that persists for decades or more and may be identified by changes in the mean or variability of its features. Traditional farming methods are being disrupted by climate change, which also affects smallholder communities that depend on farming for their livelihoods and engage in semi-subsistence farming. According to the IPCC (2020), climate variability refers to "variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events." Variability may arise naturally as a result of climate system processes that are influenced by changes in anthropogenic or natural external forcing. According to Nwaobiala and Nottidge (2013), climate change may cause crop yields in Africa to decline by 10–20% by 2050 or even by 50%. Globally, climate and weather variations account for over one-third of crop yield variation, and in many parts of the world's breadbaskets, climate variation accounts for over 60% of crop yield variation.

Nigeria's agriculture system is under extreme stress and threat due to climate change. Given that crop production accounts for a sizable portion of Nigerian agricultural activity, this suggests that food security and rural sustenance are seriously threatened. The negative effects of climate change are projected to be most severe for rural farmers whose livelihoods rely on the exploitation of natural resources (Onyeneke, Ohalete, and Uwazie, 2019). Drought, floods, crop failures, long-term changes in wind speed, changes in rainfall intensity, and rain unpredictability are examples of extreme events that have grown more common. These events lead to a decrease in agricultural production, increased hunger and malnutrition, and diseases and pests.

Table 1: Climate Change Threats and Required Climate Smart Agricultural Practices

Climate change indicators	Impact on Agriculture	CSA practices required
Higher temperatures	Reduced crop yields	New crop varieties with greater heat tolerance
Less precipitation	Reduced crop yields in rain-fed agriculture	New crop varieties with lower water requirements Improved irrigation techniques Improved water collection, storage and distribution techniques
Reduced availability of irrigation water	Reduced crop yields in irrigated agriculture	Improved irrigation efficiency New crop varieties with lower water requirements
Salt water intrusion	Reduced irrigation water	Barrier to salt water intrusion New crop varieties with greater salinity tolerance Improved water collection, storage and distribution techniques
Increased flooding or water logging	Reduced crop yields or loss of crops	New crop varieties with higher moisture tolerance Improved drainage or flood control techniques
Increased incidence of pests and diseases	Reduced crop yield	New crop varieties with improved pest and disease resistance Improved pests and disease management techniques
Extreme weather events	Loss of crops	Improved techniques to increase resilience of crops to extreme weather events. Improved extreme weather events prediction and early warning systems

Source: Adapted from Ramanchandran, (2015)

The challenges of how to turn the promises of that agreement into reality necessitates the need for agricultural practices that would address the threats posed by climate change. In response, the concept of Climate Smart Agriculture (CSA) was developed. In order to address or prevent 1992 macro- and micro-nutrient deficiencies, the Food and Agriculture Organization implemented

integrated soil fertility management, which combines fertilizers with organic matter inputs such as mulch, compost, crop residues, and green manure; improved protective soil cover through cover crops, crop residues, or mulch; and direct seeding under reduced tillage for the restoration of degraded lands and areas drained for crop production. Despite the potential advantages, CSA adoption by farmers has been comparatively modest worldwide. As a result, certain incentives have been implemented in certain nations to encourage farmers to join CSA.

Climate Change Adaptation Strategies

According to Manzoor, Haqual, and Baloch (2021), farmers' adaptation to climate change at the farm level, particularly through changes to production systems, is one of the primary adaptation mechanisms in the agricultural sector. Henri-Ukoha and Adesope (2018) listed several adaptation strategies, such as raising public awareness of climate change, identifying communities and groups most at risk from its effects, developing indigenous knowledge and technology, improving irrigation and drainage systems, managing groundwater, and implementing sustainable farming systems. Climate smart agricultural (CSA) practices are therefore necessary to reduce greenhouse gas emissions and their adverse effects, as evidenced by the growing emphasis on agriculture's adaptation to climate change (Onyeneke, Nwajiuba, Emenekwe, Nwajiuba, Onyeneke, Ohalete, and Uwazie, 2019).

According to Alabi, Oladele, and Oladele (2020), farmers can adapt by using disease-resistant crop types, afro-forestry, adjusting planting and harvesting dates, diversifying their sources of income, mulching, planting trees, mixed farming, and intercropping. Other factors include insurance, off-farm jobs, and land and water management techniques (Ali and Erensteuin, 2017). Tree planting, early maturing crop cultivation, mixed farming, improved crop varieties, pest and disease resistant varieties, increased family labor, complementary/diverse livelihoods, cover crops, crop rotation, irrigation techniques, crop rotation, and riverside/bank activation are some of the adaptation strategies farmers have adopted to counteract the effects of climate change (Anugwu, Agbo, and Agwu, 2021). Crop diversification, shifting the dates of planting and harvesting, altering the use of herbicides, conserving soil, and other adaptation techniques are some of the ways farmers have adapted. To reduce the risk of complete crop failure, crop diversification entails planting a variety of crops (Abegunde, Sibanda, and Obi, 2019). As the environment changes, farmers have been able to take advantage of good weather conditions by adjusting the dates of crop planting and harvest. It allows the farmer to sow and harvest earlier or later than is customary. The soil conservation techniques that are employed include decreasing the use of heavy machinery, rotating crops, using fertilizers sparingly, and mixed farming, irrigation, mulching, and planting trees. To lessen erosion from wind and water, trees were planted. According to Chukwuemeka, Kingsley, and Ume (2018), further adaption strategies include fasting, prayer, migration, and bush fallowing. Sustainable land management techniques such crop rotation, intercropping, mixed cropping, low tillage, agro-forestry, terracing, contour ridging, mulching/cover crops, and crop rotation are all part of adaptation methods (Obinna and Onu, 2021). Crop residue protects the soil, increases crop yields and food products, ensures food security, preserves soil moisture, improves soil properties and structure, improves the capillary action of water in the soil, increases soil microbial activity, aids in soil aeration, ameliorates soil degradation, helps reconstitute the carbon pool in soils, lowers atmospheric carbon dioxide, lowers the risk of crop failure, produces crops that are able to withstand harsh weather conditions, and adds value to indigenous knowledge. Carbon storage is increased through crop rotation, crop improvement, crop rotation, minimum tillage, cover crops, and decreased usage of fallow land (Adzawla, Azumah, Anani, and Donkoh, 2019). The emphasis will be on implementing mechanical innovations such contouring, terracing, and minimum tillage if response times to changes are prolonged, particularly in the case of proactive adaptation (Mogaka, Bett, and Ng'anga, 2021).

Benefits of Climate Smaat Agriculture on Arable Crop Production

Climate-smart agriculture (CSA) is an integrated approach to managing landscapes—cropland, livestock, forests and fisheries—that address the interlinked challenges of food security and accelerating climate change. CSA aims to simultaneously achieve three outcomes (The World Bank, 2021):

- Increased Productivity: Produce more and better food to raise earnings and improve nutrition security, particularly for the 75% of the world's poor who reside in rural regions and support themselves primarily by means of agriculture.

- ❖ Enhanced Resilience: strengthens the ability to develop and adapt to longer-term pressures like shorter seasons and unpredictable weather patterns, while lowering susceptibility to drought, pests, diseases, and other climate-related hazards and shocks.
- ❖ Reduced emissions: Aim for less emission per calorie or kilogram of food produced, steer clear of agricultural deforestation, and find methods to remove carbon from the atmosphere. CSA is unique in a number of respects, even though it is based on the current understanding, tools, and concepts of sustainable agriculture. First of all, it specifically addresses climate change. Second, CSA methodically takes into account the trade-offs and synergies between mitigation, adaptation, and productivity. Lastly, CSA aims to reduce the investment gap by seizing new financial opportunities.

CONCLUSION AND RECOMMENDATIONS

Climate-smart agriculture is a new paradigm in agricultural development that looks for ways to reduce farm level and climate change vulnerability while increasing agricultural productivity. In order to enable farmers who grow arable crops choose the optimal adaptation choice and implement climate-smart agricultural methods that will help lessen the impact of climate change on their farming operations and activities, this paper suggests that farmers adopt or practice this concept.

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Agribusiness and Entrepreneurship: A Review of Innovative Financing Mechanisms for Sustainable Food Security in Nigeria

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ABSTRACT
Food security remains a pressing challenge in Nigeria, exacerbated by climate change, socio-political instability, and inadequate financing mechanisms. Agribusiness and entrepreneurship play crucial roles in addressing food security challenges, but access to finance remains a major constraint. This paper reviews innovative financing mechanisms available to agribusiness entrepreneurs in Nigeria, including microfinance; impact investing, agricultural value chain financing, fin tech solutions, and government interventions. The study also highlights policy recommendations for improving financial access to enhance food security. A thorough literature review is conducted to provide insights into the intersection of agribusiness, entrepreneurship, and financial innovation. The findings suggest that financial constraints significantly hinder agribusiness growth, and overcoming these barriers is key to sustainable food security in Nigeria.
Keywords: Agribusiness, Entrepreneurship, Finance, Food Security, Innovative Financing Mechanisms

INTRODUCTION
Agribusiness and entrepreneurship are critical drivers of economic growth and food security in Nigeria. The agricultural sector contributes about 24% to Nigeria's GDP and employs over 70% of the workforce, making it a key component of national development (Olu, *et. al.,* 2021). However, food security in Nigeria remains fragile due to climate change, socio-political instability, and inadequate access to finance. The ability of agribusinesses to thrive is largely dependent on financial accessibility, technological advancement, and government support, Adobor, (2020).

Entrepreneurship within the agricultural sector fosters innovation, enhances productivity, and increases food availability. However, many agribusiness entrepreneurs struggle with capital constraints, which limit their ability to invest in improved farming techniques, mechanization, and value chain expansion, Panel, (2018). Traditional financial institutions often perceive agriculture as a high-risk sector, leading to limited credit access for farmers and agribusiness operators. Consequently, innovative financing mechanisms such as microfinance, fintech solutions, value chain financing, and impact investing have emerged to bridge this gap (Rayhan, *et al.,* 2024). This paper explores the various innovative financing mechanisms available for agribusinesses in Nigeria and their impact on food security. It also examines the role of government policies, private sector investments, and technology-driven solutions in enhancing financial accessibility for agribusiness entrepreneurs.

A comprehensive literature review is essential for understanding the relationship between agribusiness, entrepreneurship, finance, and food security. This section presents existing scholarly discussions on these key variables.

Agribusiness and Its Contribution to Food Security

Agribusiness encompasses the entire agricultural value chain, including production, processing, marketing, and distribution. It plays a crucial role in ensuring food security by improving productivity, enhancing supply chain efficiency, and fostering economic development. Studies indicate that agribusiness significantly contributes to food security by increasing food production, reducing post-harvest losses, and improving market accessibility, Gc, and Ghimire, (2019). The integration of agribusiness activities enhances value addition, reduces food wastage, and ensures that agricultural products reach consumers in optimal condition (Urugo, *et al.,* 2024).

Agribusiness fosters rural development by generating employment opportunities and increasing income levels for farmers and agripreneurs. According Ogunleye, (2017), the agribusiness sector in Nigeria employs over 70% of the workforce, making it a key driver of economic growth. By incorporating modern farming techniques, agribusiness improves efficiency and sustainability in food production. Mechanization, precision agriculture, and smart farming technologies have been identified as vital components of agribusiness that enhance food security, Reddy, (2022). One of the major contributions of agribusiness to food security is the reduction of post-harvest losses. Post-harvest losses in Nigeria account for approximately 40% of total agricultural output due to inadequate storage facilities, poor transportation networks, and inefficient supply chains, Ogundele, (2022). The development of agro-processing industries and cold chain logistics can significantly reduce these losses and improve food availability. The adoption of warehouse receipt systems, improved packaging methods, and supply chain digitization have proven to be effective in mitigating food losses (Reyes, *et al.,* 2024).

Agribusiness also enhances market accessibility for farmers by linking them to domestic and international markets. Value chain integration allows smallholder farmers to access stable markets, ensuring consistent income and increased production levels (Ferris, *et al.,* 2014). E-commerce platforms and digital marketplaces are further revolutionizing agricultural trade by connecting producers directly to consumers, thereby reducing the role of intermediaries and increasing farmers' profits (Emeka, *et al.,* 2023).

Despite its immense contributions to food security, the agribusiness sector in Nigeria faces numerous challenges, including poor infrastructure, inconsistent government policies, financial limitations, and climate change impacts (Ukwe, 2025). Addressing these challenges requires strategic investments in rural infrastructure, policy harmonization, and financial support mechanisms to enhance agribusiness development. Strengthening agribusiness financing, promoting innovation, and improving access to technology will further boost the sector's contribution to food security in Nigeria.

Entrepreneurship in Agribusiness

Entrepreneurship in agribusiness involves the application of innovative business models to enhance agricultural productivity and profitability. Entrepreneurs in this sector drive technological adoption, improve efficiency, and create employment opportunities, thereby fostering economic growth and food security, Odeyemi, (2023). Agripreneurs play a critical role in modernizing agriculture through value addition, market expansion, and the introduction of innovative financial mechanisms to bridge investment gaps (Bethi, *et al.,* 2023). One of the key contributions of agripreneurship is its ability to foster innovation. Research indicates that agripreneurs introduce new farming techniques, advanced mechanization, and precision agriculture to improve productivity and reduce losses (Balogun, *et al.,* 2024). The adoption of climate-smart agricultural practices, such as conservation agriculture and hydroponics, further enhances food security and resilience to climate change (Sarma, *et al.,* 2024).

However, many agripreneurs face challenges that hinder their business sustainability. Limited access to finance remains a major barrier, as traditional financial institutions often perceive agriculture as a high-risk sector, making credit accessibility difficult (Khan, *et al.,* 2024). In response, alternative financing mechanisms such as crowdfunding, cooperative societies, and agribusiness venture capital have been proposed to support agripreneurs (Havran, *et al.,* 2021). Additionally,

entrepreneurship education and business training programs have been identified as essential for improving the managerial skills of agribusiness owners and ensuring the long-term viability of their enterprises (Kalule, *et al.,* 2017). Market volatility and price fluctuations pose another challenge to agribusiness entrepreneurs. Global economic trends, currency devaluation, and unstable government policies often lead to unpredictable market conditions that negatively affect agribusiness investments (IMF and UNCTAD, (2011)). To mitigate these risks, agripreneurs are increasingly leveraging digital technologies and data analytics for market intelligence, demand forecasting, and efficient resource allocation (Ajayi, *et al.,* 2024).

Furthermore, the role of women and youth in agribusiness entrepreneurship is gaining attention. Studies suggest that empowering women and youth through agribusiness training and financial inclusion strategies enhances food production and economic diversification (Malik, *et al.,* 2019). Government policies and support programs, such as agricultural grants and business incubation hubs, have been recommended to promote inclusive agribusiness entrepreneurship (Ifeoma, 2019).

Finance and Agribusiness Growth

Access to finance is a major determinant of agribusiness success. Studies reveal that financial limitations hinder farm expansion, mechanization, and value addition (Ntagu, *et. al.,* 2022). Limited capital restricts farmers from investing in high-yield technologies, acquiring modern equipment, and improving agricultural infrastructure (Balana, *et al.,* 2022). Financial constraints also limit the ability of agribusinesses to scale operations and compete in domestic and international markets. Various financing options, including microfinance, agricultural banks, government credit schemes, and crowd funding, have been explored to support agribusiness growth (Mapanje, *et al.,* 2023). Microfinance institutions provide small-scale credit to farmers, particularly those without formal collateral, thereby enabling them to invest in productivity-enhancing technologies. Agricultural banks, such as the Bank of Agriculture in Nigeria, offer specialized credit facilities tailored to agribusiness needs (Adeniyi, 2021). Crowd funding platforms have also emerged as viable alternatives, allowing farmers to raise capital from a diverse pool of investors.

Despite these financing opportunities, high-interest rates, bureaucratic loan application processes, and stringent collateral requirements continue to hinder smallholder farmers' access to credit, Hlaing, (2024). Many financial institutions perceive agribusiness investments as high-risk due to climate uncertainties, fluctuating commodity prices, and inadequate insurance coverage, Céu, and Gaspar, (2024). To address these challenges, policymakers and financial institutions must develop tailored financial instruments such as low-interest credit facilities, agricultural insurance schemes, and blended finance models to support agribusiness development. Additionally, public-private partnerships (PPPs) and impact investment funds are gaining traction as innovative financing mechanisms for agribusiness (Nikolaevich, *et al.,* 2019). The public-private partnerships (PPPs) facilitate investment in rural infrastructure, cold storage facilities, and agro-processing industries, thereby improving value chain efficiency. Impact investors, on the other hand, focus on sustainable agribusiness models that deliver both financial returns and social impact (Kish, *et al.,* 2018). Enhancing financial literacy among farmers and agripreneurs is also critical to maximizing the benefits of available funding opportunities. Studies indicate that financial literacy training improves loan repayment rates, investment decision-making, and business sustainability in agribusiness ventures (Obi-Anike, *et al.,* 2023). Government-led financial inclusion programs and agribusiness incubators can further equip entrepreneurs with the skills needed to navigate complex financial landscapes and access funding effectively. By strengthening financial support systems, reducing bureaucratic barriers, and promoting financial literacy, agribusinesses in Nigeria can achieve sustainable growth, increased productivity, and enhanced food security.

Innovative Financing Mechanism

Recent literature highlights the role of innovative financing in transforming agribusiness. These mechanisms include:

- Microfinance Institutions (MFIs): Provide small-scale loans to farmers and agripreneurs, but often at high-interest rates, Adebisi, (2020). These institutions have expanded access to credit but need to adopt flexible repayment structures and reduce borrowing costs to enhance their impact.
- Value Chain Financing (VCF): Ensures financing along the agricultural supply chain, enabling producers, processors, and marketers to access funds, Ojo, and Ayanwale, (2019). By linking

financial resources directly to supply chain actors, VCF reduces credit risks and enhances production efficiency.

- Fintech Solutions: Mobile banking, digital lending, and blockchain financing are improving financial inclusion for smallholder farmers (Asare, *et al.*, 2024). Digital platforms such as FarmCrowdy and Thrive Agric facilitate access to investment capital while ensuring transparency and risk reduction.
- Government and Development Bank Interventions: Programs such as NIRSAL and the Anchor Borrowers' Programme provide credit and risk-sharing incentives to agricultural enterprises (CBN, 2020). These interventions address market failures and support agricultural resilience.

Expanding and integrating these financing models will enhance agribusiness sustainability, boost food security, and mitigate financial risks in Nigeria's agricultural sector.

CHALLENGES

Despite these financing innovations, several barriers hinder agribusiness development in Nigeria:

a) Inadequate Infrastructure and Logistics: Poor road networks, lack of storage facilities, and inefficient transport systems increase post-harvest losses and reduce access to markets, Bappah, and Adejoh, (2024).
b) Regulatory and Policy Inconsistencies: Frequent changes in government policies on agricultural financing and trade regulations create uncertainty for agribusiness investors (Olomu, et al., 2020).
c) High Lending Interest Rates and Collateral Requirements: Many financial institutions require high collateral, making it difficult for small-scale farmers and agripreneurs to access credit (Mohammed, et al., 2024).
d) Low Financial Literacy: Many farmers lack knowledge of available financing options, credit management, and risk mitigation strategies, which limits their ability to access and utilize funds effectively (Uche, *et al.,* 2024).

CONCLUSION AND RECOMMENDATIONS

Innovative financing mechanisms are crucial for enhancing agribusiness growth and ensuring food security in Nigeria. A diversified approach, integrating microfinance, fintech solutions, value chain financing, and government interventions, can significantly improve financial access for agripreneurs. However, addressing regulatory bottlenecks, improving infrastructure, and promoting financial literacy are essential for long-term sustainability. Future research should focus on evaluating the effectiveness of these financing mechanisms in different agribusiness sub-sectors. By addressing financing challenges and implementing strategic policy reforms, Nigeria can unlock the full potential of agribusiness entrepreneurship and ensure sustainable food security for its growing population.

To address these challenges, the following policy recommendations are proposed:

a) Strengthening Financial Literacy Programs: Educating farmers and agripreneurs on financial management, investment strategies, and available funding options will enhance their ability to secure and utilize financial resources efficiently.
b) Expanding Fintech-Driven Financial Inclusion: Leveraging mobile banking, digital lending platforms, and blockchain technology can improve access to finance for rural farmers and agribusinesses.
c) Enhancing Government-Private Sector Collaboration: Establishing partnerships between the government, financial institutions, and agribusiness investors can foster better access to credit and funding for agricultural enterprises.
d) Reducing Interest Rates on Agricultural Loans: Implementing policies to lower interest rates and providing government-backed guarantees can improve credit accessibility for agribusiness entrepreneurs.
e) Encouraging Public-Private Partnerships for Infrastructure Development: Investment in rural roads, storage facilities, and logistics infrastructure will reduce post-harvest losses and enhance market access for agricultural products.

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Effects of Input Costs on Egg Production among Poultry Farmers in Ikwuano Local Government Area, Abia State Nigeria

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ABSTRACT
The study estimated the effects of input costs on the egg production among poultry farmers in Ikwuano Local Government Area, Abia State Nigeria. The specific objectives described the socioeconomic characteristic of the farmers in the study area; identified the various poultry inputs, its associated costs incurred by the poultry farmers and estimated the effects of cost of input on egg output among the farmers. Multistage random sampling technique was used in selection of eighty (80) poultry egg farmers. Structured questionnaire were administered to the farmers in the study area. Data collected were analyzed using descriptive statistical tools and ordinary least square regression model. The results showed that the farmers had mean age of 46 years with mean household size of 5 persons. The farmers attended at least secondary school. Had mean monthly income of N48000. The variables that influence the egg output included; number of pullets (1%), cost of feed (1%), cost of drugs (5%), fuel (1%), rent (1%) and labour (1%). Recommendations include poultry farmers' use of improve high-laying efficiency breeds with better feed conversion rates. Farmers can formulate on-farm feed using locally available ingredients such as cassava peels, soybean meal, palm kernel cake and fish meal as substitute for feed and reduce reliance on commercial feed. Poultry farmers can establish cooperative feed purchasing groups to buy feed in bulk at discounted prices.

Keywords: poultry input costs, poultry farmers, egg production and Ikwuano Local

INTRODUCTION
Egg production is a significant aspect of poultry farming in Nigeria including Abia State, contributing to food security, employment, and economic development (Inyang, *et al*., 2023). Poultry farming, particularly layer production, is a vital source of protein through egg consumption, which is essential for nutritional health. The demand for eggs has been increasing due to population growth, urbanization and rising awareness of the nutritional benefits of eggs. However, several factors influence the efficiency, available and sustainability of egg production in the state.

Egg production involves the use of good layers stock for the purpose of table egg production. The eggs are sold off-fresh to the public, while the spent layers are culled off from the farm. Poultry are good converters of feeds to eggs and meat within a short period of time (Ebraheem *et al.,* 2012). The nutritive value of poultry eggs rank second to cow milk. Eggs provide essential dietary supplements such as fat and water soluble vitamins like B_{12} and chlorine. It is also rich source of minerals like phosphorus, zinc, iron and magnesium (Nega, 2020). Apart from providing employment and a livelihood to thousands of people, it also provides a remarkably high quality nutritious food. The egg is a complete protein with excellent quality; one egg gives 6g of protein (Ebraheem *et al.,* 2012; Rafed, *et al*., (2024). Egg white protein has a biological value of 100, the highest biological value of any single food protein (FAO, 2019). Therefore, consumption of eggs has

been linked to improved cognitive development and overall health outcomes (Kritz-Silverstein and Bettencourt 2023).

Depending on the farm-size, eggs production can be the main source of family income or can provide income and gainful employment to farmers throughout the year. Not all eggs produced are however, directly consumed some are further used for production of vaccines and antibodies (Ezeano *et al.*, 2019). Augmenting the production of laying chickens is an important objective in helping to meet the nutritional needs of the growing population in Nigeria. Eggs are palatable and generally acceptable and this acceptability cuts across nearly all cultural and religious boundaries in Nigeria. Furthermore, layers are adaptable to various climates and altitudes. Poultry rising can often be combined with other types of farming and offers the possibility to raise extra revenue for farmers.

Egg production in Ikwuano Local Government Area (LGA) of Abia State, Nigeria, is a significant agricultural activity with various socio-economic implications. The farmers supply eggs to households, food vendors, hotels and markets, thereby playing a crucial role in the local economy. However, despite the growing demand, egg production faces several challenges, including high costs of poultry feed, inadequate veterinary services, disease outbreaks, poor farm management practices, and limited access to finance and extension services. However, the poultry industry in Nigeria, as well as other developing countries of African, is continually characterized by low production levels (Okoli, 2002). According to Lukanov *et al*., (2015) poor input in egg production affect production, these inputs include feeding cost, medication, cost of labour, water consumption as used by poultry farmers among other factors are responsible for the low production. Researches have been conducted on egg production, marketing, technical efficiency and productivity in the study area, hence this research is aimed at bridging the gap in the area of input costs associated with egg production.

The broad objective of the study is to estimate the effects of input costs on the egg production among poultry farmers in Ikwuano L.G.A, Abia State. Nigeria. The specific objectives are to;

iii. describe the socioeconomic characteristic of the farmers in the study area;
iv. estimate the effects of cost of input on egg output among the farmers.

The research hypothesis tested was;
H_1: Costs of poultry inputs have no significant influence on egg output among poultry farmers in the study area.

METHODOLOGY

The study was carried out in Ikwuano Local Government Area (LGA) of Abia State, Nigeria. Ikwuano Local Government Area was created out of the defunct Umuahia LGA in 1991 and has its headquarters at Isiala Oboro. It shares a common boundary with Ini Local Government Area of Akwa Ibom and Umuahia North. Ikwuano LGA is made up of four clans namely Oboro, Ibere, Oloko and Ariam and 18 villages. The L.G.A is located between latitudes 5^0 24/ N and $5^0$30/ N of the equator and longitudes 7° 32' E and 30 37: E of the Greenwich Meridian. Ikwuano L.G.A has a population of 180,600 people which comprise of 92,300 males and Female 88,300 Nigeria Bureau of Statistics (NBS, 2016).

The climate is tropical and humid all the year round. There are usually two seasons, rainy season ranges from March to October. The dry season occurs from November to February. The mean annual rainfall ranges from 2000mm to 2500mm with the southern areas receiving more than the northern areas. The temperature ranges between 22°C minimum to 31°C (Maximum). The vegetation is predominantly lowland rainforest. Major occupation of the people is farming. The major food crops grown are cassava, yam, melon, vegetable, three-leaf yam and cowpea. Some important cash crops grown in Ikwuano LGA are oil palm and cocoa, while animals reared are goats, sheep, pigs and poultry.

Sampling Technique

Multi-stage random sampling technique was used in choosing the poultry egg farmers. In the first stage, all the historic clans were selected from the Local Government Area. In the second stage, two villages from each clan were purposively selected based on concentration of layer farmers in the villages, making it 8 villages namely Ihim, Isiala, Amizi, Ahaba, Ndieke, Ndiorie, Umudike and Amaoba. In the third stage, layer farmers were identified who operate layers farms in the area,

through the poultry farmers association. Fourth stage, a random selection of 10 egg production farmers from each village, given a total of 80 farmers were used for this study.

Data collection

Data were collected with the use of structured questionnaire which were administered to farmers in the study area. The questionnaire were designed to capture the socio-economic characteristics such age, experience, level of education, household size of the farmers in the study area, the various poultry inputs and its associated costs incurred by the poultry farmers.

Method of Data Analysis

Objectives i was analyzed using descriptive statistical tools such as frequency, percentage and mean. Objective ii was be realized using ordinary least regression model expressed as follows;

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}) \quad (1)$$

Where;

Y = Quantity of egg produced (Naira/kg)
X_1 = Number of pullets (Number)
X_2 = Cost of feed (Naira)
X_3 = Cost of labour (Naira)
X_4 = Cost of drugs/Vaccine (Naira)
X_5 = Cost of water consumption (in naira)
X_6 = Amount of wood shavings (Naira)
X_7 = Depreciated value of items used in the poultry farm (Naira)
X_8 = Rent for building (Naira)
X_9 = Fuel cost (Naira)
X_{10} = Cost of transportation (Naira)

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Farmers

Table 1 showed that the mean age of the farmers was 46 years which indicate active working age. The implication of this age bracket on output is increase output and income. Majority (68%) of the respondents in the study area were males, while 32% were female. The mean household size was 5 persons. The mean farming experience was 8 years. The result has some positive implications on increased output because according to Michael *et al.,* (2022). Years of farming experience of a farmer contributed to his ability to manage his holding efficiently. Thus, the higher the experience of a farmer, the higher the adoption rate of new technology will be. Mean number of years spent in school was 10 years. This suggest that majority of the farmers in the study area are lettered. The result implies that most of them can read and can therefore handle their farming activities and challenges with very minimum assistance since education has a way of improving the performance of farmers in their farming activities (Onyemekihian *et al*., 2023).

Table 1 indicated that 55% of poultry farmers in the study area are members of cooperative societies while 45% are non-members. Mean monthly income was 48,000. Mean values of 94 crates of eggs are produced monthly. Table 1 also showed that 92% of the poultry farmers in the study area have no access to any form of credit facility while only 8% are have obtained one level of credit or the other. This implies that majority are operating on self-funding basis.

Determinant of the Effects of Input on Egg Outputs

The regression estimates of the effect of inputs on egg output in the study area is presented in Table 2.

The semi-log regression function was chosen as the lead equation based on the value of R^2 (coefficient of multiple determination), F-ratio, the number of significant variables and the conformity of regression coefficient with *apriori* expectation. The R^2 value 0.869 means that 86.90% of the total variation observed in the dependent variable was accounted for by the changes in the explanatory variables included in the model. The F-ratio of 36.87 signifies that the model was statistically significant at 1% level, implying that the model was of good fit, that variables included in the model were correct. The variables that influence the egg output included; number of pullets (1%), cost of feed (1%), cost of drugs (5%), fuel (1%), rent (1%) and labour (1%).

The finding reveals that the coefficient of number of pullet (2.26) was positive and statistically significant at 1%. This implies that there is a direct relationship between number of pullets and egg output. The higher the number of birds/pullets, the efficient of stock size had a positive and significant association with output.

The coefficients of cost of feed (-4.02) have a negative sign and is significant at 1% showing a negative relationship with output of egg. This implies that a unit increase in the cost of feed will result to a decrease in quantity of feed obtained for consumption thereby leading to a reduction in egg production. This is in line with the findings of Abdulrahman *et al.,* (2022).

The coefficient of drugs (2.32) was positive and significant at 5% level which implies that effective management, which includes ensuring birds receive timely and high-quality veterinary care which enhance the egg output. The coefficient of quality of wood shaving (3.03) was positive and statistically significant at 1%. This implies that level of quality beddings provided for the pullets will enhance egg output.

The finding shows that cost of fuel (-5.66) has a negative coefficient and significant at 1%. This implies that there is a negative relationship between the light and output. The egg production is associated with the length and intensity of the light received by the bird daily. In other words, an increase in the cost of fuel, which leads to a reduction in light provided, will have a negative effect on the pullet and it leads to decrease in the egg production.

The coefficient of labour (-5.57) is negative and significant at 1%. This suggests that additional labour does not contribute positively to egg production. This could be due to inefficiencies in labour utilization, overstaffing, or other factors that reduce productivity despite increased labour input (Girei, *et al.,* 2018).

The coefficient of cost of equipment (-4.04) was negative and statistically significant at 1%; implying that increased in depreciation in value of items used in the poultry farm and will bring about decrease in egg output. Altahat *et al.,* (2012), opined that high depreciation cost reflects aging infrastructure, reduced operational efficiency, and higher maintenance costs.

Also, the coefficient of the cost of rent (-4.06) was negative and significant at 1%. The implication is that, the increase in rent will result to a reduction in space thereby reducing the number of pullets and feed purchased which will surely lead to a decrease in egg output.

CONCLUSION AND RECOMMENDATIONS

This study concludes that the major poultry input whose cost affect egg production in the study area include number of pullets, cost of feed, cost of drugs, cost of fuel, rent, cost of labour and cost of equipment. Recommendations to optimize production and reduce costs offered include, optimizing the number of birds through the use of improve breed selection by choosing high-laying efficiency breeds with better feed conversion rates. To reduce cost of feed, farmers can formulate on-farm feed using locally available ingredients such as cassava peels, soybean meal, palm kernel cake and fish meal as substitute for feed and reduce reliance on commercial feed. Poultry farmers can establish cooperative feed purchasing groups to buy feed in bulk at discounted prices. Routine vaccination programs and probiotic use to enhance bird immunity naturally should be adhered to in order to reduce unnecessary cost veterinary care. Use of alternative energy sources such as solar panels for lighting and biogas from poultry waste can reduce fuel dependence. Adopting vertical farming techniques like battery cage systems to maximize space. Workers can be trained to handle multiple tasks efficiently, reducing the need for excess labour.

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Table 1: Socioeconomic Characteristics of the Farmers

Variable	Freqency	Percentage (%)	Mean
Age			
30 -39	13	16	**46**
40 – 49	38	47	
50 – 59	26	33	
60 and above	3	4	
Gender			
Male	54	68	
Female	26	32	
Marital Status			
Single	8	10	
Married	72	90	
Household Size			
1 – 3	27	34	**5**
4 – 6	47	58	
7 and above	6	8	
Years of Experience in Poultry Farming			
1 – 5	27	34	**8**
6 – 10	44	55	
11 and above	9	11	
Years Spent in School			
0 – 6	19	24	**10**
7 -12	32	40	
13 – 16	39	36	
Monthly Egg Production in Crates			
1 – 100	44	56	**94**

Variable	Freqency	Percentage (%)	Mean
101 -200	29	36	
201 and above	7	8	
Monthly Farm Income			
10000 – 30000	16	20	**48000**
31000 – 50000	30	37	
51000 – 70000	19	24	
71000 and above	15	19	
Cooperative Membership			
Yes	44	55	
No	36	45	
Access to Credit			
Yes	6	8	
No	74	92	

Source: Field Survey Data, 2023. Total number of respondents = 80

Table 2: Estimates of the effect of inputs on egg output

Variables	Linear	Semi-log +	Double log	Exponential
Intercept	3172.459	9.594	8.3458	-860690.7
	(5.70)***	(19.08)***	(3.20)***	(-4.42)***
X_1= Number of pullets	508.34	0.857	0.232	203.75
	(2.46)**	(2.26)***	(2.19)**	(2.51)**
X_2= Cost of Feed	-7572.78	-0.153	-0.1557	28615.27
	(-4.80)***	(-4.02)***	(-0.34)	(2.31)**
X_3= Cost of Labour	3.995	0.7395	0.5309	-1036.952
	(4.66)***	(-5.57)***	(2.56)**	(-2.56)**
X_4= Amount of Drug Intake	85.65	0.789	0.3042	93973.41
	(3.21)***	(2.32)**	(2.56)**	(2.11)**
X_5= Cost of Water	51900.04	0.0019	0.1814	66156.05
	(3.35)***	(0.06)	(0.08)	(0.80)*
X_6= Wood Shaving	0.715	4.05e-06	0.1804	14982.78
	(1.41)	(3.03)***	(2.87)**	(1.22)*
X_7 = Cost of equipment	-5.457	-0.0000499	-0.4153	-10444.91
	(-11.70)**	(-4.04)***	(-13.29)***	(-1.72)*
X_8 = Cost of Rent	0.157	-1.497	-0.0871	-34778.29
	(0.73)***	(-4.06)***	(-1.86)***	(-3.82)***
X_9 = Cost of Fuel	4048.92	0.165	-0.00003	69454
	(3.69)**	(-5.66)***	(-2.58)**	(2.69)***
X_{10} = Cost of Transportation	3172.46	-0132	0.967	33751.24
	(5.70)***	(-1.57)	(0.50)	(0.89)
R^2	0.7510	0. 869	0.6958	0.6383
R^{-2}	0.7143	0.7769	0.6595	0.5851
F-ratio	26.84***	36.87***	20.60***	15.71***

Source: Field Survey (2023) + lead equation, *** Significant at 1%, ** Significant at 5%*significant at 10%. The regression coefficients (β) in parenthesis

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Analysis of the Effects of Extension Services on Smallholder Oil Palm Farmers Productivity in Edo State, Nigeria

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ABSTRACT

The need to increase productivity and strengthen output with the latest innovation is paramount to extension services as it affects farmers in their production processes. This study tends to analyze the effects of extension services on smallholder oil palm farmers in Edo State by examining the socioeconomic features and determining the factors affecting their productivity. The study employed a multistage sampling technique to obtain a random sample size of 250 respondents used for the analysis. Primary data were obtained with the use of a well- structured questionnaire and analyzed with the descriptive statistics and regression model. The result revealed that 57.6% of the farmers were above 41 years of age, 64% had primary education while 92% of them had less than 10 extension contacts per season and 18% of them earn more than ₦250000 per annum. The regression analysis revealed that age at 0.05%, farming experience and means of communication at 0.01% each with extension contact, extension visits and distance negatively at 0.10% were the factors affecting the smallholder oil palm farmer's productivity. It further showed that educational level, farm input and annual income (output) were the factors in consonant with the smallholder oil palm farmer's productivity. It was recommended that increased extension services are paramount to smallholder oil palm farmer's productivity. Also, there should be increased farmers educational level and input subsidy as to boost output and increase productivity.

Keywords: Effects, Extension Services, Smallholder, Oil Palm, Productivity.

INTRODUCTION

The rapid increase in the population growth is evident in the high demand for food due to the declining balance in food production as productivity continues to decline. Agricultural productivity is the ratio of output per unit of input used in the production process faces a lot of set back as to meet the demands of the population due to some factors such as neglect worsened by insufficient extension services to enlightened farmers on the necessary innovations to boost output and increase productivity. Extension has been an age professional field of transmitting information, educating people on how to identify and assess their own problems, acquire knowledge and skills on how to effectively deal with such problems as to improve their living conditions (http://www.novapdf.com). Extension is a system of dissemination of knowledge, information, and technology from agricultural experts, research centres and allied institutions to farmers and rural communities (Malhan & Rao, 2007). This could be achieved through a lot of programmes / projects. Agricultural extension programmes have been of great importance in addressing rural poverty, productivity and food insecurity. Productivity growth in the agricultural sector can only be successful through extension service delivery in the development and dissemination of improved agricultural

technologies to smallholder farmers in the rural area who are the major actors in food production (Asfaw, Shiferaw, Simtowe, Lipper, 2012) and (Gideon, Dennis and Robert, 2018).

Extension service delivery is imperative for the accelerated and sustainable growth and poverty reduction in agricultural productivity. This is because insufficient extension service delivery has not elevated and motivated many people in agriculture above the poverty line, especially the rural dwellers who contribute immensely to agricultural production as opined by Bonye, Alfred & Jasaw (2012). These services bridge the gap between research institutions, agricultural innovations, and local farmers by providing them with practical knowledge on how to improve farming methods with recent innovations and adapt to climatic changes as observed by Tiwari, Sitaula, Nyborg,& Paudel .(2008) and Gideon, Dennis & Robert, (2018) .

Extension services are paramount to the creation of awareness and for the dissemination of innovation from research and allied institutions such as Agricultural Development Programes, Ministry of Agriculture, Research Institutes etc to farmers on the latest technology to boost their output, increase profitability and enhance livelihood for sustainability according to Mendola,. (2017). The essence of extension services is pertinent in the existence of these institutions for the disseminations of innovations according to Swanson, (2008). This is one of the major reasons for the need and creation of extension departments in the Ministries of Agriculture, Faculty of Agriculture, ADP's, Private and Public Research Centres, Research Institutes amongst others for the transmission of ideas *visa vis*. For instance, the Federal Government of Nigeria in the establishment of the Nigerian Institute for oil palm research, (NIFOR) in 1939 with the mandate to oversee and carry out detailed research on oil palm at the Benin main station instituted the Extension Department for the dissemination of innovations for sustainable economic development. The sole responsibility of the institute is to carry out detailed research on the biology, ecology and economy of the crop with the aim of improving yield, increase production for the end users through extension service delivery and provide enabling opportunities for research purposes. Knowing the importance and impact of extension service delivery, the Extension Department was mandated on transmitting / delivering latest technologies to smallholder oil palm farmers to increase productivity. They are the mediators between the farmers and research institute through the release of research findings which are made available to the farmers in different ways at least via short message services (SMS) to activate farmers to identify, analyze and apply research innovations to solve impending problems to increases productivity. The Extension Services rendered includes; transmission of innovation from research institute to farmers, training on the adoption of new technologies / improved varieties of the Extension Work Seeds (EWS) such as hybrid tenera, supper gene, small scale processing equipment (SSPE), advanced and technological cultural and management practices, accurate farming operation activities, latest agronomic data and planting calendar, temperature and climatic adaptation strategies, like the use of organic insitu-mulching to regulate evaporation, leaching and weed suppression, drought tolerance and inhibition techniques. They enhance partnerships with farmers and others in the business as interdisciplinary research and relate farmers' disturbing needs to research institute for enquiries and solutions. They render their services through different means of communications such as personal interaction, local means through town criers and heads of villages, social gatherings and through electronic and social media such as Radio Stations, Television Stations, Facebook, Twitter, Whatsapp, Youtube, Instagram, Tiktok, Wechat, Messenger, Newspapers, Bulletin, Magazine, amongst others. Their services which entail the numbers of extension visits are paramount to disseminate and evaluate the farmers' performance as well as the impacts of farm inputs to increase productivity but have been sparingly affected by insufficient funding. Also the numbers of Extension contacts have not been enough due to the poor funding of research and allied institutions and agriculture to meet the demands of these farmers thereby limiting them to assess the latest innovation to boost output as seeking for private extension services will cost more. Consequently, improved agricultural productivity, profitability and enhanced standard of living of farmers are achieved through extension service delivery from the product of research and development (R&D). Though extension service delivery could be hindered as it passes through the channel in either ways as "Feedback"by "Noise" that may distract or distort the innovation being conveyed. Effective and Efficient Extension service delivery involves funds for regular visits, contacts, purchase of training aids, mobility, experimental sites for demonstration like the Small Plot Adoption Techniques (SPAT), advertisement such as media, town crier's, training centres amongst others and this was the reasons for the poor ratio of 1: 1189 extension agents to farmers in Nigeria as compared to the recommended ratio of 1:75 extension agents to farmers for developing countries (Agbamu, 2005). This was the current reasons for the launching of the National

Electronic Extension Platform (NEEP) by the Minister for State for Agriculture Dr. Aliyu Abdullahi on the 4th of March, 2025 in Abuja with the theme: Sustainable Agricultural Extension Service Delivery in Nigeria. This is to provide real time access to vital agricultural information, offering interactive cost effective alternatives to traditional extension services while mitigating security risks faced by extension agents (VILLA INFOSTRATIC, 2025). Also the leeway for Agricultural Research Council of Nigeria (ARCN) as they were granted approval to implement the project "RENEWED HOPE AGRICULTURAL TECHNOLOGY ADOPTION PROGRAM (RHATAP)" with the theme: increased Agricultural Productivities, Intensive Land Use, Climate Smart Agricultural Technology, Soil Conservation, Environmental Conservation and Soil Health. Therefore it is pertinent that increase in extension services for the continuous and strengthening of awareness and dissemination to increase productivity is of utmost concern as this study tends to examine the socioeconomic characteristics of the farmers and determine the factors of extension services affecting smallholder oil palm farmer's productivity.

METHODOLOGY

The study was conducted in Edo State. Edo in southern Nigeria was created in 1991 from Bendel State with its capital in Benin City. The State is made up of eighteen local government areas having three Agro-ecological zones; Edo North, Edo Central and Edo South (Edo State Agricultural Development Programme (EADP) (2018). The estimated population of the state is about 3218332 comprising 1640461 males and 1577871 females at a growth rate of 2.7% per annum (NPC, 2006). The State is located between longitude 06' 04^0 E and 06' 43^{0}E and latitude 05' 44^{0}E and 07' 34^{0}N with boundaries: Delta State in the south, Ondo State to the west, Kogi State to the North and part of Delta State to the east. The land mass is about 19187 sq km suitable for oil palm production hence the choice state. Data were collected using a well- structured questionnaire, personal observation and personal interview method. A multi-stage sampling technique was adopted for this study. The first stage was the purposive selection of three agricultural zones in the State. This is to address a complete representative of oil palm farmers in the State. The second stage was a purposive selection of twelve local government areas comprising 5 LGA from Edo South, 5 LGA from Edo Central and 2 LGA from Edo North that showed evidence of high oil palm farmers' concentration. The third stage was a purposive selection of 2 communities from Edo South and 1 community each from Edo Central and Edo North (10= ED S, 5=ED C, 2=ED N) and a random sample selection of 15 respondents from Edo South, 12 each Edo Central and 20 from Edo North giving a total of 250 respondents that were used for the analysis. This is clearly shown below:

Table 1: Sampled State by Agricultural Zones, Local Government Areas, Communities and Respondents

Parameters	ED S	ED C	ED N
Agric Zones	1	1	1
LGAs	5	5	2
Communities	2	1	1
Respondents	15	12	20
Total	1×2×5×15=150	1×1×5×12=60	1×1×2×20=40
Sum Total = 250			

Source: Field Survey 2024. *ED S = Edo South Agro Zone, ED C = Edo Central Agro Zone and ED N =Edo North Agro Zone*

Data Analysis

The analysis were done with the descriptive statistics, such as the percentages and frequencies for the socio-economic characteristics and the ordinary least square regression model for the factors of Extension services affecting smallholder oil palm farmers productivity in the area. The variables analyzed were, age, sex, marital status, educational level, farming experience, number of extension contacts, extension visits, means of communication [personal, local, media], distance among others. The variables were subjected into a regression model and the equation is stated below: Implicitly:

$$A = f(X_1 + X_2 \ldots X_n + e)$$

A = Ssmallholder oil palm farmers productivity
X_1 = Age (years)
X_2 = Sex (Male = 1 or female= 0)
X_3 = Marital Status (dummy= 1 or 0)

X_4 = Educational Level (years)
X_5 = Farming Experience (years)
X_6 = Farm Size (Ha)
X_7 = Household Size (No)
X_8 = Inputs (Naira)
X_9 = Extension Contacts (No)
X_{10} = Extension Visits (No)
X_{11} = Output (Naira)
X_{12} = means of communication [personal (1), local (2), media (3)] (No)
X_{13} = Distance (km)
e = Error Term

RESULTS AND DISCUSSION

Table 2: Socioeconomic Characteristics of Smallholder Oil Palm Farmers

Variables	Frequency	Percentage	Variables	Frequency	Percentage
Age			**Ext contact**		
			1-10	230	92
20 – 30	13	5.2			
31 – 40	93	37.2	11-20	17	7
41 – 50	46	18.4	≥ 21	3	1
≥ 51	98	39.2	**Total**	**250**	**100**
Total	250	100	**Farming Exp (yrs)**		
Sex			< 5	20	8.0
Male	150	60.0	5 – 10	24	9.6
Female	100	40.0	11 – 15	88	35.2
Total	250	100	≥ 16	118	47.2
Marital Status			Total	250	100
Single	10	4	**Farm Size (ha)**		
Married	150	60	1-2	115	46.0
Separated	40	16	3-4	90	36.0
Divorced	50	20	≥ 5	45	18
Total	250	100	Total	250	100
Educational Level:			**HHSize**		
Non formal	44	17.6	1-3	50	20
Primary	160	64.0	4-6	100	40
Secondary	29	11.6	≥ 6	100	40
Tertiary	17	6.8	Total	250	100
Total	250	100	**Annual income**		
			50000-100000	115	46.0
			150000-200000	90	36.0
			≥ 2500000	45	18
			Total	250	100

Source Field Survey: 2024

The result showed that 57.6% of the farmers were above 41 years of age tending towards old age with lesser strength to carry on their daily farming activities and unwilling to adopt the latest innovation. This is supported with the findings of Tesfahun, (2014) that older people hardly adopt new technologies. The result indicated that 60.0% were males showing that the dominance oil palm across the state is known as a male enterprise who more in need of extension services. This implies that oil palm production is the activity performed mainly by male than female farmers in the area. This is in line with the findings of Agwu, (2006) that oil palm farming are male dominated in Abia State and males operate mostly in the nurseries as they were more experienced, knowledgeable and had adequate time to cater for seedlings (Rebecca, 2016) as women traditionally do not own palm plantations in the area, except in households headed by women who had at least a heir. According to Mensah, Amegashie, & Gyasie, (2009). The result further showed that 60% were married and 64% had primary education, an indication that reasonable number of them are educated to embrace the adoption of the innovation through extension service delivery. The result further showed that 92% of them had less than 10 extension contacts per season. This is a high

indication of the effects on productivity as it is not enough to create awareness for the adoption of the innovation to boost output despite all efforts by the Nigerian government initiative of hiring 75000 extension workers as part of efforts to increase food production (Udegbunam, 2021).

It showed that 82.4% of them had 10 years above farming experience, indicating that it is an old enterprise but still depends on their old practices with little knowledge of extension services. Farm size indicated that 82.2% of them plants between 1- 4 hectares which is still at the range of smallholder farmers who hardly deem it fit to access extension services. The ressult showed that 80% of them had an average household size of 4 persons. This shows that a reasonable number of family labour will be utilized instead of sorting for the adoption of the new technologies to enhance output. The annual income indicated that only 18% of them earn more than ₦250000 per annum as compared to the estimated average annual output (income) of integrated household oil palm farmers with reasonable extension service delivery from 2.7 – 7.4 tons per hectare in Nigeria (Solidaridad, 2020).

Table 3: Factors of Extension Services on Smallholder Oil Palm Farmers Productivity

Variables	Linear
Constant	1.112(0.001)
X_1= Age (years)	-2.952(1.449)**
X_2 = Sex (Male = 1 or female= 0)	1.022(0.022)
X_3 = Marital Status (dummy= 1 or 0)	0.002(0.004)
X_4 = Educational Level (No)	5.214(0.110) ***
X_5 = Farming Experience (years)	-5.176(0.031)***
X_6 = Farm Size (Ha)	2.601(0.500)**
X_7 = Household Size (No)	1.305(0.148)
X_8 = Input(Naira)	6.505(0.105)***
X_9 = Extension Contacts (No)	-1.807(1.012)*
X_{10} = Extension Visits (No)	-1.921(1.011) *
X_{11} = Output (Income) (Naira)	1.732(0.211) *
X_{12} = means of communication (No)	-3.626***(0.201)
X_{13} = Distance (kg)	-1.806(0.002)*
R^2	0.886
Adj R^2	0.711
F-value	28.746
Std D	0.0443
Mean	0.740

Source: Field Survey 2024: ***significant level at 1%, **significant level at 5%, *significant level at 10%

Equation of Factors of Extension Services on Smallholder Oil Palm Farmers Productivity

A= $1.112 - 2.952^{**}X_1 + 1.022X_2 + 0.002X_3 + 5.214^{***}X_4 - 5.176^{***} X_5 + 2.601^{**}X_6 + 1.305X_7 + 6.505^{***}X_8 - 1.807^{*}X_9 - 1.921^{*}X_{10} + 1.732^{*}X_{11} - 3.626^{***}X_{12n} - 1.806^{*}X_{13}$

The linear form showed the best fit having the coefficient of multiple determination of 0.886 or 88.6% with F- value of 28.746 and the mean and standard deviation of 0.740± 0.0433, with the highest number of significant explanatory variables and the highest number of consistent *a priory* expectations, based on the signs of the explanatory variables making it the lead equation. The 88.6% variations of the effects of extension services on smallholder farmers productivity was accounted for by the included explanatory variables such as age, education, farming experience, farm size, input, extension contact, visits, output, means of communication and distance, with the Adj R^2 of 0.711, and an F-Stat of 28.746.

The result showed that age at 0.05%, farming experience and means of communication at 0.01%, extension contact, extension visits and distance at 0.10% were negatively significant. These were extension services factors affecting the smallholder oil palm farmer's productivity. As for age at 0.05%, indicates that the older the farmers the lesser their interest in the extension services in the adoption of innovations. This is line with the findings of Ehirim, Odurukwe, Ajero & Emenyonu, (2006) who found the same. The negative and significant effect on farming experience at 0.01% implies the farmers were not willing to adopt the extension services rather adhered to their old practices as they still believe in their years of experiences. The negative and significant effect on means of communication at 0.01% was their inability to have access to extension services to new ideas to increase productivity. Extension contacts and extension visits showed negative and

significant effect at 0.10% significant level. This implies that any decrease in the rate of extension contacts and visits leads to proportional decrease in the smallholder oil palm farmer's productivity which contrasts the findings of Mendola, (2017) that adoption of technologies is a panacea to poverty reduction. The implication revolves in the limited number or ratio of extension agents to farmeris that farmers may not be able to be reached with regard to improved farming techniques required to boost output and increase productivity as observed by Agbamu, (2005). The negative effect on distance at 0.10% level of significant to extension service on smallholder oil palm farmer's productivity indicates that distance was a barrier as increase in transportation cost of both farmers and extension agents would hinder their movement as opined by Zaal & Oostendrop, (2002) and Gideon, Dennis & Robert (2018). It could be deduced that the more the distance from the sources of information the more it affects enhanced productivity. The result showed that educational level and farm input at 0.01% each with output at .10% were positively significant. This implies that the level of education increases productivity through extension service delivery as opined by Reinfrow (2021) that increase in level of education acquired improves knowledge and the quality of labour inputs and thereby increased productivity. The result indicated that any increase in the level of farm input at a subsidized rate through extension service will increase productivity. Also, increase in output by smallholder oil palm farmers increases the chances of extension service delivery.

CONCLUSION AND RECOMMENDATIONS

Improved agricultural productivity, profitability and enhanced standard of living of farmers are achieved through effective and efficient extension service delivery from the product of research and development (R&D). Inadequate extension services is among the decline in productivity and the resultant effects of food shortage causing food insecurity as observed in most developing countries. This study was carried out to analyze the effects of extension services on smallholder oil palm farmers productivity in Edo State by examining the socioeconomic characteristics of the famers and to determine the factors affecting their productivity. The result showed that 57.6% of the farmers were above 41 years of age, 64% had primary education, 92% of them had less than 10 extension contacts per season and 18% of them earn more than ₦250000 per annum. The regression analysis revealed that age at 0.05%, farming experience and means of communication at 0.01% each, extension contact, extension visits and distance at 0.10% were negatively significant and were the extension service factors affecting the smallholder oil palm farmer's productivity while educational level, farm input and annual income (output) were the factors in consonant with the smallholder oil palm farmer's productivity. It is therefore recommended that enhanced extension services are paramount to smallholder oil palm farmer's productivity through disseminations of relevant and latest information to the farmers. Also, there should be increased educational level and input subsidy as to boost output.

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Gender Differentials in Performance of Palm Oil Marketers in Abia State, Nigeria

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ABSTRACT
The study examined the gender differentials in performance of palm oil marketers in Abia State, Nigeria. Specifically, the study described the socio-economic characteristics of the male and female palm oil marketer; determined the marketing performance with respect to net returns, marketing margin and marketing efficiency, estimated the determinants of marketing performance; analyzed the impact of gender on the performance and identified the problems faced by the palm oil marketers in the study area. A multistage random sampling techniques were used to select 80 palm oil marketers (comprising of 40 males and 40 females). Primary data was collected with the aid of structured questionnaire and analyzed using net returns analysis, marketing margin, marketing efficiency index, OLS regression and Z-test. The result indicates the mean ages were 48 and 51 years for both male and female respectively, majority of the respondents were married with mean household of 6. The average net return realized was ₦ 156,052.70 and ₦ 165,242.37 with marketing margin of N4350 and N4550 for male and female marketers. The marketers received ₦23.3k (male) and ₦22.70K (female) for every N1 invested into the business. The coefficient of age and quantity sold were positive while storage cost and distance to market were negative factors that influence the marketing performance of male oil palm marketers in the study area. Also the coefficient of education, market levies and marketing experience were positive while storage cost and distance to market were negative factors that influence the marketing performance of female oil palm marketers in the study area. The Z-test showed that gender has a significant effect on the performance. The major constraint were damage due to animal and theft, poor access road and lack of credit facilities. It was therefore recommended that variables such as age, education, quantity, experience, storage cost and levies should be taken into consideration while formulating policies on palm oil marketing market so as to further enhance the profitability of the business and also need for government to invest in human capital, educate/create awareness on the benefits of product marketing.
Keywords: Palm oil Marketing, Gender and Performance

INTRODUCTION
Palm oil is a rich source of pabulum vegetable oil mainly obtained from the African oil palm-Elaeisguineensis. The palm oil is extracted from the mesocarp (the reddish fruit) of oil palms. The high beta-carotene content of palm oil makes it naturally reddish (Tridge, 2020). Palm oil is the world`s biggest source of fat production and improved edible oil after soya bean oil. According to Stockbrokers (2020), palm oil is notably the world's second rich vegetable oil with world yearly output of fresh fruit bunches approaching 100 million metric tons per year. Gender refers to the economic, social, political, and cultural attributes and opportunities associated with being males

and females and about the socio-cultural roles assigned to men and women and the dynamics between them. Gender refers to socially constructed roles, opportunities and value associated with women, girls, boys and men. It is an acquired identity that is learned, changes over time and varies widely within and across cultures (Ezeibe, *et al*., 2015). Gender participation in palm oil marketing provides form, possession, place and time utility to commodities and services thereby adding economic value (Asogwa and Okwoche, 2018). Gender analysis examines the different roles, rights, and opportunities of men and women and relations between them. It also identifies disparities, examines why such disparities exist, determines whether there are potential impediments to achieving results, and looks at how they can be addressed (United States Agency for International Development (USAID, 2011). Palm oil agricultural marketing deals with the movement of palm oil from the farm gate to the consumption center and includes all the activities involved in the value chain. The marketing agents/middle men and women thus play a significant role in distributing products to consumers located within or outside a region.

Market performance is the appraisal of the extent to which the interactions of buyers and sellers in a market stimulate results that are consistent with social purposes (Olukosi *et al*., 2012). Market performance is the strategic end result of market adjustments engaged in by the buyers and sellers. It is the appraisal of the extent to which the interactions of buyers and sellers in a market stimulate results that are consistent with social purposes. Efficient marketing plays an important requirement in the attempt to achieve wider accessibility and affordability of palm oil to consumers as both the male and female get satisfied in the sense that both get it at an affordable price that stimulates continued consumption (Oyewo *et al*., 2018). Increasing marketing performance requires the marketers to understand the factors that influence market participation and the pricing system in the market. Poor efficiency in marketing has serious consequences for both marketers and consumer. Also the seasonal pattern of production of palm oil which creates surplus at harvest periods and shortage during the off season as well as its perishable nature affect its production and marketing. This leads to a gap in the supply and demand situation and high fluctuation in prices of palm oil. Demand of palm oil remains constant all through the year and to avoid spoilage, it requires efficient marketing.

This study therefore examined the marketing system of palm oil, including its gender differentials in performance of palm oil marketers in Abia State, Nigeria. The specific objectives are to describe the socio-economic characteristics of the male and female palm oil marketer; determine the marketing performance of male and female marketers with respect to net returns analysis, marketing margin and marketing efficiency, estimate the determinants of marketing performance of the male and female palm oil marketer; analyze the impact of gender on the performance of palm oil marketers, identify the problems faced by the palm oil marketers in Abia State, Nigeria.

METHODOLOGY

The study was conducted in Abia State, Nigeria. It has a land mass of 700 square km with 17 local government areas and was created out of Imo State on August 27, 1991. The state lies between longitudes 7^{o} 23^{1} and 8^{0} 02^{1} East of Greenwich meridian and latitudes 5^{o} 49^{1} and 6^{o} 12^{1} North of the equator. Abia State is bounded on the east by the Cross River and Akwa Ibom Sates, on the north by Ebonyi and Enugu States, on the West by Imo State and on the South by Rivers State. Abia has three agricultural zones, namely; Aba, Umuahia and Ohafia.

A multistage sampling technique was used in selecting the respondents. In the first stage, two (2) agricultural zones was randomly selected out of the three agricultural zones. In the second stage, two (2) Local Government Areas (LGAs) was randomly selected from each of the zone while the third stage involves a random selection of two markets from each of the Local Government Area (based on intensity of palm oil marketers). At the last stage, five (5) male and five (5) female palm oil marketers were randomly selected from each of the two markets. This gave a total of eighty (80) palm oil marketers comprising of forty (40) male and forty (40) female marketers.

Primary data were collected with the aid of structured questionnaire and analyzed using descriptive statistics, Net return analysis, Marketing margin, Marketing efficiency, OLS regression and Z – test.

$$NR = TRS - TMC \quad (1)$$

Where: NR = Net Returns, TRS = Total Revenue from Sales and TMC = Total marketing costs

$$Marketing\ Margin = \frac{Selling\ price\ -Supply\ Price}{Selling\ Price}\ X\ \frac{100}{1} \quad (2)$$

$$Marketing\ Effciiency\ (ME) = \frac{Value\ Added\ by\ MArketing\ (Net\ profit)}{Total\ Marketing\ costs}\ X\ \frac{100}{1} \quad (3)$$

According to Scarborough and Kydd (1992) the value of marketing efficiency ranges from 0% to infinity. If marketing efficiency is 100% (unity) it means that the market is perfectly efficient because price increase is just high enough to cover the cost of marketing such commodity. If marketing efficiency is greater than 100%, then, there is excess profit while if marketing efficiency is less than 100%, there is inefficiency in the marketing process. The implicit form of the OLS regression model is specified as:

$$\pi_i = f\ (X_1,X_2,X_3,X_4,X_5,X_6,X_7,X_8,X_9,X_{10}) \quad (4)$$

Where: π_i = Profit from i^{th} palm oil markers; X_1 = Educational level (year), X_2= Age (Year), X_3 = Purchase cost (Naira), X_4 = Quantity sold (liters), X_5 = Transport cost (Naira), X_6 = Market levies (Naira), X_7= loading and offloading cost (Naira), X_8= Storage cost (Naira), X_9= Marketing experience (Naira), and X_{10} = Distance to market (kilometers)

The functional forms were tried and the best fit was selected on the basis of the coefficient of multiple determination (R^2), F ratio and the responsiveness of the magnitude of the coefficient.

$$Z = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad (5)$$

Z = Paired Z statistics, X_1= Mean performance for male palm oil marketer, X_2= Mean performance for female palm oil marketer, S_1^2= Variance level of performance for male marketer, S_2^2= Variance level of performance for female marketer, n_1= Number of male palm oil marketers and n_2= Number of female palm oil marketers

RESULTS AND DISCUSSION

The result in Table 1 shows the socio-economic characteristics of the respondents. The mean ages of 41 and 37 years for both male and female respectively, shows that the marketers where still in their active age. Age influences the ability to seek and obtain reasonable income, which could increase palm oil marketers' income and ultimately their marketing capacity. Aina *et al*., (2021) described this age range as "working age" and noted that people within a certain age range would have acquired some good level of experience. Majority of the respondents were married for both male (97.5%) and female (95%). The implication of marital status on marketing strategy can be explained in terms of the supply of family labour. The supply of family labour would be more where the household heads are married. This is in consonance with the findings of Ridwan *et al*., (2021). Furthermore, marital status can influence the role and responsibilities as well as occupational lives of members and their family. The mean household size of 6 for both male and female palm oil marketers shows a moderate size that will provide family labour, reduced cost of marketing and increased revenue. This corroborates with the findings of Anyanwu *et al*., (2020) who made an argument that the large household have the capacity to relax the labour constraints required during introduction of new marketing technology. Majority of the respondents have formal education for both male and female palm oil marketers. The result implies that palm oil marketers are literate having acquired one level of education or the other. This means that they can be easily convinced to accept better practices of their business operations. It is in conformity with Bulama *et al*. (2020) who posited that a greater deal of change has occurred in recent times due to the introduction of education. High literacy level is an asset of palm oil marketers which would be exposed to many information sources, embrace innovations and analyze farm situations objectively. Undoubtedly, the high level of literacy predisposes some level of managerial ability in the farm business (Bulama *et al*., 2020). The result showed marketing experience of 11 and 8 years for male and female palm oil marketers respectively. Nwaru (2004), noted that the number of years spent in business may give an indication of the practical knowledge he has acquired on how he can overcome certain inherent farm marketing problems. Palm oil marketers would count more on their business experiences for improved output rather than educational attainment. A dominant number of palm oil marketers

indicated access to credit for male palm oil marketers (52.5%) and female palm oil marketers (60%). Access to credit is in turn believed to have significant negative consequences for aggregate and performance level outcomes. Improved access to credit will help poor marketers engage in more commercialization activities that will raise their living standards. Access to credit has the capacity to transform the poor through acquiring marketing capital, which improves their capacity to generate income, savings and investment for better welfare (Chukwuma et al., 2021). The mean income was 156,052.70 and 165,242.37 for male and female palm oil marketers respectively. The implication is that palm oil marketers are better positioned to expand their business with new technique and innovation through as their income continue to increase. Most markets use income to pay for loans received. Moreover some palm oil marketers have used the return from sales as well as other sources of money to invest in modest labour saving equipment suitable for palm oil marketing.

The result in Table 2 shows the marketing performance of male and female marketers with respect to net returns, marketing margins and marketing efficiency. An average net return of ₦ 156,052.70 and ₦ 165,242.37 for male and female palm oil marketers was realized, which is a meaningful amount to make per month. This shows that the business was profitable as indicated by the positive net return recorded with male marketers being more profitable than female marketers. The marketing margin was N4350 and N4550 for male and female palm oil marketers respectively. The marketing margin for the female palm oil marketers was seen to be the highest when compared with male palm oil marketers. The implication is that the female palm oil marketers ' tendency in exercising high economic power on price at the expense of male palm oil marketers is somehow checked and marketing cost was considerably reduced due to low transportation and other related costs for female palm oil marketers. The marketing efficiency for both male and female palm oil marketers revealed that for every ₦1 invested in the business, the marketers received ₦23.3k and ₦22.70K for the male and female palm oil marketers respectively, thus showing that male palm oil marketers was more efficient than female palm oil marketers. This result conforms with the findings of Oyewo *et al*., (2018) as they noted that efficient marketing plays an important requirement in the attempt to achieve wider accessibility and affordability of palm oil to consumers as both the male and female get satisfied in the sense that both get it at an affordable price that stimulates continued consumption.

The result in Table 3 shows determinants of marketing performance of the male and female palm oil marketers. The double functional form and exponential functional forms were chosen as lead equations for male and female palm oil marketers respectively. For the male palm oil marketers, the coefficient of multiple determination was 0.889 which implies that 88.9% of the variation in the marketer's returns was explained by the explanatory variables included in the model. Similarly, the F- statistic indicates that the analysis was statistically significant at 1% level of significance. The coefficient of age and quantity sold were positive and significant variables that influence their marketing performance. Age was significant at 5% level while quantity sold was significant at 1% level. This implies that increase in age or quantity sold will increase the performance/ profit level of the male marketers. The coefficient of storage cost and distance to market were negative and significant at 1% level. This implies that increase in storage cost and distance to market will decrease the performance/ profit level of the male palm oil marketers. For the female palm oil marketers, the coefficient of multiple determination was 0.521 which implies that 52.1% of the variation in the profit was explained by the explanatory variables included in the variables. The F-statistic indicates that the analysis was statistically significant at 1% level of significance. The coefficient of educational level was positive and significant at 10%, which implies that as the educational level of the female marketers increase, their performance/ profit level also increases. Better education has the effect of enabling marketer's access to conceptualize information on improved marketing methods and other related issues capable of enhancing marketing profit. Market levies was positive and significant at 1%, which implies that as the market levies increase, the performance/ profit of the marketers increase. This is against *a prior* expectation and the findings of Ibitoye (2014) who noted a negative relationship between levies and profit. Marketing experience was positive and significant at 1%, which means that as the female marketers spend more years in marketing of palm oil, their performance/ profit level increases. Increase in experience raises human knowledge and skill to adapt to new marketing techniques which increase their profit in marketing. This corroborate with the findings of Saeyang and Nissapa (2021). The storage cost was significant at 5% and negatively related to the performance of the marketers. This denotes that the storage cost significantly affected the level of performance of the marketers. An increase in the cost of storage will decrease level of marketing of palm oil by female marketers. Also distance was

statistically significant at 5% and negatively related to profit, meaning that the distance negatively affects the level of profit of the female marketers. The negative sign of the coefficient shows that as the distance increases, the profit level of the female marketers decrease and vice versa. The implication is that the greater the distance apart from market, the less likely the marketer's orientation towards marketing.

The result in Table 4 shows the impact of gender on the performance of palm oil marketers. This shows the mean, standard deviation and standard error of profit for female palm oil marketers in the area were 165,242.37, 96,587.55 and 85271.8 respectively. While for male, the mean, standard deviation and standard error of income from all source in the area were 156,052.70, 81970.386 and 81878.4 respectively. The Z-value was 4.16 ($p<0.05$) and was significant at 5%. This implies that gender has significant effect on performance of palm oil marketers in the study area as the female are making more profit than male as shown by the positive difference in profit.

Table 5 shows the problems faced by the palm oil marketers in the study area. A 5-point scale, ranging from very serious (5) to not very serious (1**)** was used. Participants were asked to show their opinion by choosing of question from 1-5, scale is compound scale. The choice reflects the argument or disagreement with the particular concept. The constraints above 3.0 are the major constraint in the area while constraints whose values were less than 3.0 are less constraints. The result shows that Nine (9) variables were perceived as constraining factors affecting palm oil marketing as their mean value was greater than 3.0. The Table further reviewed the major constraint were damage due to animal and theft ($\bar{X}$= 4.05), this was followed by Poor access road ($\bar{X}$= 3.85) and Lack of credit facilities ($\bar{X}$= 3.77) for male palm oil marketers while the major constraint for female palm oil marketers were damage due to animal and theft ($\bar{X}$= 3.80), this was followed by Poor access road ($\bar{X}$= 3.60) and Lack of credit facilities ($\bar{X}$= 3.52). This implies that the first three problems were seen as the major problems.

One of the major problems facing marketers in the developing world is damage due to animal and theft, poor access road and Lack of credit facilities (Salau *et al*., 2017). This is more so for palm oils that are mostly store without being processed properly. These resulted in low quality and poor priced oil when taken to the market. In addition, most consumer markets in Nigeria are not well developed particularly in the area of weights and measures. There are no standard units of measurement and lack of uniform means of measurement in most areas and where such exist, they have been tampered with. This leaves the consumer to their preferences and bargaining capabilities in securing a good deal. The palm oil gatherers are often times exploited by the so-called palm oil retailers and wholesalers. They end up getting peanuts for the sales of their oil, just because they cannot afford to transport their product to the cities.

Table 1: Distributions of Respondents according to socioeconomic characteristics

	Male		Female	
Variables	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Age				
25-34	9	7.5	25	10.0
35-44	21	22.5	6	15.0
45-54	3	52.5	5	12.5
55-64	7	17.5	4	62.5
Mean	**41**		**37**	
Std deviation	**8.13**		**6.96**	
Marital status				
Married	39	97.5	38	95.0
Single	1	2.5	2	5.0
Education				52.5
Primary	4	10.0	21	47.5
Secondary	24	60.0	19	95.0
Tertiary	12	30.0	0	0.00
Household Size				
1-4	16	40.0	9	22.5
5-8	11	27.5	8	20.0
9-12	13	32.5	23	57.5
Mean	**6.4**		**6.1**	
Std deviation	**3.44**		**3.53**	
Access to credit				

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	Male		Female	
Variables	**Frequency**	**Percentage**	**Frequency**	**Percentage**
No	19	47.5	16	40.0
Yes	21	52.5	24	60.0
Marketing Experience				
1-5	15	37.5	14	35.0
6-10	8	20.0	11	27.5
11-15	17	42.5	15	37.5
Mean	10.8		8.3	
Std deviation	4.25		4.07	
Cooperatives				
No	19	47.5	16	40.0
Yes	21	52.5	24	60.0
Income				
10000-100000	12	30	13	32.5
110000-200000	24	60	23	57.5
210000-300000	3	7.5	2	5
310000-400000	1	2.5	2	5
Mean	**156,052.70**		**165,242.37**	

Source: field survey, 2023

Table 2: Cost, return, marketing margins and efficiency associated with male and female palm oil marketing per month

Variables	**Male (Amount ₦)**	**Female (Amount ₦)**
Selling price (per 25 liters)	25,950.00	25,650.00
Quality sold (month)	32.00	35.00
Total return/revenue	830,400.00	897,750.00
Variable cost		
Purchase price/Per 25 liters	21,600.00	21,100.00
Quality sold (month)	29.00	33.00
Total Purchase price	626,400.00	696,300.00
Transportation cost	13,850.00	13,600.43
Other market charges	4,477.63	2,283.33
Total variable cost	644,727.63	712,183.76
Gross profit	160,622.37	169,716.24
Fixed cost		
Depreciated value of marketing items	4,569.67	4,473.87
Rent	25,050.00	15,850.00
Total fixed cost	29,619.67	20,323.87
Total cost	674,347.30	732,507.63
Net return (profit)	156,052.70	165,242.37
Marketing margin (₦)	4,350.00	4,550.00
Marketing Efficiency (%)	23.30	22.70

Source: Field Survey. 2023.

Table 3 Multiple Regression result on determinants of marketing performance of the male and female palm oil marketer is presented

Variables	Male marketers		Female marketers	
	Coefficient	t - ratio	Coefficient	t - ratio
Intercept	-1.273	-0.97	3.936	28..85***
X_1 = Educational level (year)	0.013	0.11	0.001	1.67*
X_2= Age (Year)	0.122	2.55***	-0.002	-0.96
X_3 = Purchase cost (Naira)	0.480	0.84	0.002	1.16
X_4 = Quantity sold (liters)	0.122	3.13***	-0.003	-0.51
X_5 = Transport cost (Naira)	0.058	1.02	0.010	0.32
X_6 = Market levies (Naira)	-0.079	-1.31	0.023	3.06***
X_7= Loading & offloading cost	0.076	0.82	0.003	1.04
X_8= Storage cost (Naira)	-0.792	-11.86***	-0.062	-2.05**
X_9= Experience (Naira)	0.015	-0.68	3.426E-6	5.55***
X_{10} = Distance to market	-0.859	-7.60***	-0.006	-2.18**
R^2			0.521	
R^{-2}			0.423	
F-ratio			5.325***	

Source: Field survey (2023) + lead equation ***significant at 1%, **significant at 5%, *significant at 10%

Table 4: Z-test to compare the mean income share of the different livelihood

	Mean	N	Std. Deviation	Std. Error Mean	Z	df	Sig. (2-tailed)
Female	165,242.37	40	96,587.55	85271.8			
Male	156,052.70	40	81970.386	81878.4			
Difference	9,189.67		14,617.17	3,393.42	2.243**	**39**	**0.029**

Source: Field Survey, 2023. Significant at 5%

Table 5: Constraints affecting marketing of palm oil in the study area

Constraint	Male Mean	Remark	Female Mean	Remark
Market Remoteness	3.72	Accepted	3.47	Accepted
Poor access road	3.85	Accepted	3.60	Accepted
Inadequate capital	2.60	Rejected	2.35	Rejected
Lack of credit facilities	3.77	Accepted	3.52	Accepted
Low demand for products	3.55	Accepted	3.30	Accepted
Weak advisory services	3.60	Accepted	3.35	Accepted
Damage due to animal and theft	4.05	Accepted	3.80	Accepted
High cost of transportation	3.65	Accepted	3.40	Accepted
Price Instability	3.58	Accepted	3.33	Accepted
Storage	3.28	Accepted	3.03	Accepted

Source: Field survey (2023). Benchmark = 3.0. VS = Very Serious (5), S = Serious (4), U = Undecided (3), NS = Not Serious (2) and NVS = Not Very Serious (1).

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Can Climate Change Adaptation Strategies enhance Poverty Status? A Comparative Study of Male and Female Small Ruminant Farmers in Abia State, Nigeria

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ABSTRACT
This study explores whether climate change adaptation strategies (CCAS) can enhance poverty status among male and female small ruminant farmers in Abia State, Nigeria. A multi-stage sampling procedure was used to collect data from 80 (40 males and 40 females) small ruminant livestock farmers using questionnaire and interviews. Descriptive statistics was used to describe the socio-economic characteristics of the respondents, climate change adaptation strategies adopted and livestock production constraints in the face of the changing climate. Results showed that female farmers had a higher mean age (46.45 years) and household size (6.75) compared to males (43.43 years; 5.40, HH). Both groups had an average of seven years of livestock farming experience. Farmers adopted various CCAS, including matching livestock stocking rate with pasture production, altering pasture rotation, modification of grazing time, and integration within livestock/crop systems to mitigate climate change. The MPCHE was N9, 233 for male and ₦6,101 for females, with 70% of female farmers classified as poor compared to 47.5% of males. The study showed that CCAS reduced poverty vulnerability (3.05 and 3.22), influence human security (2.85 and 3.02), and increased poverty variability (2.87 and 3.15) for both groups. Major constraints include high cost of labour, inadequate capital, price fluctuation of input materials, unavailability of veterinary services, and poor access to credit. Also, significant negative relationship was found between CCAS and poverty status. The study recommends the implementation of gender-sensitive agricultural support programs to enhance farm income and encourage wider adoption of climate adaptation strategies.
Keywords: Climate Change; Small Ruminants; Livestock farming; Gender; PovertyAlleviation.

INTRODUCTION
Climate change has become one of the most pressing global challenges, with significant implications for agriculture and rural livelihoods, particularly in sub-Saharan Africa (Intergovernmental Panel on Climate Change [IPCC], 2021; Omotoso, *et al.,* 2023). The livestock sector, which plays a crucial role in food security, income generation, and employment in Nigeria, is particularly vulnerable to climate-induced shocks such as extreme temperatures, drought, flooding, and disease outbreaks (Ozor et al., 2020). In Abia State, Nigeria, livestock farming remains a critical livelihood source by providing income, food, and employment opportunities especially for rural households that depend on cattle, goats, sheep, and other animal husbandry for subsistence and commercial purposes (Nwajiuba & Onyeneke, 2022).

To mitigate the adverse effects of climate change, small ruminant livestock-dependent households adopt various adaptation strategies, including improved animal housing, feed supplementation, rotational grazing, and access to veterinary services (Ojo & Baiyegunhi, 2019). However, the extent to which these strategies enhance livelihood resilience varies significantly based on geography and household characteristics, particularly gender. Studies indicate that male farmers often have better access to resources, credit, and extension services than female farmers, potentially influencing their adaptive capacity (FAO, 2021). Understanding these gendered differences is essential for designing targeted interventions that strengthen the resilience of all small ruminant livestock farmers in Abia State.

Despite the growing body of research on climate change and agriculture, there is limited empirical evidence comparing the effectiveness of adaptation strategies between male and female small ruminant livestock farmers in Nigeria. This study seeks to bridge this gap by assessing how different adaptation strategies impact livelihood resilience across gender lines in Abia State.

Climate change poses a severe threat to livestock farming in Nigeria, with rising temperatures, erratic rainfall, and increased frequency of extreme weather events leading to feed scarcity, water shortages, and disease outbreaks (Ezeh et al., 2021). These challenges significantly undermine the productivity and sustainability of livestock farmers, making them more vulnerable to poverty and food insecurity (United Nations Development Programme [UNDP], 2020).

While various adaptation strategies have been adopted to mitigate these risks, the effectiveness of these strategies is not uniform across the different genders. Research suggests that male farmers generally have better access to resources such as land, finance, and extension services, enabling them to adopt more effective adaptation measures (Adamu & Umar, 2022). In contrast, female farmers often face systemic barriers, including limited access to credit, lower educational levels, and socio-cultural constraints that hinder their ability to adopt climate change adaptation practices (World Bank, 2021).

In Abia State, where livestock farming supports thousands of farming households, it is unclear whether existing adaptation strategies adequately enhance resilience among all livestock farmers, particularly female farmers. Failure to address these disparities may lead to increased vulnerability, reduced livestock productivity, and deeper levels of poverty among certain demographic groups. Therefore, a comparative analysis of male- and female- small ruminant livestock farmers is necessary to identify gaps in adaptation efforts and inform policies that promote inclusive climate resilience in the livestock sector. Therefore, the study tends to; describe the socio-economic characteristics of the respondents in the study area by gender; identify the climate change adaptation strategies adopted by the farmers; determine the effect of climate change adaptation strategies on the poverty status of the respondents; and identify the constraints to livestock production in the face of the changing climate. The null hypothesis states that: There is no significant relationship between climate change adaptation strategies and poverty status of farmers.

This study is critical for several reasons. First, it contributes to the growing body of literature on climate change adaptation in Nigeria's livestock sector by providing empirical evidence on the differential impacts of adaptation strategies across gender lines. Understanding these differences will help policymakers, agencies, and agricultural extension services design more inclusive and effective adaptation programs.

Second, the study aligns with Nigeria's commitment to achieving Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 13 (Climate Action). By identifying effective adaptation strategies and addressing gender-based constraints, the research supports efforts to enhance the resilience of vulnerable livestock farmers in Abia State (United Nations, 2022).

Third, the findings will be useful to local and international organizations working on climate resilience, gender equality, and agricultural sustainability. Development agencies such as the Food and Agriculture Organization (FAO), International Fund for Agricultural Development (IFAD), and the Nigerian Agricultural Insurance Corporation (NAIC) can use the insights to refine their interventions and funding priorities for climate adaptation programs.

Finally, the study has practical implications for farmers, policymakers, and researchers. By identifying successful adaptation strategies, livestock farmers can adopt best practices to enhance their resilience. Policymakers can leverage the findings to develop gender-sensitive policies that promote equal access to resources and support services. Additionally, researchers can build on this study to explore further dimensions of climate change adaptation in Nigeria's agricultural sector.

Therefore, this research is timely and essential for addressing the growing challenges posed by climate change on livestock farming in Abia State. By focusing on gender disparities in adaptation and resilience, it will generate valuable insights that can inform sustainable agricultural policies and improve the livelihoods of rural livestock farmers.

METHODOLOGY

This study was carried out in Abia State, a state in the south eastern part of Nigeria with seventeen (17) Local government areas (LGAs). Abia was carved out of the former Imo State in 1991. The name "Abia" is an abbreviation of four of Abia state's densely populated regions Aba, Bende, Isuikwuato, and Afikpo. The state is primarily inhabited by the Igbo tribes and it is bounded on the East by the Cross River and Akwa Ibom Sates, on the North by Ebonyi and Enugu States, on the West by Imo State and on the South by Rivers State. Abia consists of three agricultural zones, namely; Aba, Umuahia and Ohafia. The population of Abia State is around 2, 833, 999 with about 1, 434, 193 males and 1, 399, 806 females. This population consists of people in all walks of life with about 65 percent of them engaged in agriculture. The annual rainfall ranges from 200-250mm while the temperature ranges from 22^0c to 35^0c. Farming is done at- subsistence level. The state is endowed with rich fertile soil that supports the growth of crops like Yam, cassava, cocoyam, melon, maize, oil palm, garden egg, cocoa, to mention but a few. Poultry, goat, pigs and sheep are the major livestock kept. It has co-ordinates of 5°25′N and 7°30′E and occupies a total area of 6,320km^2 (2,440 sq mi), a population of 4,112,230, a density of 650/km^2 (1,700/sq mi) (McCall, 1992).

This study adopted a multistage sampling procedure. In the first stage, two out of the 3 agricultural zones were purposively selected for the study (Ohafia and Umuahia). In the second stage one local government area was randomly selected from each of the zones (Bende and Umuahia south) to give a total of two local government areas. In the third stage, a simple random sampling technique was used to select two communities each from the sampled LGA's, giving a total of 4 communities. In the last stage, a snowballing technique was used to locate 20 respondents from each from the selected communities, giving a total sample size of 80 respondents. Data were collected with the aid of a well-structured questionnaire which was supported with oral interviews in cases where the respondent is not be able to read and write.

Objectives I, II and IV were analyzed using descriptive statistical tools such as means, frequencies and percentages. In objective III, the Foster, Greer and Thorbecke (FGT) Model was used to study the poverty status of the respondent. It is widely used because it is consistent and additively decomposable. A relative poverty line was constructed based on the Mean Per Capita Household Expenditure (MPCHE) of the farmers. The MPCHE is given as:

Total household expenditure / Household Size (1)

The general FGT poverty index (P_i) can be expressed as:

$$P\alpha_i = \frac{1}{n}\sum_{i=1}^{a}\left(\frac{z-y_i}{z}\right) \ldots \quad (2)$$

Where;
a = 0; i.e. poverty incidence or head count:

$$P_0 = \frac{1}{n}\sum_{i=1}^{a}\left(\frac{z-y_i}{z}\right)^0 = \frac{q}{n} \quad (3)$$

a = 1; poverty gap or depth:

$$P_1 = \frac{1}{n}\sum_{i=1}^{a}\left(\frac{z-y_i}{z}\right)^1 \quad (4)$$

a = 2; poverty severity

$$P_2 = \frac{1}{n}\sum_{i=1}^{a}\left(\frac{z-y_i}{z}\right)^2 \quad (5)$$

Where;
α = degree of poverty aversion (0, 1, and 2)
n = number of farmers in a group
y = income of the farmer
q = the number of poor farmers
z = poverty line (two-third of Mean Per Capita Household Expenditure (MPCHE of the farmers).

Then to estimate the perceived effect of climate change adaptation strategies on poverty status of the farmers, the Likert eating scale was adopted. The scale used is represented as; Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). To get the mean value, the following equation was used:

$$\text{Mean} = \sum fn/N \quad (6)$$

Where,
Mean = Likert mean score
$\sum$ = Summation
f = frequency
n = Likert nominal scale
N = Number of respondents
Mean = (1+2+3+4) /4 = 2.5

The hypothesis was tested with the use of Pearson correlation coefficient equation. The model is given as;

$$r = \Sigma[(x - \bar{x})(y - \bar{y})] / (\sqrt{\Sigma(x - \bar{x})^2} * \sqrt{\Sigma(y - \bar{y})^2}) \quad (7)$$

Where;
r is the correlation coefficient
x = climate change adaptation strategies
y = poverty status of the respondents
$\bar{x}$ and $\bar{y}$ are the means of the two variables
Σ denotes the sum of the values

RESULTS AND DISCUSSION

Socio Economic Characteristics of the Farmer in the Study Area

The results in Table 1 showed that the mean age of the female (46.45 years) livestock farmers is higher than the mean age of the male (43.43 years) livestock farmers. However, the mean age of the pooled population implied that both groups are within the productive age, therefore, they are expected to be active on the farm business and responsive to agricultural extension innovations that will improve livestock productivity. This could also lead to a boost in agricultural activities as Anyanwu *et al.,* (2011), and Masi, *et al* (2022) recognized that young people are more likely to be energetic and productive, and have more willingness to adopt new innovation.

It was also seen that the average household size of the male farmers (MF) is 5.40 and the average household size of the female farmers is 6.75 persons. The larger household size from the female farmers (FF) can be attributed to the higher mean age for FF which shows that older people are likely to have larger household size than younger people. This can lead to a reduced labour cost for the FF. This finding agrees with Ezeibe *et al.* (2015); and Ayaz and Mughal, (2022), who started in their separate works that family size is an important source of farm labour since it implies a reduction in the cost of labour. Therefore, it is safe to assume that production tends to increase if there are more members in the household unit; this can also influence the adoption of climate change adaptation strategies (CCAS).

The average number of farming experience in years for both the MF and FF were approximately about 7years of livestock farming experience, and the average number of animals in stock was about 23 and 24 for the MF and FF respectively. The farmer's experience determines the level of his exposure to risks and use of CCA strategy. A farmer who have an average of 7years farming experience as seen in the study area is expected to have gained more knowledge and have the

willingness to reinforce CCAS adoption. However, the average flock size of the respondents showed that the farmers are still operating at small scale and as such they may lack the capacity to adopt and implement CCAS. This is evident in the number of extension contacts in a year, which is less than 1 on average as seen in Table 1 (0.85 and 0.45 respectively), which may have negative effects to the farmers. According to Okoye, (2018); and Lai-Solarin, *et al.,* (2024), low number of extension contact indicate relatively low probability of access to information about new and modern agricultural practices from the extension agents.

The results also showed that a good number of the respondents had both primary and secondary education, but only about 6.25% of the total respondents had tertiary education. The results implied that both MF and FF had at least an average level of formal education. According to Okoye *et al.,* (2020), having basic education is expected to enhance the overall quality of the farmer by providing him/her with basic numeric and literacy skills and the ability to make good farming decisions. Therefore, increased participation in climate change adaptability strategy in agriculture is highly expected among the rural livestock farmers in the study area. This result is also consistent with Ayenew and Tilahun (2022). The disparity in the level of formal education attained between the Male and Female small ruminant livestock farmers in the study area show the priority families in this geographic region give in training their children which is more favorable to the male child.

Accordingly, the role of formal education in income generation is also evident as the MF were observed to have a higher average income level than their FF counterparts as shown in Table 1. However, this income levels obtained from the study implied that the income of the farmers were generally low, and this may affect their ability or willingness to adopt CCAS.

Most of the farmers belong to cooperative societies (65.00% and 77.50%), By implication, this could foster networking and mutual support opportunities among rural farmers, both of which are critical for the long-term viability of businesses and their ability to adopt CCAS. This is because cooperative societies often provide relevant information to their members, foster collective bargaining power, increase access to financial services, and shared knowledge or training. Okoye *et al.,* (2020) noted that belonging to cooperative organization ensure cooperation among farmers in the use of scarce and communal resources.

The study also revealed that goat rearing was dominant among all small ruminant husbandry in the study area. This might be due to the significant role goat plays in the socio-cultural aspects of the people in the study area (such as marriages, land purchases and church activities etc.). It also helps to balance human nutrition, Adam *et al.* (2010). According to Offor *et al.* (2018), in difficult situations, such as crop failure or family illness, sheep and goats can be sold to augment the family income and cover for some expenses. More so, the higher percentage of female farners stocking goat showed how eager the women are in taking up responsibility when it come to family income. The study also opined that dairy goats are good species for combating poverty and fostering economic development in developing countries. The study also showed that majority of the farmers do not have access to credit and this explains the low level of annual capital investment. The fewer number of the respondents with access to credit may be as a result of unavailability of credit facilities to farmers in the study area, and might discourage the adoption of CCAS practices.

Climate Change Adaptation Strategies (CCAS) Adopted by the Households

From Table 2, it can be seen that both MF and FF have high adoption of most of the CCAS strategies studied in the area, this include the matching livestock stocking rate with pasture production (100.00% and 87.50%), altering pasture rotation (92.50% and 100.00%), modification of grazing time (100.00% and 97.50%), and integration within livestock/.crop systems including the use of adapted forage crops. Re-assessing fertilizer applications on planted forage (100.00% and 95.00%), diversifying into crop and livestock production (80.00% and 95.00%), using species resistant to pest and diseases (100.00% and 77.50%), animal health management (70.00% and 87.00%) and improving quarantine capabilities and monitoring (95.00 each) for male and female farmers respectively. This finding corresponds to the expected effects of their educational level.

However, there was a moderate adoption rate for the alteration/change of forage and animal breeds/species (75.00% and 62.50%), and fewer adoption rate for the use of supplementary feeds and concentrates to increase productivity (27.50% and 20.00%) for both the MF and FF.

Perceived Effect of Climate Change Adaptation Strategies on the Poverty Status of the Household Heads Unit

Poverty Status of the farmers

The results in Table 3 showed the distribution of poverty status of the male and female farmers in the study area. The total expenditure of households on food with income consideration was used in classifying them into poor and non-poor. The mean per capita household expenditure per month (MPCHHE) was N9, 233 and N6, 101 for male farmers households and female farmers households respectively which were further used as the poverty line. On this basis, those below the MPCHHE poverty line were regarded as being poor households while those with per capita expenditure above the mean were considered to be non-poor.

The study showed that more than half (52.50%) of the male farmers households were non poor, while about (30.00%) of the female farmers households were non-poor. The implication is that the male farmers households have greater access to resources and capacity to generate more income for the family expenditure through various means that may not be available for the female farmers households. The low poverty line of (N9233 and N6101) found in the study area in this prevalence high cost of living corroborates with the findings of Ademola *et al.* (2021) who also observed a very low poverty line (N1, 949.12) among rural farm families In Akwa Ibom State, Nigeria. However, this significantly suggests the need to implement poverty alleviation programs in the country that targets farmers in rural areas, establish appropriate policy instruments and introduce sustainable approaches fashioned to lift farming household out of poverty.

Effect of climate change adaptation strategies on the poverty status of the farmers

The results in Table 4 presented the Likert analysis of effect of climate change adaptation strategies on the poverty status of the farmers. From the table, it can be seen that for the MF, climate change adaptation strategies helped to reduce their poverty vulnerability, regulates food prices and reduces climate volatility. This was in tandem with the findings by Abur (2014); and Tchonkuang, *et al.,* (2024). The table also showed that for the FF, climate adaptation strategies also helped to reduce poverty vulnerability, influences human security on the environment, contributes to poverty variability, influences livelihood and leads to reduction of climate volatility.

This explained the importance of adoption of CCAS by both the Male and Female small ruminant livestock farmers in the study area which integrates stability, access to food, availability of nutritionally adequate food and the biological utilization of food (Abur, 2014).

Constraints to livestock production in the face of the changing climate

The results in Table 5 showed that high cost of labour (85.00% and 80.00%), inadequate capital (87.50% and 97.50%), price fluctuation of input materials (95.00% and 100.00%), poor access to credit (87.50% and 90.00%), inadequate market access and information (75.00% and 82.50%), inadequate policy support and institutional framework for small ruminant farming (95.00% and 75.00%) and inadequate extension supports (75.00% and 100.00%) were the major constraints militating against livestock production in the face of the changing climate for male and female farmers respectively.

The high cost of farm labor significantly influences climate change adaptation strategies (CCAS) among small ruminant farmers, as labor-intensive farming practices are heavily impacted. This, in turn, affects the scale of operation and ultimately reduces production levels (Huffman and Orazem, 2007). However, households bear the brunt of labor transaction costs, (Roumasset and Lee, 2007). Insufficient capital, limited access to credit, and high input costs are additional constraints faced by small ruminant producers (Ajala and Adesehinwa, 2008; Zanou et al., 2023).

Nigeria's agricultural sector is hindered not by production issues alone, but also by inadequate infrastructure, including poor market linkages, insufficient storage and processing facilities, and limited access to market information (Amusa et al., 2011). These challenges affect production rates and CCAS adoption among small ruminant farmers. Effective market information is crucial for transforming small-scale farmers into commercial producers, as it provides incentives for income growth (Offor et al., 2018). Inadequate market information and price fluctuations lead to traders selling animals at lower prices, further constraining farmers (Zanou et al., 2023).

Moreover, the study also found others constraints such as; lack of access to improved breeding stock (50.00% and 80.00%), difficulty in applying technology (35.00 and 70.00%), feed scarcity (25.00% and 72.50%), high cost of transportation (62.50 and 50.00%), and environmental/crises and unfavorable weather conditions (50.00% and 80.00%) for male and female farmers respectively.

Less than half of the respondents responded that Seasonality of income from the livestock business (10.00% and 47.50%), losses due to predation by wild animals (0.0% and 30.00%), land tenure issues (0.00 and 62.50%) were constraints militating against livestock production in the face of the changing climate for male and female farmers respectively.

Ho: There is no significant relationship between climate change adaptation strategies (CCAS) and poverty status (PS) of the household units.
The results showed that there was a negative (r = 0.3382) correlation between climate change adaptation strategies and poverty status of the household units for female farmers at 1% level of probability. It implies that increase in CCAS will lead to a decrease in PS by approximately 34% and vice versa. Also, the results showed that there was a negative (r = 0.2049) correlation between change adaptation strategies and poverty status of the household units for male farmers at 1% level of probability. It also implied that increase in CCAS (female) will lead to a decrease in PS (male) by approximately 20% and vice versa.

CONCLUSION AND RECOMMENDATIONS

This study explores whether climate change adaptation strategies enhance poverty status among small ruminant livestock farmers in Abia State, Nigeria, with a comparative focus on male and female farmers. The results show that climate change adaptation strategies have a positive impact on livelihood resilience, however, female farmers face more challenges in adapting to climate change. The study identified various constraints militating against livestock production, including high cost of labour, inadequate capital, and poor access to credit. The study recommends that policymakers and stakeholders should prioritize the needs of female livestock farmers in their climate change adaptation strategies and programs. Targeted support, such as access to credit, training, and extension services, is needed to enhance the livelihood resilience of female farmers.

Furthermore, the study's findings suggest that climate change adaptation strategies should be integrated into existing agricultural policies and programs, with a focus on supporting small ruminant livestock-dependent households. This can help to ensure that these households have access to the resources and support they need to adapt to climate change and promote their livelihood resilience.

Generally, this study contributes to the growing body of research on climate change adaptation and livelihood resilience, with a focus on the gender dimensions of these issues. The study's findings and recommendations have important implications for policymakers, stakeholders, and development practitioners working to promote more equitable and sustainable development outcomes in the context of climate change.

Table. 1 Distribution of Socio-Economic Characteristics of the Farmer in the Study Area

Variables	Male	Female	Pooled
Mean values (Figures in parentheses are the standard deviations)			
Age	43.43(9.70)	46.45(9.4461)	44.94(9.65)
Household size	5.40(2.60)	6.75(2.7339)	6.09(2.74)
Livestock experience	6.60(3.07)	6.7750(2.86)	6.69(2.95)
Off farm income	39700(17005.60)	41750(20619.57)	40725.00(18807.47)
Stock size	22.97(14.50)	23.83(13.29)	23.40(13.84)
Number of extension contact	0.85(0.44)	0.45(0.93)	0.64(1.07)
Amount sold per stock	8550.00(4105.65)	9362.50(5373.23)	8956.25(4768.83)
Capital invested	169500.00(87988.93)	156375.00(96330.01)	162937.50(91905.61)
Educational Level			
No formal education	3(7.50)	7(17.50)	10(12.50)
Primary	37(92.50)	33(82.50)	70(87.50)
Secondary	29(72.50)	21(52.50)	50(62.50)
Tertiary	4(10.00)	1(2.50)	5(6.25)
Income level			
Below N50,000	7(17.50)	12(30.00)	19(23.75)
N51,000-N100,000	11(27.50)	15(37.50)	26(32.50)
N100,000-N150,000	17(42.50)	11(27.50)	28(35.00)
N151,000-N200,000	4(10.00)	2(5.00)	6(7.50)
N201,000 and Above	1(2.50)	0(0.00)	1(1.25)
Dummy (Figures in parentheses are the Percentage values)			
Religion	40(100.00)	40(100.00)	80(100.00)
Marital status (married)	30(75.00)	34(85.00)	64(80.00)
Member of cooperative society	26(65.00)	31(77.50)	57(71.30)
Access to credit	8(20.00)	4(10.00)	12(15.00)
Interact with other farmers	27(67.50)	27(67.50)	54(67.50)
Received assistance from govt.	8(20.00)	3(7.50)	11(13.80)
Produced for market	21(52.50)	21(52.50)	42(52.50)
Keep Sheep	13(32.50)	4(10.00)	17(21.30
Produce Goat	27(67.50)	36(90.00)	63(78.80)

Source: Field survey, 2023

Table 2: Distribution of Farmers on the Climate Change Adaptation Strategie Adopted by the Households

Item	Male	Female	Pooled
Matching livestock stocking rate with pasture production	40(100.00)	35(87.50)	75(93.50)
Altering pasture rotation	37(92.50)	40(100.00)	77(96.50)
Modification of grazing time	40(100.00)	39(97.50)	79(95.80)
Alteration/change of forage and animal breeds/species	30(75.00)	25(62.50)	55(68.80)
Integration within livestock/.crop systems including the use of adapted forage crops. Re-assessing fertilizer applications on planted forage	40(100.00)	38(95.00)	78(97.50)
Use of supplementary feeds and concentrates for increased productivity	11(27.50)	8 (20.00)	19(23.80
Animal health management	28(70.00)	35 (87.50)	63(78.80)
Diversifying into crop and livestock production	32(80.00)	38(95.00)	70(87.80)
Using species resistant to pest and diseases	40(100.00)	31(77.50)	71(88.80)
Improving quarantine capabilities and monitoring	38(95.00)	29(95.00)	67(83.80)

Source: Field Survey, 2023. Figures in parentheses are the percentage values

Table 3: Distribution of Poverty Status of the male headed and female headed Livestock households in the study area

Poverty Level	Male	Female	Pooled
Poor	19(47.50)	28(70.00)	47(58.75)
Non-poor	21(52.50)	12(30.00)	33(41.25)
Mean	9,233	6,101	7,667

Source: Field Survey, 2023. Figures in Parentheses are the percentage values.

Table 4: Likert analysis of effect of climate change adaptation strategies on the poverty status of the Farmers

Perceived effect	SA	A	D	SD	Mean	Pooled
Male						
Reduces poverty vulnerability	10(40)	22(66)	8(16)	0(0)	**3.05**	3.14*
Shades food security	5(20)	25(75)	10(20)	0(0)	**2.87**	2.56*
Influences human security	2(8)	30(90)	8(16)	0(0)	**2.85**	2.94*
Leads to disaster risk reduction	0(0)	18(54)	12(24)	10	2.2	2.2
Increases poverty variability	7(28)	21(63)	12(24)	0(0)	**2.87**	3.01*
Regulates food prices	0(0)	40(120)	0(0)	0(0)	**3.00**	2.25
Influences livelihood vulnerabilities	15(60)	4(12)	14(28)	7(7)	**2.67**	2.93*
Reduces climate volatility	17(68)	23(69)	0(0)	0(0)	**3.42**	3.34*
Shapes the ecosystem	8(32)	9(27)	23(46)	0(0)	**2.62**	2.66*
Female						
Reduces poverty vulnerability	18(72)	15(45)	5(10)	2(2)	**3.22**	
Shades food security	1(4)	14(42)	19(38)	6(6)	2.25	
Influences human security	11(44)	22(66)	4(8)	3(3)	**3.02**	
Leads to disaster risk reduction	1(4)	13(39)	19(38)	7(7)	2.2	
Increases poverty variability	17(68)	15(45)	5(10)	3(3)	**3.15**	
Regulates food prices	0(0)	5(15)	10(20)	25(25)	1.5	
Influences livelihood vulnerabilities	21(84)	10(30)	4(8)	5(5)	**3.17**	
Reduces climate volatility	20(80)	15(45)	0(0)	5(5)	**3.25**	
Shapes the ecosystem	11(44)	10(30)	15(30)	4(4)	**2.70**	

Source: Field Survey, 2023. SA = Strongly Agree (4), A = Agree (3), D = Disagree (2), SD= Strongly Disagree (1). *= Variable in agreement; Acceptable mean =2.50 and above

Table 5: Constraints faced by livestock producers in the face of changing climate

Perceived Constraints	Male	Female	Pooled
High cost of labour	34(85.00)	32(80.00)	66(82.50)
Inadequate capital	35(87.50)	39(97.50)	74(92.50)
Price fluctuation of input materials	38(95.00)	40(100.00)	78(97.50)
Unavailability of veterinary services	20(50.00)	32(80.00)	52(65.00)
Lack of access to improved breeding stock	30(75.00)	25(62.50)	55(68.70)
Difficulty in applying technology	14(35.00)	28(70.00)	42(52.50)
Feed scarcity	10(25.00)	29(72.50)	39(48.70)
High cost of transportation	25(62.50)	20(50.00)	45(56.30)
Environmental/crises and unfavorable weather conditions	27(67.50)	34(85.00)	61(76.30)
Poor access to credit	35(87.50)	36(90.00)	71(88.80)
Lack of technical know-how/ experience and support	20(50.00)	32(80.00)	52(65.00)
Seasonality of income from the livestock business	04(10.00)	19(47.50)	23(28.80)
Disease and pest management	16(40.00)	10(25.00)	26(32.50)
Inadequate market access and information	30(75.00)	33(82.50)	63(78.70)
Inadequate policy support and institutional framework for small ruminant farming	38(95.00)	30(75.00)	68(85.00)
Inadequate extension support	30(75.00)	40(100.00)	70()87.50
Losses due to predation by wild animals	0(0.00)	12(30.00)	12(15.00)
Land Tenure Issues	0(0.00)	25(62.50)	25(31.25)

Source: Field Survey, 2023. Figures in parentheses are the percentage values Items with up to 70% rating were considered as major constraints.

Table 6: Correlation Coefficient of relationship between climate change adaptation strategies and poverty status of the household units

Variables	CCAS(Female)	PS(Female)	CCAS(Male)	PS(Male)
CCAS(Female)	1.0000			
PS(Female)	-0.3382*	1.0000		
	(0.0056)			
CCAS(Male)	-0.0146	-0.0079	1.0000	
	(0.8680)	(0.9288)		
PS(Male)	-0.2049*	0.0049	-0.0135	1.0000
	(0.0010)	(0.9587)	(0.1011)	

Source: STATA 13 Results

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Determinants of Cocoyam (*Colocasia spp*. and *Xanthosoma spp.*) utilization among Rural Households in Enugu State, Nigeria

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ABSTRACT
*Due to the hike in food prices, people now accept the use of highly cherished foods like cocoyam within their culture. While several literatures have reported the health and nutritional benefits of cocoyam, there seems to be few studies on the determinants of utilization of this crop and the resultant effect of this, threatens the food security of households in the study area. Hence, the study assessed the determinants of cocoyam utilization among the rural households of Enugu State, Nigeria. Specifically, the study described the socio-economic characteristics of the respondents and analyzes the socio-economic factors influencing utilization of cocoyam in the study area. A Multistage random sampling procedure was used in selecting 180 respondents in the study area. Data were collected using questionnaires and analyzed using descriptive statistics (such as frequencies, percentages and mean) and inferential (ordinary least square regression analysis) statistics. The results of socio-economic characteristics revealed that majority of the farmers were Females (60.0%), while 75.0% were married, 49.4% had secondary education, mean age of 41years, mean household size of 5persons, farming was their major occupation (43.9%). Age (-1.944)**, Marital status (2.348)**, Years of education (5.050)***, Household size (3.330)*** and income (2.079)*** were the significant factors influencing utilization of cocoyam in the study area. The study recommends that Government and relevant agencies at all levels should as a matter of urgency encourage production and utilization of cocoyam among young people. Beyond production and utilization, it is essential to target value addition technologies in order to realize the usefulness of cocoyam in the area of health and nutritional benefits*

Keywords: Cocoyam, Determinants, Utilization and Rural households

INTRODUCTION
The food supply in Nigeria is not distributed fairly across the nation or even among households at times. A sizable section of the population, especially youngsters, do not utilize a balanced diet to guarantee physical development and health. Most people take the bare minimum of calories, but they do not obtain the necessary amounts of protein, critical vitamins, and minerals for living a healthy life (Onyeneke and Nwaiwu, 2012). Cocoyam (*Colocasia spp*. and *Xanthosoma spp.*) is a member of *Araceae* family and in the group of monocot plant. Cocoyam is the third important staple tuber crop after yam and cassava in Nigeria (Amadi *et al.,* 2021). It is also an important food security crop in Nigeria and variously grown by resource poor farmers mostly women who intercrop cocoyam with yam, maize, plantain, vegetables and rice (Okoye *et al.,* 2007). According to Onyeka (2014), cocoyam is nutritionally more important than yam and cassava in terms of higher protein, mineral and vitamins content as well as digestible starch. As a tuber crop, it belongs to the class of staple foods that provide most calories intake by Nigerians Onyeka (2014). Cocoyam remains an underutilized and poorly understood crop in spite of its potential as a food and cash crop and its

higher nutritive value (Onyeka, 2014). The resultant effect of this, threatens the food security of households that utilize such crops. Hence, this study aim at analyzing factors responsible for the utilization of this crop among rural households in Enugu State, Nigeria.

METHODOLOGY

The study was conducted in Enugu state. The state is located at 6030' North of Equator and 7030' East of latitude in South East geo-political zone of Nigeria. The city had a population of 820,000 according to the 2022 Nigeria census. The name Enugu is derived from the two Igbo words Enu-Ugwu, meaning ''hill top'', denoting the city's hilly geography. Enugu state is made up of seventeen 17 local Government areas. Economically, Enugu state is based around trading and services along with agriculture mainly of yam, rice, cocoyam, oil palm and cassava among others. According to Encyclopedia Britannica, (2009), Enugu state capital is a major Centre for coal mining, Iron ore also is mined and deposits of limestone fine clay, marble and silica sand are worked. A Multi-stage sampling procedure was used in the selection of 180 respondents. In the first stage, all the 3 agricultural zones were selected. In the second stage, 3 blocks were selected from each of the 3 agricultural zones of Enugu state. This gave 9 blocks in all. In the third stage, two circles were selected from each of the blocks, giving rise to a total of 18 circles. In the final stage, ten (10) rural households were selected from each of the 10 circles using simple random technique, which gave rise to a total of one hundred and eighty (180) rural households which constituted the sample size of the study. Data for the study was generated from primary and secondary sources and analyzed using descriptive statistics such as frequency distribution, percentage, mean scores and inferential statistics such as multiple regression specified thus;

$$Y = F(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8 \ldots Xn + e) \quad (1)$$

Y = Frequency of cocoyam utilization. (Mean score)
X(s) = Selected socio- economic characteristics (independent variables)
X_1 = Age in year (Measured in years)
X_2 = Marital status (married =1; unmarried =0)
X_3 = Educational level (in years)
X_4 = Income (Measured in naira)

RESULTS AND DISCUSSION

Age

Distribution of respondents according to their age was shown in Table 4.1.1. The Table revealed that a fair proportion (42.2%) and (21.0%) of the respondents were within the age ranges of 31-40years and 51-60years respectively. The mean age of the respondents was 41.2 years implying that the respondents were still young, socially active, productive, and also possess good knowledge of the phenomenon under study. The result corroborates with the findings of Onu (2022) that the respondents in Imo State were young, active and knowledgeable. This result conforms to the findings of Akinbile *et al* (2013) that majority of the rural farmers are still actively involved in farming activities. This entails that the enterprise needs active, productive and relatively young farmers who are energetic to participate actively to raise the enterprise.

Sex

The distribution of the respondents according to their sex was shown in Table 4.1. The Table showed that the larger proportion (60.0%) were female. The Table also revealed that 40.0% of the respondents were male. This implies that majority of the people involved in utilization of cocoyam were mostly female. This result disagrees with the findings of Agrawal and Gupta, (2015), that men are readily accessible in sociocultural issues than women.The result is in agreement with the findings of Agrawal and Gupta, (2015) who found out that majority of the farmers were females.

Marital Status

The distribution of the respondents according to their marital status was shown in the Table 4.1. From the Table a fairly large proportion (75.0%) of the respondents were married, 22.2% were single, 2.8% where divorced/separated. This implies that a greater percentage of the respondents were married and had family members. This reveals that more married people were engaged utilization of cocoyam in the study area. This result agrees with Iwuchukwu *et al* (2013) that greater proportions of farmers were married. Marriage is an important factor in the livelihood of individuals

in our society as it is perceived to confer responsibility on individuals. This result agrees with Onu *et al* (2022) that greater proportions of farmers in the South East were married.

Level of Education
As shown in Table 4.1, all the respondents were mostly educated at different levels. Fairly large proportion (49.4%) of the respondents had secondary education, 23.3% had tertiary education, 19.4% had had primary education and 6.7% had no formal education while 1.1% did not record their educational level. The result reveals that the respondents in the study area were educated. This could be attributed to the fact that cocoyam utilization requires some form of technical knowledge which necessitates the acquisition of formal education. The high level of literacy among the respondents is expected to have a positive influence on their perception on utilization of cocoyam in the study area. This result agrees with the findings of Akinbile *et al* (2013) and Effiong *et al* (2014), that educational level of majority of the farmers were high.

Household size
Table 4.1 showed the distribution of the respondents according to their household size. The Table revealed that fairly large proportion (39.4) of the respondents had 1-3 persons in their household. The table also showed that 20.5% of the respondents had 7-9 persons in their household. 18.9% had 4-6 persons in their household. 12.2% had 13-15 persons in their household and 8.9% of the proportion had 10-12 persons in their household. The result equally revealed a mean household size of 5 persons. These respondents may have had small household size compared to aprior expectations in the rural communities of a developing country like Nigeria because they are still young and at their reproductive stages. Therefore, there is possibility of the household size increasing in the future which will serve as family labor for Agricultural labour. The implication of these findings is that more family labour would be readily available since relatively large household size is an obvious advantage in terms of farm labour supply, where wage rate is relatively costly (Nwaobiala, 2013).

Membership of social organization
The result on table 4.1 also shows the distribution of respondents based on their membership to social organization. The result revealed that a majority (60.0%) were members of social organization while 40.0% were not members to any social organization. This implies that most of the respondents belongs to social groups which can improve interaction between the participants.

Extension contact
The result on table 4.1 also shows the distribution of respondents based on their extension contact. The result revealed that a majority (80.0%) had no extension contact while 20.0% had extension contact in the study area. This could be a serious setback in information dissemination among the rural households.

Socioeconomic factors influencing cocoyam utilization in the study area
Ordinary Least Square (OLS) regression estimates of the socio-economic determinants of frequency of utilization of cocoyam in the study area was shown on Table 4.8. Four functional forms were estimated and the semi-log function was chosen as the lead equation based on the magnitude of R^2 value and number of significant variables. The R^2 (coefficient of multiple determination) value was 0.75 which indicates that 75% of the total observed variations in the dependent variable (Y) were accounted for while 25% of the variation was due to error. F–statistics was significant at1% indicating the fitness of the model used.

The coefficient of age was statistically significant at 5% probability level and negatively related. The result implied that an increase in the age of the rural farmers will lead to a corresponding decrease in their access to frequency of utilization of cocoyam in the study area.
The coefficient for marital status of the respondents was positively related and statistically significant at 1%. This result implies that increase in the marital status of the respondents will lead to increase in the frequency of utilization of cocoyam in the study area. In agreement with the findings, Oladoja *et al.,* (2018) asserted that marriage is an important factor in the livelihood of individuals in our society as it is perceived to confer responsibility on individuals.

The coefficient for years of education was positively related and statistically significant at 1%. This result implies that increase in years of education will lead to increase in the frequency of utilization

of cocoyam in the study area. Several studies have found a positive correlation between education and utilization efficiency which is in tandem with this result. Abudu *et al.,* (2014) reported that increase in education of farmers positively influenced access and adoption of improved agricultural practices.

The coefficient for household size was positively related and statistically significant at 1%. This result implies that increase in household size will lead to increase in frequency of utilization of cocoyam in the study area. The result is in agreement with Mbawonku (2011) that rural households constitute a formidable and significant source of labour in small scale farming.

The coefficient for income was positively related and statistically significant at 1%. This result implies that increase income will lead to increase in the frequency of utilization of cocoyam in the study area.
The null hypothesis which stated that there is no significant relationship between the selected socioeconomic characteristics of the respondents and frequency of utilization of cocoyamin the study area was therefore rejected and concluded otherwise.

CONCLUSION AND RECOMMENDATIONS

The study provided empirical evidence of determinants of utilization of cocoyam in the study area and these include income level, household size, educational level, marital status and age. This avers that socioeconomic factors affected the utilization of cocoyam in the study area. Government at all levels should as a matter of urgency encourage young people to go into cocoyam production. Beyond production, it is essential to target value addition technologies in order to realize the usefulness of cocoyam, scale up production potentials of the states in turn, improve nutrition and create employment opportunities for our teeming youth population.

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Table 1: Selected socioeconomic characteristics of the respondents in the study area

Socioeconomic characteristics	Frequency	Percentages	Mean
Age			
20-30	31	17.1	
31-40	76	42.2	
41-50	18	9.9	
51-60	38	21.0	
61-70	22	12.2	
71-80	19	10.6	**41.2 years**
Sex			
Male	72	40.0	
Female	108	60.0	
Marital status			
Married	135	75.0	
Widowed	5	2.8	
Single	40	22.2	
Level of education			
Primary	35	19.4	
Secondary	89	49.4	
Tertiary	44	24.4	
No formal education	12	6.7	
Primary Occupation			
Farming	**79**	**43.9**	
Trading	61	33.9	
Civil servant	34	18.9	
Artisan	**06**	**3.3**	
Household size			
1-3	71	39.4	
4-6	34	18.9	
7-9	37	20.5	
10 – 12	16	8.9	
13-15	22	12.2	**5 Persons**
Membership of social organization			
Yes	108	60.00	
No	72	40.00	
Extension Contact			
Yes	36	20.00	
No	144	80.00	

Source: Field Survey, 2024

Table 2: OLS regression estimates of the selected socio-economic determinants of frequency of utilization of cocoyam in the study area.

Variables	Linear	Exponential	Semi-log +	Double log
Constant	3324.58	8.15	6651.8	1.324
	(2.228)**	(8.913)***	(11.334)***	-0.545
Sex	-0.228	-0.199	-0.144	0.085
	(-.991)	(-1.559)	(-1.037)	-0.402
Age	-447.06	-0.511	-891.993	-0.743
	(-1.310)	(-2.44)**	(-1.944)**	(-2.551)**
Marital status	4.023	0.009	648.511	0.37
	(2.290)**	(1.907)*	(2. 348)**	(1.972)*
Years of education	28.923	0.004	399.629	0.071
	(5.950)***	-0.132	(5.050)***	(1.830)*
Household size	0	2.30E-07	52.349	0.117
	-0.586	(6.988)***	(3.330)***	(1.716)*
Expenditure on food	5.31E-05	3.08E-08	257.252	0.134
	-1.596	-0.564	-1.039	-1.171
Income	0.002	1.48E-06	267.55	0.143
	(2.875)***	(1.706)*	(2.079)**	(2.282)**
Membership of social	9.522	0.65	8.842	0.28
organization	(1.956)*	(1.745)*	-0.26	-1.43
Extension contact	70.124	0.008	9.215	0.066
	-0.587	-0.044	-0.131	-0.255
R^2	0.62	0.73	0.75	0.64
R Adjusted	0.6	0.71	0.72	0.62
F – Ratio	44.999***	32.813***	51.942***	34.419***

Source: Field Survey, 2024. Key: * Significance at 10%, ** Significance at 5%, *** Significance at 1% ***, + = Lead Equation and the values in bracket are the t-value

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Farmer's Access to Agricultural Innovation Disseminated through Mass Media in Umuahia Agricultural Zone, Abia State

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ABSTRACT
The study assessed farmer's access to agricultural innovation disseminated through mass media, the research specifically described the socio-economic characteristics of the respondents, Examined different sources of Agricultural innovation information available in the study area and ascertained different times of accessing information on agricultural innovation. A Multistage random sampling procedure was used in selecting 50 respondents in the study area. Data were collected using questionnaires and analyzed using descriptive statistics (such as frequencies, percentages and mean) The results revealed that majority of the farmers were Female (64.0%), while 52.0% were married, 60.0% had tertiary education, 38.0% were between the age ranges of 31 to 40 years, 40.0% were civil servants, 36.0% had household size of 5 to 6 persons, 68.0% had years of farming experience of ≤10, 80.0% were non- members of cooperative society, 54.0% earned between ₦ 1000 to ₦300000. The distribution of the farmers according to different sources of Agricultural innovation information available in the study area, showed that higher proportion of the farmers (76.0%) source their agricultural innovation information through radio, 58% sometimes access agricultural innovation information, majority of the farmers (34.0%) listens to Vision Africa radio station, while 30% access bulletin monthly and once a year respectively, while 34% agreed that the broadcast is slightly conducive, and majority (30.0%) preferred listening to or reading agricultural innovation disseminated through radio and bulletin in the evening. Agricultural innovation dissemination should focus on radio channels, especially Vision Africa and evening time should be targeted since they prefer listening to or reading agricultural innovation disseminated through radio and bulletin in the evening.

Keywords: Agricultural innovation, mass media, dissemination, famers and access

INTRODUCTION
The continuing increase in the number of farming families and rapid changes happening around with globalization, uncertainty in climate change, discerning consumer segment and continued farm crisis has led to a growing emphasis on approaches that reach more people at a time and the importance of timely, appropriate and need based information and knowledge to meet the myriad challenges of agriculture (Arpita, 2011).

Dissemination of agricultural innovation through appropriate and effective communication is very important in boosting food production. Farmers must first have access to innovations information before they can adopt them or benefit from such innovations.

Mass media (electronic & print media) are playing very important role in creating awareness about new agricultural innovations among farmers at faster rates. Mass media are important in providing

information for enabling the rural community to make informed decision regarding their farming activities, especially in the rural areas of developing countries (Ike Nwachukwu, 2017). Information is said to be key for success in the operation and management process of the agriculture activities. To a large extent, mass media serve as a veritable instrument for information dissemination in agriculture. The problem therefore, lies with effective dissemination of information about these innovations by the dissemination agencies. Agricultural innovations must therefore, target the farmers who are the end users of such innovations and the place of feedback should not be neglected in ascertaining the level of success of such innovation. The feedback will show areas to work on by the innovation developer. Egesi, et.al. (2023), posited that the efficiency of innovation generated and disseminated depends on effective communication which is the key process of information dissemination. Thus, the study therefore looks at socioeconomic factors Affecting Farmer's Access to Agricultural Innovation Disseminated through Selected Mass Media in Umuahia Agricultural zone, Abia State

METHODOLOGY

The study was conducted in Umuahia Agricultural Zone, Abia State. The state is located in South East zone of Nigeria, and lies between longitudes 700E and 800E and latitude 4451N and 6171N of the equator. Umuahia Agricultural zone climate is tropical and humid all the year round, with rainy season ranging from March to October, and dry season from November to February. The mean annual rainfall ranges from 2000mm to 2500mm with the southern areas receiving more than the northern areas. The temperature ranges between 22^{o}C to 31^{o}C. The vegetation is predominantly lowland rainforest. The major crops grown are arable crops such as cassava, rice, yam etc., others include; banana, plantain, maize, and vegetables etc., with major cash crops such as, oil palm, kolanuts, cocoa, rubber and cashew nut. Other farming activities include; sheep and goat rearing, poultry and rabbit keeping and off-farm activities, especially processing and utilization. The population density is about 2364persons/km with 63% in agricultural production, and average household size of about six persons per family (NBS, 2012). Multistage random sampling procedure was used in selecting 50 respondents in this study. Data were collected through primary sources, and data collected were analyzed using descriptive statistics such as mean counts.

RESULTS AND DISCUSSION

Sex

The result in Table.1 shows that there was notable difference in the sex ratio of the respondents. Female accounted for 64.0% while male accounted for 36.0%. This result disagrees with the findings of Nwagwu and Opeyemi (2015) which said that men are deeply involved in Agriculture than women. The high participation of males in farming could be attributed to the fact that they have more household responsibilities than that of the females.

Marital status

From the results in Table 1, it showed that most of the respondents (52.0%) were married while others (48.0%) were unmarried. Among the unmarried were the single (36.0%) and widowed (12.0%). The implication of this result is that married farmers could be of advantage over unmarried as they will be in the better position to reach the families in disseminating of agricultural innovation using family approach. It could also mean that unmarried people rarely engage in farming as they may not have domestic responsibilities to shoulder (Nwaosu, *et al.*, 2012). This work also agreed with the observation of Nwagwu and Opeyemi (2015), which states that married life adds more labour to agriculture.

Level of education

The result as showed in table 1 revealed that 60.0% were well educated while 34.0% completed their secondary school. On the other hand 6.0% attended only primary school. From the above result, it could be said that the farmers had formal education and thus are expected to have a positive influence on the assessment of agricultural information through radio and bulletin to improve their farming activities and high yield. This finding is consistent with that of Nwosu et al. (2012), Emenyonu et al. (2010) and Nwachukwu (2009). That level of education of farmers increases their farm production and also enhances the ability to understand and evaluate new production technology.

Age

The result in Table 1 revealed that the majority of the farmers (38.0%) were between the age of 31 and 40 years, while (30.0%) of them were accounted to be between the age of ≤ 30 years. Those that were between age of 41 and 50 years (10.0%) and those above 50 years constituted (22.0%) each. With the majority of the farmers (38.0%) falling between the ages of 31-40 years, it implies that the famers were within an active age of strength which helps them to engage in intensive farming information through radio and bulletin.

Occupation
The result in Table 1 showed that 40.0% farmers were civil servants, 32.0% traders, 26.0% were farmers and 2.0% were artisans. This evidence is not in agreement with Mbanaso (2008) who found out that most of the farmers in the south- eastern zone have farming as their major occupation.

Household Size
Table 1 showed that the majority of household size (36.0%) were within 5-6, while (30.0%) of the household size were within the range of 3-4. The result also showed that (14.0%) of the household size were within the range of 1-2 and (20.0%) above 7 household size. The large household size would ensure more networking for information and enhance more availability of information on innovations to farmers. Household size in traditional Agriculture determines the availability of labour and level of production (Ani, 2004).

Farming Experiences
The result in Table 1 showed that majority of the farmers (68.0%) had 1 to10 years of farming experience, 16.0% had between 11 to 20 years farming experience, 12.0% had between 21 to 30 years of farming experience while 4.0% had from 31 to 40 years of farming experience. The result shows that majority of the farmers have experience of more than a decade. This implies that they can be able to adopt the technology more if exposed to radio and bulletin information. According to Mbanaso (2008,) long period of farming experience will enhance understanding and subsequent adoption of the sweet potato production and processing technologies.

Membership of cooperative society
Table 1 showed that 20.0% of the farmers were members of cooperative society, while 80.0% of them were not members of cooperative society. This means that more respondents do not belong to any group. This is not advantageous to agricultural information and utilization since farmers social organization offer an effective channel for extension contact with large numbers of farmers, as well as opportunities for participatory interaction with extension organizations.

Income
The result in Table 1 showed that majority (54.0%) of the farmers earned between ₦ 1000 to ₦30,000, while 10.0% earned ₦31000 to ₦ 60000 and above ₦ 60000 earned 36.0%. This result implies that majority of the farmers were low income earners and low income negatively affects adoption rate.

Farmers Access to Information
The result shows the different sources by which farmers in the study area obtain agricultural information in the study area. Specifically, Radio (76.0%), bulletin (22.0%) and ADP (2.0%). This result implies that very high proportion of farmers have their sources of information from Radio (76.0%) source.

The table equally showed the distribution of the farmers according to their access to radio and bulletin, the result showed that greater majority of the farmers ((58.0%) access radio and bulletin sometimes, about (18.0%) access very often, (16.0%) access often and relatively (8.0%) never had access to radio and bulletin.

Also, the distribution of the farmers according to radio station listened to showed that fairly high majority (34.0%) listens to vision Africa, (26.0%) listens to pacesetter/radio Nigeria, about (24.0%) listens BCA, (10.0%) listen to love FM, whereas (6.0%) listens to flow FM. Moreover, the distribution of the farmers according to access to bulletin showed that greater majority (30.0%) and (30.0%) access bulletin monthly and once a year respectively, whereas (24.0%) access twice a year, and 16.0% access bulletin quarterly

Table 2 showed the distribution of the farmers according to time of accessing agricultural information. The table revealed high propulsion (44.0%) of the farmers agreed that time of accessing agricultural information was slightly conducive, 30.0% agreed that the timing was conducive, 2.0% was very conducive, whereas about 24.0% agreed that the timing of agricultural information was not conducive. Also the table equally showed the distribution of farmers according to their preferred time of listening to radio or reading the bulletins, the table revealed that greater majority of the respondents (30.0%) preferred listening or reading in the evening, 28.0% preferred the night, 22.0% preferred morning and night, whereas 20.0% preferred morning hours.

CONCLUSION AND RECOMMENATIONS

The study concluded that agricultural innovation information in the study area was gotten through radio. The people sometimes access agricultural innovation information through mass media. The farmers mostly listen to Vision Africa radio station, and they prefer listening to or reading agricultural innovation disseminated through radio and bulletin in the evening.

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Table 1: The distribution of respondents according to their socioeconomic characteristics.

Variables	Frequency	percentage
Age		
≤30	15	30
31 – 40	19	38
41 – 50	5	10
≥50	11	22
primary occupation		
Farmer	13	26
Trader	16	32
Civil servant	20	40
Artisans	1	2
Full time faming		
Part time	**21**	42
Full time	**29**	58
Household size		
1-2	7	14
3-4	15	30
5-6	18	36
≥7	10	20
Years of experience		
≤10	34	68
20-Nov	8	16
21-30	6	12
31-40	2	4
Membership of cooperative society		
Member	10	20
Non-member	40	80
Monthly income		
₦1000 - ₦ 30000	27	54
₦ 31000- ₦ 60000	5	10
≥ 61000	18	36

Source: 2023 field survey

Table 2: The distribution of respondents according to sources of agricultural innovation information

Variable	Frequency (n =50)	Percentage
A) Source of information		
Radio	38	76
Bulletin	11	22
ADP	1	2
B) Access to radio/bulletin		
Never	4	8
Sometimes	29	58
Often	8	16
Very often	9	18
C) Stations listened to		
BCA	12	24
Pacesetter/ radio Nigeria	13	26
Vision Africa	17	34
Love- fm	5	10
Flow-fm	3	6
D) Assess bulletin		
Monthly	15	30
Quarterly	8	16
Twice a year	12	24
Once a year	15	30

Source: 2023 field survey

Table 3: the distribution of the respondents according to time of accessing agricultural innovation information

Variables	Frequency	Percentage (%)	Mean
A) Conduciveness of broadcast time			
Not conducive	12	24.0	2.10
Slightly conducive	22	44.0	
Conducive	15	30.0	
Very conducive	1	2.0	
B) Preferred time			
Morning	10	20.0	2.52
Evening	15	30.0	
Night	14	28.0	
Morning and night	11	22.0	

Source: 2023 field survey

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Investigation of Factors Influencing the Technical Efficiency of Noiler Farmers in Abia State, Nigeria

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ABSTRACT
Noiler is a dual purpose chicken breed that was created in Nigeria by Amo Farm Sieberer Hatchery. This breed is simpler to grow and handle, has a high survival rate, is less likely to contract infections, is hardy by nature, good swimmers, and fast runners which enables them run away from predators and can withstand severe weather. A multistage random sampling technique was adopted in selecting 120 respondents. A well-structured questionnaire was used to collect information from the respondents. An important determinant in the success rate of farms largely depends on how efficient the resources are used. The technical efficiency of the respondents was analysed using stochastic production frontier. The result of data analysis revealed that age, experience, formal education and extension services, positively influenced the technical efficiency of the Noiler farmers. Therefore, since the older farmers were more productive than younger ones, the younger farmers should consult the older farmers for advice regarding Noiler farming and farmers need to be informed and made aware of the need of sound agricultural management. In order to increase the efficiency and output level of farmers, it is necessary to expand agricultural extension services methods and include more farmers in such training programs.

INTRODUCTION
The domestication of birds such as chicken, ducks, quails, turkey, and geese with the intent of rearing them for meat, egg production as well as using their incidental products such as faecal droppings and feathers in industries as natural unprocessed materials is known as poultry farming (Stiles, 2017). The rearing of birds originated many years ago, which emanated by collection of their eggs and young ones from their natural habitat which later resulted into domesticating them as farm animals with people.

Cockfighting was initiated through rearing of chickens as well as taming of quails for their songs but were later ensnared and brought up as reared birds for consumption (Chakraborty and Chakrabarty, 2017; Chakraborty, 2018). Poultry production can be subdivided into three distinct parts known as backyard, semi-commercial and commercial (Ricke, 2017; Rimi, et al., 2017).

According to FAO (2019), the Nigerian poultry industry comprised about 180 million birds in three production systems: extensive, semi-intensive and intensive systems; accounting for 46%, 33% and 21% of the poultry population, respectively. The industry (both directly and indirectly) accounts for above 70% of the livelihoods of Nigerians with a total annual production of poultry meat and eggs, estimated at 300,000 and 650,000 tons, respectively. It is the most commercialized of the agricultural sectors, with a net worth of USD 1.7 billion per year (FAO, 2019). The poultry subsector

contributes to achieving food sufficiency and economic growth, accounting for approximately 25% of the agricultural GDP in Nigeria (Netherlands Enterprise Agency, 2020).

Poultry plays significant role in human economy through provision of food while also creating wealth through job provision for our teeming population (Alders, et al., 2019). Most poultry house in rural settlements of the country are substandard and handled by less competent farm operators who are not favourably disposed to using relevant or new approaches to managing poultry production efficiently and thus affecting poultry yield adversely (FAO, 2018).

Noiler is a dual purpose chicken breed that was created in Nigeria by Amo Farm Sieberer Hatchery. This breed is simpler to grow and handle, has a high survival rate, is less likely to contract infections, is hardy by nature, good swimmers, and fast runners which enables them run away from predators and can withstand severe weather. They are less expensive to maintain and are available as chicken breeds.

Amo Farm Sieberer Hatchery Limited came up with the idea of Noiler birds to curb poverty and malnutrition among rural people, especially women and youth. Noiler bird, a word formed by combining the two words "Nigerian" and "Broiler", they are bred for two purposes; their eggs and meat. Noiler birds are cheap, hardy and easy to handle and produce four times more eggs than chickens in most rural areas of Nigeria. Female Noiler birds produce about 160 eggs in their lifetime, after which they are sold for meat (Runsewe, 2019). Male birds mature to eating weight faster than local birds, which takes longer. Broiler weighs about 1.8kg in 6weeks, a male Noiler matures to a table weight of 2.0-2.5 kg in 14 weeks; a domestic chicken gains 1.5 kg in 10 months under the same conditions (Runsewe, 2019).

Technical efficiency in production is the physical relationship between the amount of product produced and the input of factors of production. Technological efficiency refers to the ability of a particular group of entrepreneurs to apply the best practices of their respective industries in order to avoid overusing the resources of a particular group to achieve the highest level of performance (Nwaru, 2003). However, although interventions may be relevant to improve the level of output in certain circumstances, such improvements may be inefficient, especially if available technology is not used efficiently. It can be argued that addressing existing inefficiencies is significantly less costly than introducing interventions to increase farm output (Tefaye and Beshir 2014).

For agricultural families to turn a profit, they have to be technically efficient. This is possible if they are able to use the greatest techniques to produce the highest level of output. As a result, this serves as the foundation for this study, which aims to find out what factors affect Noiler farmers' technical efficiency in Abia state, Nigeria.

METHODOLOGY

The study was carried out in the state of Abia. Abia state's population in 2016 was estimated at 3,727,347 by the National Bureau of Statistics and the National Population Commission. According to the Nigerian Investment Promotion Commission (NIPC), the term "Abia" was created in 2021 from the first initials of four different racial groups: Aba, Bende, Isuikwuato, and Afikpo. At the time of the state's founding, these were the main groupings. Abia State, often known as the God's Own State, was a part of the Eastern Region when the nation gained its independence in 1960 but was split off from Imo State on August 27, 1991. Abia state is divided into three agricultural zones, namely Aba, Ohafia, and Umuahia, which are grouped into 17 Local Government Areas (L.G.As). Farmers who were involved in Noiler farming were the target population for this study.

The respondents for the study were chosen using a multistage random selection approach. All three of Abia's agricultural zones: Abia South (Aba), Abia Central (Umuahia), and Abia North (Ohafia): were utilized in the first stage.
In the second step, two (2) Local Government areas were purposefully chosen from each of the agricultural zones. The local governments selected were Aba South and Osisioma in the Abia south zone, Umuahia North and Umuahia South in the Abia central zone, and Bende and Isiukwato in the Ohafia zone. Considering the number of Noiler farmers in each of the six local governments. In the third stage, a random selection of four (4) communities from each of the Local Government Areas was done making it a total of 24 communities.

In the last stage, five (5) Noiler households were randomly selected from each of the selected communities, giving a total of 120 respondents. Relevant data were then collected from these respondents using a well structured questionnaire.

To determine the factors affecting to technical efficiency, the stochastic production frontier was used. The stochastic efficiency frontier production function is defined by:

$$Y_i = f(Xi, \beta) \exp(Vi - Ui) \quad (1)$$

Y_i = Noiler output for i^{th} farmers

X_i = corresponding vector of inputs

$$Y_i = f(X_1 \ldots\ldots\ldots\ldots Xn) \quad (2)$$

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_{3\ldots\ldots} + \beta_n X_n + e_i \quad (3)$$

Where ei = Vi-Ui,

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_{3\ldots\ldots} + \beta_n X_n + V_i - U_i \quad (4)$$

V_i = is independently and identically distributed random errors, having $N(0, \sigma^2)$ distribution.
U_i = technical inefficiency
e_i = error term

Where;
Y_i = Noiler output for i^{th} farmer
X_1 = Flocks' size (Number of birds) per production cycle
X_2 = Feed intake in kg per production cycle
X_2 = Labor in man-days per production cycle
X_4 = Water consumption in liter per production cycle
X_5 = Vaccine used in milliliter per production cycle
In the frontier model specified, to estimate β, which is the vector of the regression parameter, the stochastic production model is linearized thus:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 \quad (5)$$

RESULTS AND DISCUSSION

Technical Efficiency

The stochastic production frontier was employed to assess the factors associated with technical efficiency. The maximum likelihood estimates using stochastic frontier parameters for Noiler farmers is presented in Table 1 and it suggests that, the coefficient of stock size, feed, labour, water consumption and vaccine were statistically significant and positively related to total output while age of respondents, household size, experience, formal education, extension contact, marital status and access to credit were all negative and significant as shown in Table 1.

Estimation was conducted using a single-stage estimation procedure for both the efficiency and the inefficiency model parameters, and employing the STATA version 16 computer program (Khan *et al*., 2022). This allows estimating the frontier production function where the Cobb–Douglas production function characterizes the farmers' production technology. The model has twelve parameters, five of which are associated with the frontier production function's explanatory variables (factor of production), seven with the explanatory variables influencing the level of technical efficiency, and other parameters related to the distribution of random errors (v_i and u_i). Tables 1 gives the ML estimates (maximum likelihood estimations) of the parameters of the frontier production functions and inefficiency effects. The entire frontier production function was used to estimate the coefficients of the input variables.

The estimated variance (σ^2), gamma (γ) and Log likelihood function indicate goodness of fit with the stochastic frontier model. For production factors, the coefficient of stock size, feed, labour, water consumption and vaccine were statistically significant and positively related to total output. This implies that increase in any of these variables will lead to increase in output and vice versa. This is expected and in accordance with *a priori* expectations. For the inefficiency factors, age of respondents, household size, experience, formal education, extension contact, marital status and access to credit were all negative and significant. This implies that increase in any of these variables will lead to decrease in output and vice versa. Hence, these variables significantly explain meat production in the study area.

Specifically, the coefficient of stock size was positive and significant at 5%, this implies that increase quantity of Stock size in Noiler production leads to greater output of the farmers and vice versa. This result is in-line with *a prior* expectation. Previous studies have consistently reported the same finding for the impact of the flock size in poultry production across countries with economies under development (Yenibehit *et al*., 2019; Ullah *et al*., 2019; Pradhan *et al*., 2019; Nihal *et al*., 2018; Birhanu *et al*., 2021). Most of those studies were conducted in African countries such as Tanzania, Ghana, or Nigeria. Thus, the results of this present study agree with the literature regarding the role of the flock size in poultry farming, and they expand and consolidate the body of knowledge by adding results for Noiler poultry farms. Also accordingly to Khan *et al*., (2022) an increase in flock size and feed will increase meat production of poultry farms. Also, Rowlinson (2008), who noted that poultry feed determines the quality and quantity of the farmer's output.

Coefficient of feed was positive and significant at 5%, this implies that increase quantity of feed in Noiler production leads to greater output of the farmers and vice versa. This result is in-line with *a prior* expectation, because quantity of feed is expected to increase quantity of meat. Previously, most studies found that feed directly affects meat production; this was consistently reported for poultry businesses across countries with economies under development (Yenibehit *et al*., 2019; Ullah *et al*., 2019; Oyakhilomen *et al*., 2015). IyiolaTunji (2015) conducted detailed studies to confirm that feed is a significant factor in poultry production. It was described as a component of several nutrients essential to make Noiler grow faster and healthier and produce quality meat, quality eggs, and good feathers. Nutritious feed is a prerequisite in Noiler production; therefore, reliable availability of the feed through value chains accessible to the local poultry farmers is very important. Nutritional deficiency is the lack of vitamins, minerals, and amino acids in the accurate estimation required.

The breakthrough and success of the Noiler business depend on the feed's efficiency. Feed must be of good quality with a high protein content that can impact the poultry growth and development (Khan *et al*., 2022). Therefore, the results of this study are generally in line with literature and complement the existing body of knowledge by adding observations from the specific situation of Noiler farms.

Log likelihood function indicates goodness of fit with the stochastic frontier model. The coefficient of labour was positive and significant at 1%, this implies that adequate labour for production leads to increase in output and vice versa. Labor is described as the effort in man-days of laborers needed to complete the work. The Noiler production operation is considered to be labor-intensive. Poultry farmers usually hire laborers, and with the family, they spend most of their own time on the farm; more laborers are hired when production expands. Labor is an essential factor in Noiler production and covers a wide variety of activities. The work (labor) at a Noiler farm includes: preparing for the arrival of birds, litter management, feed and water distribution to the birds, administering the vaccine to the birds, and frequent supervision of birds to ensure their good condition. Other activities include removing the dead birds from the flock, and lighting management. Consistently, previous studies have reported the same observations for poultry farms across countries with economies under development (Oyakhilomen *et al*., 2015; Yenibehit *et al*., 2019; Ullah *et al*., 2019), also this result is in agreement with the findings of Khan *et al*., (2022) on Technical Efficiency Analysis of poultry Farmers in where he noted that labour and water consumption had a direct relationship with production output.

Coefficient of water consumption were positive and significant at 1%, this implies that increase quantity of water consumed for production leads to increase in output and vice versa. Water has long been recognized as one of the most critical resources in poultry production. Water consumption makes an excellent litmus test for a flock's overall health condition (Garcia *et al*., 2010; Manning *et al*., 2017). Decreased water consumption can indicate health problems and productivity problems (Manning *et al*., 2017). Water consumption increases productivity and the quality of meat production. The estimated coefficient of water consumption indicates that a 1% increase in water consumption could increase meant production by 18.97percent. Similar results for water consumption were also found in previous research works (Kaine *et al*., 2017, Yenibehit *et al*., 2019, Ume, 2012); thus, this current study is in line with earlier observations, and it amends the existing knowledge by adding data for the situation Abia in particular.

Also quantity of Vaccine used was significant at 5% and positively related to output of the Noiler farmers, this implies that the higher the use of vaccine, the more productive the Noiler farmers become. This suggests that when the Noiler farmers adopt and utilize the vaccine appropriately, it would lead to improved output. The same result for vaccination was reported by Saliu *et al*. (2016) and Nihal *et al*. (2018), while Yenibehit *et al*. (2019) described some impact of vaccination on production output. This study's results therefore strengthen the evidence available in literature with the view of an insignificant impact of vaccination on the efficiency of the poultry business. Also this supports the findings of Yero (2019) which observed that the use of vaccine increased output of farming Nigeria.

The return to scale (TRS) of 0.9866 shows that Noiler production was in rational state of the production surface.

Furthermore, the coefficients of those socio-economic and institutional variables included in the inefficiency model were estimated simultaneously by the single-stage ML estimation procedure using the estimated level of TE as the dependent variable. According to Coelli (1995), in the analysis of the technical inefficiency effects model, the sign of coefficients of the parameters included in the model is to be taken into account. If the coefficient of the parameter under study in the model is positive, this means that the respective variable is increasing the level of technical inefficiency of the farmer, whereas if the sign of the coefficient of the parameter is negative, this shows that the variable under consideration is decreasing the level of technical inefficiency (or increasing the level of technical efficiency) of farmers. Thus, the form the variables entered into the inefficiency model of this study, the coefficients of all-independent variables (age, experience, education and extension contact) of Noiler farmers were statistically significant at a 5% significance level. The negative sign of these factors indicates a negative relationship between the factor under study and technical inefficiency, and consequently an increase in the technical efficiency of Noiler poultry farmers along an increase of the respective factor. These results showed that all factors (age, experience, education and extension services) positively influenced the technical efficiency of Noiler poultry farmers in the study area.

The coefficient of age and experience in this study were negative and significant at the 1% significance level. Interestingly, age was found to reduce technical inefficiency of Noiler production household because it was negative and significantly at 1%. This suggests that older farmers were more efficient than their young counterparts. Age could serve as a proxy variable of farming experience, so farmers with more years of experience are expected to be more efficient (Yenibehit *et al*., 2019, Ullah *et al*., 2019; Adedeji *et al*., 2013).

The outcomes clearly show that the more efficient farmers had more expertise in raising Noilers than the less effective ones. Because more extraordinary agricultural experience is supposed to boost knowledge of diverse farm activities, this was anticipated. Given the state of technology, farmers who have remained in the business for a long time have figured out how to combine scarce resources, thus enhancing efficiency. They might also know specific details or solutions about Noiler production which their competitors do not. Such knowledge ranges from disease control mechanisms to new technology and market opportunities. Previous studies, which were conducted in different countries, have also reported a positive relationship between farm experience and technical efficiency (Jo *et al*., 2022; Yero *et al*., 2019; Adeyonu *et al*., 2019; Gabdo *et al*., 2018); this research highlights that for Abia, similarly to other states, experience of the farmer is a key impact factor on poultry production efficiency.

The coefficient of education in this study was negative and significant at the 1% significance level; Education equips farm households with the necessary knowledge on how to allocate their scarce resources appropriately by increasing the adoption of advanced solutions and spreading technological innovations that shift their production frontier outward. Compared with their counterparts with lower education levels, educated farmers have a stronger desire to obtain information and to use it. Thus, this variable is influential in determining the technical efficiency variation among poultry farmers since it increases farmers' decisions to adopt productivity-enhancing practices and technologies. According to the findings, Noiler producers with more years of formal education were clearly more productive than their less-educated colleagues. As anticipated, these results confirm that education considerably and negatively influences the technical inefficiency effect of meat production at a 1% level of statistical significance. This suggests

that highly educated poultry producers are more efficient at producing Noilers than less educated ones, which is in line with earlier conclusions (Osinowo *et al*., 2019; Yero *et al*., 2019; Akerele *et al*., 2019).

The coefficient of extension contact in this study was negative (and significant at the 10% significance level), suggesting that extension service increases farmers' technical efficiency. This can be explained by the fact that through extension services farmers can use modern techniques of poultry production activity. The extension service is more critical for modern agricultural input mobilization, input use, and disease control, enabling the farmers to reduce technical inefficiency. For several economically developing countries in Africa, it has been found in previous reports that extension services increased the farmers' technical efficiency (Yenibehit *et al*., 2019, Oyakhilomen *et al*., 2015, Ashagidigbi *et al*., 2011), while this present study captured this effect for the Noiler sector in Abia state.

CONCLUSION AND RECOMMENDATIONS

An important determinant in the success rate of farms largely depends on how efficient the resources are used. The model has twelve parameters, five of which are associated with the frontier production function's explanatory variables (factor of production) the coefficient of stock size, feed, labour, water consumption and vaccine while seven with the explanatory variables influencing the level of technical efficiency are age of respondents, household size, experience, formal education, extension contact, marital status, access to credit.

Since the signs of the coefficient of the parameter of the explanatory variables were negative, this shows that the variable under consideration is decreasing the level of technical inefficiency (or increasing the level of technical efficiency) of farmers. The negative sign of these factors indicates a negative relationship between the factor under study and technical inefficiency, and consequently an increase in the technical efficiency of Noiler poultry farmers along an increase of the respective factor. These results showed that all factors (age, experience, education and extension services) positively influenced the technical efficiency of Noiler poultry farmers in the study area.

This study recommendation would be that since the older farmers were more productive than younger ones, the younger farmers should consult the older farmers for advice regarding Noiler farming and farmers need to be informed and made aware of the need of sound agricultural management. In order to increase the efficiency and output level of farmers, it is necessary to expand agricultural extension services methods and include more farmers in such training programs. The primary goal of extension operations should be to educate farmers on better production management so they may make optimum use of the resources at their disposal and boost output.

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Table 1: *Maximum likelihood estimate of stochastic production frontier function*

Variables	Coefficient	Standard error	t-ratio
Production factor			
Constant	5.5995	0.4340	12.90***
X_1 = Stock size	0.0682	0.0342	1.99**
X_2 = Feed	0.0314	0.0186	1.69**
X_3 = Labour	0.6542	0.0411	15.92***
X_4 = Water consumption	0.1897	0.0399	4.75***
X_5 = Vaccine	0.0430	0.0179	2.40**
Return to scale (TRS)	0.9866		
Inefficiency factors			
Q_1 = Age of respondent	-1.3725	0.5155	-2.66***
Q_2 = Household size	-0.1105	0.1336	-0.83
Q_3 = Experience	-4.2336	1.7597	-2.41*
Q_4 = Formal education	-14.0462	5.2400	-2.68***
Q_5 = Extension contact	-0.0031	0.0016	-1.93*
Q_6 = Marital status	0.1743	0.6762	0.26
Q_7 = Access to credit	-0.0095	0.0065	-1.46
Sigma squared(δ)	-41.8303	16.5120	-2.53*
Gamma(γ)	0.0854	0.0058	14.72***
Log likelihood	129.1596		
Wald $chi^2(6)$	570.39***		

Source: Field Survey data, 2022***, **, *; Significant at 1%,5%and 10%, respectively

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Entrepreneurship and Agribusiness Innovation for Food Security in Nigeria: A Review

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ABSTRACT

Entrepreneurship and innovation in agribusiness are essential for enhancing food security in Nigeria, particularly due to the country's swiftly increasing population and the hurdles presented by climate change, policy limitations, and economic instability. As Nigeria faces ongoing issues with food scarcity, new agribusiness models fueled by entrepreneurship have the potential to boost agricultural productivity, improve value chains, and create sustainable food distribution systems. This review examines how entrepreneurship promotes agribusiness innovation, emphasizing its role in food production, supply chain effectiveness, and market access. By analyzing pertinent literature, the study highlights significant challenges such as insufficient funding, inadequate infrastructure, low levels of technological adoption, and inconsistent agricultural policies. Additionally, the paper explores how digital technology, financial inclusion, and policy measures can aid agribusiness entrepreneurs. The paper concludes with practical recommendations to bolster agribusiness entrepreneurship, such as reforming policies, boosting investment in rural infrastructure, improving access to financing, and implementing capacity-building programs designed to provide farmers and agripreneurs with the contemporary skills and knowledge required for food security.

Keywords: Agribusiness, Entrepreneurship, Food Security, Agricultural Innovation, Climate-Smart Agriculture, Agricultural Finance.

INTRODUCTION

Food security is an urgent concern in Nigeria, a nation with a rapidly expanding population that heavily relies on agriculture for its livelihood and economic development. According to the Food and Agriculture Organization (FAO, 2019), food security refers to the situation in which everyone, at any time, has physical, social, and economic access to enough safe and nutritious food to satisfy their dietary requirements for an active and healthy lifestyle. Nonetheless, Nigeria grapples with considerable obstacles in reaching this objective, as issues like climate change, economic instability, and inadequate infrastructure continue to jeopardize food production and distribution (Matemilola, 2017).

Entrepreneurship within the agribusiness sector is crucial for tackling food security by promoting innovation, boosting productivity, and improving access to markets (Gadanakis, 2024). Recently, there has been an increasing acknowledgment of the significance of agribusiness startups and smallholder farmers in revolutionizing the agricultural industry through creative business strategies and value-added production methods (Casey *et al*., 2021).

In Nigeria, a number of obstacles prevent agro entrepreneurship from being as successful as it may be, despite its potential advantages. Due to strict lending criteria and exorbitant interest rates, many farmers and agribusiness owners find it difficult to obtain credit, making limited access to funding a major obstacle (Arinzeh, 2022). Agribusinesses' capacity to grow and satisfy the demands of food security is further restricted by inadequate infrastructure, which includes shoddy road networks, a lack of storage facilities, and unstable electricity (Sanusi *et al*., 2025). With unpredictable rainfall patterns, desertification, and flooding impacting crop yields and food supply, climate change also poses a serious threat to agricultural output (FAO, 2020).

Policy changes, technology breakthroughs, and financial innovations are desperately needed to encourage agribusiness entrepreneurship in Nigeria in light of these obstacles. Enhancing agribusiness regulations, expanding financing availability, and encouraging climate-smart farming methods can all greatly increase the nation's food security (Adesina and Loboguerrero, 2021). This paper highlights the importance of entrepreneurship and agribusiness innovation in enhancing food security in Nigeria while pointing out the main obstacles and prospects facing the industry.

Entrepreneurship in Agribusiness

In order to establish sustainable businesses, agribusiness entrepreneurship entails spotting opportunities in agriculture production, processing, and marketing (Obiora, 2022). In order to increase productivity and revenue, it includes taking risks, being creative, and making strategic decisions. To increase food security, agribusiness owners use technology and value addition to turn unprocessed agricultural goods into commodities that are in high demand (Omodanisi *et al*., 2020). Entrepreneurs are change agents who disrupt established markets, increase efficiency, and introduce new manufacturing techniques, according to Schumpeter's theory of innovation (Schumpeter, 1934). This may be seen in agribusiness through the use of modern farming methods, improved seed varieties, and modern agricultural techniques (Manida and Ganeshan, 2021). According to Osabohien *et al*., (2020), agripreneurs also improve rural livelihoods and generate job possibilities, which promote economic growth.

Agribusiness Innovation

Adoption of new farming methods, digital technologies, and enhanced supply chain models are all considered forms of innovation in agribusiness. For example, precision agriculture has enhanced crop yields and optimized farming methods by combining soil sensors, GPS mapping, and AI-driven decision-making (Getahun *et al*., 2024). Similar to this, year-round agricultural production in urban and peri-urban regions has been made possible by vertical farming, hydroponics, and aeroponics, which has decreased reliance on conventional farmlands (Mekonnen *et al*., 2024).

Youth-led startups, government initiatives, and international collaborations are propelling agriculture innovation in Nigeria (Yami *et al*., 2019). Crowdfunding approaches have been implemented by platforms like Farmcrowdy and Thrive Agric, which allow smallholder farmers to obtain capital and increase their output (Okpeke, 2024). Furthermore, the implementation of blockchain technology in food supply chains has increased agricultural markets' efficiency, decreased fraud, and improved traceability (Feng *et al*., 2020).

The Role of Entrepreneurship and Innovation in Food Security

Entrepreneurial agribusiness initiatives contribute to food security by:

- **Enhancing agricultural productivity** through mechanization and digital farming. Tractors, harvesters, and irrigation systems are examples of mechanized farming methods that increase productivity and lessen the need for manual labor (Manida and Ganeshan, 2021). Real-time monitoring of crop conditions and soil health is made possible by digital farming techniques including precision agriculture and Internet of Things (IoT) apps, which maximize resource utilization and boost yields (Getahun *et al*., 2024).
- **Reducing post-harvest losses** via improved storage and logistics solutions (Yami *et al*., 2025). Improved transportation networks, silos, and cold storage facilities all contribute to the preservation of perishable items and guarantee that food reaches consumers undamaged (Dani, 2015). According to studies, improved logistics can drastically increase food supply by lowering post-harvest losses by as much as 40% (Yami *et al*., 2025).
- **Promoting access to finance** through innovative credit schemes and agritech platforms (Rayhan *et al*., 2024). Digital lending services, microfinance organizations, and crowdfunding platforms have increased smallholder farmers' access to capital, allowing them to purchase upgraded

technologies, seeds, and fertilizer (Rayhan *et al*., 2024). According to data from Nigeria, farmers who have access to financing are 20% more productive than those who have without (Adegbite, 2021).

- **Expanding market linkages** through e-commerce and cooperative farming models. Farmers and consumers are connected directly through online marketplaces and digital supply chain platforms, which lowers middlemen's exploitation and guarantees fair pricing (Sanusi et al., 2025). In rural regions, cooperatives promote economic stability by assisting small-scale farmers in pooling resources, obtaining bulk purchasing discounts, and negotiating better prices (Msosa, 2022).

Food accessibility, price, and availability are all positively impacted by agribusiness entrepreneurship, according to empirical research. Food affordability, for example, is positively and significantly impacted by smart agri-preneurship dimensions, according to research by Omodanisi et al. (2020). In order to achieve food security, the study came to the conclusion that farmers should adopt smart agri-preneurial technology as innovations that might increase farm yields, lower production costs, and make food output more affordable.

Challenges Facing Agribusiness Entrepreneurship in Nigeria

Despite its potential, agribusiness entrepreneurship in Nigeria faces numerous challenges, including:

- **Limited Access to Finance** – Due to strict lending requirements, high interest rates, and a lack of collateral, smallholder farmers and agribusiness owners find it difficult to get credit (Arinzeh, 2022). Funding options are further restricted by financial institutions' frequent perception of agriculture as a high-risk industry (Ducastel *et al*., 2023).
- **Poor Infrastructure** – Poorly developed road infrastructure, inconsistent electricity availability, and a lack of adequate storage options lead to significant post-harvest waste and elevated transportation expenses (Yusuff, 2023). Research indicates that as much as 30% of the food produced in Nigeria is wasted due to inadequate storage and logistical challenges (FAO, 2020).
- **Climate Change** – Food availability and farmers' income have been impacted by decreased agricultural output caused by unpredictable weather patterns, protracted droughts, desertification, and flooding (Adesina and Loboguerrero, 2021). Initiatives for climate-smart agriculture are still underutilized because of low knowledge and barriers to adoption (Okafor *et al*., 2021).
- **Policy Inconsistencies** – Regular policy changes, poor agricultural reform implementation, and low stakeholder participation have discouraged long-term agribusiness investments. Market stability has also been disrupted by inconsistent import and export regulations, which has an impact on regional agribusinesses (Adekanle, 2024).
- **Low Technological Adoption** – Due to high costs and a lack of technical expertise, many smallholder farmers do not have access to precision farming technologies, digital platforms, or contemporary agricultural tools (Getahun *et al*., 2024). This problem is made worse by the digital gap that exists between urban and rural areas.

CONCLUSION AND RECOMMENDATIONS

Innovation in agribusiness and entrepreneurship have enormous potential to alleviate Nigeria's food security issues. Financial limitations, inadequate infrastructure, climate change, and inconsistent policies, however, still impede advancement. A multi-stakeholder strategy that includes technical advancements, private sector investments, and government assistance is needed to address these issues.

The following recommendations are proposed;

- Strengthening Policy Frameworks – For agribusiness owners, the government should guarantee stable agriculture policy, tax breaks, and subsidies that are consistent and helpful.
- Enhancing Access to Finance – Establishing venture capital funds, low-interest agriculture loans, and insurance plans for agribusiness owners to reduce risks.
- Promoting Technological Adoption – Encouraging the use of precision agriculture, digital platforms, and renewable energy solutions to enhance efficiency.
- Developing Agricultural Infrastructure – To reduce post-harvest losses, funds should be allocated to rural roads, cold storage facilities, irrigation systems, and transportation networks.

- Capacity Building – Implementing training programs for farmers and agripreneurs on business management, technological adoption, and sustainable farming practices.

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Determinants of Market Participation among Smallholder Cassava Farmers in Osisioma L.G.A of Abia State, Nigeria

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ABSTRACT
The study examined the determinants of market participation among cassava marketers in Osisioma L.G.A of Abia State, Nigeria. Specifically, the study examined the socioeconomic characteristics of cassava farmers in the study area; assessed the level of participation in the market by the farmerss; examined the cost and return of cassava farmers in the study area; estimated the determinants of net income of cassava farmers in the study area; and identified the constraints involved in market participation of cassava farmers in the study area. A multistage sampling technique was used in selecting 60 respondents for the study. Data for the study were obtained using a well-constructed questionnaire. Data were analyzed with descriptive statistics, market participation index, and multiple regression models. Results showed that most respondents (31.67%) belonged to the 30-39 age group, with a mean age of 46 years old, implying that the farmers are middle-aged marketers. The majority of farmers (68.33%) were females, while only about 31.67% were single. The majority of the farmers (68.33) recorded a participation index range of 0.10-0.24, with a mean value of 0.23, implying they were subsistent marketers. The cassava farmers realized a monthly average total revenue of ₦175,665.65 and incurred an average total marketing cost of ₦153,464.65 while the net profit was ₦22,201.00, implying that cassava marketing in the study area is profitable. Level of market participation, educational level, household size, value of output, and cooperative membership were the positive and significant determinants of the net income while market charges had a negative and significant relationship with the net income of marketers. All farmers encountered constraints such as high transportation costs, price fluctuations, and elevated market charges within the study area. The study recommended that government and governmental organizations should sensitize and motivate cassava farmers to join cooperative societies for collective bargaining and to moderate the high market charges.

Keywords: Cassava farmers, Determinants, Market **Participation, Marketing.**

INTRODUCTION
Root crops are valuable commodities in Africa, generating income and employment opportunities for farmers operating at the subsistence level (FAOSTAT, 2020). Smallholder farmers generate income through their involvement in cassava tubers marketing at the farm gate, homes, and markets in Nigeria. They also supply the commodity to industries using cassava roots as raw materials for starch, ethanol, and flour production (Otekunrin *et al.,* 2022). Cassava marketing starts at the farm when smallholder farmers harvest and gather cassava from the farm to the market (Eze *et al.,* 2023). Marketing allows the cassava roots to be sold to the customers in good form after being harvested, further sorted, cleared, and processed using different methods. Smallholder farmers expect payment when participating in the market, and the payments are made to cover

each stage of the marketing process until the product is delivered to the end user (Egbetokun *et al.,* 2017).

Market participation refers to involvement in any market-related activity that promotes the sale of cassava as the individual household's economic transactions with others in cash or kind or commercialization (Ogundele, 2020). Market participation allows smallholder farmers to sell cassava for higher profit and purchase inputs necessary for efficient production. Reliable market access improves productivity, income, and food security and could reduce poverty and hunger among smallholder farmers. Participation in the market generally provides a greater chance for smallholder farmers to expand the scope of their marketing activities and improve their income level (Zakari *et al.,* 2023). Market participation comes in different ways. It may be on the output side of marketing with sales of farm produce or on the input side regarding accumulated use of purchased inputs (Otekunrin, 2021). Smallholder farmers participate in the output market when they produce large quantities of cassava, allocate marketable commodities, and sell a significant portion, resulting in increased transactions for specialization gains (Otekunrin *et al.,* 2022).

Furthermore, market participation is a prerequisite for enhancing agriculture-based economic growth and increasing the income of smallholder farmers whose scale of operation is subsistent, associated with low income and productivity (Otekunrin, 2021). However, subsistence production cannot improve the income of smallholder farmers without participating in the output market. These emphasized the need for intensification, increased commercialization, and specialization among smallholder cassava farmers. Also, efficient marketing systems are crucial for building these systems, ensuring low transaction costs, minimizing risk, and extending information at the least possible cost (Abu, 2015).

In Nigeria, however, market participation is determined by information cost, market structure, and transaction costs (Eze *et al.,* 2023). Other determinants of markets are inadequate market infrastructure and lack of access to technology and credit facilities. All these factors negatively affect market participation, and limit smallholder farmers' income, making it difficult to enjoy the benefits of market participation (Hussayn *et al.,* 2022). Commercial cassava production is associated with a higher degree of market participation; however, smallholder farmers are resource-poor, facing financial constraints, and have a limited quantity of cassava output which lowers their involvement in the market. Low participation is often exacerbated by pest and disease attacks that reduce the quantity of output produced and the desire to participate in output markets.

Most smallholder cassava farmers in Nigeria including the study area do not have adequate information regarding risk management, resulting in seasonal crop failures and low quantity of output. With low cassava output, the farmers may have insufficient surplus to sell in the market (Egbetokun *et al.,* 2017). Furthermore, smallholder farmers also lack access to processing and storage facilities, implying that they cannot hold their commodity for an extended period after harvest. This often results in forced sales and the inability to store the product when prices are low for sales when the prices are high in the market. (Hussayn *et al.,* 2020). Inadequate processing and storage facilities make it more difficult for smallholder farmers to add value to their products or supply in forms that match market standards. High labor cost is another factor discouraging market participation among smallholder farmers in Nigeria. The net returns are reduced when labor costs are high. This could imply that high labor costs cut significantly into the net profits of smallholder farmers, making market participation less rewarding.

Research has been conducted by scholars in Nigeria to assess the determinants of market participation among smallholder cassava farmers. For example, Egbetokun *et al.,* (2017) examined determinants of market participation among maize farmers in Ogbomoso Zone, Oyo State, Nigeria; Otekunrin *et al.,* (2022) assessed the determinants of agricultural commercialization and challenges confronting cassava farmers in Oyo State, Nigeria. However, none has been conducted in Osisioma L.G.A of Abia State, highlighting the unique challenges faced by smallholder cassava farmers in accessing the market. Hence, this study tends to bridge the research gap by examining the socioeconomic characteristics of cassava farmers in the study area; assess the level of participation in market by the farmers; examine the cost and return of cassava farmers in the study area; estimate the determinants of net income of cassava farmers in the study area; and identify the constraints involved in market participation of cassava producers in the study area.

The findings of this study will provide smallholder farmers with insights into profitable market operation levels. It will also inform policymakers and government officials in developing evidence-based policies to enhance market participation among smallholder farmers and foster agricultural development. Additionally, the study will contribute to existing literature, serving as a valuable reference for researchers, students, and stakeholders interested in this field. The objectives were to; examine the socioeconomic characteristics of cassava farmers, assess the level of participation in market by the respondents; examine the cost and return of the respondents; estimate the determinants of net income of the cassava marketers; and identify the constraints involved in market participation of cassava farmers in the study area.

METHODOLOGY

The study was carried out in Osisioma L.G.A of Abia State, Nigeria. Osisioma Local Government Area is one of the existing 17 LGAs in the state with the composition of the towns of Uratta, Okpu-Umuobo, Amaitoli, Aro-Ngwa, Amasa, Oso-Okwa, Umunneise and Okupu-Umuobo. It lies between latitudes 5^0 5' 57" and 5^0 19' 32MN and longitudes 7^0 15 ' 49" and 7^0 25' 23"E) with a land area covering about 198km^2 and a total population of 321,300 (NPC, 2022). Osisioma Local Government Area has its administrative council headquarter in Osisioma with eight other towns and many communities under the local government area.

Multistage sampling technique was used in selecting 60 smallholder cassava farmers for the study. In the first stage, 6 major markets in the study area known for cassava marketing were purposively selected for the study. The markets of interest were: Ekeakpara market, Nkwo Abayi market, Afoule market, Ahia Nwankpa market, Nkwo Okpu Umuobo Market and Ahia Ekenwaobasi Markets. In the second stage, 10 cassava producers were randomly selected form each of the selected marketers from the list obtained confidentially from the market officials, giving a total of 60 respondents for the study.

Data for the study were obtained using well-constructed questionnaire. The data of interest included socio-economic characteristics such as sex, age, level of education, experience, income, access to credit, household size and cooperative membership. Others include purchase cost, transportation cost, storage cost and level of market participation.

Objectives (i) and (v) were analyzed using descriptive statistics such as frequency tables, means and percentages.
Objective (ii) was realized with market participation index

The market participation index is stated below:

$$MPI_i = \quad \times 100 \qquad (1)$$

The respondents were grouped into three levels: Subsistence marketers (value of the sale is less than 25%); Transition marketers (value of sale between 25% - 50%) and commercial marketers (value of sale is greater than 50%).
Objective (iii) was analyzed with market budgetary approach

Cost and returns formula are stated below:

$$NR = TR - TC \qquad (2)$$
$$TC = TVC + TFC$$

Where;
NR = Net Returns
TR = Total Revenue
TC = Total Cost
TVC = Total Variable Cost
TFC = Total Fixed Cost

The fourth objective was analyzed using multiple regression model.

Multiple Regression Model

The determinants of net return were analyzed with multiple regression model.

Ordinary least square (OLS) model used was implicitly stated as follows:

$$Y=f(X1, X2, X3,X4,X5,X6, X7,X8,X9) \quad (3)$$

Where;

Y = Net Returns (N)
X1 = Level of market participation (%)
X2 = Age (Years)
X3 = Education (No of years spent in school)
X4 = Household size (No of persons)
X5 = Output (Kg)
X6 = Transportation cost (Kg)
X7 = Market charges (Kg)
X8 = Amount of credit (N)
X9 = Cooperative membership (Member=1, otherwise=0)
e = error term.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Result in Table 1 showed that most respondents (31.67%) belonged to the 30-39 age group, with a mean age of 46 years old, implying that the respondents are middle-aged marketers. This finding is in-line with Osakue *et al.* (2023), who studied analysis of cassava tuber marketing in rural and urban markets in Edo South Agro-Ecological Zone, Edo State, Nigeria and reported that the most of the cassava marketers were within the age range of 41 – 50.

Results also showed that the majority of respondents (68.33%) were females. This finding implies a difference in the gender distribution among cassava marketers in the study area, reflecting broader societal norms and structures regarding gender roles in economic activities. However, the high representation of females in cassava marketing suggests that women are actively engaged in this aspect of agribusiness, potentially contributing significantly to household income and welfare. This finding contradicts with Ogundele (2020), who studied factors influencing output commercialization among small-scale farmers in Nigeria and reported that most of the marketers were males.

Table 1 also showed that the majority (75%) of respondents were married, while only about 25% of them were single. This finding implies that the majority of the male and female respondents in the study area were married. Of course, marriage often brings responsibilities and commitments, which may incentivize marketers to engage more consistently in economic activities like cassava marketing to meet their needs and those of their family members. Being married could promote market participation and income of the respondents through the combined efforts of spouses. This could mean more resources available for investment in the business, leading to potential growth and improved welfare status. This finding aligns with Otekunrin *et al.* (2022) who examined the determinants of agricultural commercialization and challenges confronting cassava farmers in Oyo State, Nigeria, and reported that the majority of the marketers were married.

The majority of respondents (50%) had tertiary education as their highest level of education. In addition to the fact that the majority of the respondents are educated and capable of making wise investment decisions regarding cassava marketing, they might be less vulnerable to exploitation by middlemen and other agents who will not be able to take advantage of them in terms of pricing mechanisms, and contractual agreements. Also, education may have provided the marketers with access to information and resources that are crucial for a successful cassava marketing business. This finding also aligns with Hussayn *et al.* (2020), who examined the effects of agricultural commercialization on poverty status of smallholder cassava farming households in Oyo State, Nigeria and reported that majority of the respondents were educated.

The majority (66.67%) of respondents lived in households with 4-6 people, with an average household size of 6 persons, implying that most of the cassava marketers had a fairly large household size that could assist them. The availability of family labor could potentially lead to increased market participation among the respondents. Also, increased market participation

consequent upon the availability of family labor could reduce the cost of marketing for the marketers and potentially lead to higher incomes for the household, promoting their overall welfare.

Results in Table.1 also showed that the majority of the respondents (78.33%) had marketing experience of 1-9 years, with mean years of marketing of 6 years, suggesting that the respondents possess a high level of expertise and knowledge about the cassava market, and are more likely to be more efficient in their marketing activities including sourcing and distributing cassava roots. Over the space of 6 years, the respondents may have developed networks and relationships with buyers and other market participants which can help in maintaining a steady flow of cassava roots to the market. This finding is in tandem with Otekunrin *et al.* (2022) that most cassava marketers in Oyo State, Nigeria are experienced.

The majority of respondents (75%) did not access credit. This finding may have negatively influenced their level of involvement in cassava marketing. Of course, without credit access, cassava marketers may struggle to scale up their marketing operations, assemble marketable surplus, or cover transportation costs. Lack of access to credit could limit the level of market participation, revenues, and profitability of the respondents in the business.

The majority of respondents (66.67%) do not belong to cooperative societies. By implication, this could restrict networking and mutual support opportunities, both of which are critical for the long-term viability of businesses and their ability to adjust to shifting market conditions. However, cooperative societies often provide members with collective bargaining power, access to financial services, better pricing, and shared knowledge or training. Without these advantages, non-members may face higher costs for inputs, limited access to credit, and weaker market connections, which can hinder their ability to compete effectively and grow their businesses.

Level of Participation in the Market by the Cassava Marketers

The level of market participation of the marketers is presented in Table 2. The result showed that the majority (68.33) recorded a participation index range of 0.10-0.24, with a mean value of 0.23. This finding implies that the farmers are subsistent marketers. This subsistent level of participation in the market could be associated with limited access to credit and poor market infrastructure among others. By implication, those operating at a subsistent level might not benefit from cost reduction advantages associated with commercial and transition marketers. Also, they cannot compete effectively with larger players in the markets. This finding contradicts with Otekunrin *et al.* (2022), who examined the determinants of agricultural commercialization and challenges confronting cassava farmers in Oyo State, Nigeria, and reported that majority of the respondents were commercial traders.

Cost and Return of Cassava Marketers in the Study Area

In a month, the respondents recorded an average total variable cost of ₦92,954.15, which is about 60.57% of the total cost. It also showed that the purchase cost of cassava formed the major cost, such that it was 40.99% of the total marketing cost. This is because purchase cost is typically the biggest outlay in marketing, particularly for agricultural products like cassava (Osakue *et al.,* 2023). Furthermore, the respondents realized a monthly average total revenue of ₦175,665.65 and the total marketing cost was ₦153,464.65 while the net profit was ₦22,201.00, implying that cassava marketing in the study area is profitable. This profit could incentivize the marketers to continue participation in the cassava market, potentially expanding their operations, investing in better technologies, and enhancing efficiency. This finding aligns with Osakue *et al.* (2023) who analyzed cassava tuber marketing in rural and urban markets in Edo South Agro-Ecological Zone, Edo State, Nigeria and reported that cassava marketing was profitable.

More so, the marketing efficiency computation showed that the respondents were only about 14.47% efficient in cassava marketing in the study area. Of course, they are inefficient because their efficiency score is less than 100%. This low efficiency could be due to several factors such as poor infrastructure, high transportation and handling costs, limited access to modern technologies, and inefficient market structures. These factors contribute to higher operational costs and reduced profit margins, preventing the marketers from maximizing returns on their investments.

Determinants of Net Income of Cassava Farmers in the Study Area

From Table 4 above, the linear functional form was chosen as the lead equation. This was based on statistical and econometric reasons which include the magnitude of the coefficient of multiple determination, the number of significant variables, as well as the significance of F-ratio. The coefficient of multiple determination (R^2) was 0.9619 which implies that 96.19% of the variations in the net returns of the respondents were explained by the independent variables included in the model while 3.81% unexplained was due to error factor. The F-ratio of 160.86 was statistically significant at a 1% significant level indicating that the variables included in the estimated regression model were correct and have a line of best fit.

The coefficient of level of market participation was statistically significant and had a positive relationship with the net income of the respondents at 1%. This means that the net income of the respondents tends to increase as the level of participation of the respondents increases. This is because greater market participation typically means selling a larger proportion of cassava output, which directly leads to higher revenue. When marketers expand their operations by selling more cassava, accessing larger markets, or improving their marketing strategies they are likely to achieve better economies of scale, reducing per-unit costs and increasing overall profitability. Otekunrin (2017) stated that market participation allows marketers to sell their products to a wider customer base, potentially fetching higher prices and income for their goods.

The coefficient of education was statistically significant and had a positive relationship with the net income of the respondents at 1%. This means that the net income of the respondents tends to increase as their educational level increases. A positive effect of education on the net income is expected because education promotes critical thinking ability, problem-solving ability, and decision-making skills of the respondents. Equipped with these abilities, they are more likely to make informed business decisions, such as optimizing pricing strategies, managing costs, and identifying profitable opportunities, which can lead to increased net income. This finding is in tandem with Egbetokun *et al.* (2017) who reported that education had a positive influence on the net income of the marketers.

The coefficient of household size was statistically significant and had a positive relationship with the net income of the respondents at 1%. This means that a unit increase in the household size of the respondents results in a corresponding increase in their net income. This could be due to several factors related to the contribution of household members to cassava marketing activities. In larger households, more family members are likely available to assist with various stages of cassava marketing, such as production, processing, transportation, and sales. Family labor can reduce the need for hired labor, thereby lowering operational costs and increasing net income. This finding contradicts with Zakari *et al.* (2023) who studied the drivers of smallholder farmer's market participation in the Sahelian region of Niger and reported that household size had negative effect on the net income of the marketers.

The coefficient of output level was statistically significant and had a positive relationship with the net income of the respondents at 5%. This means that a unit increase in the output of the respondents results in a corresponding increase in their net income. A higher output level means that the respondents are selling more of their products, other things being. This leads to higher net income especially if the cost of marketing does not increase proportionally.

The coefficient of market charges was statistically significant and had a negative relationship with the net income of the respondents at 1%. This means that the net income of the respondents decreases with an increase in the market charges. Market charges represent additional expenses for the marketers. When these costs rise, they cut directly into the marketers' revenue, leaving them with lower net income after covering these charges. In many cases, marketers may not be able to increase prices in response to rising market charges due to price sensitivity or competition in the market. This means that any increase in market charges directly reduces their net earnings, as their revenue remains constant while their costs increase.

The coefficient of cooperative membership was statistically significant and had a positive relationship with the net income of the respondents at 1%. This result aligns with *a priori* expectations, as cooperatives enable marketers to combine their limited resources to navigate challenging situations, sell at better prices, reduce expenses, and boost profitability. Additionally,

cooperative members benefit from shared resources, equipment, and services, which lowers their operating costs and enhances their profit margins.

Constraints Involved in Market Participation of Cassava Marketers

Results in Table 5 showed the constraints involved in the market participation of cassava marketers. All respondents encountered constraints such as high transportation costs, price fluctuations, and elevated market charges within the study area. The high transportation costs are apparent as many marketers travel long distances to sell are also far from their homes. The increase in transportation expenses, driven by rising fuel prices and poor road conditions, further adds to the marketing costs for respondents, ultimately reducing their profit margins. This study aligns with Otekunrin *et al.* (2022), who reported that high cost of transportation was the major problem of the marketers.

Also, cassava marketing in Nigeria is seasonal since its production depends on rainfall, and producers have limited access to modern farming tools such as irrigation systems and drought-resistant varieties. As a result, cassava prices tend to fluctuate with seasonal changes, and prices often drop unexpectedly during the offseason, negatively affecting profit margins. High market charges are evident in high taxes and fees imposed by market officials, which adds to the total cost of marketing, reducing their net income.

CONCLUSION AND RECOMMENDATIONS

This study examined the determinants of market participation among cassava farmers in Osisioma L.G.A of Abia State, Nigeria. The findings revealed that most respondents were middle-aged, educated, and had considerable marketing experience. However, they faced significant constraints, including limited access to credit, high transportation costs, price fluctuations, and elevated market charges.

The results showed that the level of market participation, education, household size, output, and cooperative membership had a positive and significant relationship with the net income of the respondents. On the other hand, market charges had a negative and significant relationship with the net income of the respondents. The study's findings have important implications for policymakers, agricultural extension agents, and other stakeholders involved in cassava marketing in Nigeria. To improve the participation of cassava farmers in the market and enhance their net income, it is recommended that:

- Credit facilities should be made available to cassava farmers to enable them to scale up their marketing operations.
- Market infrastructure should be improved to reduce transportation costs and market charges.
- Cooperative membership should be encouraged among cassava farmers to enable them to benefit from shared resources, equipment, and services.

By addressing these constraints and providing support to cassava farmers, it is possible to improve their participation in the market, enhance their net income, and contribute to the overall development of the agricultural sector in Nigeria.

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Table.1: Socio-economic characteristics of the cassava farmers

Variables	Frequency	Percentage
Age (years)		
20 – 29	4	6.67
30 – 39	19	31.67
40 – 49	14	23.33
50 – 59	13	21.67
60 – 69	6	10.00
70 – 79	2	3.33
80 – 89	2	3.33
Total	**60**	**100**
Mean	**46**	
Sex		
Male	19	31.67
Female	41	68.33
Total	**60**	**100**
Marital status		
Married	45	75.00
Single	15	25.00
Total	**60**	**100**
Education		
No formal education	11	18.33
Primary	5	8.33
Secondary	11	18.34
Tertiary	33	55.00
Total	**60**	**100**
Mean	**12**	
Household size		
1-3	3	5.00
4-6	40	66.67
7-10	14	23.33
11-13	3	5.00
Total	**60**	**100**
Mean	**6**	
Marketing experience		
1-9	47	78.33
10-19	10	16.67
20-29	3	5.00
Total	**60**	**100**
Mean	**6**	
Credit access		
Yes	15	25.00
No	45	75.00
Total	**60**	**100**
Cooperative membership		
Yes	20	33.33
No	40	66.67
Total	**60**	**100**

Source: Field survey, 2024

Table 2: Level of participation in market by the cassava farmers

Index	Levels of participation	Frequency	Percentage
0.10-0.24	Subsistence	41	68.33
0.25-0.50	Transition	12	20.00
0.51-1.00	Commercial	7	11.67
Total		60	100
Mean	Subsistent marketers	0.23	

Source: Field Survey, 2024

Table 3: Monthly cost and return of cassava farmers in the study area

Variables	Mean Values (₦)	Share (%)
Total Average revenue	**175,665.65**	
Price per bag	35,133.33	
Quantity (Bags)	5	
Fixed Costs		
Rent	56,100.00	36.56
Depreciation	4,410.50	2.87
Total Fixed Cost	**60,510.50**	**39.43**
Variable Costs		
Purchase cost	62,900.81	40.99
Labour cost	9,766.67	6.36
Market charges	6,535.00	4.26
Cost of transportation	11,105.00	7.24
Storage cost	2,646.67	1.72
Total Variable Cost	**92,954.15**	**60.57**
Total Marketing Cost (TVC+TFC)	**153,464.65**	**100**
Net Profit (TR-TMC)	**22,201**	
M.E (%) (Net profit/TMC×100**)**	**14.47**	

Source: Field survey, 2024: Note: M. E=Marketing Efficiency

Table 4: Regression estimate of the determinants of net income of cassava farmers

Variables	(+) Linear	Exponential	Semi log	Double log
Intercept	-93484.52	3.65	378170.60	4.98
	(-4.63) ***	(19.45) ***	(3.26) ***	(8.51) ***
Level of market participation	130969.6	0.32	722216.2	2.63
	(11.49) ***	(3.02) ***	(8.41) ***	(6.07) ***
Age	-6.97	0.03	-49361.18	0.22
	(-0.03)	(1.45)	(-1.00)	(0.90)
Education	2629.09	0.02	11181.06	0.25
	(4.63) ***	(5.13) ***	(0.83)	(3.65) ***
Household size	5741.98	0.03	126621.70	0.51
	(3.63) ***	(2.08) **	(3.23) ***	(2.65) **
Output	8214.53	0.33	-384017.3	-1.26
	(2.05) **	(0.91)	(-4.30) ***	(-2.80) ***
Transport cost	-0.42	-1.56	-4804.34	0.07
	(-1.07)	(-0.43)	(-0.27)	(0.82)
Market charges	-1.75	-0.01	-35287.05	-0.27
	(-4.76) ***	(-4.07) ***	(-2.76) ***	(-4.19) ***
Cooperative membership	2567.42	-0.03	-22309.75	0.06
	(2.87) ***	(-0.59)	(-0.60)	(0.35)
R^2	**0.9619**	**0.8270**	**0.8758**	**0.8338**
R^{-2}	**0.9559**	**0.7998**	**0.8563**	**0.8077**
F-ratio	**160.86*** **	**30.47*** **	**44.95*** **	**31.98*** **

Source: Field Survey, 2024, Note: Note: values in parentheses () are the respective t-ratio. ***, **, and * implies statistical significance at 0.01, 0.05 and 0.1 probability levels respectively.

Table 5: Constraints involved in market participation of cassava farmers

Variables	Frequency*	%
Lack of credit/loan	7	11.67
High cost of transportation	60	100
Perishability of the product	32	53.33
Price fluctuation	60	100
High market charges	60	100
High purchase cost	56	93.33
Under-developed market	28	46.67

Source: Field survey, 2024 *Multiple responses recorded

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Agribusiness SME'S Investment: Effect of Output on Nigeria's Gross Domestic Product

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ABSTRACT
The study analyzed the effect of agribusiness investment and output on Nigeria's gross domestic product (1980-2022). Specifically, the study assessed the contribution of the agribusiness sector to Nigeria's GDP, changes in agribusiness output and GDP and changes in agribusiness investment and GDP within the period under review. Secondary data from databases of reliable institutions like the CBN, FAO, World Bank, etc were employed. Data were analyzed using the OLS regression model. The result of the findings showed that the coefficient of agribusiness investment (5.540396) was significant at (1%), while that of agribusiness output was negatively signed (-2.079633) but also significant at (1%). The study concluded that agribusiness investment had a positive impact on the nation's GDP. Based on findings, the study recommended that more investments be made in agribusiness and policies that would improve the efficiency and productivity of agribusiness output be implemented.

Keywords; Agribusiness, Investment, Output, GDP

INTRODUCTION
Recent increases in the prices of agricultural commodities have spurred a surge of private investments into farming and agribusiness (Tyler and Dixie, 2013). The term 'agribusiness' simply refers to the breadth of businesses engaged in all aspects of agriculture, from the provision of inputs such as seeds and fertilizer, to farming, processing, marketing, distribution and retail sales. It emphasizes the notion that for agriculture to be sustainable, it needs to be viewed as a business (Nwueli, 2011). Agriculture is a vital sector in Nigeria, providing employment to a large portion of the population and contributing to the country's economy. With favourable climate conditions, fertile land and abundant water resources, Nigeria has the potential to be a major food producer in Africa. In recent years, the government has implemented policies to modernize and improve the agriculture sector, including promoting the the use of technology and improving access to finance and markets. The government has also been working to increase the production of crops such as maize, rice, cassava and yam, as well as livestock such as cattle and poultry (AFSIC, 2025).

In Nigeria, agribusiness entrepreneurship has garnered increasing attention due to population growth and limited alternative employment opportunities. Agriculture alone contributes about 24% to the nation's gross domestic product with agribusiness activities such as input supply, processing, marketing and retailing contributing an additional 20% (OECD and FAO, 2016). Approximately 85 million individuals are employed in the food economy with over 75% of these jobs concentrated in agriculture. Of the total employment, about 65% are based in local communities while 20% are involved in food processing, marketing and activities outside their local areas (Ikuemonisan, 2024: Osabuohien et al. 2018: Alola and Alola, 2019). This sector not only provides livelihood for millions,

but has the potential to drive industrialization and economic diversification. Agribusiness investment in Nigeria presents significant opportunities for economic growth, food security and poverty reduction. With a growing population, vast agricultural resources and increasing demand for high quality food products, the nation offers a favourable investment climate for both domestic and international Investors (Agenpo,2023).

After decades when developing countries tried with limited success to encourage investment in their agriculture sectors, many are now faced with difficult decisions about the number, size and type of investments to accept (Tyler and Dixie, 2013). The agriculture sector in Nigeria faces several challenges including low productivity, limited access to financing in addition to large dominance by small scale farmers, who often lack the resources and knowledge to fully realize their potential. Also,the increased investments in the agribusiness sector through government policies, programs and funds to encourage agribusiness investment and output which is affected mostly among other factors by the double digit inflation rate that stood at 29.0 percent in 1996 and have always been on the increase (Ekpo *et al,* 2013; and Onwumere *et al,* 2012)*ii,v& xiv.* It became pertinent to investigate the effect of investment and output in the agribusiness sector in Nigeria on the nation's Gross Domestic Product between 1980 and 2022 with the following objectives driving the study, to assess the contribution of the agribusiness sector to GDP; assess the changes in agribusiness output and GDP and assess the changes in agribusiness and GDP within the period under review.

METHODOLOGY

The study was carried out in Nigeria, Nigeria is located in West Africa bordering the gulf of Guinea between Benin Republic and Cameroon (CIA World fact, 2022). She covers an area of approximately 923,768Km2, with a diverse geography that includes tropical rain forests and semi-deserts (NBS, 2020). The country has the largest economy in Africa, with a normal GDP of over $240 billion (IMF, 2022). Agriculture is a vital sector in Nigeria's economy accounting for about 25% of the country's GDP (NBS, 2020). Nigeria has a relatively favourable investment climate with a large and growing market, abundant natural resources and a strategic location (World Bank, 2020). Secondary data collected from highly reliable sources like the Central Bank of Nigeria, Food and Agriculture Organization, World Bank, etc were used for the study. Data were analyzed using the Ordinary least Square Regression Analysis and the model is explicitly specified as follows

$$Y = \beta o + \beta 1X1 + \beta 2X2 + \varepsilon \quad (1)$$

Where;
Y = GDP (Gross Domestic Product)
X1 = Agribusiness Investment
X2 = Agribusiness Output
βo = Intercept or constant term
β1 = Coefficient of Agribusiness Investment
β2 = Coefficient of Agribusiness output
ε = Error term (Random variation in GDP not explained by the independent variables).

RESULTS AND DISCUSSION

Contribution of the Agribusiness Sector to Gross Domestic Product (GDP)

An overview of the changes in agribusiness sector and the Nigerian Economy from 1980 to 2022. The changes in agribusiness output and the GDP from (1980-2022) is presented in the Figure 1. Figure 1 is a histogram representation of the changes in agribusiness output and agribusiness investment in comparison to GDP. From the graph, there has been a constant rise in the GDP of the Nigerian economy, likewise the agribusiness output and agribusiness investment, though at a slower pace. No doubt, agribusiness output and agribusiness investment play crucial contributory roles to the growth of the economy (usually measured by GDP). However, the growth of agribusiness output and agribusiness investment have not been satisfactory enough. A recent NBS report (2023) has it that Nigeria's GDP grew by 3.46% year-on-year in real terms in the fourth quarter of 2023 which is lower than the 3.52% recorded in the fourth quarter of 2022 and higher than the 2.54% of third quarter 2023. According to the report, the performance of the GDP in the last quarter of 2023 was driven by the services sector which recorded a growth of 3.98% and contributed 56.55% to the aggregate GDP. Agriculture contributed about 20% to the aggregate GDP in 2023, lower than the contribution in 2022 (23.69%). While agribusiness output and agribusiness investment might have been a slow increase, the overall contribution to GDP is in a declining state. This calls for serious

attention, especially now when there are calls to DE monopolise and diversify the economy away from oil.

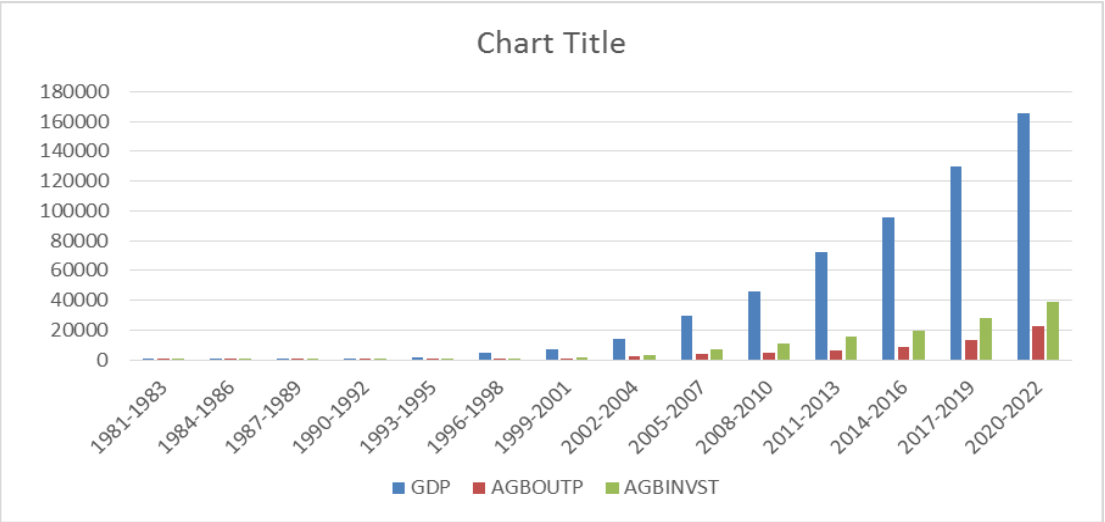

Figure 1: Contribution of the agribusiness sector to Gross Domestic Product (GDP) Source: Author's computation from CBN statistical bulletin of various issues

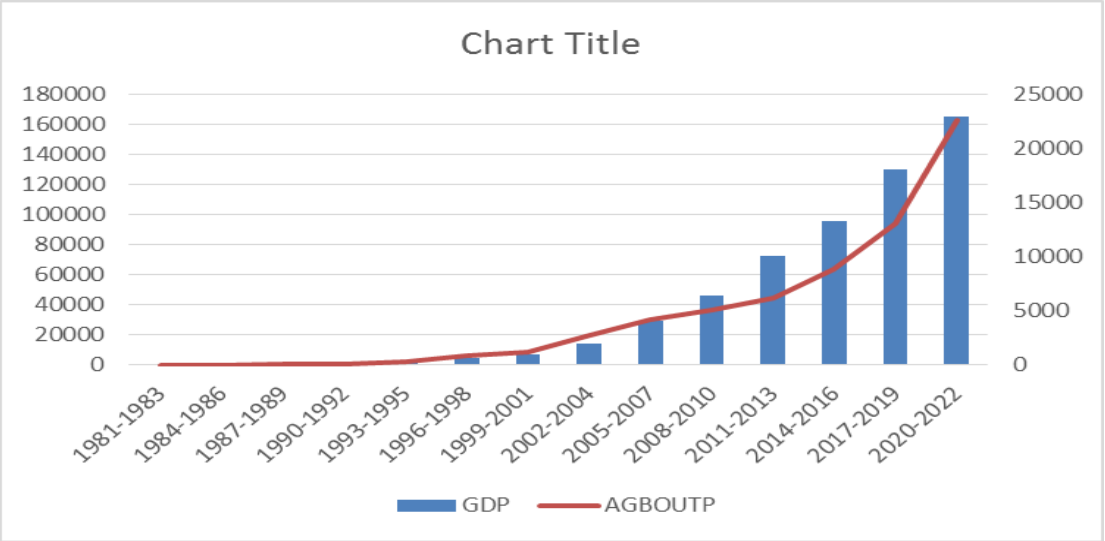

Figure 2: Changes in Agribusiness output and GDP (1980-2022) Source: Author's computation from CBN statistical bulletin of various issues

This graph in Figure 2 shows that agribusiness output and GDP trend lines are moving in the same direction. Between years 1981 and 2000, output from agribusiness remained relatively constant, while GDP was relatively constant too. From2001-2022 as seen from the agribusiness output trend line, the industry began to flourish and could be owed to the government policies being initiated during those periods, and this caused the GDP to also increase. Other sectors have contributed to the GDP growth of the economy but the oil sector gave the highest, this could be due to high dependence. However, with the introduction of some government programs and policies such as the Federal government rice initiative project, anchor borrowers, FADAMA and the likes to boost agribusiness output, agribusiness output began to rise relatively in the country. The democratic dispensation in Nigeria has caused increment in the agribusiness output owing to some policy measures most importantly on the Economic Recovery and Growth Plan of Nigeria (ERGP) which brought programs on Presidential Initiatives on Cassava, FADAMA, Agro-Processing productivity Enhancement and Livelihood Support Project (APPEALS), Anchors borrowers' program, and other World Bank and African Development Bank assisted programs to the Federal Government while the GDP continued to increase due to its contribution and the contribution of other sectors(Kilimvi, 2023).

As stated in the SMEDAN report (MSME report, 2017), the contribution of SMEs to Nigerian GDP is 47% with a total number of business formations of 96.7% and an employment rate of 84%, with more prospects preceding the sector. However, in order to sustain the growth of SMEs in Nigeria, it is imperative that they continue to receive adequate support from the government when needed (Akerejola *et al*., 2019). The challenges, including financing, poor infrastructure and an unworkable policy framework for SME creation and growth are also eliminated (Victor *et al*., 2019).

As shown by the 2017-2020 Economic Growth and Recovery Plan (ERGP) and the 2020 Economic Sustainability Plan (ESP), there is a great need for the nation to invest its resources in other sectors, and the agricultural and agro-industries are evidently boosting the Nigerian economy by promoting inclusive growth and Jobs.

The contribution of agriculture to GDP in Nigeria has been incredible. Varrella (2021) found that between October and December 2020, agriculture accounted for 26. 95% of total GDP while the total contribution of SMEs to Nigerian GDP is 47%. This means that SMEs could have greatly stimulated the agricultural contribution of 26.95% to GDP since its overall contribution to GDP stands at 47%.

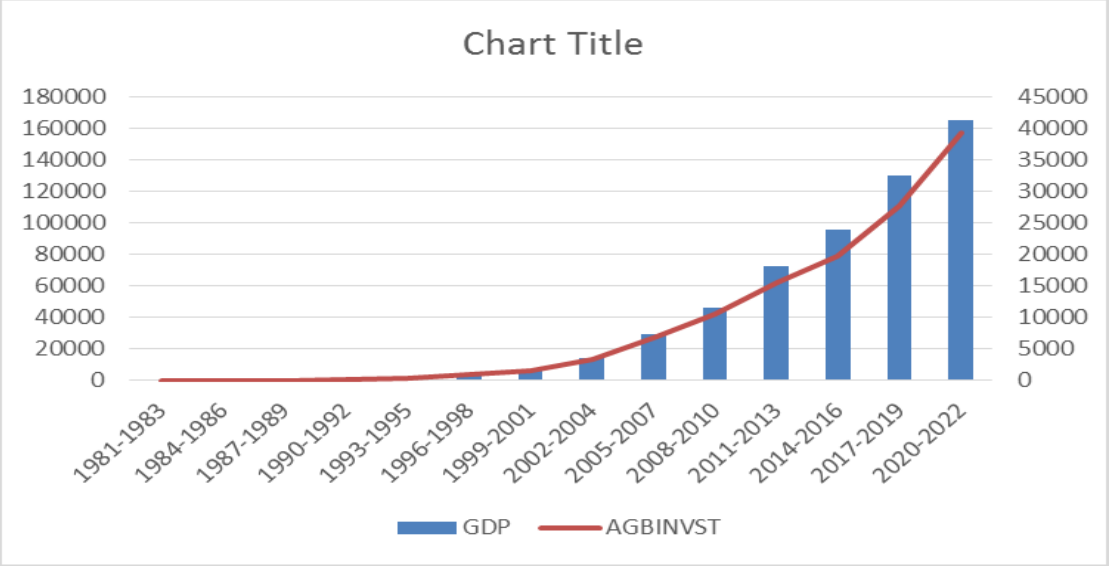

Figure 3: Changes in Agribusiness investment and GDP (1980-2022) Source: Author' computation from CBN statistical bulletin of various issues

Figure 3 shows the relationship between GDP growth and investment in the agribusiness sector. The gray line represents agribusiness investment whereas the blue line represents GDP. With a very high concentration on the oil sector till date, there has been negligence to the other sectors with little investment contribution to the GDP of Nigeria. As quoted by (Mbanasor and Okorji, 1997), the level of agribusiness investment has been relatively low from 1970s. The trend has remained the same since the discovery of oil in the country. Despite chances to improve investment in agribusiness by the government with an aim to cause a paradigm shift of concentration to other sectors more importantly, agriculture, several factors such as corruption, crude level of agriculture, and poor policy formulation and implementation have stomped the growth of agribusiness investment. This sector could boost the GDP of the economy. The trend line shows only an improvement in the Agribusiness investment from 2010-2022.

Effect of Agribusiness Investment and Output on GDP of Nigeria

To examine the effect of agribusiness investment and output on the GDP of Nigeria, the Ordinary Least Square (OLS) regression was employed and the estimates are presented in Table 1. The coefficient of multiple determination (R^2) of 0.997 indicates that the independent variables (agribusiness investment and agribusiness output) included in the model accounted for 99.7% of the total variation in GDP. The model is statistically significant at 1.0%, according to the F-test statistics value of 6056.134.

Table 1: OLS estimates of effect of agribusiness investment and agribusiness output on GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Agribusiness investment	5.540396	0.206326	26.85269	0.0000
Agribusiness output	-2.079633	0.396901	-5.239675	0.0000
Constant	428.8474	564.2075	0.760088	0.4519

R-squared	0.996872	Mean dependent var	37550.91
Adjusted R-squared	0.996708	S.D. dependent var	50434.86
S.E. of regression	2893.796	Akaike info criterion	18.84888
Sum squared resid	3.18E+08	Schwarz criterion	18.97426
Log likelihood	-383.4021	Hannan-Quinn criter.	18.89454
F-statistic	6056.134	Durbin-Watson stat	1.624984
Prob(F-statistic)	0.000000		

Source: Author's Computation, 2024

Meanwhile, agribusiness output is statistically significant at 1% and is inversely related to GDP, with a negative coefficient value (-2.079633). This indicates that as GDP increases, the value of agribusiness output decreases. The negative coefficient is counter intuitive as one would expect agribusiness output to positively impact GDP. However the result may indicate that the current structure of agribusiness output in Nigeria is not efficiently contributing to GDP growth. Possible reasons could include; inefficient production processes, limited value addition to agricultural products and weak linkages between agribusiness and other sectors of the economy.

Investment in agribusiness was statistically significant at 1% (5.540396). As indicative of the agribusiness sector from the analysis, it perhaps provides the best opportunities to the Small and Medium Enterprises which can stimulate the GPD of the economy for growth, alleviation of poverty and generation of more and better jobs. Kilimivi (2023) and Elliot *et al*. (2022) in their research gave findings on the performance of the agribusiness sector for the period of 2009–18 stating that the performance of this sector during this period, most especially off-farm agribusiness sector created better opportunities than other sectors, impacting on the GDP. These findings corroborate the findings from this study that there has been tremendous performance by the agribusiness output sector. The Agribusiness output showed capacity for boosting the economy while agribusiness investment is still significant. Furthermore, enforcing the potentials of agribusiness output has the capacity to create jobs and grow the economy because the agricultural sector as seen from literature is the bedrock for many other activities for primary development of the economy. Therefore, with regards to investment for the growth of overall GDP, more opportunities lie within off-farm segments when better inputs are supplied. In terms of growth opportunities, there would be need for better coordination within the sector. These trickles down to proper arrangements which can trigger job opportunities for SMEs in agriculture/agribusiness value chain. Furthermore, the possibility of growth can emanate from the exploration in agribusiness value chain where fragmentation can be limited while initiating strong connectivity in upstream primary production and downstream value-addition areas (Kilimivi, 2023).

CONCLUSION AND RECOMMENDATIONS

Having investigated the effect of investment and output on the GDP of Nigeria between 1980 and 2022, the study concluded that agribusiness investment has a positive and significant impact on Nigeria's GDP, suggesting that investing in agribusiness can contribute to economic growth. However, agribusiness output has a negative and significant impact on Nigeria's GDP, indicating that the current structure of agribusiness output is not efficiently contributing to GDP.

To leverage the potential of agribusiness in driving growth, policy makers should
(i) Increase investments in Agribusiness.
(ii) Implement policies to improve the efficiency and productivity of agribusiness output.
(iii) Enhance value addition to agricultural products through processing and manufacturing.
(iv) Strengthen linkages between agribusiness and other sectors of the economy.

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Analysis of Household Assets on Livelihood Strategies among Small-Scale Food Crop Farmers in Niger State, Nigeria

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ABSTRACT

The study analyzed the effects of household assets on livelihood strategies among small scale food crop farmers in Niger State, Nigeria. A multi stage sampling method was employed to collect data using structured questionnaire with the help of trained enumerators who elicited for information from 282 respondents in the study area. Analytical methods such as the descriptive statistics (percentage, mean and frequency) and inferential statistic (multinomial logit regression) were used to analyze the data collected. The result of the descriptive statistics shows that the most of the respondents were within the age group of 31-40years (39.36%), majorly males (80.14%), married (96.81) with qur'anic level of education (27.66). Results on the livelihood strategies participated among the small-scale food crop farmers was mostly LS_3 128 (45.39%), while the least participated was LS_2 28(8.16) among the respondents. The results on the effects of household assets on livelihood strategies also shows that farmers' participation on government agricultural programme was significant (1.81) on LS_1 , years of farming experience at (3.51)*** on LS_1 and (3.08)*** on LS_4. Savings was also significant on LS_2 (2.08)** among other livelihood strategies, therefore, it could be concluded that household assets affects the choice of livelihood strategies among the respondents. It was recommended that more household assets should be utilized to enable the smallholder crop farmers to carryout diversified livelihood strategies where more income could be generated to meet numerous farming and family needs.*

Keywords: Household, Assets, Livelihood Strategies

INTRODUCTION

The term "livelihood" refers to a method of fulfilling one's fundamental requirements for water, food, shelter, and clothes through engaging in combinations of activities to meet daily needs. It is chosen as a collection of activities, including requirements, carried out on an individual or group level by managing available resources (both human and material) to meet household needs on a long-term basis (Scoones, 2016; Samuel *et al.,* 2022)). The idea of Sustainable Livelihood is an effort to better present circumstances and find methods to alleviate poverty. This was determined to be controlled since emphasis has traditionally been focused on particular areas or characteristics of poverty, such as inadequate money. Kess attention has been paid to other significant elements of poverty, such as social exclusion. Different circumstances and procedures that either impede or allow impoverished people's capacity to earn a livelihood in an economically, regionally, and socially

sustainable way must be addressed (Hailay *et al.,* 2024). The notion of living means a more meaningful and dual-functioning response to poverty. In 1992 the Brundtland Committee on the Environment and Development introduced the idea of sustainable livelihoods and extended it with the emphasis on sustainable livelihoods as a wide objective for eradicating poverty. In social science, on the other hand, the concept of livelihood is expanded to encompass social and cultural means, that is, power over money or resources that may be utilized or transferred to fulfill their needs by the average man, the family or any other social class. All information, cultural experience, social connections, land and other material resources may be included. The concept is established on sustainable development and human rights principles (Abubakar, 2014).

Since livelihoods include all concepts required for living, their growth, vulnerability and coping patterns should all be taken into account. According to the United States Department for International Development (DFID, 1999., Samuel *et al.,* 2022), livelihoods are a broad and comprehensive word that may be divided into five main elements which improves the well-being of the impoverished. Individuals may take out livelihood activities to satisfy daily requirements if they have access to household assets. The availability of these assets determines the success of livelihood activities. They're categorized as follows: (Abubakar, 2014; Scoones, 2016., Gelato, *et al.,* 2023).

model's implicit form is provided in Equation 2: Natural capital - the natural resources that flow and provide benefits to individuals, such as land, water, air, wildlife (plants and animals), soil nutrients, and environmental services (hydrological cycle). The financial capital foundation (money, credit/debt, savings, pensions, income, and insurance) as well as other economic assets (basic infrastructure, manufacturing equipment, and technology) that may be utilized to follow any lifestyle strategy. Human capital - skills, expertise, experience, household labor, health condition, level of education, and age are all factors that influence the effectiveness of various livelihood strategy. Social capital - Individual association membership, sources of knowledge, involvement in government agricultural programs, and access to important adult education programs are all examples of social capital. Physical capital refers to fundamental infrastructures (access to good roads, transportation, and manufacturing, as well as the value of physical assets) that people need to pursue their livelihoods. It's essential to remember that these assets exist to improve rural people's livelihood activities; their usage and long-term management will decrease household vulnerability to shocks, help them control poverty, and enhance their household availability (DFID, 2014; Samatar, 2015; Scoones, 2016).

The individuals' capacity to pursue different livelihood choices depends on the availability of household assets, social assets such as human connections, are recognized as unacknowledged assets. From an economic standpoint, such livelihood resources may be thought of as "capital" from which different productive methods and livelihoods might be generated. According to the Department for International Development (DFID, 2020; Samuel *et al.,* 2024), capital is divided into five groups (Social capital, Human capital, Physical capital, financial capital and Natural capital). Success is linked to one's choice of profession. Households may, for example, select agricultural output or off-farm work as a source of income. Poor families select their livelihoods via a variety of activities in order to avoid risky situations and achieve a long-term revenue source (Samatar, 2015; Misganaw, 2019).

The availability of household assets is an essential element in livelihood practice. Households select activities that fit into their livelihood plans to enable individuals to meet their daily needs, and the rate utilized in each activity is based on the household's available assets. Changes in policy may impact the asset base, which ties assets together and influences lifestyle choices. The goal of a better asset is to utilize better livelihood activities to offer better living conditions and long-term growth for families while minimizing their risk exposure (DFID, 1999; Yakubu, 2014; Samuel *et al.,* 2024). When livelihood activities are varied using the available household assets, it provides individuals with additional income that may be spent in sustainable practices to prevent deterioration and ensure efficient production. Furthermore, when livelihood activities are carried out through the help of available household assets, it provides relief on land by reducing agricultural operations as well as generating more income which is investible into sustainable practices which increases crop output. This allows land to refill from degradation and ensuring natural environment regeneration as well. As a result, food crop farmers must devote immediate attention to implementing sustainable methods on endangered and expensive cultivable land. As with food crop

production, ensuring that Sustainable Land (SLMP) methods and livelihood strategies using the household assets are used correctly is crucial to ensuring crop efficiency. The following research questions were formulated: what are the socio-economic characteristics of the respondents? and, do assets owned by the households affects their livelihood strategies?

The aim of the study was the analysis of the effects of household assets on livelihood strategies among small scale food crop farmers. The objectives were to describe the socio-economic characteristics of the respondents, and, to ascertain the influence of household assets on livelihood strategies used by the crop farming households The hypothesis tested was household assets has no significant effects on livelihood strategies used by the farming households **.**The findings of this study suggested a variety of livelihood strategies using available household assets to enable the farmers to produce more as well as to meet more daily needs. In addition, increased income, improved livelihood, and overall economic well-being is achievable following the recommendations of this study. Better social, health care and other services that have negative impact on the welfare of those who are hampered by deterioration maybe achieved through the result of this study. This study aims to address knowledge and information gap. Many studies on livelihood strategies have been conducted. Such as Sallawu *et al.* (2016) reported on livelihood and income diversification in Niger State.

METHODOLOGY

The study was carried out in Niger State, Nigeria. Niger State lies between Latitudes 8^0 20' N and 11^0 30' N and Longitudes 3^0 30'E and 7^0 20' E (NAMDA, 2014, Ogaji, 2022). It has land area of 76,363km^2. Niger State lies in the Guinea Savannah vegetation zone of the country with favorable climatic conditions for crop and livestock production. The population of Niger State according to 2006 population census was 3,950,249 which could have increased at an annual population growth rate of 3.8% to give a projected value of 7,951,781 at the end of 2024.

Sampling Procedure and Sample Size

The respondents for this study were chosen using multi-stage sampling method. The first stage was a random selection of 20% of Local Government Areas in Zones I, II, and III which contain Eight, Nine, and Eight LGAs respectively. A sample of six LGAs in Niger State were randomly chosen. In stage two, one Extension Block was sampled from each of the selected LGAs which gave a sample of six Extension Blocks. Selection of 20% of Extension cell was carried out from the selected Extension Blocks which gave a total of 12 Extension Cells. The Fourth stage included random selection of one Sub-cell (10%) from each selected Cells resulting to sample of 12 Sub-cells in Niger State. The last stage involved the use of proportionate allocation method which gave 282 respondents. Proportionate Allocation Technique. (Ogaji, 2019; Samuel *et al*., 2021):

$$S_h = \frac{n \times Nh}{NT} \quad (1)$$

Where;

S_h = Number of household heads selected,
n = Total number of household heads for the survey,
N_h = Farming households in each selected Sub-Cells, and
N_T = Sum of the farming households in the selected sub-Cells

Method of Data Collection

In the months of April to June 2024, the researcher and trained enumerators used questionnaires to collect primary data from the chosen agricultural Zones in Niger State. Farm families in the research region served as the sample units. Data on livelihood/income strategies, household characteristics such as family composition, education, asset ownership, sources of income, agricultural and livestock product sales, buying and selling livelihood involvement, membership in farmer's associations and extension contacts were elicited.

Analytical Tools

Descriptive statistics such as frequency distribution, percentage, mean, and standard deviation and the multinomial logit regression model were used to analyze the objectives.

Model Specification

The effects of explanatory factors on dependent variables with unordered answer categories are estimated using the multinomial logit regression model. Following (Rodriquez, 2003; Ayinde *et al.,* 2012; Samuel *et al*., 2022). The

$$Log\left[\frac{prob\,(y=z)}{prob\,(y\neq Z)}\right] = \sum_{k=1}\beta_{zk}\,X_k \quad (2)$$

The explicit form of multinomial logit is given as Equation 3:

$$Y= B_0 +B_1S_1+...+B_4S_4+B_5H_1+...+B_9H_5+B_{12}P_1+...+B_{12}P_3+B_{13}F_1+...+B_{17}F_3+B_{18}N_1 +...B_{21}N_{21} \quad (3)$$

Where dependent variables are;

Y = Livelihood strategies (LS_1, LS_2, $LS_3$and LS_4). The staple crops in this study were cereals, tubers and legumes
Y_1 =1 for LS_1 (staple crop, off-farm income)
Y_2 =2 for LS_2 (staple crop, wages and salary)
Y_3 =3 for LS_3 (staple, fruit and vegetables crops, livestock production and off-farm income)
Y_4 =4 for LS_4 (staple, fruit vegetables and tree crops, livestock production and off-farm income)
β_o = intercepts,
β_I - β_{21} = coefficients, and
X = value of explanatory or independent variables for the i^{th} individual.

Where;

Si = *Social capital variables;*
S_1 = Farmers' participation in government agricultural programme (number);
S_2 = Sources of information (number);
S_3 = Access to adult education programmes (1 for access 0 otherwise),
S_4 = Association membership of the respondent (1 for association membership, 0 otherwise),

Hi = *Human capital variables*
H_1 = Education of the household head (years),
H_2 = Age of farmer (years),
H_3 = Health status (1 for good health status, 0 otherwise),
H_4 = Farming experience (years), and
H_5 = Family labour (Number of mandays).

Pi = *Physical capital variables*
P_1 = Value of Physical assets (₦),
P_2 = Access to good road (yes=1, No=0), and
P_3 = Distance to nearest market (km).

Fi = *Financial capital variables*
Fi = Amount of credit/annum(₦),
F_2 = Savings/annum (₦),
F_3 = Amount of pension, month/ (₦),
F_4 = Income/annum (₦), and
F_5 = Access to insurance (yes=1, No=0)

N_i = *Natural capital variables*
N_1 = Size of farm land (ha),
N_2 = Access to wildlife (1 for access, 0 otherwise),
N_3 = Rain fall Sufficiency (1 for sufficient, 0 otherwise), and
N_4 = Soil fertility adequacy for crop production (1 for adequate, 0 otherwise).

RESULTS AND DISCUSSION

The results on socio-economic characteristics is presented in Table 1, which shows the results on age, sex, marital status, level of education, farming experience, and household size respectively. Respondents 39.36% were within the age group of 31-40years with mean age of 40, This indicates that the respondents were within their productive age group. Furthermore, the younger the farmer, the more the expectation that such a farmer may accept new innovations easily including choice of livelihood and sustainable land management to undertake.

Table.1: Socio-economic characteristics of respondents

Variable	Niger State (n=282) Frequency/percentage
Age (years)	
<31	44(15.60)
31-40	111(39.36)
41-50	81(28.72)
51-60	43(15.25)
>60	3(1.07)
Total	**282(100.00)**
Mean	40
Gender	
Male	226(80.14)
Female	56(19.86)
Total	**282(100.00)**
Marital Status	
Married	273(96.81)
Single	6(2.13)
Widower	1(0.35)
Separated	2(0.71)
Total	**282(100.00)**
Level of Education	
Quranic Education	78(27.66)
Primary Education	56(19.86)
Secondary Education	62(21.99)
Tertiary Education	20(7.09)
Adult Education	11(3.90)
None of the above	55(19.50)
Total	
Farming Experience (years)	282(100'00)
<11	
11-20	56(19.86)
21-30	111(39.36)
31-40	84(29.79)
>41	24(8.51)
Total	7(2.48)
	282(100.00)
Mean	21
Household size	
<6	55(19.50)
6-10_	125(44.33)
11-15	68(24.11)
16-20	24(8.51)
>20	10(3.55)
Total	**282(100.00)**
Mean	**10**

Source: Field Survey, 2024. The figures in parentheses are corresponding percentages

The finding agrees with the report of Dankyang (2014) and Ojo (2013) who reported that most respondents involved in farming activities are regarded as economically active age and are likely to embrace new ideas in farming. Level of education of the respondents shows that the respondents had 27.66% Quranic education. This is attributable to the quest for one form of education to another among food crop producers. Respondents had more Quranic, secondary and tertiary education. The result further shows that respondents had household size between 6 and10 and mean of 8 members/household. This revealed medium to large household size which assists the farmers in carrying out farming activities as farming is labor demanding. Results also shows that 64.89% of food crop farmers were in full-time farming.

The result agrees with finding of Tesfaye (2017) who asserted that high percentage of farming as full-time farmers, primary and secondary occupation maybe due to easy access to farm land while farming livelihood is mostly inherited from their ancestors. Livelihood strategies identified in Table 2 were staple crops, off-farm income (LS_1), staple crops, wages and salaries (LS_2), staple crops, fruits and vegetable crops, livestock production and off-farm income (LS_3), staple crops, fruits and vegetable crops, livestock production, tree crops and off-farm income (LS_4).

The predominant livelihood strategy among respondents was (LS_3), that is staple crops, fruits and vegetable crops, livestock production and off-farm income with 45.39%, while the least practiced was staple crops, wages and salaries (LS_2) 8.16%. Also, it implies that less food crop farmers are in staple food crop production, wages and salary as a livelihood means possibly because of inadequacy of required skills to be employed among the rural dwellers. The finding agrees with result of Misganaw *et al*. (2019) who reported six opportunities of livelihood diversification in Ethiopia but three were agriculture based. This report also concurred with findings of Awoyinka and Akinwumi (2010) that reported four livelihood diversification strategies among food crop farmers in South-West Nigeria.

Table 2: Livelihood strategies of the respondents

Livelihood Strategies	Frequency/ Percentage (Niger State)
LS_1	66 (23.40)
LS_2	28 (8.16)
LS_3	128 (45.39)
LS_4	65 (23.05)
Total	**282 (100.00)**

Source: Field survey, 2024. The figures in parentheses are corresponding percentages

Results on effects of household assets on livelihood strategies in is shown in Table 3. The livelihood strategies were undertaken by 282 household heads. Livelihood strategy one was carried out by 23.40% of the food crop producers. Category two were undertaken by 8.16%, while 45.39% undertook category three, and 23.05% carried out livelihood strategy four. Livelihood strategy three was carried out by more farmers with 45.39%. Livelihood strategy three was super-imposed as the reference category for further discussion.

Results for category one which is staple crop production, off-farm income generating livelihood strategy shows that participation in government agricultural programmes, access to adult education programmes, age of the respondents, years of farming experience and income were significant at 10%,10%,10%,1% and 5% respectively. The coefficient of participation in government's agricultural programme implies that as farmers have more access to government agricultural programmes, the more the likelihood of such farmers to carry out livelihood strategy one which is staple crop/off farm income with respect to the reference category. Government agricultural programmes educate participants on possible choice of means of livelihood in farming which may include staple crops production/ off-farm income. When farmers' participation in government agricultural programme increases, it could lead to increase in participation in staple crops, off-farm income. Thia agrees with the report of Aba (2013)., Gelato *et al.,* (2023) asserted that the more the participation of farmers in different agricultural programmes, the more their participation in different farming livelihood activities. Access to adult education programme which was significant at 10% and negatively signed implies that, increase in farmer's access to adult education programme will reduce the likelihood of such farmers participating in livelihood strategy one with respect to livelihood strategy three. This is because when individuals have more access to education his/her awareness increases which could lead to carrying out different means of meeting livelihood needs. Age was significant at 10% and negatively signed which implies that increase in age of food crops producer will reduce the probability of the farmer to remain in carrying out livelihood strategy one with respect to reference category three. This could be because it is expected that the older the farmer, the more his experience and possibly increase in choice of livelihood outside category one based on experience conditioned by increase in age. Years of farming experience was significant at 1%. This means that increase in farming experience of respondents may lead to likelihood of such respondents to remain in participation on livelihood strategy one with respect to reference category. The result is attributable to the fact that experienced farmers may choose to carry out more of stapple crop production and off-farm income strategy based on previous experience on livelihood combination.
Age on the other hand was also significant at 10%. The implication is that increase in age could reduce the probability of food crop producer to remain in participation on livelihood strategy one with respect to reference category three. An individual could choose livelihood strategy one based on age which could have resulted in experience on livelihood strategy one. The results on farming Experience and training, age and education agree with the report of Nafiza and Qian (2017) that age, educational level of farming experience contribute to choose of means of livelihoods among small scale-farmers.

Table 3: Effects of household assets on livelihood strategies

Variables	LS1 Coeff./(Z-value)	LS2 Coeff. / (Z-value)	LS3 Coeff.	LS4 Coeff. / (Z-value)
Participation in gov't Agric program	0. 1810 (1.81)*	0.0104(0.09)	-0.2447	-0.0742(-0.64)
Source of information	0.1912 (1.25)	0.1963(0.93)	-0.0691	0.1713(1.09)
Access to adult education program	-1.2728(-2.59)*	0.3888(0.67)	0.72801	-0.9333(-1.92)*
Membership of farmer's association	-0.5269(-1.22)	-0.2816(-0.39)	0.54891	0.3036(0.61)
Years spent in school	0.0603(1.55)	0.0790(1.51)	-0.1009	0.0581(1.45)
Age	-0.0549(-1.88)*	-3.1701(-1.93)*	0.03814	-0.0324(-1.09)
Days unable to go to work or farm	-0.0025(-0.34)	-0.0048(-0.38)	-0.0127	-0.0104(0.318)
Years of farming experience	0.1055(3.51)***	0.0057(0.16)	-0.0068	0.0929(3.08)***
Total family labor	-0.0042(-0.80)	0.0081(1.14)	0.0173	0.0049(0.96)
Physical assets	-1.89e-06(0.86)	-1.03e-06(-0.28)	-3.23E-06	-3.29e-06(-0.74)
Distance from home to all season road	-0.0394(-0.53)	-0.0146(-0.13)	-0.1445	-0.1694(-1.55)
Distance from home to nearest market	-0.0165(0.39)	0.0173(0.30)	0.0052	0.0061(0.14)
Amount of credit	-0.150e-06(-0.51)	-1.89e-06(-0.38)	1.49E-06	-3.76e-06(-1.05)
Savings	–3.97e-07(-0.24)	0.377e-06(2.08)**	6.83E-07	-2.66e-06(-1.60)
Pension	3.25e-06(0.23)	-0.0006(-0.01)	-0.001	-0.0003(0.02)
Income	-2.18e-06(-2.35)**	-0.188e-06(-1.42)	-1.07E-06	-5.92e-07(-1.37)
Access to insurance	-25.8602(-0.00)	17.4490(0.01)	32.6216	-10.6875(-0.00)
Farm size	-0.0796(-1.16)	0.0401(0.50)	0.1409	0.0211(0.31)
Access to wildlife	-0.1713(-0.40)	-0.7170(-1.07)	11.576	-0.5567(-1.18)
Sufficiency of rainfall	0.5671(1.04)	-0.9015(-1.17)	-0.7642	0.7047(1.16)
Adequacy of soil nutrient	0.3509(0.78)	0.5060(0.78)	0.5664	0.4109(0.88)
Constant	-0.2971(-0.27)	-3.1801(-1.93)	-4.8161	-1.9331(-1.57)

Source: Field survey (2024). ***= 1% level of significance. ** = 5%level of significance, * =10% level of significance. LS_1=livelihood strategy one, LS_2=Livelihood strategy two, LS_3=Livelihood strategy three, LS_4=Livelihood strategy four.

The coefficient for income was significant at 5% and negatively signed. The significance is that a unit increase in income could reduce the likelihood of food crop producer to remain participatory in livelihood strategy one with respect to reference category three. More income to individual could easily lead to change in choice of livelihood. This agrees with the findings of Francis (2015) who reported that capital acquisition among farmers could result to diversification in different livelihood strategies to survive. Results for category two, which is staple crops production, wages and salaries show that two variables were significant. The variables are age and savings which were significant at 10% and 5% respectively. This indicates that farmers may likely not remain in carrying out livelihood strategy two if they are older in age considering reference category three. This means the older the farmer, the less likelihood to participate in livelihood strategy two with consideration to reference group. This is because food crop producers who are older in age may not choose wages/salary earning livelihood strategy because of the required skills or energy demand which may be required to participate in such category not commonly found among such class of the farmers. Also, a unit increase in savings of farmer will decrease the likelihood to remain in carrying out livelihood strategy two with respect to reference category three because more income could lead individual to diversify means of livelihood outside livelihood strategy three. The result agrees with Conrad *et al.* (2016) who reported that access to information, savings and active years in production determine choice of livelihoods among farmers in Zimbabwe. Years of farming experience was significant at 1%. The result signifies that for farmers' likelihoods remain in participation of livelihood strategy four depends on increase in years of farming experience considering reference category. This could be attributable to the fact that livelihood strategy four contains all livelihood activities better chosen by experienced food crop farmers who passionate about meeting daily needs through choice of complex combination pf livelihoods which guarantees such famers to meet their needs.

CONCLUSION AND RECOMMENDATIONS

Results on the livelihood strategies participated among the small-scale farmers was mostly LS_3 128 (45.39%), while the least participated livelihood was LS_2 28(8.16) among the respondents. Participation of small holder crop farmers on different livelihood strategies could therefore be concluded that the respondents carried out more LS_3 than other means of livelihoods. The results on the effects of household assets on livelihood strategies also shows that farmers' participation on government agricultural programme was significant (1.81)* on LS_1, year of farming experience was (3.51)*** on LS_1, and (3.08)*** on LS_4. Savings was also significant on LS_2 (2.08)** among other livelihood strategies. Therefore, it could be concluded that household assets affect the choice of livelihood strategies among the respondents. It was recommended that more household assets should be utilized to enable the smallholder crop farmers to carryout diversified livelihood strategies where more income could be generated to meet numerous human, farming and family needs. There is also the need for a scale up in their participation on livelihood activities to enable them to generate more income to meet daily needs.

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Determinants of Food Security Status and Constraints Faced by the Pro-Vitamin A Cassava Farmers in South-East Nigeria

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ABSTRACT

The study examined the determinants of food security status and constraints faced by the pro-vitamin A cassava farmers in South-East Nigeria. Specifically the study examined the determinants of food security status and its intensity of the Pro-vitamin A cassava farming households and to identify the constraints faced by the Pro-vitamin A cassava farmers. Multistage sampling procedures were applied in the selection of respondents. Primary data was used for the study and 360 respondents were randomly selected. Data collected were analyzed using Binary choice modeling technique and exploratory factor analysis procedure. Findings shows that gender (0.740), education (0.949), farm size (0.388) and credit (0.609) were some of the determinants causing significant positive effect on food security status of the Pro-vitamin A cassava farming households. The constraints faced by the Pro-Vitamin A cassava farmers shows access to land (0.921), high cost of labour value (0.911), access to credit (0.908), disagreements among farmers (0.901), poor soil (0.888), drought (0.887), insufficient processing facilities (0.877), scarce labour (0.870), disease/pest value (0.869), insufficient credit facilities (0.829), bush fire (0.811) and invasion of farm by grazing animals (0.810) were the significant factors influencing cassava production in the study area. The study therefore recommends that farmers should leverage on farming more hectares with minimal inputs to grow their productivity which in turn will sustain their food security status.

Keywords: Food Security, Pro Vitamin A Cassava, Cassava farmers

INTRODUCTION

Cassava (*Manihot esculenta*) is one of the staple crops cultivated by both small and large-scale farmers in Nigeria. Nigeria is the highest producer of cassava in the world with an estimated annual production of 59,485,947 metric tonnes (FAO, 2018).

According to Onunka, Ume, Ekwe and Silo (2017) cassava is quoted as the fifth most important staple crop worldwide but ranks first in many arid regions, such as in Sub-Saharan Africa. This is due to the fact that more than 500 million people in the zone take cassava meals daily throughout the year (Egesi and Eke-Okoro, 2013). Cassava has some inherent characteristics that make it attractive, especially to the smallholder farmers in these regions. These characteristics include rich in carbohydrate and starch content, as well as the multiplicity of end users. It is readily available all the year round, hence making it preferable to other more seasonal crops such as grains, peas and beans (FAO, 2007). Cassava survives droughts, is inexpensive, resistant to pests and easy to grow as a cash crop, ability to make returns of root yield even at extreme stress condition, suitable to various faming system, available all year round as well as produces efficient food energy (NRCRI, 2014).

In Nigeria, International Institute for Tropical Agriculture (IITA), Ibadan in collaboration with National Root Crops Research Institute (NRCRI), Umudike, developed and released new improved cassava varieties that contain beta carotene (β-carotene) known as "Pro-vitamin A" cassava with the Institutes naming culture such as NR07/0326, NR07/0506, NR07/0497, NR07/0499, NR07/0427, NR07/0432 (Egesi and Eke-okoro, 2013). However, apart from the "Pro-vitamin A" content of the cassava varieties, it has high dry matter content, high leaf retention in dry season (i.e. showing high drought tolerance) and possesses high quality flour for confectionaries making which is a key trait for Cassava Transformation Agenda (CTA) as reported by Egesi and Eke-okoro (2013). Achieving food security in its totality continues to be a challenge not only for the developing nations, but also for the developed world (Angela, 2004). A country should be considered as food-secure when food is not only available in the quantity needed by the population consistent with decent living, but also when the consumption of the food should not pose health hazard to the citizen (Aliyu, 2009). As a staple crop for more than 500 million people in Sub- Saharan Africa, and one of the most important local staples in Nigeria, Esuma, Nanyonjo, Miiro, Angudubo and Kawuki, (2019) stated that cassava availability (especially Pro-Vitamin A) throughout the year could support the attainment of food security and reduce the prevalence of Vitamin A deficiency among rural households in Nigeria in general and South East in particular.

Despite the innovation of Pro-vitamin A cassava, the adoption and consumption of bio-fortified Pro-vitamin-A cassava varieties remains low in South East Nigeria (Ayinde, 2017). Therefore, there is need to increase investment in Pro-vitamin A cassava farming which in turn leads to increased productivity all things being equal (Nto and Mbanasor, 2008). Hallam (2009) noted that the ability of agriculture (Pro-vitamin A cassava) in developing economies to meet food requirements by the year 2050, Food and Agriculture Organisation estimated that annual investment of USD 83 billion is needed, an amount which they argues most developing countries do not have the capacity to make in agriculture (Pro-vitamin A cassava), as spending by governments of these developing nations on agriculture has declined to seven percent (7%) and much less for those in Africa. The problem of food and malnutrition in South East Nigeria persists despite various approaches at addressing the challenges. Government through the Harvest plus has only introduced the innovation of bio-fortification of cassava with Pro- vitamin A and its adoption in some few states in South East Nigeria without taking into accounts rainfed system of farming in the area. Therefore, there is need for massive adoption and use of modern technology to improve the productivity of Pro- vitamin A cassava in South East Nigeria. Against this backdrop, the study seeks to examine determinants of food security status and constraints faced by the pro-vitamin A cassava farmers in South-East Nigeria. The specific objectives were to estimate the determinants of food security status and its intensity of the Pro-vitamin A cassava farming households and to identify the constraints faced by the Pro-vitamin A cassava farmers.

METHODOLOGY

The study was conducted in South East Nigeria. The zone consists of five states, namely, Abia, Anambra, Ebonyi, Enugu, and Imo. According to NPC (2006), the population of the South East zone is 16, 381, 729 persons, disaggregated into 8, 306,306 males and 8, 075, 423 females. With a growth rate of 2.6% per year, While 2016 projected population which was published by the National Bureau of Statistics (NBS) in 2017, estimated that the population of South East was 21,955,414 persons. The region lies in the humid tropical agro-ecological zone of Nigeria, within latitudes 04° 24'N to 07° 00'N and longitudes 05° 34'E to 09° 24'E. The humid tropical ecology is characterized by two distinct seasons, namely, the dry season, which starts from November to late March and the rainy season, which starts from April to October. The general vegetation consists of woodland savannah in the northern part of the zone and mangrove forests in the deep Niger Delta area (Onyeneke, 2010). Major food crops cultivated include cassava, maize, rice, sweet potatoes, yam, plantain, banana and vegetables.

Multistage sampling procedures were applied in the selection of respondents (sample). In the first stage, three out of the five states in the South-East Geo-Political zones were purposively selected for the study. The states selected were Abia, Anambra and Imo. For the second stage, two agricultural zones per state were randomly selected giving six agricultural zones. In the third stage, two LGAs were randomly selected from each zone, giving a sample of 12 LGAs. In the fourth stage, three communities were randomly selected from each Local Government Area giving a sample of 36 communities. At the last stage, 10 Pro-Vitamin A cassava farmers were purposively selected since the list of Pro-Vitamin A cassava farmers has an average of 10 farmers per community. This gave a

total of 360 respondents. Only 348 was completely and correctly filled and returned. The data were collected using a structured questionnaire, copies of which were distributed to the farmers with the help of the enumerators. The data for the study were analyzed using both descriptive and inferential statistics. Objective (i) was realised using Binary choice modeling technique, specifically the Logit.and objective (ii) was achieved using exploratory (principal component) factor analysis procedure.

Binary choice modeling Technique:

$$Pi = \sum X_i \quad (1)$$

Where,
Pi = Probability of an i^{th} Pro- vitamin A cassava farming households being food secure or not.
X_i = Vector of explanatory variables which are defined below
X_1 = Age of Household Head (years)
X_2 = Gender of Household Head (Male = 1, Female = 0)
X_3 = Marital Status of household Head (Married = 1 Otherwise = 0)
X_4 = Household size
X_5 = Education level of Household Head (Number of years of formal education)
X_6 = Farm size (hectares)
X_7 = Off-farm income activity (if yes =1, otherwise = 0)
X_8 = Credit Access (if yes= 1, otherwise =0)
X_9 = Total monthly income (₦)
e = error term

Based on the above the determinants of food security are specifically represented by equation below;

$$Pi = \Phi_0 + \Phi_1 X_1 + \Phi_2 X_2 + \Phi_3 X_3 + \Phi_4 X_i + \Phi_5 X_5 + \Phi_6 X_6 + \Phi_7 X_7 + \Phi_8 X_8 + \Phi_9 X_9 + U_i \quad (2)$$

Logit model is log-linear models that allow the mixture of categorical and continue independent variables with respect to categorical dependent variable. If the probability of Pro- vitamin A cassava being food secured is $P_i = e^z/1+e^z$ then, $(1 - P_i)$ is the probability of not being secured given by $(1 - P_i) = 1 - e^z/1+e^{zi}$Now $Pi/(1 - P_i)$ is the odds ratio in favor of the event (the ratio of the probability being secure to the probability of not secured). The ratio above is transformed after taking its natural logarithm to give:

$L_i = ln(P_i/1 - P_i) = Z_i = \beta_1 + \beta_2 X_i$.

$X_1 - X_9$ = Explanatory variables which were defined above
$\Phi_1 - \Phi_9$ = coefficient of the binary choice model.

Principal component factor analysis with varimax-rotation and factor loading of 0.50 was used. Variables with factor loadings less than 0.50 and variables that loaded in more than one factor was discarded following the study of Madukwe (2004). The principal component factor analysis model is stated thus:

$$Y_1 = a_{11}X_1 + a_{12}X_2 + * * * + a_1nXn \quad (3)$$
$$Y_2 = a_{21}X_1 + a_{22}X_2 + * * * + a_2nXn \quad (4)$$
$$Y_3 = a_{31}X_1 + a_{32}X_2 + * * * + a_3nXn \quad (5)$$
$$Yn = an_1X_1 + an_2X_2 + * * + anX_n \quad (6)$$

Where,
$Y_1, Y_2 \ldots Y_n$ = observed variables / constraint faced by the Pro-Vitamin A Cassava Farmers

RESULTS AND DISCUSSION

Determinants of Food Security Status and its Intensity of the Pro-Vitamin A Cassava Farming Household

Table 1 shows that the result of testing the similarity of model prediction and observations is the Chi Square value of 53.49 with a probability of error of 0.000, thus model fit. From the maximum likelihood estimates of the model, the Pseudo R^2 was 0.6158 which implies that about 61.58% of

the likelihood of Pro-vitamin A cassava farmer being food secure is strongly explained by the independent variables. Among the nine (9) variables considered in the model, five were found to have significant impact on household food security. They included gender, education, farm size, off-farm income activity and credit access. From the above table the food security of Pro-vitamin A cassava farmer was positively influenced by gender, education, farm size and off farm income. While there is significant and positive relationship between the gender and the food security of the Pro-vitamin A cassava farmers, with a positive marginal effect (dy/dx=0.1737909). This implies that gender of the household head determine the food security status of the household. The expected odd ratio of gender is equal to 2.097504 which indicate that the male-headed households have 2.10 times chance to be food secure compared to female-headed households. Similar results were found by Felker-Kantor, Erica, and Wood (2012). They revealed that the odds of food security are higher among male-headed households compared to female-headed households.

The educational status of Pro-vitamin A cassava farmers was statistically significant at 1% and positively related with a positive marginal effect (dy/dx =0.0217957). The positive signs of marginal effects increase the probability of being food secure. The finding of positive association between education of and food security is consistent with Chinnakali *et al.* (2014). Education greatly affects a person's receipt of the information. People who have higher education tend to choose nutritious, safe, and healthy foods that will encourage the achievement of household food security. The higher one's education, the more employment options can be selected. Educational status is also an important determinant of food insecurity as the higher the educational qualification of heads of household the less severe is the food insecurity situation.

Farm size was positively and significantly related to the probability of Pro-vitamin A cassava farmers been food secure. Farm size is significant at 1% with a positive marginal effect (dy/dx =0.0890513).The positive signs of marginal effects increase the probability of been food secured. The odds ratio in favour of food security increases by the factor 1.474202 when the area under cultivation is increased by one hectare. This outcome is consistent with the findings from a research conducted by Bogale (2012). It is however contradictory to the finding by Sikwela (2008) who found farm size to be negatively related to food security.

The coefficient of off farm income was positive indicating that there is a positive relationship between off farm work and food security. Off farm work is significant at 1% with a positive marginal effect (dy/dx =0.0000109). The positive sign of marginal effects for off-farm income increase the probability of being food secure. Households diversify their incomes by working as daily labourers, petty traders, artisans, and by working as daily construction labourers. Off-farm income generating activities have a paramount significance to diversify the sources of farm households' livelihoods. This result is in line with the findings of Mohammadi *et al.*(2011) who noted that revenue can be an indicator of food security because it determines the amount of food that can be purchased by a household.

Credit access was found to be significant and positively related to food security in the study area with a positive marginal effect (dy/dx =0.1384095). Farmers' access to credit will increase the food security status of his/her household by the factor 1. 839474. This may be due to the fact that households which have the opportunity to receive credit would build their capacity to produce more through the use of improved seeds and the adoption of improved Pro- vitamin A cassava technologies. This finding is also consistent with the findings of Bogale and Shimels (2009).

Constraints Faced by the Pro-Vitamin A Cassava Farmers

In Table 2, Factor analysis was employed to identify the principal component analysis on constraints faced by the Pro-vitamin A cassava farmers in the study area. The rotated component matrix, sometimes referred to as the loadings/Eigen values, is the key output of the Principal Component Analysis. It contains estimates of the correlations between each of the variables and the estimated components. The factor loadings or Eigen values is a measure of the explained variances of the constraints faced by the Pro-vitamin A cassava farmers. The cut off point for factor loadings/Eigen value was '0.50' following Madukwe (2004). Therefore, factor loadings/Eigen values less than 0.50 or variable that load in more than one factor were discarded.

Nine factors/Principal Components were extracted based on the responses of the respondents. The Kaiser criterion was employed for selecting the number of underlying factors or Principal

Components explaining the data. The number was decided by leaving out components/loadings with corresponding Eigen values of less than 0.50. Only variables with factor loadings of ≥0.50 were used in naming the factors/Principal Components. Variables that have factor loadings of < 0.50 were not used while variables that loaded in more than one constraint were also discarded.

The loadings/Eigen values under factor 1 were; Wind/storm (.511*), Insufficient supply of cassava cuttings (0.536*), poor soil (0.504*), access to credit (-0.913*), access to land (-0.832*), Disagreements among farmers (-0.713) and high cost of labour (-0.632*). The loadings/Eigen values under factor 2 were Invasion of farm by grazing animals (0.734*) and Cultural inhibition (0.705*). The third factor include Drought (0.744*), Disease/pest (0.793*) and Inadequate fertilizer supply (0.571). The fourth factor was Bush fire (-0.572), Scarce labour (0.694*) and Insufficient credit facilities (0.704*). The sixth factor was Flood (0.707*). The seventh factor was Insufficient processing facilities (-0.640).

After rotation, the first factor accounted for 19.450% of the variance of the constraints faced by the pro-vitamin A cassava farmers, the second factor accounted for 12.148% of the variances, the third factor accounted for 10.546% of the variance of constraints faced by the pro-vitamin A cassava farmers, the fourth factor accounted for 8.572% of the observed variances, the fifth factor accounted for 7.312% of the observed variances, the sixth factor accounted for 5.986% of the observed variance, the seventh factor accounted for 5.554% of the observed variances, the eighth factor accounted for 5.059% of the observed variances and the nine factor accounted for 4.8469% of the observed variances. The nine factors explained 79.474% of the variances constraints faced by the pro-vitamin A cassava farmers.

CONCLUSION AND RECOOMENDATIONS

The greatest problem of the world in recent times has remained the reduction or elimination of hunger and poverty and malnutrition as related to Vitamin A, is a devastating problem not only to its people, but also to its security and economy. Based on the findings from the study, it is imperative to conclude that majority of the pro vitamin A cassava farming households food security were influenced by some determinants such as gender, education, farm size and credit. The constraints faced by the Pro-Vitamin A cassava farmers includes access to land, high cost of labour value, access to credit, disagreements among farmers, poor soil , drought, insufficient processing facilities, scarce labour, disease/pest value, insufficient credit facilities, bush fire and invasion of farm by grazing animals Therefore, the study therefore recommends that farmers should leverage on farming more hectares with minimal inputs to grow their productivity which in turn will sustain their food security status.

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Table 1: Estimates of the determinant of household food security

Parameter	Coefficient	Odds Ratio	Std. Error	Z	P>|z|	Marginal effect (dy/dx)
Age (X_1)	.0169462	1.017091	.0113026	1.50	0.134	0.0038882
Gender (X_2)	.740748	2.097504	.2590911	2.86***	0.004	0.1737909
Marital status (X_3)	-.0747107	.9280119	.2573583	-0.29	0.772	-0.0171542
Household size (X_4)	.0061011	1.00612	.0410899	0.15	0.882	0.0013999
Education (X_5)	.0949933	1.099651	.0327835	2.90***	0.004	0.0217957
Farm size (X_6)	.3881166	1.474202	.1562961	2.48**	0.013	0.0890513
Off farm income (X_7)	.0000474	1.000047	.0000125	3.78***	0.000	0.0000109
Credit (X_8)	.6094796	1.839474	.2602887	2.34**	0.019	0.1384095
Farm income (X_9)	1.62e-06	1.000002	1.41e-06	1.15	0.250	3.71e-07
Intercept	-4.023588		2.255503	-4.31***	0.000	
LR chi2(9)	53.49					
Prob > chi2	0.00000					
Log likelihood	-204.22982					
Pseudo R^2	0.6158					

Source: Field survey (2020) + lead equation, *** Significant at 1%, ** Significant at 5%,*significant at 10%.

Table 2: Principal component Analysis on constraints faced by the Pro-vitamin A cassava farmers

Constraints	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9
Drought	-.075	.383	.744*	.133	.128	-.264	.088	.032	-.262
Flood	.155	-.311	.116	.057	.155	.707*	.202	-.014	.304
Wind/storm	.511*	.211	.198	-.174	-.249	-.066	.152	.272	.468
Disease/pest	.048	.165	.793*	-.173	.322	.252	-.113	-.017	-.014
Theft of produce	.395	.322	.472	.037	.123	.310	-.141	-.363	.058
Bush fire	-.150	-.311	.016	-.572*	.208	-.279	.363	.322	-.086
Communal/religious crisis, etc	.387	-.117	-.355	-.022	.447	-.173	-.045	-.265	.014
Invasion of farm by grazing animals	.102	.734*	.007	.040	-.114	.120	.352	-.030	-.327
Producers price fluctuation	.199	-.030	-.177	.287	.417	-.054	-.235	.337	.237
Insufficient supply of cassava cuttings	.536*	.032	-.496	-.448	-.215	-.006	-.103	-.046	.069
Poor soil	.504*	.494	-.386	.310	.018	.183	.106	.199	-.243
Lack of spraying equipment	.497	.404	-.053	.061	.442	.076	.094	.256	.266
Inadequate supply of chemicals	-.033	-.457	-.005	-.015	-.177	.427	.361	.134	-.416
Inadequate fertilizer supply	.121	-.441	.571*	.221	-.037	-.368	-.194	.036	.020
Scarce labour	.130	-.033	.018	.694*	-.122	-.296	.472	.037	.206
Insufficient credit facilities	.128	-.356	-.099	.704*	.264	.072	-.029	.232	-.227
Insufficient processing facilities	-.048	.131	-.003	.116	-.401	.243	-.640*	.452	-.097
Unstable government policy	.225	.355	.011	-.427	.448	-.081	.003	.369	-.205
Cost of technology adoption	-.215	.007	.339	-.081	-.453	.052	.190	.395	.209
Access to credit	-.913*	.097	-.097	.015	.185	.017	-.090	.111	-.031
Access to land	-.832*	.351	-.131	.067	.088	.091	.102	-.057	.234
Cultural inhibition	.103	.705*	-.103	.150	-.307	-.206	-.101	-.095	-.025
Disagreements among farmers	-.713*	.097	-.097	.015	.385	.017	-.090	.211	-.031
High cost of labour	-.632*	.451	-.231	.067	.088	.091	.302	-.057	.434

*Cut off point for factor loadings/Eigen. Extraction Method: Principal Component Analysis. 9 components extracted

Table: 3: Total variance explained on constraints faced by the pro-vitamin A cassava farmer

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Drought	4.668	19.450	19.450	4.668	19.450	19.450
Flood	2.916	12.148	31.599	2.916	12.148	31.599
Wind/storm	2.531	10.546	42.145	2.531	10.546	42.145
Disease/pest	2.057	8.572	50.717	2.057	8.572	50.717
Theft of produce	1.755	7.312	58.029	1.755	7.312	58.029
Bush fire	1.437	5.986	64.015	1.437	5.986	64.015
Communal/religious crisis, etc	1.333	5.554	69.569	1.333	5.554	69.569
Invasion of farm by grazing animals	1.214	5.059	74.628	1.214	5.059	74.628
Producers price fluctuation	1.163	4.846	79.474	1.163	4.846	79.474
Insufficient supply of cassava cuttings	.936	3.901	83.375			
Poor soil	.771	3.214	86.589			
Lack of spraying equipment	.691	2.881	89.470			
Inadequate supply of chemicals	.545	2.272	91.743			
Inadequate fertilizer supply	.465	1.936	93.678			
Scarce labour	.402	1.675	95.353			
Insufficient credit facilities	.291	1.214	96.567			
Insufficient processing facilities	.239	.996	97.562			
Unstable government policy	.195	.813	98.376			
Cost of technology adoption	.133	.553	98.928			
Access to credit	.102	.424	99.353			
Access to land	.092	.382	99.735			
Cultural inhibition	.064	.265	100.000			
Disagreements among farmers	9.048E-16	3.770E-15	100.000			
High cost of labour	2.506E-17	1.044E-16	100.000			

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Determinants of Crop Farmers' Adoption Decision of Improved Climate Change Adaptation Strategy in Anambra State, Nigeria: A Binary Logistic Regression Analysis

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ABSTRACT
This study analyzed the determinants of crop farmers' choice and adoption decision of improved climate change adaptation strategy in Anambra State Nigeria. Multi-stage sampling technique was employed to select 100 crop farmers using a well-structured questionnaire. The data were analyzed using both descriptive and inferential statistics; such as logit regression model. The result revealed that market access to crop farmers, access to training related to climate change issues and annual income from farming significantly influenced their adoption of climate change adaptation strategy. The study recommended encouragement of crop farmers in the use more improved climate change adaptation strategy, as well as teaching female crop farmers the use of these relevant improved climate change adaptation strategy and provision of training related to climate change issues at a subsidized rate for the crop farmers by extension agents.
Keywords: determinants, crop farmers' choice, adoption decision, improved climate change adaptation strategy, Anambra state, Nigeria, binary logistic regression analysis.

INTRODUCTION
The concern about the impact of climate change on sub-Saharan African agriculture stems from its potential to undermine the local economy and livelihoods in farming communities heavily depend on crop production for food and incomes (Chete, 2019). The seasonality of most agricultural activities and limited use of inputs in Africa, make it especially vulnerable to weather or climate-related challenges across the various stages of the production cycle (Bonued, 2022). Sub-Saharan Africa suffers disproportionately from climate change due to its huge dependence on rain-fed agriculture and inadequate adaptive capacities for anticipating these events and attenuating their impacts (Adimassu & Kessler, 2016). The impacts could be measured in terms of effects on crop growth, availability of soil water, health and availability of farm labour, soil fertility, soil erosion, incidents of pests and diseases, and sea-level rise (Tandzi 2019).

Climate change refers to a change in climate which is attributed directly or indirectly to human activities, that alters the composition of the global atmosphere and which is in addition to natural variability observed over comparable time periods (IPCC, 2014). Climate change is used to describe a systemic change in the key dimensions of climate including average temperature, wind and rainfall patterns over a long period of time (IPCC, 2007). Climate change is a global phenomenon that results in global warming, droughts, flooding and depletion of natural resources (Adepoju,

Yusuf, Omonona, & Okunmadewa, 2011).

According to Ibe and Amikuzuno (2019), Africa is one of the continents worst hit by climate change with an increase in severe droughts, floods and storms expected to threaten the health of populations and economies. In the same vein, Chen et al. (2018) noted that extreme climate events such as droughts and heavy rainfall are becoming more frequent over the last decades, especially in areas such as Sub-Saharan Africa. Developing countries are highly vulnerable toclimate change since their economy predominantly relies on rain-fed Agriculture that totally depends on natural factors. Traditional farming systems practised, which have low technological capacity, cannot help to adapt and mitigate drastic climate change (Awe, Olarewaju, Fatoki & Ogunsola, 2018). The harsh seasonal variations in rainfall and temperature that have come as a result of climate change expose farmers, mostly those in rural areas, to intense risks and this, in turn, has a major bearing on the production outcome. Considering the fact that a larger proportion of the local population in Nigeria operates under rain-fed agriculture, rainfall and temperature variations have severe implications on production (Asiga, 2013).

Nigeria has to adapt to the expected impacts of anticipated climate change, this makes adaptation the major response option to climate change in the nation (Oladipo, 2010). Small scale farmers, who constitute the bulk of the poor in Africa and especially Nigeria, face prospects of tragic crop failures, reduced agricultural productivity, increased hunger, malnutrition and diseases (Descheemaeker, Reidsma&Giller,2021). It is projected that crop yield in Nigeria may fall by 10-20% by the year 2050 or even up to 50% due to climate change (Jones & Thornton, 2021). There is thus need for crop farmers to engage in improved climate change adaptation strategies and as such the research question suffices: what are the determinants of crop farmers' choice and adoption decision of improved climate change adaptation strategy in Anambra state, Nigeria. The study analyzed determinants of crop farmers' choice and adoption decision of improved climate change adaptation strategy in Anambra state, Nigeria.

METHODOLOGY

The study was conducted in Anambra State. It is located in the Southeast geopolitical zone of Nigeria. The state is located between latitudes $5^{0}40^{1}$ North and $6^{0}48^{1}$ North and between longitudes $6^{0}35^{1}$ East and $7^{0}30^{1}$ East. The state is bounded by Rivers State to the west, Imo State to the south, Enugu State to the east and Kogi State to the North. It has a land area of about 4,4 15.54 square kilometers (Anambra State Government, 2007) and a population of 4,182,032 (NPC, 2006). The state has twenty-one local government areas (LGAs) grouped into four agricultural zones namely: Anambra zone; Awka zone; Aguata zone and Onitsha zone. Agriculture, therefore, remains a major source of employment especially in the areas where the economy is still at subsistence level. The predominant food crops grown in the state include yam, cassava, maize, cocoyam and vegetables.

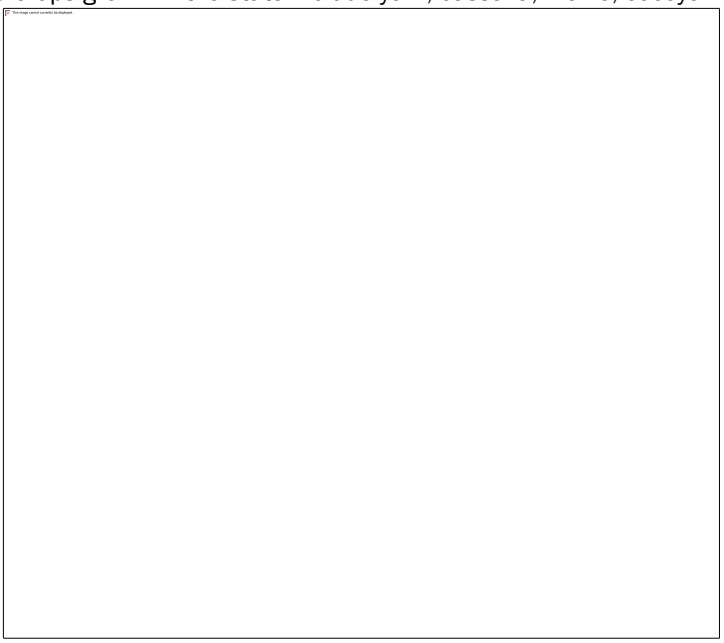

Figure 1: Map of Anambra State Source: (Akinjeye, Ogunjobi and Okogbue 2012)

Table 1: Distribution of the local government areas according to Agricultural zones

Anambra zone	Awka zone	Aguata zone	Onitsha zone
Oyi Ayamelum	Awka North	Aguata	Ekwusigo
Anambra-East	Awka South	Orumba	Ogbaru Ihiala
Anambra West	Njikoka	south	Onitsha South
	Dunukofia Aniocha	Orumba North	Onitsha North Idemili
		Nnewi south	North Idemili South
		Nnewi north	

Source: Anambra State Agricultural Development Programme (ANADEP) Report, 2007

Sampling Procedure

The sampling centered on all the four agricultural zones in the state. A multistage random sampling technique was adopted in the research. At the first stage, five Local Government Areas were randomly selected from the zones Awka, Aguata, Anambra and Onitsha zones. One local government area each was randomly selected from Awka zone, Aguata zone and Anambra zone while two local government areas were selected from Onitsha zone (due to large population of this zone). The second stage involved a random selection of two autonomous communities in each of the sampled local government areas which gave a total of ten (10) communities for the study. In the third stage, ten (10) crop farming households were selected from each of the ten communities already sampled. The list of the crop farming households was gotten from Anambra State Agricultural Development Programme (ANADEP). In all, a total of 100 crop farm households were selected and the questionnaires were administered to them. Primary data were used for this study. The data were collected using a set of pre-tested structured questionnaire coupled with interview schedule. Data collected were analyzed using logit regression model.

Model Specification

Binary Logistic Regression Models

Binary logistic regression model was the main analytical techniques used in this study. The Binary logistic regression model was used to analyze the relationship between the socio-economic characteristics and farmers' adoption decision of adaptation strategies to climate change. In accordance with studies by Nelson, Mensbrugghe, Ahammad, Blanc, Calvin, Hasegawa, Havlik, Heyhoe, and Lotze Campen, (2014), the dependent variables (Adoption of adaptation strategies) were binary and their values were 1 for a farmer who used at least one of the listed strategies and 0 for a farmer who used none for this study. This was done to distinguish between farmers who adapted and those who did not in the study area. A crop farmer was considered to have adapted to climate change if he/she has employed at least one of the adaptation strategies such as mixed farming, irrigation, early and late planting, use of improved drought-resistant crops, soil and water conservation, income source diversification and mixed cropping. The independent variables that are hypothesized to affect the farmers' adoption of adaptation strategies are combined effects of various factors such as demographic, socioeconomic and institutional characteristics in which farmers operate.

Based on the review of past studies on adaptation strategies the following explanatory variables were considered in this study and examined for their effect in farmers adopting adaptation strategies to climate change (Table 1). The hypothesized independent variables were evaluated for some statistical issues like multi-collinearity. The multi-collinearity issue among the continuous explanatory variables was detected by the variance inflation factor (VIF). The correlation matrix method was also used to detect the degree of association between dummy explanatory variables. When the coefficient correlation matrix is greater than 0.4, the variables are said to be collinear. If the correlation coefficient value is very high (greater than 0.4), it shows the presence of multicollinearity (Mandleni & Anim, 2011).

According to Osuofor and Ude (2021), a binary logistic model specification is employed to model improved climate change adaptation strategies of crop farmers involving dummy dependent variables with binary choices. The logistic distribution function for the decision on adopting adaptation measures to climate change can be specified as (Koutsoyiannis, 1977):

$$Logit\ (p) = \log(\frac{p}{1-p}) \text{.....equ.1}$$

$$let\ Pi = \Pr(\frac{y=1}{X=x1}) \text{.....equ.2}$$

$$pr\ (y = \frac{1}{x}) = \frac{exp x'b}{1+ex'b} = \log(\frac{i}{1-pi}) = Logit\ (pi) = \beta 0 + \beta 1xi \text{.....equ.3}$$

Where; Pi is a probability of deciding to adopt adaptation strategies (dependent variable), xi's are the independent variables, β0 is the intercept and β1 is the regression coefficient. We can write the model in terms of odds as:

$$\frac{pi}{1-pi} = \exp(\beta 0 + \beta 1xi) \text{.....equ.4}$$

Variables hypothesized to affect farmers' adoption decision Variable Description Value Expected sign

Binary Logistic Regression model

Y	=	Crop farmer's adoption decision of adaptation strategies (dummy variable; 1= weather forecasting technologies, supercomputing and use of sensors adoption, 0=otherwise)
X1	=	Number of family members (Number under a roof) (+);
X2	=	Total landholding in hectare (+)
X3	=	Farming experience of crop farmers in years (+)
X4	=	Age of farmers in Years (+)
X5	=	Market access to crop farmers 1 = yes, 0 = no (+)
X6	=	Access to training related to climate change issues (1 = yes, 0 no) (+);
X7	=	Access to climate change information (1 = yes, 0 = no) (+);
X8	=	Access to credit services 1 = yes, 0 = no (+);
X9	=	Member of farmer-based organization 1 = yes, 0 = no (+);
X10	=	Perception of crop farmers on climate change 1 = yes, 0 = no (+); and
X11	=	Annual income from farming in Naira (+).

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

Socio-economic characteristics of crop farmers in the study area were presented in table 1.The socioeconomic characteristics that were discussed were gender, age of the farmer, educational qualification, farming experience, household size, major occupation, farm size and annual income. As shown in Table 1 majority (71.0%) of the respondents were male while only 29.0% were female. This implies that men possibly engaged more in crop farming activities than women in the study area. The average age was 47 years with the oldest being 75 years and the youngest being 26 years. A good proportion (38.0%) of the respondents were within the age range of 41 and 50 years. This implies that crop farmers are still in their active age and will engage in climate change adaptation practices. A fewer proportion (10.0%) of the respondents fall within the age range of 20 and 30 years, 20.0% of them fell within the age range of 31 and 40 years, while 25% of them fell within the age range of 51and 60 years as 25.0% was above 60 years.

Table 1 also revealed that 27.0% of the respondents obtained first school leaving certificate (FSLC), 25.0% obtained O'Level (Senior School Certificate) and its equivalent, 17.0% had National Diploma (ND), and 19.0% had first degree (HND/Bachelor Degree) while 12.0% did not have any formal education. This result shows that majority of the farmers were literate and are likely to have knowledge of climate change and climate change adaptation measures. The average farming experience of the respondents was 15 years, this implies that the crop farmers are well experienced and are likely to have experienced climate change effect to crop production. Hassan (2008) also indicated that experience in farming increases the probability of uptake of adaptation measures to

climate change. Thirty-eight (38.0%) of the respondents had farming experience between 11 and 20 years, 31.0% had less than or equal to 10 years farming experience, 20.0% had 21 and 30 years of farming experience. This result implies that the crop farmers in Anambra State are well experienced and have good knowledge of farming and climate change.

The average household size in the study area was six persons per household. Majority (47.0%)of the households had between 6 and 10 persons. This larger household size may be an advantage to be used for farming activities and may also assist the farmers in adaptation strategies. Also, 44 .0% of the respondents had less than 5 persons as household size, 6.0% had between 11 and 15 persons while only 3.0% had 16 persons and above. Slightly above average proportion (55.0%) of respondents had farming as their major occupation; this shows that farming is the major occupation of the respondents; 18.0% were civil servants, 14.0% were traders and 13.0% were artisans.

Table1: Frequency Distribution of Respondents by their Socioeconomic Characteristics

Socio-economic characteristics	Frequency	Percentage (N=100)	Mean
Sex			
Male	71	71.0	
Female	29	29.0	
Age of farmers (Years)			
20-30	10	10.0	
31-40	20	20.0	
41-50	38	38.0	
51-60	25	25.0	
60-80	7	7.0	47 years
Educational qualification			
No formal education	12	12.0	
FSLC	27	27.0	
O'Level (SSC)	25	25.0	
ND	17	17.0	
B.Sc/HND	19	19.0	
Farming experience (Years)			
≤10	31	31.0	
11-20	38	38.0	
21-30	20	20.0	
31-40	9	9.0	
41-50	2	2.0	15years
Household size (Number)			
≤5	44	44.0	
6-10	47	47.0	
11-15	6	6.0	
≥16	3	3.0	6 persons
Primary occupation			
Farming	55	55.0	
Trading	14	14.0	
Artisans	13	13.0	
Civil servant	18	18.0	
Farm size (Hectare)			
0.1-2.39	58	58.0	
2.40-3.9	20	20.0	
≥4	22	22.0	2.538 ha
Annual farming income (₦)			
≤100,000	16	16.0	
100,001-400,000	46	46.0	
400,001-700,000	28	28.0	
700,001-1000,000	9	9.0	
≥1,000,001	1	1.0	₦357,680.05

Source: Field Survey, 2021.

Majority (58.0%) of the farmers had 4hectares and above. According to Ijere (1981), small-scale farms range between 0.1-2.39ha, the medium-scale between 2.40-3.9, and large-scale farm above 4ha. Since the majority had 2.39ha and below, it implies that the crop farmers were more small scale farmers. The average annual farming income was ₦357,680.05 with high proportion (46%)

had between ₦100,001 to ₦400,000 per year. 28 % of the crop farmers had between ₦400,001 to ₦700,000, 16% had ₦100,000 and below, 9% had between ₦700,001 to ₦1,000,000 while 1% had above ₦1000,001.

Factors Influencing Farmers' Adoption of Climate Change Adaptation Strategies

Binary logistic regression was conducted to determine the influence of the 11 variables considered in the model. The probability of the model Wald chi-square (X^2 29.101 at p-value 0.000) was found to be significantly associated with observed individual crop farmer variables related to implementing adaptation strategy and model prediction. The p- value (p 0.000) implies that a well-fitting model is significant at the 1% level, hence, Hosmer and Lama show Test p-value (p = 0.873) is in the acceptable value signifying a well-fitting model. Table 2 presents logistic estimates of the determinants of farmers' adoption of an adaptation strategy to climate change. Among the eleven independent variables considered in the binary logistic regression model, three variables were found significant at 5% alpha level that influences farmers' adoption of climate change adaptation strategy. These are annual total farm income, access to training related to climate change issues and market access which were significant at 1% and 5% confidence level. Similarly, the majority of interviewed key informants reported that there are several determinant factors that affect farmers' adoption of adaptation strategies. These are access to climate change information, annual farm income and market access, and access to training in climate change-related issues. However, land size of crop farmer's, crop farmer's' age, perception of climate change, family size, farming experience, number of farmer-based organization, access to credit and access to training on climate-related issues were found statistically insignificant (p > 0.05) factors. The logistic regression coefficients showed that a change in the log-odds resulted in a one-unit increase in the predictor variable. Thus, analyses of statistically significant explanatory variables and the finding from this study are consistent with other findings as discussed below.

The results showed that a statistically significant (coefficient 0.692, p = 0.006; odd ratio: 0.265) positive association between annual farm income and farmers' adoption of adaptation strategy. This indicates that a unit (by 1 Naira) increase in total annual farm income increased farmers' probability to adopt a climate change adaptation strategy by a factor of one. These results are in agreement with Ejechi, Onu, Muogbo, & Aboajah (2016). In both studies, a positive significant association was obtained between the adoption of climate change adaptation strategies and income level. This indicates that farmers that have better yearly income have more chance to adopt climate change adaptation strategies than farmers with less income.

Table 2. Logit regression of factors determining the adoption of improved climate change adaptation strategies

Variables	Coefficient	Standard error	Wald	Odd ratio	*p* value
Number of family members	-0.037	0.036	0.842	0.329	0.953
Total landholding	-0.052	0.204	0.043	0.835	0.929
Farming experience of crop Farmers	-0.171	0.103	1.044	0.347	0.835
Age of farmers	-0.773	0.722	1.075	0.360	0.411
Market access to crop farmers	0.020	0.034	0.446	0.576	0.040**
Access to training related to climate change issues	0.052	0.005	4.612	0.062	0.030**
Access to climate change Information	-0.630	0.476	2.165	0.182	0.701
Access to credit services	1.167	0.535	4.235	0.051	3.750
Member of farmer-based Organization	1.071	0.516	4.541	0.056	0.636
Perception of crop farmers on climate change	-0.286	0.467	0.325	0.584	0.751
Annual income from farming	0.692	0.584	1.226	0.265	0.006***
Constant	2.234	1.213	3.424	0.062	9.120

Source: computed from field survey, 2021. Notes: *significant at p < 0.05; Log likelihood. 389.101; Omnibus tests of model coefficients (Chi^2:29.101 and p 0.000); Hosmer and Lemeshow Test (Chi^2: 23.828, df 8, p 0.873); Pseudo R2 = 67.93; Cox and Snell R^2 0.570; Nagelkerke R^2: 0.539).

The results also revealed that access to training related to climate change issues (coefficient

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=0.052; p 0.030; Odd ratio: 0.062) had a positive and significant factor. This indicates that farmers having access to training related to climate change issues were appeared to have a higher probability to adopt adaptation strategy than farmers without access to training related to climate change issues. This is due to the fact that access to training related to climate change issues increases farmers' awareness and knowledge of the changing rainfall and temperature patterns as well as the possible climate change response strategies. This result is consistent with the findings of Akinseye, Ogunjobi, and Okogbue (2012) who found a positive relationship between access to climate change information and the adoption of adaptation strategies to climate change and variability in Nigeria. Similar resulted were reported by Agesa, Onyango, Kathumo, Onwonga and Karuku (2019) in sub- Saharan Africa. This implies that farmers with access to training related to climate change issues and related extension services are highly likely to adopt adaptation strategies to climatic change.

The binary logistic regression model revealed that market access had a significant (coefficient 0.020; p= 0.040; Odd ratio: 0.576) positive impact on farmers' adoption of adaptation strategy to climate change. In this study, farmers with market access were appeared to have 0.58 times higher probability to adopt adaptation strategy than farmers without access to the market. The results are similar to the conclusions by Enete and Onyekuru (2011) who reported a decrease in the tendency of farmers to adopt climate change strategies as markets get further from their neighborhood because markets are the platforms through which farmers share information and goods in Africa. As stated by Amusa (2010) market access is an important factor that significantly affects farmers' technology adoption by farmers. Antwi-Agyei, Stringer and Dougill (2014) also indicated that accessibility of markets creates an opportunity for farmers to grow cash crops and thereby enhancing their income and capacity to cop-up climate change variabilities. This also indicates that farmers with easy access to different drought resistance seed varieties and irrigation technologies in the market are highly likely to accept adaptation strategies.

CONCLUSION ANDA RECOMMENDATIONS

The study also concludes that market access to crop farmers, access to training related to climate change issues and annual income from farming significantly influenced their adoption of climate change adaptation strategy.

Based on the findings of this study the following recommendations were made, which have some policy implications:

a) Male farmers are to be encouraged by extension agents to use more improved climate change adaptation strategy, and they can in turn teach the female farmers the use of these relevant practices, which symbolise farmer-to-farmer paradigm in adoption of agricultural practices.
b) Provision of training related to climate change issues should be enhanced by extension agents
c) Also, improved climate change adaptation strategy like weather forecasting technologies, supercomputing and use of sensors are to be encouraged among the crop farmers in the study so that flood can be mitigated and their income enhanced.

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Economics of Tomato Production on Ogbuoji Farm, in Edda Local Government Area of Ebonyi State

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ABSTRACT
The study analyzed the economics of tomato production on ogbuoji farm, in Edda local government area of Ebonyi state. The specific objectives were to describe the socio-economic characteristic of tomato farmers, estimate the resource use efficiency in tomato production, identify the constraint associated with tomato production and analyze the profitability of tomato production on Ogbuoji farm. Random sampling was employed to sample 48 respondents who constituted the sample size. Data were collected primarily using structured questionnaire and analyzed with the aid of descriptive, stochastic frontier production function and cost-benefit ratio. The results showed that young farmers were single, educated, experienced and fairly large scale farmers. Price of labour (1%), price of seeds (5%), price of irrigation (5%), price of capital (1%), price of fertilizer (10%), price of stock (10%) and farm size (1%) were the major predictors of production but Seed and labour resources was effectively utilized. Pest and diseases greatly constrained the farmers in the production of tomatoes in the study area. The study therefore recommended that all the resource variables must be considered when designing a technological package for tomato production and should be further exploited to improve productivity level of the farmers in the study area.

Keywords: Resource efficiency, Tomato, Tomato production, Ogbuoji farm

INTRODUCTION
Tomato is globally cultivated for its fleshy fruits and is known as a protective food because of its special nutritive value and its widespread production (Ajibare et al., 2022. Tomatoes are eaten directly as raw vegetables or consumed in a variety of processed products like ketchup, sauce, chutney, juice, diced, soup, paste, puree, etc. It is a rich source of vitamins A and C, and it also contains minerals like iron, phosphorus and is the richest source of nutrients, dietary fibers, antioxidant like lycopene and beta-carotene, compounds that protect cells from cancer (Punit and Arindam, 2019).

Tomato was originated from Southern and Central America; it is known to be a native of Brazil. The current the scientific name of tomato is Solanum lycopercicum, it belongs to vegetable family called Solanaceae. The total output world production capacity of fresh tomato fruit in 2021 was about 186.107,972 metric tonnes with China accounting for 37% of global production, India is ranked the second (Ajibare et al., 2022) Other countries that are also leading in tomato production are the United States of America, Turkey, Egypt, Iran, and Italy (Oishimaya,2017; Kushwaha, 2018). Aminu and Sadi (2020) reported that Nigeria is now considered the 14th largest producer of tomato in the world and second to Egypt in the African continent, producing a total of about 1.51 million metric tons of tomato, which is valued at ₦ 87.0 billion, cultivated on a land area of 254,430 hectares in Nigeria, the recorded drop in the production level of tomato from 6 million tons down to 1.86 million

tons and subsequently to 1.51 million metric tons which have now resulted to its scarcity and this may be as a result of low return on investment in the tomato production due to high risk involved, unplanned production process and distribution network problems (FAO, 2010). Nigeria is an agrarian country with about 70 percent of the population engaged in agricultural production (Yusuf 2020).

Resource use efficiency can be defined as the ability of a farm firm to derive maximum output per unit of resources used in the line of the production cycle. The efficiency of resource use and its predisposing determinant factors is important for guiding any decision-making that makes farm business planning better (Muhammad-Lawal et al., 2013). Efficiency in general terms has a link with and it is associated with the possibility of attaining an optimal level of total output from a given bundle of production inputs at least cost combination (Guta et al, 2020). Understanding the level of resource use efficiency and its predisposing factors is particularly of high policy relevance for tomato production, a crop that has recently gained prominence and popularity in terms of poverty alleviation and food security of farming households in Nigeria (Tilaye, 2010). To ensure maximum profit level and efficiency of resource use, a farmer must utilize the available resources at hand to the level where their marginal value product (MVP) is equal to their marginal factor cost (MFC) under perfect competition. The efficiency of a resource is determined by assessing the ratio of MVP of inputs (based on the estimated regression coefficients) and the marginal factor cost MFC (Kafle and Shresth, 2017). Inefficiency in the use of available resources according to (Idah, 2007) has prevented the ability of farmers to increase the level of food production resulting in low income of farmers all over the nation.

However, the efficiency of tomato production is often affected by disparities in access to resources such as land, credit, inputs, and labour (Umeh, et al., 2021). Ayinde et al., (2013a) opined that, it is of importance to have strategy to put farmers concerns and experiences at the centre of research design, implementation, monitoring, and evaluation.

Tomato production is a critical component of smallholder farming systems, contributing significantly to food security, income generation, and agricultural development in Nigeria. Despite its importance, the productivity of tomato farming in many regions, including Edda Local Government, Ebonyi State, remains suboptimal. This challenge is attributed to inefficiencies in the use of key production resources such as land, labor, capital, and inputs. Studies have shown that resource use inefficiency is a common issue in Nigerian agriculture, often resulting from limited access to improved technologies, inadequate knowledge of best practices, and infrastructural deficits (Umeh, et al., 2021). Efficient utilization of resources is crucial for enhancing productivity and profitability in tomato production. However, empirical evidence on the resource use efficiency of tomato farmers in Edda Local Government is scant. Previous studies in other regions suggest that inefficiencies in resource use are influenced by socio-economic factors, access to credit, and extension services, as well as market dynamics (Yakubu et al., 2019; Adetunji & Rauf, 2020). It is with this concern that this study embark in assessing the profitability of tomato production in Ogbuoji farm, in Edda Local government Area. The specific objectives were to:

a) describe the socio-economic characteristic of tomato farmers onObuoji farm;
b) estimate the resource use efficiency in tomato production on Ogbuoji farm;
c) identify the constraint associated with tomato production on Ogbuoji farm;
d) analyze the profitability of tomato production on Ogbuoji farm.

METHODOLOGY

This study was conducted in Obuoji farm, in Edda Local Government Area of Ebonyi State. Ogbuoji farm lies about 2.5 km along the Owutu–Ogbu Edda Road, next to the Anyebe Stream It is located on the eastern margins of the Benue Trough in the Afikpo Basin [NIPC, 2023]. Edda Local Government Area (LGA), also known as Afikpo South, is located in Ebonyi State, Nigeria. Administratively, it's designated as Afikpo South LGA by the Nigerian government, but is referred to as Eddaland by its inhabitants. Eddalands are characterized by their shared language, culture, and traditions, making it a highly homogeneous LGA. The LGA's headquarters is located in Nguzu. Edda LGA Experience a distinct dry and rainy season with temperatures ranging from 16°C to 38°C.

The study made use of survey research design. Out of a total population 55 workers at Ogbuoji farm, the study randomly sampled 48 workers and their opinions on issues concerning the impact of revenue generation on rural development were taken. A well structured questionnaire was used to collect the data from respondents.

Objective one (1) and three (3) was analyzed using descriptive statistics such as tables, frequency and percentage. Objective two (2) was analyzed using stochastic frontier production function model and resource use efficiency method. Stochastic frontier production function was used to empirically estimate the resource efficiency of the tomato enterprise.
The model is specified as:

$$In\pi^*B=In\beta_0^*+\beta_1^*Inq_1+\beta_2^*Inq_2+\beta_3^*Inq_3+\beta_4^*Inq_4+\beta_5^*Inq_5+\beta_6^*Inq_6+\beta_7^*Inq_7+\beta_8^*Inq_8+Vi-U \quad (1)$$

Where;
π^*B = Normalized profit (in ₦ per basket of tomato)
q_1= price of labour
q_2= price of seeds
q_3= price of irrigation
q_4=price of capital inputs
q_5= price of fertilizer
q_6= price of Stock
q_7=farm size (hectare of tomato farm)
q_8= annual depreciation on durable capital items
Vi =Normal random error assumed to be independent and identically distributed
Ui= Non negative random variables associated with the resource efficiency of the respondents

The Resource-use efficiency, stated a:

$$r = MVP/MFC \quad (2)$$

Where MVP = Marginal value product of a variable input; MFC = Marginal factor cost; r = Efficiency ratio.

The MVP was estimated as follows:

$$MVP = MPP.PY \quad (3)$$

Where PY = Price of output, and MPP is the marginal physical product.

The decision rule implies that; if r =1, resources are efficiently used. If r > 1, resources are underutilized, if r<1, resources are over utilized.

Objective four (4) will be analyze using cost-benefit ratio, which is specified as:

NR = TR-TC
RoI= TR/TC

Where NC= Net returns, TR= Total revenue, Tc= Total cost, ROI= Return on investment

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Tomato Farmers

Results from Table 1 showed that majority (66.67%) of the respondents were between the ages of 31-40 years old. By implication, most of the farmers were within the middle age groups, energetic, productive and rational decision makers within the farm organization (Emenyonu *et al,* 2010). 58.33% of the respondents were single, while 37.5% of them were married. Nwigwe et al (2020) who opined that married farmers are more responsible and equipped to engage in improved farming practices that will translate to better income. 95% of the respondents in the study area had one form of education or another. 41.67% of the respondents had stayed in the farming between at least 9 years. Enemosah et al (2022) stated that the more experienced a farmer is, the more efficient he/she will be in decision-making processes and he/she would be willing to take risks associated with adoption of innovations. Majority (95.83%) of the respondents agreed that the tomato farm size was between 7-9 hectares. Major source of water in the study area for the tomato production is that from borehole with 79.17 percent of the farmers affirming to it. 75% of the respondents confirmed the adoption the drip type of irrigation. 83.33% of the respondents sourced

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there tomato seedlings through seed companies and 83.33% of the respondents agreed that tractor was the major type of farm machinery used in the farm.

Table 1: Socioeconomic characteristics of the tomato farmers

Socioeconomic characteristics	Frequency	Percentage (%)
Age of respondents (years)		
< 30	8	16.66
31 – 40	32	66.67
41 – 50	5	10.42
Above 50	3	6.35
Total	48	100.0
Marital status		
Single	28	58.33
Married	18	37.50
Separated	2	4.17
Total	48	100.0
Educational qualification		
No formal education	2	4.17
FSLC	10	20.83
ND	20	41.67
BSC/HND	16	33.33
Total	48	100.0
Farming Experience (years)		
1 – 3	10	20.83
4 – 6	17	35.42
7 – 9	20	41.67
Above 10	1	2.08
Total	48	100.
Size of farm (ha)		
1-3	-	-
4-6	2	4.17
7-9	46	95.83
Above 10	-	-
Total	48	100.0
Source of water		
Rain water	10	20.83
Borehole	38	79.17
River water	-	-
Municipal water	-	-
Total	48	100.0
Type of irrigation		
Manual watering	11	22.92
Drip irrigation	36	75.00
Sprinter irrigation	-	
Furrom irrigation	1	2.08
Total	48	100.0
Source of seed		
Local seeds		- -
Own seed	8	16.67
Agricultural extension	-	-
Seed companies	40	83.33
Total	48	100.0
Types of machinery used		
Tractor	40	83.33
Plough	7	14.58
Harvester	1	2.08
Total	48	100.0

Source: Field survey data 2024

Table 2: Maximum Likelihood Estimates of Parameters of the Stochastic Frontier Production Function for the Measurement Resource Efficiency of Tomato Production

Variables	Parameters	Coefficients
Constant	β_0	1.2267(2.4835)
price of hired labour	β_1	0.1151(2.3772)***
price of seeds	β_2	0.1206(3.0205)**
price of irrigation	β_3	0.2265(2.6301)**
price of capital inputs	β_4	0.0345(0.6841)***
price of fertilizer	β_5	0.1470(2.1110)*
price of Stock	β_6	0.2225(2.6346)*
Farm size	β_7	0.5420(2.1251)***
Annual depreciation	β_8	-0.1549(-1.8201)*
Log-likelihood function		-37.87756
Sigma squared(σ^2)		1.1324(4.2272)***
Gamma ($\boldsymbol{\gamma}$)		0.9667(152.934)***
L-R test		78.1824

Note: ***,** and * implies statistical significance at the 0.01, 0.05 ans 0.10 probability levels respectively. Values in parenthesis are t-ration

Table 2 shows the results of stochastic frontier normalized profit function for the resource efficiency of tomato production enterprise. The estimates of sigma-squared (σ^2) for the tomato function was 4.2272 and it is significant at 0.01 probability levels, indicating that it are significantly different from zero. It assures us of the goodness of fit as well as the correctness of the specified distributional assumptions of the composite error term. The value of the gamma ($\boldsymbol{\gamma}$) is high 0.9667 and it showed that the unexplained variation in the output of tomato is the major sources of random errors. It also indicates that about 96 percent of the variation in output of tomato was caused by inefficiencies of the producers.

The result indicates that the MLE estimate of price of hired labour, capital inputs and farm size were 0.1151 and 0.5420 respectively and was significant at 1% level. This implies that a 1% increase in the use of hired labour, capital and farm size will result in a 0.1151%, 0.0345% and 0.5420% increase in the level of profit. The MLE estimate of price of seeds and irrigation were 0.1206 and 0.2265 and significant at 5% level. This implies that a 1% increase in the use of price of seeds and irrigation will result in a 0.1206% and 0.2265% increase in the level of profit. The MLE estimate of price of fertilizer and stock is 0.1470 and 0.2225 and were significant at 10% level. This implies that a 1% increase in the use of fertilizer and stock will result in a 0.1470% and 0.2225% increase in the level of profit.

Determination of Resource Use Efficiency

Table 3: Determination of resource use efficiency

Inputs	MPP(kg/Unit of input used)	MVP (₦)	MFC (₦)	MVP/MFC	Efficiency
Labour	320	2240	2198	1	Efficiently Utilized
Seeds	30.54	274.86	324.77	1	Efficiently Utilized
Irrigation	22.08	154.56	553.91	0.27	Over-Utilized
Capital inputs	4421	35,368	30233	1.17	Under-Utilized
Fertilizer	300	1200	2920	0.41	Over-Utilized
Farm size	1.05	19.95	13.40	1.49	Under-Utilized

Source: Field survey data 2024

The concept of efficiency indicates the maximum benefits derived from allocation and use of resources. The result in Table 3 showed that the ratio of the marginal value product (MVP) to Marginal factor cost (MFC) was 1 for cost of labour and cost of seeds, and it implies the efficient utilization of these resources due to availability of labour and seeds to carry out farming. The ratio of the marginal value product (MVP) to Marginal factor cost (MFC) was; 0.27 and 0.41 for Cost of irrigation and Cost of fertilizer. This indicates that costs of irrigation and fertilizer were less than 1 implying over-utilization of the resources. While capital inputs and farm size was above 1; 1.17 and 1.49 respectively, indicating under-utilization of both resources. The under-utilization of these resourcesmay due to their unavailability to carry out farmingin the study area. Farmers are still facing problems of inefficiency of resource allocation in the study area.

Constraint Associated with Tomato Production

Table 4: Constraints to tomato production

Variable	Frequency*	Percentage
Pest and diseases	46	95.83
Lack of quality seeds	2	4.17
High input cost	36	75.00
Water scarcity	2	4.17
Access to market	12	25.00

Source: Field survey data, 2024. *= multiple responses

The result on table 4.4 shows that most dominant constraint was the incidence of pest and disease (95.83%) and high input cost (75%). The economic implication is that, since tomato is a perishable commodity, its producers will likely suffer loss from pest and disease attack if it is not discovered quickly.

Profitability of Tomato Production

Table 5 Cost-benefit analysis of tomato

Item	Amount
Fixed inputs	
Land rent	40,561
Cost of machineries	122,433
Depreciation on equipment	4,000
Total fixed cost (TFC)	166,994
Variable inputs	
Cost of seed	41,250
Cost of fertilizer	12,122
Cost of transportation	34,566
Marketing charges	3,344
Labour cost	223,400
Total variable cost (TVC)	**314,682**
Total Cost (TC)	481,676
Total Revenue (TR)	1,670,566
Net Revenue (TR-TC)	1,188,890
Net return on Investment (TR/TC)	3.47

Source: Field survey, 2024

Table 5 shows that the total fixed cost of production per annum was N166,994, the total variable cost of production per annum is N**314,682,** the total cost per annum **N481,676** and the total revenue was given as N1,670,566. The Net revenue which is the annual profit is N1,188.890. The rate of return on investment of N3.47 was obtained by (TR/TC), implying that for every N1 invested yields a profit return of N3.47. Overall, this result shows that tomato production is profitable and is supported by the findings of. Nwigwe *et al*. (2020).

CONCLUSION AND RECOMMENDATIONS

In conclusion, majority of tomato were young farmers are single, educated, experienced and fairly large scale farmers. Price of labour, price of seeds, price of irrigation, price of capital inputs, price of fertilizer, price of stock and farm size were the major predictors of production but Seed and labour resources was effectively utilized. Pest and diseases greatly constrained the farmers in the production of tomatoes in the study area. All these variables must be considered when designing a technological package for this resource and should be further exploited to improve productivity level of the farmers in the study area.

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Precision Agriculture: Reviewing the Problems and Prospects in Precision Agriculture for Improved Crop Productivity and Resource Management

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ABSTRACT
Precision agriculture is an agricultural management concept that seeks to maximize agricultural operations via the use of technology in order to achieve greater levels of efficiency, production, and conservation of resources. It explores the role of sensing technologies, such as remote sensing, ground-based sensors, and GPS/GIS applications, in data collection and analysis for informed decision-making. It investigates the role that a variety of technologies, including global navigation satellite systems (GNSS), geographic information systems (GIS), remote sensing, and sensor technology play in making it possible to implement precision agricultural methods. In addition, it addresses the advantages, disadvantages, and potential future applications of precision agriculture in the context of solving issues related to the sustainability of agriculture and the security of food supplies on a worldwide scale. The article also examines the impact of variable rate technologies, including variable rate seeding, nutrient application, and irrigation, on optimizing input usage and improving crop performance. Furthermore, it discusses the integration of precision crop management techniques, such as remote sensing, artificial intelligence, and the Internet of Things (IoT), in enhancing farming practices. While precision agriculture offers significant benefits, challenges related to cost, accessibility, data management, and education need to be addressed. It is crucial to overcome these challenges to fully harness the potential of precision agriculture for sustainable and efficient food production. By acknowledging and addressing these challenges, farmers and stakeholders can work towards the widespread adoption of precision agriculture, leading to improved crop productivity, resource management, and environmental sustainability.

Keywords: Precision Agriculture, GNSS, GIS, Remote sensing

INTRODUCTION
Precision Agriculture (PA) is the art and science of utilizing advanced technologies such as global navigation satellite systems (GNSS), geographical information system (GIS), remote sensing, spatial statistics, and farm management information systems (FMIS) for enhancing efficiency, productivity, and profitability of agriculture while reducing environmental pollution. Given the projected global population of nearly 10 billion by 2050, there is a pressing need to increase food production by approximately 50% compared to the levels achieved in 2013 (FAO, 2017). Unpredictable factors such as weather, soil conditions, pests, and changing crop conditions influence the dynamic nature of crop growth and its potential outcomes (Phupattanasilp and Tong, 2019). With the increasing global demand for sustainable food production and the need for efficient resource management, the development of Precision Agriculture has emerged as a promising solution. It was developed in the mid-1980s with an objective to enhance crop yield production and quality while simultaneously reducing operational expenses and minimizing environmental pollution (Shikha, 2023) as well as

enhancing the utilization of resources and minimize uncertainties associated with monitoring farm responses to spatial and temporal variations (Gorevlisi and Kekec, 2023). It encompasses a set of tools and technologies that enable farmers to make informed decisions for optimal resource management (Tom, *et al*., 2024). By focusing on the right actions, in the right location, at the right time, and in the right manner, Precision Agriculture strives to maximize efficiency and productivity in farming practices (Franca, et al., 2022).

Precision agriculture (PA) refers to the implementation of hardware and software technologies that enable farmers to make informed and customized decisions about various agricultural activities, including planting, fertilizing, pest control, and harvesting (Dutta *et al*., 2021). Precision agriculture enhances resource allocation efficiency and overall farm management effectiveness (Liaghat and Balasundrsm, 2010). The allocation of energy resources in agricultural production varies significantly depending on the specific activities, production practices, and geographic locations involved, and the increasing reliance on imported energy sources for lubricants and nutrients raises concerns regarding its impact on the agricultural sector (Dhaya and Kanthavel, 2022). Precision Agriculture (PA) offers a paradigm shift towards a safe, sustainable approach, providing numerous benefits in terms of profitability, productivity, sustainability, crop quality, environmental protection, and rural economic development through efficient resource utilization and variability management (Liaghat and Balasundrsm, 2010). The success of precision agriculture lies in its ability to effectively utilize and analyze spatial and temporal data to assess, manage, and evaluate crop production, making it a fundamental principle for sustainable soil and crop management in the modern era (Pierce and Nowak, 1999).

In recent years, precision agriculture has witnessed remarkable advancements, with the application of artificial intelligence (AI) playing a pivotal role. AI has addressed challenges related to climate changes, population growth, employment, and food security while optimizing resource usage and improving crop productivity and quality (Talaviya *et al*., 2020). The advancement of precision agriculture is further supported by the application of blockchain technology, which enables transparent and trustworthy food supply chains, ensuring the traceability and provenance of agricultural products (Xiong et al., 2020). The integration of IoT-based technologies in agriculture, such as sensor networks and automated systems, has also significantly advanced precision agriculture practices. These technologies enable precise monitoring and control of environmental parameters, leading to improved crop quality and quantity in controlled environments like greenhouses. Additionally, IoT-enabled systems in hydroponics and vertical farming optimize resource consumption, enhance production efficiency, and reduce water usage compared to traditional farming methods, further contributing to the advancement of precision agriculture (Dhanaraju *et al*., 2022)

Precision Agriculture

PA is an innovative production system that is accomplished through the measurement of crop production variables coupled with the application of information technologies. Multiple terms have been coined by researchers to describe the application of PA practices to modern farming. The application of PA practices is sometimes termed “precision farming,” “site-specific farming,” “site-specific management,” “spatially variable crop production,” “grid farming,” “technology-based agriculture,” “smart farming,” “satellite farming,” and so on. The National Research Council defined PA as “a management strategy that uses information technologies to bring data from multiple sources to bear on decisions associated with crop production” (Ahirwar et al., 2019). According to Olson (2019), Precision Agriculture is “the application of a holistic management strategy that uses information technology (IT) to bring data from multiple sources to bear on decisions associated with agricultural production, marketing, finance, and personnel.” More simply defined, PA is a farming concept that utilizes GIS to map in-field variability to maximize the farm output via optimal use of inputs.

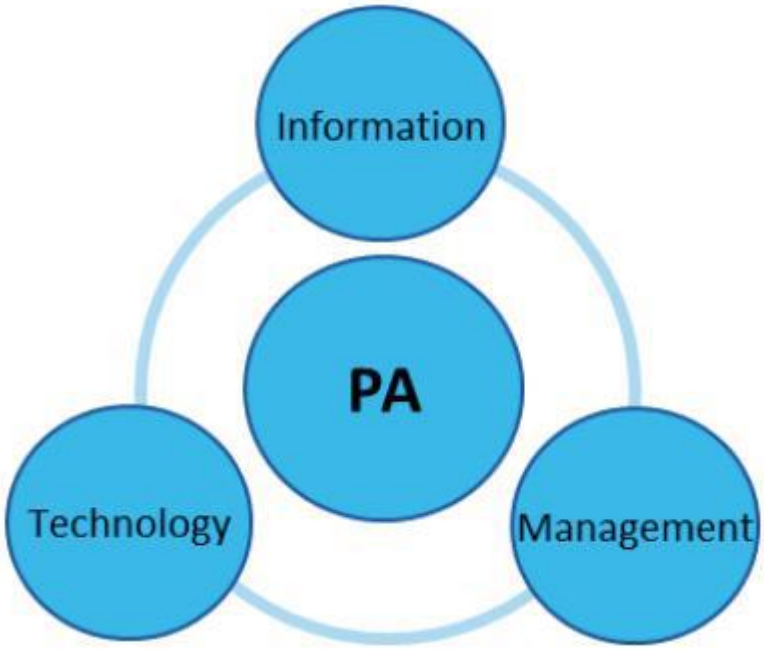

Figure 1: Major components of Precision Agriculture (Adapted from Tom *et al*, 2024)

Precision agriculture encompasses the integrated use of GIS and GNSS tools to provide detailed information on crop health and soil variability. It combines sensors, IT tools, machinery, and informed management decisions to enhance and optimize agricultural productivity by accounting for in-field variability and uncertainties within agricultural systems (Dulta *et al*., 2021).

Imagine a future where each plant receives personalized care, optimizing its growth and minimizing resource waste. This is the promise of precision agriculture, a cutting-edge field that combines advanced technologies and data analytics to revolutionize crop productivity and resource management. Given the projected global population of nearly 10 billion by 2050, there is a pressing need to increase food production by approximately 50% compared to the levels achieved in 2013 (FAO, 2017).

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Sensing technologies form a vital component of precision agriculture, facilitating data collection and analysis for informed decision-making in various aspects of crop management (Lee *et al*., 2010). The combination of cutting-edge sensing and actuating technologies, along with advancements in information and communication systems, creates the potential for significant progress in agricultural operations (Bochtis *et al*., 2014). There are various technologies encompassed within sensing technologies, including remote sensing techniques such as satellite imagery, aerial photography, and drones, as well as ground-based sensors like weather stations, soil moisture sensors, and nutrient sensors. Furthermore, the utilization of global positioning system (GPS) and geographic information system (GIS) applications in precision agriculture further enhances data collection and analysis for informed decision-making in crop management as well as precise location tracking, mapping, and informed decision-making in crop management, optimizing resource utilization (Tayari *et al*., 2015). Another study claimed that GPS and GIS technologies, when combined with other digital tools, play a crucial role in monitoring and optimizing agricultural practices, facilitating precision farming and sustainable food production. The utilization of precision agriculture technologies, such as GPS, GIS, remote sensing, and active canopy crop sensors, including sensor-based N optimization algorithms, can optimize crop yields with minimal input usage, making them valuable tools for maximizing profitability and sustainability in developing countries (Farid *et al*., 2023). The use of remote sensors in precision agriculture involves both passive and active sensors. Passive sensors detect and record natural energy, typically reflected sunlight from the Earth's surface, while active sensors emit internal stimuli to collect data about the earth.

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Variable Rate Technologies
Variable rate technologies (VRT) have revolutionized modern agriculture by enabling farmers to apply inputs such as fertilizers, seeds, pesticides, and irrigation water in a site-specific manner, taking into account the spatial variability of soil properties and crop needs. A survey conducted has resulted in a decrease in input use for fertilizer, lime, and seed inputs, leading to potential cost savings and improved resource efficiency by implementing variable rate technology in cotton production (Mooney *et al*., 2009). Additionally, for inputs such as irrigation and sprayer-applied substances, an increase in application has been reported, suggesting more precise and targeted use of these inputs, potentially enhancing crop performance and yield outcomes.

Variable Rate Seeding (VRS)
Variable rate seeding (VRS) is an accurate agricultural technology that adjusts seed quantities based on soil variability and other factors, leading to increased crop yields and improved farm profitability (Sarauskis *et al*., 2022). VRS in corn production, compared to uniform rate seeding (URS), resulted in a potential economic benefit ranging from $0.15 to $12.83 per hectare, depending on the availability of information and technology adoption. In addition, implementing variable rate seeding using the soybean VRS simulator resulted in potential profit improvements ranging from $5 to $57 per hectare compared to typical fixed seeding rate choices (Correndo *et al*., 2022). This demonstrates the potential economic benefits of adopting VRS in different crop production systems. The implementation of variable rate seeding (VRS) in agriculture has been limited globally, but with advancements in technology and easier implementation, there is increasing interest. The integration of high-precision satellite systems with Variable rate seeding (VRS) solutions empowers farmers to develop and implement customized strategies for precise seed placement, resulting in enhanced yield outcomes (Fulton, 2018).

Variable Rate Nutrient
Variable rate nutrient application (VRNA) is a precision agriculture technique that involves the application of varying fertilizer or manure rates across different sections of a field growing the same crop, according to a predetermined prescription. The practice of variable rate fertilizer management is expected to result in reduced fertilizer usage, increased or sustained yield, improved crop quality, and ultimately improved environmental quality (Teoh *et al*., 2016). The advantage of variable rate nutrient application is the potential for improved profitability and environmental benefits. VRNA for phosphorus (P) can lead to long-term economic benefits by building up soil-test phosphorus, while VRNA for nitrogen (N) has the potential for economic and environmental benefits, although its adoption by producers is currently low. The use of real-time sensors for VRNA-N offers the potential to optimize nitrogen application based on crop needs, further enhancing the benefits of variable rate nutrient management (Grisso *et al*., 2011).

Variable Rate Irrigation
Variable Rate Irrigation can be defined as the ability to apply water with varying depths across a field in a spatially specific manner, taking into account specific crop needs and other relevant conditions. VRI technology offers varying degrees of benefits and drawbacks depending on the specific field characteristics, with outcomes differing from field to field. Factors such as crop type, equipment lifespan, water cost, and pumping expenses play a crucial role in determining the return on investment associated with VRI implementation. The states site specific Variable Rate Irrigation technology has the capacity to generate positive effects on crop water productivity, while also promoting water and energy conservation, and contributing to environmental sustainability (Envas et al., 2012). A study conducted in a vineyard resulted in a significant reduction of water use by 18% without compromising yield and product quality. The study also demonstrated that variable-rate irrigation in vine cultivation can effectively optimize water management and improve crop uniformity. In a study comparing variable rate irrigation (VRI) management to uniform rate irrigation (URI) management, it was demonstrated that VRI resulted in a 25% reduction in irrigation water usage and a 2.8% increase in soybean yield by (Sui and Yan, 2017).

Despite the potential benefits of variable rate irrigation technology in improving water management and increasing crop yields, its implementation may encounter challenges such as insufficient leaching of salts, unintentional yield reductions in large fields, and the need to address the attitude and philosophy of the owner/operator (Sui and Yan, 2017).

Precision Crop Management

Precision Crop Management (PCM) is a data-driven approach in agriculture that optimizes profitability, sustainability, and environmental protection through the integration of diverse data sets and precision agriculture techniques. Various types of data, including yield distribution, soil characteristics, remote sensing, crop scouting observations, and weather information, can be collected at a site-specific level during the growing season to aid farm managers in optimizing crop management practices. It enables farmers to make informed decisions based on precise information, maximizing crop productivity while minimizing resource waste and environmental impacts. The analysis and interpretation of collected data in precision agriculture enable the delineation of management zones, allowing for the optimization of crop management practices. Management zones formed based on data analysis and geo-statistics in precision agriculture facilitate the implementation of variable rate application of inputs, enhancing crop management effectiveness. GIS applications encompass land suitability assessment, water resource management, soil health and fertility management, biotic and abiotic damage assessment and intervention, crop monitoring and yield prediction, and biomass assessment (Taylor et al., 2007).

Remote sensing (RS) technology offers the capability to monitor the dynamic conditions of soil, plants, and the area under cultivation with high accuracy, achieving 95% accuracy in assessing the cultivated area and 90% accuracy in identifying single crop cultivation areas within a 10-day timeframe. The use of drones in agriculture has emerged as a valuable tool for inspecting large areas, implementing smart irrigation, and targeted fertilization. Infrared sensors in drones optimize crop monitoring and management, leading to improved crop conditions and increased yields, while also serving as valuable tools for power and pipeline inspections. Drones equipped with infrared cameras enable the detection of irrigation needs and the spread of foliage diseases, leading to significant time and resource savings for agronomists while reducing the use of agrochemicals. GIS-enabled cloud technology serves as a decision support system for soil fertility management, utilizing soil test and crop response data to provide accurate fertilizer recommendations. This enables farmers to optimize fertilizer usage and maximize crop yield (Leena *et al*., 2016).

Furthermore, remote sensing enables precise identification and mapping of weed patches within fields, allowing targeted herbicide applications and minimizing environmental contamination while optimizing weed control (Jr *et al*., 2003).

The application of GPS guidance in sugarcane farming enables the implementation of controlled traffic systems with wider row spacing and permanent cropping beds, which can help mitigate yield decline caused by wet conditions and soil compaction, leading to potential yield increases. Ground-based or near-range sensors, such cameras, spectrometers, fluorometers, and distance sensors, have the potential to be employed for the detection and quantification of weed presence and infestation levels in precision agriculture (PA) applications. Moreover, these advanced farming techniques contribute to increased crop productivity and improved quality by precisely identifying and addressing issues such as water deficiency, nutrient stress, and diseases. The use of thermal indices derived from infrared radiation has been investigated for precise water management in agriculture. These methods allow for monitoring plant water status, estimating evapotranspiration rates, and optimizing irrigation timing and quantities based on crop water requirements (Jr *et al*., 2003). CIR (Color Infrared) photography from remote sensing technology is used to identify areas affected by specific diseases, estimate yield losses caused by disease in crops, and detect diseases that hinder water flow in plants and thermal infrared (TIR) imaging is used for early detection of diseases (Jr *et al*., 2003). These applications enable farmers to take proactive measures in disease management.

In addition, Artificial Intelligence (AI) has also emerged as a powerful tool in crop management. The use of AI-powered chatbots assists farmers in receiving real-time answers, advice, and recommendations on crop diseases, pest control, and irrigation practices by analyzing queries, accessing relevant data, and delivering tailored solutions. This AI-enabled support system enhances farmer knowledge, decision-making, and efficiency, minimizing losses and reducing workloads in

farming. Moreover, the IoT technology, with its sensors and instruments, enables farmers to remotely monitor plants and animals, assess weather conditions, and anticipate production levels. For example, through IoT-enabled systems, farmers can effectively manage water resources by monitoring and controlling the flow amount, assessing crops' water requirements, and optimizing the timing of water supply, leading to significant water savings and improved crop productivity in precision agriculture (Dhanaraju *et al*., 2022)

Robotics and Automation in Precision Agriculture

In precision agriculture, automation and robotics have emerged as a central framework, extensively researched and applied in various agricultural operations such as planting, inspection, spraying, and harvesting, with a focus on minimizing environmental impact and maximizing agricultural productivity. Agricultural robots have expanded in categories and diversified in application scenarios, including field robots, fruit and vegetable robots, and animal husbandry robots, to meet the practical needs of labor-saving and efficient agricultural production (Cheng, *et al.*, 2022). Field robots in agriculture are autonomous, mechatronic devices that primarily utilize wheels for locomotion and are designed to perform various tasks such as tilling, sowing, plant protection, data gathering, and harvest operations, with drones being primarily used for pesticide spraying. Seeding robots, as part of field robot systems, have been developed to precisely sow seeds in designated positions, contributing to enhanced accuracy, time efficiency, and cost savings for farmers (Cheng *et al*., 2022). Transplanting robots offer the benefit of improved accuracy and stability during the transplanting process, ensuring successful transplantation with a high success rate even at accelerated speeds; 95.3% even at an acceleration of 30 m/s^2 (Yang, *et al*., 2020). In harvesting fields, a cost-effective two-wheeled robot equipped with a spraying mechanism and wireless control for pesticide and fertilizer application has been developed. The robot also utilizes cameras to monitor crop growth conditions, and health factors, and detect pests in the field. By utilizing robots for fertilizer spraying, farmers have the potential to reduce pesticide usage by up to 80%, while also benefitting from the robots' ability to navigate around obstacles such as trees, rocks, and lakes, thereby enabling more efficient cultivation across fields (Cheng *et al*., 2022). Automation and robotics in precision agriculture have revolutionized farming operations, offering enhanced accuracy, efficiency, and cost savings while minimizing environmental impact, with the potential to reduce pesticide usage by up to 80% and navigate challenging terrain for more efficient cultivation.

Benefits of Precision Agriculture

a) Precision agriculture offers a range of benefits that can revolutionize agricultural practices as highlighted below:
b) Increased Productivity and Resource Efficiency: Precision farming optimizes resource use by applying inputs, such as water, fertilizers, and pesticides, precisely where and when they are needed. By tailoring management practices to match specific field conditions, precision farming maximizes crop yields while minimizing input wastage.
c) Reduced Environmental Impact: Precision farming practices help mitigate environmental degradation by minimizing nutrient runoff, soil erosion, and chemical leaching. By promoting sustainable agricultural practices, precision farming contributes to soil health, water quality, and biodiversity conservation.
d) Enhanced Profitability and Sustainability: Precision farming improves farm profitability by reducing input costs, increasing yields, and optimizing operational efficiency. By adopting precision farming practices, farmers can achieve higher returns on investment while promoting long-term sustainability and resilience in agriculture.

Challenges

1. Though Precision Agriculture offers a range of benefits that can revolutionize agricultural practices, but it also faces significant challenges that need to be addressed for widespread adoption. Some of the notable challenges facing precision agriculture
2. Initial Investment Costs: The adoption of precision farming technologies often requires significant upfront investments in equipment, sensors, software, and training. High initial costs may pose barriers to adoption, particularly for small and medium-sized farmers with limited financial resources.
3. Data Privacy and Security Concerns: Precision farming involves the collection, storage, and analysis of sensitive data related to farm operations and management. Data privacy and security concerns, including unauthorized access, data breaches, and misuse of information, need to be addressed to maintain trust and confidence in precision farming technologies.

4. Accessibility and Adoption Barriers in Developing Regions: Limited access to technology, infrastructure and technical support services may hinder the adoption of precision farming practices in developing regions. Challenges such as inadequate internet connectivity, lack of skilled manpower, and insufficient funding for technology investments need to be overcome to promote inclusive adoption of precision farming.

Future Prospects

The future prospects of precision farming are promising, driven by advancements in technology, data analytics, and the potential to address global food security challenges.
Here are some key areas of development and opportunities for precision farming:

1. Advancements in Technology and Data Analytics: Continued advancements in sensor technology, remote sensing, and data analytics will enable more precise and efficient monitoring and management of agricultural systems. Emerging technologies such as Internet of Things (IoT), unmanned aerial vehicles
2. (UAVs), and blockchain will further enhance data collection, connectivity, and traceability in precision farming. Integration of advanced sensors, robotics, and automation will enable autonomous farm operations and real-time decision-making, improving productivity and sustainability.
3. Integration of Artificial Intelligence and Machine Learning: Artificial intelligence (AI) and machine learning (ML) algorithms offer new opportunities for predictive modeling, pattern recognition, and decision support in precision farming. AI-driven systems can analyze large datasets, identify trends, and generate actionable insights for optimizing agronomic practices, input applications, and resource allocation. ML algorithms can learn from historical data, adapt to changing conditions, and optimize management strategies, leading to more efficient and adaptive precision farming systems.
4. Potential for Addressing Global Food Security Challenges: Precision farming has the potential to contribute significantly to global food security by increasing agricultural productivity, improving resource use efficiency, and reducing food losses. By optimizing crop yields and minimizing input wastage, precision farming practices can help meet the growing demand for food in a sustainable and environmentally responsible manner. Precision farming technologies can also enhance resilience to climate change, mitigate the impacts of extreme weather events, and improve the adaptive capacity of agricultural systems.

5. Sustainable Intensification and Resilience: Precision farming enables sustainable intensification of agricultural production, allowing farmers to produce more food on existing land while minimizing environmental impacts. By adopting precision farming practices, farmers can enhance the resilience of agricultural systems to climate variability, water scarcity, and other challenges, ensuring food security for future generations.
6. Adoption of Digital Agriculture Platforms: Digital agriculture platforms, powered by cloud computing, big data analytics, and mobile technologies, will facilitate the adoption and scaling of precision farming practices. These platforms provide farmers with access to real-time data, decision support tools, and agronomic services, empowering them to make informed decisions and optimize farm operations. Digital agriculture platforms also foster collaboration, knowledge sharing, and innovation across the agricultural value chain, driving continuous improvement and transformation in agriculture.

CONCLUSION

Precision agriculture is a promising solution for improving crop productivity and resource management. By leveraging advanced technologies like sensing, variable rate applications, and automation, precision agriculture optimizes farming practices. It enables informed decision-making, reduces resource waste, and enhances sustainability. However, challenges remain in terms of cost, accessibility, data management, and education. Looking ahead, the future prospects of precision farming are promising, with advancements in technology, integration of artificial intelligence and machine learning, and the potential to address global food security challenges. As precision farming continues to evolve, it holds the key to unlocking sustainable and resilient agricultural systems that can meet the growing demand for food while preserving natural resources for future generations. With further research and collaboration, precision agriculture also has the potential to revolutionize farming and meet global food demand while minimizing environmental impact.

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Gender-Based Analysis of Productivity in Rice Farming Activities in Abia State, Nigeria

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ABSTRACT
This study analyzed gender-based productivity in rice farming activities in Abia State, Nigeria. A multi-stage sampling procedure was employed in data collection with structured questionnaires to collect data from 204 respondents; the average age of both men and women was 37 years. The majority of respondents (38.7%) were between the ages of 26 and 30. 62.8% had secondary education, which may have helped them adopt modern farming methods. The majority of respondents (58.8%) were married, and there were slightly more men than women (55.9% and 44.1%), which is consistent with traditional gender roles that assign men the more physically demanding farm jobs. The majority of farmers (73.5%) cultivate between one and three hectares of land, the majority (77%) is full-time rice farmers, and the majorities (38.2%) are involved in both farming and trading. The results show that drought, the adoption of local varieties, inconsistent government regulations, inadequate soil fertility, and pest and disease attacks are the main production issues faced by rice producers (mean scores: 3.07 – 3.38) with mean ratings ranging from 3.07 to 3.38, the results indicated the main difficulties encountered by rice farmers. The results also indicated that deep-water varieties, which make up 46.1% of the total, are most prevalent in the lowland, rainy regions of Abia State. The model is not statistically significant at the 5% level, according to the results, which indicate an F-value of 1.561 with a significance level of p = 0.129. Promotion of improved rice varieties, cooperative creation, irrigation systems, income, and involvement are all recommended by the study.

Keywords: Agriculture, Rice production, Gender, Activities, Roles

INTRODUCTION
In Abia State, Nigeria, rice is a basic food that is enjoyed by people from various socioeconomic backgrounds and geopolitical zones (Kamai *et al.,* 2020). Nigeria's use of rice is rising quickly due to a shift in consumer preferences, increased urbanization, rising income levels, and population expansion. It is typically boiled and consumed with vegetable soup or stew. Additionally, it is utilized in the cooking of several regional foods that are consumed in every household, particularly during celebrations and festivals (FAO, 2020).

Rice (Oryza sativa), is one of the most widely grown crops worldwide. After maize and wheat, it is the third most significant cereal cultivated and consumed worldwide (Agro-Nigeria, 2018). Since they all offer favorable conditions for the crop's growth, rice is grown in practically every ecological area in Nigeria (Agro-Nigeria, 2018). According to research done in Nigeria among both urban and rural families (anonymous, 2015), the demand for rice has increased dramatically over the past 40 years as a result of shifting consumer dietary habits and population expansion. Numerous enhanced rice varieties may be cultivated in Abia State, Nigeria. For example, the

National Cereal Research Institute (NCRI), Baddegi, has developed numerous improved rice varieties that can be grown in a variety of agro-climatic situations. The varieties were classified into four main groups namely;

- Early maturing varieties (FARO 27 and FARO 44).
- Medium maturing varieties (FARO 29, FARO 35, FARO 37, FARO 50, FARO 51, FARO 52 and FARO 57).
- The late maturing varieties (FARO 7, FARO 8, FARO 12, FARO 14 and FARO 15 and
- Deep water (floating) areas, FARO 7, FARO 14 and FARO 15, respectively (NCRI, 2009).

FARO 44 is one of the many developed rice varieties that is widely distributed and highly adopted compared to other developed varieties (Adesina, 2012). The roles, behaviors, identities, and expectations that society ascribes to being male, female, or non-binary are collectively referred to as gender. Many people now see gender as a social and personal construct that differs among cultures and individuals, although historically it was believed to be firmly associated with biological sex (male or female). There are common trends in many rural and agricultural communities around the world, although gender roles in agricultural production vary greatly based on cultural, economic, and regional considerations. Tasks, responsibilities, and resource access are frequently divided according to gender roles, which can have an impact on social dynamics, economic results, and productivity.

Typical gender roles in agriculture are broken down as follows:
Crop cultivation: Men tend to do physical labor-intensive tasks like plowing, tilling, and harvesting; they may be in charge of crops grown primarily for sale and income; women tend to concentrate on crops for domestic consumption, such as vegetables, grains, and legumes, though they also contribute to commercial crops; in some regions, they are involved in planting, weeding, and post-harvest activities, such as processing and storage; and in animal husbandry, men tend to handle larger animals, such as cattle, camels, and buffalo, and are in charge of activities like herding and marketing livestock; women tend to smaller animals, such as chickens, goats, and rabbits, frequently as a source of additional household income or food; they may be in charge of feeding, milking, and cleaning (FAO, 2011).

Land ownership and decision-making: Men typically have more influence over land ownership, crop revenue, and farming decision-making authority. Particularly in patriarchal cultures, women's decision-making responsibilities can be restricted, which can hinder their capacity to invest in agriculture or embrace new technologies. However, in other areas, women own land and run farming businesses.

Labor division family roles: women's involvement in agriculture are typically in addition to their responsibility for household tasks, childcare, and food preparation, resulting to a double load. Men may be less involved in household chores and more focused on farming activities, especially those that are related to revenue. Technology and resource availability: Men typically have greater access to resources including training, credit, better seeds, and agricultural technologies. Contrariwise, women might not have as much access to these resources, which could limit their output and capacity to expand their farming operations. Given their expertise in crop diversification, water management, and local resilience tactics, women frequently play a key role in agriculture's adaptation to environmental changes. Large-scale adaptation resources like irrigation systems and machinery may be more accessible to men. In addition to recognizing and appreciating women's contributions to agricultural output, efforts to make agricultural systems more egalitarian frequently concentrate on enhancing women's income, access to resources, and decision-making possibilities. Gender roles in rice production vary significantly across regions, but certain patterns emerge, particularly in labor division, decision-making, and access to resources. Here are the main gendered aspects of rice production:

- Field preparation: women may help by weeding or cleaning waste, but men are typically in charge of labor-intensive jobs like plowing and leveling the field, particularly when machinery is involved (FAO, 2011).
- Planting and transplanting: In many rice-growing countries, women typically carry out the labor-intensive task of planting, particularly when it comes to transplanting rice seedlings, where accuracy is required. Men may occasionally supervise or assist in this procedure (Saito *et al.,* 2019).

- Weeding and fertilization: Since these tasks need constant care throughout the crop cycle, women typically conduct regular weeding and fertilization. Depending on the area, men may use chemical pesticides or fertilizers that need special handling (International Rice Research Institute, 2020).
- Water management: The more technical facets of irrigation management, particularly those involving intricate or physical systems, are usually handled by men. Women can help, especially when it comes to smaller or more conventional watering techniques (Pari and Chi, 2005).
- Harvesting and post-harvest activities: Harvesting jobs frequently involve both men and women. Women concentrate on cutting bundles, while males handle machines when available and carry heavier loads. Women typically handle post-harvest duties like threshing, drying, and storing (Agarwal, 2003).
- Decision-making and income control: In many traditional communities, women may have control over smaller sales for local markets, especially if rice is partially consumed at home, but males are the main decision-makers on land use, equipment purchases, and large-scale sales (Saito *et al.,* 2019).
- Access to resources; men often have better access to resources like credit, agricultural training, and advanced tools, enabling them to adopt productivity-enhancing practices. Women's access to these resources is more limited in many regions, which can hinder their productivity despite their significant labor contributions (FAO, 2011).

In areas that produce rice, initiatives to raise women's income, access to resources, and decision-making possibilities can maximize output and boost economic advantages (Pari and Chi, 2005). Both men and women have actively participated in the rice industry; however their duties in farming households are frequently divided based on gender. Selection of sites, suggested rice varieties, preparation of the land, seed preparation, timing of sowing, fertilizer application, composting from rice residues, weed control (hand weeding and herbicide use), pest and disease control, harvesting (threshing and winnowing), storage, parboiling, transportation, packaging, and marketing of rice are some of the activities they do in the production of rice.

In almost all society, men and women differ in the activities and the undertakings, regarding access to and control over resources in participating in agricultural activities. Generally, men are presumed to be the chief actors in agricultural production activities such as farm clearing, planting of seedlings as well as chemical application (Dalai *et al.,* 2020, cite in Maduka *et al.,* 2023).

Problem Statement
In Abia State, Nigeria, there might be gender differences in the allocation of responsibilities, access to resources, and decision-making authority despite the substantial contributions made by both men and women in rice cultivation. These differences may affect the rice farming community's overall production, sustainability, and fair economic gains. Designing policies and interventions that effectively help both male and female farmers requires an understanding of the complexities of gender roles in rice farming production activities. Therefore, to support balanced development and raise productivity among rice farmers in Abia State, this study aims to explore the unique roles and difficulties related to gender in rice farming operations. Therefore, an analysis of gender-based productivity in rice farming activities in Nigeria's Abia State is required.

The following objectives will be analyzed:
1) Describe The demographic characteristics of the respondents;
2) Evaluate the factors influencing rice production activities;
3) Identify major rice grown by rice farmers in the area.

Hypothesis of the Study
H_1 = the demographic characteristics of the farmers have no significant influence on major rice grown in the area.

METHODOLOGY
Study Area
Nigeria, located in West Africa with a population exceeding 230 million, is the most populous nation on the continent. The tropical regions in the south receive annual rainfall between 1,500 to 2000 millimeters, which supports various agricultural enterprises (Iowa, 2009). Abia State is a state in the Southeast geopolitical zone of Nigeria, it is bordered to the Northwest by Anambra State and

Northeast by the states of Enugu, Ebonyi, and Imo State to the west, Cross River State to the East, Akwa Ibom State to the Southeast, and Rivers State to the South. The predominant languages spoken in Abia State are Igbo and English languages. Abia state is in the humid forest zone of Nigeria. The Local Government Area has an average rainfall of 2351 mm, average minimum diurnal temperature of 28 °C and relative humidity range between 80 and 90%. The vegetation of the area is predominantly lowland rainforest, which makes it suitable for growing rice, and other etc. This has led to the area becoming the food basket of Abia State. The area is inhabited primarily by the Igbo people (all news, 2023). It experiences an average weather temperature of 28 °C. The area witnesses two distinct seasons which are the rainy and dry seasons. The average humidity level is 62% (meteotrend, et: al, 2023).

Data Collection

Data for this study were generated from primary sources through the administration of a questionnaire, and the use of an oral interview schedule. Furthermore, likert type measuring scale was developed to elicit information from the respondents, especially for realizing objective 2, of the study.

Sampling Technique

A multi-stage sampling procedure was adopted in selecting a sample of 204 respondents. The first stage was a purposive selection of Umuahia, Ohaifia and Aba Agricultural zones from the three agricultural zones in Abia state. These zones were purposively selected because of the high level of rice farm production activities they undertake. In the second stage Ikwuano, Bende and Ukwa – ngwa Local Government Area were purposively selected based on the number of rice farmers in the area. The third stage involved a random selection of two (2) extension blocks from each of the selected LGAs, given a total of 6 blocks. Two (2) cells were randomly selected from each of the six (6) extension blocks to get the total number of twelve (12) cells. Sixteen (17) rice farmers were randomly selected from each of the twelve (12) selected cells -10 males and 7 females to get a total of 204 respondents. Thus, a sample size of 204 rice farmers production was selected for the study; hundred and four (104) men and hundred (100) women.

Data collection

Data for the study were collected using a structured questionnaire, for the effective, some extension agent were trained on how to administer the questionnaire and they served as enumerators who helped in the distribution and retrieval of the questionnaire.

Measurement of variables

Objective i and iii, was realized using frequencies and percentages while objective ii was realized using mean scores derived from a four-point a Likert-type rating scale of strongly agree (4 points), agree (3 points), disagree (2 points), and strongly disagree (1 point). A benchmark mean of 2.5 was used in decision-making. X_m was used to represent the mean score for males while X_f was for females.

Hypothesis 1:

The demographic characteristics of the farmers have no significant influence on the major rice grown in the area. The implicit and explicit forms are specified as follows:

$$Y = \alpha + Xi\ \beta + \varepsilon i \quad (1)$$

$$Y = a + \beta\ 1X1 + \beta\ 2X2 + \beta 3X3 + \beta 4X4 \ldots \beta n\ Xn \quad (2)$$

Where,

Y	=	Major Rice grown (mean score)
X - Xn	=	Farmers' demographic characteristics
X1	=	Age (Years),
X2	=	Employment Status (employed = 1, otherwise = 0)
X3	=	Entrepreneurial Experience (Years),
X4	=	Sex (Male = 1, Female = 0),
X5	=	Level of Education (years).
X6	=	Marital Status (Single = 0, Married = 1),
X7	=	Occupation (Farming =1, Otherwise = 0).

X8 = Cooperative society
e = error term.

RESULTS AND DISCUSSION

Table 1: The socio-economic characteristics of the Rice farmer's production in Abia state

Variable	Frequency	Percentage	Mean
Age			
≤ 20	23	11.3	
21 – 25	41	20.1	
26 – 30	79	38.7	
≥ 40	61	29.9	
Levels of education			
No schooling	29	14.2	
Primary	43	21.1	
Secondary	65	31.9	
Tertiary	63	30.9	
Marital status			
Yes	120	58.8	
No	84	41.2	1.41
Gender			
Female	90	44.1	
Male	114	55.9	0.56
Occupation			
Farming	64	31.4	
Trading	33	16.2	
Civil servant	29	14.2	
Farming and trading	78	38.2	1.59
Unemployment			
1 – 3	108	52.9	
4 – 5	96	47.1	3.17
Farming experiences			
1 – 2	69	33.8	
3 – 5	135	66.2	3.17
Levels of participation			
≥ 4	107	52.5	
≤ 8	97	47.5	5.90
Hectares of land			
1 – 3	150	73.5	
4 – 5	54	26.5	2.88
Nature of participation			
Part-Time	47	23.0	
Full-Time	157	77.0	1.77
Cooperative membership			
Yes	100	49.0	
No	104	51.0	0.49

Source: field survey, 2024

Table 1: the socio-economic characteristic of rice farmers, this table highlights the demographic diversity among rice farmers in Abia State. Ages, the majority (38.7%) are aged between 26 – 30 years with a mean age of 37, reflecting a relatively young and active farming workforce. Those aged 40 and above constitute 29.9%, suggesting significant involvement of middle-aged farmers. Educational levels, a combined 62.8% have secondary (31.9%) or tertiary education (30.9), which might positively influence their ability to adopt modern farming techniques. Most respondents (58.8%) are married, implying potential family labor support in farming activities. Males slightly outnumber females (55.9% and 44.1%), aligning with the traditional gender roles that assign men the more physically demanding farm tasks. Most farmers engage in both farming and trading (38.2%), indicating the diversification of income sources as a coping strategy against agricultural risks. A significant majority (73.5%) cultivate between 1 – 3 hectares of land, showing the dominance of smallholder farmers. Most farmers (77%) are full-time participants, suggesting that rice farming is their primary livelihood.

The demographic characteristics highlight the dual role of gender in rice farming, with men dominating physical tasks while women contribute to processing and marketing. The high level of education supports the likelihood of adoption of improved farming methods.

Table 2: Factors influencing Rice production activities

Factors influencing rice production activities;	Strongly agree	Agree	Disagree	Strongly disagree	Sum of scores	Mean score
use of poor agronomic practices (such as planting patterns or seeding methods)	78(38.7)	78(38.2)	30(14.7)	17(8.3)	627	3.07
drought(Strongly	104(51.0)	82(40.2)	9(4.4)	9(4.4)	689	3.38
use of local varieties	104(51.0)	82(40.2)	9(4.4)	9(4.4)	689	3.38
inconsistency of government	104(51.0)	82(40.2)	9(4.4)	9(4.4)	689	3.38
import restriction	-	-	112(54.9)	92(45.1)	316	1.55
tariff restriction	-	-	112(54.9)	92(45.1)	316	1.55
poor soil fertility	79(38.7)	78(38.2)	30(14.7)	17(8.3)	627	3.07
pest and diseases attack	104(51.0)	82(40.2)	9(4.4)	9(4.4)	689	3.38
Total Mean						22.76
Grand Mean						**2.85**

Source: field survey, 2024

This table identifies the challenges rice farmers face. Major challenges: key challenges include drought, use of local varieties, inconsistent government policies, poor soil fertility, and pest and disease attacks (mean scores: 3.07 – 3.38). These issues significantly hinder productivity, as farmers lack access to improved seeds and modern agronomic practices. Lesser challenges: import restrictions and tariff policies have the least impact (mean score; 1.5), indicating local farmers rely less on imports. Insights: the grand mean of 2.85 highlights widespread agreement on the critical nature of these challenges. Challenges such as drought and pest attacks align with global agricultural concerns, especially in regions reliant on rainfall and traditional farming techniques.

Table 3: Identify the major rice grown by rice farmers in the area

Variables	Frequency	Percentage	Mean	Std. Devi.
Early Maturing Varieties	56	27.5		
Medium Maturing Varieties	33	16.2		
Late Maturing Varieties	21	10.3		
Deep Water	94	46.1		
Sum	459		2.25	1.291
Total		100		

Source: field survey, 2024

The Dominance of Deep-water Varieties: representing 46.1%, this variety thrives in Abia State's rainy, lowland areas. Implication: farmers adapt to local climatic conditions but may benefit from diversification into drought-resistant varieties. Early maturing varieties: second highest (27.5%), reflecting farmers' preference for shorter cropping cycles to mitigate risks from climatic unpredictability. Implication: promoting these varieties could improve food security and income stability.

Hypothesis 1a

Table 1a. The demographic characteristics of the farmers have no significant influence on major rice grown in the area.

Model summary

Model	R Square change	F-Change	df	Sig. F Change
	.068	1.561	194	.129

Source; field survey, 2024

Table 1a: the demographic characteristics of the farmers have no significant influence on major rice grown in the area. The regression analysis investigates how factors such as education, experience, and farm size influence major rice grown in the area. Model summary (R-Squared): the R-squared value of 0.068 indicates that 6.80% of the variation in major rice grown in the area is explained by the socioeconomic characteristics of the farmers included in this model. This relatively low R-squared suggests that while socio-economic factors contribute to income variations, other factors not captured in the model may also be influential. A study by Ogunleye and Ojedokun (2014) similarly found that while socio-economic factors impact farm income, external influences like market prices and access to inputs also play a substantial role.

The demographic characteristics have no significant influence on the choice of rice varieties grown (p = 0.129). Farmers' preferences for rice types are likely influenced more by environmental or market factors than personal demographics.

Hypothesis 1b

Table 1b. ANOVA

Model		Sum of squares	df	Mean square	F	Sig.
	Regression	22.837	9	2.537	1.561	.129
	Residual	315.413	194	1.626		
	Total	338.250	203			

Source; field survey, 2024

Significance of the model (ANOVA Test): the ANOVA results show an F-value of 1.561 with a significance level of p = 0.129, indicating that the model is not statistically significant at the 5% level and 10% significance level. This suggests that socio-economic characteristic have a borderline influence on major rice grown in the area, though not strongly enough to be deemed conclusive. Role of specific socio-economic variable: although the does not provide coefficients for individual socio-economic variables, the modest R-squared and near-significant p-value suggest some degree of influence from factors such as education, age, or years of farming experience. Studies indicate that education can improve farm income by enabling farmers to adopt better agricultural practices, while experience can lead to more efficient farming techniques (FAO, 2020).

Table 1b indicates that socio-economic characteristics have a modest and borderline significant impact on major rice grown in the area. While education and experience may contribute to income generation, other factors such as market access and input costs likely play a larger role in determining income. This finding suggests to enhance rice farmers' income, efforts should focus on improving market access, stabilizing input supply, and supporting farmer education, consistent with best practices in agricultural development.

CONCLUSION AND RECOMMENDATIONS

The study concludes that rice farming in Abia State is a vital economic activity influenced by gender dynamics and socio-economic factors. While men dominate labor-intensive tasks, women play crucial role in ensuring productivity and sustainability through planting, marketing, and processing. Addressing challenges such as drought, poor practices, and limited resource access is critical for enhancing rice production. Strengthening gender inclusion and supporting farmers with improved technologies and consistent policies can significantly improve productivity, income, and overall livelihood outcomes for rice farmers in the region.

Based on the findings, the following recommendations are made:

1) Efforts should focus on the distribution and awareness of early and medium-maturing rice varieties to improve yield and reduce risks associated with deep-water varieties.
2) Encouraging cooperative membership among farmers can improve access to resources, enhance bargaining power, and facilitate knowledge sharing.
3) Invest in infrastructure to mitigate drought effects and enable year-round rice cultivation.
4) Encourage adoption of medium and late-maturing varieties through farmer education.

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Laboratory Trial on Rearing of Black Soldier Fly (*Hermetia illucens*) Larva and Its Proximate Composition

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ABSTRACT
Insects are a subject of discussion as potential replacement for Fish meal in aquaculture and poultry diet. They contain relatively high protein levels that have been found acceptable for animals. The Black soldier fly (BSF) is one species that has been investigated; this research thus used different waste materials found in our environment to rear the larva. This was carried to access their suitability and alsoand ascertain the proximate content of the larva reared on the different substrates. The materials used were waste Banana, Water melon and Telferia occidentalis stalk which werewhich were sourced from local fruit vendors and markets in our locality. Young instars of BSF larva were harvested from poultry droppings in a farm within the locality. The materials and the larva were taken to the Laboratory in Department of Zoology and Environmental Biology in MOUAU and reared in appropriate containers. Growth performance and Mortality from the different substrates were used to ascertain the suitability of the different substrates for rearing BSF larva. The result showed all substrates were suitable. However, the mortality record differed significantly with respect to days ($p>0.05$). The result obtained from the proximate analysis using the AOAC method recorded values ranging from 26.36±0.04 % to 30.76±0.06 % for the crude protein content. Ash and moisture content recorded 9.64±0.05% to 10.42±0.03% and 14.42±0.09% to 18.68±0.08 %. The carbohydrate content ranged from 4.52±0.06 to 14.82±0.17 % while the crude fibre recorded values ranging from 3.97±0.02 to 4.86±0.05%. The energy content had values ranging from 399.01±0.38 % to 461.06±1.54 %. The results affirms the nutritional value of BSF larva and calls for more efforts in research geared towards its mass production and inclusion in diets for farm animals. This may help to reduce reliance on fish meal which may result in lower cost of feed in the animal industry.

INTRODUCTION
Insects have been a subject of discussion as potential replacements for fish meal in aquaculture because they contain relatively high protein levels with high availability for animals (Bosch *et al*., 2019). Scala *et al.* (2020) and Tepper *et al.* (2024) reported that the Black soldier fly (BSF) Larva, *Hermetia illucens* (L.) (Diptera: Stratiomyidae) are voracious consumers of a wide range of organic materials ranging from fruits and vegetables to animal remains, and manure. Lu *et al*., (2022) reported that the BSF can play a key role in helping societies efficiently handle bio-waste through enabling an effective and low-impact transformation of it into useful products, the larva in animal feed. Their utilization as ingredients for animal feeds has gained considerable interest. The potentials of using BSF larvae as a cheap alternative protein source for animal feeds seems to show

promising perspectives, especially for poultry and aquaculture feeds (Salahuddin *et al*., 2024; Silva *et al.*, 2024).
H. illucens is a mimic fly, very close in size, color, and appearance to the organ pipe mud dauber wasp and its relatives. A cardinal advantage that BSF has over other insect species used for biomass production is that the adult does not feed but relies on the fat stored from the larval stage (Mutafela, 2015). The BSF larvae appear to be superior among other insects as a potential source of protein in fish feed formulations (Muin *et al*., 2017). The addition of BSF larva does not have any adverse effect on meat quality and the production performance of broilers or laying hens. Broilers fed with BSF larval meal have shown to possess higher unsaturated fatty acid content and 8 % of larval meal was able to reduce the atherogenic index and thrombogenic index effectively reducing cardiovascular health risk in broilers. Seventy five percent (75 %) inclusion of BSF maggot meal was effective in improving the relative length of digestive tract organs, histomorphological characteristics of small intestinal villi and proportion of carcass parts in ground chickens (Meneguz *et al*., 2018, Ruhnke *et al.*, 2018; Mlaga *et al.*, 2022). These Studies have shown that insect products can be added to poultry feed as a partial substitute for protein to ensure or improve the growth performance and product quality of poultry or poultry products while reducing costs. Overall, insect-based feed is a viable and sustainable alternative protein source for the poultry industry, and it is a growing trend in the feed market (Khan *et al*., 2018, Elahi *et al*., 2020, Elahi *et al.*, 2022, Hamani et al., 2022, Zou *et al.*, 2024).

The Black soldier fly is not a potential carrier of diseases but reduces to almost zero the risk of pathogens and bacterial activity; thereby making it safe to handle (Liu *et al*., 2008). In addition, it is known to reduce the presence of harmful bacteria from food substrates and has a probiotic effect on the fish (Gariglio *et al*., 2019, de Souza *et al.*, 2021). The larvae of BSF could feed quickly on a wide range of decaying organic materials (van Huis *et al*., 2013). The larvae could easily be dried for longer storage, fed to animals and also used as fish bait (Kihia *et al.*, 2018). Successful dietary inclusion of BSF larvae in fish diets has shown improved fish yields and reduced production cost, thus promoting profitability and resource utilization. The aim of this study was to determine the growth performance and mortality of the BSF larva in the different organic wastes, and ascertain the nutrient composition of the black soldier fly reared on the different substrates.

MATERIALS AND METHODS

Field work: Larva of the Black soldier fly were harvested from a poultry farm and taken to the Laboratory. Fresh wastes of Banana, watermelon and *Telfaria occidentalis* (pumpkin or ugu) stalk were collected from fruit and vegetable vendors around the Campus.

Laboratory work: 20 larva were randomly selected, weighed and kept in appropriate jars with a little quantity of water sufficient to maintain minimal moist environment. Twenty-five (25g) of the different fruit wastes were weighed and carefully introduced into the jars with the larva. There were four replicates of each of the materials while one had a mixture of all substrates (banana, watermelon and *pumpkin* stalk) The plastic containers were covered with a netting material and held in place with a rubber band. The length of each larva was recorded before they were introduced into the various substrates; average length was calculated and used to represent the length. The substrates (fruits and vegetable wastes) were changed every 5days for a period of 21days. Weight and length of larva were recorded at every change of substrate. Dead larva were recovered and counted from each substrate at every change. The Growth performance of the BSFL was determined on day 21 of the study by subtracting the initial readings from the final.

Analysis on Proximate composition of BSF larva: These analyses were for the moisture, crude protein (total nitrogen), crude fibre, crude lipids, and ash contents of the larva. The methods of AOAC (1984) was adopted and used to ascertain the proximate composition of the larvae harvested from the different substrates.

Data Analysis: The data were subjected to a descriptive statistical analysis using a Statistical Products and Service Solutions (SPSS) version 22 and the results presented as mean ± standard deviation. One – way ANOVA was used to ascertain significant differences among the treatments and significant level was assessed at $p<0.05$.

RESULTS AND DISCUSSION

Growth Performance

The results showed decrease in the larva weight across the three substrates - banana (-0.66g), water melon (-0.67g) and pumpkin (-0.23g) (Table 1). However, there was increase in length after the 21-day of the study. Larva reared on pumpkin substrate had the highest length gain of 0.35 cm while the least (0.08 cm) was among those reared on banana waste (Table 1).

Mortality of the BSFL across the different substrates

There were variations in the number of mortality observed in BSFL across the different substrates. At day 6, mortality of larva was 6 in larva fed on banana and pumpkin stalk by the 11th day, more mortality was observed in larva fed on pumpkin stalk with additional 17 deaths, while the least was 3 recorded for banana and the watermelon had 8. At day 16, 11 more were recorded from Pumpkin substrates while 6 and 4 were recorded from banana and water melon respectively. At day 21, more than half of the population of larva fed with Pumpkin did not survive. The percentage that survived from the different substrates are shown in the pie chart (Table 2) with Water melon having the highest percentage of 61.67 followed by Banana and pumpkin with 58.33 and 40 respectively.

Proximate composition of larva from the different substrates

The result the proximate composition of the BSF larva from the different substrates differed. Crude protein was higher in larvae fed reared on water melon and least in those on banana. Crude content fibre content was almost the same in value across the four treatment groups. Nevertheless, it was higher in larvae fed on banana/watermelon/pumpkin stalk combination (4.86±0.05%) while the least (3.97±0.02%) was recorded among those on banana substrate. For Ash, the highest content was among larva harvested on pumpkin substrate (10.42±0.03%), followed by 10.22±0.07 % (water melon) while the least (9.40±0.05 %) was recorded for the composite substrates There was a remarkable variability in the carbohydrate content in the larvae reared on the four substrates. The highest (17.39±0.11 %) was recorded for water melon substrate while the least (4.52±0.06 %) was recorded for pumpkin substrate. The highest energy value (461.06±1.54 Kcal) was recorded among the larva reared on pumpkin substrate while the least (339.57±1.86 Kcal) was recorded among those reared on the composite substrate.

Proximate composition of the larva with respect to the four types of substrate did not differ considerably from each other, hence values were statistically insignificant (P>0.05) (Table 2).

The result showed that all waste materials are suitable for the rearing of *H. illucens.* The species has been named as one of the well-known recycling organisms (Kihia, 2018). The negative length recorded in the growth of the larva is not as surprise as Nijhout *et al*., (2013) reported that most insects stop feeding and wander around looking for a suitable place to pupate. The result of the nutritional content also supports that this species is ideal as source of nutrient and can play an important role in a variety of sectors within the food and livestock industries (Delicato *et al*., 2020). The high mortality in the pumpkin treatment showed the importance of moisture in the survival of insects. From the results also, we may conclude that it may be easy to mass produce BSF according to Bava *et al*. (2019), and if this is achieved, the larva may be used as animal feed, thereby enhancing bio-conversion as a commercial venture. Weththasinghe *et al*. (2024) reported that BSFL oil is a sustainable alternative in fish-meal and fish oil in aquaculture; suggesting BSFL can reduce reliance on traditional feed sources thus having the potential to lower environmental impacts like green house emissions. The actualization of this calls for more research and may form an important part of our growing economy.

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Table 1: Growth performance of BSFL reared on different substrates

Fruits/Vegetable substrate	Initial weight (g)	Final Weight (g)	Weight gain/Loss (g)	Initial length (cm)	Final length (m)	Length gain/loss(cm)
Banana	2.33	1.67	-0.66	1.49	1.57	0.08
Water melon	2.67	2.00	-0.67	1.42	1.57	0.15
Pumpkin	2.33	0.00	-2.33	1.32	1.67	0.35

Table 2: Observed mortality among larva fed on different substrate

Days	Total number of larva carcass recovered		
	Banana	Water melon	Pumpkin
Day 1	0	0	0
Day 6	6	0	6
Day 11	9	8	23
Day 16	15	12	34
Day 21	25	23	36

No. of replicates = 3 Number of larva in each replicate = 20

Table 3a: Proximate composition of BSF from the different substrates

Proximate Parameters	Substrate			
	Banana	Water Melon	Ugu stalk	Banana/watermelon/Ugu
MC* (%)	18.68±0.08	14.42±0.09	14.30±0.08	25.58±0.13
CP (%)	26.36±0.04	30.76±0.06	30.61±0.08	28.72±0.04
EE* (%)	26.29±0.10	22.87±0.07	35.58±0.08	19.75±0.05
CF* (%)	3.97±0.02	4.36±0.05	4.68±0.06	4.86±0.05
ASH* (%)	9.90±0.12	10.22±0.07	10.42±0.03	9.64±0.05
CHO (%)ss	14.82±0.17	17.39±0.11	4.52±0.06	11.59±0.18
EV Kcal	400.8±0.27	399.01±0.38	461.06±1.54	339.57±1.86

Values are presented as mean ± standard deviation (n = 3). P-value = 0.997

Table 3b: Analysis of variance (ANOVA) for the proximate composition of larva of BSF fed on four different type of substrate.

ANOVA				
Source of Variation	SS	MS	F	P-value
Between Groups	1054.019	351.3397	**0.016451**	**0.997043553**
Within Groups	512568.1	21357		
Total	513622.1			

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Assessment of Adaptation of Climate Smart Poultry Production Practices by Small-Scale Poultry Farmers in Enugu State, Nigeria

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ABSTRACT
This study was conducted in Enugu state. The study assessed the adaptation of climate smart poultry production practices among small scale poultry farmers in the state. The study employed multi-staged sampling technique to select 220 poultry farmers in the state. Data were collected through primary sources with the aid of structures questionnaire. The analysis of the collected data was achieved by using descriptive statistics and logit regression model. The findings of the study showed that poultry farmers had high perception of climate change in Enugu state. The signs of climate change as perceived by the respondents were high temperature (92.7%), increase in intensity of heat (90.9%), increase in total rainfall (86.4%), variation in rainfall pattern (85.5%), increase in heavy rainfall (79.0%) and among others. The effect of this climate change on the poultry farmers were high rate of poultry disease and parasite (3.27), high mortality rate of the birds (3.23). Other effects were decrease in feed and water consumption (3.19), high cost of feed (3.16) and decrease in the income and profit of the farmers (3.11). The poultry farmers adapted the following CSPPP to mitigate the effect of the climate change: proper housing system (98.7%), proper feeding (97.4%), tree planting around the poultry houses (96.8%), provision of enough ventilation (96.8%), prompt cleaning of equipment (92.4%), prompt removal of poultry droppings (90.6%), diversification (86.5%) and among others. The adaptation of the CSPPP was positively and significantly influenced by education ($p<0.05$), income ($p<0.01$), experience ($p<0.10$), membership ($p<0.01$), size of poultry pen ($p<0.01$), participation in farmers' training ($p<0.05$) and awareness of climate change ($p<0.05$) and was negatively and significantly influenced by farmers' age ($p<0.05$). The study recommends that government agencies and NGO should sponsor radio and television programmmes and workshops on climate change, its effects and mitigation measures to reduce the effect of climate change. Extension programme on climate change adaptation strategies in poultry farming should be intensified in Enugu state so that the state would maintain its position in poultry production in the country. The poultry farmers should endeavor to strengthen their associations as these serve as forum for information, training and reception of government assistance.

INTRODUCTION
Poultry industry plays a major role in the economy of Nigeria. The industry contributes about 25% to the country's agricultural GDP (Netherlands Enterprise Agency, 2020). The poultry industry contributes significantly to the economic, nutritional wellbeing of Nigerians, it is a source of meat, raw materials (feather, waste-product), income and employment compared to other livestock especially in Enugu state (CADP, 2012). It has been observed that the effectiveness of the poultry industry and level of performance of the birds depends on the environmental conditions such as

rainfall, temperature, relative humidity, and sunshine prevailing at a given time (World Bank Group, 2023). These environmental conditions is being threatened by climate change, in that the climate change in Nigeria in recent times has been overwhelming and worrisome to the poultry producers because of the vulnerability of the poultry production (World Bank Group, 2023). One of the effects of climate change is loss of livestock productivity due to heat stress. Among poultry and other livestock, high temperatures lower feed intake, limit weight gain and have negative impact on the fertility as well as egg production. High temperature also increases livestock mortality rates, owing primarily to decreased output (Adeyemi *et al.,* 2023; Elijah and Adedepo, 2006). Changes in temperature and precipitation patterns affect crop yields which includes maize and soyabeans which are essential components of poultry feeds, the inadequacy of these components affects feed availability and cost which invariably affect the profitability of poultry farming (Demeke, 2004). Similarly, high rainfall and relative humidity provide a conducive environment for breeding of parasites that cause outbreak of diseases which invariably reduces egg production (Zhang *et al.,* 2023). Also climate change negatively affect the quantity and quality of feed stuff, water for production and the growth of birds (Rojas-Downing *et al.,* 2017; Abdel-Wareth *et al*., 2023, 2024). These problems of change in climate and their consequences need to be addressed through smart farming. The smart farming entails modern technology practices in agriculture which embraces those practices in crop and livestock production. The smart farming involves the practicing of climate smart agriculture which is the alternative form of agriculture for conserving the environment, while addressing the food needs of the world population. It is a form of agriculture that sustainably increases agricultural productivity and income, enhance adaptation and building resilience to climate change, reducing Green House Gases (GHGs), where possible and enhancing the achievement of national food security and sustainable development (FAO, 2014). One of the aspects of climate smart agricultural practices is Climate Smart Poultry Production Practices (CSPPP). This smart practices embrace the technologies that are used by poultry farmers to reduce the effect of climate change on poultry production. The climate smart poultry production practices (CSPPP) involves the adaptation and implementing strategic management practices such as adjusting feeding schedules, ensuring adequate ventilation and water supply, proper housing, planting of trees around poultry houses, prompt vaccination and alongside the use of additive. These practices can effectively mitigate the adverse impacts of climate change on poultry production, thereby ensuring sustainable and resilient farming practices in the face of environmental challenges (Amer *et al.,* 2022; Almeldin *et al*., 2024). Transitioning towards CSPPP not only tackles the problems of agricultural system but mitigates GHGs emission from poultry and enhances the productivity of the poultry farmers in Enugu state.

Therefore, in order to ensure that poultry farmers in Enugu state survive and continue production from the threat of climate change, it is imperative that the farmers utilize climate smart poultry production practices. It is on this background that the study assessed the CSPPP in Enugu state and specifically identified the perceived signs and effect of climate change in poultry production, ascertained the adaptation of CSPPP by the farmers and estimated the determinants of the adaptation.

METHODOLOGY

Study Area

This study was carried out in Enugu state, Nigeria. The state is in the South-east Nigeria. The state is made up of 17 Local Government Areas (LGA). It is located between latitudes 5^0 56/ N and 6^0 05/ N of Equator and longitudes 70 05/ E and 70 55/ E of Greenwich meridian (ENADEP, 2009). The state has a land area of 7,625 km^2 with population of 4,690,100 people and population density of 615persons per km^2 (NBS, 2022). The mean temperature is between 20^oC – 30^o C (ENADEP, 2009). There are two distinct seasons in a year, namely; dry and rainy seasons. Dry season starts in the month of November and ends in March while rainy season is between April and October. The range of annual rainfall is from 1600mm – 3570mm (ENADEP, 2009). The features of weather in the state favours poultry production as the state ranked third highest poultry producer in the country (CADP, 2011). The farmers also rear other livestock such as sheep, goat, and pigs. The inhabitants of the state are mainly farmers who also cultivate both arable and cash crops.

Sampling Procedure

The study employed multi-stage sampling technique. Purposive sampling was used to select six LGAs with high concentration of poultry production namely; Enugu north, Enugu south, Enugu east, Udi, Nkanu west and Nsukka. From each of the selected LGA two autonomous communities were

purposively chosen as a result of dominance of poultry farmers. Then from each autonomous community selected, two villages were chosen making it 24 villages. Finally, 10 poultry small-scale farmers were selected from each village, making it 240 respondents that were administered with questionnaire. Extension staff who are resident in the LGA assisted the researchers in the administration and collection of the questionnaire. Out of the 240 questionnaire administered, 220 (91.7%) questionnaire were collected and used for the study.

Data Collection

Primary data were used for the study. They were collected with the aid of questionnaire and oral interview schedule. The data collected were on the socio-economic characteristics of the respondents, perceived evidence of climate change in the area, effect of the climate change, climate smart poultry production practices being adapted by the farmers and factors that influenced the adaptation of the smart practices.

Data Analysis

The data analysis was achieved with descriptive statistics and logit regression analysis. Descriptive statistics was used to achieve the perceived sign and adaptation of climate smart poultry production practices while logit regression model was employed to analyse the determinants of adaptation of CSPPP. Four-point Likert scale was used to realize the effect of climate change on poultry production in the study. The four-point scale was graded thus: Not serious = 1, Less serious = 2, Serious = 3, Very serious = 4. Respondents rated various effects of climate change on poultry production based on their perception of the seriousness. The mean cut point was calculated thus:

$$X_S = \frac{\sum X}{N} \quad (1)$$

Where: X = Weight on scale, N = Total number of weight, $\sum$ = Summation

Therefore, $X_S = \frac{1 + 2 + 3 + 4}{4} = 2.5$

The mean score was computed by multiplying the total number of responses for a particular cause of perceived effect of climate change on the poultry production with the weight attached to the response chosen and then divided by the total number of respondents. That is,

$$\overline{X}s = \frac{\sum fn}{N} \quad (2)$$

Where;

$\overline{X}$ = Mean score

f = Number (frequency) of respondents

n = Likert nominal value

N = Total number of respondents

Perceived effect of climate change on poultry production with score less than 2.5 was considered not serious while those with 2.5 and above were considered serious.

The determinants of adaptation of climate smart poultry production practices was achieved using logit regression model. The model is expressed thus:

$$Yi = Ln\ (P/1\text{-}P) = f(Xi, \beta) + e \quad (3)$$

The logit of a number P is between 0 and 1 and is given thus:

$$(P) = Ln(P/1\text{-}P) = LnP = Ln(1\text{-}P) \quad (4)$$

Where;

P = Probability, while (1-P) is the corresponding odds and the logit of the probability is the logarithm of the odds.

Yi = Observable variables that indexes adaptation to CSPPP (Adapted = 1; Otherwise = 0)

f = Logistic cumulative distribution function

β = Vector of estimated parameter

Xi = Independent variables considered which include: Age (Years); Education (Years); Income (Naira); Household size (Number); Experience in poultry farming (Years); Contact with extension staff (Number); Membership of poultry farmers association (Member = 1, Not member = 0), Access to credit (Accessed = 1, Not accessed = 0), Size of poultry pen (Metres), Awareness of climate change,

(Aware = 1, Otherwise = 0), Participation on farmers' training on climate change issues (Number of times)

RESULTS AND DISCUSSION

Perceived Sign of Climate Change in Enugu State

Table 1 presents the perceived sign of climate change in Enugu state. The results in the Table shows high perception of climate change in Enugu state by the poultry farmers. This result corroborates the findings of Igberi *et a*l. (2022) who reported that there was high perception of climate change in southeast, Nigeria. From the perception of the farmers, 92.7% and 90.9% of them perceived high temperature and increase in the intensity of heat. The outcome of high temperature is the increase in the intensity of heat which results to heat stress on the poultry. The result affirmed that high temperature and intensity of heat are signs of climate change and this affect poultry production leading to high incidence of poultry disease (Sesay and Kallen, 2022). The result also indicated that 86.4%, 85.5%, 79.4% and 60.5% of the farmers perceived increase in total rainfall, variation in rainfall pattern, increase in frequency of rains and incidence of flooding respectively as the evidence of climate change in the study area. This finding agrees with Munonye *et al*. (2022) who noted that one evidence of climate change revolve around volume of rainfall, rainfall deviation pattern and its frequency. The farmers noticed and complained that it is the increase in frequency of heavy rains that usually caused the increase in the flooding because previously the rains that would have fallen in six hours now fall heavily within two hours thereby leading to increase in flooding (60.5%).

About 57%, 54.2%, and 52.0% of the farmer in the Table showed that they noticed increase in frequency of heavy wind, increase in duration of coldness during rainy season and harmattan and decrease in number of sunshine days during rainy season respectively. The coldness of weather makes the birds more vulnerable to respiratory illness and frostbite which further jeopardizes their health and wellbeing (Rosinger, 2023). From the researchers' personal interview, the farmers responded that they were able to notice the signs of the change in climate through their personal observations and experience of change in weather condition of the area.

The Perceive Effect of Climate Change on Poultry Production in the Study Area

Table 2 presents the perceived effect of climate change on poultry production in the study area. From the result analysis, the critical mean score was 2.5 and any mean greater or equal to 2.5 was regarded as having serious effect on the poultry farmers. The result indicated that there was high rate of disease and parasites incidence on the poultry production with mean score of 3.27. This shows that climate change has serious negative effect on poultry farmers through outbreak of poultry diseases and prevalent of pests (Rojas-Downing *et al.,* 2017). This invariably leads to increase in mortality rate of birds as this had mean score of 3.23. This equally causes decrease in the income and profitability of the farmers (De-Sousa *et al.,* 2023). From the Table it is observed that heat stress in the poultry house (3.19) was a serious effect. This implies that the prevalence of heat stress make the birds to be drinking more water than consuming feed, hence decrease in feed consumption by the birds (Kpomasse *et al.,* 2021). Reduction in the water intake by the birds and high cost of feed each had score of 3.16 respectively. Reduced water intake affects the health and wellbeing of the birds which leads to dehydration, heat stress and decreased productivity (Gonazelax-Rivas *et al.,* 2020), while the implication of high cost of feed is low profit and income earned by the farmers. Low quantity and quality of egg produced (3.07) and decrease in body weight (3.11) imply that the farmers may be making loss in their poultry enterprise as they would be having low number of customers that patronize them. The result of the study generally as could be seen from Table 2 showed that out of fourteen events enlisted, only three variables were perceived not to be having serious effect on the poultry farmers, depicting that the poultry farmers were experiencing serious effect of climate change in Enugu state.

Adaptation of Climate Smart Poultry Production Practices in Enugu State

The Table 3 presents adaptation of climate smart poultry production practices in Enugu state. The general result as shown in the Table depicts that the respondents adapted multiple practices to mitigate the effect of climate change on the poultry production in the state. This is because farmers enjoy more benefits when they adopt multiple strategies as some of the strategies can be complimentary to one another and enables the farmers to exploit relevant strategies (Vera *et* al., 2017). Hence adaptation of multiple climate smart agricultural practices enhances sustainable agricultural system that is resilient to shocks of climate change and other factors posing challenges to agricultural production (Opeyemi *et al.,* 2024). The result showed that 98.3% of the farmers

adapted proper housing system, 97.3% proper feeding and 96.8% provision of enough ventilation. Optimizing housing condition, proper feeding and provision of enough ventilation effectively mitigate the adverse impact of climate change on poultry production and ensure resilient farming practices in the face of environmental challenges (Amer et al., 2022; Almedin *et al.,* 2024). About 96.8% of the farmers plant trees around the poultry houses. This result is similar with Chah *et al.* (2013) who reported that 95.0% of poultry farmers in Enugu state plant trees and plantain around poultry pens. Also planting of trees around the poultry house helps to lower high temperature and reduce heat stress on the birds. The Table showed that 94.5% of the respondents adapted prompt vaccination and use of drugs, 92.4% clean their equipment daily while 90.6% ensured prompt removal of poultry droppings and fumigation of the poultry pens before stocking. All the climate smart practices were carried out to ensure prevention of outbreak of diseases which would kill the birds and bring losses to the poultry farmers. About 86.5% engaged in combined poultry farming and crop/non-farming activities (diversification). In livestock management, diversification is one of the approaches in climate smart agriculture for increasing resistance against climate change (Junaid *et al.,* 2024). Diversification also enhances resilience by distributing risk, in that poultry waste can fertilize crops or feed fish, thereby improving sustainability (Abioja and Abiona, 2021). From the Table, 85.6% of the respondents' adapted proper stocking as right stocking of the birds prevents transference of outbreak of diseases occasioned by climate change (Ifabiyi et al., 2024). The least proportion (28.4%) of the farmers practiced insurance of their poultry farms. This is an indication that most farmers do not insure their farms in Enugu state. This result is in tandem with the findings of Ebe *et al. (*2018).

Determinants of Adaptation of Climate Smart Poultry Production Practices in the Study Area

Table 4 also presents determinants of adaptation of climate smart poultry production practices in the study area. The result in the Table showed that the value of R^2 was 0.75 which indicates that 75% of the variation by the variables included in the adaptation of CSPPP were explained by the variables included in the model while 25% was due to error. The F-ratio was 11.942, which is statistically significant at 1% level. It also indicates goodness of fit. From the Table, out of eleven factors that were considered, seven variables were positively signed and significant at 1%, 5% and 10% levels respectively while only one was negative and significant at 10% level.

Education was positive and significant at 5%. This is in conformity with *a priori* expectation because as the educational attainment of the farmer increases it will enhance the farmer's knowledge on the adaptation of CSPPP. It implies that adaptation strategies of climate change is greater to those that have higher educational attainment compared to less educated farmers (Adeyemi *et al,* 2023). The positive sign and significance of income implies that as income increases, there is likelihood that farmers will adopt more climate smart adaptation practices. Farmers with more financial resources have the capacity to implement CSPPP such as better housing, proper feed management and bio-security measures etc (Abioja and Abiona, 2021). There is positive relationship between the farmers' experience in poultry farming with adaptation of CSPPP. This implies that as the experience of the farmers' increases in poultry farming there will be more likelihood in the adaptation of CSPPP as highly experienced farmers are expected to adapt improved climate smart agricultural practices. Farmers' associations play great role in the education of the farmers. It is through those associations that farmers are trained on emerging innovative technologies and techniques. Members of poultry farmers association have higher chances of adopting climate smart poultry practices than non-members (Lenis *et al*., 2018). Participation in farmers' training enhances farmers' knowledge on new technologies as it affects their farming enterprise. The result in the Table showed there was positive relationship of this variable with the adaptation of the CSPPP. This result is in line with the findings of Aroyehun (2023) who reported that participation in climate change workshops increases the likelihood of poultry farmers to adapt to climate change. The awareness to climate change was positively signed and significant at 5% level. The implication of this, is that as awareness to climate change increases, the farmers become more conscious of its effect and seek for solution to reduce the impact. As farmers become aware of climate change and its effect, the more they employ some measures to reduce the effect on their farming enterprise (Ebe et al., 2021). The farmers' age was inverse to the adaptation of CSPPP. This implies that as the farmer is aging, there is less likelihood that he will adapt the CSPPP, indicating that advancement in age of the farmer signals decline in the implementation of CSPPP and less receptive to innovation practices.

CONCLUSION AND RECOMMENDATIONS

The findings of the study showed that poultry farmers had high perception of climate change in Enugu state. The signs of climate change as perceived by the respondents were high temperature, increase in intensity of heat, increase in total rainfall, variation in rainfall pattern, increase in heavy rainfall, flooding, decrease in sunshine days during rainy season. This leads to coldness during this season and ill-health of the birds. The effect of this climate change on the poultry farmers were high rate of poultry disease and parasite and high mortality rate of the birds. The death of the birds resulted to decrease in the income and profit of the farmers. Other effects were decrease in feed and water consumption, high cost of feed, low quantity and quality of eggs produced. The poultry farmers adapted the following CSPPP to mitigate the effect of the climate change: proper housing system, proper feeding, tree planting around the poultry houses, provision of enough ventilation, prompt cleaning of equipment, and removal of poultry droppings, diversification and among others. The adaptation of the CSPPP was positively and significantly influenced by education, income, experience, membership, size of poultry pen, participation in farmers' training and awareness of climate change and was negatively and significantly influenced by farmers' age. The study recommends that government agencies and NGO should sponsor radio and television programmmes and workshops on awareness of climate change, its effects and mitigations measures that could be used to reduce the effect of climate change. Extension programme on climate change adaptation strategies in poultry farming should be intensified in Enugu state so that the state would maintain its position in poultry production in the country. The poultry farmers should endeavor to strengthen their associations as these serve as forum for information, training and reception of assistance from government. These will help the farmers to increase their resilient to climate change, income and further improve their livelihood.

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Table 1: Perceived Sign of Climate Change in the Study Area

Perception	Frequency	Percentage
High temperature	204	92.7
Low temperature	104	47.3
Increase in total rainfall	190	86.4
Decrease in temperature	114	51.8
Variation in rainfall pattern	188	85.5
Increase in frequency of heavy wind especially at the beginning and ending of rainy season	125	56.8
Increase in flooding	133	60.5
Dry spell	112	50.9
Drought	99	45.0
Increase in intensity of heat	200	90.9
Decrease in number of sun shine days during rainy season	114	52.0
Increase in duration of coldness during rainy season and harmattan	119	54.2
Increase in frequency of heavy rains	174	79.0

Table 2: Perceived Effects of Climate Change on Poultry Production in Enugu State

Perceived Effect	Total	Mean	Decision
Decrease in income and profitability	700	3.18	S
Decrease in feed consumption by the birds	702	3.19	S
Displacement of the poultry farmers as a result of flooding	460	2.09	NS
High cost of feeds	695	3.16	S
Heat stress in the poultry house	702	3.19	S
Low quantity and quality of egg produced	675	3.07	S
Reduction in meat production	653	2.97	S
Soft egg shell	468	2.13	NS
Increase in mortality rate of the birds	711	3.23	S
Reduction in the water intake by the birds	695	3.16	S
Decrease in body weight	684	3.11	S
High rate of disease and parasite incidence	719	3.27	S
Frequency of shivering of birds especially during cold weather	506	2.30	NS
Body weakness and sleepiness	618	2.81	S

S = Serious; NS = Not serious

Table 3: Adaptation of Climate Smart Poultry Production Practices in the Study Area

Climate Smart Poultry Production Practice	Frequency	Percentage
Fumigation of poultry pens before stocking	196	89.0
Prompt cleaning of equipment	203	92.4
Bio-security measures – use of foot mat and washing of hands etc	176	80.0
Prompt vaccination and use of other drugs on birds	208	94.5
Proper housing system	216	98.3
Proper feeding	214	97.4
Tree planting around the poultry house	213	96.8
Proper stocking density	188	85.6
Adjusting stocking period to the time of favourable weather	140	63.8
Rearing more than one breed of bird	121	55.2
Provision of enough ventilation	213	96.8
Provision of clean and cool water to the birds during heat period	116	62.9
Insurance of the poultry farm	62	28.4
Use of energy efficient bulbs	158	72.0
Use of solar energy to power the poultry house	89	40.5
Prompt removal of the poultry droppings	199	90..6
Diversification (poultry and crop/non-farming activities)	190	86.5
Prompt burning of dead birds	128	68.4
Use of disinfectant on the poultry waste	80	36.2
Ensuring proper measures to prevent predators	160	72.7

Table 4: Determinants of Adaptation of Climate Smart Poultry Production Practices

Variables	Coefficient	Standard Error	t-values
Constant	6651.804	586.90	11.334***
Age	-891.993	458.844	-1.944*
Education	648.511	272.026	2.348**
Income	399.629	79.134	5.050***
Household size	-35.354	350.030	-0.101
Experience in poultry farming	420.526	214	1.962*
Contact with extension staff	220.904	360.365	0.613
Membership of poultry farmers' association	52.349	15.720	3.330***
Access to climate change information	-69.215	528.359	-0.131
Access to credit	--230.946	206.202	-1.120
Size of poultry pen	509.856	166.456	3.063***
Awareness of climate change	257.252	126.166	2.039**
Participation in farmers' training	-267.550	1288.691	2.079**
R^2		0.75	
F-ratio		11.942	

***, **, and * = Significant at 1%, 5%, and 10% levels

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The Perceived Effects of Technology on Rice Production in Afikpo North Local Govt Ebonyi State, Nigeria

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ABSTRACT
Rice has become an important staple food for over half the world's population, with 480 million metric tons of milled rice produced annually. In Nigeria, rice production has failed to keep pace with the growing domestic demand, leading to an increase in rice imports. This rapid increase in rice demand is largely due to population growth, increased urbanization and people's preference for rice as a convenience food. This research aimed to determine the perceived effects of technology in rice production in Afikpo North, Ebonyi State. A sample of 364 was drawn from the population using purposive sampling. Findings showed that technology plays an active role in rice production and there are factors that encourage and militate against the application of technology in rice production.
Keywords: Rice, technology and Production

INTRODUCTION
Over the years, Rice has become an important staple food for over half the world's population and the most important among all the cereal crops (Khush, 1997; Dogara & Jumare, 2014). Rice is very important in Nigeria, based on the various ways it can be used. The capability to produce more rice has aided in development of numerous communities, while its failure has led to the spread of starvation, death and political uncertainty in many countries including Nigeria (Seck et al., 2012; Oludare, 2014). The acceptance of rice as food has witness an upsurge lately by becoming a major crop in many countries in America and Africa (Seck et al., 2012). Local dishes prepared with rice in Nigeria most especially the northern part include "Masa", or "Waina", "Tuwo", and "Alkakki", while the most common form of food prepared with rice all over the country include pudding and boiled form eaten with stew, jollof fried, coconut rice or combined with potatoes, beans and pears (Oludare, 2014). Despite many policies made by Nigerian government in the rice sector, rice production has failed to keep pace with the growing domestic demand. The demand for rice will continue to grow in Nigeria, due to rapid growth in population (IFPRI, 2016). A comprehensive and up to date picture of the rice sector in general and rice production and processing in particular was lacking (Akpokodje et al., 2001). The need to bridge the gap between rice demand, and supply has led to increases in rice imports. It was reported that Nigeria spent N1billion per day on rice imports in 2013 (Onyekwena, 2016). Nigeria ranked as the highest importer of rice in West Africa, and the second largest rice importer in the world, after Indonesia (Onyekwena, 2016). The practice of subsistence agriculture on marginal lands and low resource utilization is no longer feasible for sustaining farm families in Afikpo North Local government area. There has therefore arisen the need for the development of farming systems that stems from the need to integrate components and resources

of farming families in order to minimize costs and maximize positive outcomes. This development of farming systems arises in a bid to ensure the sustainability of farmers' livelihood. Advanced rice technologies include all kinds of improved techniques and practices which affect the growth of rice output (Jaine, Arora & Raju, 2009). Advanced rice technologies are seen as an important way out of poverty in most of the developing countries because they help in increasing rice yields and income (Margaret & Samuel 2015). Unfortunately, the majority of rice farmers in Afikpo North rely on traditional methods of production and this has lowered their level of productivity.

Afikpo North local Government area is credited as one of the highest rice producing local government areas in Ebonyi state Nigeria; however, the total produce of the area has not been enough to meet with the total demands for rice. There have been many reasons that account for these, some of which includes, lack of incentives to farmers, poor demand for locally produced products, insecurity, lack of funds, shortage of man power, unwillingness to adapt to advance technology as well as little or absence of government intervention. Despite these setbacks, farmers have continued to find ways to increase farm income and productivity (Nwite *et al*, 2008).

It is widely agreed that Afikpo North has great potential to greatly enhance productivity in rice production and processing. It is one of the largest rice producing local government areas of the country (Chukwuemeka 2005). Though the rice locally produced and processed do not compare the foreign rice products. It is therefore a problem of this research, to determine the available technology that affects rice production, examine the various value chains in the production and processing of rice in the area, as well as to identify the perceived effects of technology on rice production in Afikpo north local government in Ebonyi state factors that technology in Ebonyi State. Which arise the following questions:
What are the Socio-economic characteristics of Rice producers in Afikpo North?
What are the perceived effects of technology on rice business to the study area?
What are the factors militating against rice production in Ebonyi State?

METHODOLOGY

The Study Area

The study covers the major villages in Ehugbo often referred to as Afikpo, is the second largest urban area in Ebonyi State, Nigeria. It is the headquarters of the Afikpo North Local Government Area. It is situated in the southern part of Ebonyi State and is bordered to the north by the town of Akpoha, to the south by Unwana, to the south west by Edda LGA, to the east by the Cross River State and to the west by Amasiri town. Afikpo spans an area approximately 164 km^2 (63 sq mi). It is located on 6 degrees north latitude and 8 degrees east longitude. Afikpo is a hilly area despite occupying a region low in altitude, which rises 350 feet (110 m) above sea level. It is a transitional area between open grassland and tropical forest and has an average annual rainfall of 79 inches (2,000 mm). The primary occupation of the inhabitant includes: fishing, farming, and trading. They are considered one of the major producers of agricultural products in Nigeria. These include rice, yam, palm produce, maize, groundnut, plantain, banana, cassava, fruits and vegetables. The population of Afikpo is estimated at 156,611, according to the Nigerian 2006 Census (Wikipedia).

The study adopted non-probability sampling method, using purposive sampling. Non-probability methods are used in situations where a sampling frame is not available and cannot be improvised due to some difficulties and it may not be possible to sample the study units such that the probability for different units to be selected is known.

Non-probability sampling method includes convenience sampling, purposive sampling and quota sampling. (Leary 2001) argued that in purposive sampling: The researcher uses his/her judgment to decide which of the respondents to include in the sample. Trying to choose respondents who are typical of the population.

The methods used in data collection depend largely on the type of data being considered. The information from the field was gathered through the administration of questionnaires. This information was directly related to the research problems and objectives. The questionnaire is a list of questions design to collect information on aspect of research problems from the respondents on the field. Closed and open ended questions was made use of. Closed ended questionnaires limits the opinions of the respondents to the options available in the questionnaire: Options was provided and the respondents questions were expected to choose from the options. On the other hand, the

open ended questionnaire allows respondents to give their own opinions in their own words. The questionnaire was divided into two sections: the first section contained demographic characteristics such as age, gender, marital status while the other section seek data that aided the researcher's study. A total of 346 questionnaires were used out of the 400 that was distributed.

RESULTS AND DISCUSSION

This work adopted a quantitative empirical strategy. Hence this work was analyzed using tables, percentages, and descriptive analysis in the study.

Table 1 Socio-Economic Characteristics of Respondents

Variables/responses	Frequency	Percentage
Age Distribution of Respondents		
Age		
18 – 30	70	20.0
31 – 40	209	61.0
41 and above	67	19.0
Total	**346**	**100.0**
Religious disposition of respondent		
Religion		
Christianity	299	86.0
Islam	47	14.0
Others	0	0.0
Total	**346**	**100.0**
Distribution of Marital Status of Respondents		
Status		
Single	27	7.0
Married	293	85.0
Divorced	7	2.0
Widowed	0	0.0
Total	**346**	**100.0**
Occupational Distribution of Respondents		
Place of Work		
Personal business/farming	97	28.0
Full time Farming	117	34.0
Civil servants/Farming	32	9.0
Total	**346**	**100.0**
Educational Distribution of Respondents		
Qualification		
Tertiary Education	143	41.0
Primary/Secondary School Education	203	59.0
No formal education	0	0.0
Total	**346**	**100.0**
Do you own an asset like television		
Options		
YES	141	41.0
NO	205	59.0
Total	**346**	**100.0**
Do you have mobile phone		
Options		
YES	307	89.0
NO	39	11.0
Total	**346**	**100.0**
Do you have rice farming experience		
Options		
YES	289	84.0
NO	57	16.0
Total	**346**	**100.0**
Are you a member of cooperative		

Variables/responses	Frequency	Percentage
Options		
YES	206	60.0
NO	150	40.0
Total	**346**	**100.0**
Do u have a tricycle		
Options		
YES	17	5.0
NO	329	95.0
Total	**346**	**100.0**
Do u have a bicycle		
Options		
YES	322	93.0
NO	24	7.0
Total	**346**	**100.0**
Are you a member of any farmer group		
Options		
YES	301	87.0
NO	45	13.0
Total	**346**	**100.0**

Source: Field Survey, 2023

Table 2: Perceived effects of technology on rice production

Variables	Strongly Disagree		Disagree		Undecided		Agree		Strongly agree	
	F	%	F	%	F	%	F	%	F	%
Do you adopt the improved rice varieties	28	8.1	88	25.4	18	5.2	112	32.4	100	28.9
Do you adopt the use of fertilizer application in your rice production	24	6.9	48	139	54	15.6	128	37	92	26.6
Do you think that application of Technology will increases the total output of rice produce in afikpo north.	28	8.2	40	11.6	26	7.5	148	44.8	104	30.1
Do you accept the use of agrochemicals in your rice production	32	9.2	24	6.9	18	5.2	140	40.5	132	38.2
Do you think mechanized harvesting will increase the output of rice production in afikpo north.	40	11.6	62	17.9	0	0	124	35.9	120	34.7

Source: Field Survey, 2023

Table 3: Factors militating against rice production in Afikpo North

Variables	Strongly Disagree		Disagree		Undecided		Agree		Strongly agree	
	F	%	F	%	F	%	F	%	F	%
Inadequate Financial empowerment	30	8.6	64	18.5	8	2.3	82	23.7	162	46.8
Lack of demand for locally produced rice	40	11.6	62	17.9	0	0	124	35.9	120	34.7
Inadequate technology needed to boost production	32	9.2	24	6.9	18	5.2	140	40.5	132	38.2
Inadequate awareness for modern farming technology in rice production	28	8.2	40	11.6	26	7.5	148	44.8	104	30.1
Lack of interest by Farmers to adopt the Modern technology in rice production	100	28.9	31	8.9	15	4.3	100	28.9	100	28.9

Source: Field Survey, 2023

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CONCLUSION AND RECOMMENDATIONS

Few of the farmers agreed to adopt the improved variety of rice seeds technology, site-specific-nutrient technology, direct-seeded-rice technology and pests and diseases technology. Majority of the respondent agree that most rice farmers in Afikpo North are not properly empowered by the government, Lack of domestic demand for locally produced rice, Farmers are not properly equipped with sophisticated technology needed to boost production, and farmers in Afikpo North are illiterates and are not conversant with modern farming technology making them unwilling to embrace modern technology in rice production. This has adversely affected rice production and marketing in the study area.

It is therefore recommended that improved rice seeds technology, site-specific-nutrient technology, direct-seeded-rice technology and pests and diseases technology need to be considered by farmers under investigation for improved outcomes. Rice farmers should also be encouraged by organizing seminars, workshops and training that enlightens them on the need to embrace modern technology since it brings about positive and productive returns. Funds in form of soft loan should be made accessible for individual farmers and cooperatives as the case may be. Government can promote rice production in Afikpo North by collaborating with international nations that are major rice producers the likes of China and India

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Assessing the Impact of Improve Cassava Varieties on Yield as Disease Management among Male Smallholder Farmers in South-east Nigeria, using Endogenous Regression Estimators

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ABSTRACT
This study assesses the impact of improved cassava varieties on yield among male farmers in Southeastern Nigeria, employing endogenous regression estimators such as Endogenous Switching Regression (ESR) and Augmented Inverse Probability Weighting (AIPW) to address selection bias and unobserved heterogeneity. The findings reveal that adoption of improved cassava varieties significantly enhances yield, with adopters experiencing approximately 9.125 kg/ha higher yields and greater economic benefits compared to non-adopters; these effects are further influenced by factors such as access to capital, proximity to markets, and participation in extension services. The results underscore the importance of promoting technology dissemination through targeted policies that improve access to credit, strengthen extension services, and foster cooperative engagement, thereby accelerating the adoption of disease-resistant cassava varieties and advancing sustainable agricultural development in the region.
Keywords: Improved Cassava varieties, yield impact, disease management, adoption, Southeast Nigeria, smallholder farmers

INTRODUCTION
Cassava is a vital staple crop in Nigeria, serving as a primary source of food, income, and employment for millions of smallholder farmers (FAO, 2020; Nweke *et al*., 2021). As the country continues to grapple with challenges such as pests, diseases, and climate variability, the adoption of improved cassava varieties has emerged as a promising strategy to enhance productivity, ensure food security, and promote sustainable agricultural development (Adebayo *et al.,* 2022; Ojo *et al*., 2023). These improved varieties are often designed to possess higher yields, resistance to pests and diseases, and tolerance to environmental stresses, thereby functioning as effective tools for disease management and yield enhancement (Akinboade and Oladipo, 2021). Despite the proven benefits of these innovations, adoption rates among smallholder farmers remain uneven, influenced by factors such as access to resources, knowledge, and market dynamics (Eze *et al*., 2022; FAO, 2021). Understanding the impact of improved cassava varieties on farmers' yields and income, particularly among male smallholders in southeastern Nigeria, is crucial for designing targeted policies and extension programs that facilitate wider dissemination of these technologies (Omoregie and Oladipo, 2022). Empirical evidence, especially through robust econometric approaches like Endogenous Switching Regression (ESR) models, provides valuable insights into the benefits, barriers, and determinants of adoption, guiding efforts to leverage agricultural innovations for rural development (Nuss *et al*., 2021). This study aims to assess the impact of improved cassava varieties on yield among male farmers in southeastern Nigeria, highlighting the role of socioeconomic and institutional factors, and offering policy recommendations to foster wider adoption and sustainable intensification of cassava production in the region.

METHODOLOGY

The study focuses on four States in Southeast Nigeria: Abia, Ebonyi, Anambra, and Imo. These regions are notable for their historical significance and remarkable agricultural productivity, particularly in cassava, which serves as a vital staple crop for millions of people (FAO, 2021). With a combined population exceeding twenty million, these states are engaged in substantial economic activities centered on agriculture. The cultural homogeneity of the region, predominantly comprised of the Igbo people, further underscores the critical role of cassava farming in the local economy and livelihoods (National Bureau of Statistics, 2021). These States were selected due to their exemplary cassava production and consumption practices, providing an optimal context for examining the impacts of cassava disease management technologies. Specifically, Abia State lies between longitudes 4°45' and 6°07' East and latitudes 7°00' and 8°10' North. Anambra State has a longitude range of 4°45' E to 6°07' E (approximately 140 km wide) and a latitude range of 7°00' N to 8°10' N (approximately 110 km wide), covering an area of roughly 4,844 km² (1,870 sq mi). Ebonyi State is situated between longitudes 7°45' E and 9°05' E and latitudes 5°45' N and 7°15' N. The sample size for this study was calculated using Cochran's Sample Size Formula, targeting a 5% margin of error and a 95% confidence level, which yielded an initial sample size of approximately 128 respondents:

$$n = \frac{Z^2 p(1-p)}{e^2} \quad (1)$$

Where,

ɳ = Minimum sample size to obtain meaningful results for a given event and risk level
e = desired level of precision, the margin of error is usually set at 5%.
P = the fraction of the population (as a percentage) that displays the attribute (i.e., estimated proportion of the population with the characteristic).
Z = the z-value, extracted from a z-table, Confidence level (typical value of the 95% confidence level will be 1.96)

A multi-stage sampling approach was employed to select participants, beginning with the random selection of the four states, followed by the identification of one agricultural zone within each state. Subsequently, one local government area (LGA) was randomly chosen from each state, and two communities per LGA were selected. Sixteen cassava farmers were then randomly identified from each community, culminating in a total of 64 smallholder farmers. Data collection was executed through a structured survey research design, utilizing an electronic questionnaire administered via Kobo Collect. Additionally, the study employed the Endogenous Switching Regression Model, facilitating a nuanced analysis of income outcomes based on the adoption status of disease management technologies among the sampled farmers. The findings derived from these methodologies aim to enhance understanding of the dynamics within cassava cropping systems and the implications of disease management interventions for improving income in the region:

$$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8 + a_9X_9 + a_{10}X_{10} + a_{11}X_{11} + a_{12}X_{12} + a_{13}X_{13} + a_{14}X_{14} + a_{15}X_15 + ei \quad (2)$$

Where,

X_1= Income (kg)
X_2= age (years)
X_3 = educational background (years) '
X_4 = Number of Extension Contacts (1,2,3)
X_5 = Capital
X_6 = household size (number)
X_7 = Distance to the nearest market (km)
X_8 = Area of land planted cassava (ha)
X_9 = Native of community (yes = 1, No = 0)
X_{10} = Farming experience (years)
X_{11} = Market Experience (years)
X_{12} = Cooperative Membership (Yes = 1, No =0)
X_{13} = Credit access (dummy, yes = 1, no = 2)
X_{14} = Adoption index
X_{15} = Improved Cassava Varieties (ICVs)

ei = error term

The equations and models presented aim to analyze the adoption of improved cassava varieties as cassava disease management technology among male farmers and its impact on yield. The probability that a farmer adopts a specific technology is given by:

$$P_{ij} = \exp(X_i\beta_j)/\Sigma^{j}_{m=1}\exp(Xi\beta j) \quad (3)$$

Where;
P_{ij} = Probability that a farmer I chooses to adopt ICV technology j
X_i = vector of observed variables
B_j = the parameters to be estimated

$$\{\text{Regime } 1 = Q_{i1}=Z_i\ \alpha_i + \mu_{ij} \text{ if } 1 = I \quad (4)$$

$$\{\text{Regime } J = QiJ = Zi\ \alpha j + \mu iJ \text{ if } 1 = J..... \quad (5)$$

Where;
I = index that denoted farmer I's choice of adopting ICV technology
Q = outcome variables for the ith farmer
Z = vector of exogenous variables;
α_i and αj are parameters to be estimated
u_i and u_{ij} = the error terms

The outcomes for different regimes are captured with equations that incorporate selectivity correction terms to address unobserved biases, allowing for the calculation of the average treatment effect on the treated (ATT) by comparing actual outcomes for adopters and counterfactual scenarios for non-adopters. This comprehensive econometric approach is used to ensure accurate data interpretation regarding the impact of ICV adoption on yield within cassava farming communities.

RESULTS AND DISCUSSION

Determinants of the Impact of Improved Cassava Varieties as Cassava Disease Management Technology Adoption on the Yield among Male Smallholder Farmers

Empirical evidence from the Endogenous Switching Regression (ESR) models underscores the nuanced impacts of improved cassava varieties on yield among male farmers in southeastern Nigeria, highlighting both the benefits of adoption and the complexities faced by non-adopters. The ESR framework effectively captures selection bias and treatment effects, providing robust insights into how adopting improved cassava varieties functions as a disease management strategy and influences productivity. The significant Wald (χ^2) statistic affirms the model's overall explanatory power, indicating that the included variables meaningfully account for variations in yield among male adopters (Nuss *et al*., 2021). Notably, the high negative correlation (rho = -0.926) reveals that unobservable factors negatively influence both the propensity to adopt and yield outcomes, suggesting that unmeasured barriers or risks may deter adoption and constrain productivity gains. This aligns with FAO (2019), which emphasizes the importance of targeted interventions to address such hidden factors, including risk aversion and access constraints.

The variability measure (sigma = 0.724) indicates moderate dispersion in yield responses among adopters, implying that while adoption generally enhances yield, the extent of benefit varies across individuals. The inverse Mills ratio (lambda = -0.670) points to potential disadvantages faced by non-adopters, possibly due to unobserved factors such as risk preferences or access issues, reinforcing the need for policies that mitigate these barriers to promote equitable technology uptake (FAO, 2019). The positive impact of improved cassava varieties on income (coefficient = 2.27, significant at 5%) underscores the economic benefits of adoption, corroborating studies that demonstrate technology-driven productivity improvements translate into higher farmer incomes (Okoi *et al*., 2022). This reinforces the argument for scaling dissemination efforts, especially among smallholder farmers seeking income diversification.

Financial capital emerged as a significant determinant of yield, with increased capital availability (coefficient = 1.8706, significant at 5%) facilitating investments in improved inputs and practices,

thus boosting productivity. This aligns with Mastrorillo *et al*. (2016), who highlight the critical role of financial resources in enabling technology adoption and farm expansion. Additionally, proximity to markets positively influences yield (coefficient = 0.076, significant at 1%), implying that access to markets enhances farmers' capacity to procure inputs, obtain information, and sell produce efficiently, which is consistent with findings by Adeleke *et al*. (2022) and Abid *et al*. (2023). Conversely, market experience shows a negative relationship with yield (-0.022, significant at 5%), suggesting that beyond a certain point, extensive market exposure may lead to diminishing returns, potentially due to market saturation or increased transaction costs, a pattern observed in recent studies by Smith and Johnson (2023) and Thapa *et al*. (2022). Training participation positively influences yield (coefficient = 1.134, significant at 5%), emphasizing the importance of capacity-building initiatives in enhancing farmers' technical skills and productivity, aligning with Walker *et al*. (2022).

Among non-adopters, the ESR results reveal significant factors influencing yield outcomes. The Wald χ^2 of 756.03 indicates the model's high explanatory power in distinguishing non-adopters' yield determinants. The high rho value (0.925) suggests unobservable factors jointly influence both the likelihood of adopting improved varieties and yield levels, emphasizing the importance of addressing hidden barriers like access to credit and extension services. The substantial variability (sigma ≈ 3.79) reflects diverse experiences among non-adopters, indicative of heterogeneity in resource endowments and market engagement. The positive coefficient of income (3.8906, significant at 10%) implies that higher income levels, possibly derived from better market access or higher-value markets, motivate non-adopters to improve productivity, echoing findings by Mwalilishi *et al*. (2022). Conversely, market experience exhibits a negative effect (-0.1119, significant at 5%), indicating that more extensive exposure may not necessarily translate to higher yield, possibly due to market saturation or inefficiencies, a phenomenon discussed by Tambo and Diedhiou (2023). The negative association between cooperative membership and yield (-2.7612, significant at 5%) underscores the role of cooperatives in providing resources, training, and better marketing channels, which are crucial for enhancing productivity, as demonstrated by Davis et al. (2023).

Overall, these empirical findings affirm that adopting improved cassava varieties significantly enhances yield and income among male farmers in southeastern Nigeria, especially when complemented by access to capital, training, and proximity to markets. However, they also highlight the persistent barriers faced by non-adopters, such as limited access to cooperatives and possibly unobservable constraints, which adversely affect productivity outcomes. Addressing these barriers through policy interventions—such as financial support, extension services, and cooperative strengthening—can foster wider adoption and maximize the benefits of improved cassava varieties as a disease management technology, contributing to sustainable agricultural intensification and rural livelihoods (FAO, 2019; Nuss *et al*., 2021; Okoi *et al*., 2022).

Results from the Endogenous Switching Regression (ESR) model may be sensitive to its underlying assumptions; therefore, the Augmented Inverse Probability Weighting (AIPW) approach was employed to select appropriate instrumental variables and to assess the robustness of the estimated treatment effects from ESR. The AIPW estimates presented in Table 2 clearly isolate the impacts of cassava variety adoption on yield (kg/ha). The AIPW average treatment effects on the treated (ATT) and on the untreated indicate that the adoption of improved cassava varieties (ICV) positively and significantly increases yield. Specifically, farmers who adopted ICV experienced higher yields by approximately 9.125 kg/ha compared to non-adopters. This finding underscores that the adoption of agricultural technologies plays a vital role in enhancing crop productivity and, consequently, farmers' incomes. Such technologies that effectively increase yields and address production and marketing constraints are instrumental in reducing poverty and achieving food security goals (Smith and Doe, 2022). The consistency of these results across different estimation techniques reinforces the importance of promoting the adoption of improved cassava varieties as a strategic intervention for sustainable agricultural development in Nigeria.

CONCLUSION AND RECOMMENDATIONS

The study confirms that adopting improved cassava varieties significantly boosts yield and income among male smallholder farmers, highlighting their vital role in effective disease management and sustainable productivity. To maximize these benefits, policies should focus on improving access to credit, strengthening extension services, and enhancing market infrastructure to address existing barriers to adoption. Promoting widespread dissemination of these technologies will be crucial for

achieving rural development, food security, and resilient agricultural systems in southeastern Nigeria.

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Table 1: Impact of improved cassava variety as a disease management technology on yield among male smallholder cassava farmers in south-east region, using endogenous switching regression estimates

	Male		
Variables	**Adopters**	**Non -Adopters**	**Pooled**
Income (₦)	7.2607	3.8906	.00496
	(2.27)**	(1.65)*	(1.31)
Age (yrs)	-.0003213	-.0094345	-44.74045
	(-0.04)	(-0.35)	(-1.13)
Education (Years)	-.023823	-.0781807	-71.83967
	(-1.21)	(-1.32)	(-0.80)
Number of Extension Contacts (Number)	.0662862	-.6961817	-694.4009
	(0.70)	(-0.46)	(-0.93)
Capital (₦)	1.8706	-.0000173	.0010722
	(2.05)**	(-1.10)	(0.14)
Household Size (Number)	-.0278813	.0722492	180.7137
	(-0.73)	(0.35)	(0.74)
Distance from Farm to Market (Km)	.0760099	-.2288277	-59.75377
	(2.71)***	(-0.76)	(-0.28)
Area of land planted Cassava (Ha)	.0188897	.3196011	717.0691
	(0.21)	(0.50)	(1.30)
Native of the Community (Dummy)	.2979556	-2.163235	-2218.266
	(1.12)	(-1.00)	(-1.07)
Farming Experience (Years)	-.0049337	-.0224026	-19.76597
	(-0.61)	(-0.76)	(-0.43)
Market Experience (Years)	-.0229737	-.1119412	-97.75597
	(-2.45)**	(-1.96)**	(-1.76)**
Cooperative Membership (Dummy)	.0115712	-2.761205	-956.6799
	(0.06)	(-2.20)**	(-0.74)
Credit Access (Dummy)	-.0004692	-.5855851	8.073985
	(-0.42)	(-0.77)	(1.55)
Adoption Index			-2917.662
			(-1.70)**
Improved Cassava Variety	2.277237	-5.785723	11718.04
	(5.29)***	(-1.66)*	(4.22)***
Constance	4.971821	20.10185	-998.1836
	(5.62)***		(-0.21)
Wald χ^2	104.82***	756.03***	27.23**
rho	-.9260159	.9251815	-.7274709
Sigma	.724404	3.791693	6861.943
lambda	-.6708097	3.508004	-4991.862
Log-likelihood	-72.393619	-168.03933	-1335.1525
Number of Observations	64	64	128

Table 2: Estimated treatment effects based on the aipw estimator on cassava disease management technology on income for the male adopters and non-adopters

Mean value of outcomes			
Outcomes	**Adopters**	**Non-adopters**	**Treatment Effect**
Improved Cassava Variety	9.124694	4.159244	ATE
	(6.28)***	(4.87)***	

Note: Z test reported in parentheses, ***,** and *denotes significance at 1% , 5% and 10% levels respectively.

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Exploring The Role of Legumes in Sustaining Food Security in Nigeria

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ABSTRACT
The paper reviewed the roles of legumes in the sustainability of food security in Nigeria. Legumes are indispensable for human diet in respect to their bioactive molecules and provide all nutritional and physiological beneficial effects on human health. Legumes are rich in proteins, carbohydrates, dietary fiber, vitamins and some valuable phytochemicals which exhibit important biological activities. Due to their high dietary fiber content and low fat content, legumes aid in maintenance of body weight and reduce the risk of cardiovascular disease. Legumes can be broadly grouped into oilseed legumes and non-oilseed legumes. Oilseed legumes are high in oil contents and they includes crops like soybeans and peanuts. Non oilseed legumes are those whose seeds are not primarily used for oil extraction, and they include various types of beans, peas and lentils. As part of agro ecological approaches, legumes contribute to more sustainable food systems by promoting practices that are environmentally and economically viable. It can be cultivated in diverse environments from smallholder farms to large-scale agriculture, contributing to global food security. With an increase in area of production, food security could be achieved through legume production.
Keywords: Legumes, Food security, Sustainability, Roles, Nigeria

INTRODUCTION
Food security is pressing global challenge that encompasses the availability, accessibility, utilization, and stability of food. In the quest to achieve food security, legumes have emerged as a critical component due to their multifaceted benefits in nutrition, agriculture and environmental sustainability. It's the availability of food and one's access to it (Borlaug, 2007). Legumes are crucial component of food security strategies worldwide, supporting nutrition, environmental sustainability and economic stability. They are plants in the pea family fabaceae (or leguminosae), or the fruits or seeds of such plants. When used as a dry grain for human consumption, the seeds are also pulses. Legumes are grown agriculturally, primarily for human consumption, but also as livestock forage and silage, and as soil- enhancing green manure. Legumes produce a botanically unique type of fruits- a simple dry fruits that develops from a simple carpel and usually dehisces (open along a seam) on two sides. They are significant source of protein and fiber, and many are also rich in vitamins and minerals. They includes peas, soy beans, lentils and peanuts. Some legumes are also grown as plants which include groundnuts, alfalfa, tamarinds, common beans and chick bean. Legumes are valuable world wide as a sustainability and inexpensive meat alternative and considered the second most important food sources after cereals (FAO, 2016) .Legumes are sustainable and inexpensive sources of protein, complex carbohydrates, dietary fiber, unsaturated fats, micro nutrients and important phytochemicals. Hence, their consumption could contribute to healthier life style (Messina, 2016). They are considered appropriate foods for health conscious consumers, celiac and diabetic patients as well as those concerned with weight loss. It is recommended that legumes should be incorporated in children and infants diet at home and

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through school feeding program (Messina, 2016). (Shiferaw *et al,* 2011) maintained that legumes are among the crops that feed the world. A combination of legumes with vitamin C rich foods helps to prevent anemia in women of reproductive age .Legumes are food for all ages and all animals depend on plant (Okigbo,2008; Agbogidi *et al* ., 2017; Agbogidi, 2019) Legumes are nutritional valuable food crops rich in protein and dietary fibers. They have been given economic, cultural physiological and medicinal roles owing to their possession of bioactive compounds. Their consumption has been reported to be associated with various beneficial health attributes including hypocholesterolemic and hypoglycemic properties (Ndidi *et al*; 2014; Messina, 2016) Legumes are affordable and do not require expensive irrigation system and fertilizers because they can do well in poor soil and adverse weather condition. As cover crops, they reduce erosion and have symbiotic relationship with nitrogen fixing Rhizopus resident in their root nodules thus making them excellent rotational crops. Beside nutritional demand of legumes, it is still rising globally due to their consumer awareness of their nutritional and health benefits. According to Norman *et al* (1995) and Kouris-Blazoas and Belski (2016), the following constitute the nutrients compositions of legumes:

- Protein(20-25%) generally rich in essential amino acids lysine
- They are sources of a complex, energy giving carbohydrates with up to 60% carbohydrates (dry weight)
- Legumes have no cholesterol. They are generally low in fat with the exception of peanut 45% and soybean 47%. They are rich in more and polyunsaturated fatty acids.
- They are also available source of dietary fiber (5-37%) containing significant amount of both soluble and insoluble dietary fiber.
- Legumes are good source of micronutrients like B-group vitamins and poor in fat soluble vitamins. They are sources of abundant essential minerals including zinc, iron, calcium, selenium, phosphorus, potassium, magnesium and chromium with great roles in enzyme activity, iron metabolism, hemoglobin synthesis, bone health and other general body metabolism. Figure 1 shows the desirable attributes of legumes.

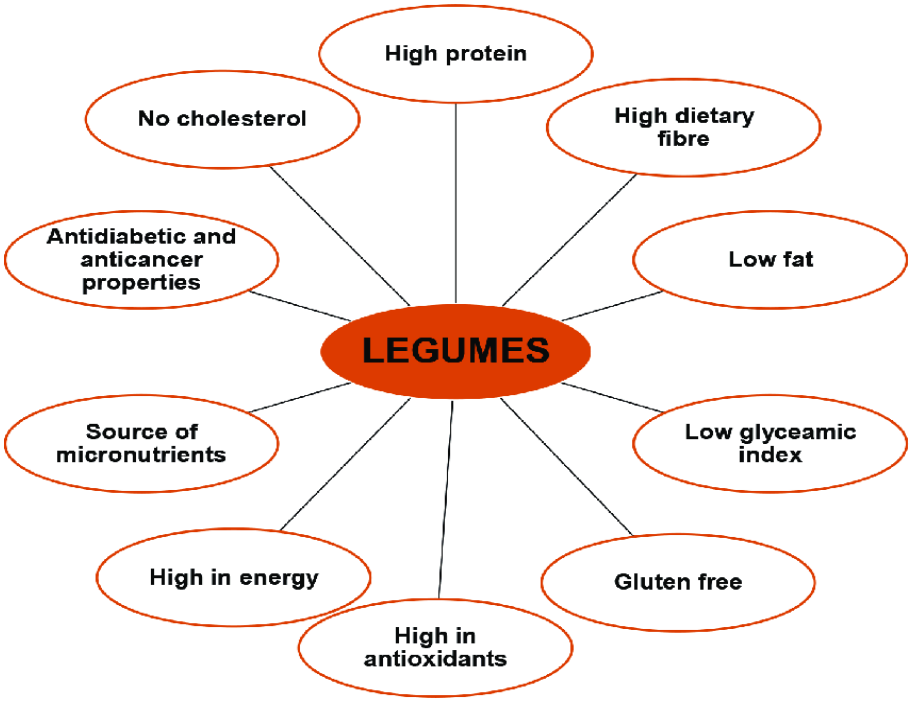

Figure 1: Desirable attributes of legumes. Source: (Qayyum *et al.,* 2012)

Legumes can be broadly grouped into oilseed legumes and non-oilseed legumes. Oilseed legumes are high in oil contents and includes crops like soybeans and peanuts. Non oilseed legumes are those where the seeds are not primarily used for oil extraction, and they include various types of beans, peas and lentils. As part of agro ecological approaches, legumes contribute to more sustainable food systems by promoting practices that are environmentally and economically viable. It can be cultivated in diverse environments from smallholder farms to large-scale agriculture,

contributing to global food security. They are also an important crop for developing countries, where they can help alleviate hunger and malnutrition. Their diverse benefit makes them an essential focus for agricultural development and food policy initiatives. Comparative protein yield of legume crops is shown in Table 1 while the area, yield and production of crop legumes in the tropics are presented in Table 2. Table 1 indicated that the average protein yield of soy bean, groundnut, beans and chick pea are appreciably high hence when efficiently harnessed could contribute to food security. Similarly, on world production and yield, with an increase in area of production, food security could be achieved through legume production.

Table 1: Comparative protein yield of legume crops

S/N	CROP	Average Tropical Yield (t ha-1)	Protein Content	Average Protein Yield (kg ha)
1	Soybean	1.34	38.0	509
2	Groundnut	0.89	25.5	227
3	Beans	0.60	22.0	132
4	Chicken pea	0.66	20.0	132

Sources: Norman *et al* (1995)

Table 2: Area, Yield, and Production of crop Legumes in the Tropic

Crop Legumes	Tropical Africa	Tropical America	Tropical Asia	Total World Tropics as % of the	World	Tropics as % of the WOrld.
Area(m ha)						
Soya bean 0.47	0.47	10.32	4.81	15.60	55.37	28
Groundnut	5.80	0.32	10.00	16.12	20.36	79
Pulse	12.00	9.36	29.34	50.70	70.38	72
Total	18.27	20.00	44.15	82.42	146.11	56
Yield (t ha $^{-1}$)						
Soyabean	0.94	1.53	0.97	1.34	1.86	72
Groundnut	0.84	1.36	0.90	0.89	1.15	77
Pulse	0.55	0.59	0.60	0.59	0.85	69
Total	0.65	1.09	0.72	0.80	1.27	63
Production (m t)						
Soyabean	0.44	15.78	4.66	20.88	103.07	20
Groundnut	4.89	0.44	9.02	14.35	23.37	61
Pulse	6.54	5.50	17.75	29.79	59.90	50
Total	11.87	21.72	31.43	66.02	186.33	35

Sources: Norman et al; 1995

Challenges of Legumes in human nutrition

Legumes, while nutritionally valuable, presents several challenges in human nutrition. These challenges include the presence of antinutritional factor like phytates, tannins and lectins, which can hinder nutrient absorption and digestion. They are however rich in alkaloids, saponins and other phytochemicals that prevents cancers, heart diseases and other chronic degenerative diseases (Kouris-Blazoas and Belski, 2016). Many legumes require soaking, cooking or fermentation to reduce the levels of antinutritional factors and improve digestibility. Some legumes can be relatively low in certain nutrient compared to animal products. For example, while legumes are a good source of protein, they may be lower in certain amino acids compared to animal proteins. Additionally, legumes can be relatively expensive, have a complex preparation process and may face challenges in their sustainable production.

Way forward

- Building economically sustainable and effective legume seed systems in Nigeria are seen as a way of boosting legume production to meet the Nigerian seed road map target. The use of legumes to improve soil nitrogen content can also be a practicable way to improve soil fertility that guarantee food security.
- Development of new legumes products hence increasing the production for commercial purposes by local Farmers could help to improve food security.
- Cooking prior to cooking to often the seeds thereby reducing the cooking time.

- The need for aggressive education worldwide about the nutritional value of legumes, genetic modification to develop transgenic leguminous species that cook fasters and have low level of anti nutrients (Messina, 2016)

CONCLUSION

Legumes are indispensable in the pursuit of food security, offering a range of benefits that encompass nutrition, agricultural sustainability, economic viability and cultural significance. Their ability to enhance soil health, provide essential nutrient in the face of climate change positions legumes as a cornerstone of sustainable food systems. Humanity is facing a lot of global challenges and the chief among these challenges is achieving food security for a rapidly growing population estimated by United Nations (2019) as 7.7 billon. Adopting legume based cropping practices can improve the food security of Nigeria. This has to do with recognizing the numerous benefits of grain legume production as well as other strategic legume species. Agbogidi *et al*., (2017) posited that global food security requires a major refocusing of plant sciences, crop improvement and production agronomy. Throughout the world, legumes of different classes are used for household food security.

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Effect of Fermentation Biotechnology on the Nutritive Value and Anti-Nutrient Content of Cassava Peels Meal

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ABSTRACT
The proximate and anti-nutritional composition of dried cassava peel meal (DCPM) and fermented cassava peel meal (FCPM) was determined. The dry matter of the FCPM 89.24%, crude fiber 13.41% and CHO 60.57% were found to be significantly (P<0.05) higher than dry matter of DCPM 88.66%, crude fiber 12.77 and CHO 58.09%. The result of the ash 8.40%, crude protein 7.84% and ether extract 0.57% of DCPM were significantly (P<0.05) higher than the ash 7.81%, crude protein 6.95% and ether extract 0.52% of FCPM. The result of the anti-nutritional factors showed that tannin 1.91 mg, hydrogen cyanide 2.51mg, saponin 1.37mg and phytate 1.79mg of DCPM were significantly (P<0.05) higher than tannin 1.81mg, hydrogen cyanide 2.28mg, saponin 1.25mg and phytate 1.25mg of FCPM. The results of the study indicate that, DCPM and FCPM are potential feed ingredients for livestock feeding.

INTRODUCTION
Cassava (Manihot esculenta Crantz.) is a woody perennial shrub that grows up to five meters in height and has large, spirally arranged, lobed leaves of variable forms (Kouakou *et al.* 2016). It is the third largest source of carbohydrates for humans and animals in tropics (FAO and IAEA, 2018). Recently, more efforts have been directed towards harnessing and utilizing by-products and wastes which are not directly utilized by man, thus converting them to value-added products that can be used in feed formulation for livestock (Atteh, 2002). One of such agro-industrial by-products with potentials of providing adequate energy in livestock feed is cassava peels and was estimated to be about 15 million metric tons in Africa as at 2015 (Okike *et al*., 2015). Most of the products produced from cassava are usually without its peels which contribute up to 13% of the cassava root (Omotosho and Sangodoyin, 2013). Cassava peels are obtained after the roots have been washed with water and peeled mechanically (Aro *et al.*, 2010). Over the years, cassava products have long been used as a major source of energy in place of cereal grain by both man and his livestock (Ikurio and Akeem, 1998). Cassava peels meal has been one feed ingredient that is consistently incorporated as a potential feed ingredient for livestock. It is a rich source of readily fermentable carbohydrates and can be used to improve the energy concentration of tropical grass silage diets (Onua and Okeke, 1999).

Despite the nutritional advantage of cassava peels, its usage is usually restricted due to the large amounts of cyanogenic glycosides and phytates. Different processes had been adopted to reduce the levels of these anti-nutritional contents such as sun-drying, fermentation, and soaking + sun-drying. Some of these methods may pose some challenges in quality and quantity of the cassava peels. Also longer period of drying may encourage the growth of mold and fungal microorganism such Aspergillus *flavus* (Clerk and Caurie, 1968) which may constitute a great risk to livestock production. Fermentation is one of the oldest technologies, having been used in food processing for over 600 years (Mortarjem, 2002). Fermentation is the reaction of oxidation reduction in

biological synthesis that results in energy production. This process also has ability to enhance the nutritional value of food, the biosynthesis of vitamins, essential amino acids, protein quality and fiber digestibility. Fermentation of cassava peels has been reported to increase protein content from 2.4% to 14% (Antai and Mbongo, 1994) also Obasi *et al*. (2017) reported an increase in crude protein level and lower levels of crude fiber of fermented cassava peels.

Therefore, the objective of this research is to evaluate the nutrient composition and anti-nutritional factors of dried cassava peels meal and fermented cassava peels meal as a potential feed ingredients for livestock.

MATERIALS AND METHODS

Sourcing and preparation of test ingredients

Cassava peels of yellow root cassava variety (Pro – vitamin A cassava variety) was harvested from a cassava farm in Ajata Ibeku Umuahia North Abia State. The roots were washed and peeled mechanically using a knife. The peels were gathered and separated into two batches. The first batch of the peels was washed, sundried for 7 days and milled, while the second batch was washed, drained, allowed to wilt for two days to reduce the moisture content and was further cut into smaller particle sizes (2-4mm) to allow easy compaction for fermentation. It was fermented for 14 days in an air tight container. After 14 days, the fermented cassava peels were sundried for 7days and milled. The milled cassava peels meals (non-fermented and fermented) were subjected to laboratory analysis at the Institute of agricultural research and Training Laboratory, Ibadan to assess the nutrient composition and anti-nutrients contents.

Determination of Proximate composition of Dried Cassava Peel Meal (DCPM) Fermented Cassava Peel Meal (FCPM)

Samples of test ingredients (DCPM and FCPM) were analysed for proximate composition according to the methods of A.O.A.C. (2010).

Determination of Anti-nutritional composition of Dried Cassava Peel Meal (DCPM) Fermented Cassava Peel Meal (FCPM)

Samples of test ingredients (DCPM and FCPM) were analysed for anti-nutritional composition. Tannin and phytate was determined according to the methods of Maga (1983), spectrophotometric method of Brunner (1983) was used to determine saponin, while oxalate was determined according to the procedure of Fasset, (1996) and HCN was determined according to the methods of FIIRO (2004)

Data analysis

All data analyses were done using IBM SPSS version 20.0. The data were then analysed using independent T-test

$$t = \frac{x_1 - x_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_1^2}{n_2}}}$$

t = student's t-test
x_1 = mean of first group
x_2 = mean of second group
s_1 = standard deviation of group 1
s_2 = standard deviation of group 2
n_1 = number of observations in group 1
n_2 = number of observations in group 2

RESULTS AND DISCUSSION

Proximate composition of DCPM and FCPM

The proximate composition of dried cassava peels meal (DCPM) and fermented cassava peels meal (FCPM) are shown in table 1 (Appendix). The result of the dry matter, crude fibre and CHO showed the same level of significances where FCPM was significantly ($P<0.05$) higher than DCPM. The result of the ash, crude protein and ether extract showed that DCPM was significantly ($P<0.05$) higher than FCPM.

The result of the proximate composition of DCPM and FCPM showed that cassava peels meals are potential feed ingredients for livestock feeding, as they contained appreciable amount of various

nutrients. Crude protein value was decreased in FCPM as compared to DCPM; this may be due to prolonged period of fermentation. This result agrees with the report of Obasi et al. (2017) and Boonnop (2014). The result also indicates that fermentation did not show any consistent effect on crude fiber and crude protein. The result of the crude fiber agrees with the report of Olufunke *et al*. (2010) who observed that fermented cassava peels had higher crude fiber than the unfermented cassava peels. The CHO values showed an increase level in FCPM which does not agrees with the report of Oboh and Elusiyan (2007) who reported a decreased level of CHO content of cassava flour treated with S. cerevisae. The report of Obasi *et al*. (2017) and Oboh and Akindahunsi (2003) agrees with the observed pattern in this study with DCPM.

Anti-nutritional composition and pH of DCPM and FCPM

Table 2 (Appendix) showed the anti-nutritional composition of DCPM and FCPM. The result showed that the tannin, HCN (Hydrogen cyanide), saponin and phytate were significantly ($P<0.05$) higher in DCPM than FCPM, while oxalate did not show any significant ($P>0.05$) difference. The result of tannin, saponin, oxalate and phytate were below the values obtained by the report of Amaza (2021), it also showed that result of all the anti-nutritional factors obtained in this study were all below the threshold of lethal levels and therefore safe for animal consumption. The result of the HCN is in agreement with the study of Olufunke *et al*. (2010), it also agrees with the report of Sudharmono *et al.* (2016), where it was observed that cyanides reduced more in fermented as compared to unfermented cassava peels. The levels of cyanides obtained in this study are lower than the tolerable level (100ppm). Generally, no feedstuff is free from toxic substances; it is the concentration of the toxic constituents that determines the edibility of the food. The concentration of anti-nutrients is highly variable; the levels that researchers find when they analyze a specific feedstuff probably depends on growing conditions, harvesting techniques, processing methods, testing methods and even the age of the feedstuff being tested (Srivastava, 1955).

CONCLUSION

The results from the proximate analysis showed that cassava peels have the potential to serve as a valuable source of nutrients for livestock feed. The values of anti-nutrients recorded were all below the threshold of lethal levels and therefore safe for animals' consumption.

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Table 1: Proximate composition of dried cassava peels meal (DCPM) and fermented cassava peels meal (FCPM)

Parameters %	DCPM	FCPM
Dry matter	88.66^{b}±0.03	89.24^{a}±0.02
Ash	8.40^{a} ±0.04	7.81^{b} ±0.10
Crude protein	7.84^{a} ±0.02	6.95^{b} ±0.01
Ether extract	0.57^{a} ±0.01	0.52^{b} ±0.00
Crude fibre	12.77^{b}±0.03	13.41^{a} ±0.01
CHO	58.09^{b}±0.15	60.57^{a} ±0.06

CHO: Carbohydrate; DCPM: dried cassava peels meal; FCPM: fermented cassava peels meal (FCPM); Values are mean± standard deviation for DCPM and FCPM.

Table 2: Anti- nutritional compositions of DCPM and FCPM

Parameter (mg/100g)	DCPM	FCPM
Tannin	1.91^{a}±0.02	1.81^{b}±0.01
HCN	2.51^{a}±0.02	2.28^{b} ±0.02
Saponin	1.37^{a}±0.01	1.25^{b} ±0.01
Oxalate	1.18±0.02	1.09±0.01
Phytate	1.79^{a}±0.01	1.25^{b}±0.01

Values are mean± standard deviation for DCPM and FCPM. HCN: Hydrogen cyanide

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Analysis of Men and Women Involvement in Oil Palm Fruit Processing in Imo State, Nigeria

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ABSTRACT

*The study analyzed men and women involvement in oil palm fruit processing in Imo State. The study specifically identified the methods used by men and women in the processing of oil palm fruits, ascertained the level of involvement of men and women in oil palm fruit processing and examined the constraints faced by men and women in oil palm fruit processing in the study area. Multi-stage sampling procedure was adopted in selecting 240 respondents comprising 120 men and 120 women oil palm processors for the study. Data for the study were collected with the use of structured questionnaire and analyzed with the use of both descriptive (frequency, percentage and mean) and inferential statistics (Z-test). The results revealed that semi-modern (52.50%) and modern (38.33%) methods were the major methods used by men in the processing of oil palm fruits in Imo State. The results also revealed that semi-modern (60.00%) and modern (29.17%) methods were the major methods used by women in the processing of oil palm fruits in the study area. The results also showed that men ($\bar{x}$ = 2.45) and women ($\bar{x}$ = 2.76) were highly involved in oil palm fruits processing activities in the study area. Unavailability of improved technology and equipment ($\bar{x}$ = 2.27), poor access to improved seedlings ($\bar{x}$ = 2.26), inadequate land ($\bar{x}$ = 2.21) and distance to processing mills ($\bar{x}$ = 2.19) were serious constraints faced by men in oil palm fruit processing in Imo State. The results also showed that unavailability of improved technology and equipment ($\bar{x}$ = 2.43), inadequate land ($\bar{x}$ = 2.41), poor access to improved seedlings ($\bar{x}$ = 2.35) and distance to processing mills ($\bar{x}$ = 2.16) were serious constraints faced by women in oil palm fruit processing in Imo State. The Z–test result revealed a significant difference (2.453**) in the level of involvement of men and women in oil palm fruit processing at 5% level of probability. The study concluded that both men and women were highly involved in oil palm fruit processing in the study area. The study therefore recommended that the State government gears up efforts in providing adequate infrastructure such as processing mills and modern,efficient processing equipment which would further enhance men and women involvement in oil palm fruit processing in the study area.*

Keywords: Oil palm, analysis, men, women, involvement, oil processing.

INTRODUCTION

Oil palm (*Elaeis guineensis*) is one of the most economically significant oil crops to have been cultivated in Nigeria (Adeomi and Fadoju, 2023). The high demand for palm oil is making oil palm cultivation become a means of livelihood for many rural families, and indeed the farming culture of millions of people in Southeast Nigeria, Imo State inclusive (Onu, Ekwe and Onuekwusi, 2021). In Nigeria, oil palm serves as a crucial livelihood resource for many rural families, particularly

smallholder farmers who cultivate it as a communal cash crop (Abushe, Ikenga, Umehai, Emenim, Ototoh and Ofuoku, 2025).

In Nigeria, oil palm fruit processing is an economically significant activity, particularly in Southern Nigeria. Oil palm fruit processing is defined as a process by which palm fruits are processed into palm oil through threshing or stripping, milling and digestion, pressing and clarification (Onu *et al.,* 2021). Oil palm fruit processing involves harvesting, threshing or bunch quartering, fruit loosening, boiling, digestion, pressing/oil extraction, clarification and packaging/storage (Adeomi and Fadoju, 2023). Oyeronke and Adedotun (2019) stated that oil palm fruits can be processed by using the traditional method or industrial method. Traditionally, the process of producing palm oil involves distinct gender roles with women primarily responsible for tasks such as carrying harvested bunches and processing while men typically engage in activities related to land preparation and maintenance and harvesting of bunches (Abushe *et al.,* 2025). Onu, Ekwe and Nwachukwu (2021) also reported that oil palm fruit processing is mostly carried out by women under manual and subsistence methods in Southeast Nigeria, Imo State inclusive.

However, despite oil palm processing being a major economic activity of rural households in Imo State, Adam (2018) opined that men and women involvement in agricultural activities is still a challenge due to the disparity in access to agricultural resources by both men and women notwithstanding the equal roles they play in agricultural activities. Similarly, Esu and Akam (2023) noted that unequal access to resources by men and women results in different levels of their involvement in the production, processing and marketing of high-rated crops such as oil palm. Onu *et al.* (2021) also reported that rural households in Imo State faced constraints such as lack of modern processing equipment, lack of infrastructure, high cost of labour and difficulty in obtaining credit facilities in oil palm processing. Obviously, oil palm fruit processing activities are dominated by smallholders located in the rural communities of Imo State. These smallholders account for the greater percentage of palm produce output in the State but their output cannot even satisfy local demands both quantitatively and qualitatively (Onu *et al.,* 2021). For rural poor households, the traditional method of oil palm processing is very tedious and labourious compared to mechanical methods and requires a substantial proportion of labour force. Similarly, Nwandu, Ike, Okonye and Onwuaroh (2021) noted that traditional oil palm processing is labour-intensive and involves the following activities; threshing, picking, parboiling, digestion, extraction and separation and these result in the production of low-quality palm oil with a high proportion of free fatty acid (FFA) contents and a large quantity of dirt and water. This suggests the need for the increased involvement of men and women in oil processing activities in order to increase palm oil output to bridge the demand-supply gap. However, the level of involvement of men and women in oil palm fruit processing in Imo State has not been extensively studied.

Onyinyechukwu (2023) noted that gender inequality in access to land and other farm inputs has been identified as one of the causes of the declining productivity in agriculture in various parts of Nigeria, Imo State inclusive. Chakma, Ruba, Senthi and Rahman (2021) also reported that women have limited access to resources such as land, capital, input, technology, training, and marketing facilities as well as farm machinery, and transport equipment. These could have huge implications for the level of involvement of men and women in oil palm fruit processing in the study area. Onu *et al.* (2021) noted that the scarcity of gender-disaggregated data was the biggest constraint to the effective recognition of the roles and levels of involvement of men and women in agro-enterprises. It is against this backdrop that the study sought to empirically analyze men and women involvement in oil palm fruit processing in Imo State. The broad objective of this study was to analyze men and women involvement in oil palm fruit processing in Imo State. The specific objectives include the following: identify the methods used by men and women in the processing of oil palm fruits; ascertain the level of involvement of men and women in oil palm fruit processing and examine the constraints faced by men and women in oil palm fruit processing in the study area. It is hypothesized that (i) There is no significant difference in the level of involvement of men and women in oil palm fruit processing in the study area.

METHODOLOGY

The study was carried out in Imo State. Imo State is one of the Southeastern States of Nigeria. The State is subdivided into 27 Local Government Areas (LGAs). The State has a population of 4.6 million persons with women constituting about 2.7 million (National Bureau of Statistics, 2017). The State lies between latitude 5°10'N and 6°35' and longitudes 6°35'E of the Equator and 7°28'E of the

Greenwich Meridian. It is bounded on the East by Abia State, on the West by Anambra and Rivers States, on the North by Isu and Isiala Mbano Local Government Area of the State (Imo State Agricultural Development Programme (ISAP), 2015). The major crops cultivated include cassava, yam, maize, cocoyam, plantain, banana, oil palm, melon and vegetables. The animals reared include pigs, poultry, sheep, goats, rabbits, snails and apiculture (Mgbada, Ohajianya, Nzeh, Unaeze, Nwibo and Nwachukwu, 2021). Agriculture in the State is practiced by both men and women.

Multistage sampling procedure was adopted for the study. In the first stage, the three (3) agricultural zones (Okigwe, Orlu and Owerri) that make up Imo State were selected. In the second stage, two Local government areas (LGAs) were purposively selected from each of the three zones making a total of six LGAs. The purposive selection was based on the intensity of oil palm processing activities and the presence of oil processing mills. In the third stage, two communities were randomly selected from each of the six LGAs making it a total of twelve (12) communities. In the final stage, simple random sampling technique was used to select ten (10) men oil palm processors and ten (10) women oil palm processors respectively from each of the 12 (twelve) selected communities, which gave a grand total of one hundred and twenty (120) men oil palm processors and one hundred and twenty (120) women oil palm processors for the study. Primary data were obtained with the aid of structured questionnaire, and analyzed using descriptive and inferential statistics such as frequency, percentages, means and Z-test.

Model Specification

To identify the methods used by men and women in the processing of oil palm fruits was realized using frequency and percentages. To ascertain the level of involvement of men and women in oil palm fruit processing was realized using mean scores. The rating scores were assigned as follows: Not involved = 1; occasionally involved = 2; always involved = 3. The options were quantified as 1, 2 and 3. The mean of 1, 2 and 3 equals 2.0 i.e. 1+2+3/3 = 2.0. For the purpose of decision making, any mean score response ≥ 2.0 was adjudged to be a high level of involvement in oil palm fruit processing, while a mean score that is < 2.0 was adjudged to be a low level of involvement in oil palm fruit processing in the study area. To examine the constraints faced by men and women in oil palm fruit processing in the study area was realized using a 3 point rating scale of; very serious = 3, serious = 2, not serious = 1. In using the 3 point rating scale, a mid-point was obtained by adding 3, 2 and 1 which gave 6 and when divided by 3 gave a mean score of 2.0. For the purpose of decision making, any mean score response ≥ 2.0 was adjudged to be a serious constraint, while a mean score that is < 2.0 was adjudged not to be a serious constraint faced by men and women in oil palm fruit processing in the study area.

The hypothesis testing for significant difference in the level of involvement of men and women in oil palm fruit processing in the study area was estimated using Z-test. Given as:

$$Z_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S^2\bar{x}_1}{n_1} + \frac{S^2\bar{x}_2}{n_2}}} \quad (1)$$

Where,

$\bar{x}_1$ = mean responses of men on their level of involvement in oil palm fruit processing.
$\bar{x}_2$ = mean responses of women on their level of involvement in oil palm fruit processing.
$S^2\bar{x}_1$ = variance of the mean responses of men on their level of involvement in oil palm fruit processing.
$S^2\bar{x}_2$ = variance of the mean responses of women on their level of involvement in oil palm fruit processing.
n_1 = sampled number of men involved in oil processing.
n_2 = sampled number of women involved in oil processing.

RESULTS AND DISCUSSION

Methods used by men and women in the processing of oil palm fruits

The methods used by men and women in the processing of oil palm fruits is presented in Table 1. The result in Table 1 revealed that semi-modern (52.50%) and modern (38.33%) methods were the major methods used by men in the processing of oil palm fruits in Imo State. The result also revealed that semi-modern (60.00%) and modern (29.17%) methods were the major methods used by women in the processing of oil palm fruits in the study area.

Table 1: Methods used by men and women in the processing of oil palm fruits

Methods of oil palm processing	Men Frequency (n = 120)	Percentage (%)	Women Frequency (n = 120)	Percentage (%)
Traditional	11	9.17	13	10.83
Semi-modern	63	52.50	72	60.00
Modern	46	38.33	35	29.17

Source: Field survey, 2019

This finding implies that men and women used a combination of both semi-modern and modern methods in the processing of oil palm fruits in the study area. The reason for the predominant use of traditional and semi-modern methods of oil palm fruit processing may be attributed to the lack of capital to purchase the modern methods of processing and lack of technical know-how on the use of the modern methods. This finding is in agreement with Adejo, Ibrahim, Opeyemi, Negedu and Oyewole (2023) who reported that female oil processors used semi-modern (76.36%) and mechanized (20.00%) methods in the processing of oil palm fruits while male processors used manual (60.00%) and semi-mechanized (23.64%) methods in Kogi State.

Level of involvement of men and women in oil palm fruit processing in the study area

Level of involvement of men and women in oil palm fruit processing in the study area is presented in Table 2.

Table 2: Ascertain the level of involvement of men and women in oil palm fruit processing in the study area

Oil palm processing activities	Men (n = 120) 3	2	1	Mean	Women (n = 120) 3	2	1	Mean
Stripping	81(67.5)	34(28.3)	5(4.2)	2.63	78(65.0)	25(20.8)	17(14.2)	2.51
Picking/removal from spikelet	44(36.7)	38(31.7)	38 (31.7)	2.05	110(91.7)	4(3.3)	6(5.0)	2.87
Sterilization	51(42.5)	43(35.8)	26(21.7)	2.21	113(94.2)	5(4.2)	2(1.7)	2.93
Fruit digestion	88(73.3)	25(20.8)	7(5.8)	2.68	83(69.2)	21(17.5)	16(13.3)	2.56
Pulp processing/extraction	92(76.7)	24(20.0)	4(3.3)	2.73	79(65.8)	38(31.7)	3(2.5)	2.63
Oil Clarification/drying	79(65.8)	24(20.0)	17(14.2)	2.52	98(81.7)	19(15.8)	3(2.5)	2.79
Nuts/Fibre separation	48(40.0)	49(40.8)	23(19.2)	2.21	107(89.2)	7(5.8)	6(5.0)	2.84
Storage of palm oil	78(65.0)	36(30.0)	6(5.0)	2.60	116(96.7)	3(2.5)	1(0.8)	2.96
Grand Mean				**2.45**				**2.76**

Source: Field survey, 2019 Note: < 2.0 = low involvement; ≥ 2.0 = high involvement; figures in parentheses are percentages

The result in Table 2 revealed that men were highly involved in pulp processing/extraction ($\bar{x}$ = 2.73), fruit digestion ($\bar{x}$ = 2.68), stripping ($\bar{x}$ = 2.63), storage of palm oil ($\bar{x}$ = 2.60) and oil clarification/drying ($\bar{x}$ = 2.52). The result also revealed that women were highly involved in storage of palm oil ($\bar{x}$ = 2.96), sterilization ($\bar{x}$ = 2.93), picking/removal from spikelet ($\bar{x}$ = 2.87), nuts/fibre separation ($\bar{x}$ = 2.84), oil clarification/drying ($\bar{x}$ = 2.79), pulp processing/extraction ($\bar{x}$ = 2.63), fruit digestion ($\bar{x}$ = 2.56) and stripping ($\bar{x}$ = 2.51). This implies that men and women were highly involved in oil palm fruits processing activities in Imo State. However, there was a higher involvement of women ($\bar{x}$ = 2.76) in oil palm fruits processing activities than men ($\bar{x}$ = 2.45) in the study area. The high involvement of men and women in oil palm fruits processing could be attributed to the fact that rural households perceived oil palm processing activities as major sources of livelihood in the study area. This finding is in consonance with Ajaero, Umunakwe and Anele (2021) who reported that the majority (41.4%) of sampled women in Imo State were actively involved in oil palm processing at various stages, and perceived oil palm processing as a source of income and employment. The result also agrees with Adejo *et al.* (2023) who reported that women (62.5%) and men (37.5%) were involved in oil palm processing in Kogi State.

Constraints faced by men and women in oil palm fruit processing in the study area.

Constraints faced by men and women in oil palm fruit processing in the study area is presented in Table 3.

Table 3: Constraints faced by men and women in oil palm fruit processing in the study area

Constraints	Men (n = 120)			Mean	Women (n = 120)			Mean
	3	2	1		3	2	1	
High cost of milling	16(13.3)	17(14.2)	87(72.5)	1.41	4(3.3)	34(28.3)	82(68.3)	1.35
Lack/inadequate land	51(42.5)	43(35.8)	26(21.7)	2.21	63(52.5)	43(35.8)	14(11.7)	2.41
Poor access to improved seedlings	56(46.7)	39(32.5)	25(20.8)	2.26	66(55.0)	30(25.0)	24(20.0)	2.35
Cultural belief	0(0.0)	25(20.8)	95(79.2)	1.21	0(0.0)	21(17.5)	99(82.5)	1.18
Unavailability of improved technology and equipment	44(36.7)	64(53.3)	12(10.0)	2.27	65(54.2)	41(34.2)	14(11.7)	2.43
Lack of knowledge of use of improved technology	33(27.5)	21(17.5)	66(55.0)	1.73	33(27.5)	22(18.3)	65(54.2)	1.73
Distance to processing mills	44(36.7)	55(45.8)	21(17.5)	2.19	42(35.0)	55(45.8)	23(19.2)	2.16
Method of processing	9(7.5)	71(59.2)	40(33.3)	1.74	7(5.8)	71(59.2)	42(35.0)	1.71
Grand Mean				**1.88**				**1.92**

Source: Field survey, 2019. $\bar{x}$ < 2.0 = not severe constraint; $\bar{x}$ ≥ 2.0 = severe constraint; figures in parentheses are percentages

Table 3 showed that unavailability of improved technology and equipment ($\bar{x}$ = 2.27), poor access to improved seedlings ($\bar{x}$ = 2.26), inadequate land ($\bar{x}$ = 2.21) and distance to processing mills ($\bar{x}$ = 2.19) were serious constraints faced by men in oil palm fruit processing in Imo State. The result also showed that unavailability of improved technology and equipment ($\bar{x}$ = 2.43), inadequate land ($\bar{x}$ = 2.41), poor access to improved seedlings ($\bar{x}$ = 2.35) and distance to processing mills ($\bar{x}$ = 2.16) were serious constraints faced by women in oil palm fruit processing in the study area. This implies that unavailability of improved technology and equipment, poor access to improved seedlings, inadequate land and distance to processing mills were serious constraints faced by men and women in oil palm fruit processing in Imo State. Oil palm processors in the rural areas may lack the required capital to afford improved technology and equipment needed for oil palm fruit processing. This result further implies that men and women faced similar constraints in oil palm fruit processing in the study area. However the grand mean scores of 1.88 and 1.92 for men and women respectively reveal that women oil processors were faced with more constraints than men in oil palm fruit processing in the study area. This calls for urgent steps by the extension agencies, ministry of agriculture, non-governmental organizations and other related stakeholders in the agricultural sector to implement policies that would assist in addressing the identified constraints faced by oil palm processors in the study area. This finding is in conformity with Onu *et al.* (2021) who reported that high cost of labour (88.9%), lack of infrastructure (82.2%), lack of modern processing equipment (80.0%) and difficulty in obtaining credit facilities (71.7%) were major constraints to rural household engagement in processing of oil palm produce in Imo State. This finding also agrees with Alabi, Famakinwa and Akinnawonu (2020) who noted that lack of funds, poor processing facilities and transportation problems constitute the major challenges facing the oil palm industry in Nigeria.

Testing of Hypothesis

Test for significant difference in the level of involvement of men and women in oil palm fruit processing in the study area is presented in Table 4

Table 4: Z-test result of significant difference in the level of involvement of men and women in oil palm fruit processing in the study area

Mean difference in level of involvement	No. of respondents	Mean	Standard deviation	Df	Z-statistic	Z-tab
Mean level of women involvement [a]	120	2.758	1.136			
Mean level of men involvement [b]	120	2.450	0.859			
Difference (a-b)		0.308	1.377	119	2.453**	1.96

Source: Field survey, 2019 NB: ** = significant at P≤0.05; Df = Degree of freedom
Ho rejected at 0.05 level.

The Z-test result of significant difference in the level of involvement of men and women in oil palm fruit processing in the study area is presented in Table 4. The result shows that the mean levels of involvement of men and women in oil palm fruit processing were 2.450 and 2.758 respectively. This result implies that there was a higher involvement of women in oil palm fruits processing activities

than men in the study area. The Z-calculated value of 2.453 was also statistically significant at 5% level of probability, implying that there was significant difference in the level of involvement of men and women in oil palm fruit processing in the study area. The finding in agreement with Abushe *et al.* (2025) who reported a significant difference in gender-related tasks in oil palm processing in Delta State State at 5% level of significance.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, the study concluded that men and women were highly involved in oil palm fruits processing activities in Imo State. However, there was a higher involvement of women in oil palm fruits processing activities than men in the study area. Men and women processors also used a combination of both semi-modern and modern methods in the processing of oil palm fruits in the study area. Unavailability of improved technology and equipment, poor access to improved seedlings, inadequate land and distance to processing mills were serious constraints faced by men and women in oil palm fruit processing in Imo State. Therefore, it recommended that:

i) There is the need for the State government to gear up efforts in providing adequate infrastructure such as processing mills and equipment which would further enhance men and women involvement in oil palm fruit processing in the study area.
ii) Extension agencies, ministries of agriculture, non-governmental organizations and other stakeholders in the agricultural sector should assist in improving men and women access to improved oil palm seedlings in Imo State.

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Credit Use and Profitability of Cocoa Seeds Processing Entrepreneurs in South East-Nigeria

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ABSTRACT
The study analyzed credit use and profitability of cocoa processing entrepreneurs in South-east, Nigeria. Multi-stage and purposive sampling technique was employed in the selection of hundred and eighty (180) cocoa seeds processing entrepreneurs in the study. Data were analyzed using descriptive statistics and budgetary analysis. The findings showed average (56years, 57years, 56years, 57years respectively) age of the respondents for pooled, formal, informal and both credit users respectively. The sex of the entrepreneurs showed that majority (86.67%, 98.3%, 88.78%, 87.5% respectively for pooled, formal, informal and both credit users) were male. Level of experience showed that majority (17years, 16years, 17.8years, 18.5years respectively for pooled, formal, informal and both credit users). Majority (81.67%, 83.78%, 81.25%, 80% respectively for pooled, formal, informal and both credit users) we're married. Cocoa seed processing in Nigeria is very profitable as the cost and returns analysis of cocoa seeds processing entrepreneurs per production cycle showed that the gross profit of N3,130,909.38 and N1,540,308 for formal and informal credit users respectively. The net income of N3,029,769.28 and N1,470,868.16 for formal and informal credit users respectively. Cocoa seedlings producing entrepreneurs had gross profit of ₦2,319,717 and ₦1,057,358.5 for formal and informal credit users respectively. Furthermore, it is recommended that government should provide credit, and other modern facilities to the cocoa seed processing and cocoa seedlings producers to enable them acquire more equipment and resources so as to commercialized their enterprise and increase more revenue. Governments should also encourage youths to participate in cocoa production as those engaged in cocoa production are aging.
Keywords: Cocoa, seeds processors, credit, formal and informal credit users, profitability.

INTRODUCTION
Cocoa remains one of the foremost crops in some African countries, contributing significantly to rural employment, foreign exchange earnings and agricultures Gross Domestic Product (GDP). Cocoa has a very high food value; it contains more than 15 percent protein, 35 percent carbohydrate and 35 percent fat (Timothy, 2024).

Cocoa production has contributed enormously to the economic development of Nigeria and it is considered as the most important non - oil export crop. Cocoa is among the top agricultural export commodities in terms of foreign exchange. The Cocoa sub-sector employs a good number of people both directly and indirectly as farmers, seedlings producers, processors, licensed buying agents, marketers, and exporters (Afolayan, 2020; Ejike and Chidiebere-Mark, 2019). The southwest region accounts for 70% of Nigeria's annual cocoa production, estimated at 250,000 to 280,000 tons. The southeast accounts for 25% of national output (Amao, Oni, and Adeoye, 2015; Ministry of Agriculture Ondo State, 2021).

According to National Bureau of Statistics (2025), cocoa was the first among the top seven agricultural exports in 2024. Nigeria's cocoa exports has witnessed a significant increase with the country exporting N1.2 trillion in 2024, up from N171 billion in 2023. This represents 606 percent increase in the fourth quarter of 2024 (National Bureau of Statistics, 2025).

There is a need to increase cocoa productivity as part of the post-COVID economic recovery strategy in Nigeria. For the sustainability and improvement of the cocoa sector, the Government introduced an exceptional programme to improve the cocoa producing entrepreneurs' productivity such as free distribution of cocoa seedlings to the various cocoa producing entrepreneurs, credit from the Central Bank of Nigeria, and Cocoa Rebirth. The cocoa rebirth programme was mainly designed to create the awareness of the profit capabilities of cocoa and encourage youth partispation in cocoa production (Timothy, Chima, Onwumere and Igwe, 2024).

In Nigeria about 80% cocoa produced is exported as cocoa beans while 20% is processed into powder, butter, cake and liquor locally before being exported. This implies that Nigeria is yet to fully capitalize on cocoa production, as most of the beans are sold unprocessed (Afolayan, 2020). According to Ejike and Chidiebere - Mark (2019), local industrial processing capacity is inadequate for handling the national beans output. Other factors includes little agricultural mechanization, inadequate credit, disease incidence and use of simple tools (Waliu and Akinmola, 2022). Hence, some cocoa entrepreneurs obtain credit to finance the purchase of equipment and inputs as credit affects cocoa productivity (Abiola, 2019).

Credit supply to processing entrepreneurs is perceived as a strategy for the transformation of the rural economy from poverty (Chima and Timothy, 2022). Credit is defined as a development tool so powerful to capitalize farm households to invest and adopt improved farming methods and production technologies to enhance productivity (Silong and Gadanakis, 2020). Credit increases the output of an enterprise significantly, hence helps the producing entrepreneurs towards accumulating wealth to invest in production. Credit is an instrument that encourages the use of modern technologies in production and create employment opportunities. Hence, credit is an important component that could tackle productivity problems, reduces extreme poverty, and one of the core strategies for alleviating poverty (Tiken, 2018).

Credit given to agribusiness entrepreneurs play important roles in making production more productive and efficient. Unavailability of credit is usually not the problem rather inadequacy of credit, inability of credit to circulate and be sufficient for producing entrepreneurs has hampered the growth and development of cocoa sub-sector (Ben-Chendo, Ohaji and Iweanya, 2018).

The availability of formal credit is a prerequisite for the adoption and diffusion of innovative and high-impact technologies in agriculture and the enhancing of agriculture growth. The improved technologies in agriculture productivity are almost being associated with increased demand for working and fixed capital (Sonny, Coa and Yaa, 2020). According to Ben-Chendo et al. (2018), most producing entrepreneurs in Imo State use informal sources of credit due to inability to access institutional form of credit. This could be as a result of financial institutions which are suppose to provide formal financial credits being controlled from headquarters located in the cities, hence, cannot adequately cater for the need of subsistence producing entrepreneurs. Furthermore, use of collateral, the complicated procedures involved in securing credit coupled with the high-interest rates charges, have restricted the access of producing entrepreneurs to fund in the formal credit sector (Friday, Ikechukwu and Fredrick, 2016). Empirical evidence has established a positive link between declining agricultural profitability and limited credit facilities.

Profitability is one of the most essential ingredients of performance evaluation as it shows the proportion of profit relative to asset investment, equity, or sales (Nguyen and Nguyen, 2019). Profitability as measured by income and costs forms the primary objective of all commercial activities of entrepreneurs. Profitability simply means an income earned in a business after subtracting expenses from revenue. It is defined as the difference between revenue of an enterprise and operational expenses incurred in the enterprise. Entrepreneurs should maintain a positive net income by reducing their operational expenses while increasing their revenues. Profitability is one of the most important factors to consider when evaluating the success of a business enterprise. Profitability influences the business's value as it represents shareholders wealth (Chima, 2024).

Profitability can also be considered as the ability of a business enterprise to make earnings from all enterprise activities and stages. It refers to the potential of any given investment to earn a return (Timothy, 2019). According to Ardina and Isnalita (2018), a business's value can be seen on the business's ability to generate profits. They are of the opinion that profitability is the ability of the business to make profit in relation to sales, total assets, and the capital itself. Profitability is measured by various ratios which include gross profit margin, operating profit margin, and net profit margin, which indicate the relationship between profits and revenue.

Agribusiness entrepreneurs are more efficient when there is an increase in output which leads to profitability. Credit-constrained entrepreneurs are more likely to use lower levels of input in production which will decrease their out thereby decreasing profitability. Thus, Credit is a prerequisite for the empowerment of cocoa entrepreneurs to increase productivity (Timothy, 2024).

METHODOLOGY

This study was conducted in South-east Nigeria. The South-east zone comprises five states namely: Abia, Anambra, Ebonyi, Enugu and Imo States. The states are within the South-east rainforest zone of Nigeria. The area has a population of 21,955,334 and this comprise of Abia State 3,727347 people, Imo State 5,408,756 people, Anambra State 5,527,809 people, Enugu state 4,411,119 people while Ebonyi State has 2,880,303 people (NPC, 2017). Imo and Anambra are the most populous states of the zone and have high concentration of economic activities. The zone is located on latitudes 5006'N to 6034'N of the Equator and longitudes 6038'E and 8008'E of the Greenwich (Prime) Meridian. The location of the zone within the tropical rain forest belt gives it the ecological essentials for production of a wide range of tropical agricultural products such as cocoa, rice, yam, oil palm, maize, cassava and vegetables. The population of the study consisted of all cocoa seeds processing and seedlings producing entrepreneurs in Abia state, Imo State and Ebonyi State. Multi-stage and purposive sampling technique was employed in the selection of cocoa seed processing entrepreneurs in the study. Firstly, three States out of the five States in Southeast Nigeria was purposively selected. The selected States are Abia, Imo and Ebonyi State. These states were chosen based on their high-level activities on cocoa seed processing and seedlings producing activities. Secondly, two agricultural zones per state was randomly selected based on their intensity on cocoa seed processing activities. Thirdly, two Local government areas was randomly selected from each of the agricultural zone. In the fourth stage, three communities was selected randomly from each Local Government Area giving a total of 36 communities. Finally, five entrepreneurs was randomly selected from the entire thirty six (36) communities making it a total of 180 respondents for this study. Primary data was used in this investigation. The data for this study was acquired by the administration of a questionnaire, observation and an oral interview. The instrument was validated prior to delivery, and item statements were checked to ensure that the respondents addressed the study objective, questions, and the appropriateness of the constructs employed in the questionnaire. The study's data was analyzed using descriptive statistics and budgetary analysis.

Model Specification

To examine the profit performance of the cocoa seed processing entrepreneurs was addressed using the budgetary analysis model. The budgetary analysis is given as:

$$NR = TR - TC \quad (1)$$

Where;
NR= Net Revenue
TR = Total Revenue
TC = Total cost

$$TC = TVC + TFC \quad (2)$$

TVC = Total variable cost
TFC = Total fixed cost

$$TR = \Sigma PxQx \quad (3)$$

Px = Unit cost (Naira)
Qx = quantity of sold (kg)

$$GP = TR - TVC \quad (4)$$

Where; GP = Gross profit (Naira)
Net I (NI)

NI = Gross cash income – Total cost (TVC+TFC including depreciation costs and cost of owner-capital.

That is;

NI = GCI - TC

Where;
Gross cash income (GCI) is the total cash received by entrepreneur.
Total cost (TC) is the sum of total variable costs, total fixed/depreciation expenses and cost of owner capital measured in naira (N).
Total variable costs include all variable operating costs
Capital depreciation was computed as annualized capital by dividing the total value of capital by the estimated total life span in years.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

The age of cocoa seed processing entrepreneurs varied across age brackets. The average age for the pooled, formal and informal credit users were 56years, 57years, 56years and 57years respectively. The study further showed that many of the cocoa seed processing entrepreneurs (49.44%, 60%, 43.75% and 45% for pooled, formal, informal and both credit users respectively) were within the age range of 50 59 years. The dominant age range for the entrepreneurs (50-59 years) was disimilar to the findings of Ben-Chendo et al.(2018), on Credit Sources Utilized by Crop Entrepreneurs in Imo State, Nigeria. They reported that the entrepreneurs between the ages of 30-49years had highest percentage (41.25%). Another study by Popoola et al. (2015), on Technical Efficiency of Cocoa Production in Southwest Nigeria showed that the mean age of cocoa entrepreneurs was 55years. The mean of 56.4years, 57.4years, 56.5years and 56.6years by pooled, formal, informal and both credit users imply that most cocoa entrepreneurs were aged. According to the report from Ministry of Agriculture Ondo State (2021), those engaged in Cocoa production had aged, while youths do not show much interest in producing cocoa. Cocoa seed processing needs young entrepreneurs who are energetic to carry out cocoa seed processing operations as this will increase efficiency and processing capacity.

Sex of the respondents revealed the result for pooled, formal, informal and both credit users showed that majority of the entrepreneurs (86.67%, 98.3%, 88.75% and 87.5% respectively) were males. This is due to the fact that a typical farm household in Nigeria constitute male as the households head, also cocoa processing is energy demanding. This also implies that cocoa business in South East Nigeria is predominantly dominated by men, as men have more access to the credit and information required to process cocoa more efficiently than their female counterparts. This finding is in line with a study by Ejike and Chidiebere-Mark (2019), in their studies on analysis of cocoa processing and marketing in Abia, State found that 51.7% of the Cocoa processors were male while 48.3% were females. Also John and Charles (2015), in their study on Agricultural Credit sources in Idemili Local Government Area of Anambra State reported that majority (74.4%) of their respondents were males. This study is dissimilar to the findings of Shazma, Nadeem and Waseem (2019), in their studies in factors affecting the elasticity of micro credit demand revealed that females dominate processing activities in Nigeria as most male had migrated out processing location in search of white-collar job.

Level of experience of the respondents showed an average level of processing experience for the pooled, formal, informal and both credit users were 17.4years, 16 years 17.8years and 18.5years respectively. This drew from the dominance of cocoa seed processors who had 11-20years processing experience consisting of 47.78%, 48.3%, 50% and 42.5% respectively. According to Ebe et al. (2018), the number of years an entrepreneur spent in processing business gives an indication of the practical knowledge he has acquired in order to overcome certain processing problems so as to increase productivity and efficiency. The average processing experience by the pooled, formal and informal credit users imply that the entrepreneurs had long period of farm experience which will enhance their ability to efficiently make decisions. Cocoa seed processors would count more on their processing experiences for improved productivity rather than educational attainment. Ogbonna

(2018), reported that entrepreneurs years of experience impacts positively on their productivity and efficiency due to efficient allocation of resources overtime arising from acquired practical knowledge through trial and error over time in farming business. This findings is in line with the study of Popoola et al. (2015), who reported that cocoa producing entrepreneurs had more than 10years of experience.

Marital status of the respondents showed that majority of the cocoa seed processing entrepreneurs were married (81.67%, 83.78%, 81.25% and 80.00%) and others (18.33%, 16.67%, 18.75 and 20%) for pooled, formal, informal and both credit users respectively in the study area. This indicated that cocoa seeds processing was a source of livelihood for the entrepreneurs and their families. This is in line with study by Ejike and Chidiebere-Mark (2019), who reported that majority (86.7%) of the respondents were married while 13.3% were single. This implies that married people were predominated in cocoa seed processing. Marriage creates a conducive environment for good citizenship training, development of personal integrity and entrepreneurship skills which are very important for efficient use of resources (Aigbokie et al., 2021). This implies that a greater percentage of the population had family members as family members often serve as a source of additional labor together with cultural value attached to marriage. The dominance of the married people in cocoa seeds processing in the study area may be attributed to the fact that married people are more settled as it relates to giving appropriate attention to processing operations. Furthermore, this dominance of married processors could arise from the demanding nature of cocoa seeds processing which required the support of family members in the business.

Cooperative membership of the respondents revealed result for pooled, formal, informal and both credit users showed that 67.22%, 71.67%, 62.5% and 70.00% of cocoa seeds processing entrepreneurs in the area belonged to cocoa cooperatives. Membership of a cooperative group usually provides the entrepreneurs social capital and opportunity of sharing information on modern practices. This corresponds with the findings of Nyor (2017), who reported that 78% of the respondents belong to coorperative society where as membership of cooperative group increase the interaction base of entrepreneurs as well as provides entrepreneurs with bargaining power in the acquisition of input, selling of their output and access to credit. Eshiet (2017), reported that membership of association satisfies the social needs of entrepreneurs and serve as an avenue for access to information on agricultural technology. Membership also enables entrepreneurs acquire better skill and knowledge on cocoa processing. Cooperatives are vehicle for development since it provides entrepreneurs with access to information necessary for cocoa processing.

Extension service of the respondents showed the result for pooled, formal, informal and both credit users showed that 66.11%, 58.33% , 75% and 60% respectively of cocoa seeds processing entrepreneurs in the study area did not have access to extension services while 33.89%, 41.67%, 25% and 40% respectively had access to extension services. Access to extension services usually enhances cocoa processing entrepreneurs access to information and improve their management skills. However, access to extension services remains a challenge. This result tallys with the findings of Popoola et al. (2015), in their study on technical efficiency of cocoa production in Southwest Nigeria. They reported that 54% of respondents did not have access to extension services, while 46% had access to extension services. The result also is dissimilar with the findings of Ejike and Chidiebere-Mark (2019), who revealed that 60% of the cocoa processors in Abia State had extension contact. Extension contact helps entrepreneurs to improve cocoa processing skills and to gain knowledge on best practices in cocoa processing. According to Nyor (2017), access to extension services by entrepreneurs is considered to be factor influencing agricultural productivity.

Household size of the respondent showed average household size of the pooled, formal, informal credit and both users were 8, 7, 8 and 9 respectively. This is evident as 57,22%, 46.67%, 68.75 and 50.00% respectively) of the respondents across the cocoa seed processing channels had their household sizes between 6 and 10 persons. The economic implication is that it will provide the processors with family labour and reduce cost of processing and increase their revenue. A large household size may likely enhance family labour supply for the entrepreneurs. Agricultural activities in developing countries like Nigeria are highly subsistent and labour intensive and often times depend on household labour. Cocoa seeds processing involves breaking of pods, fermentation, sun-drying and packaging. These activities are done in subsistence ways which require a lot of labour. This result is also in line with Ejike and Chidiebere-Mark (2019), who reported that drawing family labour would be cheaper in cocoa processing than engaging hired labour. Furthermore,

according to Onwumere et al. (2017), large family size is desirable, consistence and of great importance in processing because entrepreneurs may rely more on their family members than hired workers for labour on their processing business. This result is similar with the findings of Popoola et al. (2017), in their study on technical efficiency of cocoa production in Southwest Nigeria reported that about 90 percent of their respondents to have household sizes with a mean of 7 in their study. Education of the respondents revealed that majority (82.78%, 86.67%, 81.25 and 80%) of the pooled, formal, informal and both credit users in the study acquired one form of formal education or the other. This shows that the Cocoa seeds processors in the study area were literate. This implies that processing could be enhanced through embracing innovative processing techniques thereby increasing productivity. Education is vital for cocoa seeds processors in making investment decisions and as well as determining the efficiency in the use of resources. Also education enhances the skill and entrepreneurial ability of the cocoa seeds processing entrepreneurs to organize inputs required for maximum efficiency and making right choices. Nugroho and Abdani (2017), had opined that high literacy level is a desirable condition for development by entrepreneurs. The main aim of education is to impact knowledge which would influence entrepreneurs' attitude, skills, or knowledge. High education level is necessary to entrepreneurs as it would exposed them to many information sources, embrace innovations and analyze situations objective. This tally with the findings of Ejike and Chidiebere-Mark (2019), who reported that majority (83%) of the respondents had formal education.

Profit performance of the cocoa seed processing entrepreneurs

From the result in Table 2, revenue realized from the formal credit users was N 4,185,402.97 while N2,092,650 was realized from informal credit users. The revenue from the formal credit users was higher than the revenue from the informal credit users. This is probably because formal credit sources disburse more credit needed for investment than the informal credit sources. According to Silong and Gadanakis (2020), most of informal credit sources cannot meet all cash requirements for agribusiness purposes and the interest rates are high.

Table 2 also showed that the total cost were N 1,155,530.72 and N 602,781.84 respectively for formal and informal credit users in a year, with total variable costs accounting for N 1,054,390.72 and N552,341.84 in a year for formal and informal credit users respectively. The total fixed costs accounted for N101,140 and N50,440 for formal and informal credit users respectively in a year. The total variable costs were far much higher than the total fixed cost. This agrees with the findings of Simpa (2014), Simpa and Nmadu (2015) and Simpa et al., (2016) that fixed costs were always lower than variable costs.

The table further reveals that cocoa seed processing entrepreneurs had gross profit of ₦3,130,909.28 and ₦1,540,308.16 per year for formal and informal credit users respectively. The net income of ₦3,029,769.28 and ₦1,470,868.16 per year for formal and informal credit users respectively. From the analysis the study reveals that cocoa seeds processing in Southeast Nigeria is very profitable. Profitability is one of the most essential factors of performance evaluation. This study tallied with the findings of Ejike and Chidiere-Mark (2019), who reported cocoa seed processing to be a profitable business. Also Popoola et al. (2015), reported cocoa production to be a profitable enterprise. Odegbade et al. (2021), in their studies on efficiency of appraisal of cocoa farming in Ondo state reported that cocoa production is a profitable business for entrepreneurs to venture into. They reported that the gross margin analysis showed that cocoa production incurred a total variable cost of ₦ 64,588.38 and earned total revenue of ₦ 90,584.50 per hectare with gross margin of ₦25,995.12 and total cost of ₦ 74,059.09 and net revenue of ₦16,524.41.

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Table 1: Socioeconomic characteristics of cocoa seeds processing entrepreneurs using pooled, formal credit, informal credit, and both credit.

Source: Field survey, 2023

Table 2: Net returns analysis of cocoa seeds processing entrepreneurs per production cycle in Southeast, Nigeria.

Variable	Formal Credit Users			Informal Credit Users		
	Quantity	Unit cost (N)	Average cost(N)	Quantity	Unit cost (N)	Average cost (N)
Revenue	**2989.5kg**	**1400/kg**	**4185300**	**1494.75kg**	**1400/kg**	**2,092,650**
Variable Cost						
Seed cost	2989.5kg	334.5	999,987.75	1494.75kg	334.5	50074.125
Drying cost	2989.5kg	6.86/kg	20,507.97	1494.75kg	6.86/kg	10250.99
Bag cost	20bags	200	4000.00	10 bags	200	2000
Storage cost	2989.5kg	10/kg	29895	1494.75kg	10	14947.5
Labour Man Day (per day)	10persons	5000	50000	5persons	5000	25000
Total Variable Cost (TVC)	-	-	**1,054,390.72**	-	-	**552,201.49**
Depreciation On fixed cost	-	-	101,140	-	-	50440
Total fixed cost	-	-	**101,140**	-	-	**50,440**
Total cost (TVC + TFC)	-	-	**1,155,530.72**	-	-	**602,641.49**
Gross Profit	-	-	**3,130,909.28**	-	-	**1,540,308.16**
Net Income	-	-	**3,029,769.28**	-	-	**1,470,868.16**

Source: Field survey, 2023

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Effect of Land Management Practices on Crop Productivity among Smallholder Arable Crop Farmers in Abia State

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ABSTRACT
This study determined effect of land management practices on crop productivity among smallholder arable crop farmers in Abia State, Nigeria. The study involved the use of eighty smallholder arable crop farmers. Total factor productivity analysis and ordinary least square regression method were used in analyzing the data. The result of the study showed that farmers from the study area identified mulch tillage (98%), minimum tillage (94%), mixed cropping (90%), and the use of organic manure (88%) as the major land management practices used by farmers in the study area. Majority (78%) of farmers had low use level while (23%) recorded high use level of land management practices with mean probability of 0.48. The mean productivity level of smallholder farmers was 2.13. The positive coefficients of use-level of land management practices, age of farmers, access to credit, educational status, extension contact, farm size and labour were variables that influenced productivity level of farmers. Major constraints to the use of land management practices among farmers were non-availability of credit (100%), transportation problem (100%), high cost of land management (95%), and inadequate supply of fertilizer (93.8%), insufficient extension services (93.8%) and low productivity 988.8%). The study recommends the need to educate and expose farmers to new technologies, innovations and programmes such as climate smart agriculture adaptation programmes that are easy to practice, cost effective and ensure soil and nutrient conservation; the need for smallholder arable crop farmers to avail themselves of training opportunities on appropriate use of farm input especially farm land for optimum production and increase productivity levels of farmers; increase in the supply of crop production inputs such as inorganic fertilizer, agrochemicals, soil micronutrients for soil etc, by government and other key stakeholders in agriculture at subsidized rates to smallholder crop farmers.

INTRODUCTION
Smallholder farmers are farmers face many challenges that affect their agricultural productivity one of such is land degradation, causing decline in soil nutrients (FAO, 2018). Depletion of soil nutrients result from several climate change manifestations, including increases in average temperatures, severity of extreme weather such as heavy rains (causing flooding), droughts and suggested over-exploitation of scarce natural forest (Climate Change Knowledge Portal- CCKP, 2021). Therefore, land management practices are target of conservation measures because of the perceived relationship between cultivation practices, land management practices, and livelihoods of farmers (Onyeneke et al., 2020). The sustainability of land resource and soil nutrients by the use of effective land management practices, is key to addressing depletion of agricultural lands (Abdulazeez et al.,

2014; Gomiero, 2016). It helps in bridging the gap of agriculture and environment, with the twin objectives of maintaining long term productivity and ecosystem functions (land, water, biodiversity); and increasing productivity (quality, quantity and diversity) of goods and services including safe and healthy food (Zita et al., 2018). The various land management practices with potentials for promoting crop productivity include; proper management of organic soils avoiding deep drainage and deep ploughing, row crops and tubers and maintaining a shallower water table, reduced or zero tillage and several others (FAO, 2018; FAO and International Crops Research Institute for the Semi-Arid Tropics- ICRISAT, 2019).

Abia State depends heavily on rain-fed agriculture making rural livelihoods and food security highly vulnerable to climate change variability. The agricultural sector in the state is struggling to meet the increasing food demand for its growing population as it battles with low productivity arising from climate change, causing environmental degradation. Existing technologies and current institutional structures seem inadequate to achieve improve productivity needed to adequately slow climate change effects, while also meeting the needed food security, livelihood and sustainability goals. Therefore, in a situation where smallholder farmers are exposed to climate variability resulting to depletion of soil nutrients, it is important to understand how land management practices improve productivity.

MATERIALS AND METHODS

Study Area and Sampling Technique

This research was carried out in Abia State, Nigeria. A multi-stage sampling technique was used in selecting 80 arable crop farmers from two Agricultural Zones namely Umuahia and Aba Agricultural Zones. Data for this study were collected from primary sources. A well-structured questionnaire and oral interview was used to illicit information from the respondents. To estimate the use-level of various agricultural land management practices was realized using the individual use-level which was obtained by dividing the number of practices used by a farmer to the over practices available and was classified as low use- level and high use- level using the weighted average mean of all the individual use score divided by the number of total agricultural land management practices. Total Factor Productivity analysis was used to estimate the level of agricultural productivity of smallholder arable crop farmers while ordinary least square (OLS) regression analysis was used to determine the effect of land management practices and other socioeconomic factors on productivity of smallholder arable crop farmers. The models are specified as follows:

Use-level

The use-level of land management practices of farmers expressed as:

$$LMIi \text{ use-level} = \frac{U}{V} \quad (0 \leq LMIi \text{ use-levels} \leq 1) \qquad (1)$$

Where;
U = Number of land management practices used by a farmer,
V= Total number of land management practices available to all farmers in the study area.

Total factor productivity

The productivity of the arable crop farmers will be analyzed using total factor productivity. It is stated as follows.

$$\text{Y (Total factor productivity)} = \frac{\text{Total value of crop output (₦)}}{\text{Total cost of inputs used in production (₦)}} \qquad (2)$$

Ordinary least squares (OLS) regression model

Effect of land management practices on productivity of the arable crop farmers will be realized analyzed using Ordinary Least Square model (OLS).

The implicit functional form is stated as follows:

$$Y = f(X1, X2, X3, X4, X5, X6, X7, X8, X9, X10) \qquad (3)$$

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Where;
Y = Total productivity (value of output/ cost of input),
X1 = Land management practices (use-level = U/V where 0 ≤ LMP use level ≤ 1),
X2 = Age of farmer (Years),
X3 = Sex (1 if male, 0 otherwise)
X4 = Education (Years spent in school),
X5 = Access to credit (Amount received),
X6 = Farm income (Naira),
X7 = Household size (Number of persons),
X8 = Extension visits (No of visits/year),
X9 = Farm size (Ha),
X10 = Labour (man-day).

RESULTS AND DISCUSSION

Types of land management practices among smallholder farmers in Abia State

The various types of land management practice used by smallholder arable crop farmers are presented in Table 1. Among the structural and mechanical land management practices, construction of water ways, drainages/flood barriers was the most widely used by farmers in the study area for crop production activities; this was followed by creation of sedimentation basins (37.5%) while construction of ridges across the slope was used by 27.5% of the farmers.

The use of structural and mechanical erosion control management practices in the study area was generally poor. This may be as a result of the associated costs which are beyond farmers' capacity. Agronomic practices used for crop production activities revealed that the majority of the farmers (94%) engaged in intercropping (76%), mixed cropping (90%), multiple cropping (70%) and mulch tillage (98%), sediment incorporation (51.3%). This result agrees with the findings of Aduo and Nwadili (2019); Opeyemi et al. (2021) whose studies showed that the popular farming system comprise mixed cropping/intercropping or combination of crops in mixed cultivation with the dominance of root crops like cassava, yam and cocoyam then maize and vegetables in cycles of land rotations. The major soil management practices used by the farmers were the application of inorganic fertilizers (88% of manure and use of fertilizer which was 66%). Organic manure is largely practiced by the smallholder farmers to improve the fertility of the soil. This could be its local accessibility and cheap source of the manure.

Use levels of land management practices by smallholder arable crop farmers in Abia State

The distribution of the use levels of land management practices of the smallholder farmers are shown in Table 2. It could be deduced from Table 2 that the mean probability of use levels of the land management practices was 0.48. Farmers with use levels ranging from 0.41-0.50 were more (31%), this was followed by 21% of farmers with 0.51-0.60 use levels of land management practice. The use levels became thresholds for the classification of the land management practices into low and high use levels/adopters as presented in Table 3. The result showed that majority (78%) of farmers had low use level of land management practices compared to about 23% of them who had high use level of land management practices. The use level of land management practices among smallholder arable crop farmers was relatively low.

Total factor productivity of smallholder arable crop farmers

Distribution of Respondents according to their productivity levels is presented in Table 4. The analysis of the productivity levels of the farmers were measured in monetary values of arable crops produced to the cost of all variable inputs used. Farmers with productivity levels ranging from 2.1 - 3.0 were 30% while 26.25% had productivity level between 0.1 - 1.0. The mean productivity level of 2.13 was achieved by the farmers. This implies that the level of agricultural productivity of farmers in the study area was low.

Determinants of agricultural productivity of smallholder arable crop farmers

The estimated determinants of the level of agricultural productivity of farmers are presented in Table 5. The double-log model was chosen as the lead equation. The value of the coefficient of multiple determinations (R2) was 0.757, implying that about 75.7% of the variations in the productivity of the farmers in the study was explained by the regressors (independent variables) included in the model.

Use-level of land management practices was positive and statistically significant at 5% level. This implied that an increase in use level of land management practices by one unit will increase the land productivity by 8.6%. The implication is that the adoption and investment in soil conservation and management will enhance the land productive capacity of the soil. According to Tesfaye (2017), adoption of sustainable land management practices plays a critical role in achieving food security, household income and poverty reduction through reducing soil erosion and improving soil fertility.

Age of farmers was significant and positively related to the productivity at 1% level of significance. This implies that with a one year increase in the age also productivity increases. The implication is that farmers are more productivity in land use with advancement in age.

The coefficient of access to credit was positive and significant at 1%, implying direct relationship with agricultural productivity of the farmers. This result implies that access to credit enhances the farm productivity of farmers. Farm size was significant at 5% level of significance and positively related to the land productivity of the farmers. This implies that increase in the size of farm cultivated would lead to an increase in productivity. This could be as a result of the application of superior land management technologies and use of conservation practices such as use of fertilizer, herbicides etc which is only possible with increase farms. Contrary to the findings of this study, the study of Haftu et al. (2019) showed an inverse relationship between productivity and farm size as a result of constraints faced by large farm size holders like labour and input market, access to credit etc) that limit them to achieve optimum use factors of production. Labour was found to be statistically significant at 1% level and positively related to productivity. The regression coefficient of labour was positive and significant at 1%, implying direct relationship with agricultural productivity of the farmers. This result implies that increased use of labour increases the farm productivity.

Constraints to the use of land management practices among smallholder arable crop farmers
Constraints to the use of land management practices by the smallholder arable crop farmers in Abia State are presented in Table 6. The study also revealed that the major constraints to the use of land management practices among the farmers included non-availability of credit (100%), transportation problems (bad road, distance to plots etc.,) (100%), high cost of land management (95%), inadequate supply of fertilizer (94%), insufficient extension services (94%) and low productivity (89%) among others. This is in line with the results of Abdulazeez et al. (2014); Ekpa et al. (2021), whose study revealed that the major constraints to the use of sustainable land management practices among the farmers included inadequate supply of fertilizer, inadequacy and high labour cost and credit, poor knowledge of improved agricultural practices, poor transportation, low produce prices and high cost of production.

CONCLUSION AND RECOMMENDATIONS

Farmers from the study area identified construction of water ways, drainages/flood barriers, mixed cropping, mulch tillage and the use of organic manure as the major land management practices used in crop production. The mean probability use levels of farmers in land management practices was 0.48, implying farmers had relatively low use level of land management practices. The mean productivity level of smallholder farmers was 2.13. This implies that the level of agricultural productivity of farmers in the study area was low. The positive coefficients of use-level of land management practices, age of farmer, access to credit, education status, extension contact, arm size , and labour were the variables that influenced productivity level of farmers in the study area. The major constraints to the use of sustainable land management practices among the farmers in the study area were non-availability of credit, transportation problems (bad road, distance to plots etc.,), high cost of land management, inadequate supply of fertilizer, insufficient extension services and low productivity.

The study therefore recommends;

i) the need to increase the knowledge of farmers particularly on land management by extension workers, improve the access and supply of crop production inputs such as inorganic fertilizer, agrochemicals, micronutrients for soil etc,.

ii) the need to educate and expose farmers to new technologies and programmes such as climate smart agriculture programmes and innovations that are easy to practice, cost effective and will promote soil and nutrient conservation;

policies aimed at reducing land degradation in the state should be focused on enhancing farmers' active and genuine participation in such programmes. It is recommended that if appropriate extension services, social, economic and institutional conditions are put in place, farmers' productivity levels in the study area will increase.

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Table 1: Distribution of framers according to types of land management practices.

Land management practices	Frequency*	Percentage (%)
Construction of water ways, drainages/flood barriers	48	60.0
Creation of sedimentation basins	30	37.5
Construction of ridges across slopes	22	27.5
Intercropping	61	76.3
Mixed cropping	72	90.0
Multiple cropping	56	70.0
Crop rotation	43	53.8
Mulch tillage	78	97.5
Sediment incorporation	41	51.3
Use of manure	70	88.0
Fertilizer application	53	66.0
Use of agrochemicals / micronutrients (herbicides etc)	63	78.8
Fallowing	34	43.0
Minimum tillage	75	94.0

Source: Field survey data (2024) * indicate multiple responses recorded.

Table 2: Distribution of the smallholder farmers based on use levels of land management practices.

Use levels of LMP	Frequency	Percentage
0.11 – 0.20	4	5.00
0.21 – 0.30	8	10.00
0.31 – 0.40	14	17.50
0.41 – 0.50	25	31.25
0.51 – 0.60	17	21.25
0.61 – 0.70	4	5.00
0.71 – 0.80	5	6.25
0.81 – 0.90	3	3.75
Total	80	100.0
Mean	0.48	
SD	0.09	

Source: Field survey data (2024). LMP = Land Management Practices

Table 3: Classification of the smallholder farmers based on the use levels of land their management practices.

Class of LMP	Frequency	Percentage (%)
High use level (≥ 0.48)	18	23.0
Low use level (< 0.48)	62	78.0
Total	80	100.0

Source: Field survey data (2024)

Table 4: Distribution of respondents according to their productivity levels.

Productivity level	Frequency (f)	Percentage (%)
0.1-1.0	21	26.25
1.1-2.0	16	20.00
2.1-3.0	24	30.00
3.1-4.0	15	18.75
4.1-5.0	4	5.00

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Mean	**2.13**	
Total	**80**	**100.00**

Source: Field survey data (2024).

Table 5: Determinants of the agricultural productivity of smallholder arable crop farmers

Variables	*Linear*	*Exponential*	*Double log+*	*Semi log*
Intercept	128300.231 (2.053)**	12.538 (40.453)***	4.590 (2.266)**	- 2921396.004 (-6.233)***
Use level of land management practices **(X1)**	-32.668 (-0.353)	-0.001 (-1.417)	0.086 (2.327)**	24723.120 (2.899)***
Age (X_2)	-687.796 (-0.770)	-0.006 (-1.351)	0.069 (3.220)***	42456.963 (0.778)
Sex (X_3)	-16714.415 (-1.128)	-0.047 (-0.643)	-0.023 (-0.264)	-8311.947 (-0.417)
Marital status (X_4)	-2551.608 (-0.371)	-0.050 (-1.459)	-0.021 (-0.570)	6070.285 (0.709)
Farm income (X**5**)	9709.957 (0.643)	0.112 (1.490)	0.150 (1.707)	13335.538 (0.658)
Access to credit (X_6)	7.488 (12.387)***	2.737E-5 (9.129)***	0.761 (4.710)***	288926.364 (7.735)***
Educational status (X_7)	8.680 (5.620)***	4.166 (5.200)***	0.513 (5.040)***	3.946 (2.880)***
Extension visit (X_8)	11279.302 (0.582)	-0.164 (-1.707)*	0.414 (6.590)***	5885.280 (0.233)
Farm size (X_9)	26609.191 (3.674)***	-0.029 (-0.818)	0.204 (2.203)**	80111.693 (3.743)***
Labour(X_{11})	600.654 (0.313)	-0.009 (-0.895)	0.094 (2.630)***	11306.895 (-0.679)
R^2	0.436	0.575	0.757	0.575
Adj. R^{-2}	0.356	0.523	0.727	0.515
F-ratio	5.473***	11.036***	25.393***	9.561***

Source: field survey (2024). + means lead equation, ***, **, * significant at 1%, 5% and 10%, respectively.

Table 6: Constraints to the use of land management practices of smallholder arable crop farmers

Constraints	Frequency*	Percentage
High cost of land management practices	76	95.0
Inadequate improved variety of seed/planting material	68	85.0
Low productivity	71	88.8
Inadequate access/supply of fertilizer	75	93.8
Non-availability of credit	80	100.0
Inadequate knowledge of modern land management practices	69	86.3
High labour cost	62	77.5
Transportation problems (bad road, distance to plots etc.,)	80	100.0

Insufficient extension services	75	93.8

Source: Field survey (2024).* indicate multiple responses

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Women Farmers' Use of Improved Dry Season Vegetable Production Technologies in Umuahia Agricultural Zone of Abia State

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ABSTRACT
The study investigated women farmers' use of improved vegetable production technologies in Umuahia Agricultural Zone of Abia State. A multistage random sampling procedure was used in selecting 72 women vegetable farmers in the study area. Both descriptive and inferential statistical tools were used in realizing the objective. Result show that majority (41.7%) of the respondents are aged 16 - 30 years with a mean age of 40. Also, majority (68.1%) of respondents are married with a mean household size of 5. Furthermore, the result showed a **5.6** *mean years of experience in vegetable production. Result indicates that majority of the respondents (75.0%) are Part time vegetable farmers in the zone. Also, women vegetable farmers were high in using 'Improved varieties of crops (($\bar{x}$ = 3.43), 'Replacement/Supplying (($\bar{x}$ = 3.47), and Use of fertilizers (($\bar{x}$ = 3.5). However, Farmers recorded low usage on 'Irrigation' (($\bar{x}$ = 1.32). At P<0.05, the coefficients of marital status (2.873), Age (-3.408), Years of Experience (2.440), Level of Education (1.999), and monthly income (3.316) were significant and related to farmers' level of use of improved vegetable production technologies. The study therefore concludes that; such technologies as 'Improved varieties of crops, 'Replacement/Supplying, and Use of fertilizers were the most used by women vegetable farmers in the study area. It is therefore recommended that Women vegetable farmers should go into cooperative formations in order to have the capacity to attract interventions from Government and other development agencies, pull resources together and expand production.*

Keywords: Vegetables, Women, Farmers, Dry season, Production Technologies

INTRODUCTION
Agricultural technology can be defined specifically as consisting of the nature, system and types of available inputs that are combined to carry out agricultural activities. It may include inputs such as seeds, fertilizers, chemicals, tools, machines, etc and the way in which they are combined to perform agricultural operations. Improved technology in agriculture includes all materials, techniques, practices and innovations used to maximize agricultural production. These may include high yielding varieties of crops, early maturing crops and animals, herbicides, use of synthetic irrigation, good drainage systems, fertilizers, etc (Nnadi, et al, 2014; Manu, Mustapha and Alhasan, 2019).

Farming is commonly associated with the rural areas especially in developing countries like Nigeria. This is so because farming is the dominant livelihood activity of most rural dwellers. Vegetable production is a key component of agricultural production, and as reported by Nnadi et al (2014),

most women farmers have had to grapple with the issue of using appropriate technology to maximize production. Ibidapo *et al* (2016) investigated the determinants of youth participation in dry season vegetables cultivation in urban areas of Ondo state, Nigeria and observed that Youth engagement in dry season vegetables cultivation helped to provide employment/jobs, income, alleviate poverty, and arrest youth restiveness in the urban centres.

According to Nnadi et al (2014), certain technologies have been pushed out to farmers to maximize gains in vegetable production and they include 'Use of improved varieties of crops, Seed treatment before planting, Replacement/supplying, Line planting, Irrigation, Use of fertilizers, Maintenance of recommended, spacing, Mulching, Staking, Drainage, Rouging.

Although women are increasingly involved in vegetable production, there are limited empirical evidence to show their level of use of Dry season production technologies. Hence the need to investigate women farmers' use of improved dry season vegetable production technologies in Umuahia Agriculural Zone of Abia State.

a) The broad objective of this study was to evaluate women farmers' use of improved technologies in dry season vegetable production in Umuahia Agricultural Zone of Abia State, Nigeria. The specific objectives are to:
b) describe the socio-economic characteristics of women vegetable farmers in the study area.
c) determine the level of utilization of vegetable production technologies by women farmers in the area,

Hypothesis of the Study
H_{01}: The socio-economic variables of the farmers are not the determinants of utlization of improved dry season vegetable production technologies in the study area.

METHODOLOGY

Abia State comprises three (3) Agricultural Zones of Aba, Umuahia and Ohafia and 17 Local Government Areas. Created out of the then Imo State on the 27th of August 1991, Abia State has however evolved over the years with Umuahia as the State Capital, Afikpo which was part of Abia State was removed to form the present Ebonyi State in 1996. The population of Abia State from 2006 population census stood at 2, 833, 999, made up of 1,234,193 males, 1,599,806 females, and a population density of 578 persons per square kilometer with a land mass of 448.4/km^2 (NPC, 2006) with majority living in the rural areas, agriculture has been noted as employing 70 per cent of the work force (www.Abiastate.gov.ng). Major occupation of the people, mostly in the rural areas are Crop and Livestock production such as poultry, vegetables
The population of this study consists all women vegetable farmers in Umuahia Agricultural Zone, Abia State.

Sample and Sampling Procedure

A Multi-Stage sampling technique was used in selecting the sample size. The sample size for this study is made up of 72 respondents. First stage was a purpose selection of three (3) Local Government Areas (Umuahia South, Isiala Ngwa North and Ikwuano) based on proximity and notable presence of vegetable farmers. The second stage was a selection of six (6) communities each from the Local Government Areas to give a total 18 communities. Finally, 4 vegetable farmers were selected from each community to give a total of 72 vegetable farmers.

Data collection: Data collection were analyzed using descriptive and inferential statistics. Objective 1; to describe the socio-economic characteristics of the respondents in the study area was analyzed using frequency counts, percentages and mean. Objective 2; to determine the level of use of vegetable production technologies by women farmers was analyzed using mean score, realized from the 4-point rating scale of; Always = 4, Sometimes = 3, Rarely = 2, Never = 1. In using the rating scale, a mid-point was obtained by adding 4, 3, 2 and 1 which gives 10 when divided by 4 gives a mean score of 2.5. For the purpose of decision making, the maximum weighted score of 4 was further divided by 3 to obtain the class interval of 1.33. Therefore, the class interval (1.33) was successively deducted from the maximum mean score of 4 to obtain the three (3) levels of utilization as applied by Oduehie, Ifenkwe, Shu'aibu and Adolphus (2023). This gave class ranges of 0.00 -1.33 = low level of use; 1.34 - 2.67 = moderately used; and 2.68 – 4.00 = highly used.

Test of Hypotheses
Ordinary Least Square (OLS) regression analysis was used to ascertain the socioeconomic determinants of farmers' use of improved dry season vegetable production technologies. For the regression analysis, the four functional forms (linear, semi-log, double-log, and exponential functions) of the OLS were tested and the one that produced the best fit in terms of conformity to a priori expectations, number of significant variables, size and signs of regression co-efficient, and the magnitude of the co-efficient of multiple determination (R^2) selected as the lead equation.
The model is specified as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, e)$$

Where;
Y = Utilization of vegetable production technologies (mean score)
X_1 = Age (measured in years)
X_2 = Major occupation (Full time women vegetable farming = 1, part time women vegetable farming = 0)
X_3 = Household size (the number of persons sharing one roof and feeding with one pot)
X_4 = Years spent in school (years spent in formal school)
X_5 = Vegetable farming experience (years spent in urban farming)
X_6 = Estimated monthly income (in naira)
e = error term

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

The distribution of respondents by age from Table 1 indicate that majority (41.7%) of the respondents are aged 16 - 30 years with a mean age of 40 implying that women vegetable farmers are young. Being young and energetic prepares one to meet with the labour demands of any productive entreprise. The finding is in consonance with Nnadi et al (2019) were it was reported that women vegetable farmers are middle-aged and energetic.

The distribution of respondents by marital status from Table 1 indicates that majority (68.1%) of respondents are married. This findings implies that majority of Vegetables farmers are perceived to be responsible parents. Similarly, empirical studies have shown that healthy marriages increases business profitability. This finding agrees with that of Kalu *et al* (2021) who noted that married people dominate agricultural production. The result is also in tandem with Manu et al (2019) that reported more married persons involved in vegetable production.

Majority (55.6%) of the Vegetables farmers have house hold sizes between the range of 1-5 with a mean household size of 5. It is important to note that size of household serves as a source of labour in most agricultural productions. Furthermore, most (47.2%) of the respondents have Secondary education, followed by 25.0% who had Tertiary education. Education contributes immensely to the productivity and profitability of most businesses.

A mean years of experience of 5.6 was recorded. According to Onyekuru *et al.* (2019), the farming experience distribution of the respondents is important in at least two different aspects; first is increased productivity which comes with more experience, while the second is in the ability to diversify into different off-farm activities which comes with time, and also increases household income. Farming experience is very important as it gives more insight into the understanding of the dynamics of Vegetables production venture. It is expected that experienced farmers would be more productive. With a mean year of experience of **6.3**, it is therefore deduced from this finding that majority of the respondents do not have enough experience in Vegetables production. Result indicates that majority of the respondents (75.0%) are Part time vegetable farmers in the zone, while the remaining 25% are into full time vegetable production. The implication is that more people are yet to get involved in vegetable production as major source of income. However, due to the need to diversify income, most women engage in vegetable production while involved in other livelihood activities to make ends meet.

Extent of Use of Vegetable Production Technologies by Women Farmers

Result in Table 2 shows the vegetable farmers' Use of improved production technologies. Result revealed that of the nine (9) improved technologies studied, women vegetable farmers were high in using 'Improved varieties of crops ($\bar{x}$ = 3.43), 'Replacement/Supplying ($\bar{x}$ = 3.47), and Use of

fertilizers ($\bar{x}$ = 3.5), but moderately used 'Seed treatment before planting ($\bar{x}$ = 2.0), Line planting ($\bar{x}$ = 2.03), Maintenance of recommended spacing ($\bar{x}$ = 1.97), Mulching ($\bar{x}$ = 2.13), and Staking ($\bar{x}$ = 2.31),. However, Farmers recorded low usage of 'Irrigation' ($\bar{x}$ = 1.32) implying that women vegetable farmers are not doing much in dry season vegetable farming that requires irrigation. This findings corroborates the work of Nnadi et al (2014)that reported low usage of irrigation agriculture among vegetable farmers in Imo State, but, Manu et al (2019) reported high use of irrigation among vegetable farmers in the Benue. The low attention to irrigation agriculture in vegetable production poses a threat to food security especially during dry seasons.

Test of Hypothesis
There is no significant relationship between the socio-economic characteristics of the respondents and the extent of use of production technologies.

The four functional forms of the multiple regression model were tried and the Exponential model selected as the lead equation due to the highest number of significant variables and a significant F-value of 9.930 at P<0.05 which shows the overall significance of the regression line and a high R^2 value of 0.497 which implies that 49.7% of the total variation in the dependent variable was accounted for by the explanatory variables.

The coefficient of marital status (2.873) was significant and positively signed. This implies that being in marriage contributes to the extent of use of technologies which in turn affects productivity. This finding is in tandem with Onyekuru *et al.* (2019) who asserted that marital status interacts with productivity and has been identified as a tool to increasing profitability.

From the result, at P<0.05, Age (-3.408) was significant and negatively related to farmers extent of use of improved vegetable production technologies. The implication of the result is that the more advanced the respondents are, the less their drive for information that will enable them do well in their entreprises. Maduka, Kalu and Odoemelam (2020) asserted that age affects ones tendency to be very inquisitive and receptive to new ideas/innovations in other to meet personal and family needs.

The coefficient of Years of Experience (2.440) was significant and positively related to farmers extent of use of vegetable production technologies. The implication of the result is that the more advanced in learning an individual farmer is, the more likely he will be open to new ideas and innovations. This finding agrees with that of Ekwe *et al.,* (2017) who asserted that higher literacy level increases the chances of acceptance of a technology.

The coefficient of Level of Education (1.999) was significant and positively related to farmers extent of use of vegetable production technologies. The implication of the result is that the more advanced in learning an individual farmer is, the more likely he will be open to new innovations. This finding agrees with that of Onumadu *et al.,* (2008) who asserted that higher literacy level increases the chances of adoption of a technology.

The coefficient of monthly income (3.316) was significant and positively related to farmers' extent of use of vegetable production technologies. The implication of the result is that the more the income, the more farmers will go for innovations that will impact positively on their farms This finding agrees with that of Kalu and Ekwe (2020) who asserted that farmers who operate at a larger scale will most likely adopt innovations. It also corroborates the study by Nnadi et al (2014) that reported significant relationship between income and use of technologies in vegetable production. Therefore there is a significant relationship between socio-economic characteristics such as marital status, Age, Level of Education, years of experience and income with the level of utilization of vegetable production technologies by women farmers.

CONCLUSION AND RECOMMENDATIONS

The study investigated women farmers use of improved vegetable production technologies in Umuahia, Agricultural Zone of Abia State. The study therefore concludes that; such technologies as 'Improved varieties of crops, 'Replacement/Supplying, and Use of fertilizers were the most used by women vegetable farmers in the study area. It is therefore recommended that Women vegetable farmers should go into cooperative formations in order to have the capacity to attract interventions from Government and other development agencies, pull resources together and expand production.

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Table 1: Distribution of Respondents based on Age

Variables	Frequency	Percent	Mean
Age (in years)			
16 - 30	30	41.7	
31- 45	12	13.8	
46- 60	25	5.6	
61 - 75	5	34.7	**40**
Marital status			
Single	3	4.2	
Married	49	68.1	
Widow/widower	20	33.3	
Household size			
1-5	40	55.6	
6-10	29	40.3	
≥11	3	4.2	5
Household size			
1-5	40	55.6	
6-10	29	40.3	
≥11	3	4.2	5
Educational qualification			
Primary education	10	13.9	
Secondary education	34	47.2	
Diploma	10	13.9	
Tertiary education	18	25.0	
Years of experience			
1 - 5	44	61.1	
6 – 10	18	25.0	
11 - 15	10	13.9	5.6
Major Occupation			
Full time Vegetable farmer	18	25.0	
Part time Vegetable farmer	54	75.0	

Source: Field Survey Data, 2024

Table 2: Vegetable farmers' Extent of use of Vegetable Production Technologies in Umuahia Agricultural Zone, Abia State

S/N	Vegetable Production Technologies used	Always (4)	Sometimes (3)	Rarely (2)	Never (1)	Σfx	Mean $\Sigma fx/n$	SD	Remark
1	Use of improved varieties of crops	40(160)	23(69)	9(18)	0(0)	247	3.43	0.469	High
2	Seed treatment before planting	6(24)	13(39)	28(56)	25(25)	144	2.0	0.464	Moderate
3	Replacement/supplying	43(172)	20(60)	9(18)	0(0)	250	3.47	0.500	High
4	Line planting	5(20)	13(39)	33(66)	21(21)	146	2.03	0.479	Moderate
5	Irrigation	2(8)	3(9)	12(24)	54(54)	95	1.32	0.767	Low
6	Use of fertilizers	40(160)	28(84)	4(8)	0(0)	252	3.5	0.712	High
7	Maintenance of recommended spacing	7(28)	22(66)	5(10)	38(38)	142	1.97	0.756	Moderate
8	Mulching	3(12)	10(30)	42(84)	27(27)	153	2.13	0.581	Moderate
9	Staking	10(40)	13(39)	38(76)	11(11)	166	2.31	0.469	Moderate
	Grand Mean						2.53		

Source: Field Survey Data, 2024 Decision rule: 0.00 -1.33 = low use; 1.34 - 2.67 = moderately used; and 2.68 – 4.00 = highly used..

Table 3: Ordinary least square multiple regression results of the relationship between the socio-economic characteristics of the respondents and the extent of use of production technologies

Variable	Linear	Exponential+	Semi-log	Double-log
Constant	2.312	0.901	3.139	1.335
	(5.773)***	(8.295)***	(2.466)**	(9.908)***
Marital Status	0.325	0.103	0.436	0.133
	(3.232)***	(2.873)**	(2.554)**	(2.189)**
Age	0.003	-0.001	-0.263	-0.133
	(-3.016)***	(-3.408)***	(-2.102)**	(-2.164)**
Household Size	0.005	0.004	0.008	0.004
	(0.187)	(0.319)	(0.159)	(0.031)
Years of Experience	0.049	0.020	0.621	0.230
	(2.432)**	(2.440)**	(3.597)***	(3.757)***
Level of Education	-0.006	-0.006	0.025	0.057
	(2.153)**	(1.999)**	(2.196)**	(1.609)
Cooperative membership	0.172	0.043	-0.081	-0.094
	(1.042)	(0.734)	(-0.450)	(-1.092)
Income (₦)	0.320	0.130	0.206	0.510
	(4.326)***	(3.816)***	(3.473)***	(3.819)***
R^2	**0.421**	**0.497**	**0.407**	**0.438**
Adj. R^2	**0.368**	**0.338**	**0.357**	**0.316**
F-statistic	**7.882*** **	**9.930*** **	**9.910*** **	**9.577*** **

Source: Computed from field survey data, 2024. ** = significant at 5% and *** = significant at 1% $H0_1$ rejected at 5% level

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Impact of External Inflows on Agricultural Value Addition: A Sectoral Analysis

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ABSTRACT
Agriculture remains a pivotal sector in Nigeria's economy, contributing significantly to employment, food security, and GDP. However, the predominance of subsistence farming and limited agro-processing has constrained the sector's transformative potential. This study investigates the impact of financial inflows—specifically agricultural credit (AGR-CRED) and foreign direct investment (FDI)—on agricultural value addition (VA-AGR) in Nigeria. Using time-series data from 1991 to 2023 sourced from FAOSTAT, the study applies descriptive statistics, correlation analysis, and multiple regression modeling to examine the relationships among key macroeconomic indicators: GDP, GNI, AGR-CRED, FDI, and VA-AGR. The findings reveal a strong positive correlation between VA-AGR and both GDP and AGR-CRED, while FDI shows a weak but significant positive correlation. However, regression analysis uncovers a paradox: agricultural credit exhibits a statistically significant negative effect on value addition, suggesting inefficiencies in credit utilization. Conversely, FDI has a positive and significant impact, albeit small, indicating its potential when channeled effectively into agro-processing. Multicollinearity among GDP, GNI, and AGR-CRED necessitated model adjustments, leading to the exclusion of GNI for improved reliability. The refined model explains over 83% of the variation in VA-AGR, highlighting the robustness of the framework. Policy recommendations arising from the findings include incentivizing FDI into agro-processing, developing industrial clusters near farming communities, and improving credit efficiency through monitoring and targeted disbursement.

Keywords: FDI, value addition, agro-processing, processing clusters

INTRODUCTION
Agriculture remains a strategic sector in Nigeria, contributing significantly to employment, food security, and rural development. Historically, it has accounted for about 25% of the country's GDP and provides employment for over 70% of the rural population (World Bank, 2021). However, despite its importance, the sector is still dominated by subsistence farming with low productivity and limited processing capabilities. The lack of transformation from primary production to value-added agro-industrial outputs has stunted Nigeria's quest for economic diversification and industrialization (Iheke et al., 2016).

Value addition in agriculture involves enhancing the economic worth of agricultural commodities by processing them into finished or semi-finished goods. These processes increase farmers' income, reduce post-harvest losses, expand market access, and promote agro-industrial linkages (Adewumi & Omotesho, 2002). Nigeria, though richly endowed with agro-resources, suffers a persistent paradox: while it produces vast amounts of crops such as cassava, maize, and yams, it imports large volumes of processed food items due to an underdeveloped agro-processing sector (National

Bureau of Statistics [NBS], 2020). This situation highlights the urgent need for greater value addition to harness agriculture's full economic potential.

Several efforts have been made to address this gap through policy reforms, institutional interventions, and development financing. One of the most impactful interventions is the Central Bank of Nigeria's (CBN) Anchor Borrowers' Programme (ABP), launched in 2015. The ABP connects smallholder farmers with agro-processors through financing and input provision to ensure raw material availability for processing industries (Oxford Business Group, 2022). This linkage is vital for stimulating value-added activities and reducing reliance on raw commodity sales.

Another significant effort is the Agro-Processing, Productivity Enhancement and Livelihood Support Programme (APPEALS), supported by the World Bank and implemented in six pilot states. APPEALS supports farmers in upgrading their production systems while strengthening access to markets and modern processing infrastructure (Lagos State Ministry of Agriculture, 2023). This directly enhances agro-processing capacities, especially for priority commodities like rice, aquaculture, and poultry.

To catalyze industrial-scale processing, the federal government, with support from international partners, launched the Special Agro-Industrial Processing Zones (SAPZs) in 2022. These zones aim to co-locate agro-processing firms near production clusters, thereby reducing post-harvest losses and improving logistics efficiency. The African Development Bank (AfDB) recently announced a $2.2 billion expansion of this initiative, targeting 28 states across the federation (Reuters, 2025).

Central to these efforts are financial inflows such as agricultural credit and foreign direct investment (FDI). Agricultural credit is pivotal in facilitating access to modern technologies, mechanization, improved seeds, irrigation infrastructure, and agro-processing equipment (Olagunju & Ajiboye, 2010). Credit financing also helps smallholders scale operations and improve their market competitiveness (Afolabi, 2010). However, the informal and fragmented nature of the rural credit market in Nigeria often limits access to finance for most farmers, especially women and youth (NIRSAL, 2022).

FDI, on the other hand, is recognized globally as a catalyst for economic transformation. It brings in not just capital but also technology, expertise, managerial know-how, and international market linkages (UNCTAD, 2023). In the context of agriculture, FDI can help upgrade value chains, support large-scale agro-processing, and stimulate rural industrialization (Kolawole & Torimiro, 2006). In Nigeria, however, FDI flows into agriculture have been historically low and inconsistent, representing less than 5% of total FDI over the last two decades (CBN, 2022). Additionally, most FDI is channeled into primary production or export of raw commodities, with limited impact on local processing capacities (Ayanwale, 2007).

The challenges impeding the impact of financial inflows on agricultural value addition are multifaceted. These include poor infrastructure (such as roads, electricity, and storage facilities), weak policy implementation, insecurity in rural areas, low capacity utilization of agro-processing firms, and lack of incentives for private sector investment in agribusiness (Iheke et al., 2016; Eze et al., 2021). Moreover, the informal nature of rural economies and the fragmentation of the agricultural landscape make it difficult for both local financial institutions and foreign investors to engage sustainably.

Problem Statement

Nigeria's ambition to transform its economy through agriculture faces a fundamental barrier: the limited contribution of agricultural value addition to GDP. Although the country is a major producer of several crops, most of these commodities are exported or consumed locally in raw form. The absence of effective value-adding processes, such as drying, canning, milling, or packaging, reduces both the shelf-life and market value of these commodities (FAO, 2023). This problem contributes to high post-harvest losses (estimated at 30 - 40%) and low returns on investment for farmers and agro-entrepreneurs (AfDB, 2021).

One of the key assumptions in Nigeria's agricultural policy framework is that increased access to financial inflows, particularly agricultural credit and FDI, will stimulate value-adding activities. Yet, the empirical link between these inflows and value addition outcomes remains under-explored and, in some cases, contradictory. For instance, while agricultural credit is presumed to facilitate

investment in processing and marketing infrastructure, several studies have found that such credit is either underutilized or diverted to non-agricultural purposes (Afolabi, 2010; Eze et al., 2021). Weak monitoring mechanisms, high default rates, and lack of financial literacy among beneficiaries often diminish the impact of credit schemes.

Similarly, foreign direct investment in Nigeria's agriculture sector has not yielded the expected value chain development. Many FDI projects are concentrated in primary production - such as plantation farming or export-oriented commodity extraction - rather than in value-adding processes like food processing, agritech, or branding (Ogbanje & Salami, 2022). Structural issues such as inconsistent government policies, land acquisition challenges, corruption, and insecurity further deter investors from committing to long-term, capital-intensive agro-industrial ventures (Kolawole & Torimiro, 2006).

Moreover, the macroeconomic environment, being characterized by inflation, exchange rate volatility, and poor infrastructure, discourages both local and foreign investment in the agro-processing sub-sector. While the Central Bank of Nigeria (CBN) has introduced several intervention programs (e.g., Anchor Borrowers' Programme, Commercial Agriculture Credit Scheme), evaluations of these programs have shown mixed results. Many beneficiaries report insufficient disbursement, politicization of fund allocation, and lack of technical support (CBN, 2022; NIRSAL, 2022).

There is also the issue of spatial inequality. Agricultural inflows are often skewed toward a few regions or large-scale agribusinesses, while smallholders in remote areas remain excluded. This exacerbates rural poverty and further marginalizes regions with high agricultural potential but low investment penetration (Iheke *et al.,* 2016).

The lack of synergy between inflows and agro-processing outcomes reveals a critical policy gap. Nigeria's national development plans, such as the Agricultural Promotion Policy (APP) and the Nigeria Industrial Revolution Plan (NIRP), emphasize the importance of agro-industrialization. Yet, the execution of these policies has not translated into measurable increases in value-added output. What remains unclear is whether the problem lies in the volume of inflows, their distribution, or the structural barriers that dilute their impact.

Given this context, a data-driven analysis becomes essential in understanding the dynamics between inflows and value addition. Quantitative methods, especially econometric analysis, can offer empirical insights into the effectiveness of agricultural credit and FDI as instruments for driving agro-industrial transformation. Such insights are critical for informing policy design, allocating investment resources, and enhancing institutional effectiveness. This study, therefore, aims to investigate the impact of agricultural credit (AGR-CRED) and foreign direct investment (FDI) on agricultural value addition (VA-AGR) in Nigeria using historical data and regression analytics. The study answered the following research questions:

a) What is the trend and interrelationship among the variables within the study period?
b) What is the relationship between AGR-CRED and VA-AGR?
c) Does FDI have significant effect on agricultural value addition?

METHODOLOGY

The data were drawn from the Food and Agricultural Organization Statistics (FAOSTAT) data portal. They include annual records of Agricultural Credit (AGR-CRED) and Foreign Direct Investment (FDI) influence Value Addition in Agriculture (VA-AGR), and Gross Domestic Product (GDP) from 1991 to 2023.

Given the dataset, basic preliminary procedures were performed to prepare the data for analysis. The average substitution method was used to fill missing observations for GNI in 2023. Descriptive statistics were used for preliminary examination of the dataset. Correlation analyses were conducted to ascertain relationships between the variables. Regression analysis was used to establish causal relationship between some variables, and predict future values of dependent variables. Charts and graphs were used where necessary to bring clarity to observed trends and relationships among the variables.

The regression analysis was performed to ascertain causal relationship between the dependent variable VA-AGR and the independent variables GDP, GNI, AGR-CRED, and FDI-AGR. The model estimated for the relationship was:

$$VA\text{-}AGR = \beta0+\beta1GDP+\beta2GNI+\beta3AGR\text{-}CRED+\beta4FDI\text{-}AG+e \quad (1)$$

Where;
β0 = intercept
β1, β2, β3, β4 = regression coefficients
e = error term

Table 1: Dataset (1991 - 2023)

Year	GDP (M'N)	GNI (M'N)	AGR-CRED (M'N)	FDI-AG (M'USD)	VA-AGR (M'N)
1991	590059.74	545487	31300	1123.9	123235.65
1992	906029.29	799898.05	42700	1156.7	184115.65
1993	1257174.9	1125337.6	65700	1878.1	295324.59
1994	1768791.5	1641678.5	94200	2287.4	445272.89
1995	3100235.1	2904078.8	144600	1271.053	790141.62
1996	4086065.2	3827534.1	169400	2190.685	1070514.7
1997	4418708.7	4139130.8	385600	1642.472	1211462
1998	4805156.4	4501127.4	272900	1210.105	1341040.9
1999	5482354.3	5084310.5	322800	1177.708	1426973.8
2000	7062751.1	6516317.5	508300	1309.665	1508408.8
2001	8234493.7	7652494.7	796200	1277.421	2015421.5
2002	11501450	10878747	954600	2040.182	4251520.6
2003	13556974	12894353	1210000	2171.39	4585925.7
2004	18124060	17440401	1519200	2127.086	4935263.8
2005	23121879	22214059	1976700	4978.26	6032332.4
2006	30375179	29872170	2524300	4897.811	7513297.8
2007	34675944	32228196	4606562	6086.73	8551981.4
2008	39954212	37062851	7411425.8	8248.64	10100325
2009	43461459	39767913	8912143	8649.527	11625442
2010	54612264	52240903	7706430.4	6098.963	13048893
2011	63134735	59837070	7312726	8915	14037826
2012	72351452	68662171	8150030.3	7127.383	15815998
2013	81009965	76458783	10005594	5608.464	16816553
2014	90136985	86364888	12889400	4693.828	18018613
2015	95177736	92255556	13086205	3064.169	19636969
2016	102575418	94892575	16117286	3453.258	21523513
2017	114899000	105427601	15740594	2412.975	23952601
2018	129086908	117786703	15134203	775.2474	27371296
2019	145639000	134024000	17187766	2305.1	31904100
2020	154252000	143965000	20373488	2385.278	37241600
2021	176076000	162913000	24378193	3313.21	41126100
2022	202365027	185966598	29475192	894.7624	47944063
2023	236229355	30658829	44536126	1872.521	52917248

Source: FAOSTAT. Key: GDP = Gross Domestic Product; GNI = Gross National Income; AGR-CRED = Agricultural Credit; FDI-AGR = Foreign Direct Investment in Agriculture; VA-AGR = Value Addition in Agriculture

RESULTS AND DISCUSSION

Table 2 presents some relevant descriptive statistics of the variables. According to Table 2, GDP has a standard deviation of ₦65.68 million and a range of ₦235.64 million. These are indications of high variability across the years, and suggests that GDP has grown significantly over the time period, though with major yearly fluctuations. On the contrary, although GNI shows similar trend as GDP but slightly lower. This is an indication the net income from abroad has not fluctuated as wildly as GDP.

Table 1: Descriptive Analytics of Variables

	Range	Minimum	Maximum	Mean	Std. Deviation
GDP (M'N)	235639294.85	590059.74	236229354.58	59819055.12	65676005.66
GNI (M'N)	185421110.85	545487.00	185966597.84	50077265.48	53324272.56
GFCF (M'N)	71267130.01	285589.99	71552720.00	14077110.99	19163920.41
AGR-CRED (M'N)	44504826.23	31300.00	44536126.23	8304298.94	10317626.20
FDI-AG (M'USD)	8139.75	775.25	8915.00	3292.27	2411.20
VA-AGR (M'N)	52794012.35	123235.65	52917248.00	13617071.90	14740572.41

Source: Computed from dataset

Figure 1a: Trend of GDP, GNI, AGR-CRED, FDI-AG, VA-AGR

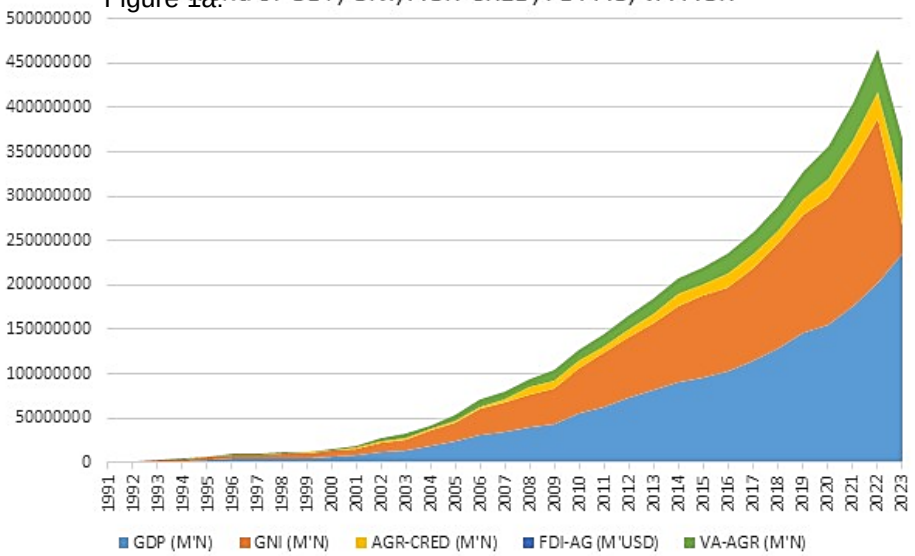

Figure 1b: AGR-CRED vs VA-AGR

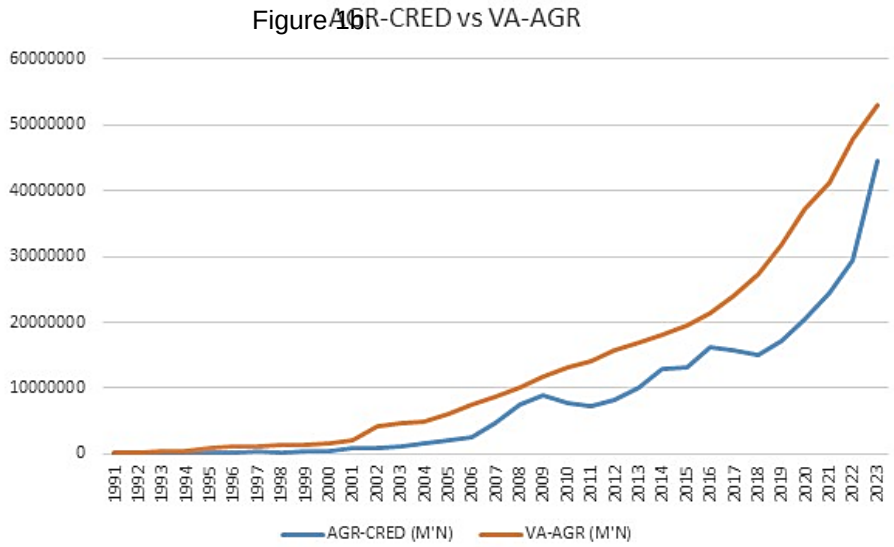

Figure 1c: GDP vs VA-AGR

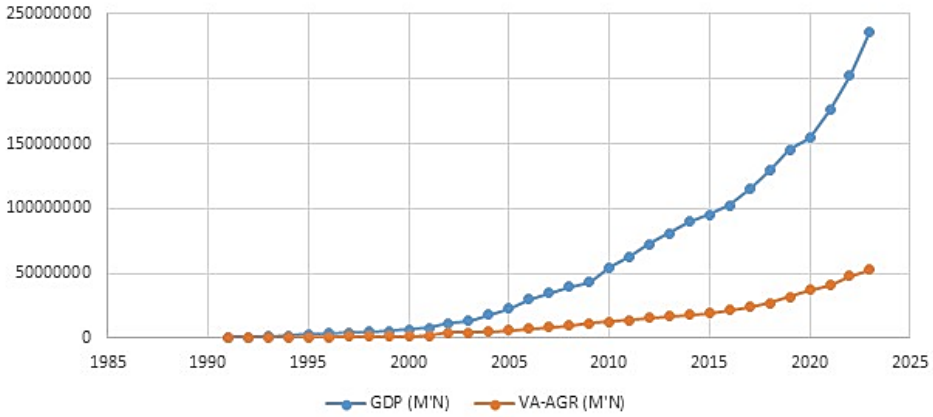

Figure 1d: FDI vs VA-AGR

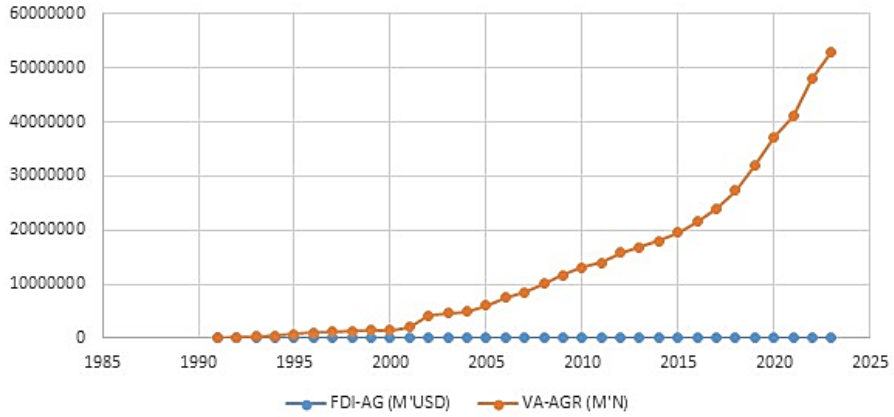

Figure 1: Dashboard showing interactions between the variables

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Table 3 presents summary of the paired trend analysis as presented in Figure 1. Of particular interest is the seemingly non-response of FDI to AG-AGR. The trend graph rather shows that foreign direct investment does not visibly respond to agricultural value addition out. This is suspected to be as a result of injection of FDI into export product or primary production rather than agro-processing.

Table 3: Variable-pair observations

Variable Pair	Observed Pattern	Possible Explanation
VA-AGR & AGR-CRED	Often moves together, but not always proportionally	Credit access alone may not lead to value addition unless tied to processing input
VA-AGR & FDI	FDI is inconsistent; VA-AGR does not always respond	FDI may target export or primary production rather than local processing
VA-AGR & GDP	Weak and inconsistent link	Agricultural value chains are not strongly contributing to GDP growth
AGR-CRED & FDI	Not directly correlated	Credit institutions and foreign investors may act independently

Table 4: Correlation matrix between variables

	GDP (M'N)	GNI (M'N)	AGR-CRED (M'N)	FDI-AG (M'USD)	VA-AGR (M'N)
GDP (M'N)	1.00				
GNI (M'N)	0.88	1.00			
AGR-CRED (M'N)	0.98	0.79	1.00		
FDI-AG (M'USD)	0.27	0.33	0.24	1.00	
VA-AGR (M'N)	1.00	0.88	0.98	0.27	1.00

Source: Computed from dataset

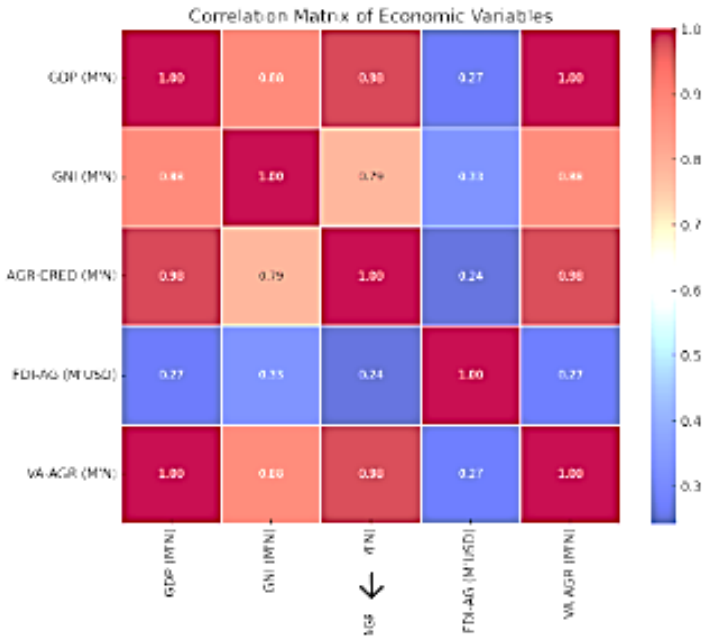

Figure 2: Correlation heatmap

From the correlation matrix in Table 2 and correlation heatmap in Figure 2, the following can be deduced:

- GDP and VA-AGR (0.997) have an extremely strong positive correlation.
- AGR-CRED and VA-AGR (0.979) also show a very strong positive correlation.
- GNI and VA-AGR (0.881) have a high positive relationship, though slightly weaker than GDP.
- Unfortunately, FDI-AG correlations with the other variables are low (~0.24–0.33), which implicates the fact that FDI in agriculture does not move strongly with value addition or broader economic aggregates in the dataset.

- FDI-AG and VA-AGR have very weak but positive correlation (0.272), which shows potential for boosting the agro-processing sub-sector since increased FDI into that sector will enhance the correlation between it and value addition in agriculture.

Preliminary investigations of the regression analysis shows that there was serious multicollinearity among the independent variables. The Variance Inflation Factor (VIF) of GDP, GNI and AGR-CRED were very high. The VIF measures how much the variance (i.e., the uncertainty or instability) of a regression coefficient is increased because of multicollinearity among independent variables. Multicollinearity means that some independent variables are too closely related to each other. In this case, these three variables are understandably related. The gross national income (GNI) is mostly partly derived from the country's GDP. Similarly, the volume of credit the government would advance to the agricultural sector would also be dependent upon the country's output which is measured by the GDP. Recall from the regression matrix that these variables have strong positive correlation coefficients. So the issue needed to be addressed.

Table 5: Regression estimates

Variables	Coefficients	Std. Error	t-value	p-value	VIF	Remarks
Constant	13.30	0.260	51.097	0.000	-	-
GDP	4.15E-08	0.000	1.816	0.080	131.44	Extreme multicollinearity
GNI	-7.39E-10	0.000	-0.083	0.934	13.035	Very high multicollinearity
AGRCRED	-1.30E-07	0.000	-1.149	0.260	79.656	Extreme multicollinearity
FDIAG	0.00	0.000	4.598	0.000	1.08	No multicollinearity

Source: Computed from dataset. Dependent variable: LnVA-AGR. Obs: 33

The simplest econometric method to fix multicollinearity would have been to drop the variable that had the highest VIF, which was GDP. However, since GNI and GDP were highly positively correlated, on the assumption that GNI was derived from GDP, it was safe to assume that the effects of GNI on the dependent variable can equally be represented by the effects of GPD on the same variable. So GNI being a derivative of GDP, and having the least significant p-value, was dropped from the model, to become:

$$VA\text{-}AGR = \beta 0+\beta 1GDP+\beta 2AGR\text{-}CRED+\beta 3FDI\text{-}AG+e \quad (2)$$

The result of the re-estimation of the model is presented in Table 6 below:

Table 6: Regression results (treated multicollinearity)

Variables	Coefficients	Std. Error	t-value	p-value	VIF	Remarks
Constant	13.30	0.250	53.135	0.000	-	-
GDP	3.973E-08	0.000	4.379	0.000	21.486	Notable multicollinearity
AGRCRED	-1.22E-7	0.000	-2.111	0.043	21.487	Notable multicollinearity
FDIAG	0.0003	0.000	4.837	0.000	1.000	No multicollinearity

Source: Computed from dataset. Dependent variable: LnVA-AGR. Obs: 33

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.913[a]	.833	.815	.72711	.286

a. Predictors: (Constant), FDIAG, GDP, AGRCRED
b. Dependent Variable: LNVAAGR

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	76.302	3	25.434	48.107	.000[b]
	Residual	15.332	29	.529		
	Total	91.634	32			

a. Dependent Variable: LNVAAGR
b. Predictors: (Constant), FDIAG, GDP, AGRCRED

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The model summary shows that the regression model has an R^2 value of 0.833, which explains that 83.30%, of the variations in the dependent variable is account for by the independent variables fitted in the model. The f-ratio of 48.10 which is significant at 1% level of significance, indicates that the model is good enough to test the relationship between the variables.

After addressing multicollinearity by excluding GNI from the model, the revised regression model indicates that GDP, AGRCRED, and FDIAG are statistically significant determinants of agricultural value addition in Nigeria. Now let us look deeper into the results. GDP and FDIAG positively influence VA-AGR, while AGRCRED shows a negative relationship, suggesting inefficiencies in agricultural credit utilization. Despite slight residual multicollinearity between GDP and AGRCRED (VIF ~21), the model is substantially more stable and reliable compared to the original version.

The intercept of the model was 13.303. This is of the natural logarithm of VA-AGR if the independent variables GDP, AGRCRED, and FDIAG were zero. Recall from the descriptive analysis of the data, the mean of VA-AGR is 13617071.90 for the period under review.

The coefficient indicates that the effect of GDP on VA-AGR (Value-Added Agriculture) means that for each unit increase in GDP, VA-AGR increases by a fraction (3.973×10^{-8}) which is statistically significant (p = 0.000). The positive coefficient means that as GDP increases, VA-AGR is expected to increase.

The result shows an inverse relationship between agricultural credit (AGRCRED) and value-added agriculture (VA-AGR). The implication is that for every unit increase in agricultural credit, the value-added agricultural output would decreases by $1.219x10^{-7}$.The negative sign of the coefficient suggests that more credit does not directly lead to an increase in value-added agricultural activities. Instead, it seems to have a diminishing effect on VA-AGR. This is contrary to theoretical expectations, and can be an indication of funds diversion. While the government designs policies and programmes to boost agricultural credit, such policies are not properly implemented. As a result, the nominal value of credit advanced to the agricultural sector is far higjer than the actual value of credit that got the farmers. Hence, the result obtained above.

The coefficient of FDIAG on VA-AGR (value-added agriculture) is an indication is that for each unit increase in foreign direct investment in agriculture, VA-AGR increases by 0.0003. This suggests that foreign investment does have a positive impact on value-added agricultural activities.

These indices are pointers that foreign investment does contribute to agricultural value addition. The p-value of 0.000 still indicates strong statistical significance, meaning that there is causal relationship between FDIAG and VA-AGR. This supports the fact that FDIAG has a statistically significant positive impact on agricultural value addition. The positive coefficient suggests that foreign direct investment is positively related to agricultural value addition. As foreign investment increases in the agricultural sector, value addition is expected to increase accordingly. It could suggest that foreign investors are either not investing enough to cause a significant change or that their investments are not being channeled effectively into value-added activities like processing, marketing, or innovations such as branding and having legally-structured business ventures.

It can be observed that question (1) was answered by the charts in Figure 1, which showed the trend of these variables within the period under study. In reflection to question (2), we can show from the regression results, that there is statistically significant negative relationship between credit to agriculture and value addition in agriculture. This result raises questions about the effectiveness of agricultural credit programs in improving agricultural value addition. If agricultural loans are not contributing to increased value-added output, it suggests that credit policies and implementation strategies may need to be re-evaluated.

To answer question (3) from the regression results also, the FDI has significant positive influence on agricultural value addition. While FDIAG is positively associated with VA-AGR, the effect suggests that foreign investment is not yet a major driver of value-added agricultural activities. Some factors may be responsible for this. First of all, foreign investments might be directed toward primary production (like land acquisition, crop production, etc.) rather than value-added activities such as processing, packaging, or branding. Also, in the short-term, the impact may not be readily visible. The impact of foreign investment might take time to materialize in terms of value addition. Some of

the positive effects could be seen in the long run rather than immediately. This is truer when it is observed that the trend in value addition in agriculture spiked from around 2007-2008, less than two decades ago when the government started paying attention to that sub-sector of agriculture.

To predict value addition in agriculture using the model from the regression results, the prediction model would be:

$VAAGR = 13.30 + 3.97*10E^{-8}(GDP) - 1.22*10E^{-7}(AGRCRED)+0.0003(FDIAG)$

Substituting with the means of the variables, we have:

$VAAGR = 13.30 + 3.97E^{-8}(59819055.12) - 1.22E^{-7}(8304298.94) + 0.0003(3292.27)$
$VAAGR = 13.30+(3.97\times10^{-8}\times59819055.12) - (1.22\times10^{-7}\times8304298.94) + (0.0003\times3292.27)$
$VAAGR = 13.30 + 2.374768891264 - 1.01312367268 + 0.987681$
$VAARG = 15.649326218584 \sim 15.65$

Based on the above, the estimated regression model predicts that based on the effects of the independent variables in the model, there is an indication of a moderate level of value addition in agriculture relative to the other sectors of the economy. This figure shows that value addition is positive and relatively small. It is an indication that the agricultural sector is lacking in the conversion of raw agricultural products into higher-value goods through processing. While the agricultural sector is growing, this prediction hints that more needs to be done to drive greater value addition. What is needed now are policies that will channel the needed resources towards agro-processing. These could be policies that improve the efficiency of credit use, target foreign direct investment, and drive domestic investment in agro-processing.

CONCLUSION AND RECOMMENDATIONS

Data forms the backbone of decision-making processes. In the stiff competitive business environment, businesses need accurate, reliable data for making all their operational and marketing decisions. This report adopted data-based approach at arriving important decisions about the Nigerian value-addition subsector, which in turn, informs needed interventions for the sector studied. Data on variables which included gross domestic product, gross national income, agricultural credit, value addition in agriculture, and foreign direct investment in agriculture, between 1991 to 2023. The focus was to show empirically, how these variables affected and interacted with the agro-processing industry in Nigeria, as shown by value-addition trend within the period of study. The data were subjected to descriptive and inferential analysis. The results showed that the trend of all the variables was consistent improvement, except FDI into agriculture which flattened for a bit before picking up. Correlation analysis showed strong relationships among the variables. Regression results showed that GDP, AGRCRED and FDIAGR had significant effects on the value addition output with the period. Based on this, it projects that would attract FDI into the agro-processing subsector and thereby enhance output from there, were recommended.

To achieve an effective intervention that will change the tide of value addition in the Nigerian agro-processing subsector, project-based interventions which focus on improving infrastructure are needed. These interventions could include:

Programme to Enhance Foreign Direct Investment (FDI) in Agro-processing
The objective is to introduce incentives for foreign investors, to encourage them to channel more investments into agro-processing. Target is to divert a good proportion of FDI in primary agricultural production towards processing. The incentives can include tax breaks, infrastructure support, and market access. The rationale for this is predicated on FDI's modest impact on value-added agriculture, as shown by the results of the analysis. It is suspected that this due to the lack of targeted investments in agro-processing. So directing FDI towards processing activities could lead to more substantial value addition. Furthermore, based on the findings of the analysis, if there is increased foreign investments in agro-processing, it can boost the sector's contribution to the economy by enhancing the processing, branding, and marketing aspects of agriculture.

Development of Agro-processing Clusters and Industrial Value Addition Parks
The project intervention would be the establishment of agro-processing industrial parks or clusters where raw agricultural products can be processed in proximity to farms. These hubs would provide

the necessary infrastructure, such as storage facilities, transportation, processing plants, and internet access. Proximity to raw materials reduces logistics costs and improves the efficiency of value addition. The clusters would take comparative advantage of proximity to source or raw materials. Clusters also facilitate shared knowledge and resources which would lead to improved quality and innovation. Furthermore, establishing agro-processing hubs can create economies of scale, reduce post-harvest losses, and increase the marketable value of agricultural products. It can also attract young people, who generally see agriculture as "dirty" profession. Facilities that are youth-savvy can be moral boosters for the young ones to take to agro-allied activities as sources of livelihood.

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Utilization of Orange Flesh Potato Among Rural Households in Abia State Nigeria

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ABSTRACT
The study investigated the extent of utilization of orange flesh potato among rural households in of Abia state Nigeria. The specific objectives were to identify the sources of information on OFSP among rural households, ascertain the level of utilization of OFSP among the rural households, examine the perception of the rural households on OFSP and ascertain the constraints to the utilization of OFSP among rural households in the study area. A multistage sampling procedure was used in sampling 60 respondents for the study. Primary data were collected for the study and analyzed using both descriptive and inferential statistics. The result major result revealed that farmers sourced information on sweet potato farming practices from personal observations (90.0%), fellow farmers (86.67%) and television programmes (78.67%), while most (63.3%) of the farmers cultivated sweet potatoes with cassava and maize. The result revealed a grand mean of 2.15 which affirms that rural households highly utilized orange flesh sweet potato. The mean perception score of the farmers was 2.9, indicating that the farmers have favorable perception of the sweet potato cultivar characteristics. The mean constraint scores for the farmers in sweet potato farming practices was 2.1, which indicates that they are serious in these practices. The Multiple regression estimates gender (5%), age (5%,), marital status (1%), occupation (5%) and farm size (1%) were the determinants of utilization of sweet potato farming practices in the study area. The study concluded that there was a high level of utilization of orange flesh sweet potato by rural households in the study area. The study recommended that a more increase in utilization of orange flesh sweet potato could be achieved by encouraging old farmers and the experienced ones to remain and enter into sweet potato production as a business.

INTRODUCTION
Sweet potatoes (*Ipomea batatas Lam*) play an immense role in human diet, animal feed, and industrial raw materials and is considered as second staple food in developed and underdeveloped countries. Moreover, sweet potato production and management need low inputs compared to the other staple crops. It also gives satisfactory yields under unfavourable climatic and soil conditions, as well as under low or non-use of external inputs (Getachew and Jens, 2018). Scientific studies such as Agbarevo and Okringbo (2019) indicated that the diversity in sweet potato flesh color vary from white, yellow, purple, and orange. and is connected with it nutritional and sensory acceptability. Harvest Plus, (2019) reported that the Orange-Fleshed Sweet potato (OFSP) is an improved breed of sweet potato (*Ipomea batatas Lam*.) and is rich in β-carotene which is the most important pro-vitamin A carotenoid. The OFSP is one of the bio-fortified crops being developed as part of the global effort to control vitamin A deficiency.

Orange fleshed sweet potato (OFSP) plays a significant role in addressing situations of food shortages and malnutrition. It also has the potential to maintain human health by mitigating diseases and generating income as well as improving the overall livelihood of the people. As a result of the importance of Orange flesh sweet potato as food in Nigeria, the National Root Crops Research Institute (NRCRI) Umudike in Abia State, Nigeria has the national mandate to carry out research into the genetic improvement, production, processing, utilization, marketing and storage of all root and tuber crops of economic importance (including sweet potato) in Nigeria. In other to increase the genetic base of the crop in Nigeria, the NRCRI has developed and released four new varieties of sweet potato. These varieties are given official catalogued code named as UMUSPO/1, UMUSP/2, UMUSPO/3 and UMUSPO/4 released in 2018 christened Solo-gold. Three (UMUSPO/1, UMUSPO/3 UMUSPO/4) out of the four varieties released by the Institute are orange-fleshed sweet potatoes (OFSP). According to (Low, Arimond, Osman, Cunguara, Zano and Tschirley 2017), they stated that these varieties are high-yielding and resistant tolerance to major sweet potato pests and diseases. OFSP is rich in beta-carotene which is converted into vitamin A in the human body.

The (WHO, 2024) has viewed vitamin A deficiency (VAD) among people in most sub Saharan African countries including Nigeria, results in high rates of blindness, increased risk of severe infections and even premature deaths from common diseases such as diarrhea and measles. According to (IFPRI, 2019), Young children and pregnant or lactating women are particularly at risk of VAD. As a result of the nutritious food benefit of OFSP, the challenge is to introduce the beta-carotene rich varieties and promote their production, uptake and consumption.

Vitamin A is an essential nutrient that prevents blindness in children and build up immunity in pregnant women (IFPRI, 2019). The OFSP is a nutritionally rich crop. It contains antioxidants, such antioxidants in the orange fleshed sweet potato include; phenolic acids, anthocyanins and carotenoids, especially beta-carotenes. Betacarotene and anthocyanins exist in high quality OFSP roots with a range of flesh and skin colours. The crop also contains vitamins such as (B1, B2, B3, B5, B6, B9, C and E), minerals like (iron, calcium, magnesium, phosphorus, potassium and zinc), others include; high amount of soluble sugar such as cellulose, pectin, and hemicellulose, dietary fiber, protein and carbohydrates. According to SASHA (2023) reported that the roots and leaves of OFSP contain appreciable amount of protein (about 5% of the dry matter), Lipid (approximately 1.2-2.7% of the total fresh weight), amylases and phytochemicals such as ascorbic acid.

However, OFS is among the most resilient crops to abiotic stresses, and is considered a key crop for mitigation of climate change and weather variability as Sorense (2013) reported. Since the official release of the OFSP in the country Nigeria in 2012 and 2013, the production, marketing and utilization of the OFSP have expanded to almost all the ecological zones within the past seven years starting from 2012 to 2019. For instance, over 400,000 hectares of lands are under OFSP cultivation. Yields of OFSP storage roots have increased from farmers' pre-research era of about 3 tonnes per hectare to 20-30 tonnes per hectare. The total annual production of OFSP in Cross River, Ebonyi, Nasarawa, Benue and Enugu States of Nigeria increased from 47,580 to 95,596 tonnes from the years 2014 to 2018. Similarly, its consumption as food and in processed forms increased tremendously in many States within the same periods. The utilization of the roots as feed increased from 340 to 11,520 tonnes while domestic sales increased from 33,550 to 90,970 tonnes. Traditionally, method of utilization of OFSP are used as boiled storage roots and eaten with stew, eaten raw or sliced and eaten as root salad, or grind and drink as juice. OFSP is also dried and milled for sweetening of gruel ('ogi') porridge, sliced into chips, dried and boiled with beans or vegetables, sliced into chips and fried in vegetable oil, in addition to processing into flour for sweetening 'kunu' or pap. OFSP root are boiled, sliced, sun-dried and used later as snacks, processed into flour for making buns, chin-chin, doughnut, noodles, alcoholic beverages, protein-enriched pulp and canned foods. OFSP is making a positive wave in the country. National Root Crops Research Institute, Umudike, the originating Institute of OFSP in Nigeria has a Kiosk designated for the selling of OFSP processed products within the Institute. In many urban cities across the country fast food outlets using inexpensive OFSP products are springing up. OFSP roots and products are healthier foods required by urban dwellers. The nutritional advantage of OFSP offers the opportunity to promote increased marketing and processing of OFSP. This in turn boosts the demand and increase the income of OFSP producers. The sliced flesh roots could be dried and ground into flour or as chips for animal feeds. The leaves could be used as fodder for livestock. The leaves of OFSP could be dried and mix with poultry feeds and fed to laying hens to increase the vitamin A contents of eggs. The root of this variety contains moderate amount of micro-nutrients

such iron and zinc as well as betacarotene. OFSP does not have the problem of anti-nutritional factors such as cyanides and oxalates that exist in cassava and cocoyam respectively.

OFSP like other Sweet potatoes can be grown and harvested within four months than other root and tuber crops such as cassava, yam, cocoyam and ginger. Enlarged roots of OFSP harvested in three months could be used for making vegetable Salad. Specifically, OFSP can be grown two to three times in a year with supplementary irrigation. NRCRI made tremendous efforts in producing quality pre-basic seed planting materials and making these materials available to farmers under the Sweet potato Action Security and Health in Africa (SASHA) Project. This project aimed at ensuring that quality seed vines of the OFSP varieties released by the Institute are produced under disease free environments using the net tunnel and screen house and are sold to farmers to enable them have a stock of clean materials for their OFSP root production on sustainable basis. This project was carried out on a pilot scale using 3 states in Nigeria (Abia, Nasarawa and Osun). The result of this project enabled many more OFSP-producing states with funding limitation access to clean planting material instead of using and exchanging poor quality, disease-infected seed vine materials for commercial storage root production (Dangler, Scheuerman, Campbell and Clark 2014). Today sweet potato research programme of NRCRI, Umudike is rated by CIP as one of the programmes that has active sweet potato breeding programme in Africa.

Several articles such as those by Okello, Shikuku, Sindi, Low (2014); and Omoare, Fakoya, Fapojuwo, Oyediran (2014) have considered the potentials and consumption of OFSP, however, little or none have considered the intensity of its cultivation by farmers specifically in Nigeria. Despite its growing importance and the tremendous potentials as food, animal feed, and source of raw material, sweet potato is still not widely cultivated. Therefore, it is imperative to assess the benefit and constraint to orange flesh sweet potato utilization among rural household in Abia State, to elucidate and document major constraints of utilization of the orange flesh sweet potato. The specific objectives were to identify the sources of information on OFSP among rural households, ascertain the level of utilization of OFSP among the rural households, examine the perception of the rural households on OFSP and ascertain the constraints to the utilization of OFSP among rural households in the study area.

METHODOLOGY

The study was conducted in Abia State. Abia State is located in the South-East agro-ecological zone of Nigeria. Abia State lies within Longitude 7^0 23E and 8^0 2E and Latitude 4^0 47N and 6^0 12N. The State is bounded in the West by Imo State, and shares common boundaries on its North and North East, by Anambra, Enugu and Ebonyi States. Cross River and Akwa Ibom States are in the East and South-East, while it shares its borders at the South with Rivers State, which is demarcated by Imo River. Geographically, Abia State lies within Longitude 7^0 23^l and Latitude 4^0 47^l N and 6^0 12N and the temperature range from 20^0c to 30^0c. Abia State is made up of 17 Local Government Areas and three agricultural zones namely, Aba zone, Ohafia zone and Umuahia zone.

The study made use of a multi-stage, random sampling procedure in selecting 120 respondents for the study. At the first stage, three political zones of the state were selected for the study. At the second stage the study made use of random sampling techniques to select 4 (four) Local Government Area each from the three political zones of the state making a total of 6 (six) LGAs. In the third stage simple random sampling technique was used to select three (2) autonomous communities each from the 6 LGAs making a total of 12 autonomous communities. Finally, the fourth stage involved a random selection of ten (10) youths each, from the 12 autonomous communities, making a total of 120 respondents as the sample size for the study.

The study was made use of multi-stage sampling procedure in the selecting 60 respondents for the study. In the first stage, 6 autonomous communities were purposively sampled based on their prominence for OFSP production as well as their accessibility to the researcher. In the second stage, two (2) villages were selected by simple random sampling technique from each of the six (6) communities selected which made a total of 12 villages. In the third and final stage, five rural household heads were randomly selected from each of the 12 villages making a total sample size of sixty (60) respondents for the study. Primary data were used for this study. The data were collected through a structured questionnaire and interview which were administered to the households on a single visit to each of the 12 villages.

The data collected for the study were analysed with both descriptive and inferential statistics. All the specific objectives were analysed using descriptive statistic while hypothesis was tested using Ordinary Least Square regression model.

The formula to compute the mean count to be used in this study is specified below. The mean ($\bar{x}$) is computed by multiplying the frequency (f) of the responses under each category by assigned value and dividing the sum (∑) of the product by (N) number of respondents to the particular indicator as shown:

$$\bar{X} = \frac{\sum fx}{N} \quad (1)$$

Where,
∑ = Summation
F = Frequency
X = assigned scores to response category
N = number of respondents
$\bar{X}$ = Arithmetic mean

$H0_1$: There is no significant relationship between farmer's socio-economic characteristics and the level of utilization of OFSP in the study area was tested using Ordinary Least Square regression model. Multiple regression helps to learn more about the relationship between one dependent variable (Y) and two or more independent variables (X). It is used when we want to predict the value of a variable based on the value of two or more variables. It calculates a coefficient for each independent variable, as well as its statistical significance, to estimate the effect of each predictor on the dependent variable, with other predictors held constant. The OLS/Multiple regression expressed implicitly as follows:

$$Y = f\ (X_1\ X_2\ X_3\ X_4\ X_5\ X_6\ X_7, X_8X_9X_{10}X_{11}X_{12,}\ X_{13},\ e_i) \quad (2)$$

The four functional forms of OLS in explicit form is specified as:
Linear Function

$$Y = ß + ß_1{+}x_1{+}\ ß_2x_2{+}\ \ldots ß_nx_{n+}\ ei$$

Exponential function

$$LogY = ß + ß_1{+}x_1{+}\ ß_2x_2{+}..ß_nx_{n\,+}\ ei$$

Semi-log function

$$ß_0{+}\ ß_1lnx_1 + ß_2lnx_2 \ldots\ ß_nlnx_{n\,+}\ ei$$

Cobb Douglas function

$$Log\ Y = ß_0{+}\ ß_1lnx_1 + ß_2lnx_{2\ \ldots}\ ß_nlnx_{n\,+}\ ei$$

Where,
Y = Utilization of OFSP (mean score)
X_1 = Age (years)
X_2 = Education level (Number of years spent in school)
X_3 = Marital status (1 = married, 0 = single)
X_4 = farm size (ha)
X_5 = farmers experience (years)
X_6 = household size (number of persons)
X_7 = farm output (km)
X_8 = cost of labour (₦)
X_9 = farm income (₦)
X_{10}= membership of cooperative (yes = 1, No = 0)
e = error term

RESULTS AND DISCUSSION

Sources of information orange flesh sweet potato

The frequency distribution of respondents according to sources of information on orange flesh sweet potato farming practices is shown in Table 1. The result indicates that majority (90.0%) sourced information from fellow farmers, personal observations (86.67%) and most (78.67%) of the farmers, sourced information on sweet potato practices from fellow farmers and ministry/ADP. Also, most (61.67%), 58.3% and (45%) sourced information from seminar/workshop and television programmes while 38.3% sourced from research institutes. The result is in agreement with the

finding of Yusuf et al., (2018), and Ajala, Ogunjimi and Farinde (2023) as they obtained similar result among arable crop farmers in Nigeria.

Table 1: Frequency Distribution of Respondents according to the Sources of Information on Sweet Potato

Sources	Frequency	Percentage*
Ministry of Agriculture/ADP	47	78.67
Seminars/Workshops	35	58.3
Research Institutes	23	38.3
Television programme	27	45
Radio programme	37	61.67
Fellow farmers	54	90.0
Personal observations	52	86.67

Source: Field Survey, 2023. *Multiple Responses Recorded

Level of utilization of OFSP among the rural households

Table 2: Mean rating of the extent of utilization of Orange Flesh Sweet Potato in the study area

S/N	OFSP products available	Always	Occasionally	Never	Total	Mean
1	Chips	36(108)	22(44)	2(2)	154	**2.6**
2	Crisps	27(81)	30(60)	3(3)	144	**2.4**
3	Puree	14(42)	41(82)	5(5)	129	**2.2**
4	Flour	22(66)	33(66)	5(5)	137	**2.3**
5	Juice	21(63)	29(58)	1(1)	122	**2.0**
6	Bread and other bakery products	20(40)	2(4)	38(38)	156	**1.4**
	Total mean					**12.9**
	Grand mean					**2.15**

Source: Field Survey, 2023

The result on Table 2 shows the mean rating of the level of utilization of Orange Flesh Sweet Potato in the study area. The result revealed a grand mean of 2.15 which affirms that rural households highly utilized orange flesh sweet potato in the study area. The result implies that there was a high level of utilization of orange flesh sweet potato in Abia State, Nigeria. Agbarevo and Okringbo (2019) and Ukoha and Okonkwo, (2019) asserted that sweet potatoes is a major arable crop that is being promoted by National Root Crops Research Institute Umudike that encourages adoption and participation of farmers due to its economic and nutritious value. Ume, Onunka, Nwaneri and Okoro, (2016) posited that participation of farmers in sweet potato farming is driven by the status and importance attached to the crop by rural dweller who consume it as an energy food source.

Perception on orange flesh sweet potato

Table 3: Mean frequency distribution of respondents according to perception on orange flesh sweet potato

Perception Statements	Strongly agree	Agree	Disagree	Strongly Disagree	Total	Mean
It has high yield in Kg/ha	33(132)	27(81)	0(0)	0(0)	213	**3.5**
It has a high vine yield	18(72)	27(81)	14(28)	1(1)	182	**3.0**
Its varieties mature early	28(112)	25(75)	14(8)	3(3)	198	**3.3**
It has drought resistant	16(64)	4(12)	23(46)	17(17)	139	**2.3**
It is disease tolerant	17(68)	4(12)	19(38)	20(20)	169	**2.3**
It is resistant to pest attack	15(60)	24(72)	19(38)	2(2)	172	**2.9**
It has a good culinary taste	25(100)	26(78)	6(12)	3(3)	193	**3.2**
It has high dry matter	21(84)	26(78)	10(20)	2(2)	184	**3.0**
The skin colour makes it nutritious	26(104)	15(45)	17(34)	2(2)	185	**3.1**
It has sweet taste when consumed or processed	38(152)	15(45)	0(0)	7(7)	174	**2.9**
Total						**29.5**
Mean						**2.95**

Source: Field Survey, 2023

The mean rating of respondents' perception on sweet potato cultivar characteristics is shown in Table 3. Result indicates that the respondents perceived that the crop has high yield in Kg/ha ($\overline{X} = 3.5$), it natures early ($\overline{X} = 3.3$) and has good culinary taste ($\overline{X} = 3.2$). Furthermore, they agreed that sweet potato the skin colour makes it nutritious ($\overline{X} = 3.1$), it produces high vine yield ($\overline{X} = 3.0$), it is resistance to pest attack and very sweet when consumed with mean scores of 2.9 respectively. The

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mean perception score of the farmers was 2.9, indicating that the farmers has favourable perception of the sweet potato cultivar characteristics. Nwaobiala and Isaac, (2017) in their study found that technology attributes of a crop influences farmers' decision to participate and adopt its farming practices. This result is in tandem with the findings of Ayodeji, Ajayi, Solagberu, Olawunmi and Babatunde, (2019) and Ajala, Adigun, Ajiboye and Gbotosho (2016) as they obtained a similar result on perceived attributes of sweet potatoes among farmers in Nigeria.

Constraints to utilization of orange flesh sweet potato

The distribution of respondents according to constraints to utilization of orange flesh sweet potato is shown in Table 4.

Table 4: Mean of Constraints to utilization of Orange Flesh Sweet Potato.

Constraints	Severe	Mild	Never	Total	Mean	Decision
Lack of farm credit	31(93)	27(54)	2(2)	149	**2.5**	Serious
Inadequate land	27(81)	25(50)	8(8)	139	**2.3**	Serious
Disease and pest infestation	18(54)	38(76)	4(4)	134	**2.2**	Serious
Marketing problems	13(39)	19(38)	28(28)	105	**1.8**	Not Serious
Poor extension contacts	14(42)	24(48)	22(22)	112	**1.9**	Serious
Attributes of technology	16(48)	22(44)	22(22)	92	**1.5**	Not Serious
Higher wages of labour	34(90)	24(52)	2(2)	130	**2.3**	Serious
Poor income from sweet potato production	8(24)	17(34)	35(35)	93	**1.6**	Not Serious
Poor storage affects harvest	26(78)	26(52)	17(17)	147	**2.5**	Serious
Total					**18.6**	
Mean					**2.1**	

Source: Field Survey, 2023

The result revealed that the respondents affirmed that lack of farm credit and poor storage as it affects harvest with mean scores of 2.5 were serious constraints to sweet potato farming in the study area. Also, they inferred that inadequate land and high labour wages having mean scores 2.3 were serious problems as against disease and pest infestation ($\overline{X} = 2.2$). The mean constraint scores for the farmers in sweet potato farming practices was 2.1, which indicates that they are serious in these practices. Tewe, Ojeniyi and Abu, (2012) posited that majority of these constraint factors outlined affected sweet potato farming in Africa. Obabire and Ogunjimi (2018) and Ukoha and Okonkwo (2019), in their study asserted that these serious constraints were faced by extension in disseminating technologies to famers and are the problems in utilizing improved farming practices.

Hypothesis Testing

$H_0$1: There is no significant relationship between selected socio-economic characteristics of farmers and their level of utilization of orange flesh sweet potato in the study area.

The results in Table 5 shows the Multiple regression estimates of effect of some socioeconomic characteristics on *level of utilization of orange flesh sweet potato in the study area*. Among the four functional forms estimated, the Semi-Log form was chosen as the lead equation based on a high R^2 value, number of significant variables and agreement with a priori expectations. The F-value was highly significant at 1.0% level indicating a regression of best fit. The R^2 value of 0.5997 showed that 59.97% of the variability in *level of utilization of orange flesh sweet potato* was explained by the independent variables.

The result showed that the coefficient of gender was positively signed and significant at 5.0% level of probability. This implies that increase in female farmers will lead to increase in *level of utilization of orange flesh sweet potato* in the study area. In other words, having female headed households will increase household's involvement in sweet potato production activities. This is expected and in accordance with a priori expectations. This is also an indication that female headed households are more likely to participate in sweet potato production activities than their male-headed household's counterparts following the findings of Arega et al., (2007) and Makhura et al., (2001). The finding is consistent with the empirical result obtained by David and Madu, (2014) and Okoye. (2018) who noted that sweet potato was traditionally grown and produced by women in South East Nigeria.

Table 5: Regression Estimates of Effect of Selected Socioeconomic Characteristics on Farmers' Participation in Sweet Potato Farming Practices

Variables	Linear	Exponential	Cobb Douglas	Semi-log+
Constant	3324.578	8.150	6651.804	1.324
	(2.228)**	(8.913)***	(11.334)***	(0.545)
Gender	-0.6219	0.2681	0.1631	0.6216
	(-2.13)*	(1.86)*	(1.78)*	(2.28)**
Age	0.0202	0.00429	0.2284	0.1514
	(0.88)	(0.64)	(0.78)	(2.42)**
Marital Status	0.0852	0.1422	0.0631	0.6178
	(2.84)**	(3.098)**	(3.42)***	(4.32)***
Education	-0.0375	-0.00573	-0.0106	-0.1318
	(-1.01)	(-0.53)	(-0.16)	(-0.58)
Occupation	-0.5020	-0.1341	-0.1335	-0.5798
	(-2.73)*	(-0.95)	(1.49)	(-2.34)**
Farming Experience	-0.0170	-0.0082	-0.0462	-0.1267
	(-0.33)	(-0.54)	(-0.43)	(-0.34)
Household Size	0.01926	0.0226	0.0845	0.0958
	(0.15)	(0.59)	(0.54)	(0.18)
Farm Size	-1.6978	-0.5252	-0.3091	-0.7685
	(-1.78)*	(-1.89)*	(-4.29)***	(-4.66)***
Extension Contact	0.0182	0.009133	0.0411	0.0689
	(0.08)	(0.16)	(0.25)	(0.12)
Income	0.4759	-0.0131	0.0068	0.0662
	(0.62)	.(0.24)	(0.07)	(0.18)
Constant	1.1843	-0.3133	-1.5414	20.1984
	(0.75)	(1.68)*	(1.96)	(8.48)***
R^2	0.5610	0.5076	5706	0.5997
R – Adjusted	0.3930	0.3420	0.4013	0.5292
F – Ratio	21.5060***	27.6245***	24.4601***	39.92***

Source: Field survey, 2023. *P≤ 0.10, ** P≤ 0.05 and ***P≤ 0.01respectively.

Coefficient of age was significant at 5.0% level and positively related with *level of utilization of orange flesh sweet potato* in the study area. This implies that increase in age will lead to a corresponding increase in *level of utilization of orange flesh sweet potato*. This could be that older farmers gained experience over years in sweet potato production activities encouraging them to remain in production unlike their younger counterparts. More so, the older farmers tend to have more dependents, thus more consumption, hence increased participation to produce surplus for consumption and sale (Ehui et al., 2009). Although this finding is in contrast with Mahlet (2007) and Sisei, (2014) who noted that younger farmers are more risk takers, thus they are capable of searching markets in the distant and competitive places like local markets than the aged farmers. Younger ones tend to have more strength and stamina to sustain the production.

The coefficient of marital status was positively signed and highly significant at 1.0% level of probability. This implies that farmers whom are married will increase *level of utilization of orange flesh sweet potato* in the study area. This is expected because married farmers tend to have more responsibility to remain in business with increased *level of utilization of orange flesh sweet potato*. The married have advantage over others since the spouse and children will serve as major sources of labour hands in farms and play major roles in sweet potato production following Okoye, (2018). Harun (2014) noted that singlehood, divorced and widowhood had negative impact on agricultural production and economic growth of farm households. This is a clear indication that a high proportion of married farmers will access more production inputs like land which are traditionally owned by families following the study of Onubogu and Onyeneke (2012).

The coefficient for occupation was significant at 5.0% and had an indirect relationship with *level of utilization of orange flesh sweet potato*. This implies that increase in number of full time farmers will lead to a corresponding decrease in *level of utilization of orange flesh sweet potato* in the study area. This is against a priori expectation probably because farmers in the study area are involved more in other income earning activities other than farming. This is also an indication that sweet potato production is not the primary crop grown in the area, those that are more likely to participate in sweet potato activities are non-full farmers.

The coefficient for farm size also had an indirect relationship with the *level of utilization of orange flesh sweet potato* in the study area and highly significant at 1.0% level. This implied that increase in farm size will decrease the *level of utilization of orange flesh sweet potato*. The result is also against a priori

expectation probably because crop versus land allocation in the study area may be a function of priority. Most areas are known for production of particular crop and have comparative advantage in producing such crop than the other. The finding agrees with that of Randela et al., (2008) who noted an inverse relationship between land size and participation. In contrast, Adeoti et al., (2014) found that with relatively large land size, farmers are likely to have higher levels of participation. The larger the farm size, the larger the area allocated to sweet potato production, thereby increasing the quantity of produce available for sale.

Therefore, the hypothesis which states that *there is no significant relationship between selected socio-economic characteristic of respondents and their level of utilization of orange flesh sweet potato is hereby rejected at 5% alpha level.*

CONCLUSION AND RECOMMENDATIONS

The study provided empirical evidence on the extent of utilization of orange flesh sweet potato by rural households in the study area. It was evident that personal observations, fellow farmers and television programmes, had favourable perception of sweet potato cultivar characteristics and had high level of utilization of orange flesh sweet potato. Also, cultivar characteristics and selected socio-economic characteristics influenced farmers' participation in sweet potato farming practices in the study area.
Based on the finding of the study, the following recommendations were made;

a) Improvement of high yielding varieties orange flesh sweet potato since high yield will influence extent of utilization. Efforts to improve current production and promote already existing high yielding varieties should be encouraged by the extension agents in the study area.
b) Effort should also be made by the extension agent to popularize orange flesh sweetpotato varieties released which are of early maturing varieties for increased utilization by rural households.
c) Effort should also be made by researchers towards coming up with disease and pest resistant orange flesh sweet potato and varieties with good culinary attributes which can be traded at all times of the year. These are of importance because it will increase production hence high volume of production, which will promote sweet potato utilization.
d) Increase utilization of orange flesh sweet potato could be achieved by encouraging old farmers and the experienced ones to remain and enter into sweetpotato production as a business. This group of farmers would be able to put in a lot of effort at raising the current level of utilization.

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Assessment of the Training Needs on Climate-Smart Agriculture by SIWES Students in Michael Okpara University of Agriculture, Umudike, Abia State

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ABSTRACT
This paper seeks to assess the climate smart technology training needs of SIWES students of Michael Okpara University of Agriculture Umudike, Abia state. The specific objectives described the socio-economic characteristics of the SIWES students in MOUAU Abia state; ascertained SIWES students training needs on climate smart agriculture in MOUAU Abia state and and identified the constraints to training activities in climate smart agriculture by SIWES students in MOUAU Abia state. The hypothesis testing was that there is no significant relationship between the socio-economic characteristics of SIWES students and their training needs.A random and purposive sampling methods was used to sample 120 SIWES students from whom data was collected using a structured questionnaire. Data was analysed and interpreted using descriptive and inferential statistics. Findings from this study revealed that the majority of the students (51%) were males between the age of 21-30 years (96.67%), were single (90.83%) and were from CASAP college (39.17%). Further results showed that the majority of the students needed training on the use of drought resistant crops ($\bar{x}$=4.48) and Limited collaboration between the university and external agricultural organizations was a major constraint to having effective training on CSA. The hypothesis testing showed that at $P < 0.05$, age (2.968) was significant and positively associated with the training needs of SIWES students. The study concludes that SIWES students in MOUAU need more training in CSA and recommends collaborations between the university and external agricultural organizations to improve the quality of training received by the SIWES students.

INTRODUCTION
The world's climate is changing, and its widespread effects are becoming a global reality. This poses a significant threat to sustainable agricultural production and food availability in Nigeria (Ekweanya, Anyanwu, Onuoha, and Onu, 2021). Crop and livestock production are particularly vulnerable to climate variability due to their heavy dependence on climatic variables (Mashi, Inkani, and Oghenejabor, 2022). The increasing concentration of greenhouse gases, such as carbon dioxide, is projected to double by 2030, leading to a substantial rise in global temperatures (IPCC, 2019). Recognizing these challenges, there is a global effort to promote climate-smart agriculture (CSA) as a strategy to mitigate and adapt to the impacts of climate change (Barasa Botai, Botai, and Mabhaudhi, 2021). CSA offers solutions for bolstering food production, enhancing farmers' resilience, and mitigating greenhouse gas emissions. For Nigerian agriculture, which relies heavily on smallholder farmers, CSA practices are vital for achieving resilience and sustainability under changing climatic conditions (Barasa et al., 2021).

The integration of climate-smart agriculture into the Students Industrial Work Experience Scheme (SIWES) is essential for preparing agricultural students to address climate-related challenges in their

future careers. Exposure to CSA practices during industrial training equips students with innovative strategies to enhance resource efficiency, reduce emissions, and foster sustainable agricultural practices. This preparation enables students to align their practical skills with global efforts to combat climate change (Santosh, 2024).

Climate-smart technologies, which encompass solutions like renewable energy systems and precision farming, aim to enhance resilience and promote sustainability while mitigating greenhouse gas emissions. These technologies foster food security, resource conservation, and economic growth, supporting the transition to a low-carbon, climate-resilient future (Zilberman, Lipper, McCarthy, and Gordon, 2017; The World Bank, 2021). By gaining knowledge of CSA through SIWES, students can become advocates for environmentally responsible practices, thereby contributing to Nigeria's climate goals and sustainable development efforts (Santosh, 2024).

The Students Industrial Work Experience Scheme (SIWES) plays a crucial role in bridging the gap between theoretical classroom knowledge and practical agricultural experiences. However, the rising impact of climate change on agricultural productivity necessitates incorporating climate-smart agriculture training into SIWES programs (Adefalu, Ahmed, Aliyu, and Ajibade, 2021).

Given the dynamic climate conditions affecting agriculture, it is imperative for SIWES students to receive training on climate-smart technologies. This training prepares them for real-world challenges by imparting knowledge and skills related to resilient farming practices, sustainable methods, and technological solutions for enhanced agricultural efficiency (Santosh, 2024).

Practical training under SIWES should include climate-resilient agricultural practices such as adopting drought-resistant crops, efficient irrigation methods, and sustainable soil management. Additionally, students should learn adaptation strategies like adjusting planting schedules and selecting climate-resilient crops, as well as mitigation practices such as conservation tillage and agroforestry (Santosh, 2024). Integrating technology, including precision farming and innovative agricultural solutions, is another essential component of their training.

Recent studies have explored the training requirements of various agencies, particularly extension agents, across different areas. Danladi, Burabe, Manga, and Bako (2023) conducted a study on the Evaluation of Training Needs among Agricultural Extension Agents regarding Information and Communication Technologies in Kaduna State Agricultural Development Programme, Nigeria, Tafida *et al.* (2021) examined the Evaluation of Training Needs and Competency Levels of Extension Workers in Kano State, Nigeria, Eremi, Hilda, Eremi, and Evey (2023) investigated the Analysis of Training Needs of Agricultural Extension Workers on Agroforestry in Cross River State, Nigeria, Anyanwu, Ekumankama, and Onwukwe (2021) conducted a Comparative Analysis of the Training Needs and Job Performance of Extension Agents in Abia and Akwa Ibom States ADPS of Nigeria, Additionally, Adefalu, Ahmed, Aliyu, and Ajibade (2021) studied Assessing Agricultural Students' Attitudes towards Farm Practical Training in Selected Universities in Kwara State, Nigeria, closely related to the subject. However, there's a gap in the literature concerning the detailed examination of the training needs of Students Industrial Work Experience Scheme (SIWES) agricultural students in the context of climate-smart technology. Therefore, this study aims to fill this gap by providing valuable insights into the training requirements of SIWES agricultural students regarding climate-smart agriculture, contributing to the existing knowledge in this specific area.

Therefore this study assessed the climate smart agricultural training needs of SIWES students of Michael Okpara University of Agriculture Umudike. The specific objectives are to; (i) describe the socio-economic characteristics of the SIWES students in MOUAU Abia state; (ii) ascertain SIWES students training needs on climate smart agriculture in MOUAU Abia state and; identify the constraints to training activities in climate smart agriculture by SIWES students in MOUAU Abia state.the hypothesis testing was there is no significant relationship between the socio-economic characteristics of SIWES students and their training needs.

METHODOLOGY

Study Area

The study was carried out in Michael Okpara University of Agriculture (MOUAU) Umudike in Ikwuano Local Government Area of Abia State (Ebube, Miracle, Onyinye, Blessing, 2023). MOUAU is located at latitude $5^{0}40^{1}$ and $6^{0}4^{1}$ north, and longitude $7^{0}1^{0}1$ and 7^{0} 34^{1} east of Ikwuano local government

area. The climate is purely tropical with wet and dry seasons. The rainy season goes from March to October while the dry season is from November to February. The mean daily rainfall and relative humidity are 146.5 mm and 80% respectively. The mean daily temperature ranges from 21.9 ^{0}C to 31.5 ^{0}C (Ebube *et. al.,* 2023). The university consists of twelve (12) colleges but this study will focus on the four (4) Agricultural Colleges namely College of Agricultural Economics, Rural Sociology and Extension (CAERSE), College of Animal Science and Animal Production (CASAP) and College of Crop and Soil Sciences (CCSS).

Sample and Sampling Procedure
For this study, random and purposive sampling methods were utilized. Specifically, three colleges—College of Animal Science and Animal Production (CASAP), College of Crop and Soil Sciences (CCSS), and College of Agricultural Economics, Rural Sociology, and Extension (CAERSE)—were selected because of their involvement in the B.Agric. SIWES program (2022/2023 SIWES year). From each of these colleges, 40 B.Agric. Students was chosen randomly, resulting in a total sample size of 120 SIWES students.

Model Specification
Objective 1: which seeks to describe socio-economic characteristics of the SIWES students in MOUAU was analyzed using frequency count, means and percentage.
Objective 6: which seeks to access the areas were training is needs in climate smart agriculture by SIWES students in MOUAU was realized using a 4 point Likert-type scale of strongly agree-5, agree-4, Undecided – 3, disagree-2 and strongly disagree-1. A midpoint was obtained thus; 1+2+3+4+5= 10 ÷ 5= 3.0. The mean score greater than 3.0 implies a positive and a mean score less than 2.5 implies a negative.
Objective 7: which seeks identify the constraints to training activities in climate smart agriculture by SIWES students in MOUAU was realized using a 4 point Likert-type scale of strongly agree-5, agree-4, Undecided – 3, disagree-2 and strongly disagree-1. A midpoint was obtained thus; 1+2+3+4+5= 10 ÷ 5= 3.0. The mean score greater than 3.0 implies a positive and a mean score less than 2.5 implies a negative.

Hypothesis
There is no significant relationship between the socio-economic characteristics of SIWES students and their training needs was analysed using multiple regression analysis:

$$Y = a + b_1 X_1 + b_2X_2 + b_3X_3.....b_9X_9 + u \quad (1)$$

Where:
Y = Training needs
X_1 = sex (male – 1 female – 0)
X_2 = Age (in years)
X_3 = Marital status
X_4 = Academic level
X_5 = College
X_6 = Access to ICT resources
A = constant
b_1-b_3 = Regression coefficient
u = error term

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Students

Sex

Table 1: Distribution of students according to sex

Sex	Frequency	Percentage
Male	62	51.67
Female	58	48.33
Total	**120**	**100**

Field survey 2024

Table 1 presents the result of the distribution of the students according to their sex. The result reveals that majority of the students were male (51.67%) while 48.33% represented the females in the population. The result suggested that there were more males in the sample population than

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females but the slight marginal differences also indicates that females had a good representation in the study.

Age

Table 2: Distribution of students according to age

S/N	Age	Frequency	Percentage	Mean
1.	10-20	2	1.67	**25years**
2.	21-30	116	96.67	
3.	31-40	2	1.67	
TOTAL		**120**	**100**	

Field survey 2024

Table 2 presents the distribution of the students according to their age. The result reveals that the majority of the students (96.67%) fell within the 21-30 age range, indicating that most of the students were young adults. This result agrees with the findings of Ekweanya, Mbah, Odoh and Nwankwo, (2019) which also state that the B. Agric students within the study area were also young adults. A smaller proportion of the students, representing 1.67%, were in the 10-20 age range, and an equally small percentage (1.67%) were aged 31-40. The mean age of the students was 25 years, suggesting that the typical student in the sample is in their mid-twenties. Despite the slight marginal representation of both younger and older age groups, the study population was predominantly composed of students in the 21-30 age bracket

Marital status

Table 3: Distribution of students according to marital status

S/N	Marital status	Frequency	Percentage
1.	Single	109	90.83
2.	Married	11	12.22
3.	Divorced		
4.	Widow/Widower	-	-
TOTAL		**120**	**100**

Field survey 2024

Table 3 presents the distribution of students according to their marital status. The result reveals that the overwhelming majority of the students were single, (90.83%). This suggests that most students are likely focused on their studies without the added responsibilities of marriage. The single students implies that the majority may have fewer personal obligations outside their studies, which could positively influence their academic availability and focus. The result also shows that 12.22% of the student were married, indicating that a few students are balancing both academic and marital responsibilities. There were no students reported as divorced or widowed in the sample.

College

Table 4: Distribution of students according to college

S/N	College	Frequency	Percentage
1.	CCSS	35	29.17
2.	CASAP	47	39.17
3.	CAERSE	38	31.67
TOTAL		**120**	**100**

Field survey 2024

Table 4 presents the distribution of students according to their respective colleges. The results show that the majority of the students (39.17%) were from CASAP. This indicates that a significant portion of the study population is focused on animal science and production-related disciplines. The result also revealed that 31.67% of the students were from the College of Agricultural Economics, Rural Sociology, and Extension (CAERSE) which highlights another substantial group with an interest in agricultural economics and rural development.

Table 5: The areas where training is needed in climate smart agriculture by SIWES students

S/N	Climate Smart technologies	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Total	Mean
1	The use of drought resistant crops	73(365)	35(140)	10(30)	NIL	2(2)	537	4.48
2	Employing the use of irrigation systems	67(335)	50(200)	3(1)	NIL	NIL	536	4.47
3	The use of improved crop variety	70(350)	41(164)	5(15)	2(4)	2(2)	535	4.46
4	Practice of cover cropping	54(270)	54(216)	10(30)	2(2)	NIL	518	4.32
5	Conservation agriculture	57(285)	49(196)	13(39)	1(2)	NIL	522	4.35
6	Preparing of compost	54(270)	48(192)	13(39)	5(10)	NIL	511	4.26
7	Grazing management	46(230)	55(220)	14(42)	5(10)	NIL	502	4.18
8	Nutrient management/use of organic fertilizer	61(305)	49(196)	5(15)	3(6)	2(2)	524	4.37
9	Agroforestry practices	54(270)	52(208)	12(36)	2(4)	NIL	518	4.32

Field survey 2024

Table 5 presents the distribution of SIWES students regarding the areas where training is needed in climate-smart agriculture. Based on a 5-point Likert-type scale, a mean score greater than 3.0 indicates that training is needed in a specific area, while a score below 3.0 suggests that it is not a priority for training. The use of drought-resistant crops achieved the highest mean score of 4.48, indicating a strong consensus among students that training in this area is essential. The high level of agreement highlights the importance of equipping students with knowledge and skills related to drought-resistant crops, especially in the face of increasing climate variability. Following closely, employing the use of irrigation systems recorded a mean score of 4.47. This result underscores the need for training in effective irrigation techniques, which are crucial for optimizing water use and enhancing crop yields in varying climatic conditions. The use of improved crop varieties also indicated a significant training need with a mean score of 4.46. This suggests that students recognize the importance of understanding and utilizing improved crop varieties to enhance agricultural productivity and resilience to climate change.

Nutrient management and the use of organic fertilizers garnered a mean score of 4.37, indicating that students seek training in managing soil nutrients effectively. This knowledge is vital for promoting sustainable farming practices and enhancing soil health. Conservation agriculture received a mean score of 4.35, reflecting a strong interest in acquiring training related to practices that improve soil quality and reduce environmental degradation. This area is critical for promoting sustainable land management. Grazing management showed a mean score of 4.18, indicating that students believe training is needed in managing livestock grazing effectively. This knowledge can help optimize resource use and enhance the sustainability of integrated crop-livestock systems. Preparing compost achieved a mean score of 4.26, signifying that students recognize the need for training in composting practices, which are essential for nutrient recycling and sustainable soil management.

Practice of cover cropping and agroforestry practices both recorded mean scores of 4.32. This suggests that students are interested in training related to these practices, which can enhance soil health, biodiversity, and overall sustainability in agricultural systems. The results indicate a strong demand for training across various areas of climate-smart agriculture among SIWES students in MOUAU.

Table 6: The constraints encountered by SIWES students to training activities in climate smart agriculture

Constraints	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Total	Mean
High costs associated with implementing and maintaining CSA training programs	49(245)	49(196)	12(36)	5(10)	5(5)	492	4.10
Insufficient access to modern CSA technologies and equipment.	55(275)	45(180)	12(36)	5(10)	3(3)	504	4.20
Lack of trainers with expertise in CSA practices.	48(240)	45(180)	23(69)	3(6)	1(1)	496	4.13
Low levels of student interest or awareness in CSA practices.	48(240)	48(192)	10(30)	9(18)	5(5)	485	4.04
Limited collaboration between the university and external agricultural organizations.	60(200)	43(172)	11(33)	3(6)	3(3)	514	4.28
Difficulty in integrating modern CSA tools with traditional farming practices.	44(220)	55(220)	12(36)	4(8)	5(5)	489	4.08

Field survey 2024

Table 6 outlines the distribution of SIWES students regarding the obstacles to training activities in climate-smart agriculture (CSA). According to a 5-point Likert-type scale, a mean score exceeding 3.0 indicates that a specific factor is perceived as a constraint, while a score below 3.0 suggests it is not regarded as such. Insufficient access to modern CSA technologies and equipment received the highest mean score of 4.20. This finding highlights a significant challenge for students in acquiring the essential tools and technologies necessary for effective training in climate-smart practices. The unavailability of modern resources hinders the implementation of CSA and limits students' practical experience.

Next, limited collaboration between the university and external agricultural organizations received a mean score of 4.28. This reflects students' perception of the need for stronger partnerships with agricultural entities to enhance training opportunities and resources. Strengthened collaboration could promote knowledge sharing and access to expertise, which are vital for effective CSA training. High costs associated with implementing and maintaining CSA training programs recorded a mean score of 4.10. This finding indicates students' concerns regarding the financial implications of CSA programs, suggesting that funding and resource allocation are critical issues that must be addressed to support training initiatives. This result is in agreement with the findings of Ifeanyi-obi and Ekere (2021) who also reported in their study that funds was also a challenge to accessing training programs on climate Smart agriculture among extension agents in Abia state.

The constraint of lack of trainers with expertise in CSA practices attained a mean score of 4.13. This underscores the necessity of having qualified trainers to deliver CSA education effectively. Without knowledgeable instructors, the quality of training may be compromised, which could limit students' comprehension and application of CSA principles. Difficulty in integrating modern CSA tools with traditional farming practices yielded a mean score of 4.08, signifying that students view this as a barrier to adopting CSA. The challenge lies in reconciling innovative methods with existing farming techniques, which may require additional training and support.

Lastly, low levels of student interest or awareness in CSA practices achieved a mean score of 4.04. This suggests that increasing student engagement and awareness about climate-smart practices is essential for improving participation in training programs. Ekweanya, *et al.* (2023) also indicated in their study that lack of interest was also a major constraint influencing SIWES Students in MOUAU from being aware and utilizing climate smart technologies.

In conclusion, the results reveal several constraints affecting training activities in climate-smart agriculture among SIWES students in MOUAU.

Table 7: Ordinary least square multiple regression results of the relationship between the socio-economic characteristics of SIWES students and their training need.

Variable	Linear(+)	Exponential	Double-log	Semi-log
Constant	2.569	1.032	0.440	0.119
	(5.293)***	(8.838)***	(1.256)	(0.082)
Sex (X_1)	0.131	0.033	0.048	0.186
	(1.443)	(1.519)	(1.506)	(1.417)
Age (X_2)	0.060	0.015	0.319	1.321
	(2.968)***	(2.984)***	(2.894)**	(2.885)**
Marital Status (X_3)	0.240	0.053	0.083	0.374
	(1.799)	(1.651)	(1.624)	(2.885)
Colloge (X_4)	-0.087	-0.019	-0.033	-0.145
	(-1.365)	(-1.276)	(-1.232)	(0.199)
R^2	**0.132**	**0.130**	**0.124**	**0.126**
Adj. R^2	**0.102**	**0.100**	**0.094**	**0.096**
F-statistic	**4.388**	**4.303**	**4.083**	**4.158**

Source: Field survey, 2024. $H0_1$ reject at 5% level. Key: ns = not significant; ** = 5% significant; *** = 1% significant; ( ) = t-ratios; + = lead equation

Four functional forms of the multiple regression model were evaluated, with the linear model being selected as the preferred equation. This selection was based on the model having the highest number of significant variables and an F-value of 4.388, significant at $P < 0.05$, indicating the overall significance of the regression line. The model's R^2 value of 0.132 suggests that 13.2% of the total variation in the dependent variable is explained by the independent variables. The result revealed that at $P < 0.05$, age (2.968) was found to be significant and positively associated with the training needs of SIWES students at MOUAU. This indicated that that as the age of the SIWES students increases, their need for training also increases. This could imply that older students may require more or different types of training compared to their younger counterparts, possibly due to differences in experience, learning style, or career focus.

CONCLUSION AND RECOMMENDATIONS

The study concludes that the majority of SIWES students at MOUAU were young, single, and primarily from CASAP and CAERSE colleges, reflecting a focus on agricultural disciplines. Key training needs in climate-smart agriculture included drought-resistant crops, irrigation systems, and improved crop varieties, among others, highlighting students' strong interest in sustainable farming practices. However, significant constraints, such as insufficient access to modern technologies, high costs, and limited collaboration with external organizations, hinder effective training. The regression analysis further revealed that age positively influenced training needs, suggesting that older students may require tailored training approaches.

Based on the findings of this study, the following recommendations are proposed:

a) Enhance Access to CSA Resources and Expertise: Universities should invest in modern climate-smart agriculture (CSA) technologies, equipment, and skilled trainers to improve the quality and accessibility of practical training for students.
b) Strengthen Institutional and External Partnerships: Collaborations with agricultural organizations, policymakers, and funding bodies should be established to provide financial support, knowledge-sharing opportunities, and hands-on training in CSA practices.
c) Promote Awareness and Tailored Training Programs: Awareness campaigns should be launched to engage students in CSA practices while designing training programs that cater to diverse age groups and experience levels to maximize their effectiveness and impact

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Outreach and Performance of International Fund for Agricultural Development (IFAD) on the Livelihood Improvement of Family Entreprise Project in the Niger Delta Region

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ABSTRACT
The study assessed the outreach and performance of IFAD on the livelihood improvement of family enterprises project in the Niger Delta region of Nigeria. The objective of the study were to: assess the outreach achieved by the livelihood improvement family enterprise project in the Niger Delta, determine the performance of IFAD LIFE ND on the implementation status of non-physical and physical infrastructure, evaluate the financial inclusion support for Enterprise Development under IFAD- LIFE ND and Financial performance of financiers of IFAD LIFE-ND. This study used secondary data sourced from the IFAD Supervision Report, 2024. Data were analysed using simple statistical tools such as percentage, Enterprise Percentage Increase (EPI). The result showed that IFAD LIFE-ND reached more female (69%) than the male (53%) gender, indicating a deliberate efforts to empower and increase their participation in economic activities. Moreso, 87% of the beneficiaries/households were reached with one service or the other at the same time showing the effort of IFAD LIFE-ND at achieving their goals of enhancing the welfare of persons and enterprises in the region. Also, there was a moderate (60%) level of performance on the realization of physical project goals which could lead to increased access to more functional infrastructure that has the potentials of stimulating their economies and that of the Niger Delta. Moreso, 62% of IFAD LIFE-ND project focused on priority activities that enhances access to financial services for beneficiaries and their organizations. The result showed that IFAD had the largest allocation, primarily funding core enterprise development and project management components. The study therefore recommended that IFAD LIFE-ND should be focused on the goals of transforming rural enterprises and improving the socioeconomic wellbeing of people in the region. More so, IFAD LIFE-ND should make more efforts at reaching more beneficiaries by seeking for improved funding from funding partners. For a more sustainable and functional infrastructure IFAD LIFE-ND beneficiaries and host communities should be incorporated in project management and implementation process.

Keywords: Financing Livelihood, Improvement, Family, Entreprise, Project.

INTRODUCTION
Agriculture plays a leading role in terms of contribution to the Gross Domestic product (GDP), employment generation, sources of raw material, most of which are used for manufacturing industrials goods and are seen as market for other sector of the economy as well as export earnings (Adefeko, 2018). Therefore, in order to improve the national economy, entrepreneurs who own family agro-enterprises should be supported to expand their scale of production through financial institutions (Akpokodje and Salau, 2015). Agriculture can help reduce poverty, raise incomes and

improve food security for 80% of the world's poor, who live in rural areas and work mainly as farmers (World Bank Group, 2024).

Agricultural development is one of the most powerful tools to end extreme poverty (World Bank Group, 2024). Within the agricultural sector, family enterprises are involved in multitudes of livelihood activities such as Agro-based industries, Agricultural services, Agricultural processing, and value addition, fisheries and agriculture, Agroforestry, livestock production and crop production. Outreach is the action taking to deliver amenities and skills to people that do not have access to these interventions (Hardy *et al*., 2010; LSRC, 2009). According to LTKM (2022) outreach is the reaching out to others or becoming involved in a community or effort. In addition, Mikkonen *et al.* (2007) described outreach as follows:

i) making the target group's voice heard in policy-making.
ii) providing services to the target group when the society's existing services are out of reach or insufficient. Whenever outreach interventions are brought nearer to anywhere people inhabit by the unconventional service providers their actions are considered as charitable (Ogbe, 2023). In addition, outreach is intended to complement the services provided by the state, however these services are usually provided for by non-profit, non-governmental organizations among others.

In financial studies outreach is refers to financial intervention organizations' ability to provide high quality services which may be financial or non-financial to many clients. These financial intervention organizations are extending services to poor and disadvantaged group as their goals and commonly used outreach indicators such as quality (worth)-describes the tastes (perceptions), constraints (limitations) and opportunities of the clients, breadth-number of benefitting clients, length-time frame for operation of the social investment programme (Nara,2013). According to Navajas *et al,* (2000) length matters because society cares about the wellbeing of the needy both now and in the future. Without length of outreach, a social investment organization may improve social welfare in the short term but wreck its ability to do so in the long (Navajas *et al*., 2000) and variety of outreach (Nara, 2013). However, Zerai and Rani (2012) used average financial outreach balance per client/beneficiaries, Number of active clients/and Percentage of women clients as indicators to measure outreach.

However, family enterprises capacities other the years has been limited due to unavailability of credit services which has undermined rural income activities and has prevented farmers from adopting improved farming practices. Other problems associated with family enterprises include market access, lack of access to information and technologies and resource degradation. These challenges can significantly impact the livelihood of family enterprises, hindering their growth, reducing their income and increasing their vulnerability to shock and uncertainties. To solve these problems, the Federal Government went into an agreement with International Fund for Agricultural Development for the funding of small-scale family enterprises in Nigeria including Niger Delta States. The International Fund for Agricultural Development (IFAD), a specialized agency of the United Nations, was established as an International Institution in 1977 as one of the major outcomes of the 1974 World Food Conference. The conference was organized in response to the food crises of the early 1970s that primarily affected Sahelian countries of Africa. Therefore, IFAD was created to mobilize resources (financial and non-financial) for programmes/projects that alleviate rural poverty, improve nutrition, enhance food security, Rural Infrastructure Development, Value Chain development and empowering rural people and improving the livelihood of family enterprises especially in the nine states of the Niger Delta. To achieve this objective, IFAD cooperates and collaborates with government and its agencies/ parastatals such as Agricultural Development Programmes (ADP), Ministries of Agriculture and Rural Development Niger Delta Development Commission (NDDC) among others.

METHODOLOGY

The study was conducted in Niger Delta comprising of 9 states that were only funded by IFAD financing .The study was conducted in Niger Delta which is situated in the southern part of Nigeria, encompassing a vast area along the coast of the Gulf of Guinea between Latitude 4.15°N – 7.17°N and longitude 5.05°E – 8.68°E. It covers parts of several states including Bayelsa, Delta, Rivers, Ondo, Akwa Ibom, Abia, Cross Rivers, Edo, Imo. The main occupation of the people of Niger Delta region is fishing, hunting, and farming. Therefore an ex-post factor research design was employed as it is suitable for this study as it deals with facts and matters that had an already pre-existing data

which were ready for use. Secondary data was used in this study. Specifically, data were obtained from the International Fund for Agricultural Development (IFAD) Supervision Report, 2024. Data were analyzed with the use of simple statistical tools such as percentages, means and the measures of outreach indicators. In this context, outreach refers to the proportion of the target population that benefited from the programme. The outreach indicators are: the number of beneficiaries and the percentage of women beneficiaries. In addition, the contribution of livelihood improvement family enterprise project on enterprise development in the Niger delta was analyzed using Enterprise Percentage Increase (EPI). The Enterprise Percentage increase is presented as follows:

$$EPI = \frac{\text{Final Outcome}}{\text{Initial outcome}} \times \frac{100}{1} \quad (1)$$

Decision Rule:
1 — 33% = Low
34 — 67% = Moderate
68 — 100% = High

RESULTS AND DISCUSSION

Outreach of IFAD under the livelihood improvement family enterprise project in the Niger Delta

The level of outreach achieved by the programme is a measure used to assess the percentage of the target clients covered by the programme with credit and non-credit facilities. In Table 1 the percentage of the target clients serviced with credit and non-credit facilities in the 9 States of Niger Delta region is shown as thus;

Table 1: Percentage of the target clients serviced with credit and non-credit facilities

Target Clients	Targeted outreach	Achieved outreach	% Achieved	Level of achievement
Male	13050	6946	53.2	Moderate
Female	13050	8959	68.7	High
Total	26100	15905	60.9	moderate

Source: IFAD Publication, 2024

Table 1 shows that IFAD under the livelihood improvement family enterprise project in the Niger Delta reached 53% and 69% of male and female beneficiaries. This means that majority of the beneficiaries of the programme are the female. The programme included additional 30% over the male gender as beneficiaries in order to show their biased towards the female gender. This action of the operators of the programme could a smart way in liberating and breaking off the chain of poverty off the shoulders of the female gender.

Performance of IFAD Livelihood Improvement Family Enterprise Project in the Niger Delta based on the implementation status of non-physical infrastructure

The performance of IFAD Livelihood Improvement Family Enterprise Project in the Niger Delta based on enterprise creation, training and nutrition outreach, access to business development services and production inputs is presented in Table 2. Table 2 shows the performance of IFAD LIFE- ND project on non-physical infrastructure. It was discovered that IFAD LIFE-ND project led to the creation of 18,749 new enterprises and employment for 9,980 women (53%) and 8,769 men (47%). This effort of IFAD LIFE-ND project would bring about increased economic opportunities among the beneficiaries and in the region. Also, there was 101% level of project actualization on number of rural enterprises accessing business development services and number of persons trained in income generating activities. Moreso, 72% of the beneficiaries who are rural producers accessed improved production inputs and/or technological packages. Furthermore, 86% of beneficiaries / households were provided with targeted support to improve their nutrition. On the overall, 87% of the beneficiaries/households were reached with one service or the other at the same time showing the effort of IFAD LIFE-ND at achieving their goals of enhancing the welfare of persons and enterprises in the region.

Table 2: Performance of IFAD Livelihood Improvement Family Enterprise Project in the Niger Delta on the implementation status of non-physical infrastructure

IFAD-LIFE-ND implementation status	Targeted	Achieved	Performance	Level of performance
Number of new jobs created	25,500	18,749	73.53	High
Number of rural enterprises accessing business development services	26,100	26,470	101.42	High
Number of persons trained in income generating activities.	26,100	26,470	101.42	High
Number of rural producers accessing improved production inputs and/or technological packages	26,100	18,749	71.84	High
Number of persons / households provided with targeted support to improve their nutrition	13,050	11,250	86.21	High
Total	**116,850**	**101,688**	**87.02**	**High**

Source: IFAD Publication, 2024

Performance of IFAD Livelihood Improvement Family Enterprise Project in the Niger Delta based on the implementation status of physical infrastructure

Performance of IFAD Livelihood Improvement Family Enterprise Project in the Niger Delta based on the implementation status of physical infrastructure is presented on Table 3

Table 3: Performance of IFAD Livelihood Improvement Family Enterprise Project in the Niger Delta based on the implementation status of physical infrastructure

Implementation status	Targeted	Achieved	% Achieved	Performance level
Number of kilometres of road constructed, rehabilitated or upgraded	180	83.78	46.54	moderate
Number of climate-resilient small bridges/culverts /jetties constructed/rehabilitated	180	51	28.67	Low
Number of hectares of land developed for agricultural production	6,000	3589.3	59.82	Moderate
Number of market, processing or storage facilities constructed or rehabilitated	120	173	144.17	High
Total	**6480**	**3894.08**	**60.09**	**Moderate**

Source: IFAD Publication, 2024

Table 3 shows the performance of IFAD on physical infrastructure. The Table shows that 47% of the targeted number of kilometres of roads were constructed, rehabilitated or upgraded indicating a moderate implementation level. In addition, 60% of the targeted number of hectares of land were developed for agricultural production. In order to the commitment and drive improve access to conductive business environment and post-harvest infrastructure, IFAD had 144% increase exceeding infrastructure project goals with respect to the number of market, processing or storage facilities constructed or rehabilitated. On the overall, there was a moderate (60%) level of performance on the realization of their physical project goals. This level of performance could mean that more individuals and enterprise owners could access more functional infrastructure that has the potentials of stimulating their economies and that of the Niger Delta.

Financial inclusion support for Enterprise Development under IFAD livelihood improvement family enterprise project in the Niger Delta

Financial inclusion support for Enterprise Development under IFAD- livelihood improvement family enterprise project in the Niger Delta is presented in Table 4. Table 4 shows financial inclusion support for Enterprise Development under IFAD- livelihood improvement family enterprise project in the Niger Delta. IFAD LIFE-ND project focused on priority activities to enhance access to financial services for beneficiaries and their organizations, resulting in increased savings and capital accumulation. By May 2024, the project leveraged USD 1,113,997 in credit to support agribusinesses, achieving 55.70% from the targeted 2,000,000 USD. Moreso, 63%, 52%, 62% of the targeted beneficiaries had an increase in their savings, access to credit, insurance, and remittances indicating a moderate performance level. Additionally, 20,393 individuals, or 78.13% of the targeted 26,100 individuals, were trained in financial literacy and the use of financial products and services, indicating a high level of performance IFAD on the implementation of their stated activities.

Table 4: Financial inclusion support for Enterprise Development under IFAD livelihood improvement family enterprise project in the Niger Delta

Financial inclusion Indicators	Targeted value	Achieved value	%Achieved	Performance level
Amount of credit leveraged for supported enterprise development	2,000,000	1,113,997	55.70	Moderate
Persons accessing financial services(savings)	25,500	16,116	63.20	Moderate
Persons accessing financial services(Credit)	25,500	13,362	52.40	Moderate
Persons accessing financial services(insurance)	25,500	15,716	61.63	Moderate
Persons accessing financial services(remittance)	25,500	15,716	61.63	Moderate
The number of persons in rural areas trained in financial literacy and the use of financial products and services	26,100	20,393	78.13	High
Average			**62.12**	**Moderate**

Source: IFAD, 2024

Financial Performance of financiers of IFAD livelihood improvement family enterprise project in the Niger Delta

Financial performance of financiers of IFAD livelihood improvement family enterprise project in the Niger Delta is presented in Table 5

Table 5: Financial performance of financiers of IFAD livelihood improvement family enterprise project in the Niger Delta

Funding partners	Role	Allocation at Appraisal(USD)	Actual disbursement(USD)	% disbursement	Performance level
IFAD	Primary financier	60,000	49,682	82.8	High
NDDC	Regional development commission	30,000	Nil	Nil	Nil
Federal government	Government body	4,908	504	10.27	Low
State Government	Government bodies	3,761	607	16.14	Low
Total		**98,669**	**50,793**	**36,40**	**Moderate**

Source: IFAD, 2024

Table 5 shows the financial performance of financiers of IFAD livelihood improvement family enterprise project in the Niger Delta. The Table shows that IFAD being the primary financial contributed about 50, 000 USD out of 60,000 USD allocated to livelihood improvement family enterprise project in the Niger Delta representing 83% disbursement indicating high financial performance especially when compared with the contributions from the federal (10%) and State (16%) governments. This result has shown that IFAD had the largest allocation primarily funding core enterprise development and project management components.

CONCLUSION AND RECOMMENDATIONS

IFAD livelihood improvement family enterprise project in the Niger Delta reached more female than the males which could be a deliberate efforts at their emancipation and financially empowering them. Moreso, 87% of the beneficiaries/households were reached with one service or the other at the same time showing the effort of IFAD LIFE-ND at achieving their goals of enhancing the welfare of persons and enterprises in the region. Also, there was a moderate (60%) level of performance on the realization of physical and non-physical project goals which could lead to stimulation of the economies of beneficiaries in the project. The result showed that IFAD had the largest allocation, primarily funding core enterprise development and project management components. The study therefore recommended that IFAD LIFE-ND should be focused on the goals of transforming rural enterprises and improving the socioeconomic wellbeing of people in the region. More so, IFAD LIFE-ND should make more efforts at reaching more beneficiaries by seeking for improved funding from funding partners. For a more sustainable and functional infrastructure IFAD LIFE-ND beneficiaries and host communities should be incorporated in project management and implementation process.

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Effect of Flooding on Rice Production in Ebonyi State, Nigeria

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ABSTRACT
This study assessed the effect of flooding on rice production in Ebonyi State, Nigeria and specifically ascertained the causes of flooding in the rice fields; the effect of flooding on the rice fields; the effect of flooding on rice yields in different production system; various strategies adopted in handling the effect of flooding; and identified the constraints associated with rice production in the study area. Multistage sampling procedure was used to select 120 rice farmers for the study. Data were collected using structured questionnaire, analysed using descriptive and inferential statistics and confirmed during focus group discussion (FGD). Results show that there are several causes of flooding in the study area. Some of which are heavy rainfall ($\bar{x}$ = 3.92), absence of proper and coordinated watershed management practices ($\bar{x}$ = 3.92), poor drainage ($\bar{x}$ = 3.82), and climate change ($\bar{x}$ = 3.55). The effects of flooding on rice fields include labour shortage ($\bar{x}$ = 4.0), loss of rice seeds ($\bar{x}$= 3.6), loss of farm field ($\bar{x}$ = 3.5), reduced growth rate of shoots ($\bar{x}$ = 3.05), submerged whole rice fields ($\bar{x}$ = 3.0). gradual decrease in germination rate ($\bar{x}$ = 3.25) and non-emergence of seeds ($\bar{x}$ = 3.25). Lowland, swamp and upland rice production systems suffer 67%, 57% and 51% loss of yield respectively. Strategies adopted to manage flooding include planting of early maturing rice varieties (92%), cleaning out drainages (82%), building irrigation channels (77%), construction of terrace slopes (59%) and building of flood barriers (57%). Constraints faced by the farmers include low productivity (98.3%), poor access road (98.3%) and climate variability (98.3%). The study concludes that flooding has negative effects on rice production in the study area. The study therefore recommends the adoption of irrigation farming so that farmers can take advantage of off-season production and avoid the flooding season. Farmers should ensure that water ways are clear to ensure free flow of water.
Keywords: Flooding, Rice field, climate change

INTRODUCTION
Rice (*Oryza sativa*) is common meal eaten by most families in Nigeria. It is a delicacy prepared in different ways to suit the occasion, time and taste. Rice forms a significant portion of food consumed in most households either as jollof rice, white rice and sauce/stew, fried rice or even as local delicacies such as *massa, kunu, tuwo chinkafa* among others. It is a leading cereal crop of Southeast Asia origin and now among the most widely cultivated food crops globally (FAO, 2013). Rice is consumed by more than 60 percent of the world population (Chikezie, Benchendo, Ibeagwa, et al., 2020). Its consumption cuts across all cultural, social, economic, ethnic, religious and political classes (Nnamdi et al. 2023). It is a rich source of energy and the demand for it has increased tremendously. It has moved from its status of being eaten only when there is serious occasion to being a daily consumed food (FAO, 2018). The increase in demand and consumption of rice can be

attributed to rapid population growth, increased income level, urbanisation and change in preference pattern (Kamai, Omoigui, Kamara, and Ekeleme 2020).

Nigeria is one of the largest producers of rice, in West Africa, with an average production capacity of 3.2 million tons of paddy rice or 2.0 million tons of milled rice annually (Akenbor et al., 2022). However, between 2017 and 2018 there was a paradigm shift as the volume of rice produced rose from 3.7 million metric tonnes to 4.0 million metric tonnes (Kamai, Omoigui, Kamara, and Ekeleme, 2020). Sasu, (2022) also reported that Nigeria has recently experienced a significant increase in rice production, as evidenced by the rise in milled rice from 2,818 million metric tonnes in 2010 to 5,000 million metric tonnes in 2021. This increase can be attributed to government's new policy on ban of imported rice as well as other policies targeted at improving private sector participation and boosting local production.

While there is a significant increase in rice production in Nigeria, the Nation is yet to meet her local demand for the produce. Nigeria's inability to meet her local demand for rice, has necessitated massive importation of the produce. Kamai et al. (2020) and Akinbile (2023) reiterated that Nigeria spends over US$480 annually on importation of over 3 million tonnes of rice to help meet her annual national demand.

Nigeria has very good ecology that favours rice production, yet her paddy output is quite low. It is estimated that smallholder resource poor farmers produce over 90% of rice locally using low input and obsolete technologies. This could be one of the reasons for the low output they get in return. (International Fund for Agricultural Development [IFAD], 2012). Utilizing rice production techniques in a balanced manner offers a chance that should be taken advantage of (Macauley 2015).

Rice production in Nigeria, is facing a lot of challenges. Some of which are natural, and others man made. Some of the challenges include reliance on traditional farming technologies, poor agronomic practices and low use of improved varieties. Others include pests and diseases attack, environmental and climate change issues such as drought and flooding.

Rice according to Nwangwu et al (2024) is highly sensitive to weather changes and can easily be destroyed by incessant climatic changes. These changes in climate can lead to excess rainfall overflow of rivers - when snow melts and when dams break. These would usually result in flooding. Floods occur when the rains are heavy, when the waves from the ocean break on the shore, when snow melts quickly, or when dams or levees break. Floods can be destructive with only a few inches of water, or when it is high enough to cover a house. It can happen within a short time or over a long period, and may last days, weeks, or longer. Floods are the most common and widespread of all weather-related natural disasters.

Flooding is a significant challenge for rice farming systems worldwide due to its negative impacts on crop growth and yield (FAO. 2018). It significantly affects rice production in Nigeria, particularly in the southern regions of the country. It is a great threat to food security because large volumes of food are lost in the process. It is worthy to note that flooding can be beneficial to the system if it occurs during the early stage of the crop development but can also have negative effects if it happens at the later stages (Singh & Mishra, 2015). Ebonyi State like other states across the country has been placed on high alert for flood and other extreme weather conditions by the Nigerian Metrological Agency (NIMET). A lot of flooding incidents and the attendant destructions have been recorded across the states (Chidiebere-Mark *et al.,* 2019 and Elum and Ibraye, 2022). Most significant of these episodes are those of 2012 and 2022 (NEMA, 2022). It was based on the alert that the study effect of flooding on rice production system was conceived since it is one of the major crops in the State. The study seeks to:

i) ascertain the causes of flooding in rice fields in the study area;
ii) ascertain the effect of flooding on the rice fields;
iii) ascertain the effect of flooding on rice yields in different production system;
iv) examine the various strategies of handling the effect of flooding on rice production; and
v) identify the constraints associated with rice production in the study area.

METHODOLOGY

The study was carried out in Ebonyi State, Nigeria, popularly called "the Salt of the Nation". Ebonyi is a state in Southeast Nigeria, inhabited and populated mostly by *ndi Igbo*. The State has a land area of about 5, 935 km2 and an estimated population of 4,339,136 projected from the 2006 census. It shares boundaries with Benue State to the north, Enugu State to the west, Imo and Abia States to the south and Cross River state to the east. (Ebonyi State Government). Multi-stage sampling procedure was used to select 120 respondents for the study. Firstly, two LGA – Abakiliki and Izzi - were purposively selected because of their high level of rice production. Secondly, three (3) communities, seriously involved in rice production were purposively selected from each LGA. This gave a total of six communities. In the third stage, a random sampling procedure was used to select two villages from each of the communities making a total of twelve (12) villages. Finally, ten (10) respondents were randomly selected from each of the villages, giving a total sample size of one hundred and twenty (120) respondents. Enumerators were trained who helped to administer questionnaire /interview schedule to the respondents. Primary data generated from the questionnaire were analysed using descriptive and inferential statistics and focus group discussions (FGD) were conducted to help authenticate responses.

Measurement of variables
Objectives (i) and (ii) were realised using mean scores generated from a four-point rating scale of strongly agree (4 points), agree (3 points), disagree (2 points) and strongly disagree (1 point). A benchmark mean of 2.5 was used in decision-making, while objectives (iii) and (iv) were realised using frequencies and percentages.

RESULTS AND DISCUSSION

Causes of Flooding in Rice Fields in the Study Area

Result on Table 1 shows a grand mean of ($\bar{x}$ = 3.52) indicating there were several causes of flooding in rice fields in the study area. From the results, heavy rainfall and the absence of proper and coordinated watershed management practices both had mean scores of ($\bar{x}$ = 3.92) and were reported by majority as the cause of flooding. These were followed by lack of flood management structures ($\bar{x}$ = 3.85), poor drainage ($\bar{x}$ = 3.82), climate change ($\bar{x}$ = 3.55) and lack of flood risk mitigation and changes for a fast response ($\bar{x}$ = 3.52). Others include deforestation ($\bar{x}$ = 3.02) and increase in urbanization ($\bar{x}$ = 2.59). The implication of this result is that flood menace always reflects the changes that have taken place in the physical environment. Flooding could have natural and man-made causes.

Table 1: Causes of Flooding in Rice Fields in the Study Area

Variables	SA	A	D	SD	Mean
Heavy rainfall	110(440)	10(30)	0	0	3.92
Poor drainage	98(392)	22(66)	0	0	3.82
Climate change	76(304)	34(102)	10(20)	0	3.55
Increase in urbanization	0	81(243)	29(58)	10(10)	2.59
Deforestation	35(140)	52(156)	33(66)	0	3.02
Lack of flood management structures	102(408)	18(54)	0	0	3.85
Lack of flood risk mitigation and changes for a fast response	62(248)	58(174)	0	0	3.52
The absence of proper and coordinated watershed management practices	110(440)	10(30)	0	0	3.92
Grand					**3.52**

Source: Field data, 2023

Extreme climate as well as climate change which caused heavy and frequent rainfalls, and overflow of the Obubra River located in Cross River State and Akpoha River in Ebonyi State were reported by the respondents during the FGD as the major causes of natural flooding. Deforestation and urbanization often lead to undue exposure of rice fields, blockage of waterway and alteration of environmental structure. Poor management of drainages and water run-offs. Ani et al (2020) had similar results in their study of Orashi region where prolonged rainfall, overflow of rivers, continued release of excess water from artificial reservoirs, climate change amongst others were the major causes of flooding in the region.

Table 2: Effects of Flooding on Rice fields

Statements	SA	A	D	SD	Mean
The whole field is submerged	61(224)	28(84)	18(36)	13(13)	2.98
Shoots relative growth rate are reduced	65(260)	40(80)	11(22)	4(4)	3.05
Loss of farm field	80(320)	25(75)	10(20)	5(5)	3.5
Loss of rice seeds	95(380)	10(30)	7(14)	8(8)	3.6
Gradual decrease in germination rate	85(340)	5(15)	15(30)	5(5)	3.25
No seedling emergence	65(260)	32(96)	18(24)	11(11)	3.25
Labour shortage	120(480)				4.0
Grand mean					**3.38**

Source: Field data, 2023

Results on Table 2 show effect of flooding on rice production system. From the table, labour shortage ($\bar{x}$ = 4.0) has the highest mean score. The implication is that extent of production is affected because few people will be doing so many things at a time, loss of rice seeds ($\bar{x}$= 3.6), loss of farm field ($\bar{x}$ = 3.5). This implies that seeds and seedlings for next planting season will be difficult and expensive to get and loss of farm field will lead to hunger and food insecurity. According to one of the rice farmers, "...most of us have lost our farmland due to devastating flooding that swept our farms". This, the farmers fear may cause a possible shortage of paddy rice in the year. The table further revealed that growth rate of shoots was relatively reduced ($\bar{x}$ = 3.05) leading to poor yield. It was also observed from the result that whole rice fields were submerged ($\bar{x}$ = 3.0). During the discussion, the farmers explained that rice grows well under water but if the flood levels are high and submerged the whole field, then the rice plant will be ruined. Furthermore, the result revealed that gradual decrease in germination rate ($\bar{x}$ = 3.25) and non-emergence of seeds ($\bar{x}$ = 3.25) respectively were also effects of flooding on rice fields. Field observation showed that most of the farmers have lost everything because their crops were either washed away or submerged. This forced some of them to resort to harvesting their crops prematurely to avoid total loss. Supporting this finding, future agriculture (2020) noted that rice grows well under water, but are ruined when the whole field is submerged due to high flood level.

The results on the Table and the field observation showed the devastation cause by flooding on rice field were enormous. Seeds, plants and fields were destroyed leading to reduction in expected output, possible rise in price, hunger and the resultant food insecurity. These the farmers confirmed had been frequently reoccurring with each flooding season especially that of 2012 and 2022. In line with this, Nwangwu et al. (2024) noted that there had been a rise in the frequency of flood occurrence with the most devastating happening in various communities in 2012 and 2022. This they affirmed led to reduction in rice yield and loss of revenue.

Table 3: Effect of flooding on farmers yield per production system

Production system	estimated mean yield before flooding	estimated mean yield after flooding	mean difference	% loss
Swamp	2055.32	885.24	1170.08	57%
Upland	2800.00	1380.00	1420.00	51%
lowland	7421.18	2444.65	4976.53	67%

Source: Field data, 2023

The result on Table 3 shows the effect of flooding on rice farmers' output. The result shows that all farmers, irrespective of production systems suffered great setbacks due to flooding. The lowland rice farmers had the highest estimated mean yield before flooding and lost about 67% as a result of the flood. The swamp farmers lost about 57% of his estimated yield of 2055kg while the upland rice farmers were the least affected with 51% loss of 2800kg the implication is that flood affects depression more (when water enter ditches and valleys, they stagnate and do not have where to flow to and swamps have difficulty with percolation.

Table 4: Strategies in handling flood in the study area

Statements	Frequency	Percentage (%)
Building irrigation channels	94	76.7
Building ditches	55	45
Building barriers	68	56.7
Terrace slopes to reduce slope flow	71	59.2
Planting trees	42	35.0
Use of early maturing rice varieties	110	91.7
Cleaning out drainages	98	81.7

Source: Field data, 2023

Table 4 shows the Strategies adopted by the rice farmers in handling floods. The results revealed that most of the respondents (92%) adopted early maturing rice varieties as strategy for handling flood. The implication is that they hope to harvest their crops before the fields are submerged. The result also showed that 82% clean out drainages to enhance free flow of water and prevent it from entering their farms and 77% build irrigation channels to control flood and direct the water to their places of choice where it might be more useful, 59% construct terrace slopes to reduce slope flow while 57% build barriers to keep off flood so that it will not enter their rice fields.

The rice farmers in the study area made conceited efforts to control the flood by adopting strategies they believed would reduce or completely eradicate the effect. Lending credence to this Oladapo (2021) found that strategies employed by rice farmers to cope with flooding include planting improved/early maturing rice seedling variety, application of flood prediction by Nigerian Hydrological Services Agency, changing of planting date and improved drainage system.

Table 5: Factors constraining rice farmers in Ebonyi state (n = 120)

Constraints	Frequency	Percentage (%)
Low productivity	118	98.3
Pests and disease	78	65.0
Inadequate post-harvest knowledge and handling	102	85.0
Inadequate storage facilities	114	95.0
Variability in price of rice	104	87.0
Poor access to production credit	104	87.0
Competition from imported brands	116	96.7
Climate change that affects crop production/output	118	98.3
Poor access roads	118	98.3
Lack of timely access to improved rice seed and other	96	80.0

Source: Field data, 2023. Multiple responses

The results of the constraints faced by rice farmers in Ebonyi State are shown in Table 5. The results revealed that low productivity 98.3%, poor access road 98.3% and climate variability 98.3% were identified as constraints by most of the respondents. Low productivity discourages farmers from investing more on rice production and poor access roads disconnects them from other areas for easy marketing of their produce. The result further revealed that about 97% of the respondents, stated competition from imported rice brands as their major constraint. Also 95% of the farmers reported poor storage facilities as their major constraint.

About 87% of the respondents complained about poor access to credit and variability in rice prices (87%) as a major constraint. Inadequate credit facilities make it difficult for farmers to purchase the inputs needed for their operations. Production credits can be sourced from both formal and informal financial institutions. However, the inherent risks associated with agricultural production have affected the ability of the farmers to source for loan. Nawaz (2022) reported that the negative effect

of climate change on rice production includes: reduction in yield and grain quality, destruction of farmlands by flood, high increase of weeds, pests, diseases and decline in soil fertility.

Finally, the table revealed that about 80% of the farmers stated that they were constrained by lack of timely access to improved rice seeds and other inputs. Unfortunately, it is assumed that the Federal Government through the Ministry of Agriculture provides seeds, fertilizer and other farm inputs to rice farmers to enhance their production performance. However, according to Odoemelam (2021) agriculture operations are timely and the late supply of these inputs hinders production and yield.

CONCLUSION AND RECOMMENDATIONS

The study assessed the effect of flooding on rice fields in Ebonyi state. Rice is in high demand in Nigeria as a staple food consumed by many and there is urgent need to improve and enhance its production. However, flooding as a natural disaster is a militating factor against this. The study concludes that flooding has very devastating effect on rice fields in the study area which resulted in poor yields, and this in turn, negatively affects food security.

The study therefore recommends that farmers should plant early maturing varieties that will be harvested before the floods come. Government should assist in the provision of storage facilities to help preserve the rice. Farmers should be trained on climate change mitigation and adaptation strategies to help them cope with the menace. Irrigation farming should be encouraged so that farmers can take advantage of off-season production and avoid the flooding season. Farmers should ensure that water ways are clear to ensure free flow of water.

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Nwangwu K. N, Udeh E.A., Chiemela C. J., Onah O. G., Omeje, E. E., and Onyia, C. C. (2024). Assessment of Climate Change on Living Standard: Evidence from Flood-Prone Smallholder Rice Farmers in South-East Nigeria International Journal of Integrative Sciences 3(3): 297-308 ascertain the causes of flooding in rice fields in the study area;

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Determinants of Agricultural Export Diversification of Selected Cash Crops (Cashew Nuts, Cocoa, Palm Oil, and Sesame) in Nigeria from 1980 to 2023

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ABSTRACT
This study examines the determinants of agricultural export diversification of selected cash crops—cashew nuts, cocoa, palm oil, and sesame—in Nigeria from 1980 to 2023. Using secondary data sourced from the Central Bank of Nigeria, National Bureau of Statistics, FAO, World Bank, and other relevant institutions, the study analyzes the level and drivers of diversification using the Sectoral Hirschman concentration index and a Tobit regression model. The Hirschman index revealed a moderate average diversification level (mean = 0.36), indicating Nigeria's export portfolio remains somewhat concentrated on a few commodities. Tobit regression results show that inflation rate, exchange rate, GDP per capita, and agricultural credit had a statistically significant and positive impact on export diversification. Conversely, external debt exhibited a significant negative effect, highlighting its constraining role on agricultural development. These findings underscore the need for strategic policy reforms aimed at improving credit access, managing inflation, and reducing debt burdens to foster broader export diversification. The study recommends targeted investments in value chains and institutional support to enable Nigeria's agricultural sector to become more resilient, competitive, and less dependent on a narrow range of export commodities.
Keywords: Export diversification, cash crops, cashew nuts, cocoa, palm oil, sesame, Nigeria

INTRODUCTION
Agricultural export diversification has become a central focus in development strategies for many low- and middle-income countries seeking to reduce vulnerability to external shocks and foster sustainable economic growth. In nations with high dependency on a narrow range of export commodities, such as Nigeria, diversification into non-oil exports—particularly agriculture—has been emphasized as a pathway to stabilize foreign exchange earnings and promote structural transformation (UNCTAD, 2020). Diversifying agricultural exports not only enhances economic resilience but also expands market opportunities and stimulates rural employment (World Bank, 2021).

Despite Nigeria's vast agricultural potential, the country has historically remained reliant on crude oil exports, which account for over 90% of its total export revenues (CBN, 2022). This overdependence has rendered the economy susceptible to oil price volatility and global energy market fluctuations. While agriculture continues to employ a significant proportion of the population, its contribution to foreign exchange earnings remains limited. Several high-value cash crops—such as cashew nuts, cocoa, palm oil, and sesame—possess untapped export potential but remain underexploited due to structural, policy, and logistical constraints (FAO, 2019).

In this context, export diversification of selected cash crops is crucial. Crops like cocoa and palm oil have long-standing historical significance in Nigeria's export economy, while cashew nuts and sesame have gained prominence more recently due to rising global demand and market prices (ITC, 2020). However, the degree of diversification in their export patterns over time has been uneven. Factors such as infrastructure, market access, institutional quality, exchange rate volatility, and investment in value chains are believed to play a central role in influencing export performance (Ajakaiye & Fakiyesi, 2009).

This study seeks to analyze the determinants of agricultural export diversification of cashew nuts, cocoa, palm oil, and sesame in Nigeria from 1980 to 2023. By using a time-series econometric approach, the study investigates the influence of macroeconomic variables such as exchange rate, inflation, trade openness, and agricultural productivity on export diversification. Additionally, it explores the impact of policy frameworks, global demand dynamics, and infrastructural development on the export outcomes of these crops (Olayemi et al., 2017; Adegbite & Olorunfemi, 2020).

The significance of this study lies in its potential to inform policy recommendations aimed at enhancing non-oil export capacity and broadening the base of Nigeria's foreign exchange earnings. It contributes to the growing body of literature on economic diversification by providing a sector-specific analysis of export trends over four decades. Moreover, it offers empirical evidence that can guide stakeholders in designing targeted interventions to overcome the existing constraints hindering Nigeria's agricultural export competitiveness (NEPC, 2022; Eze & Ogiji, 2021).

RESEARCH METHODOLOGY

Study Area

The study was carried out in Nigeria. Nigeria as a geo-political and sovereign country is made up of thirty-six (36) states and the Federal Capital Territory (FCT), Abuja (Abdullahi, 2003). The country is located in West Africa on the Gulf of Guinea and is one of the largest countries in Africa occupying a geographical area of about 923,770 square kilometers with an estimated population of 182,000,000 (NBS, 2015). It lies between latitudes 4^{o} 1' and 13^{o} 9' North of the equator and longitudes 2^{o} 2' and 14^{o} 30' East of the greenwash meridian. It shares a common boundary with Niger republic on the West, Cameroun Republic on the East, Gulf of Guinea on the south and Chad to the northeast. Nigeria enjoys the humid tropical climate with two clear identifiable seasons, the wet and dry seasons. The climate condition varies among regions: equatorial in the south, tropical in the center and arid in the north; the climate makes her suitable for agriculture.

Agriculture is the mainstay of Nigeria's economy accounting for more than 40% of the gross domestic product (GDP) and provides subsistence for two-third of population who are low income earners (FAO, 2021). The country has an agricultural land of about 84 million hectares of which 33 million hectares is currently under cultivation. About 3.14 million hectares of the agricultural land is irrigable but only about 220,000 hectares is actually irrigated. There is also diverse and rich vegetation capable of supporting a heavy population of livestock, 267.7 billion m^{3} of water for irrigation, 14 million ha surface water, 57.9 billion m3 of underground water. However, with the advent of commercial oil exploration in the early 1970s, the fortunes of agriculture started to dwindle with the resultant downward decline in productivity. Average annual rainfall ranges from 500 mm in the northern part to 1200 mm in the southern part of the country (FAO, 2021).

Different kind of crops are grown which include; cereals, root and tubers, legumes, oil seeds, fruits and vegetables etc. Major cash crops include cocoa, oil palm, cotton, groundnuts, ginger and sesame (NBS, 2010; Ghanbari, 2011). The country has been warned against food scarcity and famine in 2017 (FAO, 2017). The map of Nigeria showing the national and state boarders is shown in figure 1.

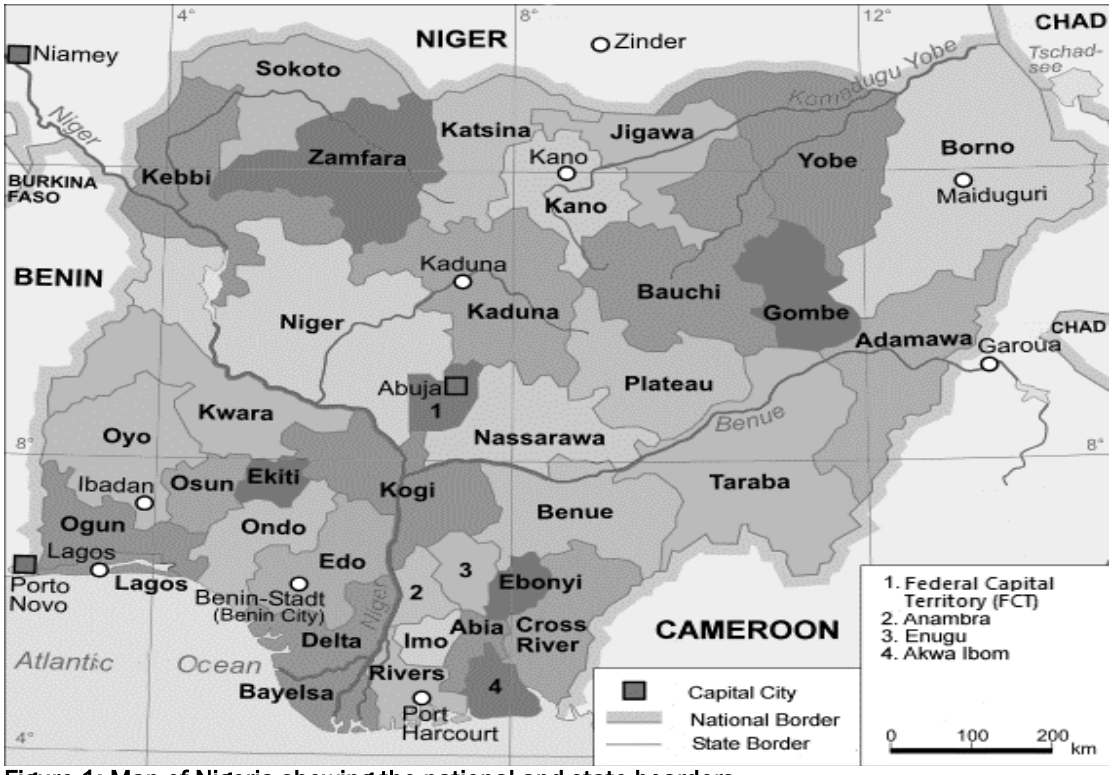

Figure 1: Map of Nigeria showing the national and state boarders

Method of Data Collection

The study made use of secondary data. The data were obtained from the Central Bank of Nigeria (CBN) statistical bulletins, National Bureau of statistics (NBS), Annual reports and statements of accounts, Economic and financial review, National Bureau of Statistics (NBS), World Bank publications, Food and Agriculture Organization (FAO) publications etc. The secondary data for the research covered a period of 1980-2023 and covered data cash crop export (Palm oil, sesame, cocoa and cashew) as well as macroeconomic variables such as trading costs proxy: distance between the two countries, exchange rate for the time periods under consideration, foreign direct investment in agriculture for the time period, oil price at time, external debts at time, credit loans to agriculture at time and political instability, government expenditure on agriculture at time and Nigeria's GDP per capita etc.

Methods of Data Analysis

The level of export diversification and of selected cash crop in Nigeria within the study period and it's determinants was analyzed using the Sectoral Hirschman (H) concentration index and tobit model. The sectoral Hirschmann index is a measure of the sectoral concentration of a region's exports and tells us the degree to which a sector or country's exports are dispersed across different economic activities. The index is based on the ratio of the value of each exported commodity to total exports in the sector. The index can be calculated thus:

$$H = [\sum_{i=1}^{n}(X_i/X_e)^2]^{1/2} \quad (1)$$

Where;

X_i = value of the export of a particular industry or (export sector) in a given year

X_e = total value of exports of the country in a given year

n = number of export commodities or export commodity classes

Where there is export diversification, the index tends to zero because X_i / X_e gets smaller. When exports are concentrated on a few commodities, the value of X_i approaches the value of X_e causing the H to tend to unity. Thus H ranges from zero to one. The H measure is useful when compared inter temporally (Osuntogun *et al.,* 1997)

Tobit model was used since the index range from 0 – 1. The structural equation of the Tobit model is given as:

$$Y^* = X_i\beta' + \varepsilon_i \quad (2)$$
$$e \sim N(O,s)$$

Where, the Y^*_j's are latent variables generated by the classical linear regression model:

$$Y^*_j = \beta' X_j + U_j,\ Y_j = \begin{cases} Y_j^* \text{ if } Y_j^* > 0 \\ 0 \text{ if } Y_j^* \geq 0 \end{cases} \quad (3)$$

Where X_j denotes vector of regressors, possibly including 1 for the intercept and β^1 the corresponding vector of parameters and U_j the model errors. The empirical model for quantifying the determinants of agricultural export sophistication in Nigeria from 1980 to 2023 is specified as follows:

$$Y^*_i = (X_{1t}, X_{2t}, X_{3t}, X_{4t}, X_{5t}, X_{6t}, X_{7t}, X_{8t}) \quad (4)$$

Where,
$Y^*_{1=}$ H_t = Agricultural export diversification at time, t define in Eqn 3.5)
X_{1t} = Inflation rate at time, t (percentage)
X_{2t} = Foreign direct investment in agriculture for the time period, t (Naira)
X_{3t} = Exchange rate for the time periods under consideration, t (Naira per USD)
X_{4t} = Government expenditure on agriculture at time, t (Naira)
X_{5t} = External debts at time, t (Naira)
X_{6t} = Nigeria's GDP per capita (Naira)
X_{7t} = Oil price at time, t (USD per barrel)
X_{8t} = Credit loans to Agriculture at time, t (Naira)
e_t = error term

RESULTS AND DISCUSSION

Table 1 shows the estimate of the level of export diversification of selected cash crop in Nigeria within the study period using the Sectoral Hirschman (H) concentration index. Thus H ranges from zero to one. The Hirschman concentration index (H) is a valuable tool for measuring the degree of concentration or diversification in a sector, specifically in the context of agricultural exports in Nigeria. As explained, the value of H ranges from zero to one, where zero indicates complete diversification (numerous products exported) and one indicates total concentration (dominance of few products) (Herzer, 2017; Szirmai, 2021). Therefore, the lower the value of the index, the more diversified Nigeria's export sector is in terms of cash crops. The implications of a Hirschman concentration index approaching zero suggest that the country is exporting a wider variety of agricultural products, which can be beneficial for economic resilience. This finding suggests that Nigeria's agricultural export diversification is relatively moderate, as shown by the varying index values in Table 1.

Table 1: Agricultural Export Diversification Level

Diversification Level	Frequency	Percentages
0.10 - 0.19	11	25.00
0.20 - 0.29	9	20.45
0.30 - 0.39	7	15.91
0.40 - 0.49	6	13.64
0.50 - 0.59	5	11.36
0.60 - 0.69	4	9.09
0.70 - 0.79	2	4.55
Min	**0.101**	
Max	**0.74**	
Mean	**0.36**	
Total	***44***	**100.0**

Source: Computed from time-series data, 1980-2023.

The data presented in Table 1 provide an overview of Nigeria's agricultural export diversification from 1980 to 2023. The minimum value of the Hirschman index (0.101) represents a period of

relatively high diversification, while the maximum value (0.74) points to times of higher concentration. The mean value of 0.36 indicates a moderate level of diversification during the study period. This implies that while Nigeria's agricultural export sector has not been entirely concentrated on a few crops, it also has not achieved optimal diversification (Iyer *et al.,* 2020; Nwachukwu *et al.,* 2017). The degree of diversification in Nigeria's agricultural exports, particularly with a mean Hirschman index of 0.36, signals that while there is some level of diversification, much remains to be done to reduce the risks tied to dependency on a few crops. This corroborated to result from many researcher (viz: (Adeola and Awolaja, 2018; Babajide *et al.,* 2019). Diversification is crucial for enhancing the resilience of the agricultural sector, especially in the face of climate change and fluctuating global commodity prices by focusing on diversifying export markets and products, Nigeria could buffer against the economic consequences of international price volatility. Such findings are critical for policy-making. A mean value of 0.36 suggests that there is room for improvement in diversifying Nigeria's agricultural exports to reduce dependency on a few cash crops such as cocoa, oil palm, and groundnuts. Achieving a more diversified export sector could help stabilize foreign exchange earnings and promote sustainable economic growth.

According to the distribution of agricultural export diversification levels, 45.45% of Nigeria's agricultural exports fall within the 1-29% range, indicating that a significant portion of exports is concentrated on a small number of cash crops. Meanwhile, 40.9% fall within the 30-59% range, showing a moderate level of diversification, and 13.63% have a higher diversification level, above 59%. These results suggest that while the majority of exporters concentrate on a few crops, a notable portion is actively working towards a more diversified export portfolio as noted by Osundare and Ayoola, (2022).

The implications of this distribution revealed the different strategies adopted by agricultural exporters in Nigeria. A large portion of exporters (45.45%) focusing on the 1-29% range highlights the lack of diversification in Nigeria's agricultural export base. This may limit the potential for economic growth and stability as it exposes the country to risks related to over-reliance on a few crops (Adebayo and Tunde, 2019; Akinola *et al.,* 2021). However, the presence of 40.9% of exporters with moderate diversification (30-59%) and 13.63% with higher levels of diversification indicates progress and opportunities for Nigeria to expand its export markets and enhance the competitiveness of its agricultural sector.

The concentration levels of agricultural exports in Nigeria, as shown in Table 1, provide valuable insights for policymakers. The fact that nearly half of Nigeria's agricultural exporters fall within the 1-29% concentration range indicates a need for strategic interventions aimed at encouraging diversification across the sector. Policies that support agricultural innovation, increase access to markets, and enhance the value chain for different crops could help shift this trend toward more diversified export patterns (Afolabi *et al.,* 2017; Ogunniyi, 2021).

Additionally, a moderate level of export diversification, as evidenced by the 40.9% of exporters falling in the 30-59% range, suggests that there was an emerging opportunity for greater market access and export expansion. Nigerian policymakers could focus on creating enabling environments for these moderately diversified exporters by improving trade facilities, strengthening infrastructure, and fostering better linkages between farmers and global markets (Ogunyemi *et al.,* 2019; Akinmoladun *et al.,* 2020). Moreover, greater diversification could lead to the stabilization of foreign exchange earnings and boost Nigeria's agricultural competitiveness on the global stage. With the current concentration trends in place, Nigeria's agricultural sector remains susceptible to international market shocks, which can negatively impact the economy's overall growth (Bamidele *et al.,* 2019; Olowu and Ige, 2020.

Table 2: Tobit regression estimate for determinants of export diversification

Variables	Coefficients	Std. Error	z-value
Inflation rate	0.0033083	0.0010894	3.04***
Foreign direct investment	0.0000155	0.0000107	1.45
Exchange rate for the time periods	0.0004769	0.0001863	2.56**
Government expenditure	-0.0000445	0.0000906	-0.49
External debts at time	-2.99e-06	3.39e-07	-8.82***
Nigeria's GDP per capita	0.0001317	0.0000475	2.77***
Oil price at time	0.0011014	0.0009284	1.19
Credit loans to Agriculture at time	0.0000578	0.0000049	11.79***
Constant	0.7038507	0.1444051	4.87***
LR chi^2 (8)	46.43		
Prob> chi^2	0.0000		
Pseudo R^2	0.8672		
log likelihood	36.975806		
Number of observation	44		

Source: Field Survey, 2024 ** & *** denotes 5% and 1% significant respectively

Analysis of determinants of agricultural export diversification level in Nigeria from 1980 – 2023 was summarized and presented in Table 2. The Tobit regression analysis was employed to assess the determinants of agricultural export diversification level. This choice was based on the nature of the dependent variable, which is censored and bounded between 0 and 1.

The Tobit model is particularly suitable when dealing with such variables, as it accounts for the fact that the data does not fully range over all possible values but is restricted within a certain range (Cameron and Trivedi, 2010; Greene, 2018). The result showed chi-square significant at 1% level (46.43), log likelihood (36.975806) and Pseudo R^2 (0.8672) showing strong explanatory power of the model). The findings from the regression analysis indicate that the model provides a good fit, as evidenced by the significant chi-square statistic (46.43) and the log likelihood value (36.98). The Pseudo R^2 of 0.8672 further confirms that the model explains a large portion of the variation in agricultural export diversification in Nigeria.

These results revealed that there are a number of factors that influence agricultural export diversification level. Agricultural export diversification level had a significant and positive relationship with Inflation rate at time ($p < 0.01$), Exchange rate for the time periods ($p < 0.05$), Nigeria's GDP per capita ($p < 0.01$) and Credit loans to Agriculture at time ($p < 0.05$), while Agricultural export diversification level had a significant and negative relationship with External debts at time ($p < 0.01$).

The coefficient for inflation rate was significant at the 1% level ($p < 0.01$), suggesting that higher inflation rates were associated with greater diversification in agricultural exports. This relationship may seem counterintuitive at first, but it can be explained by the fact that inflation can reduce the purchasing power of domestic consumers, which may push exporters to seek foreign markets for their products (Zaki *et al.,* 2018; Emmanuel and Olayemi, 2020). The implication of this finding is that inflationary pressures may incentivize Nigerian exporters to diversify their markets to mitigate the risks associated with a weak domestic economy. By seeking more diversified export opportunities, Nigeria could reduce its reliance on a few agricultural products and potentially buffer itself from the adverse effects of inflation on the local market (Akinlo and Adejumo, 2016; Dinh *et al.,* 2020). Thus, policymakers should be aware that controlling inflation may also indirectly reduce the need for export diversification by improving domestic demand conditions.

The exchange rate is another variable that significantly affects agricultural export diversification in Nigeria. The Tobit regression analysis showed a positive relationship between exchange rate fluctuations and the level of export diversification, significant at the 5% level ($p < 0.05$). This suggests that when the exchange rate depreciates, Nigerian exporters may be incentivized to increase the diversification of their export products to capitalize on more favorable exchange rates in foreign markets, This is similar to the findings of Ajayi *et al.,* (2020); Nwachukwu *et al.,* (2018). A weaker exchange rate makes Nigerian exports cheaper and more attractive to foreign buyers, which can promote the export of a broader range of agricultural commodities. In turn, this could help diversify Nigeria's agricultural export base and reduce its vulnerability to price volatility in a few key commodities (Ghartey, 2019; Odugbesan *et al.,* 2018). From a policy perspective, exchange rate

management becomes a critical tool in encouraging export diversification. Ensuring stability in the exchange rate could have significant long-term benefits for Nigeria's agricultural export sector.

Another significant factor influencing agricultural export diversification in Nigeria was the GDP per capita, which had a positive and significant relationship with export diversification ($p < 0.01$). This finding suggests that as Nigeria's GDP per capita increases, the level of agricultural export diversification also tends to increase. Economic growth, as indicated by rising GDP per capita, generally enhances a country's ability to invest in new industries and export products, which can drive diversification (Akpan and Akinwale, 2017; Yusuf *et al.,* 2020).

This relationship highlights the importance of economic growth in facilitating the expansion of agricultural exports beyond traditional commodities. An increase in GDP per capita can lead to higher disposable incomes and improved access to capital, which in turn can support agricultural innovation and the expansion of export markets (Hossain *et al.,* 2017; Folarin and Ogundipe, 2019). Thus, fostering higher economic growth through strategic investments in sectors like agriculture could stimulate the diversification of Nigeria's export base, contributing to more sustainable economic development.

The relationship between credit loans to agriculture and export diversification was also significant, with a positive and significant coefficient at the 5% level ($p < 0.05$). The findings suggest that increased access to credit loans for agricultural purposes was associated with greater diversification in agricultural exports. This is likely because credit loans provide farmers and exporters with the financial resources necessary to invest in a broader range of crops and agricultural products, as well as to improve production techniques and marketing strategies (Raza and Shabbir, 2017; Eze *et al.,* 2020). Access to credit plays a crucial role in agricultural modernization, which is essential for achieving export diversification. By providing financial support to farmers, the government and financial institutions can encourage investment in more varied agricultural products and export activities, which could lead to a more resilient agricultural sector. As such, policies that enhance access to agricultural credit should be prioritized to support the diversification of Nigeria's agricultural export base (Fayomi, 2020; Olalekan *et al.,* 2019).

On the other hand, the Tobit regression analysis reveals a significant negative relationship between external debts and agricultural export diversification, with a coefficient that was significant at the 1% level ($p < 0.01$). This negative relationship implies that an increase in external debt is associated with a decrease in the level of agricultural export diversification in Nigeria. External debts can impose financial constraints on the government, limiting its ability to invest in agricultural development and export diversification initiatives (Olayiwola *et al.,* 2020; Afolabi and Adejumo, 2019). External debt obligations often lead to the prioritization of debt servicing over domestic investment, including in agriculture. This can stifle the growth of the agricultural sector, particularly in terms of expanding the range of exportable products. To mitigate this issue, it is essential that Nigeria adopts sustainable debt management practices that free up resources for investments in agricultural diversification (Olayiwola and Olasehinde, 2021; Odugbesan *et al.,* 2020). Ensuring that external debt does not crowd out investment in agriculture was key to fostering a more diversified export sector in the future.

CONCLUSION AND RECOMMENDATIONS

This study provides critical insights into the determinants of agricultural export diversification in Nigeria, focusing on selected cash crops (cashew nuts, cocoa, palm oil, and sesame) from 1980 to 2023. The findings reveal a moderate level of export diversification in Nigeria's agricultural sector, as indicated by the Hirschman concentration index (mean = 0.36). While diversification has progressed, the export sector remains vulnerable to over-reliance on a few commodities. The Tobit regression analysis identifies key determinants influencing diversification, with significant positive relationships between inflation rate, exchange rate, GDP per capita, and agricultural credit. These factors suggest that external economic conditions and access to financial resources play crucial roles in encouraging agricultural exporters to diversify. However, external debt, which negatively affects diversification, remains a major obstacle, highlighting the financial constraints that hinder agricultural growth. The results point to the need for enhanced policy intervention to reduce dependency on a few cash crops and build a more resilient agricultural export sector.

Based on the findings of this study, the following recommendations are proposed to promote agricultural export diversification in Nigeria:

1. Promote Access to Credit for Agricultural Sector: The positive relationship between credit loans to agriculture and export diversification highlights the importance of financial support for farmers and exporters. The Nigerian government should enhance access to affordable agricultural credit, especially for smallholder farmers, to enable them to diversify crops, improve production techniques, and invest in new agricultural ventures.
2. Manage External Debt Effectively: The negative impact of external debt on export diversification underscores the need for prudent debt management. Policymakers should adopt strategies to reduce reliance on external borrowing, ensuring that domestic resources are available to fund agricultural development programs that encourage diversification.
3. Strengthen Exchange Rate Stability: Given the positive relationship between exchange rate fluctuations and export diversification, policies aimed at maintaining exchange rate stability should be prioritized. A stable currency will incentivize exporters to diversify their portfolios, making Nigerian agricultural products more competitive in global markets.
4. Encourage Economic Growth and Increased GDP Per Capita: As higher GDP per capita is associated with increased export diversification, the Nigerian government should focus on policies that foster overall economic growth. This can be achieved through investments in infrastructure, education, and industrial development, all of which would contribute to greater purchasing power and increased capacity for diversification in agricultural exports.
5. Tackle Inflationary Pressures: While inflation has been linked to greater export diversification, controlling inflation could reduce the push for diversification that arises from domestic economic pressures. Ensuring stable price levels will create a more conducive environment for sustainable diversification and long-term agricultural growth.
6. Support Agricultural Research and Development: To further diversify the agricultural export sector, Nigeria must invest in research and development to improve crop yields, reduce post-harvest losses, and develop new exportable agricultural products. This can be done through collaborations between the government, private sector, and academic institutions.
7. Diversify Export Markets: Nigeria should also focus on exploring and expanding its agricultural export markets. By targeting new regional and international markets, Nigeria can reduce risks associated with over-dependence on traditional export destinations and increase its global agricultural footprint.

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Effect of Corporate Governance Monitoring Mechanism and Firm Value of Listed Commercial Banks in Nigeria

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ABSTRACT
This study examined the effect of corporate governance monitoring mechanism on firm value of listed commercial banks in Nigeria. The study adopted ex-post facto research design. The population of the study consisted of all the 24 commercial banks while a sample of 14 banks that were listed in Nigeria Exchange Group were used in the study. Data for the study was sourced from the audited financial statement of all the 14 commercial banks that was selected for the study. The study utilized the Ordinary Least Squares Regression Analysis as the method of data analysis, having presented the descriptive statistics and the Pearson Correlation analysis. Having used price to book value as proxy for firm value and the dependent variable and board size, board independence and audit committee size as the proxies for corporate governance and the independent variable, the following findings were made: Audit committee size shows a positive but insignificant influence on the Price to book value of listed commercial banks in Nigeria. Board independence was found to respond positively but insignificantly influence on the Price to book value of listed commercial banks in Nigeria. Board size shows a positive but insignificant influence on price to book value of listed commercial banks in Nigeria. The study highlights the following possible recommendations: Commercial banks in Nigeria should have non-executive directors who act as professional advisers to ensure that competition among insiders encourages measures consistent with the maximisation of shareholder value. The audit committee should consist of men of experience and integrity; they are to be directly responsible to the shareholders and be independent of the board of directors and the management. This will augur for more transparency, better checks and balances and enable the shareholders to assert their rights. Commercial banks in Nigeria should maintain optimum board composition of board size and audit committee which should be reviewed periodically in ensuring proper governance structure and value creation of the institution.

Keywords: Corporate governance, Monitoring Mechanism, Firm Value, Commercial banks

INTRODUCTION
The financial performance of the banking industry had witnessed dramatic growth in the global economy due to the critical role the sector played in the investment scale. In spite of contribution of the banking industry to the economy, banking sector across the globe continued to face enormous difficulties such as macro-economic instability caused by large and sudden capital inflows, a major failure in corporate governance, lack of investor and consumer knowledge, inadequate disclosure

and transparency about the financial position of banks and critical gaps in regulatory framework and regulations which has inhibited the financial performance of banks in Nigeria. Corporate governance in recent years assumed considerable significance as a veritable tool for ensuring corporate survival since business confidence usually suffers each time a corporate entity collapses (Benjamin, 2014).

He further opines that the crisis of confidence that had rocked nation's banking sectors alerts government to the importance of maintaining efficient corporate governance mechanism to ensure stability of the economy. The financial crisis of 2007 and subsequent ones led to a renewed interest in financial institutions' corporate governance mechanisms in order to put them in strong financial standing. The essence was to find a proper and adequate equilibrium for shareholders and managers who were able to align their interest and ensure stability and solidity of the financial system through a healthy and cautions bank management (Matten, Marco & Arturo, 2015).

The imperative for sound corporate governance was at early stages underscored by the need to safeguard shareholder's interest, but overtime, the scope was extended to include protection of other important interests in business organization (Jizi, Salama, Dixon & Startling 2014). The shift to stakeholder emphasis derives from the argument that these other interests are equally threatened when business organizations are poorly managed. The significance of sound governance practice to business performance is well established in literature. For instance, Kolk & Pinske (2010) posit that strong corporate governance structures boost stakeholder confidence strongly indicating management commitment to the efficient and responsible management of business organization. Good corporate governance also minimizes exposure to risk for investors and promotes firm performance (Spanos, 2015).

Corporate governance is a control mechanism put in place to enable firms adhere to best practices in a way by which the firms are operated. It promote high level of transparency, accountability, fairness and integrity in an entity dealings with all its numerous stakeholders. Sound corporate governance promotes efficiency and effective working environment. Apart from reducing chances of management acting in its self-interest as well as takes actions that deviate from maximizing the value of the firm, corporate governance mechanism also affect the quality of information disclosed by the firm to its stakeholders (Nwokeji, 2017).

Ahmed (2024), investigated the effects of corporate governance characteristics and firm value of deposit money banks in Nigeria from 2010 to 2023. The specific objectives include investigating the relationship between board size and Tobin q; evaluating the relationship between board independence and Tobin q; determining the relationship between board ownership and Tobin q; investigating the effect of committee size on book value per share and evaluating the relationship between board independence and price per book value. The study population consisted of all deposit money banks and the Taro Yamene method of sample size determination was applied. The secondary data for the study was from the published financial statements of sampled banks for the period after the validity and reliability test of data. The data obtained were tested using univariate, bivariate and multivariate analysis. The results from the multiple regression results disclosed that board independence, the board size, ownership structure, gender diversity and board meetings negatively but significantly influence the value of deposit money banks in Nigeria.

Ali et al (2024) examined corporate governance and firm performance using meta-analysis. The study employed an ex post facto research design. The study employed secondary data from existing studies and meta-analysis was employed for the process of data analysis. The dependent variable was firm performance while independent variables were corporate governance and control variables of firm size, firm age, firm leverage and industry. Employing multiple regression analysis. The meta-analysis showed for developing countries that audit committee and board size significantly and positively affect firm book value per share while board independence, managerial ownership, board size and committee size significantly and negatively affect firm performance.

Naveed et al (2023) examined the corporate governance and market value of banks in Pakistan. The study employed ex post facto and correlational research design. The target population consisted of 5 banks representing a sample size. The dependent variable was book value per share and price to book value while the independent variables were board size, audit committee size and board independence. The study employed secondary data from the financial reports of sampled banks.

The secondary data collected was analysed using univariate, bivariate and multivariate analysis. The study revealed that board size is negatively related to book value per share and price to book value while board independence showed a positive relationship with book value per share and price to book value. Again, audit committee size revealed a negative but significant relationship with book value per share.

Maya, Chrisna, & Rustam, (2023), examines the influence of corporate governance mechanism to enhance firm value. The corporate governance mechanism uses three variables: managerial ownership, independent commissioner, and audit committee. The population of this research is manufacturing companies listed in the Indonesia Stock Exchange during the period of 2015-2023, from which 144 companies were selected as the sample. The hypothesis testing was conducted through multiple regression analysis. This research finds that audit committee, independent commissioner, and managerial ownership have a positive and significant effect on firm value.

Al-Hamadsheh et al (2022), examined the moderating role of voluntary disclosure on corporate governance and financial performance in Jordan for the period 2012 to 2021. The study used ex post facto and correlational research designs. The target population consisted of 249 companies and a sample of 208 companies was used for the analysis. The study employed secondary data from the published financial reports of sampled companies obtained from the Amman Stock Exchange. The secondary data obtained from the published financial reports were analysed using multiple regression analysis. The findings revealed a statistically significant relationship between board committee, board activity, the board size, board independence, foreign ownership, audit committee size, and institutional ownership on market value (price to book value and Tobin Q) while audit committee and government ownership indicate a statistically insignificant relationship with market value (price to book value and Tobin Q).

Jacobus (2022), empirically examine the effect of corporate governance and corporate social responsibility on corporate value using agency perspectives and stakeholder theory. The research data were obtained from manufacturing companies listed on the Indonesia Stock Exchange in 2015-2022. The test results using multiple linear regression indicate that corporate governance as measured by the board of directors and audit committee has a positive effect on firm value. The results of the sensitivity analysis show that the research model is robust, both by measuring PBV or Tobin's Q for the dependent variable.

Elvi & Dina (2022), carried out a research on the impact of corporate governance mechanism and firm value. Their study aims to analyze the effect of board size, independent board, audit committee, and institutional ownership on firm value. The population of this research is 539 companies which are registered in Indonesia Stock Exchange. By using purposive sampling method, we used 242 companies which are listed from 2013 to 2020. The analysis technique is multiple linear regression analysis. The results show that the size of director board, independent board, audit committee, and institutional ownership have positive and significant impacts on firm value.

Appiah (2022), investigated the effects of corporate governance mechanisms on the value of deposit money banks in Nigeria from 2010 to 2020. The study population consisted of all deposit money banks and the Taro Yamene method of sample size determination was applied. The secondary data for the study was from the published financial statements of sampled banks for the period after the validity and reliability test of data. The data obtained were tested using univariate, bivariate and multivariate analysis. The results from the multiple regression results disclosed that board independence, the board size, ownership structure, gender diversity and board meetings positively and significantly influence the value of deposit money banks in Nigeria.

Boshnak (2021) studied the impact of corporate governance characteristics on market value of firms in Saudi Arabia from 2017 to 2020. The study employed ex post facto and correlational research designs. The study used secondary data from the published financial reports of sampled companies. The target population comprised 135 listed companies in Saudi Arabia and a sample size of 70 non-financial firms was randomly selected for data analysis. The study dependent variable was market value of firm (book value per share and Tobin Q) and independent variables of corporate governance (board size, board independence, CEO duality, audit committee size, audit committee meeting frequency, ownership concentration) while firm size, firm leverage and firm age were also applied as control variables. The secondary data collected from financial reports were analysed

using descriptive statistics, correlation matrix and multiple regression analysis. The study results revealed a negative relationship between board size and book value per share, though Tobin Q showed a significant association; a negative relationship between board independence and book value per share. Audit committee size negatively influenced book value per share though Tobin Q revealed a significant relationship; board independence negatively affects Tobin Q though significant at 5% for book value per share and ownership concentration positively and significantly affects book value per share and Tobin Q.

Nkechi (2021), uses ex-post facto research design to examine whether corporate governance mechanism accelerate firm market value. Data was extracted through content analysis from annual report of 93 non-financial firms listed on the Nigerian Stock Exchange from 2006 to 2015 based on availability of dada. Data were analyzed with pooled ordinary least square regression conducting diagnostic test to confirm the assumption of the regression. Analysis revealed that board size, board gender diversity and audit committee size positively and significantly affect firm market value. Board independence and board remuneration has significant negative effect on market value of sample companies. Directors' shareholdings has insignificant negative effect on market value while auditors' credibility has positive but insignificant effect on market value.

Khanifah et al (2020) examined the influence of corporate governance mechanism on banking performance in Iran, Saudi Arabia and Malaysia for the period 2014 to 2019. The study used ex post facto and correlational research designs. The target population consists of Islamic banks in the 3 countries and purposive sampling was used to arrive at a sample size of 10 banks. The dependent variable financial performance (price to book value, book value per share, and Tobin Q) and the independent variable corporate governance (audit committee, transparency and openness, board independence, risk management, sharia supervisory and board size). The control variables consisted of size and bank equity and economic indicators. The study employed secondary data from the published financial reports of sample banks. The study used descriptive and multiple regression analysis. The result revealed that corporate governance mechanisms has positive and significantly influences price to book value and an insignificant relationship between corporate governance mechanisms on book value per share and Tobin Q.

Urhogghide & Korolo (2020), investigated the effect of corporate governance characteristics on market value of listed companies in Nigeria. The objectives of this study were to respectively analyze and determine, individually and jointly, the influence of board size, board independence and audit committee size on corporate performance (CP).The study employed exploratory research design. Ten (10) listed firms were chosen through a purposive sampling technique and data extracted from the annual reports of these firms from year 2010 to 2019. A panel data regression was used to analyse the data. Corporate Governance was proxied with board size (BS), board independence (BI) and audit committee size (ACS) while Market value was proxied with price to book value (PBV) and Tobin Q. Findings revealed that board size had a significant negative correlation with PBV, board independence had a significant positive correlation with TobinQ, audit committee size had an insignificant correlation with PBV and board size, board independence and audit committee size had a significant joint effect on PBV.

Statement of the problem

The problem in the banking industries prior to the post-consolidation has been that of risk management arising from accumulation of huge non-performing accounts. This is as a result of non-application of five "C" of lending – Character, Capacity, Capital, Condition and Collateral. The banking industry experienced misused of shareholders' funds and governance malpractice. In addition to Chief Executive Officer (CEO's), board members and managers lend money to themselves at the expense of many depositors and investors for stock price manipulation and other activities in variance with corporate governance. Poor corporate governance practices had led to incessant episode of distress due to declining profitability and erosion of public confidence in banking operations. Banks gave out loans without adequate collateral or no collateral in some cases, directors gave loans to themselves and staff collided with outsider to defraud bank lending to massive non-performing loans (Akpan & Riman, 2012).

Weak corporate governance may manifest in form of non-accountability and transparency to stakeholders, bribery scandals, violation of the rights of the minority shareholders, official

recklessness among the managers and director, weak internal control system, insider abuses and fraudulent practices (Olumuyiwa & Babalola, 2017).

Based on the description of the background and statement problem, this study examined the influence corporate governance monitoring mechanism represented by board size, board independence, and audit committee size on the value of commercial banks listed on the Nigeria Exchange Group. The difference between this study and previous research is that, this study includes three variables for corporate governance namely board size, board independence, and audit committee size, and conducts sensitivity analysis by using one proxy for the dependent variable (firm value), namely Price to book value (PBV).

Objectives of the Study

The broad objective of this study is to examine the effect of corporate governance monitoring mechanism and firm value of listed commercial banks in Nigeria. To achieve the broad objectives, the specific objectives are to:

i) Examine the effect of Audit committee size on Price to book value (PBV) of listed commercial banks in Nigeria.
ii) Examine the effect of Board independent on Price to book value (PBV) of listed commercial banks in Nigeria.
iii) Determine the effect of Board size on Price to book value (PBV) of listed commercial banks in Nigeria.

Research Hypotheses

To answer the research questions of this study, the following hypotheses were formulated and presented in their null forms:

HO1. Audit committee size does not have any significant effect on the price to Book Value (PBV) of listed commercial banks in Nigeria.

HO2. The effect of Board independent on the Price to Book Value (PBV) of listed commercial banks in Nigeria is not statistically significant..

HO3. Board size does not have any significant effect on the Price to Book Value (PBV) of listed commercial banks in Nigeria.

Scope of the Study

This study investigated the nexus between corporate governance monitoring mechanism and firm value of listed commercial banks in Nigeria. The study also covered a fourteen (14) years period starting from 2011 to 2022. Basically, the geographical scope of this study was limited to (14) listed commercial banks listed on Nigerian Exchange Group as at 2022.

METHODOLOGY

This study adopts ex-post facto research design. Ex-post facto allows for the examination of variables in retrospect and without any intentional manipulation and control. It specifically used cross sectional and times series (longitudinal) data to evaluate the relationship of the variable over time. The population of this study consists of all the twenty four (24) commercial banks listed in Nigeria Exchange Group as at 2022. The time frame considered for this study is 2008 to 2022. For the sample size, this study made use of thirteen (13) commercial banks operated in Nigeria, as at the time of this study that are listed in Nigerian Exchange Groups. They are: Access Bank Plc, Eco Bank Plc, FCMB Bank Plc, Fidelity Bank Plc, First Bank Plc, Guaranty Trust Bank Plc, Skye Bank Plc, Sterling Bank Plc, Union Bank Plc, United Bank of Africa Plc, Unity Bank Plc. Wema Bank Plc, Zenith International Plc, This study essentially made use of secondary data. Data that used for this study were derived from the audited financial statement of the commercial banks listed on the Nigerian Exchange Group. This study also made use of books and other related materials especially the Central Bank of Nigeria bullion and the Nigerian Exchange Group Fact Books. Below is the table showing the measurement of variables, both dependent and independent variables

Table 1: Variables, proxies, measurements, and sources

Variable Type	Variable	Proxy	Measurement	Source
Dependent Variable	Firm Value	P/B Value	Market Price Per Share / Book Value Per Share (MPPS/BVPS)	Faozi & Ghoniyah (2019)
Independent Variable (Corporate Governance)	Board Size	BSIZE	Total number of board members	Wardryo & Veronica (2013)
	Board Independence	BIND	Proportion of non-executive directors to total directors	Rofika (2016)
	Audit Committee Size	ACSIZE	Number of audit committee members	Anderson, Mansi, & Reeb (2004)*

The study utilized the Ordinary Least Squares Regression Analysis as the method of data analysis, having presented the descriptive statistics and the Pearson Correlation analysis. Specifically, the study used pooled regression, fixed effect and random effect regression, while the Hausmans test were used to distinguish between the fixed and random effects (Gujarati 2013).

The model specification is based on the empirical studies, theoretical framework and empirical reviews supporting that corporate governance have effect on listed commercial banks value. Specifically, the study adopted the Okoye (2016) model, but were modified in respect of the independent variables.
Consequently, the functional forms of the model are:

$$P/B = f(ACSIZEit\ BINDit,\ BSIZEit,) \quad (1)$$

Where;
P/B = Price to book value
ACSIZE = Audit Committee Size
BIND = Board Independent
BSIZE = Board Size
i = Cross section of banks
t = time period of data

Since the variables above are merely functional equations and do not have probability distribution, the researcher include explanatory variables and a stochastic error term or stochastic distribution term as follows:

$$P/B = \beta_o + \beta_3 ACSIZEit + \beta_2\ BINDit + \beta_1 BSIZEit + e_{it} \quad (2)$$

RESULTS AND DISCUSSION

Descriptive Analysis

The descriptive analysis of the variables conducted for the listed commercial banks in Nigeria.

Table 2: Descriptive Statistic

	PBV	AUCSIZE	BODIND	BODSIZE
Mean	1.182718	4.774359	3.082051	13.26154
Median	0.770000	5.000000	3.000000	14.00000
Maximum	4.510000	7.000000	4.000000	17.00000
Minimum	0.010000	3.000000	2.000000	7.000000
Std. Dev.	1.164941	1.089007	0.734591	2.538022
Skewness	1.279948	0.432086	-0.128765	-0.467514
Kurtosis	3.585199	2.794869	1.868330	2.481926
Jarque-Bera	56.02619	6.409580	10.94437	9.284255
Probability	0.000000	0.040567	0.004202	0.009637
Sum	230.6300	931.0000	601.0000	2586.000
Sum Sq. Dev.	263.2749	230.0718	104.6872	1249.662
Observations	195	195	195	195

Source: E-views 9.0. NB: Rely on Central Limit Theorem for handling abnormal data distribution cases for large observations randomly selected from a sample.

Table 2 shows the descriptive statistics of corporate governance monitoring mechanism data. PBV has a mean value of 1.1827 and standard deviation of 1.1649. The maximum and minimum value obtained for the period were 4.5100 and 0.0100 respectively. BODSIZE has a mean of 13.2615, and a standard deviation of 2.5380. The minimum and maximum value obtained were 7.0000 and 17.0000 respectively. BODIND for the period has a mean 3.0820 and a standard deviation of 0.7345. The minimum and maximum values obtained were 2.0000 and 4.0000 respectively. Finally, the table shows that AUCSIZE has a mean of 4.7743, and a standard deviation of 1.0890. The minimum and maximum value obtained were 3.0000 and 7.0000 respectively. The Jarque-Bera value obtained affirms the normality of the data.

Table 3: Correlation Analysis

	PBV	AUCSIZE	BODIND	BODSIZE
TOBIN_S_Q	-0.338410	-0.100964	-0.003690	0.252246
BVPS	-0.100758	-0.042095	-0.028510	0.255337
PBV	1.000000	0.415781	0.232847	-0.135338
AUCSIZE	0.415781	1.000000	0.029706	0.351561
BODIND	0.232847	0.029706	1.000000	0.383791
BODSIZE	-0.135338	0.351561	0.383791	1.000000

NB: Evidence of Multicollinearity Problem is unlikely to exist as the correlation coefficients of pairs of IVs are not more than 0.80.

Test of Hypotheses

Table 4: Effect of Corporate Governance Mechanism on Price to book value (PBV)

Variable	Coefficient	Std. Error	t-stat	Probability
AUCSIZE	0.018282	0.078808	0.231984	0.8168
BODIND	0.045498	0.129655	0.350918	0.7260
BODSIZE	0.018326	0.039458	0.464449	0.6429
C	0.712169	0.630126	0.630126	0.2598
		Model parameters		
R^2	0.303465			
Adj R^2	-0.012187			
F-stat	0.221369			
Prob(F-stat)	0.881477			
Durb Wat-stat	1.312588			

Source: Authors Computation in Appendix 11

The value of the coefficient for AUCSIZE is 0.018282, BODIND 0.045498 and BODSIZE is 0.018326 while the constant intercept C is 0.712169. The value of 0.712169 for C represent what price to book value (PBV) is without AUCSIZE, BODIND and BODSIZE. The value 0.018282, 0.045498 and 0.018326 implies that holding all other factors constant, a unit increase will lead to 0.018282, 0.045498 and 0.018326 increase in price to book value (PVB).

The R^2 test is used to show the total variation of the dependent variable. The R^2 tells the percentage variation in PBV explained by AUCSIZE, BODIND and BODSIZE. By implication the value 0.303465 means 30% of total variation in PBV is as a result of changes in AUCSIZE, BODIND and BODSIZE while 70% is unexplained. This remaining percentage could be caused by other factors or variables not built in the model.

The Durbin Watson statistics is used to test the existence of serial correlation between the variables. Durbin-Watson statistic is between1-3 implies the absence of auto correlation. This is because the closer the Durbin Watson value is to two (2), the better the evidence of the absence of multi-correlation. The combine relationship effect of the variables shown in F-statistics as 0.221369 with P.value of 0.881477 prove that all the variables combined collectively is not significant at 5% level of relationship with PBV.

Test of hypothesis one (Ho1)
Testing the effect of Audit Committee Size on book Price to Book Value (PBV).
H01: Audit committee size does not have any significant effect on the price to book value (PBV) of listed commercial banks in Nigeria.
HA1: Audit committee size have significant effect on the price to book value (PBV) of listed commercial banks in Nigeria.

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From the analysis in Table 4.3, the result of the effect of audit committee size on price to book value shows a positive and insignificant effect at 5% level. The researcher therefore, fail to reject the null hypothesis (H01), which states that audit committee size have no significant effect on the price to book value (PBV) of listed commercial banks in Nigeria.

Test of hypothesis two (H02)
Testing the effect of Board Independence on the price to book value (PBV).
H02: The effect of Board Independence on the price to book value (PBV) of listed commercial banks in Nigeria is not statistically significant.
HA2: The effect of Board independence on the price to book value (PBV) of listed commercial banks in Nigeria is statistically significant.
From the result of the analysis in Table 4.3, it shows that the effect of Board independence on Price to book value (PBV) of listed commercial bank in Nigeria is not statistically significant at 5% level of significant. On this premises therefore, the researcher accept the null hypothesis (H02) which posits that the effect of Board independence on price to book value (PBV) of listed commercial banks in Nigeria is not statistically significant.

Test of hypothesis three (Ho3)
Testing the effect of board size on Price to Book Value
H03: Board size does not have any significant influence on the price to book value (PBV) of listed commercial banks in Nigeria.
HA3: Board size have significant influence on the price to book value (PBV) of listed commercial banks in Nigeria.

From the statistical analysis in Table 4.3, the result indicates that board size have a positive influence but statistically insignificant on price to book value of listed commercial banks in Nigeria at 5% level of significance. On this premises, the researcher therefore fail to reject the null hypothesis (H03) which indicates that Board size does not have any significant influence on the price to book value (PBV) of listed commercial banks in Nigeria.

In hypothesis one, from the result of the analysis on Table 4.3 which indicates that the t-statistics 0.231984 is positive but not significant at 5% level (i.e PV = 0.8168 > 0.05). Therefore, the study fail to reject the null hypothesis (H01) which affirm that Audit committee size have no significant effect on price to book value (PBV) of listed commercial banks in Nigeria.

This is not in line with the Apriori expectation which states that the independent variable (Audit committee size) should relate positively with the dependent variable (PBV). The findings of this study agrees with the findings by Al-Hamadsheh *et al* (2022). Their findings revealed that audit committee size have statistically insignificant relationship with market value (price to book value). Also the findings from the study of Urhogghide & Korolo (2020) indicates that audit committee size have an insignificant negative correlation with PBV. Again, in the study made by Muhammed & Sutrisno (2024), their findings reveal that audit committee size has no effect on firm value. Contrary to the above empirical findings, Maya, Chrisna & Rustain (2023) in their study, revealed that audit committee size significantly and positively affect firm book value per share. Also the findings on the study by Yusheng *et al* (2023) shows that audit committee size has a positive and significant effect on market value proxied by price to book value. By implication, since the audit committee size have a positive but insignificant effect on price to book value, statutory audit committee size should be reviewed periodically and maintained to enhance firm value.

In hypothesis two, from the analysis result in Table 4.3 which reveals that the t-statistics, 0.0350918 is not positively significant at 5% level (ie PV = 0.7260 > 0.05). Therefore, the study accept the null hypothesis (H02) and concludes that the effect of board independence on the price to book value (PBV) of listed commercial banks in Nigeria is not statistically significant.

The result of the hypothesis fail to support the study Apriori expectation which states that the independent variable (BOIND) should relates positively with dependent variable (PBV). However, board independence impacted positively to PBV of listed commercial banks in Nigeria. Meanwhile, the result of the findings concur with the findings made by Boshnak (2021), which reveals that board independence negatively and insignificantly affect price to book value (PBV).

However, the result of the findings is inconsistent with the study made Al-Hamadsheh *et al* (2022). Their findings reveals a statistically significant relationship between board independence and market value proxied by price to book value. Hence, the implication of the finding of this study provides that the board independence should be non-executive directors that will enhance the value and wealth of shareholders in commercial banks in Nigeria.

In hypothesis three, from the statistical analysis in Table 4.3, the result indicates that t-statistics, 0.464449 is positive but not significant at 5% level that is (i.e PV = 0.6429 > 0.05). Therefore, the research fail to reject the null hypothesis (H03), which states that Board size have no significant influence on the price to book value (PBV) of listed commercial banks in Nigeria.

The result of the hypothesis did not agree with the Apriori expectation which states that the independence variable (Board size) should relate positively with the dependent variable to (price to book value) of listed commercial banks. Meanwhile the result of this analysis is in contrary with the findings made by Naveed *et al* (2023). Their findings revealed that board size positively related to price to book value. Again, the analysis from the study made by Ahmed (2024), shows that board size negatively but significantly influence the value of DMB in Nigeria. However, the analysis from the study made by Ali *et al* (2024) is in line with the findings of this study. Their finding indicates that board size has an insignificant association with price to book value. By implication, the insignificant effect of board size implies that the role of board size in ensuring corporate governance and evaluating management ability to control and promote value-creating activities is not adequate enough to actually influence the market value of listed commercial banks in Nigeria.

The results of the analyses and their findings are justified because of the series of statistical tests conducted and post-estimation diagnosis carried out, proving that the model is appropriately specified.

CONCLUSION AND RECOMMENDATIONS

Corporate governance of banks in emerging economies is of crucial importance as banks hold an overwhelmingly dominant position in the financial systems of the Country. Moreover, banks are extremely important engines of growth in this country as they are typically the most important source of finance for the majority of firms, in addition to playing a major role in the payment and saving system. Therefore, bank governance is of crucial importance as the reduced role of economic regulation has resulted in the managers of banks having greater freedom on how they run their banks. Emerging economies are likely to require more effective and stronger governance mechanisms than their western developed counterparts if they are to become equal, full, and active participants in the global financial marketplace.

The results reveal that certain corporate governance mechanisms have impact on market value of firm. Meanwhile, it is worth-mentioning that book value performance is affected by different corporate governance mechanisms. Firms that practice corporate governance strictly in relation to these corporate governance mechanism can increase their value and also avoid corporate collapse.

i) Based on the findings and conclusion made in this dissertation so far, the study highlights the following possible recommendations:
ii) Commercial banks in Nigeria should have non-executive directors who act as professional advisers to ensure that competition among insiders encourages measures consistent with the maximisation of shareholder value.
iii) The audit committee should consist of men of experience and integrity; they are to be directly responsible to the shareholders and be independent of the board of directors and the management. This will augur for more transparency, better checks and balances and enable the shareholders to assert their rights.
iv) Commercial banks in Nigeria should maintain optimum board composition of board size and audit committee which should be reviewed periodically in ensuring proper governance structure and value creation of the institution.

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APPENDIX 1

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	9.508273	3	0.0232

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
AUCSIZE	0.617615	0.018282	0.599333	0.0357
BODIND	0.642622	0.045498	0.597124	0.0162
BODSIZE	-0.226669	0.018326	-0.245000	0.0730

Model: PBV (Fixed Effect is Preferred)
Dependent Variable: PBV
Method: Panel Least Squares
Date: 08/29/25 Time: 05:55
Sample: 2008 2024
Periods included: 15
Cross-sections included: 13
Total panel (balanced) observations: 195

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AUCSIZE	0.617615	0.064457	9.581829	0.0000
BODIND	0.642622	0.096874	6.633585	0.0000
BODSIZE	-0.226669	0.029937	-7.571438	0.0000
C	-0.740612	0.428285	-1.729249	0.0854

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.915907	Mean dependent var	1.182718
Adjusted R-squared	0.908860	S.D. dependent var	1.164941
S.E. of regression	0.351689	Akaike info criterion	0.826351
Sum squared resid	22.13966	Schwarz criterion	1.094905
Log likelihood	-64.56919	Hannan-Quinn criter.	0.935085
F-statistic	129.9725	Durbin-Watson stat	1.115183
Prob(F-statistic)	0.000000		

APPENDIX 11

Dependent Variable: PBV
Method: Panel EGLS (Cross-section random effects)
Date: 08/29/25 Time: 05:49
Sample: 2008 2024
Periods included: 15
Cross-sections included: 13
Total panel (balanced) observations: 195
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AUCSIZE	0.018282	0.078808	0.231984	0.8168
BODIND	0.045498	0.129655	0.350918	0.7260
BODSIZE	0.018326	0.039458	0.464449	0.6429
C	0.712169	0.630126	1.130202	0.2598

	Effects Specification	
	S.D.	Rho
Cross-section random	0.938310	0.8768
Idiosyncratic random	0.351689	0.1232

Weighted Statistics			
R-squared	0.003465	Mean dependent var	0.113926
Adjusted R-squared	-0.012187	S.D. dependent var	0.355471
S.E. of regression	0.357631	Sum squared resid	24.42886
F-statistic	0.221369	Durbin-Watson stat	1.012588
Prob(F-statistic)	0.881477		

Unweighted Statistics			
R-squared	0.012668	Mean dependent var	1.182718
Sum squared resid	259.9397	Durbin-Watson stat	0.095162

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Performance of Poultry Farmers in Formal Micro Credit Source and Informal Micro Credit Source in Imo State, Nigeria

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ABSTRACT
This study examines the performance of poultry farmers in Imo State, Nigeria, with a focus on the role of formal and informal microcredit sources in their profitability. The research investigates various socio-economic factors such as gender, age, marital status, education, household size, access to credit, and cooperative membership to assess their impact on poultry farming outcomes. The findings reveal that the majority of poultry farmers in the area are male, with a predominant proportion of married individuals contributing to farm labor, particularly in formal and informal microcredit sources. Formal microcredit farmers have higher average revenue (N2,049,600.00) compared to informal credit farmers (N1,772,050.00), though the net income from informal microcredit (N75,071.11) exceeds that from formal credit (N48,079.40). This suggests that informal credit might offer short-term benefits for profitability. A Z-test analysis indicates a significant difference between the profitability of formal and informal microcredit farmers, with formal credit leading to higher profitability. Both credit sources play crucial roles in supporting poultry farming, enhancing revenue generation, and improving productivity. The study recommends improving access to formal credit, increasing financial literacy programs, regulating informal credit sources, investing in modern poultry farming technologies, and promoting agricultural cooperatives to enhance the financial sustainability and growth of poultry farming in the region.
Keywords: Performance, poultry farmers, formal micro credit source and informal micro credit source, Imo State, Nigeria.

INTRODUCTION
The poultry sector in Nigeria has been a significant contributor to the country's agricultural economy, providing a substantial portion of animal protein for the population. Poultry farming in Imo State, like in other parts of Nigeria, plays an essential role in rural livelihoods, employment, and food security. However, despite its potential, the growth and sustainability of poultry farming in Imo State are often hampered by various financial challenges. The access to adequate and affordable credit remains one of the most critical barriers faced by poultry farmers. Farmers require financial resources to invest in purchasing day-old chicks, feed, medication, and other essential inputs for their businesses (Olubunmi & Obiora, 2020). Consequently, exploring the performance of poultry farmers in both formal and informal microcredit sources in Imo State is crucial for understanding how financial support influences the success or failure of poultry farming.

In Imo State, two primary sources of microcredit are commonly available to farmers: formal and informal. Formal microcredit refers to loans provided by regulated financial institutions such as banks, microfinance institutions (MFIs), and government programs designed to offer affordable and accessible credit to rural farmers. These formal financial institutions are typically characterized by a structured loan application process, lower interest rates, and more reliable repayment terms

(Olayemi, 2017). On the other hand, informal microcredit comes from non-institutional lenders, such as family members, friends, local money lenders, and cooperative societies. This form of credit often lacks the regulatory oversight found in formal sources and can involve higher interest rates and more flexible, but sometimes exploitative, repayment terms (Ogunlade et al., 2020). Understanding the dynamics of both sources in relation to poultry farming is vital for identifying the most effective ways to support this critical industry.

Poultry farmers' performance is influenced by the availability, accessibility, and terms of credit provided by both formal and informal sources. In theory, formal credit sources are expected to provide better conditions for farmers, offering lower interest rates and longer repayment periods, which could contribute to sustainable farm growth. However, research has shown that the bureaucratic hurdles and strict lending requirements associated with formal credit can limit its effectiveness for small-scale poultry farmers (Akinola & Olagunju, 2021). In contrast, while informal credit sources are often more accessible and flexible, they come with challenges such as high-interest rates, which can put a strain on the farmers' financial capacity (Adeoye & Olamide, 2018). These contrasting features raise the question of which source of credit better supports the growth and sustainability of poultry farming in Imo State.

This study aims to evaluate the performance of poultry farmers in both formal and informal microcredit sources in Imo State, Nigeria. By examining the access to credit, loan terms, and repayment patterns, the study seeks to understand how these financial sources affect the productivity, profitability, and sustainability of poultry farming in the state. Given the pivotal role poultry farming plays in Imo State's economy, understanding how different credit sources contribute to the success or failure of these businesses is essential for developing targeted policies to improve farmers' access to financial resources (Olufunke et al., 2020). Moreover, this research will provide insight into how formal and informal credit mechanisms can be better tailored to meet the needs of smallholder poultry farmers.

The findings of this study will be beneficial to policymakers, financial institutions, and agricultural extension services by identifying the strengths and weaknesses of formal and informal credit sources for poultry farmers. With the results, stakeholders can design more effective credit policies and interventions aimed at enhancing access to credit, improving financial literacy, and increasing the performance of poultry farmers in Imo State. It is hoped that by providing a clearer picture of the financial constraints faced by poultry farmers, this research will contribute to improving the overall performance of the poultry industry in Imo State and Nigeria at large.

METHODOLOGY

Study Area

The study was carried out in Imo State, Nigeria. The State lies within latitudes 5° 40ˡ and 7° 5ˡ North and longitudes 6°35ˡ and 8°30ˡ east. The State covers a land area of 7,480km^2 with a population of 3,939,899 people (NPC, 2006). The vegetation of the area is tropical rainforest which experiences soil erosion and degradation. The soil is slightly acidic with a pH of 5.0 to 5.5 (ISMANR, 1986). The state is characterized by tropical climate with high humidity and temperatures that range between 1500mm to 2300mm and 34°C to 37°C respectively (ISMANR, 1986). The State has very rich potential for agriculture supported by its numerous water resources including rivers, ponds and streams. The rivers support a wide range of irrigation farming and fishing, while its green vegetation also supports livestock farming. Crops widely grown include food crops such as yam, swamp rice, cassava, cocoa, plantain, banana and vegetables such as, water leaf, fluted pumpkin, and garden egg. Tree crops common in the area include oil palm, citrus, rubber and mango. There are also numerous forest reserves in different areas within the State useful for a wide range of forestry activities to support the livelihood of the rural people. Five distinct soil types have been identified in the state and these include lithosols, alluvial soil, ferralithic soils, medium fine alfisols and clayey hydromorphic soils. The state is divided into three main agricultural zones, namely Owerri, Okigwe and Orlu. It is further divided into 27 local government councils. The main crops grown in the area include cassava, cocoyam, yam, maize, melon and vegetables (green, fluted pumpkin, water-leaf, bitter leaf, etc). The livestocks reared include; sheep, goats, fishes, pigs and poultry.

Sampling Technique

The population of the study constitute all poultry farmers in the state. The study was carried out in all the 3 zones of the state, namely Okigwe, Owerri and Orlu. The sampling frame was obtained with

the assistance of village heads and resident extension agent within the communities. Multi-stage sampling techniques was adopted in selecting respondents. The first stage involve the purposive selection of two LGA's from the 3 zones making a total of 6 LGA's. The purpose selection was based on the highest producing LGA's in terms of output of poultry. Simple random sampling was adopted in selecting two communities from each LGA to give a total of 12 communities. From the communities we randomly select one village to get 24 villages. From each village we randomly select 10 poultry farmers (5 formal source and 5 informal source) to obtain a sample of 120 poultry farmers.

Data Collection

The study used only primary data sources. The primary data were obtained through the aid of questionnaire and interview schedule. Additionally, personal observations also form a critical means of data collection. Information elicited from the questionnaire will cover socio-demographic and economic profile of respondent such as age, education, marital status, household size, farming experience etc. The nature and cost and return involved in production to include feed, labour use, wood shaving, cost and types of equipment used etc, type and amount of microcredit accessed by the poultry farmers in formal micro credit source and informal micro credit source, determinants access and level access to microcredit among beneficiaries in formal and informal micro credit source; factors affecting of performance among beneficiaries in formal and informal micro credit source; effect of microcredit on the performance of poultry farmers in formal and informal micro credit source as well as identify the constraining factors to access microcredit by the poultry farmers in the area.

Model specification

Net return analysis

The profit of poultry enterprise was estimated as follows:

$$\boldsymbol{\pi} = TR - TC \quad (1)$$

$TR = PQ$

$$TC = TVC + TFC \quad (2)$$

$$GP = TR - TVC \quad (3)$$

Where;

$\boldsymbol{\pi}$ = Profit
P = Unit price of poultry
Q = Quantity of poultry
TC = Total cost
TVC = Total Variable Cost
TFC = Total Fixed cost – Depreciation on fixed, asset, rents, interest on loan, taxes and insurance.
GP = Gross profit

NB: This was estimated for both formal and informal source

The Z-test for comparison is stated as follows:

$$Z = \frac{X_1 - X_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad (4)$$

Where;

$n_1 + n_2$ = Degree of freedom
Z = Paired Z statistics
X_1 = Mean level of cost, return and profit of poultry farmers in formal micro credit source
X_2 = Mean level of cost, return and profit of poultry farmers in informal micro credit source
S_1^2 = Variance level of cost, return and profit of poultry farmers in formal micro credit source
S_2^2 = Variance level of cost, return and profit of poultry farmers in informal micro credit source
n_1 = Number of poultry farmers in formal micro credit source
n_2 = Number of poultry farmers in informal micro credit source

RESULTS AND DISCUSSION

Table 1: Distributions of Respondents according to socioeconomic characteristics

Variables	Formal microcredit Frequency	Percentage	Informal microcredit Frequency	Percentage
Sex				
Male	47	78.33	55	91.67
Female	13	21.67	5	8.33
Age				
25-34	9	15.00	8	13.33
35-44	11	18.33	32	53.33
45-54	26	43.33	11	18.33
55-64	14	23.33	9	15.00
Mean	47	39.63	43	42.13
Std deviation	11.435		9.564	
Marital status				
Married	44	73.33	38	63.33
Single	16	26.67	22	36.67
Education				
Never attended	0	0.00	0	0.00
Primary	9	15.00	31	51.67
Secondary	34	56.67	17	28.33
Tertiary	17	28.33	12	20.00
Household Size				
1-4	31	51.67	44	73.33
5-8	11	18.33	5	8.33
9-12	18	30.00	11	18.33
Mean	6	5.35	4	5.10
Std deviation	3.44	2.87	3.53	2.94
Access to credit				
No	24	40.00	14.5	24.17
Yes	36	60.00	41	68.33
Experience				
1-5	28	46.67	20	33.33
6-10	14	23.33	19	31.67
11-15	18	30.00	21	35.00
Mean	7		8	
Std deviation	4.25		4.07	
Cooperatives				
No	23	38.33	25.5	42.50
Yes	37	60.67	34.5	57.50

Source: Field survey, 2024

Performance of Poultry Farmers in Formal Micro Credit Source and Informal Micro Credit Source in Imo State, Nigeria

Sex

The Table shows that majority of the poultry farmers in the study area were males, for Formal microcredit (78.33%) and Informal microcredit (91.67%). This is attributable to the intensive labour demand of poultry farming which the female gender could most time not afford. Although females are found to be more caring as is required by poultry rearing then males, in the area. However, this result proves positive since women in African countries form big portion of the population undertaken farming activities, though they face socially conditioned inequalities in the access, use and control of household resources. Uka et al., (2021) and Falola et al., (2017) noted that males dominated farming activities. Although Okelola *et al*., (2014) stated that most agricultural practice in developing countries are essentially promoted by women.

Age

The result indicates the mean ages were 47 and 43 years for both Formal microcredit and Informal microcredit respectively; this is expected to impact positively on their profitability. Given that energy require for production increases as man advances in age. This implies that majority of the respondents were adults, matured and energetic and should be reasonable enterprising. This represents an active stage in life. Ojedokun et al., (2020) reported mean ages of 43 years. This means that the respondents are able to work and generate income and should be enterprising. The implication is that people always changes and become less choosy as they get advanced in age and tends to engage in some sort of economic activity in order to attain self-dependence. The implication

of this result is availability of able-bodied manpower for primary production. Moreover, age influences the ability to seek and obtain jobs, which could increase their production capacity.

Marital Status
The Table shows that majority of the respondents were married for both Formal microcredit (73.33%) and Informal microcredit (63.33%). The implication of marital status on profitability can be explained in terms of the supply of family labour. The supply of family labour would be more where the household heads are married. This is in consonance with the findings of Zalkuwi *et al.,* (2014). Furthermore, the dominance of the married people in production according to Ojedokun et al., (2020) is attributed to the fact that married people are more settled as it relates to giving appropriates attention to production operation. The implication is that there are more stable households which are better positioned to practice serious production.

Level of Education
The Table shows that majority of the respondents have formal education for both Informal microcredit and Formal microcredit. With about 85% of respondents in Formal microcredit with secondary and tertiary qualifications while 48.33% of Informal microcredit with secondary and tertiary qualifications. The result implies that the Formal microcredit highly literate having acquired more level of education than both Informal microcredit in the area. This means that they can be easily convinced to accept better practices and innovation. Literacy (ability to read and write) would enable the farmers to better utilize effectively and efficiently go skill and technologies in the area and curtail frivolous spending. As expected, higher education would enhance improved business ideas, skills, innovation and managerial ability for business sustainability. This result is in agreement with Katanga et al., (2018) that as an individual increases his educational attainment, his production quest and skill increase, thus expanding his knowledge base which makes him more alert to new production technologies.

Household size
The Table shows that mean household was 6 and 4 persons for Formal microcredit and Informal microcredit respectively. The economic implication is that it will provide the Formal microcredit and Informal microcredit with family labour and reduce cost of production and increase their revenue. This is desirable, consistence and of great importance. This is so if members are not made up of the aged and very young people, otherwise scare capital resources that should have been employed for production would be channeled for upkeep of these dependent members. The economic implication is that it will provide the labour and reduce cost of production and increase their revenue. This corroborates with Sanusi and Dada (2016), who posited that a relatively large household size may likely enhance family labour supply on production operation.

Access to Credit
From the result, a dominant number of the poultry farmers indicated access to credit for Formal microcredit (60.0%) and Informal microcredit area (68.33%). Access to credit is in turn believed to have significant positive consequences for aggregate and household-level outcomes, such as technology adoption, profitability, food security, nutrition, health, and overall household welfare (Diagne and Zeller, 2011). Improved access to credit will help poor poultry farmers engage in more income-generating activities that will raise their living standards. Access to credit has the capacity to transform the poor through acquiring productive capital, which improves their capacity to generate income, savings and investment for better welfare (Diagne and Zeller, 2011).

Experience
The Table shows that on average the poultry farmers has spent about 8 and 7 years have been in production for Informal microcredit' area and Formal microcredit respectively. The result has some positive implications on increased output, efficiency and profit because according to Obayelu *et al*., (2014), as the number of years a farmer has spent in production business may give an indication of the practical knowledge he has acquired on how he can overcome certain inherent problems and increase profit. Farmers experience is expected to enhance farm participation as those who had stayed long in poultry farmers tend to be more efficient, have better knowledge of the farms, better knowledge of efficient allocation of resources and farm situation. Experience has a positive effect on farm participation because it enhances the skill and ability to utilize better on farm information, which may in turn reduces production costs and make it more profitable to participate in the farm.

Cooperative Membership
From the result about 61.67% and 57.50% of the Formal microcredit and Informal microcredit in the area belong to production cooperative. Production cooperative is expected to impact positively on farm profitability as well as farm participation because it is the extent of membership that poultry farmers are able to acquire better skill and knowledge on production which lead to surplus to be taken to the farm for sales. Membership to the group has both positive and negative impact on farm participants. It positively impacts on profitability and farm participation because it increases household's access to information vital to production and production decisions (Olwande and Mathenge, 2012). On the other hand, it can negatively impact profitability and farm participation in case disagreement emerges among group members, distorting production and production decision.

Table 2 Sources, types and amount of credit accessed by the poultry farmer

	Formal		Informal	
Variables	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**
Type of credit				
Short term credit	41	68.33	53	88.33
Intermediate term credit	11	18.33	4	6.67
Long term credit	8	13.33	3	5.00
Amount of credit received (₦)				
0 – 500000	31	51.67	42	70.00
50,0001 – 1,000,000	15	25.00	9	15.00
100,0001 – 1,500,000	10	16.67	5	8.33
2,000,001 – 2,500,000	4	6.67	4	6.67
Mean	675,000.24		541,666.82	
Total	**60**	**100**	**60**	**100.00**

Source: Field survey (2024)

Result shows that majority of the respondent in formal source (68.33%) and informal (88.33%) obtained short term credit. The short term has a repayment period of 12 months or less. This is followed by intermediate term credit, for both formal source (18.33%) and informal (6.67%) and only few obtained long term credit. It may be inferred from the data that the major concern of the respondents was about addressing their needs pertinent to raising seasonal poultry production. This type of credit is generally used credit for feed, fertilizers and pesticides etc. to maintain the desired level of inputs. This conform with finding of Chukwuma et al., (2021) The implication of short term credit is to meet an immediate farm expense, because the longer the farmers owe, the more interest, thus they prefer short term credit. This type of credit does not allow for consistent farm growth and expansion.

The average amount of credit received was ₦675,000.24 and ₦ 541,666.82 respectively for formal source and informal. Diagne and Zeller (2011) stated that improved access to credit will help poor farmers engage in more productive income-generating activities that will raise their living standards and ability to payback. Access to credit has the capacity to transform the poor through acquiring productive capital such as planting materials (Dzadaze *et al*., 2012) reported that banks use their lending criteria to select credit beneficiary among applicants to whom to grant credit. Access to credit increases the income of the farmers, expands farms and enables farmers to acquire technologies. It also enables farmers to procure farm inputs and hire labour for enhanced productivity and income (Idu *et al.,* 2016). The implication of low amount of credit is that farmers may lack the ability to make appreciable investments in poultry production thereby reducing the amount of possible returns. This will have significant negative consequences for aggregate and household-level outcomes such as technology adoption, agricultural productivity, food security, nutrition, health, and overall household welfare (Diagne and Zeller, 2011).

Access to high amounts of credit will help poor rural households engage in more productive income-generating activities that will raise their living standards and soil conservation practices. Access to credit has the capacity to transform the poor through acquiring productive capital, which improves their capacity to generate income, savings and investment for better welfare (Beck and Demirguc-Kunt, 2005; Diagne and Zeller, 2011).

Table 3: Cost and returns of poultry per batch

Items	Formal credit		Informal credit	
Price of Mature Bird	4,200.00		4,150.00	
Quantity	488 birds		427 birds	
Revenue	2,049,600.00		1,772,050.00	
Variable cost		% of total cost		% of total cost
Day old chicks	117,976.32	15.28	126,379.36	17.53
Feed	516,146.46	66.85	442,327.72	61.34
Mediation/ drugs	32,867.36	4.26	35,208.36	4.88
Transportation	13,312.16	1.72	14,260.36	1.98
Monthly Utility	6,198.92	0.80	6,640.44	0.92
Security per month	29,833.32	3.86	35,208.36	4.88
Other cost	12,083.32	1.57	14,260.36	1.98
Total variable cost	**728,417.86**	**94.34**	**674,284.96**	**93.51**
Fixed cost				
Depreciation	43,676.46	5.66	46,787.37	6.49
Total fixed cost	43,676.46	5.66	46,787.37	6.49
Total cost	**772,094.32**	**100.00**	**721,072.33**	**100.00**
Net return (Profit)	**1,277,505.68**		**1,050,977.67**	

Source: Field Survey Data, 2024

From the result presented in Table 4.5, the average revenue/return realized were ₦ 2,049,600.00 and ₦ 1,772,050.00 per month for poultry farmers in Formal credit and Informal microcredit respectively. This was realized from sales of 488 birds of poultry at ₦ 4200 per mature for farmers in Formal microcredit while farmers in Informal microcredit sold 427 birds at 4150 per batch. The Table showed that the total cost for production were ₦ 772,094.32 and ₦721,072.33 for an average farmer in Formal credit and Informal microcredit. While the net income for an average farmer were ₦ 48,079.40 and ₦75,071.11.

This shows that the poultry farming is a high yielding venture as indicated by the positive net returns recorded. Ojedokun et al., (2020) also recorded a positive result and showed that the is profitable. Shehu and Mohammed (2017) also noted that poultry production is a profitable venture. The figure was moderate as indicated by Sanusi and Dada (2016) and Obayelu, et al., (2014).

Table 4: Z-test for comparison of profit between Formal and informal credit poultry farmers

Variables	Mean	Std. Deviation	Std. Error Mean	Z-value
Formal microcredit	1,277,505.68	621011	391145	4.395***
informal microcredit	1,050,977.67	536148	368113	
Combined	226,528.01	83631.00		

Source: field survey (2024) *** Significant at 1%,

Z-test to determine whether significant difference exist between profit of formal and informal microcredit poultry farmers is presented in table 4.6 above. The result shows that there was a significant difference between the two groups of farmers in the area. The Z-value was 4.395 significant at 1% level of probability and positively sign. This implies that profit of poultry in formal credit source was significantly higher than informal credit farmers in the area in the area.

CONCLUSION AND RECOMMENDATIONS

The study on the Performance of Poultry Farmers in Formal Micro Credit Source and Informal Micro Credit Source in Imo State, Nigeria highlights the significant role that both formal and informal microcredit sources play in the profitability of poultry farmers. The findings indicate that poultry farming remains a high-yielding and profitable venture in the region, with positive net returns recorded by both groups of farmers. Poultry farmers accessing formal credit generated an average revenue of N2,049,600.00, yielding a net income of N48,079.40, while those accessing informal credit realized N1,772,050.00 in revenue, with a higher net income of N75,071.11. Despite the higher revenue generated by formal credit farmers, the net income from informal credit was slightly higher, suggesting that informal credit might offer some short-term benefits in terms of higher profits.

The results of the Z-test further corroborate the significant difference in profitability between the two groups. The formal microcredit source showed a much higher Z-value (4.395), significant at the 1% level, indicating that formal credit tends to contribute to greater profitability in poultry farming in Imo

State. However, this does not diminish the importance of informal credit sources, which still play a crucial role, particularly for farmers with limited access to formal financial institutions. Both credit sources, though different in structure, support the sustainability and growth of poultry farming in the region.

The profitability of poultry farming in the study area is a positive indicator for the agricultural sector in Nigeria. Both formal and informal microcredit sources have been instrumental in enabling farmers to meet operational costs, increase productivity, and generate revenue. However, the profitability gap between formal and informal credit users underscores the importance of structured financial support for sustainable agricultural growth.

i) Improving access to formal credit for poultry farmers should be a priority. While formal credit sources showed higher profitability, limited access among small-scale farmers remains a barrier. Financial institutions and government agencies should work to streamline credit access, offering more accessible terms, lower interest rates, and flexible repayment schedules. This would encourage greater participation from a wider demographic of farmers, ensuring they have the financial support needed for long-term growth.
ii) There is also a need for financial literacy programs targeted at poultry farmers. These programs would enable farmers to better understand how to manage loans, use credit effectively, and apply business management skills that can maximize their returns. Educating farmers on the advantages of formal credit and how to optimize its benefits could significantly improve their ability to use loans efficiently.
iii) While formal credit plays a central role, informal credit sources are still critical to the success of small-scale poultry farmers. To enhance the impact of informal credit, it is recommended that these sources be better regulated and formalized. By establishing frameworks for monitoring and guiding informal credit providers, farmers can receive fairer terms and avoid exploitation, while still benefiting from the flexibility that informal credit offers.
iv) Investment in modern poultry farming technologies and infrastructure is crucial for improving the overall performance of farmers. Poultry farmers should be encouraged to adopt new farming techniques, better disease control methods, and more efficient management practices. Both formal and informal credit can be better utilized if there is adequate support in terms of technology and infrastructure, which will help farmers increase productivity, lower costs, and improve overall profitability.
v) Finally, promoting membership in agricultural cooperatives can be a valuable strategy for enhancing farmers' access to credit and increasing their bargaining power. Cooperatives can also facilitate the exchange of knowledge, skills, and resources, which can help farmers make better production and financial decisions. This, in turn, would lead to improved farm participation and profitability, benefiting both formal and informal credit farmers alike.

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Resource Use Analysis among Female Cucumber Farmers in Umuahia Agricultural Zone of Abia State, Nigeria

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ABSTRACT

This study analyzed resource use among female cucumber farmers in Umuahia Agricultural Zone of Abia State, Nigeria. The specific objectives were to: describe the socio-economic profile of the cucumber farmers; examine the various resources used by the cucumber farmers; determine influence of resource use on the output of the farmers; ascertain determinants to resource use among them, and examine limitations to cucumber farming in the study area. Multi-stage and purposive random sampling techniques were adopted in 2 LGAs, 4 communities and 8 villages to get 80 female cucumber farmers for the study using primary data only which were collected with questionnaire administered on the respondents. Different analytical tools such as the descriptive statistics, Univariate regression analysis and multinomial logit regression were used in data analysis. Most of the respondents (62.5%) were of the age range of 36 – 45 years, with a mean age of 42.092 years; 62.5% were married, 35.0% have households of 11 persons and above with a mean household size of 7 persons. The respondents used various resources in their cucumber farming such as organic manures - 2.4 bags of N:P:K 15:15:15 fertilizer at the cost of ₦ 47,200, and 1.2 bags of N:P:K 20:15:15 fertilizer at the cost of ₦ 26,400; inorganic manures - 4kg of compost manure at no cost, 2.1kg of farm yard manure at no cost and 3.3kg of animal dungs at the cost of ₦ 4,700; labor – 2 skilled labor at the cost of ₦ 6,000 and 9 unskilled labor at the cost of ₦ 36,000; seed types – 215 improved seeds at the cost of ₦ 1,820 and 42 local seeds at the cost of ₦ 645; land – 3.73 plots of land rented at the cost of ₦ 6,400; management -1 hired person who was paid ₦ 8,000 per month and 4 family members who managed the farm at no cost. The highest resources used by the farmers included unskilled labor (97.5%), self-management (95.0%), animal dung inorganic manure (88.75%), N:P:K 15:15:15 fertilizer (85.5%), and farm yard inorganic manure (78.75%) among others. Four resources - Organic manure (1.0%), inorganic manure (1.0%), seed type (10.0%) and land use (1.0%) determined the output level of cucumber in the area. Access to credit (5.0%), education (5.0%), household size (10.0%), years of experience (1.0%) and cost of production (1.0%) were the main variables that statistically and significantly determined resource use among the female cucumber farmers in Abia State, while lack of credit facilities (58.75%), followed by perishability of cucumber seeds (57.50%), cost of labour (41.25%), high cost of input (38.75%), pest and diseases attacks (33.75%) and inadequate capital (31.25%) were the major limitations to the farming attested by the respondents. It was recommended that financial support specifically for the women marketers by the government, NGO's and financial institutions would go a long way in increasing their scale, returns and ease some of the problems encountered in the farming.

Keywords: Resource Use, Female Farmers, Cucumber Farming, Female Farmers in Abia State.

INTRODUCTION

Resources are the various inputs and utilities combined and used in every production process to generate required output (Edet and Oluwatoyin, 2006). Resources are considered to include the various factors of production ranging from land, labour, capital and management; and be at its highest and best use when it is put a use with highest comparative advantage to other uses. Efficiency of resource use can therefore be assessed from the productivity of the output. It suffices to say that the knowledge of efficiency of resource use is vital to farmers in agricultural productivity. As stated by Eyoh and Igben (2002), that the utilization of land resources is closely guided by the concept of highest and best use; so is labour, capital and management resource necessary to be put to best use for maximum agricultural productivity.

Cucumber (*Cucumis sativa*) is an important vegetable crop cultivated Globally. cucumber was spread beyond Indian borders, moved through Ancient Greece, Rome, Europe, New World, China, and eventually It is the fourth most cultivated vegetable in the world and known to be one of the best foods for body's overall health (Ghile et al., 2022, Aziza et al, 2019). Cucumber is an annual deep-rooted crop with tendrils and hairy leaves. Cucumbers are classified as accessory fruits but are however perceived, prepared and eaten as vegetables. Cucumber is a member of the Cucurbitaceae, a long, cylindrical green fruits that contain about 95% water and is for this reason often recommended as natural diuretics and helpful for body building (Elum et al., 2016). It is an excellent source of vitamins and minerals such as vitamin C, Vitamin K, multiple B Vitamins, molybdenum, manganese, biotin, magnesium, phosphorous among others (Lybrate, 2020). Besides, it is one of the very low-calorie vegetables; provide just 15calories per 100g. It is an excellent source of potassium, an important intracellular electrolyte. 100g of cucumber provides 147mg of potassium but only 2mg of sodium. Cucumbers contains unique antioxidants in moderate ratios such as ß-carotene and α -carotene, vitamin-C, vitamin-K vitamin-A, zeaxanthin, and lutein. It helps in checking weight gain and high blood pressure. The demand for fresh cucumber in Nigeria is high as they are used in preparing salads, juice, stews and curries or eaten raw as a snack. Its production is gaining more popularity because of its nutritional and economic values (Ghile et al., 2022). Cucumbers are planted year-round. They are produced in Nigeria through commercial and smallholder farmers. Production varies from cultivating few plants in the backyard for home consumption to a large-scale production of domestic and export markets (Ohen et al., 2014). Cucumber production often requires a small area of land, unlike other crops which require a large area of land. They can be directly seeded or transplanted and growing of vegetables like cucumber can result in high yield even on small farm land (Ghile et al., 2022, Pozderec et al., 2010). It gives a higher number of employments per hectare of land, off-farm and on-farm enterprise (Ridwan et al., 2021).

Women are acknowledged to contribute significantly to the nation's economy through their participation in agricultural production, processing and marketing (Isitor, 2015). They are known to be involved in food crop production in multiple ways all over the world. Nze (2021) noted that up to 74.54% of rural women have farming and farming activities and less of non-farm activities which could be in industries, business and services such as sewing, hairdressing, trading, to mention but a few, as their major livelihood. Kanu et al. (2016), Mazza (2016) and Nwakwasi et al. (2016) affirmed that farming is the mainstay of higher percentage of women especially those in the rural areas. Farming among women is mostly practiced at subsistent level and is characterized by numerous farmers operating several scattered small fragmented lands using traditional methods such as land rotation, bush burning and use of crude implements (Nze, 2021).

Women have realized the potential - cash to spend on basic necessities of life and promoting farm production. Vegetable production therefore ensures food security, employment and income generation in rural areas, thereby reinforcing the overall development and poverty reduction goals in most countries (Ohen et al., 2014).

Although vegetable production has been an ongoing practice as a source of livelihood for many people in Nigeria, it is a relatively recent addition to the diet of Nigerians. However, vegetable producers are faced with challenges that could be grouped into agronomic and socio-economic factors (Elum et al., 2016, Sabo and Zira, 2009). For instance, many farmers are smallholders who are unable to adopt mechanized farming and therefore experience low farm productivity. Thus, the production of cucumbers in Abia State is mostly carried out in small scale (Irozuru, 2021).

Resource use in Nigeria is very poor due to bad governance, poor orientation, dwindling of educational system and among other factors. Farmers that produce little quantity of food are discourage from cross-carpeting from subsistent to commercial level due lack of access to credit facility. Young ones in higher institutions have been deceived into erroneous ideology that farming is for people in the village. According to Ohaeke, (2016), resource use in agricultural production has suffered reckless abandonment due to reliance on crude oil. Poor resource use in a country depicts instability and bad governance and as well as lack of future plan for unborn generation. National domestic product is boost when 70 percent citizen of a country massively engaged into production (Palmed, et al., 2018).

Generally, resource supply from the family level has been dwindling considerably over the past years due to a number of factors, some of which are related. The achievement of the international labour organization in with the increasing awareness of the importance of education even in the rural areas has increased the proportion of children in schools hence reducing time available to work on the farm (Diallo et al., 2013).

Cucumber producers are faced with challenges that could be grouped into agronomic and socio-economic factors (Sabo and Zira, 2009). Poor visitation by agricultural extension worker to educated farmers on new approach of production also contribute to high poverty level and poor production of cucumber in Abia state. Cucumber production in the study Abia state has therefore been heavily labour-intensive with farmers relying on their households for labour supply. Gocowski and Oduwole (2003) confirmed lack of resources as the major constraint to peasant cucumber producers in Nigeria especially during planting, weeding and harvesting. Insufficient land hinders large amount of cucumber production and the actualization of food poverty reduction in Abia state owing to the fact that cucumber does not grow in every soil rather on a soil rich in phosphorus.

Furthermore, despite the roles of women in agriculture and marketing, yet more than 60 percent of the world-poor are women and they have fewer options than men to escape poverty (Ajani, 2009). They have not been the focus of attention in empowerment policies and programmes. Empowerment of the women folk is necessary to bring about sustainable development most especially for enterprises which have greater potential at impacting the women. It will not only increase the women's incomes but also improve the wellbeing of the entire family and ultimately touching on the national economic advancement.

Objectives
The broad objective of this study is to analyse resource use among female cucumber farmers in Umuahia Agricultural Zone of Abia State, Nigeria. The specific objectives are to: describe the socio-economic profile of the cucumber farmers In Umuahia Agricultural Zone of Abia State; examine the various resources used by cucumber farmers in the study area; determine influence of resource use on the output of the farmers; ascertain determinants to resource use among the respondents; and examine limitations to cucumber farming in the study area.

Hypotheses
The following null hypotheses were tested in this study:
Ho_1: Resource use has no influence on the output of female cucumber farmers,
Ho_1: Age, access to credit, education, household size, marital status, years of experience, enterprise monthly expenditures and cost of production are not determinants to resource use among female cucumber farmers.

METHODOLOGY

The study area is Umuahia Agricultural Zone of Abia State. Abia State is one of the 36 States in Nigeria. The State lies between Longitude 040 45' and 060 07' North and Latitude 070 00' and 080 10' East. It is situated in the south-east geo-political zone of Nigeria and is bounded by Imo State on the West, Ebonyi and Enugu States on the North, Cross Rivers and Akwa Ibom States on the East and Rivers State on the South. (NPC, 2018). It has three agricultural zones, namely – Aba Agricultural Zone, Umuahia Agricultural Zone and Ohafia Agricultural Zone, with seventeen Local Government Area. The major occupation of the people is farming and crops grown include cucmber, okra, maize, yam, cassava, among others.

Multi-stage and purposive sampling technique were adopted for this study. First, two local government areas were randomly selected from the Umuahia Agricultural Zone to give all the LGAs equal opportunity for participation. Secondly, from these local government areas, stratified sampling was used to select two communities each LGA to give four communities. The reason for the stratified sampling is to have a fair representative of the Local Governments involved. Thirdly, two villages were randomly selected from each the communities to give eight villages, and Finally, and a random sampling selection of ten female cucumber farmers was done from each of selected villages making it a total of eighty female cucumber farmers for the study.

The study made use of primary data only. These were collected with the use of structured questionnaire which were administered on the female cucumber farmers by the researcher and some enumerators from the study area. Different analytical tools were used in analyzing the objectives of this study, such as descriptive statistics, univariate regression analysis and multinomial logit regression.

Model Specification
Univariate Regression Model
Univariate regression analysis was deployed in determining the influence of resource use on the output of the farmers. The model is stated below as follows:

$$Y = F(x_i) \text{ ... Implicit form} \quad (1)$$
$$Y = a_o + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + et \text{ ... Explicit form} \quad (2)$$
$$lnY = a_o + lnb_1x_1 + lnb_2x_2 + lnb_3x_3 + lnb_4x_4 + et \text{ ... Explicit form} \quad (3)$$

Where;
ln = Natural logarithm
Y = Output of the female cucumber farmers (Kg)
a_0 = Intercept (constant)
b_1 - b_{et} = coefficients
X_i - X_{et} = various resources used by the female cucumber farmers in the study area
e_i = Error term.

Multinomial Logit Regression Model
The multinomial logit regression model used in to ascertain determinants to resource use among the respondents as adopted by Melese *et al*. (2018) and Simon and Scott (2017) is specified as follows:

$$Pij = \frac{e^{\beta j\, X_i}}{1+\sum_{k=0}^{j} e^{\beta k\, X_i}} \quad (4)$$

Pij = Probability of choosing among the various resources reduces to:

$$Pij = \frac{e^{\beta j\, X_i}}{1+\sum_{k=j}^{j} e^{\beta k\, X_i}} \quad (5)$$

While the probability of being in the base outcome group was:

$$Pi_0 = \frac{1}{1+\sum_{k=0}^{3} e^{\beta\, X_i}} \quad (6)$$

Where;
i =1,2.....4 variables;
k = 0,1,2,3 groups (the number of various resources in the choice);
e = random disturbance term and unobserved attributes of alternatives.
βj = a vector of parameters that relate Xi's (independent variables) to the probability of being in group j where there is j+1 groups.
x = predictors of response probability specified as
X_1 = Age (Years)
X_2 = Access to credit (Amount Accessed)
X_3 = Education (years)
X_4 = Household size (number of persons)

X_5 = Marital Status (dummy; 1= male, 0 female)
X_6 = Years of experience (years)
X_7 = Monthly expenditures (₦)
X_8 = Cost of production (₦)

RESULTS AND DISCUSSION

Socioeconomic Profile of Female Cucumber Farmers in Umuahia Agricultural Zone of Abia State

According to the Table, most of the respondents (62.5%) were of the age range of 36 – 45 years of age, followed by 31.3% that were of 26 -35 years, 3.8% of 16 – 25 and 2.5% that were of 45 years of age and above. The mean age was 42.092 years denoting that the respondents were young and economically active female farmers. According to Ghide et al. (2022), this age group are usually matured enough to make decisions on the use of resources and capable of handling any strenuous activities that come with the farming. This result is in consonant with Mukaila et al. (2021) who posited that the mean age of cucumber agripreneurs in Enugu State, Nigeria, was 37.53 years. Thus, consolidating that cucumber farmers were within their economically active age and are likely to perform the farming functions effectively. Most of the respondents (62.5%) were married, 25.0% were single, 8.8% were widowed and very few (3.8%) of them were divorced. This indicates female cucumber farming was dominated by the married females in the study area. This could be because married female farmers have increased responsibilities, thus, they engage in cucumber farming in order to increase family income (Afoma, 2021). This finding is also in line with the report of Etinohu et al. (2013) which revealed that 90% of small crop farmers were married. Furthermore, the high proportion of married respondents suggests that they have defendants, some of whom may form resource for the farming as well Mukaila et al. (2021). Majority (60.0%) of the female farmers have households of 6 – 10 persons, 35.0% have households of 11 persons and above, while 5.0% others have minimal household of 1 - persons. The mean household size was 7 persons. This is similar to the finding of Saviour (2019) who noted that the household sizes of cucumber farmers and marketers were moderately high with a mean of 7 and 8 persons respectively. According to Ohen et al. (2014) this implies that the respondents have relatively large family size which will help in farming activities in order to increase productivity of cucumber in terms of reducing the cost of hiring labour. If the productivity of cucumber is increased, the farmers will likely participate in the market in order to sell and generate more income. Regarding their educational status, majority (55.0%) of the respondents were educated up to the tertiary level, while 45,0% others were educated up to the secondary education level. None attested to attaining only informal education or the basic education. This indicates that the female cucumber farmers in the study area acquired adequate level of education in terms of resource management to ensure not just productivity but enhanced output, thus, consolidating with the findings of Irozuru (2021). On the other hand, this is contrary to the report of Etinohu et al. (2013) which stated that crop farmers are majorly primary school leavers. From the Table, it could be deduced that majority (52.5%) of the female cucumber farmers have been in the business for a period of 1 -10 years, 41.25% have been in it for a period of 11 – 20 years, while very few (6.25%) have been in the farming for 21 years and above.

The mean age of farming was 12.731years. with a mean year of 12, It can be concluded that farmers have good farming experience as majority have spent above 5 years in cucumber farming (Ohen et al., 2014; Mukaila et al., 2021). This suggests that the farmers are well established and knowledgeable in applying the use of various resources in the cucumber farming. The longer time a farmer spends in farming activities, the better the farmer understands the farming atmosphere, crop behavoir, etc. Mukaila et al., 2021). This is because the number of years a farmer has spent in the farming business is an indication of the level of practical knowledge he may have acquired through experience on decisions taken and dealing with production, processing and marketing challenges. Increase in number of farming years would likely result in higher efficiency for the farmer by improving their level of productivity and income (Elum et al., 2016). A good proportion (42.5%) of the female farmers produced 11 – 20 kg of cucumber in one season of production, followed by 31.3% that produced 31 – 40kg, 23.8% that produced 1 -10kg and lastly 2.5% that produced 21 - 30kg of cucumber. The mean of cucumber production by the farmers in the area was 26.859kg, and this denotes moderately high quantity produced. It could be of the fact that cucumber serve various purposes in the area ranging from being excellent source of vitamins and minerals such as vitamin C, Vitamin K, multiple B Vitamins, molybdenum, manganese, biotin, magnesium, phosphorous among others (Lybrate, 2020). It is one of the very low-calorie vegetables provide just 15calories per 100g. It is an excellent source of potassium, an important intracellular electrolyte. 100g of cucumber provides 147mg of potassium but only 2mg of sodium. Cucumbers contains

unique antioxidants in moderate ratios such as ß-carotene and α -carotene, vitamin-C, vitamin-K vitamin-A, zeaxanthin, and lutein. It helps in checking weight gain and high blood pressure. The demand for fresh cucumber in Nigeria is high as they are used in preparing salads, juice, stews and curries or eaten raw as a snack. Its production is gaining more popularity because of its nutritional and economic values (Ghile et al., 2022).

Tabel 1: Distribution of female cucumber farmers according to their socio-economic profile

Socio-Economic Profile	Frequency	Percent	Mean Age
Age Range			
16 – 25	3	3.8	**42.092**
26 – 35	25	31.3	
36 – 45	50	62.5	
45 and above	2	2.5	
Marital Status			
Single	20	25.0	
Married	50	62.5	
Divorced	3	3.8	
Widowed	7	8.8	
Household Size			
1 – 5	4	5.0	**7.462**
6 – 10	48	60.0	
11 and above	28	35.0	
Level of Education			
No Formal	**Nil**	**Nil**	
Basic	**Nil**	**Nil**	
Secondary	36	45.0	
Tertiary	44	55.0	
Duration in Cucumber Farming			
1 – 10 years	42	52.5	**12.731**
11 – 20 years	33	41.25	
21 years and above	5	6.25	
Quantity of Cucumber Produced (kg)			
1 - 10	19	23.8	**26.859**
11 – 20	34	42.5	
21 – 30	2	2.5	
31 – 40	25	31.3	
Total	**80**	**100**	

Source: Field Survey, 2023

Resources Used by Female Cucumber Farmers

Table 2 summarized and presented the various resources, their quantity/amount and the costs accrued to the resources used in cucumber farming in the study area. The Table revealed that the respondents used various resources in their cucumber farming such as organic manures - 2.4 bags of N:P:K 15:15:15 fertilizer at the cost of ₦ 47,200, and 1.2 bags of N:P:K 20:15:15 fertilizer at the cost of ₦ 26,400; inorganic manures - 4kg of compost manure at no cost, 2.1kg of farm yard manure at no cost and 3.3kg of animal dungs at the cost of ₦ 4,700; labor – 2 skilled labor at the cost of ₦ 6,000 and 9 unskilled labor at the cost of ₦ 36,000; seed types – 215 improved seeds at the cost of ₦ 1,820 and 42 local seeds at the cost of ₦ 645; land – 3.73 plots of land rented at the cost of ₦ 6,400; management -1 hired person who was paid ₦ 8,000 per month and 4 family members who managed the farm at no cost. The highest resources used by the farmers included unskilled labor (97.5%), self-management (95.0%), animal dung inorganic manure (88.75%), N:P:K 15:15:15 fertilizer (85.5%), and farm yard inorganic manure (78.75%) among others. Ohen et al., (2014) posited that cucumber production varies from cultivating few plants in the backyard for home consumption to a large-scale production of domestic and export markets. Consolidating on this, Ghile et al. (2022) and Pozderec et al. (2010) also noted that cucumber production often requires a small area of land, unlike other crops which require a large area of land.

Tabel 2: Distribution of Various Resources Used by the Female Cucumber Farmers

Various Resources Used	Category	Average Quantity/Number	+Frequency	Percent	Cost of Resources (₦)
Organic Manure:	NPK, 15:15:15	2.4 bags	68	85.50	47,200.00
	NPK, 20:10:10	1.2 bags	22	27.50	26,400.00
Inorganic Manure:	Compost	4 kg	19	23.75	-
	Farm yard	2.1kg	63	78.75	-
	Animal dungs	3.3kg	71	88.75	4.700.00
Labor Type:	Skilled	2 persons	18	22.50	6,000
	Unskilled	9 persons	78	97.50	36,000
Seed Type:	Improved	215 seeds	51	63.75	1,820.00
	Local	42 seeds	27	33.75	645.00
Land	Plots of land	3.73 plots	53	66.25	6,400
Management:	Employed	1 person	44	55.00	8,000.00
	Self	4 family members	76	95.00	-

Source: Field Survey, 2023. + = Multiple Responses Recorded

Influence of Resource Use on the Output of the Female Cucumber Farmers in the Study Area

Univariate regression analysis was deployed in determining the influence of resource use on the output of the farmers and the result was summarized and presented on Table 3. The R^2 high value of 0.994 shows that the various resources used explained up to 99.4% of the variations in the output of the female farmers. Thus, the remaining 0.6% could be due to other factors not accounted for by the model. The F-ration of 19.586 statistically significant at 1% level of significance also showed that the model fit the regression and that all the independent variables have joint significant effects on the level of cucumber output. Four independent variables, namely – organic manure, inorganic manure, seed type and land use statistically and significantly at 1.0% level of probability determined the output level of cucumber in the study area with varying signs.

Inversely, the coefficient of seed type (-31.533) had a negative relationship with the output of cucumber and was statistically significant at 10% level of probability. This implies that a unit increase in the use of improved seeds decreased the output of cucumber. This result is not expected, because improved seeds are believed to give more yield and output. The reason for the result could be an indication that the female farmers were not conversant with the required techniques in planting improved seeds. Land size had a direct relationship with the output of cucumber and was statistically significant at 1% level of probability implying that increase in the amount of land used in the farming will lead to a corresponding increase in the output of cucumber in the study area and vice versa.

Tabel 3 Regression Result on Influence of Resource Use on the Output of the Female Cucumber Farmers

Variables	Unstandardized Coefficients		Standardized Coefficients	T - value	Sig.
	B	Std. Error	Beta		
(Constant)	1142161.696	1574215.535		0.726	.600
Organic Manure	113638.929	30186.444	0.882	3.765***	.165
Inorganic Manure	1128907.191	254814.673	1.663	4.430***	.141
Labour Type	54705.977	61651.205	0.136	0.887	.538
Seed Type	-31.533	17.133	-0.354	-1.840*	.317
Land Size	27.605	2.902	2.310	9.511***	.067
Management	-22.612	16.475	-0.314	-1.372	.401
R	0.997[a]				
R-Squared	0.994				
Adjusted R-Squared	0.943				
F -ratio	19.586***				

Source: Field Survey, 2023. ***, ** and * = 1%, 5% and 10% levels of significance.

Determinants to Resource Use among the Female Cucumber Farmers

The multinomial logit (MNL) regression result on determinants to resource use among the female cucumber farmers was summarized and presented in Table 4. The likelihood ratio statistics as indicated by χ2 statistic (74.20) was highly significant at 1.0%, suggesting the model has a strong explanatory power. The categorically distributed variables were manure, labor and land with management as the base category. The MNL was run with and without many explanatory variables

while some were later dropped because of their insignificant effects on the parameters of the estimates as they were in many studies. In all cases, the estimated coefficients were compared with the base category of contribution. Access to credit, education, household size, years of experience and cost of production were the main variables that statistically and significantly determined resource use among the female cucumber farmers in Abia State.

The coefficients of access to credit (7.43e-06 and 7.08e-06) were significant at 5.0% level of significance in both cases and positively determined resource use (manure use and labour) in the cucumber farming, implying that a unit increase in access to credit of the respondents is associated with the likelihood of increase in manure by 74.3%, and labor by 70.8% with a decrease in the management. It could be deduced that crop farms with increased manure and labor will require more credit to fund these variables.

Education had a positive and significant relationship with land at 5.0% risk level, meaning that a unit increase in the years of education led to a higher chance of using manure and labour with a relative decrease to management. Education attainment increases ability to understand and evaluate information. The more educated the female cucumbers are, the more effective, productive and efficient they become in their farming (Agboola et al., 2016). This is consistent with *a priori* expectation, and Nwaru et al. (2011) who noted that education improves the capability for resourcefulness and invention.

The coefficient of household size (-9.71e-06) had a negative relationship with the use of manure at 10% level of significance, implying that a unit decrease in household size of the farmers will lead to the use of more manure and increased level of management among the female farmers and vice versa. Increased household size will utilize household labour, thus discourage the usage of hired labor or manager (Nze, 2021).

Years of experience had positive coefficient for land and statistically significance at 1.0%. This implies that a unit increase in the years of experience in cucumber farming will lead to the cultivation of more plots of land and reduced level of management employed among the female farmers. This result is plausible because experienced farmers may become more efficient in the utilization of the resources, which could lead to maximum benefits thereby discouraging their need of employed assistance. They are also better able to understand the dynamics of production. Saviour (2019) emphasized that as farmers become more experienced in the production of vegetables through their involvement, their probability to participate in economic transactions will be higher and self-entrepreneurship will be buttressed. This result supports the findings of Emenyonu et al. (2012) and Awotide et al. (2012).

The coefficients of cost of production (-0.4148 and -0.8619) were both negative and statistically significant for manure (10.0%) and land (1.0%); implying that a unit increase in costs of producing cucumber is associated with the likelihood of 4.148% decrease in use of manure which will in turn proportionally increase management by the respondents. Also 1 unit decrease in cost of production will lead to 8.619% increase in use of land with a relative increase in management. The implication of this finding is that an increase in the respondents' cost of production in the area will increase their use of management. decrease in cost of production enhances the rate at which other inputs are acquired and this increases output, and according to Elum et al. (2016) increased output would invariably translate to increased profit, if the cost of operation is not increasing at the same rate. This result is in agreement with the submission of Badmus and Yekini (2011).

Table 4: Determinants to Resource Use among the Female Cucumber Farmers

Variables	Manure (1)		Labor (2)		Land (3)	
	Coefficient	Z-value	Coefficient	Z-value	Coefficient	Z-value
Age	-0.0117	-0.54	0.0106	0.46	0.0164	0.61
Access to credit	7.43e-06	2.25**	7.08e-06	2.08**	4.42e-06	0.088
Education	0.0532	0.81	0.0281	0.41	0.1856	2.57**
Household size	-9.71e-06	-1.89*	5.38e-06	1.43	7.08e-07	0.16
Marital Status	-0.5882	-0.89	-0.4486	-0.61	-1.0818	-1.45
Years of Experience	0.0012	0.03	-0.0084	-0.16	0.1688	2.68***
Monthly Expenditures	1.47e-06	0.09	2.65e-006	0.15	0.0000	1.44
Cost of Production	-0.4148	-1.88*	-0.0423	-0.20	-0.8619	3.39***
Constant	1.0840	0.64	-1.3152	-0.71	-1.4733	-0.82
LR Chi^2 (30)	74.20***					
Prob > Chi^2	0.000					
Pseudo R^2	0.1500					
Log likelihood	-210.2765					
Number of observations	80					

Source: Field Survey, 2023. Base category = Management employed. *, **, *** denotes 10%, 5% and 1% significant respectively.

Limitations to Female Cucumber Farming in the Study Area

The limitations to cucumber arming by the female cucumber farmers in Umuahia Agricultural Zone of Abia State was summarized and presented in Table 5. The major limitations to the farming attested by the respondents were firstly, lack of credit facilities (58.75%), followed by perishability of cucumber seeds (57.50%), cost of labour (41.25%), high cost of input (38.75%), pest and diseases attacks (33.75%) and inadequate capital (31.25%). Other minor limitations included weather condition (27.5%), poor storage facilities (26.25%), Inadequate transportation facilities (23.75%) with type of manure as the least (20.0%) limitation to the farming. According to Ghile et al. (2022) lack of credit facilities and inadequate capital were rather expected since most of these female farmers were operating on a smaller plot of lands and so may not have what is required by financial institutions to get access to credits such as collateral. Elum et al. (2016) also reported the problems of weather condition as well as pest and diseases attacks as limitations to cucumber production.

Table 5: Limitations to Female Cucumber Farming in the Study Area

Limitations to Female Cucumber Farming	Frequency	Percentage	Rank
Lack of credit facilities	47	58.75	1st
Perishability of cucumber seeds	46	57.50	2nd
Cost of labour	33	41.25	3rd
High cost of input	31	38.75	4th
Pest and diseases attacks	27	33.75	5th
Inadequate capital	25	31.25	6th
Weather condition	22	27.5	7th
Poor storage facilities	21	26.25	8th
Inadequate transportation facilities	19	23.75	9th
Type of manure	16	20.00	10th

Source: Field Survey, 2023. + = Multiple Responses Recorded

CONCLUSION AND RECOMMEMDATIONS

In conclusion, it could be deduced that most of female cucumber farmers in Umuahia agricultural zone of Abia State, Nigeria were young, economically active well educated married female farmers with moderately high household sizes. They have good farming experience in cucumber production, who produce 26.859kg of cucumber per production season. They use various resources in their cucumber farming such as organic manures, inorganic manures, labor, improved seeds and employ the services of managers in their farming. Organic manure, inorganic manure, seed type and land use determined the output level of cucumber, access to credit, education, household size, years of experience and cost of production were the main variables that statistically and significantly determined resource use among the respondents, while the major limitations to the farming included lack of credit facilities, perishability of cucumber seeds, cost of labour, high cost of input, pest and diseases attack and inadequate capital. The study recommends that - Financial support specifically for the women marketers by the government, NGO's and financial institutions would go

a long way in increasing their scale, returns and would ease some of the problems encountered in marketing. The major limitation to the farming included lack of credit facilities, perishability of cucumber seeds, cost of labour, high cost of input, pest and diseases attack and inadequate capital, therefore, an improvement in these constraints would enhance the performance of this business in the study are. Awareness campaign for cucumber producers and extension workers is necessary in order to train them in the best farming practices to deal with pest and diseases as well as cope with changing climatic conditions. In addition, farmers need assistance in obtaining credit facilities for better production.

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Gender Dynamics of the Effects of Stone Quarrying Activities on Livelihood of Arable Crop Farmers and their Coping Capacity in Ebonyi State, Nigeria

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ABSTRACT
The study examined gender dynamics of the effects of stone quarrying activities on livelihood of arable crop farmers and their coping capacity in Ebonyi State, Nigeria. Efforts were made to comparatively examine socioeconomic and environmental effects of stone quarrying activities on livelihood of the farmers and coping strategies adopted by the farmers along gender line. In addition, factors influencing coping capacity of the farmers in stone quarrying affected areas were estimated. The study adopted purposive and multi-stage sampling procedure for selection of 192 smallholder arable crop farmers across the three agricultural zones in the state. Primary data were collected for the study with the use of structured questionnaire. Data collected were analyzed using mean (x) and standard and Ordinary Least Squares (OLS) multiple regression model. The result of the study showed that the severity of the socioeconomic and environmental effect of stone quarrying activities is relatively higher on the livelihood of women farmers than men. Also, men appeared to show more capacity to cope with the effects of stone quarrying activities on their livelihood than the women farmers. Out of the eleven explanatory variables specified, six variables which are gender, years of education, access to credit, household size, experience and cooperative membership statistically and significantly influenced farmers' capacity to cope with the effects and threats occasioned by stone quarrying on the farmers' livelihood. Hence, the study concluded that male and female farmers are disproportionately affected by the effects and threats of stone quarrying activities on rural livelihoods in affected areas of Ebonyi State. The study among others recommended concerted efforts by state and federal government through ministries or agriculture and environment to ensure excessive activities of miners and stone quarrying companies in the study area are reduced or put under significant check if food self-sufficiency must be achieved in short and long runs.
Keywords: Gender dynamics, stone quarrying, livelihood, crop farmers, coping capacity, Ebonyi State.

INTRODUCTION
Stone quarrying is a form of exploitative activities of removal of top soil, drilling, blasting and crushing of the wanted sedimentary or ignites rocks into desired smaller fragments which are evacuated either manually and/or with the use of heavy machine and vehicle (Akanwa, *et al*. 2017). According to Peter, *et al*., (2018), stone quarrying activity is the process of identifying and mapping of a stony area, clearing of top soil or removal of overburden, excavation, extraction and breaking of the wanted stone into different sizes for building and construction purposes. As noted by Alaba and Agbalajobi (2017), stone quarrying typically include the drilling of holes on the bench, followed by blasting the holes using explosives. Stone quarrying activities whether on small or large scale has different degrees of effects on environment and human life (Ogbonnaya, *et al.,* 2016). Once the

holes on the bench are blasted, heavy equipments (excavators) are used to remove the blasted rocks to inspection area for grading and eventual haulage from the site using trucks to crushing plant.

The quarrying activities have had a substantial effect on the natural environment and agricultural production because the process has so much damaged the cultivable soil use for crop production. For instance, Oyegbile *et al.,* (2017) pointed out that some of the negative effects of quarrying activities include noise, dust, effects on fauna, flora and the general environment. These effects could further result to permanent destruction or displacement of some infrastructures such as residential homes and farmlands. The report of World Bank (2023) affirmed that occupations such as mining, stone quarrying and sandblasting degrade the environment and worsen the plight of the poor who are majorly farmers. Min'gate and Mohammed (2016) also affirmed that several activities or stages of stone quarrying result into threats to health and safety of host communities, damage to cultural sites, displacement of the community, permanent vegetation loss, destruction of habitat, and altered livestock and crop production. United Nations Development Programme [UNDP] (2019) reported that the continuous flooding and erosion of the nearby arable land by water from the perennial ponds of abandoned pits after stone quarrying has remained disruptive to most agricultural productions and so poses threats to rural water and food security.

In Nigeria, the increase in food production has not matched with the rapid population growth and yield from food crops has continued to fall due to a lot of factors including environmental issues, such as the unabated stone quarrying activities on arable lands and environmental degradation as being experienced across the country, Ebonyi State inclusive. Crop production in Ebonyi State for instance is capable of alleviating the rising poverty, food insecurity and the widen food deficit gap but the effect of unabated stone quarrying activities among other factors has contributed significantly to inability of the state to maximize its food production potential. The report of World Bank (2016) showed that the likelihood of being poor and food insecure remains high, particularly for rural livelihoods that are solely agriculture dependent.

Farming techniques have changed over the decades, yielding low outputs and making farmers more vulnerable to the effects of environmental challenges such as the resultant effects of stone quarrying and mining activities (Agricultural Transformation Agency, 2016). In the context of efficiency in food production, access to farm resources and vulnerability of smallholder farmers, gender perspective is vital for effective policies. This is because, gender inequality is one of the main drivers of food insecurity in sub-Saharan Africa, as it is the main threat to the agricultural production activities. The interplay between gender and vulnerability to the impacts of environmental threats especially on agriculture and food security in Nigeria requires more attention (Anugwa, et al, 2023). It is imperative to note that in spite of the level of negative impact of stone quarrying on farmers' livelihood, not much empirical efforts available to the researchers had attempted or assessed socioeconomic effects and coping capacity of farmers in affected areas in relation to gender in the state. Hence, this study examined gender dynamics of the effects of stone quarrying activities on livelihood of arable crop farmers and their coping capacity in Ebonyi State. Specifically, the study examined socioeconomic and environmental effects of stone quarrying activities on livelihood of the farmers by gender, identified various coping strategies adopted by the farmers along gender line to remediate the effects of stone quarrying activities and estimated the factors influencing coping capacity of the farmers in stone quarrying affected areas.

METHODOLOGY

Area of Study

The study was carried out in Ebonyi State, Nigeria. The state is bounded to the north by Benue State, to the south by Abia State, to the west by Enugu State, to the east by Cross River State. Ebonyi State has a estimated population of 4,816,675 (NBS, 2019). This is made up of thirteen local government areas, broadly divided into three agricultural zones which are; Ebonyi North, Ebonyi South and Ebonyi Central. Ebonyi State covers a land mass of 5,670 square kilometers, and it lies 56m above sea level and approximately within longitude 7° 59' 38.1372"E and latitude 6° 12' 43.2235"N. Ebonyi State is popularly known and called the "Salt of the Nation' because of the large deposits of salt water in the state, particularly at Enyimgba, Uburu and Okposi. Apart from salt, other minerals in the state include granite, sedimentary rocks, lead, limestone, zinc ore, gypsum, etc, making quarrying part of major activities across the state (Ebonyi State Solid Mineral Development, 2020). Due to the heavy natural resource endowment of the state, quarry locations are growing in numbers

across seven major local government areas which include Abakaliki, Ohaukwu and Izzi in Ebonyi North, Ishelu and Ezza north in Ebonyi Central and Afikpo North and Ivo in Ebonyi south (Ebonyi State Ministry of Commerce and Industry, 2023). Ebonyi State is generally known for agricultural productions of crops such as cassava, rice, yam, cocoyam, sweet potatoes, oil palm, ground nut, maize, vegetable among others. Livestock reared among the farmers include; poultry birds, cattle, goats, sheep and pigs among others.

Sampling Techniques

The study adopted purposive and multi-stage sampling procedure for selection of 192 smallholder arable crop farmers across the three agricultural zones in the state. Firstly, two Local Government Areas (LGAs) where stone quarrying activities are predominantly carried out were purposively selected from each of the three agricultural zones. Secondly, there was purposive selection of two communities from each of the six sampled LGAs given a total of 12 communities. Thirdly; two villages were purposively sampled from each of the 12 selected communities giving a total of 24 villages. The purposive sampling of the communities and villages was to ensure that communities and villages that are noticeably affected by stone quarrying activities are selected. Lastly, 8 crop-based farmers (4 males and 4 females) were randomly selected from each of the sampled 24 villages, giving a total sample size of 192 smallholder arable crop farmers (96 males and 96 females) from stone quarrying affected areas of the state.

Data Collection and Analysis

Primary data were collected for the study with the use of structured questionnaire. The questionnaire was made to collect data on socioeconomic characteristics of crop-based farmers in stone quarrying affected areas of the state, the socioeconomic and environmental effects of stone quarrying activities and various coping strategies adopted by the crop-based farmers to remediate the effects of stone quarrying in affected areas. Simple descriptive statistical tools such as frequency, percentage, mean and inferential statistical tools such as multiple regression analysis were employed in analyzing the data.

To address identification of socioeconomic and environmental effects of stone quarrying activities on the livelihood of the arable crop farmers, and various coping strategies adopted by the farmers to remediate the effects of stone quarrying in affected areas, mean (x) and standard deviation were employed based on the 4-point rating scale data collected as follows:

Response Categories	Ratings	Class Boundaries
Very Severe (VS)/Highly Adopted (HA)	4	3.50 – 4.00
Moderately Severe (MS)/Moderately Adopted (MA)	3	2.50 – 3.49
Less Severe (LS)/Less Adopted (LA)	2	1.50 – 2.49
Not Severe (NS)/Not Adopted (NA)	1	1.00 – 1.49

Based on this computation, items with mean value within 3.50 – 4.00 were interpreted as "Very Severe (VS)/Highly Adopted (HA)"; those with mean values within 2.50 – 3.49 were interpreted as "Moderately Severe (MS)/Moderately Adopted (MA)"; while items with mean values within 1.50 – 2.49 were interpreted as "Less Severe (LS)/Less Adopted (LA)" and 1.00 – 1.49 were interpreted as "Not Severe (NS)/Not Adopted (NA)".

To estimate the factors influencing coping capacity of farmers in remediating the socioeconomic and environmental effects of stone quarrying activities, Ordinary Least Squares (OLS) multiple regression model was employed as implicitly stated below:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_{7,} X_{8.,} X_{9,} X_{10}) \quad (1)$$

Explicitly the model is given as:

$$Y = b+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6.....+et \quad (2)$$

Where;

Y = Coping capacity index for ith farmers
B = constant
X_1 = Gender (1 if male, 0 if female)
X_2 = Age (in years)
X_3 = Education (in years)
X_4 = Land ownership (1 if owned, 0 if otherwise)

X_5 = Access to credit (amount received in naira)
X_6 = Off-farm income (in naira)
X_7 = Farm Size (in ha)
X_8 = Household size (number of persons)
X_9 = Extension contact (number of extension visits in last cropping season)
X_{10} = Farming experience (in years)
X_{11} = Membership of cooperative (1 if a member, 0 if not a member of cooperative)
et = error term

RESULTS AND DISCUSSION

Effects of Stone Quarrying Activities on Livelihood of the Farmers

The result in Table 1 shows that the mean ratings of men to: causes air and noise pollution due to blasts (3.89***), rendering arable soil unsuitable for crop production (3.88***), worsened environmental degradation in affected areas (3.87***), destruction of vegetation and forest (3.56***) and conflicts and crisis between communities and companies (3.52***) ranged between 3.50 to 4.00 on 4-point rating scale indicating that the identified socioeconomic and environmental effects of stone quarrying activities are very severe as reported by the male farmers. Furthermore, contamination of water and streams in communities (3.48**), dead traps created by pits in affected areas (3.45**), diversion of youths minds from schooling through menial jobs (3.43**), reduction in crop yield due to quarrying activities (3.42), reduced access to farmlands for farming (3.36**), causes soil erosion (3.29**), destruction of roads thereby hampering transportation (3.28**) and increase cost of crop production due to cost of remediation (3.20**) ranged between 2.50 to 3.49 on 4-point rating scale indicating that the identified socioeconomic and environmental effects of stone quarrying activities are moderately severe as rated by the male farmers.

On the other hand, the result in Table 1 further showed that the mean ratings of women farmers to: rendering arable soil unsuitable for crop production (3.84***), contamination of water and streams in communities (3.72***), reduction in crop yield due to quarrying activities (3.63***), causes air and noise pollution due to blasts (3.63***), reduced access to farmlands for farming (3.62***), diversion of youths minds from schooling through menial jobs (3.60***), damages of building or farm structures (3.58***), dead traps created by pits in affected areas (3.58***), conflicts and crisis between communities and companies (3.55***), destruction of vegetation and forest (3.52***) and increase cost of crop production due to cost of remediation (3.50***) ranged between 3.50 - 4.00 on 4-point rating scale implying that the identified socioeconomic and environmental effects of stone quarrying activities are very severe to the women farmers.

The mean ratings on worsened environmental degradation in affected areas (3.44**), destruction of roads thereby hampering transportation (3.37**), causes soil erosion (3.39**), landslides as a result of quarrying activities (2.65**) and respiratory sickness and diseases to farm households (2.64**) ranged between 2.50 to 3.49 on 4-point rating scale indicating that the identified socioeconomic and environmental effects of stone quarrying activities are moderately severe to female farmers. From the trend of the results, it could be deduced that the severity of the socioeconomic and environmental effect of stone quarrying activities is relatively higher on the livelihood of women farmers than men. Abedin, et al (2013) affirmed that women are disproportionately vulnerable to all forms of environmental challenges because they are more likely to be found in the poorest sections of society, have fewer resources to cope, and are more reliant on climate-sensitive resources. Ndu-Ogbuji and Mbelegberi (2022) reported that because women are the closest gender to the environment, hence the impact of environmental degradation is felt more by women than men

Table 1: Mean Ratings of Socioeconomic and Environmental Effects of Stone Quarrying Activities on Livelihood of the Farmers (n= 192)

SN	*Socioeconomic effects of quarrying activities:*	Men Mean ($\bar{x}$)	Women Mean ($\bar{x}$)
1	Rendering arable soil unsuitable for crop production	3.88*** (0.10)	3.84*** (0.62)
2	Reduction in crop yield due to quarrying activities	3.42** (0.49)	3.63*** (0.63)
3	Increase cost of crop production due to cost of remediation	3.20** (0.86)	3.50*** (0.54)
4	Reduced access to farmlands for farming	3.36** (0.45)	3.62*** (0.86)
5	Reduced market quality output due to pollution	2.04* (0.30)	1.87* (0.59)
6	Destruction of roads thereby hampering transportation	3.28** (0.90)	3.37** (0.61)
7	Damages of building or farm structures	2.39* (0.36)	3.58*** (0.65)
8	Displacement of farm households from their communities	2.02* (1.01)	2.41* (0.73)
9	Conflicts and crisis between communities and companies	3.52*** (0.90)	3.55*** (0.66)
10	Diversion of youths minds from schooling through menial jobs	3.43** (0.66)	3.60*** (0.71)
	Environmental effects of quarrying activities:		
11	Worsened environmental degradation in affected areas	3.87*** (0.36)	3.44** (0.63)
12	Contamination of water and streams in communities	3.48** (0.47)	3.72*** (0.66)
13	Increase in cases of pests and diseases outbreak	1.56* (0.77)	1.82* (0.72)
14	Landslides as a result of quarrying activities	2.11* (1.12)	2.65** (0.80)
15	Causes soil erosion	3.29** (0.39)	3.39** (0.80)
16	Destruction of vegetation and forest	3.56*** (0.42)	3.52*** (0.77)
17	Causes air and noise pollution due to blasts	3.89*** (0.33)	3.63*** (0.89)
18	Dead traps created by pits in affected areas	3.45** (0.33)	3.58*** (0.71)
19	Respiratory sickness and diseases to farm households	2.33* (0.81)	2.64** (0.75)

Source: Field Survey, 2025. Figures in parentheses represent the standard deviation.
Note: *** = Very Severe; ** = Moderately Severe; * = Less Severe; = Not Severe.

Coping Strategies by Farmers to Remediate the Effects of Stone Quarrying Activities

The result in Table 2 shows that the mean ratings of men to: relocation of farms to non-affected areas (3.86***), farm enterprise diversification to other economic activities (3.84***), cut down household spending/expenditure (3.70***), seeking government support in terms of challenge (3.54***), resource use intensification (3.53***) and borrowing to sustain farm households (3.51***) ranged between 3.50 - 4.00 on 4-point rating scale indicating that the identified coping strategies are highly adopted by the male farmers for remediating the effects of stone quarrying on their livelihood. Mean ratings on leveraging on cooperative supports (3.43**), demanding compensation from quarrying companies (3.13**) and relocation from affected rural areas to urban centres (2.83**) ranged between 2.50 – 3.49 on 4-point rating scale indicating that the three coping strategies are moderately adopted by the male farmers for remediating the effects of stone quarrying on their livelihood.

On the other hand, the mean ratings of the women farmers to: cut down household spending/expenditure (3.76***) ranged between 3.50 - 4.00 on 4-point rating scale and therefore indicate that cutting down household spending/expenditure is the major coping strategies highly adopted by the women farmers for remediating the effects of stone quarrying on their livelihood. However, mean ratings of the women farmers on farm enterprise diversification to other economic activities (3.41**), borrowing to sustain farm households (3.39**), demanding compensation from quarrying companies (2.89**) and seeking government support in terms of challenge (2.50**) ranged between 2.50 – 3.49 on 4-point rating scale indicating that the four coping strategies are moderately adopted by the women farmers for remediating the effects of stone quarrying on their livelihood.

Table 2: Mean Ratings of Coping Strategies Adopted by the Farmers to Remediate the Effects of Stone Quarrying Activities on Livelihood of the Farmers (n= 192)

SN	Coping strategies adopted by the farmers:	Men Mean ($\bar{x}$)	Women Mean ($\bar{x}$)
1	Cut down household spending/expenditure	3.70*** (0.45)	3.76*** (0.53)
2	Farm enterprise diversification to other economic activities	3.84*** (0.39)	3.41** (0.66)
3	Borrowing to sustain farm households	3.51*** (0.81)	3.39** (0.81)
4	Leveraging on cooperative supports	3.43** (1.09)	2.39* (0.98)
5	Insurance of farm enterprise	1.40 (0.80)	1.11 (0.85)
6	Relocation of farms to non-affected areas	3.86*** (0.45)	2.37* (0.65)
7	Seeking government support in terms of challenge	3.54*** (0.59)	2.50** (0.74)
8	Demanding compensation from quarrying companies	3.13** (0.78)	2.89** (0.59)
9	Relocation from affected rural areas to urban centers	2.83** (1.13)	2.35* (0.78)
10	Sale of farm land, farm equipment, family assets etc	1.36 (1.05)	1.23 (0.83)
11	Resource use intensification	3.53*** (0.72)	2.47* (0.80)

Source: Field Survey, 2025. Figures in parentheses represent the standard deviation.
Note: *** = Highly Adopted; ** = Moderately Adopted; * = Less Adopted; = Not Adopted.

The results as shown in the table, men appeared to show more capacity to cope with the effects of stone quarrying activities on their livelihood than the women farmers. Noah (2023) found that gender is a key factor that has a substantial impact on farmers' ability to cope with environmental stressors and threats, and women farmers are often disadvantaged due to lower ability to cope. Ndu-Ogbuji and Mbelegberi (2022) submitted that numerous impact of environmental degradation is severe in society and particularly on people with lack of resilient like women. Abedin, et al (2013) reported that women are often vulnerable to environmental externalities where their endowments, agency and opportunities are not equal to those of men. This is because, women farmers are more dependent for their livelihood on natural resources that are threatened by climate change and other human-induced environmental degradation such as quarrying activities. Though both male and female farmers within the same geographical location in Ebonyi State are exposed to the same environmental threats occasioned by stone quarrying activities. Daudu, *et al*., (2021) submitted that that environmental disturbances such as stone quarrying and its related activities impacts have the potential to increase the vulnerability, and threaten the livelihoods of millions of poor people across the world majority of who are women.

Factors Influencing Coping Capacity of the Farmers in Stone Quarrying Affected Areas

Table 3 presents the results of the regression analysis of the socioeconomic factors influencing coping capacity of the farmers in stone affected areas, The values of R^2 (0.798), number and levels of significant of explanatory variables and their signs showed that the model had behaved well. For instance, the R^2 value of 0.798 indicates that the significant variables are responsible for about 80% variation in the coping capacity of the farmers. The F-value of (34.033) indicated that the overall equation was significant at ($p<0.01$) while Durbin-Watson (DW) of 2.113, showed the absence of autocorrelation. Out of the eleven explanatory variables specified, six were statistically significant; these were gender, years of education, access to credit, household size, experience and cooperative membership.

The coefficient of gender was significant and positive influence coping capacity of the farmers at ($p<0.01$). This suggests that male arable crop farmers in the stone quarrying affected areas perhaps have higher capacity to cope than their female counterparts. The findings of this study agreed with that of Noah (2023) who reported that gender is a key factor that has a substantial impact on farmers' ability to adapt to environmental stressors and threats and often against women due to less capacity to cope with environmental threats.

The coefficient of years of education was positive and significantly ($p<0.10$) influence the coping capacity of farmers to effects of stone quarrying on their livelihood. This conform with *a priori* expectation as years of education increase, the efficiency and technical-know-how of farmers in dealing with farming challenges. Swami and Parthasarathy (2021) found that education helps farmers make informed adaptation decisions, as higher level of formal education positively influences decision-making process across various agricultural domains, including building capacity to negative externalities. Aryal, *et al*., (2021) reported that education plays a pivotal role in raising awareness about the potential impacts of environmental challenges such as climate change, degradation and facilitating farmer engagement in adaptation measures. This is because, educated farmers are better positioned to leverage adaptive capacity.

Access to credit was highly significant at ($p<0.01$) and positively influence capacity of the arable crop farmers to cope with the effects of stone quarrying activities in the affected area. This implied

that farmers with higher tendency to access credit are in vantage position to cope with the effects stone quarrying activities have on their livelihoods. This findings alighted with that of Chapagain, et al (2025) who identified factors influencing capacity of farmers to cope with environmental degradation to include income and access to financial institutions; and financial services. Jha and Gupta (2021) equally submitted that access to financial services is crucial for enhancing farmers' adaptive capacity as it provides households with credit, loans, and subsidies which in turn strengthen adaptation measures.

Table 3: Estimates of the Multiple Regression Analysis of the Factors Influencing Coping Capacity of the Farmers in Stone Quarrying Affected Areas of Ebonyi State

Variables	Coefficients	Std. Error	t-value
Intercept	97.416	5.977	16.29***
Gender*	0.710	0.173	4.10 ***
Age	0.266	0.203	1.31
Years of Education	0.427	0.229	1.86*
Land Ownership	-3.885	2.535	-1.53
Access to Credit	9.130	2.320	3.94***
Off-farm Income	5.6227	1.043	-1.48
Farm Size	-0.155	0.193	-0.80
Household Size	0.398	0.125	3.18***
Extension	-0.272	0.551	-0.49
Experience	0.212	0.094	2.26**
Cooperative Membership	1.566	0.306	5.78***
No of Observation	192		
R^2	0.798		
Durbin-Watson	2.113		
F-value	34.033		

Source: Field Survey, 2025. Note: *** denotes $p \leq 0.01$; ** denotes $0.01<P\leq0.05$; *denotes $0.05<p\leq0.10$.

Household size of the farmers was highly significant ($p<0.01$) and positively related with capacity of farmers to cope with effects of quarrying activities on their livelihood. This shows that as households' size increase in number, there is likelihood for increased capacity of the households to cope with effects of stone quarrying activities through possible diversification of livelihood to reduce the shock. The effects of increase in household size could also suggest labour availability for improved remediation of whatever effects stone quarrying have on their livelihood. Years of farming experience is significant and positively influence coping capacity of the farmers at $p<0.05$ level. The significant and positive relationship indicates that as years of farming experience of the farmers increase, there is also increase in the capacity to cope with the devastating effects of stone quarrying activities. Choden, *et al*. (2020) reported that experience and training empower farmers to make informed investment and adaptation decisions under diverse weather conditions, thereby bolstering their capacity to adapt to environmental challenges in farming. Chapagain, et al (2025) noted that farmers that lack experience are likely to lack critical insights into effective agricultural practices, hence worsening their vulnerability.

The coefficient of cooperative membership was positive and significantly related with coping capacity of the farmers at $p<0.01$, indicating that the farmers who are members of cooperative societies are more likely to have higher capacity to cope with the devastating effects of stone quarrying activities on the livelihood of the farmers. This could be linked to the strength of the cooperative society (financially, informatively and socially) in bearing the problems face by their members through cooperative management of farm-related challenges. Mohammed, et al (2014) identified farmers' involvement in cooperatives activities significant factors that stimulate their ability to adapt and cope with environmental related threats. Similarly, Mbwambo, et al (2022). The findings from Multivariate Probit Model showed some households' characteristics that influenced the choice of coping strategies were; the age of household head, household size, farm size, farming experience, technology uses, annual income, extension services, livestock ownership, and shift in rain season.

CONCLUSION AND RECOMMENDATIONS

Stone quarrying has many negative agricultural impacts ranging from disruption of animal habitat, destruction of natural vegetation, soil erosion to river siltation among others. Stone quarry activities as observed in Enbonyi State are well known to cause significant loss of farm land, threaten underground and surface water thereby impairing directly the environmental quality, ecosystems and threatening rural livelihood majority of who are farm women. Hence, this study examined gender dynamics of the effects of stone quarrying activities on livelihood of arable crop farmers and their coping capacity in Ebonyi State, Nigeria. From the findings, the study concluded that male and female farmers are disproportionately affected by the effects and threats of stone quarrying activities on rural livelihoods in affected areas of Ebonyi State. The study therefore recommends

i) Concerted efforts by state and federal government through ministries or agriculture and environment to ensure excessive activities of miners and stone quarrying companies in the study area are reduced or put under significant check if food self-sufficiency must be achieved in short and long runs.
ii) Specific policies providing increased women access to education, land and off-farm activities that will alleviate their vulnerability to environmental externalities such as threats emanating from stone quarrying activities in the study area.
iii) Government at all levels should ensure capacity building of the farmers in quality adaptive response to negative externalities with special attention to the vulnerable group (women farmers).

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Food Security Indicators (Food Availability & Utilization) of Rural Women in Livelihood Activities in South East Nigeria

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ABSTRACT

The study assessed food availability and utilization of rural women in livelihood activities in South East Nigeria. The study identified the livelihood activities involved by the rural women; examined food availability and food utilization of the rural women. A multi-stage random sampling technique was used to select a sample size of three Hundred and sixty (360) respondents from three (3) states in the South East Nigeria. Data collection was done with copies of questionnaire and analyzed using both descriptive and inferential statistics such as regression model. Result showed that majority (80%) of the women were into root/tuber production, petty trading (54.2%) and cereal cropping (43.9%). The result on food availability showed a grand mean of 1.7 indicating that food was not available and the grand mean of 2.2 showed a high food utilization in the study area. The regression result showed that there was a positive and significant relationship between livelihood activities and food security indices (food availability & utilization). Therefore, the null hypothesis was rejected. The study concluded that involvement of rural women in livelihood activities supported their household food availability & utilization. The study recommends that women be empowered with free interest loans and capacity training in small scale snailery/ goat/sheep farming as this will improve and ensure food availability/utilization at the household level.

INTRODUCTION

To have an active life it is expedient to take sufficient food and in the right amount (Thomas, 2023). Food is a means of nourishment and support for the human body. People engage in livelihood activities to sustain their families and mostly to achieve food security. Today, the issue of food security has become pertinent as most organizations and government seek lasting solution to step down the pangs of hunger and food insecurity. The quest for oil-money and abandonment of the hoes, matchet and farm work has made hunger our closest neighbor with greed, corruption and frustration as its siblings.

Presently, agriculture is taken as a seasonal occupation except for a few areas that practice irrigation and agriculture. FAO (2024) has given four examples of what makes a nation food insecure, the as follow:

a) When the food source has greatly reduced and there isn't efficient way to replace it.
b) High incidence of malnutrition that is not related to health factor for some parts of the year.
c) Unsustainable food base.
d) When people's livelihood has become very unstable, thereby endangering their lives.

GRFC (2024) suggested that in the recent times, there has been an occurrence of food crisis in the nation due to unimproved food production and the incessant attack of herdsmen and kidnapping around Nigeria's rural farm families; hence, they require livelihood assistance to empower women and as such secure their dwelling places which has become paramount if our food will be readily available and be properly utilized (Beriso, G. 2023).

Essentially, rural women play important roles as home managers, food producers/ processors, preservers of agro-diversity and their roles and more, make them indispensable in the quest to achieve food security. Rural women have diversified into on-farm and off-farm activities just to get more income to support family needs and hence improve food availability and its utilization at the household level in the South East, Nigeria.

Objectives of the Study
The broad objectives of the study was to evaluate the food availability & utilization of rural women in livelihood activities in South East Nigeria. The study had the following specific objectives to; determine livelihood activities involved by the rural women; determine food availability of rural women engaged in livelihood activities; and determine food utilization of the respondents.

MATERIALS AND METHODS

Sample and Sampling Procedure
The multi-stage sampling method was adopted for the study, in the first stage, purposive sampling technique was used to select rural women in livelihood activities in 3 States, out of 5 States in the South East Nigeria. At the second stage, random sampling technique was used to select 2 (two) geographical zones in the 3 states; giving a total of 12 (twelve) Local Government Areas. At the 3rd stage, stratified random sampling technique was used to select two rural communities each from the 12 local government areas in the 3 States. This gave a total of 24 communities. Finally, random sampling techniques were used to select 15 (fifteen) rural women from each of the 2 communities from the two geographical zones each in the 3 states in the study area. This gave a total of 360 respondents.

Method of Data Collection
Primary Data was collected for the study through a well-structured questionnaire. Data collected where subjected to descriptive statistical tools such as measures of central tendency (mean) and Regression Analysis.

Method of Data Analysis
Objectives i was realized using frequency and percentages to describe the livelihood activities engaged by these rural women. Objectives ii and iii were realized using the mean of the food security indicators to ascertain food availability and utilization of these rural women. Basically, a three-point rating scale of Always = 3, Sometimes = 2, Never = 1 were used to realize the benchmark for decision making. A benchmark of 2.0 was obtained for the individual tables of the food security indications.

Hypothesis Testing
HO_1: Livelihood activities of the rural women has no significant influence on their food security in the South East. This was tested using Ordinary least squares Regression model.
The model is expressed as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_n, e_i)$$

Where;
Y = Food Security Indicator (Food Availability/utilization)
$X_1 - X_n$ = Livelihood Activities
X_1 = Cereal farming (mean)
X_2 = Roots/Tuber Farming (mean)
X_3 = Vegetable/Plantation (mean)
X_4 = Poultry Farming (mean)
X_5 = Labour Services (naira)
X_6 = Goat/Sheep Farming (mean).
X_7 = Snailery/Snail picking mean)
X_8 = Tailoring (mean)

X_9 = Weaving of Hair (mean)
X_{10} = Petty Trading(mean)
X_{11} = Restaurant(mean)
X_{12} = Hawking of Food(mean)
X_{13} = Selling Beans ball/Yam/Potatoes (mean)
X_{14} = Babysitting Children/Elderly(mean)
e_i = error terms.

RESULTS AND DISCUSSION

Livelihood Activities of Rural Women

Table 1: Distribution of Rural Women by their Livelihood Activities

Variables	Abia n=120 (%)		Imo n=120 (%)		Ebonyi n=120 (%)		South east	
	Yes	No	Yes	No	Yes	No	Yes	No
Cereal cropping	50	50	40	60	41.7	58.3	43.9	46.1
Roots and tubers	87.5	12.5	86.7	13.3	66.7	33.3	80.3	19.7
Vegetable/plantation	87.5	12.5	75.8	24.2	72.5	27.5	80	20
Poultry farming	27.5	72.5	25.8	74.2	14.2	85.8	22.5	97.5
Labour services in Farms	10.8	89.2	15.8	84.2	16.7	83.3	14.4	85.5
Goat/ sheep farming	5.8	94.2	3.3	96.7	7.5	92.5	5.6	94.4
Snailry /Snail picking	2.5	97.5	15	85	6.7	93.3	8.1	91.9
Sewing	29.2	70.8	15	85	14.2	85.8	19.4	80.6
Weaving of hair and salon	15	85	22.5	77.5	7.5	92.5	15	85
Petty trading	70	30	54.2	45.8	38.3	61.7	54.2	45.8
Restaurant	14.2	85.8	17.5	82.5	20	80	17.5	82.8
Hawking food items	11.7	88.3	11.7	88.3	15	85	13.3	86.7
Selling value addition of beans and potatoes	14.2	85.8	14.2	85.8	11.7	88.3	13.3	86.7
Babysitting children and the elderly	3.3	96.7	3.3	96.7	23.3	76.7	10	90

Source: Field survey, 2019. *multiple responses

The result on Table 1 showed that 43.9% of the rural women were involved in cereal cropping, 80.3% of them were into root and tubers, 80% of the women were into vegetable/plantation farming while 20% were not, 22% were into poultry farming, 14.4% of the rural women provided labor services, while 5.6% of the rural women were into goat farming and 94.4 were not, 8.1% of them were into snailry. This result implied that the majority of this rural women in the study area were into cereal; root/tuber farming and vegetable/plantation farming as their on-farming activities.

Furthermore, for the off-farming activities, 19.4% of the women were into sewing business; 15% were into weaving of hair/salon; 54.2% were into petty trading; 17.2% were into restaurant business; 12.8% hawked food items/snacks. The hawking activity where mostly done by their grown-up children. About 13.3% of the women were into frying and selling of beans balls, potatoes and yam and 10% of them were into babysitting of elderly/children. The results showed that for the off-farming activities, most women were into petting trading. This finding agrees with Hegazi and Katongo (2023) that rural women have majorly diversified activities to generate income from farming and non-farming activities. Okoro et al, (2020) insisted that 70% of the women are into trading, as this contributes to household income and upkeep.

Ahi et al (2023) insisted that only few households get income from one source while others engage in a combination of activities as on-farming and off-farming activities, in order to create more income base for their rural households.

Food Availability of the Rural Women

Table 2: Distribution of Respondents on Food Availability in the Study

Variables	Abia		Imo		Ebonyi		South east
	X	SD	X	SD	X	SD	X
Food storage safety							
i. cooked food	1.2	0.5	1.5	0.8	1.2	0.4	1.3
ii. uncooked food	1.6	2.0	1.5	1.0	1.3	0.6	1.5
2. Savings in food cost							
Cooking fuel	1.2	0.7	1.5	0.9	1.4	0.8	1.4
Locally produced your food.	2.0	0.2	1.9	0.2	1.9	0.6	1.9
iii Bought your food from the market	2.2	0.4	2.0	0.3	2.4	0.6	2.2
3. Adult/child food allocation							
i. Cutting food size of adult	1.8	2.3	1.9	2.4	1.7	1.8	2.3
ii. children not having enough food	1.6	2.0	1.4	0.8	1.4	1.5	1.2
Grand mean							1.7

Source; Field survey, 2019

The results on Table 2 showed a grand mean of 1.7 indicating that food was not available in the study area. This could be attributed to the main occupation of the respondents in the study area which was mainly peasant farming. A mean score of 1.9 was relatively low, showing that respondents' food production was at the subsistent level. A moderately high mean score of 1.7 showed that majority of the respondents bought most of their food from the market. This finding agrees with Han, Paul and Kamal (2022) who observed that rural women supported their food base by making purchases from the market.

The results also showed that food items were expensive in the market with a relatively high mean of 2.3. This could be attributed to the seasonality of food stuff in the agricultural sector. This finding agrees with FAO (2024) which observed that the food items were expensive in the market.

The result also showed that seedlings were readily available for purchase during the planting season, with a high mean score of 2.5 in the study area. Though the focus group discussion conducted in the area showed that the prices of these seedlings are on the high side in most recent times. Nidhi et al, (2019) agreed that though seedlings were available in the planting periods, their prices have increased due to increased demand and costs associated with production and transportation.

Food Utilization of the Rural Women

Table 3: Distribution of Respondents according to their Food Utilization

Variables	Abia		Imo		Ebonyi		Southeast
Production of food from farm	2.0	0.2	1.9	0.2	1.9	0.6	1.9
Purchase some foodstuff from market	2.2	0.4	2.0	0.3	2.4	0.6	2.2
Hiked prices of food in market	2.4	0.5	2.3	0.6	2.2	0.6	2.3
Availability of planting seedlings during planting seasons	2.6	0.5	2.5	0.6	2.4	0.6	2.5
Grand mean							2.2

Source; Field survey, 2019

The result on Table 3 showed a low grade mean of 2.2, indicating a high food utilization level in the study area. Food storage safety which was expressed as where food was kept, was with low a means scores of 1.3 and where uncooked food was kept was also low with a means score of 1.5. This indicated the food storage safety was low in the study area. This finding agrees FAO, IFAD, UNICEF, WFP and WHO (2024) who opined that food storage safety was low in rural areas of Nigeria, due to inadequate provision of food storage facilities.

The study also showed that savings in food cost, which was seen as domestic food production, was low with a mean score of 1.9, purchases of food in the market was high (x = 2.2) and savings in cooking fuel (x = 1.4) was low. This indicated that though the market facilities were readily utilized, cooking fuel was conserved but not much food was produced domestically from the study area. This disagrees with the opinion of Adedotune (2024) who believed that there is incessant felling of trees

and conversion into wood, used for cooking and so cooking fuel wasn't actually conserved. The result showed that allocation of food to adults and children in rural household was low. The cutting of food size to feed children was low (x = 1.8). This showed that food wasn't always cut to feed the children. This means that children had appreciably enough quantity of food to eat for the available meals in the rural Households. Sanni (2024) opined that allocation of food especially to children had a low dietary diversities score in rural communities (24.8%) than urban communities.

Testing of Hypothesis
$H0_1$: Livelihood activities of the rural women has no significant influence on their food availability and utilization in the South East. This was analyzed using ordinary least square regression.

Table 4: Regression estimates of the relationship between women's livelihood activities and food security (on-farm)

Variables	Abia (linear)	Imo (double log)	Ebonyi (linear)	South East (linear)
Constant	-2.257	3.434	2.102	3.961
	(-5.99)**	(4.723) **	(5.045) ***	(4.142)***
Cereal cropping	-.642	.218	057	.168
	(-2.665)	(.863)	.268	.852
Roots/Tuber farming	1.299	-388	-3.15	-.405
	(7.101)**	(-1.094) **	1.290	(-2.909)**
Vegetable /plantation	.275	457	433	423
Farming	(2.503)**	(1.748)*	(2.664) **	(2.964) **
Poultry farming	.707	447	.363	.340
	(2.714)**	(-2.066) **	(1.622)	1.845
Provision of labour in the	062	094	.125	.042
farms	(.812)	(.482)	(.625)	.243
Goat/sheep farming	279	-0.57	-.027	-.063
	(2.425)	(-.296)	(-.133)	(-.369)
Snailry/snail farming	.670	-.038	.231	-.011
	(5.831) ***	(-.184)	(2.811) **	-.060
R^2	.930	.557	.311	.484
f-stat	16.413**	1.287	1.126	12.270**

Source; field survey, 2019. Ho rejected at 5%. Keys: ***= significant @1%; **=significant @ 5% *=significant at 10%

The linear model was chosen as the lead equation. The coefficient of the determination was 0.484 which indicated that 48.4% of variation in the livelihood activities was explained by the explanatory variables stated in the model. Roots/tuber cropping, vegetable farming and poultry services were significant at 5% alpha level respectively. Roots/tuber cropping was significant at 5% and directly related to food security. This meant that increase in the number of rural women engaged in roots/tuber cropping will increase food security thus, making food cheaper and accessible to the rural household. This will also expand the food base of the rural farm family and also create more job opportunities for the farm family. IITA (2024) believes that involvement of women in roots/tuber cropping will bridge and alleviate poverty and ensure food security.

The vegetable/plantation farming was significant at 5% alpha level and directly related to food security. This implies that increase in number of rural women engaged in vegetable/plantation farming venture will increase food security. Since the cost of establishing a vegetable/plantation is small, getting involved in this venture will create more financial basis for the rural households to cater for her food needs/other household needs. This agrees with Nakwe et al (2024) that opined that involvement of rural women in vegetable/plantation venture will improve the food security of rural households.

The poultry farming was significant at 5% alpha level and directly related to food security. This implied that increase in the number of respondents engaged in poultry farming will increase the food security status of the rural household. Women were involved in this venture but received low returns from it. Women need to be encouraged to get more committed to run this venture, not at the free-range level but at intensive poultry care level, as this will make cash available to run family needs in the study area.

Table 5: Regression estimates of the relationship between women's livelihood activities and food utilization

Variables	Abia (linear)	Imo (linear)	Ebonyi (linear)	South East (linear)
Constant	1.878	2.332	1.835	2.165
	(6.529)**	(4.748)***	(3.181)***	(6.000)***
Sewing of cloth	-.012	079	.007	.042
	(-.137)	(.828)	(.062)	(.605)
Weaving of hair salon	.301	-.104	-.143	-1.33
	(3.244)**	(-.976)	(-1.329)	(-1.774)
Petty trading	334	.152	.040	.103
	(1.601)	(1.315)	(.346)	(1.284)
Running of restaurant	.685	464	-1.47	.313
	(3.675)***	(4.202)***	(-1.343)	(4.098)***
Hawking of food items/	-.290	-.090	.366	-.057
snacks	(-1.151)	(-.935)	(2.879)***	(-.816)
Sale of beans value	-.316	.420	-.095	-387
addition	(-1.975)*	(3.074)***	(-.863)	(4.249)***
Babysitting of children /	-3.86	-.362	-0.95	-.278
caring for the elderly	(-2.407)***	(-3.203)***	(-8.63)***	(-3.617)***
R	.626	531	421	.645
R2	342	282	.271	.452
f-stat	8.011***	4.993***	2.733**	6.820***

Source; field survey, 2019. Ho rejected at 5%. Key: ***= significant @ 1%; **=significant @ 5% *=significant at 10%.

The lead equation chosen was the linear model. The coefficient of the determinative was 0.452 which indicated that 45.2% of variation in the livelihood activities are explained by the explanatory variables stated in the model. Running of restaurant, sale of value addition of beans products and babysitting of children/elderly, were significant at 1% alpha level respectively. The running of restaurant was significant at 1% and directly related to food security. This implies that the increase in the number of rural women running restaurants will increase foods security as this could make food cheaper and accessible to the rural household. It will also reduce the number of hours spent by rural women in less lucrative ventures of rural women. Ale et al (2022) opined that running of restaurants for rural women was more convenient and attractive for low-income earners and other rural women.

The sale of value addition products from beans were significant at 5% alpha level and directly related to food security. This implied that increase in the number of respondents engaged in this venture will increase food security status of rural households. This suggested that, since it requires low capital to start up, it will certainly create financial basis for rural household to cater for their food needs.

CONCLUSION AND RECOMMENDATIONS

The study concluded that across the three states (Abia, Imo, and Ebonyi) that the involvement of the rural women in on-farm and off-farm activities positively influenced the food security status of the rural households in south east, Nigeria.

Furthermore, that off-farm livelihood activities contributed more to household upkeep as it replaced the idle hours of the rural women in the study area.

i) Effective grassroot empowerment programmes should be organized by the government for the rural women in on-farm (poultry, goat/sheep and vegetable farming) and off-farm activities (running of restaurants) to conduct capacity trainings on value addition technologies.
ii) Rural women should be encouraged to acquire skills on on-farm activities as this will ensure they are food secure since there was positive and significant relationship between livelihood activities activities and food security.

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Food Security & Climate Change: Nigeria's Contemporary Socio-Political & Technological Environment

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Trade and Trade Policy: Addressing the Hydrodynamic Hazards and Atmospheric Pollution in Nigeria

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INTRODUCTION

The climate crises in Nigeria have caused environmental problems that affect economic activities and human well-being. (UN News, 2024; World Bank Group, 2022). Displacement and Social Disruption are common effects of hydrodynamic hazards and atmospheric pollution in Nigeria. These crises include coastal erosion, heat waves and high temperatures, flooding, and Air and water pollution. They are exacerbated by natural variabilities and human activities like agriculture, urbanization and industrialization that lead to the release of harmful gaseous substances, and the pollution of land and water bodies with industrial wastes. Past studies have majorly focused on the implementation and analysis of environmental policies as an instrument to address the rising effect of climate change in Nigeria. However, with trade liberalization and the implementation of trade policies like tariffs, carbon emission cost and trade sanctions that have become a global concern and adopted by several countries, this paper, therefore, focuses on analyzing how to address the hydrodynamic hazards and atmospheric pollution that are prevalent in Nigeria using Trade and Trade policies.

Nigeria is a nation in West Africa, officially known as the Federal Republic of Nigeria. It is located in the Atlantic Ocean, with the Gulf of Guinea to the south and the Sahel to the north. Its total size is 923,769 square kilometers (356,669 square miles). With a population of over 230 million, it is the sixth most populated nation in the world and the most populous country in Africa. Nigeria has borders with Benin in the west, Cameroon in the east, Niger in the north, and Chad in the northeast. Nigeria is made up of 36 states plus the Federal Capital Territory, Abuja. The climate disposition of Nigeria differs from one region of the country to the other, however, three different climatic zones are paramount: a tropical monsoon climate in the south, a tropical savannah climate in much of the country's center, and a hot, semi-arid Sahelian climate to the north of the country (World Bank Climate Change Knowledge Portal). Generally, it is characterized as Tropical climate.

Nigeria, together with other African countries have high abundance of natural resources but makes little effort towards economic diversification (Banjo *et al* 2024). These resources include a large expanse of arable land for agriculture and high Oil deposition in the Niger Delta region. Banjo *et al* (2024) argued that a lack of economic diversification prevents a country the chance of addressing the environmental and climate volatility associated with natural resource dependency. Hence Nigeria is prone to various climate-related crises including the Hydrodynamic (Flooding and coastal erosion), and Atmospheric hazards (Air pollution resulting from the emission of gaseous compounds like Nitrogen Oxide NOx, Carbon Dioxide CO2, chlorofluorocarbon CFC).

A significant disturbance or imbalance in water systems, which often result in extreme weather and natural disasters, are referred to as hydrodynamic hazards. Floods, coastal erosion, hurricanes, and other extreme weather events caused by variations in atmospheric conditions, and precipitation patterns may all fall under this category. Human activities and Climate change, which is explained as consistently prolonged statistical variations in weather patterns (Ucheje *et al* 2024; Ugbuabor & Egwuchukwu, 2017), are often blamed for these crises because they aggravate their frequency and severity, which affects ecosystems, infrastructure, human health, and agriculture (Nigerian Department of Climate Change).

Hydrodynamic Hazard Scenarios

Within the past two decades, there have been a reoccurring displacement and social disruption challenges in Nigeria. They result from severe climate change conditions including Flooding and Coastal erosion. During this period, Nigeria has recorded at least 10 displacement and social disruption that have led to loss of lives, properties and natural habitats. Displacement in this context is defined as the compelled evacuation of individuals from their homes or common places of residence owing to environmental threats such as floods and coastal erosion or abrupt air pollution. Social Disruption refers to the collapse or major alteration of community structures, social interactions, and everyday life as a consequence of environmental and climate disasters. Here are three significant climate crises of flood and coastal erosion leading to severe displacement and social disruption in Nigeria.

i) **2012 Nationwide Floods**: One of the biggest flood disasters in Nigerian history with over 30 states impacted. A combination of high rainfall, dam releases, and inadequate drainage infrastructure resulted in the historic floods. *Influence*: A little over 1.3 million people were displaced. Due to many individuals being taken off guard by the fast-rising waters, the floods caused around 360 fatalities. Many people were left without shelter as thousands of houses were completely destroyed or seriously damaged. Roads, bridges, schools, and medical facilities are examples of critical infrastructures that were destroyed, interfering with everyday living and vital services. Farmlands were submerged, resulting in the loss of agricultural produce. Food security and the means of subsistence for several rural communities were severely impacted by this. With damages totaling billions of naira, the economic losses were significant.

ii) **2018 Niger and Benue River Floods**: Two of Nigeria's main watercourses, the Niger and Benue rivers, saw significant flooding in 2018. Prolonged, heavy rain combined with the overflow of water from dams in Nigeria and neighboring countries caused the floods. Due to a confluence of these causes, the rivers overflowed their banks, submerging the surrounding towns and wreaking havoc. Influence: More than 600,000 people were affected by these floods, and many of them were displaced to seek safety in makeshift shelters, camps, or with family elsewhere. Drowning, injuries, and unintended consequences like disease epidemics claimed a great deal of life. Numerous people were left homeless as thousands of houses were completely demolished or seriously damaged. Roads, bridges, schools, and medical facilities are examples of critical infrastructures that were impacted, interfering with everyday living and vital services. Numerous farmlands were flooded, resulting in the damage of crops. Poverty and hunger were made worse by this, which had a serious effect on food security and rural communities' means of subsistence.

iii) **2020 Kebbi State Floods**: The disastrous floods that occurred in Kebbi State in 2020 had a major influence on the area. The severe weather occurrences that were caused by poor infrastructure and climate change were part of a larger trend that included these floods. Since the majority of the population in Kebbi State, northwest Nigeria, is agricultural, the state's economy and way of life are especially vulnerable to natural disasters. *Influence*: The floods displaced around 500,000 people and destroyed over 500,000 hectares of farmland, causing food security concerns and economic losses.

These floods have highlighted Nigeria's susceptibility to natural disasters and the pressing need for all-encompassing plans for disaster preparation and management. While quick relief operations were necessary to meet the needs of the impacted people right away, long-term solutions are also necessary to guarantee the resilience and well-being of the nation's citizens.

The dreadful tendency of global warming has been increasing the pressure on policymakers to adopt trade policy as a mitigation tool (Moreira & Dolabella 2024). However, the need to address the rising climate crisis has also suggested the importance of aligning trade policies with environmental sustainability objectives (Leal-Arcas *et al* 2024). Therefore, adopting trade and trade policies in addressing climate crisis requires careful assessment of the possible outcome to the environment and economy. In the case of air pollution from greenhouse gas emissions, several countries including the EU in 2005, China in 2011 and the United States have implemented the carbon trading policy (Feng, *et al.,* 2024). This is seen as a typical market-oriented environmental regulation. Here the government establishes a limit and offers initial emission quotas for market entities and industries based on the market environment, likewise, each entity can purchase or sell emission

quotas in the trading market based on their market status, leading to reduction in carbon emissions (Xuan *et al* 2020; Lin & Huang, 2022). With the speed of urbanization and steady growth of industrial activities in the busy cities of Nigeria like Lagos and Abuja, the carbon trading policy should be adopted by the Nigerian government to curb the rising carbon emission. Feng *et al* (2024), have shown in their work that the carbon trading policy has a positive and significant effect on the reduction of carbon emissions following their finding in China.

Discharge from dams of neighboring countries have been a significant factor contributing to the reoccurrence of flood and coastal erosion in Nigeria. This can be mitigated through the use of trade sanctions. Though environmental degradation has been linked as one of the unforeseen outcomes of sanctions, Khalid *et al* (2024) established that different types of international sanctions, including trade sanctions have been utilized by a good number of countries as a coercive measure in achieving a stipulated policy goals. Therefore, with the rising level of environmental hazards resulting from the activities of these countries, and the fact that Nigeria is both a major importer and exporter of agricultural commodities and energy to these countries, temporary trade sanctions for these countries may be used to secure their attention to the dreadful outcome of their action and so device an alternative working system.

In the words of Pascal Lamy as quoted by Kee, and Xie (2024), "*The old world of trade was a world where production systems were national and where obstacles to trade were about protecting domestic production from foreign competition. By contrast, the new world of trade is a world where production is transnational along the global supply chains of goods and services and where obstacles to trade are about protecting the consumer from risks. This is a new version of the old divide between tariffs and non-tariff measures.*" The use of tariffs, which is the simplest trade policy and non-tariff measures as policy instrument have proven to be both substitutes and complements (Kee & Xie 2024). Nigeria is known to be highly dependent on import to satisfy the local demands for food and clothing. Most of these commodities come along with toxic materials that are not easily decomposed like plastic and textile materials. These materials leads to pollution of sea, rivers and oceans with tons of toxic substances that further result in the blockage of water ways and drainage systems that causes water to run off from its original channel, leading to erosion and flooding. Both tariffs and non-tariff measures can be adopted as both substitutes and complementary policies to control the importation of these commodities with high environmental hazards and refocus on the importation of les toxic and fast degrading substances. This will be similar to the adoption of article 232 by president Trump administration in 2018 against steel importation from china and other UE countries with the aim of advancing the U.S. social security.

CONCLUSION AND RECOMMENDATIONS

The severity of the climate crisis in Nigeria has become a significant concern to policymakers as there are yet little or no policies implemented to aggressively target the effect of climate change issues resulting from human and industrial activities. These crises, including the hydrodynamic and atmospheric hazards discussed in this paper have had a great deal of negative impacts on the environment, human well-being and national economy; resulting in the displacement and social disruption claiming both lives and properties in the last two decades. Following the findings in the reviewed literature, relevant trade and trade policies have long been adopted as the second-best policy option in addressing climate change crisis. Simple policies like tariffs and non-tariff measures can both be employed to address the rising climate crisis, as shown above and in relevant literatures. Therefore, Nigeria should adopt policies like trade sanctions, tariffs and non-tariff measures, as well as carbon emissions costs as a measure to mitigate the impact of climate crisis in the country.

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Awareness, Knowledge and Use of Beetroots among Farming Households in Abia State, Nigeria

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ABSTRACT
The study investigated the awareness, knowledge and use of beetroots among farming households in Abia State, Nigeria. Multistage sampling involving purposive and random sampling were used to select the sample size of 84 farmers for the study. Data were collected using a structured questionnaire analyzed using both descriptive and inferential statistics. The findings of the study reveal that the mean age was 43 years, the respondents in the study area were married and have families with a moderate household size. The result showed that the respondents have understanding about the plant, but limited to only the existence of the plant and not the uses and benefits of the plant. The result on awareness of beetroot showed that 76.2% of the farmers are aware of the plant while 23.8% of them were not aware of the plant. This implies that most of the respondents have the awareness of beetroot. The grand mean of 1.86 showed that the respondents have limited knowledge of the plant. The grand mean of the level of use of beetroot is 1.5 which implies that the level of use of the plant is low. The low level of use could be attributed to the low level of knowledge of the plant. The result showed multiple regression estimates of the relationship between selected socio-economic characteristics and use of beetroot plant in the study area. It was therefore recommended that Farming households should be encouraged by extension agents to use and consume beetroot plants for building of the health and immune system.

INTRODUCTION
Beetroot (Beta vulgaris .L) belongs to family of Chenopodiaceae. It is indigenous to Asia Minor and Europe. They were first used for food about before the 3rd century although they had been grown for thousands of years for medicinal purposes (Winkler, Wirleitner, and Schroecksnadel, 2005). It is grown widely in Germany and France and in lesser amounts in other European countries, Africa and South America; It is very popular in USA. It is mainly grown for its swollen roots but the leaves can also be eaten as spinach (Rubatzky, and Yamaguchi, 1998). This popular vegetable is a good choice; it is easy to grow and produces a good yield. Beetroot is a close relative of Swiss chard and sugar beet, and has many health benefits. In Kenya and in some African countries, beetroot is consumed in salads and as juice. Beetroot contains anthocyanins pigments that give the sweet, earthy-tasting vegetable its deep indigo colour. It also provides antioxidant, vitamins A and C, and is an excellent source of betaine and methionine, that support liver detoxification (Lu, Fellman, Edwards, Mattinson, and Navazio, 2003).

Beetroot is grown for its high dietary value and good flavour, it can be processed in many different forms. It owes its organoleptic properties mainly to the large sugar content (7-10%), and the beautiful colour which derives from the presence of betalains, among which there are red-

purple betacyanins (mainly betanine) and yellow betaxanthines (mainly vulgaxanthine) (Winkler, Wirleitner, and Schroecksnadel, 2005).

The young leaves are tasty, a good source of vitamin A and can be prepared in the same way as Swiss Chard. The beets are rich in vitamin C. Beetroot is a cool weather crop, but the hybrid (F1) cultivars available for summer production offer many advantages. The seed is expensive, but these beets are worth growing because they are of a better quality, more adaptable to extreme high temperatures and so are uniform in shape, produce greater yields and have better internal colour. Hybrids also taste better, especially out of season.

Beta vulgaris is considered to be one of most powerful antioxidant vegetables. Khyati and Kirti (2022) studied antioxidant activity of apple, red beetroot peel and pulp, the findings showed that Beta vulgaris specific impact was smaller than that of grapes at maximum activity. Antioxidant elements found in fruits and vegetables are well recognized for its importance in maintaining human health & neutralizing harmful effects of oxidative stress. Oxidative stress is caused by an imbalance between production and accumulation of oxygen reactive species in cells and tissues and the ability of a biological system to detoxify these reactive products. Oxidative stress is linked to a variety of illnesses in humans, including arosclerosis, neurological diseases, myocardial infarction, cancer, and aging (Hobbs, Kaffa, George, Methven and Lovegrove, 2012).

Agriculture is one of the most hazardous industries in the United States. According to the National Institute for Occupational Safety and Health (NIOSH), in Nigeria, 368 farmers and agricultural workers died from a work-related injury and stress in 2020, a rate of 18.0 deaths per 100,000 workers. Each day, agricultural workers experience 100 non-fatal lost-work-time injuries. Transportation incidents, including tractor rollovers, were the leading cause of death, but many other hazards exist on the farm. Such harzards can be exposure to farm chemicals, such as pesticides and fertilizers, as well as toxic gases which may be produced from common farm practices like manure decomposition and silo crop storage, exposure to high levels of dust, which can contain mold, bacteria, and animal droppings, among other things, exposure to ultraviolet rays from the sun, which can result in skin cancer (Rural Health Information Hub (RHIhub), 2021).

Furthermore, joint and ligament injuries, which can result in arthritic conditions affecting mobility, exposure to loud noises and sounds from machinery and equipment which can result in hearing loss and Stress from environmental factors, such as droughts, floods, wildfires, pests, and diseases affecting crops and livestock, as well as from working long hours, financial concerns, and feelings of isolation and frustration among others. Agriculture is different from many industries in that it can present hazards to people not actively involved in the industry, such as family members living on the farm and visitors, in addition to workers.

Khyati Varshney and Kirti Mishra (2022), studied the health benefits of beetroot. Dejene Abera (2019) evaluated beetroot productivity and quality as influenced by organic and chemical fertilizer. Farmers in Abia State have conducted little or no study on the consumption frequency of beetroot. Considering the health importance of beetroot and the stress and many hazards farmers are exposed to as a result of farming activities, it is important to create awareness of the crop and to established how frequent farmers consumed this plant in the study area, hence the study. describe the socioeconomic characteristics of respondents in the study area; determine the awareness of respondents on beetroot; estimate the level of knowledge of respondents about beetroot and ascertain the level of use of beetroot by the farmers.

Hypotheses of the Study
HO_1: Socioeconomic characteristics of the respondents do not significantly influence their level of use of beetroot in the study area.

METHODOLOGY

Study Area

Abia state has a land mass of 700 square km with 17 Local Government Areas and was created out of Imo State on August 27, 1991. The state lies between longitudes 7^0 23` and $8^0$ 02` East of Greenwich Meridian and latitudes 5^0 49 and 6^0 12` North of the Equator. The Cross River and Akwa Ibom States bound Abia State on the east, on the north by Ebonyi, Anambra and Enugu States, on the West by Imo State and on the South by Rivers State. Abia consist of three agricultural zones,

namely; Aba, Umuahia and Ohafia. These zones favour the production of roots and tuber crops. The population of Abia State is 2,833,999 comprising 1,434,193 males and 1,399,806 females. This population consists of people in all occupations with about 65 percent of them engaging in agriculture (NPC, 2008).

Sampling Technique

A simple random technique was used for the selection of 84 farmers for the study. Three LGAs will be randomly selected out of the 17 LGAs in Abia State. Two communities from each LGAs will be selected randomly making a total of 6 communities. In each community, two villages will be selected randomly giving a total of 12 village. In each village 7 farmers will be selected at random giving a total of 84 respondents for the study.

Data Analysis

Data for the study was analyzed using both descriptive and inferential statistics. Specifically, all the objectives i, ii, iv and v were analyzed using descriptive statistics such as mean, frequency, percentage while objective iii was analyzed using a 3 point likert rating scale. Inferential statistics such as multiple regression analysis was employed for the hypotheses.

Model Specification

The respondents knowledge on beetroot were realized using a 3 point rating scale of strongly agree (3), agree (2), disagree (1). The mean levels were obtained by adding together 1 + 2 + 3 = 6, which was later divided by 3 to get a mean score of 2.0. Any mean score ≥ 2.0 was considered high knowledge while any mean score < 2.0 was considered low knowledge. The level of use was realized using a three point likert type scale of strongly agree (3), agree (2) and disagree (1). The mean levels were obtained by adding together 1 + 2 + 3 = 6, which was later divided by 3 to get a mean score of 2.0. Any mean score ≥ 2.0 was considered high level of use while any mean score < 2.0 was considered no low level of use. This was tested using multiple regression analysis. The model is expressed as follows:

$$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, ei) \quad (1)$$

Where;

Y = consumption frequency of beetroot (mean score)
X_1-X_7 = selected socio-economic characteristics
X_1 = age (years)
X_2 = sex (female=0, male=1)
X_3 = marital status (married=1, otherwise=2)
X_4 = level income (Naira)
X_5 = household size (number)
X_6 = level of education (years)
e_i = error term

The four functional forms are explicitly specified as follows:

Linear function:

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6\ e_i \quad (2)$$

Double log function:

$$Ln\ (Y) = b_0 + b_1Lnx_1 + b_2Lnx_2 + b_3Lnx_3 + b_4Lnx_4 + b_5Lnx_5 + b_6Lnx_6 + e_i \quad (3)$$

Semi-log function:

$$Y = b_0 + b_1Lnx_1 + b_2Lnx_2 + b_3Lnx_3 + b_4Lnx_4 + b_5Lnx_5 + b_6Lnx_6 + e_i \quad (4)$$

Exponential function:

$$Ln\ (Y) = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + e_i \quad (5)$$

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Farmers in the study Area

The socioeconomic characteristics of the respondents in the study area was discussed under this section and presented in table 1. They include age, marital status, household size, educational level and income of the respondents.

Age of the Respondents

Table 1: distribution of the respondents according to their age

Age	Frequency	Percentage	Mean
31-40	40	47.6	43years
41-50	20	23.8	
51-60	18	21.4	
61-70	6	7.1	
71-80	-	-	
Total	**84**	**100**	

Source: field survey, 2024

The result showed that 47.6% of the respondents were within the age range of 31-40 years, 23.8% of them were within the age range of 41-50 years, 21.4% were within the age range of 51-60 years, 7.1% of them were within the age range of 61-70 years, the mean age was 43 years. This implies that respondents were still in their active age of years. Domínguez R, Maté-Muñoz JL, Cuenca E, GarcíaFernández P, Mata-Ordoñez F, Lozano-Estevan MC, (2018) opined that young farmers tend to adopt new technologies than aged farmers, farmers in their active age use beetroot more and can search for the importance of such plant on the health of the farmers.

Marital Status of the Respondents

Table 2: distribution of the respondents according to their marital status

Marital status	Frequency	Percentage
Single	21	25.0
Married	54	64.3
Divorced	05	5.9
Widowed	04	4.8
Total	**84**	**100**

Source: field survey, 2024

According to the table 2, 25.0% of the respondents are single, 64.3% of the respondents are married, 5.9% of the respondents divorced, while 4.8% of them were widowed. This means that the respondents in the study area were married and have families.

Household size of the Respondents

Table 3: distribution of the respondents according to their household size

Household size	Frequency	Percentage	Mean
1-4	26	30.9	5 persons
5-8	42	50.0	
9-12	16	19.0	
Total	**84**	**100**	

Source: field survey, 2024

From the table 3, 30.9% of the respondents were within the range of 1-4, 50.0% of the respondents were within the range of 5-8, 19.0% were within the range of 9-12 and a mean of 5persons. This implies that the respondents in the study area have moderate household size. This could be attributed to their level of education and income of the farmers.

Educational Level of the Respondents

Table 4: distribution of the respondents according to their Educational level

Educational level	Frequency	Percentage	Mean
No formal education	4	4.7	16 years
Primary education	30	35.7	
Secondary edu	42	50.0	
Tertiary education	8	9.5	
Total	**84**	**100**	

Source: field survey, 2024

Table 4, shows that 4.7% of the respondents had no formal education, 35.7% of them attainted primary education, 50.0% of the respondents attainted secondary education while 9.5% got to tertiary level with the mean of 16 years. This implies that the farmers in the area could understand the importance and health benefit of beetroot plant which will increase their use of the plant, The more educated a farmer is, the more likely he is to adopt new ideas (Babarykin *et al* ., 2019).

Income Level of the Respondents

Table 5: distribution of the respondents according to their income level

Income level	Frequency	Percentage	Mean
20,000 - 80,000	8	9.5	556600.000
90,000 – 150,000	32	38.1	
160,000 -220,000	20	23.8	
>230,000	24	28.6	
Total	**84**	**100**	

Source: field survey, 2024

The distribution of the respondents by their income level is presented on Table 5. The findings revealed that 9.5% of the respondents had income level ranging from ₦20, 000 – ₦ 80, 000, 38.1% had income level of ₦90,000-₦ 150,000 while 23.6% had income level > ₦230,000 with the mean income of ₦556,600.000. This implies that farmers in the study area are low income earners, considering the cost of beetroot plant in the market, it might be difficult to spend money buying beetroot in the market except for farmers that understands the health implication of the plant. Antioxidant activity of red beetroot peel and pulp was studied, and findings indicated that Beta vulgaris specific impact was smaller than that of grapes at maximum activity. Antioxidant elements found in fruits & vegetables are well recognized for its importance in maintaining human health & neutralizing harmful effects of oxidative stress (Jasmitha et al., 2018).

Awareness of the Respondents on Beetroots

Table 6: distribution of the respondents according to their awareness on beetroots

Awareness	Frequency	Percentage
Yes	64	76.2
No	20	23.8
Total	**84**	**100**

Source: field survey, 2024

The result on awareness of beetroot showed that 76.2% of the farmers are aware of the plant while 23.8% of them were not aware of the plant. This implies that most of the respondents have the awareness of beetroot. Awareness is the quality of understanding that the respondents have that beetroot plant exist, the result showed that the respondents have understanding about the plant, but limited to only the existence of the plant and not the uses and benefits of the plant. Dejene Abera (2019) opined that beetroot juice has been used as a vegetable dye since the sixteenth century. It was fashionable in Britain during Victorian times, for instance, where it was used to dye all manner of foodstuffs.

Level of Knowledge of the Respondents about Beetroot

Table 7: distribution of the respondents according to their knowledge on beetroots

Knowledge on beetroot	Strongly agree	Agree	Disagree	Total	Mean
Beetroot plant have a lot of health benefit	56(168)	20(40)	8(8)	216	2.6
Beetroot is use for Juice, salad and as vegetable	12(36)	32(64)	40(40)	140	1.7
Beetroot is a detoxifier of the liver	07(21)	13(26)	64(64)	111	1.3
Beetroot combats high blood pressure	32(96)	01(2)	51(51)	149	1.8
Beetroot has anti-cancer effect	29(87)	17(34)	38(38)	159	1.9
Grand mean					**1.86**

Source: field survey, 2024. Cutoff mean = 2.0

The result on the level of knowledge on beetroot showed that the respondents have the knowledge that beetroot plant have a lot of health benefit with a mean of 2.6 which is above the cutoff mean of 2.0. The respondents did not have the knowledge of the following; beetroot is used for juice, salad and as vegetable x=1.7, beetroot is a detoxifier of the liver x=1.3, beetroot combats high blood pressure x=1.8 and beetroot has anti cancer effect x=1.9. The grand mean of 1.86 showed that the respondents have limited knowledge of the plant.

Dejene Abera (2019) reported that one of the food supplements that is very useful in households is beetroot juice, which is obtained from the root vegetable *Beta vulgaris*. However, beetroot juice also contains further ingredients such as polyphenols, pigments and organic acids that may as well be of

benefit, beetroot juice as a common food supplement as an ergogenic aid. The aforementioned effects attributed to beetroot juice have contributed to an increase in its popularity, and therefore, in its consumption. It has been reported that the global market of beetroot juice increases by 5% every year, a trend that is estimated to remain steady in the following years (Zamani *et al.,* 2021).

According to Ormesher (2018), chemicals contained in beetroot cleanse liver and have potential to treat digestive system disorders in humans. It promotes liver cleaning, enhances liver function, and protects liver from harmful effects of excessive alcohol use. Beetroot juice has potential to treat liver and kidney disorders, especially fatty liver deposits caused by alcohol misuse, protein insufficiency, or diabetes. In addition, beetroot juice may dissolve kidney stones and relieve discomfort.

Level of Use of Beetroot by the Respondents

Table 8: distribution of the respondents according to their level of use of beetroots

Level of use of beetroot	Always	Sometimes	Never	Total	Mean
Salad	50(150)	4(8)	30(30)	161	1.91
Juice	21(63)	23(46)	40(40)	149	1.77
Beetroot powder	13(39)	12(24)	59(59)	122	1.45
Beetroot jam	-(0)	10(20)	74(74)	94	1.11
Beetroot cookies	-(0)	20(40)	64(64)	104	1.23
Grand mean					**1.5**

Source: field survey, 2024

A three point likert scale was used to ascertain the level of use of beetroot plant, the result on the table 8 showed that the respondents have low use of beetroot particularly on the following areas; using beetroot as salad (X=1.91), juice (X=1.77), beetroot powder (X=1.45), beetroot jam (X=1.11), and beetroot cookies (X=1.23). The grand mean of the level of use of beetroot is 1.5 which implies that the level of use of the plant is low. The low level of use could be attributed to the low level of knowledge of the plant. According to Ormesher (2018), reported a high level of use of beetroot because it has the highest sugar content of all vegetables but is very low on calories and have negligible quantities of cholesterol. Incorporating beetroot into daily diet can be very beneficial and healthy as they are rich in vitamins, minerals and organic compounds like carotenoids, lutein or zeaxanthin, glycine, betaine, dietary fibre and Vitamin C.

Hypothesis Testing

HO_1: Socioeconomic characteristics of the respondents do not significantly influence their level of use of beetroot in the study area.

Table 9: Summary of the regression result on no significant influence of the socioeconomic characteristics on their level of use of beetroot

Variables	+Linear	Semilog	Exponential	Double log
Constant	2.654	.713	-9.395	-.336
	(1.840)*	(5.819) ***	(-.485)	(-.290)
Age	.006	-.004	-.075	-.080
	(.252)	(-.102)	(-.796)	(-.864)
Sex	-.029	.064	.278	.337
	(-.867)	(1.361) *	(2.573) ***	(3.183) ***
Marital status	-.042	-.006	-.127	-.096
	(-1.881)**	(-.187)	(-1.451) *	(-1.123)
Income	-.013	-.018	-.121	-.125
	(-.574)	(-.547)	(-1.334) *	(-1.404) *
Household size	-.050	-.043	-.098	-.088
	(-2.031)***	(-1.273)	(-1.042)	(-.949)
Educational level	1.004	.917	.491	.459
	(29.845) ***	(19.617) ***	(4.489) ***	(4.284) ***
F stat	334.361***	167.210***	10.275***	11.289***
R^2	.963	.930	.448	.471
R adjusted	.961	.964[a]	.404	.471

Source: field survey, 2024

Table 9 showed multiple regression estimates of the relationship between selected socio-economic characteristics and use of beetroot plant in the study area. The four functional forms were fitted in the regression model and based on some econometric criterion, such as the level and signs of the significant variables and their conformity to *apriori* expectation, the lead equation was chosen. The

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linear function was chosen as the lead equation. The R^2 value was 0.963 indicating that 96.3% of the variation in the use of beetroot plant was accounted for by the explanatory variables expressed in the models. Marital status was significant at 5% level and was inversely related to use of beetroot plant. This implies that married people tend to use beetroot plant more than unmarried ones and vice versa. Married household would want to use a product that have high health benefit and tend to use the product more. The health benefit of beetroot cuts across pregnant mothers, children and the entire household.

Zamani (2021) opined that red beetroots focus on iron anti-oxidative properties in human body. Nutritional iron insufficiency occurs when dietary iron absorption is insufficient to meet physiological needs , which is commonly found in large households, this could be attributed to high cost of the food that are rich in iron. Secondary iron deficiency is caused by a variety of clinical diseases. Therefore intake of red beet in iron metabolism must be mentioned in households because iron may not be present in virtually all meals, dietary iron intake is linked to energy consumption. Therefore married people tend to go for beetroot plant because of its nutritional and health benefits. The coefficient of household size was significant at1% level and was inversely related to the use of beetroot plant in the study area. This implies that the higher the number of the household members, the lower the use of beetroot plant, this could be as a result of the high cost of the plant in the market. Cost of the plant can reduce the use of the plant in bigger households, the lower the household number, the higher the use of the plant.

The coefficient of the level of education was significant at 1% level and was directly related to the use of beetroot plant. This implies that the higher the level of education of the respondents, the higher the use of beetroot plant and vice versa. Education creates awareness about opportunities existing elsewhere and the knowledge and skills acquired to support individual's quest for better standard of living, hence, improving the opportunity to leave a healthy life in the study area (Igwe *et al,.* 2020).

CONCLUSION AND RECOMMENDATIONS

The use of beetroot plant is very important to the farming households because it improves the health condition of the farmers and keep them fit for farming activities. The study concludes that the farmers are aware of the plants but not having a quality knowledge of the plant and its health benefits. Farming households in Abia state have low use of the beetroot plant having some socioeconomic factors that affect the use of the plant such as marital status, household size and educational level of the farming households in the study area.

Based on the major findings of the study, the following recommendations were made;

i) Farming households should be encouraged by extension agents to use and consume beetroot plants for building of the health and immune system.
ii) Farmers should be trained on the importance of incorporating agriculture and health inorder for them to live a healthy lifestyle.
iii) Farming households should be encouraged by extension agents to include beetroot plant among the crops they plant in their farms.

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Adoption of Improved Cassava Production Technologies by Cassava-Based Farmers in Abia State, Nigeria

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ABSTRACT

The main objective of the study is to examine the adoption of improved cassava production technologies by cassava-based farmers in Abia State, Nigeria. The specific objectives are to: identify the cassava production technologies available to farmers in Abia State; and determine the levels of adoption of improved cassava production technologies by cassava-based farmers in Abia State. Multistage random sampling technique was employed in the selection of locations and respondents for the study and a sample of ninety six (96) rural farm households was selected for this study. The study made use of primary data, obtained with the use of pre-tested structured questionnaire which was administered to the chosen farm households. Objectives i was analyzed using descriptive statistics such as means, percentages, and frequencies. Objective (ii) was analyzed using mean score from adoption score index. Results show that cassava production technologies available to the cassava-based farmers in Abia State are sixteen, but they adopted only five. There is a low level of adoption of improved cassava production technologies in Abia State. Therefore, incentives should be made available to the cassava-based farmers by the government and other interested stakeholders, to encourage the farmers to adopt all the available cassava production technologies in the state. In addition to this, the capacity of Agricultural Extension Services in Abia State should be strengthened to reach out to all farmers in the State.

Keywords: Level, Adoption, Improved, Cassava, Production, Technologies.

INTRODUCTION

Cassava is one of the fastest expanding staple food crops in Nigeria and has continued to gain prominence among farmers, while the industrial demand is also rising consistently (FAO, 2018). Nigeria, can only experience economic growth and social process if their agricultural systems were revolutionized. Such revolution requires not only the development, but the transfer and adoption of improved cassava technologies that are proven to increase productivity. The improved varieties adopted include high-yielding mosaic resistant varieties namely TMS 50395, 63397, 3055, 4(2) 1425, 30572, IBA 961632 (farmers pride), and IBA980505 (fine face).

The demand for cassava root products is high and fast rising, but the current production is far from being able to meet the needs of the population (Poverty Oxford and Human Development Initiative, 2017 and FAO, 2018). Consequently, there is threat of hunger and poverty. Small holder farmers constitute about 80% of all farm holdings with inefficient production. There is a widening gap between domestic food supply and demand. Food deficit has not only remained but has been on the rise, so citizens are food poor. Increasing bills of food imports, increasing prices, declining foreign exchange earnings from agricultural export are the order of the day.

The failure of the current cassava output to meet domestic and industrial demand could be attributed in part to failure to accept and adopt available cassava production technologies. Inadequate adoption of contemporary innovations and technologies have constrained cassava productive efficiency to less than 60% in most countries, including Nigeria (Ajibefun, 2015).

In view of the problems highlighted in the preceding discussion, this study provided answers to the following questions: What are the cassava production technologies available to farmers in Abia State? What is the level of adoption of improved cassava production technologies by the cassava-based farmers in Abia State? Which cassava production technologies are adopted by the farmers? The main objective of the study is to examine the adoption of improved cassava production technologies by cassava-based farmers in Abia State, Nigeria. The specific objectives are to: (i) identify the cassava production technologies available to farmers in Abia State; (ii) determine the levels of adoption of improved cassava production technologies by cassava-based farmers in Abia State; and (iii) identify the improved cassava production technologies adopted by the farmers.

In this study, the adoption and diffusion theory was used, because it has something to do with innovation decision process. The theory states that the factors that influence innovation process are the social system, personal characteristics of the farmers and the technical characteristics of the innovation. The social system consists of various interactions within the society. It is made up of political, economical, socio-cultural, education, etc subsystems. Social system involves the norms, values, social status, taboo etc, these features of the social system influence the behavior of individual to utilize or not utilize an innovation. Personal characteristics of the extension agents and that of the farmer affect their ability to transfer and to utilize an agricultural technology.

Technical characteristics of an innovation helps to determine the rate of adoption/utilization of an innovation, those innovations that are relatively simple and compatible with the previous-experience are usually faster in the transfer and adoption process than the more complicated ones. There are five main characteristics upon which innovation is judged which affect their rate of utilization and dissemination. These characters are relativity, compatibility, complexity, trialability and observability.

These characteristics will be there before the farmer passes through the various stages of awareness, interest, evaluation, trial and final adoption stage. Hence the theories of social change were exclusively considered in course of this study. Such theories were; the Social System Theory, Functional Theory and Marxist/Conflict Theory.

The Social System Theory insists that it is only when units are properly integrated that organizational goals can be achieved (Olantunji, 2005 and Ironkwe, 2011). It is on this premise that the REFILS approach was created for development, transfer and adoption of appropriate agricultural technologies to increase production and income of the farmers. The Functional theory views society as a social system that is made up of different parts' which are inter-dependent and interrelated (Igbo, 2003). These different parts of society perform various functions toward the maintenance, stability, as well as survival of the social system, and they are held together by value consensus. Therefore one part of the system cannot succeed in the production functions without the other. The proponents of this theory further believed that individuals tend to identify with those who share the same views or ideas with themselves, leading to technological transfer and adoption (Collinson, 2001).

Marxist Theory states that conflict is a normal feature of society because economic and social groups with conflicting interest and values are bound to clash from time to time (Ironkwe, 2011). Hence the theory considered change as constant and unavoidable characteristics of a society, even in technology development and adoption process (Igbo, 2003).

The intensity of adoption is the degree of use of the improved technology, while the rate of, adoption is the relative speed with which an improved technology is adopted by a producer (Rogers, 1983). The five main characteristics of the improved technology that explains the rate and intensity of adoption, are: awareness, compatibility, complexity, complexity, trainability and observability. The steps in the diffusion process are awareness of the new idea, interest, trial, evaluation, rejection and adoption.

A number of studies have been carried out on the level of adoption of cassava production technologies. Onwusiribe et al (2022) studied the levels of adoption of improved cassava production technologies and its impact on output, income and poverty status of male and female cassava farmers in Abia State, Nigeria. Multi-stage random sampling techniques was adopted in selection of two hundred and sixteen (216) respondents, mainly 108 male and 108 female headed cassava farm households. The level of adoption of selected cassava production technologies by the male and female respondents showed that cassava production technologies adopted by the male and female headed cassava farm households were improved cassava varieties such as NR 8082 (X= 3.68 for males and X=3.58 for females) and UMUCASS 43 (X= 3.75 for males and X=3.69 for females) ploughing and ridging before planting (X=4.37 and X=4.19). Other technologies were application of recommended fertilizer to improve soil fertility (X= 4.69 for males and X=4.79 for females), improved cassava stem cuttings (X= 4.25 for males and X=4.39 for females) and weeding at least two times in a year (X= 4.02 for males and X= 4.68 for females).

Ayedun et al, (2019), determined the effects of adoption of cassava production technologies on farmers from southern zones of Nigeria. Data were obtained using structured questionnaires from 480 farming households from the three southern geographical zones of Nigeria using a multistage sampling technique. Data were analyzed using descriptive statistics, budgetary analysis. P-Alpha measures of Poverty (FGT) and log it model. Result showed that of all production technologies disseminated, awareness and adoption of improved cassava production technologies, both in intervention villages (IVs) and non-intervention villages (NIVs) were the highest processes of diffusion. The IVs had 93% awareness rate and 72% adoption rate while NIVs had 81% awareness rate and 64% adoption rate on improved cassava varieties.

Ezike et al (2022) studied factors affecting farmers' adoption of improved agricultural technologies in Kuje area council, Abuja. Adoption of improved technology in the study area shows that 50% of the farmers adopted improved cassava varieties. Proper spacing was adopted by 50% of the farmers. Proper weeding was adopted by 56% of the farmers. Herbicides and Pesticides were adopted by 45% of the farmers. The least adopted technology was fertilizer. This shows that majority of the farmers do not use fertilizer in production of cassava which may cause low yield.

METHODOLOGY

This study was conducted in Abia State, Nigeria. The state is located in the South East geopolitical zone of Nigeria. It lies between latitudes 5°6ˈN and 5°24ˈN of the equator and longitudes 7°18ˈE and 7°24ˈE of the Greenwich meridian. The state covers a land mass of about 5,243.7km², approximately 5.6 percent of total land area of Nigeria. The state has a population of 2,833,998 persons (NPC, 2006). The state is located in the rain forest zone of Nigeria with temperature range of 20°C to 31°C and a mean temperature of 27°C. It is low lying with heavy rainfall of about 2400mm/year, intense between the months of April and October. The relative humidity is usually high throughout the year between 70.0% and 80.0%. The state comprises of seventeen local government arcas (LGAs). (Aba South, Aba North, Obingwa, Osisisioma Ngwa, Ugwunagbo, Ukwa East, and Ukwa West, Arochukwu, Bende, Isuikwuato, Ohafia, Ikwuano, Isialangwa south, Isialangwa North, Umuahia North and Umuahia South and Umunneochi), with Umuahia as its capital.

Agriculturally, the state is divided into three (3) Agricultural zones namely; Aba, Ohafia and Umuahia zones with thirty eight (38)Agricultural extension blocks (Aba Agricultural zone has 12 blocks, Ohafia Agricultural has 13 blocks and Umuahia Agricultural zone has 13 blocks). Aba. Agricultural zone has 96 circles and 768 sub circles, Ohafia Agricultural zone has 104 circles and 832 sub circles; Umuahia Agricultural zone has 104 circles and 832 sub circles (Abia ADP. 2012).

Abia State as an agrarian state, is richly endowed with land suitable for growing various tropical crops. Primary occupation of inhabitants of Abia state is farming. Arable crops cultivated include yams, cassava, maize, cocoyam, potato, plantain, banana, ginger, rice and garden egg. Major tree crops cultivated are oil palm, cocoa, rubber and citrus. Small herds of sheep, pigs, goats and poultry are kept.

According to International Institute of Tropical Agriculture (IITA), cultivating cassava comes with a lot of convenience. Some of which include: its ability to do well in poor soils, its labour requirements are low, it can be inter-cropped with other crops, it matures within a period of 6 months-3 years after planting. According to Hauser et al. (2014), the most preferred precipitation for cassava plant is an

annual rainfall of 1000 mm or more. It thus implies that an average of 50mm rainfall per month spreading over a period of 6 months can sufficiently meet the water need of cassava plant. The plant does not tolerate extremely stony or sandy, clayey, salt affected, waterlogged and shallow soils, but performs excellently well on well-drained soils rich in aluminum and manganese. Notwithstanding, cassava is highly tolerant to erratic weather condition including a range of rainfall (El-Sharkawy, 2003).

Multistage random sampling technique was employed in the selection of locations and respondents for the study. Stage 1 involved a random selection of two (2) blocks from each of the Agricultural zones that make up Abia state to give a total of six (6) extension blocks. Stage 2 involved a random selection of two (2) circles from each of the selected blocks to give a total twelve (12) circles. Stage3 involved random selection of two (2) sub-circles from the selected circles to give a total a total of twenty-four (24) sub circles. Finally, four (4) cassava based farm households were randomly selected from each of the selected sub circles to give a sample of ninety six (96) rural farm households for this study.

Objectives (i) was analyzed using descriptive statistics such as means, percentages, and frequencies. Objective (ii) was analyzed using adoption score index and seven point Likert type scale. Adoption score index was achieved with the aid of a 7 point Likert scale graded thus; unaware = 0, Aware = 1, interest = 2, evaluation= 3, trial = 4, accept = 5 and satisfaction = 6. In accordance with Okoye *et al.* (2007 and 2009). The mean adoption level was determined as follows:

$$\bar{X} = \frac{0 + 1 + 2 + 3 + 4 + 5 + 6}{7} = \frac{21}{7} = 3.0$$

Decision rule: Mean score ($\bar{X}$) Less than 1.0 = Unaware stage, 1.0- 1.49 = Awareness stage of, 1.5 – 1.99 = interest stage, 2.0 – 2.49 = Evaluation stage, 2.5 – 2.99 = trial stage, 3.0 – 3.49 = adoption stage.

RESULTS AND DISCUSSION

Identified Cassava Production Technologies in the Study Area

The farmers were asked to identify the cassava production technologies available to them. Their responses are recorded on Table 3.1 (See the Appendix). The cassava production technologies available to the cassava-based farmers in Abia State are sixteen technologies, as shown on Table 3.1 in the Appendix. This shows that the ADP is effective in making available improved cassava production technologies to farmers in the study area Nigeria.

Levels of Adoption of Improved Cassava Production Technologies by Cassava-based Farmers in Abia State

Distribution of the cassava farmers according to the levels of their adoption of improved cassava production technologies is presented in Table 3.2, in the Appendix. Using a bench mark score of 3.0, the cassava production technologies fully adopted by the farmers in Abia State, arranged from the technology with the highest level of adoption to the least, with their respective Likert Scale mean scores shown are: use of pesticides (3.64), use of insecticides (3.57), application of fertilizer (3.28), use of improved varieties of cassava (3.09) and use of rodenticides (3.01).

On the other hand, the cassava production technologies poorly adopted by the cassava farmers scored below the bench mark score of 3.0. The technologies and their respective scores are: application of herbicides (2.97), correct spacing (2.95), correct weeding (2.94), optimum plant population (2.88), timely harvest (2.84), (crop geometry (2.82), and line planting (2.75), ridging (2.56), harrowing (2.41) and ploughing (2.20). The overall grand mean adoption score was 2.93, indicating low adoption of improved cassava production technologies among the farmers. The result is in tandem with finding of Nwaobiala et al. (2018), who found that cassava farmers in Abia State adopt improved production technologies such as improved varieties of cassava, fertilizer application and pest and disease control. Ijioma and Osondu (2013) reported low adoption of improved cassava production technologies among Nigerian farmers. They attributed it to factors such as insufficient extension personnel, poor extension service and inadequate finance.

CONCLUSION AND RECOMMENDATIONS

The study concludes that there is low level of adoption of improved cassava production technologies in Abia State. The grand mean adoption score was 2.93, as against a bench mark score of 3.0. The cassava-based farmers adopted five, out of available sixteen cassava production technologies in the state. Therefore, incentives should be made available to the cassava-based farmers by the government and other interested stakeholders, to encourage the farmers to adopt all the available cassava production technologies in the state. In addition to this, the capacity of Agricultural Extension Services in the Abia State should be strengthened to reach out to all farmers in the state.

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Table 1: Cassava Production Technologies identified as available in Abia State, Nigeria (Sample size = 96)

S/N	Improved Cassava Production Technology	No. of persons who identified it as available to them.
1	Improved Technologies	80
2	Ploughing	80
3	Harrowing	88
4	Ridging	92
5	Improved varieties of cassava	88
6	Fertilizer application	91
7	Use of Insecticide	94
8	Use of pesticide	95
9	Use of rodenticide	91
10	Application of herbicides	88
11	Optimum plant population	88
12	Line planting	87
13	Correct spacing	93
14	Crop geometry	91
15	Timely weeding	87
16	Timely harvest	78

Source: Field Survey, 2024

Table 2: Levels of adoption of improved cassava production technologies among the sampled farmers (n = 96)

Improved Technologies	Unaware (0)	Aware (1)	Interest (2)	Evaluation (3)	Trial (4)	Accept (5)	satisfied (6)	Total	MS	Rank
Ploughing	16	28	17	10	10	11	4			15
	(0)	(28)	(34)	(30)	(40)	(55)	(24)	211	2.20	
Harrowing	8	33	20	9	7	11	8			14
	(0)	(33)	(40)	(27)	(28)	(55)	(48)	231	2.41	
Ridging	4	36	17	10	6	13	10			13
	(0)	(36)	(34)	(30)	(24)	(65)	(60)	249	2.56	
Improved varieties of cassava	8	19	17	7	11	25	9			4
	(0)	(19)	(34)	(21)	(44)	(17825)	(54)	297	3.09	
Fertilizer application	5	14	16	12	18	25	6			3
	(0)	(14)	(32)	(36)	(72)	(125)	(36)	315	3.28	
Use of Insecticide	2	12	18	9	19	24	12			2
	(0)	(12)	(36)	(27)	(76)	(120)	(72)	343	3.57	
Use of pesticide	1	13	11	14	20	30	7			1
	(0)	(13)	(22)	(42)	(80)	(150)	(42)	349	3.64	
Use of rodenticide	5	22	7	23	17	16	6			5
	(0)	(22)	(14)	(69)	(68)	(80)	(36)	289	3.01	
Application of herbicides	8	20	5	24	16	19	4			6
	(0)	(20)	(10)	(72)	(64)	(95)	(24)	285	2.97	
Optimum plant population	8	12	31	9	13	15	8			9
	(0)	(12)	(62)	(27)	(52)	(75)	(48)	276	2.88	
Line planting	9	13	25	20	9	15	5			12
	(0)	(13)	(50)	(60)	(36)	(75)	(30)	264	2.75	
Correct spacing	3	19	20	17	17	15	5			7
	(0)	(19)	(40)	(51)	(68)	(75)	(30)	283	2.95	
Crop geometry	5	21	24	11	11	19	5			11
	(0)	(21)	(48)	(33)	(44)	(95)	(30)	271	2.82	
Timely weeding	9	29	14	5	3	18	18			8
	(0)	(29)	(28)	(15)	(12)	(90)	(108)	282	2.94	
Timely harvest	18	24	11	2	5	15	21			10
	(0)	(24)	(22)	(6)	(20)	(75)	(126)	273	2.84	
Grand mean									**2.93**	

Source: Field Survey, 2024. MS = Mean score. Decision Rule Mean score value of 3.0 and above = Adoption; 2.50 – 2.99 = Trial stage; 2.0 – 2.49 = Evaluation stage; 1.5-1.99 = Interest stage; 1.0 – 1.49 = Awareness stage. Figures in parentheses are Likert scores multiplied by frequencies.

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The Nexus of Leadership on Job Satisfaction in Selected Agribusiness Enterprises in Abia State

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ABSTRACT
The study examined effects of leadership on job satisfaction in selected Agribusiness enterprises in Abia state. The study adopted the descriptive survey design using percentages on hypothesis and questions formulated. The findings of the study revealed that good leadership style enhances employee job satisfaction and that there is what is known as contra productive leadership style of management where employers and employees do not have a good communication platform to take decisions that have positive impact on the growth of the organization. The null hypothesis were tested with (2-tailed) level when lower than the 0.05 level of significance. This study therefore concludes that there was a positive and significant relationship between the work effectiveness and employee satisfaction in Agribusiness enterprises in Aba, also that there is a significant relationship between the positive leadership style and employee satisfaction in Agribusiness enterprises in Aba, and also there was a negative but significant relationship between contra productive leadership style and job satisfaction. The study concluded that the contra productive leadership style does not always give a good satisfactory environment for subordinates, the study therefore recommends proper leadership style like constructive leadership should be imbibed in the selected Agribusiness Enterprises.

Keywords: Leadership style, job satisfaction, Contra productive leadership behaviour, Agribusiness Enterprises and Management.

INTRODUCTION
The formula for good management of Agribusiness Enterprises is simple enough to develop a sound plan, design appropriate organizational structure, to implement the plans and monitoring the performance of the business. But these activities are easier said than done. According to Lawal, Kio and Adebayo (2000), good leadership is a pre-requisite for effective accomplishment of these tasks. However, they opined that an entrepreneur has different leadership roles to play; he is the chief risk bearer, chief administrator and strategy implementer, crises solver, figure head, spokesperson, policy maker. Stoner and Gilbert (2001), stressed that an understanding of leadership is important to Agribusiness enterprises because leadership binds subordinates to work together and stimulate employees motivation. Also, leadership assists in management development and training, effective leadership provides the building block for organizational performance. It is absolutely essential to the survival and growth of every organization.

However, swift changes in the business environment, organizational structures, technology and life styles are introducing a considerable rethinking of leadership development. Leadership concerns the ability to influence the style of others to move accord with the desire of the leader and pursuit of goals (Low and Jiang, 2004). Modern businesses face bigger challenges due to rapidly changing world. These challenges comprise socio cultural, economic, technological legal and regulatory, environmental and ethical issues (Toor, *et al.* 2007). In several instances, people use the term "manager" and "leader" in the same context. Therefore, a clear difference should be recognized between leadership and management and more specifically leaders and European Journal of Business and Management managers. Mowson (2001) believes that leaders may not excel at management and what is more often the case, managers do not necessarily make great leaders. Though some scholars have argued that no particular Leadership style is the best, the level of participation of workers in the decisions that affect them or the organization as a whole will spur them to better commitment to the realization of set goals. Comparatively, participation provides outstanding long term results which are by no means far better than effective short term results. Leadership is more of establishing direction, aligning people, and motivating and inspiring others. Leadership is concerned with long-term outcomes and future goals of the organizations. Leadership is more about people and less about tasks. Leaders often put many of these skills and interests to good use but often to better effect because they focus on areas such as discovering solutions (not problems), managing changings, excelling in spite of organizational structure, and inspiring personnel to achieve their goals. Leaders achieve objectives through energized and excited subordinates who share their passion, vision, and direction. Good leaders feel comfortable challenging the status quo and finding efficient as well as long-term solutions to challenges. Good leaders develop through a never-ending process of self-analysis, and the utilization of education, training, and experience to improve. The best leaders are continually working and studying to improve their leadership skills (Clharehbaghi and Mcmanus, 2003).

Leadership styles of management is a pre-requisite for effective accomplishment in organizations. The Leadership style determine the level of employees participation in decision making and the way an organization is run administratively. Organizations which are low in efficiency tend to have leaders who are highly bossy. Decision making is centered on them alone. Participation in decision making creates an individual's mental and emotional involvement in a group situation which encourages him or her to contribute to group goals and share responsibility for them (Chruden and Sherman, 1975). The problem with most Agribusiness enterprises is that the leaders are not democratic in their relationship with their employees. In fact, leaders in most small and medium enterprises are usually authoritarian in style. They dictate the tune and have the administration of the organization centered on them. The need for employees to participate in decision making is not a passing fancy. It is rooted deep in the culture of free men around the world and it is no doubt the basic drive in men. Another problem affecting Leadership style in Agribusiness enterprises is the competence of the leaders so appointed. In most cases, some of their appointments lack merit. What becomes of such organization is having competent leaders who lack the abilities or capacities to use the appropriate Leadership style to lead the members to attain set goals or objectives. Thus, what are usually found in some of these organizations are "round pegs in a square hole" rather than "round pegs in round holes". Once this situation arises, there will be utterances in the way such leaders behave or administers the organization and these will in-turn affect the goals of the organization.

Objectives of the Study

The main objective is to examine the effect of leadership on job satisfaction of Agribusiness enterprises; other specific objectives include:

1. To find out if the type of leadership style adopted in study organizations.
2. To examine the effect of leadership style on employees satisfaction in Agribusiness enterprises in Aba, Abia state.
3. To examine the effect of contra productive leadership style on employees satisfaction in Agribusiness enterprises in Aba, Abia state.

Research Hypotheses

The study will geared towards testing the following hypotheses.

H_{01}: Employee satisfaction has no effect on work effectiveness.

H_{02}: There is no significant relationship between positive leadership style and employees' satisfaction in Agribusiness enterprises in Nigeria.

H_{03}: There is no significant effect of contra productive leadership style on employee satisfaction in Agribusiness enterprises in Nigeria

METHODOLOGY

For the purpose of this study, explorative qualitative research of the case study was used. This approach is suitable in diagnosing research problems, in screening alternatives and for discovering new ideas. It also made use of survey research. The nature of the study necessitates the use of a descriptive research design as it is concerned with finding out the respondents' attitudes towards Leadership behaviour in their workplace and how it affect their employees' performance.

Data for this study was collected from primary and secondary source respectively. The primary source was obtained from a well-structured questionnaire designed to capture the type of Leadership style adopted in study organizations, effect of Leadership style on employees' morale in Agribusiness enterprises, impact of autocratic Leadership style on Agribusiness enterprises, relationship between the managers' Leadership style and employees commitment.

The study population is the aggregation of overall Agribusiness enterprises employees' in Aba, Abia state. However, one hundred (100) employees' were purposively selected from only four (4) registered Agribusiness enterprises in Aba, Abia State. Options (answers) in the questionnaire from which the respondents had to choose will be all numbered using Likert 5, ranging from 1 to 5, that is - Strongly agree (5), Agreed (4), Undecided (3) disagree (2) and Strongly disagree (1) the number against each option (answer) ticked by the respondent was taken as his/her score for that question. Then the total score of each respondent in the first and second tests was separately. Pearson's Product Moment Correlation Co-efficient was used in examining the relationships between the variables.

Reliability of the Instrument

The above calculation shows that the Pearson's Product Correlation Coefficient result is 0.98. This shows that there exists a positive relationship between the two variables, X and Y, Leadership behaviour effect and performance in Agribusiness enterprises since the coefficient, or Standard Deviation is close to 1. This is an indication that the data collection instrument has very high degree of reliability.

RESULTS AND DISCUSSION

This section concentrates on the presentation, analysis and interpretation of the data gotten through the questionnaires distribution to employees of the company. The analysis was strictly based on the responses from the respondents' sequel to the research questions conducted.

Demographic Characteristics of Respondents

The simple percentage and frequency tabulation format is used in presenting the demographic characteristics of the respondents.

Table 1: Distribution of respondents by Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	40	40.0	40.0	40.0
	Female	60	60.0	60.0	100.0
	Total	100	100.0	100.0	

Source: Field survey, 2024

From table 1, it can be observed that out of the one hundred (100) respondents, forty (40) were male representing 40.0 percent while sixty (60) were female representing 60.0 percent. This however, depicts that the respondents from are majorly male in gender.

Table 2: Distribution of respondents by Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 - 30	44	44.0	44.0	44.0
	31 - 40	47	47.0	47.0	91.0
	41 - 50	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Source: Field survey, 2024

From table 4.2 above, presents the age of the respondents, 44 respondents representing 44.0% were in the 20 - 30 age brackets. Followed by 31 - 40 age bracket with a frequency of 47 representing 47.0%, 9 of the respondents representing 9.0 were in the age bracket of 41 – 50 years. Meaning that Major Agribusiness enterprises work force comprises more of active persons.

Table 3: Distribution of respondents by Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Certificate	38	38.0	38.0	38.0
	Diploma	43	43.0	43.0	81.0
	BA or BSC	19	19.0	19.0	100.0
	Total	100	100.0	100.0	

Source: Field survey, 2024

From table 3 it could be observed that 38 of the respondents representing 38.0 percent are certificate holders, 43 of the respondents have Diploma representing 43.0 percent, while 19 of the respondents have BA/BSC representing 19.0 percent. This suggests that employees Agribusiness enterprises have more Diploma holder employee in the workforce.

Table 4: Distribution of respondents by Monthly Salary

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4000 – 6000	23	23.0	23.0	23.0
	6001 – 8000	28	28.0	28.0	51.0
	8001 and above	49	49.0	49.0	100.0
	Total	100	100.0	100.0	

Source: Field survey, 2024

From table 4 it could be observed that 23 of the respondents representing 23.0 percent are earning 4000-6000 naira monthly, 28 of the respondents representing 28.0 percent are earning 6001-8000, while 49 of the respondents representing 49.0 percent are earning 8001 and above. This suggests that the selected Agribusiness enterprises have more employees paid 8001 and above in the workforce.

Table 5 Correlations Table

		Employee_Effectiveness	Positive_leadership_style	Contra_productive_leadership_style	Employee_satisfaction
Employee_Effectiveness	Pearson Correlation	1	.121	-.173	.071
	Sig. (2-tailed)		.229	.085	.480
	N	100	100	100	100
Positive_leadership_Style	Pearson Correlation	.121	1	.165	.148
	Sig. (2-tailed)	.229		.102	.143
	N	100	100	100	100
Contra_productive_leadership_style	Pearson Correlation	-.173	.165	1	.249*
	Sig. (2-tailed)	.085	.102		.013
	N	100	100	100	100
Employee_satisfaction	Pearson Correlation	.071	.148	.249*	1
	Sig. (2-tailed)	.480	.143	.013	
	N	100	100	100	100

Source: SPSS 22.0. *. Correlation is significant at the 0.05 level (2-tailed).

The Table 5 above shows the correlations between employee satisfaction and positive leadership style of four selected Agribusiness enterprises located in Aba, Abia State. From the table it could be seen that positive leadership style have a positive relationship with employee satisfaction. While contra-productive leadership style has a negative relationship with employee effectiveness. Furthermore, the table show that the statistical relationship of the variables are mixed at the acceptable 0.05 level. The test of hypothesis will be based on the level of statistical significance of the variables.

Test of hypotheses
After a detailed investigation on the effect of leadership style on employee satisfaction in business organizations, which was based on three hypothetical statement, some structured questionnaire were distributed to the chosen respondents for their views. The answers given by the respondents have also been presented and analyzed in this chapter. Therefore statistical significance of the collected of the view of the respondents is tested in order to validate or disprove the claims. All hypotheses are tested using simple correlation coefficient (r) test.

Decision Criteria
Reject the null hypothesis if the sig. (2-tailed) level is lower than the 0.05 level of significance.

$H0_1$: Employee satisfaction has no effect on work effectiveness.

Table 6 Employee satisfaction has no effect on work effectiveness

		Work_Effectiveness	Employee_satisfaction
Work_Effectiveness	Pearson Correlation	1	.071
	Sig. (2-tailed)		.480
	N	100	100
	Pearson Correlation	.071	1
Employee_satisfaction	Sig. (2-tailed)	.480	
	N	100	100

Source: SPSS 22.0. *. Correlation is significant at the 0.05 level (2-tailed).

A critical observation of the table 6 above shows that there is a positive correlation between work effectiveness and employee satisfaction, this is clear as the Pearson correlation has a value of .071. However, a closer investigation reveals that the relationship is not statistically significant, because the value of the sig. (2-tailed) of .480 is higher than the acceptable significant value of 0.05. Therefore, we reject the null hypothesis that says there is no significant relationship between employee satisfaction and work effectiveness in business organization.

$H0_2$:There is no significant relationship between positive leadership style and employees' satisfaction in Agribusiness enterprises in Nigeria.

Table 7: There is no significant relationship between positive leadership style and employees' satisfaction in Agribusiness enterprises in Nigeria.

		Positive_leadership_style	Employee_satisfaction
Positive_leadership_style	Pearson Correlation	1	.148
	Sig. (2-tailed)		.143
	N	100	100
	Pearson Correlation	.148	1
Employee_satisfaction	Sig. (2-tailed)	.143	
	N	100	100

Source: SPSS 22.0. *. Correlation is significant at the 0.05 level (2-tailed).

A critical observation of the table 7 above shows that there is a positive correlation between positive leadership style and employee satisfaction, this is clear as the Pearson correlation has a value of .148. Furthermore, a closer investigation reveals that the relationship is statistically significant, because the value of the sig. (2-tailed) of .143 is higher than the acceptable significant value of 0.05. Therefore, we reject the null hypothesis that there is no significant relationship between pay differential and employee productivity in business organization.

HO_3: There is no significant relationship between contra productive leadership style and employees' satisfaction in small and medium enterprises in Nigeria

Table 8: There is no significant effect of contra productive leadership style on employees' satisfaction in Agribusiness enterprises in Nigeria

		Positive_leadership_style	Employee_satisfaction
Contra_productive_leadership_style	Pearson Correlation	1	.249*
	Sig. (2-tailed)		.013
	N	100	100
Employee_satisfaction	Pearson Correlation	.249*	1
	Sig. (2-tailed)	.013	
	N	100	100

Source: SPSS 22.0. *. Correlation is significant at the 0.05 level (2-tailed).

A closer observation of the table 8 above shows that there is a negative correlation between contra productive leadership style and employee satisfaction. This is evidenced by the Pearson correlation value of .249. A further examination of the result reveals that the relationship is statistically significant, as the value of the sig. (2-tailed) .013 is lower than the acceptable significant value of 0.05. Therefore, we accept the null hypothesis that there is no significant relationship between contra productive leadership style and employee satisfaction in the selected Agribusiness enterprises.

Findings from the socio-economic characteristics of the respondents reveal that Agribusiness enterprises in Aba, Abia State have staff which comprises mostly of young people within the age bracket of 31-40 years which is very good for a small scale industry. From result of the analysis above it could be seen that although all the variable–work effectiveness, positive leadership style and Contra productive leadership style shows a positive relationship with Employees satisfaction, the statistical significance of the relationship is heterogeneous. The result shows a positive but insignificant relationship between socio-economic and employee productivity. The positive association implies that leadership style adopted by an Agribusiness enterprises owner is capable of instigating the spirit of productivity in the employee when structured in a way that will satisfy the employees.

The findings therefore calls for strategic considerations when formulating and implementing leadership style adopted by various Agribusiness enterprises. This is needful because of the critical role and the huge effect pay differential and related rewards have on the productivity of the employees.

CONCLUSION AND RECOMMENDATIONS

This study therefore conclude that there is a relationship between the managers' leadership style and employees' satisfaction in Agribusiness enterprises in Aba, also that there is a negative but significant relationship between the managers' leadership style and employees' satisfaction in Agribusiness enterprises in Aba. This research work has outlined the effect of leadership style on employees' satisfaction in SMEs, using selected SMES in Abia State. Aspects of the leadership style pattern studied related to the quality of work of the employees. Among specific areas that fall under the rubric of leadership grid management, quality of work life includes a challenging job, a safe working environment, human dignity in the work environment, an equitable wage, and the right to improve one's skills level (MBO) techniques (Luthans *et al.*, 1980). This work has proved that the better the organizational Leadership style, the greater the employee satisfaction in SMES.

In view of the findings of this study, the following recommendations would be helpful to the selected SMEs and other organizations in Nigeria, to redress some of the challenges facing them, especially in the area of Leadership style of management and general management of people at work.

i. Aside from the academic qualification and seniority, workers should be rewarded more on the basis of performance. In other words, performance appraisal should play a greater role in the promotion process. And every level of responsibility and result achieved must be with a corresponding of remuneration.

ii. On performance, it is strongly recommended that workers should be periodically promoted or upgraded within a period of not more than four years. While this serves as recognition of their good work, it provides a larger scale for measuring their benefits. This brings satisfaction to the employee and encourages him/her to improve in performance. Finally, organizations should, adopt the humane management practices in order to adequately commit the workforce to the work activities.

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Trends of Cocoa, Cashew, Sesame, and Ginger Exports in Nigeria: An Empirical Investigation (1980–2022)

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ABSTRACT
International trade is the exchange of money, goods, and services across national boundaries or territories when there is a demand for those goods or services. International trade allows participating countries to access new markets and products like food, clothing, spare parts, oil, jewelry, wine, stocks, and currencies as well as services like tourism, banking, consulting, and transportation. This study analyzed trends of cocoa, cashew, sesame, and ginger exports in Nigeria: an empirical investigation (1980–2022). This study used time series data for 43 years, obtained from various sources from 1980 to 2022. The data were sourced from the Central Bank of Nigeria's annual report and statement of account, the National Bureau of Statistics (NBS), an online database maintained by the Food and Agriculture Organization (FAO), and other relevant publications. The study used descriptive, and trend analysis. The study showed significant variations in the export volumes of cocoa, cashew, sesame, and ginger over the years. Cocoa was the most exported commodity, with fluctuations influenced by government policies such as the Cocoa Re-birth Programme and the Structural Adjustment Programme. Cashew exports started in 1988 and showed a general increasing trend despite some fluctuations, notably a decline in 2020 due to the COVID-19 pandemic. Sesame exports reached their peak in 2021, while ginger exports demonstrated substantial growth, with 2021 recording the highest volume. There was a positive relationship between time and the volume of cocoa, cashew, and sesame exports, indicating that their growth rates increased over the study period, while ginger export showed a negative relationship with time, reflecting a decelerating growth trend. These variations points to the influence of economic policies, global demand, and external shocks on Nigeria's agricultural export performance. The study recommended that the government should enhance policies that support export growth by investing in modern processing facilities, efficient transportation systems, and storage infrastructure. This will help reduce post-harvest losses and improve the competitiveness of Nigerian agricultural exports in the global market.
Keywords: Export commodities, non-traditional exports, traditional exports, trade, international markets

INTRODUCTION
An export in international agricultural trade is a commodity produced in one country that is sold into another country or a service provided in one country for a national or resident of another country. Many countries use trade in agricultural products as real tools to boost their economies and achieve sustainable development (Benson and Robert, 2022). The same is true for Sub-Saharan African (SSA) countries, where agricultural exports exceeded imports from 1961 to 2005, indicating a

positive balance of trade. The SSA's total imports are about 11.7 billion USD from other countries within the region and 36.8 billion USD from other countries (Osabohien *et al.,* 2019). In Nigeria, the share of agriculture in total exports was 5.23% in 1987, 2.21% in 1990, 1.63% in 1995, 0.48% in 2000, 0.61% in 2005, 1.18% in 2010, 1.85% in 2014, and 3.35% in 2018 (Udo and Joshua, 2022). The Nigerian agricultural export products can be divided into traditional and non-traditional crops (Olaiya, 2016). Cocoa, palm kernel, rubber, coffee, kola nuts, groundnuts, and cotton are grouped under the traditional export crops. However, non-traditional export crops like pineapple, cashew nuts, eggs, processed fruits, alcoholic beverages, and spices are more valuable on the world market.

Cocoa bean (technically called cocoa seed) or simply cocoa is the dried and fully fermented seed of Theobroma cacao, from which cocoa solids (a mixture of non-fat substances) and cocoa butter (the fat) can be extracted (Abdullahi, Shahriar, Kea, Abdullahi, Zhang and Huo, 2021). It plays a significant role in the country's economic policy-making processes and significantly increases agricultural income (Osabohien *et al.,* 2019). Cocoa contributes significantly to the economic growth of Nigeria, adding an average of US$313.33 million to the annual Gross Domestic Product of the country (Oni, 2020). Nigeria's top ten cocoa export destinations are as follows: Netherlands (36.74%), Germany (13.34%), France (6.66%), United Kingdom (6.15%), Belgium (5.89%), Spain (5.64%), USA (4.35%), Canada (4.15%), Malaysia (2.48%), and Italy (1.58%) (Abdullahi *et al.,* 2021). In 2018, Nigeria exported 321.99 thousand tons of cocoa worth $ 657.61 million to the global market (FAOSTAT, 2020).

Furthermore, the cashew (*Anacardium occidentale*) is a tropical evergreen tree native to South America in the genus Anacardium that produces the cashew seed and the cashew apple accessory fruit (Eze, Macharia and Ngare, 2022). The cashew seed is frequently used as a snack nut (cashew nut), cooked into cashew cheese or cashew butter, or consumed on its own. Cashew nuts have a sizable market, with an estimated $5.26 billion in global sales in 2017 (International Nut and Dried Fruit Council (INDC), 2019). The world production quantity of raw cashew nuts stood at 4,898,210 metric tons, with a gross production value of US$4,287,466.57 at constant price (Alawode and Adesoji, 2020). Available statistics have shown that the major cashew-producing countries in the world and their respective outputs in 2017 were Vietnam (1,221,070 MT), Nigeria (982,530 MT), India (671,000 MT) and Ivory Coast (607,300 MT), implying that Nigeria is the major cashew-producing nation in Africa and second in the world (Food and Agriculture Organization (FAO), 2018). The average annual cashew nut export in the country was US$31.19 million, this value increased the country's gross domestic product (FAO, 2019).

Ginger (*Zingiber officinale*) is a flowering plant whose rhizome, ginger root, or ginger, is widely used as a spice and a folk medicine. Ginger originated in Maritime Southeast Asia and was domesticated first by the Austronesian peoples. Ginger is consumed in its fresh form or dried, powdered forms such as delicacy, spice, or medicine used for ailments such as high blood pressure, diarrhea, nausea, diabetes, high cholesterol, and inflammation. In 2019, world production of ginger was 4.1 million tonnes, led by India with 44% of the world total (Nair, 2019). Nigeria produces about 110,000 tonnes of ginger annually 10% is consumed locally and 90% is exported (Omotayo *et al.,* 2021).

Sesame (*Sesamum indicum*) is a plant in the genus Sesamum, also called benne, occurring naturally in tropical regions around the world and is cultivated for its edible seeds, which grow in pods. Sesame seed is considered to be the oldest oilseed crop known to humanity (FAOSTAT, 2020). Sesame seed has one of the highest oil contents, with a rich, nutty flavor, a common ingredient in cuisines. World production in 2018 was 6 million metric tons (5,900,000 long tons; 6,600,000 short tons), with Sudan, Myanmar, and India as the largest producers (Ibrahim *et al.,* 2022).

Despite numerous campaigns by relevant stakeholders in favor of agriculture and the sizable revenues from oil before the crash in oil prices, investment in the agricultural sector has been slow in Nigeria (Anthony *et al.,* 2020). It is crucial to keep in mind that investment in agriculture, particularly in cash crops that are valuable on the global markets, is desperately needed in Nigeria due to its growing population and slow rate of economic growth. This is because non-traditional cash crops are highly valuable in the international markets and would indirectly but more significantly increase per capita income, increase capital inflows, increase economic growth, decrease urban/rural migration, increase export, increase balance of payments, reduce mortality rate, and spur growth in the real sectors.

Empirically, studies have been conducted to proffer solutions to the problems of agricultural export trade and economic growth in Nigeria. Most of these studies are focusing on traditional agricultural commodities like cocoa. For instance, Busari *et al.* (2022) studied factors influencing the domestic supply of cocoa in Nigeria (1980-2019), Oni (2020), and Abdullahi *et al.,* (2021) studied Nigeria's cocoa exports using a gravity model approach; and Oni (2020) studied the determinants of cashew supplies and prospects for diversification into agro-allied industries in Nigeria. This study filled the research gap by analyzing the trends of cocoa, cashew, sesame, and ginger exports in Nigeria: An empirical investigation (1980–2022).

METHODOLOGY

The Study Area

This study was carried out in Nigeria. The country is beautifully situated along the coast of West Africa between latitude 9°4'55.2'N of the Greenwich Meridian and longitude 8°4'31'E of Equator. Nigeria is one of the sub-Saharan African nations in the western part of the Africa and shares land border with the republic of Benin to the west, Chad and Cameroon to the east, Niger republic to the north, and its coast lies on the Gulf of Guinea. The country occupies a total land area of 923,770 Km2, of which only about 34.2 million hectares are being cultivated and less than one percent of the arable land is irrigated (NBS, 2016). It is divided into seven broad ecological or land resource zones namely Rainforest, Montane Forest/grassland, mangrove swampy forest, Sudan savanna, Derived savanna, Sahel savanna and Guinea savanna. Farming is the predominant occupation of the people. Cassava, cocoa, ginger, sesame, groundnut, yam, sorghum, maize, millet and rice are among the major food crops in Nigeria.

Method of Data Collection

This study made use time series data of a period of 43 years, obtained from various sources spanning from 1980 to 2022. The data were sourced from Central Bank of Nigeria annual report and statement of account, National Bureau of Statistics (NBS), an online database maintained by Food and Agriculture Organization (FAO) and other relevant publications.

Analytical Technique

Unit root used the Augumented Dickey-Fuller (ADF) (Dickey and Fuller, 1979). This was used to test for being stationary or non-stationary. A stationary series is one with a mean value which will not vary with the sampling period. A non-stationary series would exhibit a time varying mean (Juselius, 2006). The ADF test consist of estimating the following regression:

$$\Delta Y_t = \beta_1 + \beta_1 + \delta Y_{t-1} + \Sigma^m_{t=1} \alpha_1 \Delta Y_{t-1} + e_t \quad (1)$$

Y is the series
t is trend factor
e_t is the stochastic error term
t_{-1} is the lad length

It is a one-sided test whose null hypothesis is $\delta = 0$ versus $\delta < 0$ (hence large negative value of the test statistics leads to the rejection of the null) and Δ is the difference operator. Under the null, Y_t must be differenced to achieve the stationarity; under the alternative, Y_t is already stationary and no differencing is required.

The trends of cocoa, cashew nut, ginger and sesame export in Nigeria was achieved using exponential trend model. The exponential trend was adapted from Onyenweaku (2004) and Onu et al, (2017) as;

$$LNCOEX_t = \beta_0 + \beta_1 t + \mu_t \quad (2)$$
$$LNCAEX_t = \beta_0 + \beta_1 t + \mu_t \quad (3)$$
$$LNSEEX_t = \beta_0 + \beta_1 t + \mu_t \quad (4)$$
$$LNGIEX_t = \beta_0 + \beta_1 t + \mu_t \quad (5)$$

Where:
$LNCOEX_t$ = Natural log of cocoa export volume of Nigeria at period t
$LNCOEX_t$ = Natural log of cashew export volume of Nigeria at period t
$LNSEEX_t$ = Natural log of sesame export volume of Nigeria at period t
$LNGIEX_t$ = Natural log of ginger export volume of Nigeria at period t

Where,
β_0 = the constant in the regression line.
β_1 = the trend coefficient.
t = trend variable measured in years (1,2,3, ...4)
μ_t = the error term.

RESULTS AND DISCUSSION

Table 1: Summary statistics of the selected agricultural commodity exports volume in Nigeria (1980-2022)

Variable	N	Minimum	Maximum	Mean	Std. Dev
Qty of cocoa export (COEX) (tons)	43	92891.00	344659.56	191064.2088	58007.07995
Qty of cashew export (CAEX) (tons)	43	232.00	261976.31	44843.7288	66324.14201
Qty of sesame export (SEEX) (tons)	43	0.00	297022.00	71989.6079	82222.67659
Qty of ginger export (GIEX) (tons)	43	0.00	262615.63	14921.3700	40450.22995

Source: FAOSTAT, 2021

Result in Table 4.1 shows the summary statistics of the four selected agricultural commodity exports in Nigeria during the study period (1980 – 2022). The result shows that cocoa had a maximum and minimum quantity of 344659.56 tons 92891.00 tons respectively with a mean export quantity of 191064.2088 tons. This finding is in tandem with Busari *et al.* (2022) who examined the determinants of domestic supply of cocoa in Nigeria (1980-2019) and reported that the minimum quantity of cocoa exported was 344659.56 tons. Furthermore, the average quantity of cashew exported during the period under study stood at 44843.7288 tones. Mean exported volume of sesame and ginger sweet were 71989.6079 tons and 14921.3700 tons respectively. These results indicated that Nigeria exported more cocoa beans when compared to the other three agricultural commodity exports. This result is not surprising given the fact that Nigeria occupies the fourth position in the world in terms of cocoa exportation.

Trends of Cocoa, Cashew Nut, Ginger and Sesame Export in Nigeria

Figure 1 shows the trend of annual cocoa export in Nigeria from 1980 - 2022**.** It could be seen from the Figure 1 that the estimates are not consistent as they do not show steady increasing or decreasing trend over the period. This confirmed that during the study period, the export volume of cocoa in Nigeria increased and decreased severally. Specifically, the result showed a lower level of cocoa from 1980 to 1987 with the least recorded in 1985; this may be as a result of the oil discovery in country in the 1970s and 80s with the effort of the government concentrated more on oil than agriculture as well as the adverse effect of the Cocoa Marketing Board.

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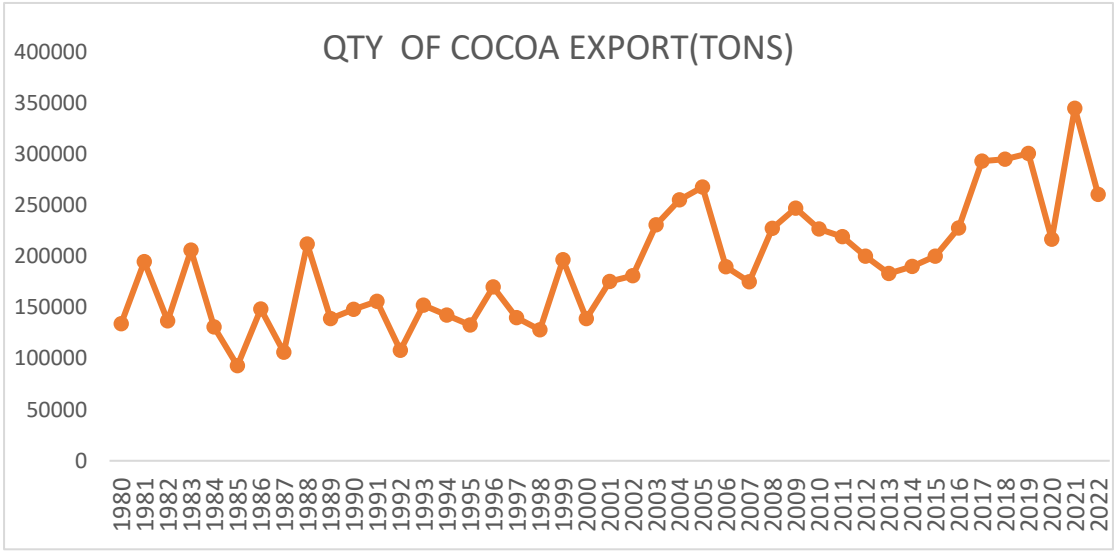

Figure1: Trend in cocoa export volume of Nigeria (1980-2022)

This finding corroborates with Akpaeti *et al.* (2020) who assessed the trend of agricultural export crops in Nigeria and reported lower level of cocoa export from 1980 to 1995. There was increase in the cocoa

beans export 1988 which dropped again in 1989. Cocoa export maintain a decreasing and increasing trend from 1989 to 2000; rose sharply in 2003 and maintained an increasing trend till 2005 , indicating good performance of the Cocoa Re-birth programme launched in 2005 by the federal government This sharp and consistent increasing trend within that period could also be as a result of the success of the Structural Adjustment Programme (SAP), introduced by then-government, on cocoa production which triggered increase in its exportation (Olufikayo, 2019). This was followed by a sharp decline of annual cocoa export from 2005 to 2007. There was a sharp increase of cocoa export in 2017 which continued through 2021, reaching the maximum export volume of (344659.56 tons) of annual cocoa export of the period under study.

Figure 2 presents the trend in the export supply of cashew nuts in Nigeria from 1980 to 2022. The Table shows that the average export supply of cashew nuts fluctuated between 1980 and 2022. Average export of cashew nuts stood at 44843 tons for the entire study period. The average annual export volume of cashew nuts decreased and increased alternately across the study period. No cashew nut was exported in Nigeria from 1980 to 1987. Exportation of cashew nuts in Nigeria commenced in 1988.

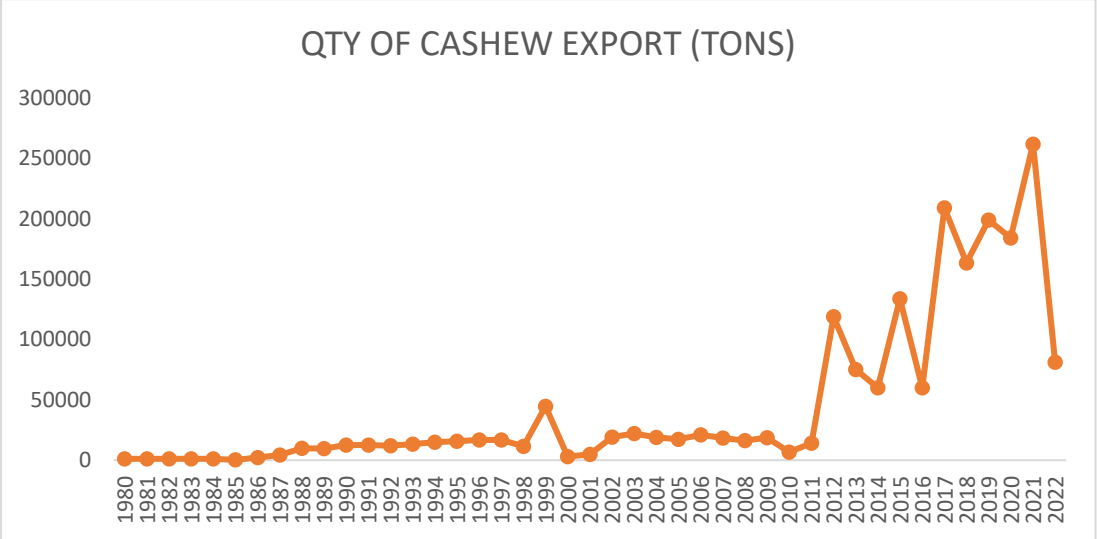

Figure 2: Trend in cashew export volume in Nigeria (1980 – 2022)

There was a stable and consistent cashew export in Nigeria from 1988 – 1998. This finding is in line with Ogunwolu *et al.* (2023) who examined the factors affecting the export value of Nigerian cashew nut and reported that cashew export was consistent in Nigeria from 1988 – 1998. Before it increased sharply in 1999, declined again in 2000. There was steady increase in cashew nut export supply from 2012 till 2021. However, in between 212 and 2021, there a drop in the export especially in 2020. The fall of the export volume of Nigerian cashew nut in 2020 can be directly attributed to the emergence of corona virus and consequently the lockdown in many cashew producing and consuming countries.

The result of value of exported sesame seed in Nigeria is presented in Figure 3. A steady increase in sesame export was recorded from 1988 to 2017 except in 2014 and 2018 when the export volume declined by 2.86% and 2.76% from the value recorded in 2013 and 2017 respectively. Overall, the result indicates value of sesame seed from Nigeria increase about 13%, from 1980 to 2022. The results also showed that from 1980 to 2022, a total of 3513202 tons of sesame was exported from Nigeria. This finding also aligns with Usman *et al.* (2024) who assessed the dynamics and competitiveness of Nigeria's sesame production in international trade: Vector error correction method. The highest quantity of sesame (297022 tons) exported in Nigeria within the period under review was recorded in 2021; while the minimum export quantity (1026 tons) was in 1990. The result also showed that the mean quantity of sesame export in Nigeria during the study period was 81702 tons while the percentage mean changes in sesame output within the same period stood at 7.74%.

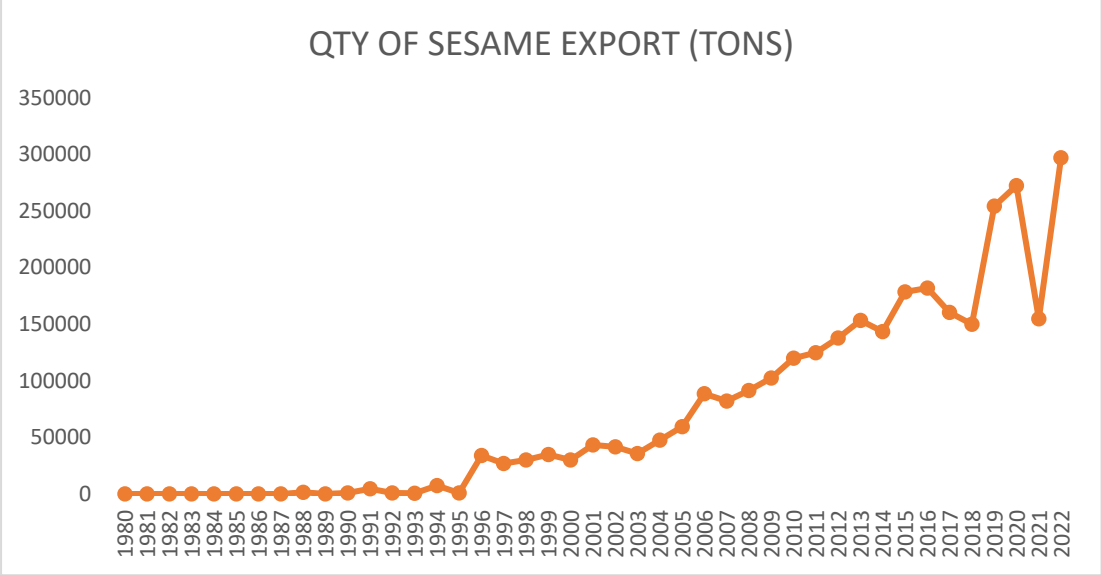

Figure 3: Trend in Sesame Export in Nigeria from 1980 to 2022

The result showed that ginger has an all-time maximum export volume of 262615 tons (2021) and an all-time minimum output of 534 tons (1989) over the considered time period. This report aligns with Alabi *et al.* (2024) examined the factors influencing export performance of ginger (*Zinbiger officinale*) in Nigeria. The trend of enormous growth in ginger export indicates that ginger export could be a potential enterprise contributing to the national economy.

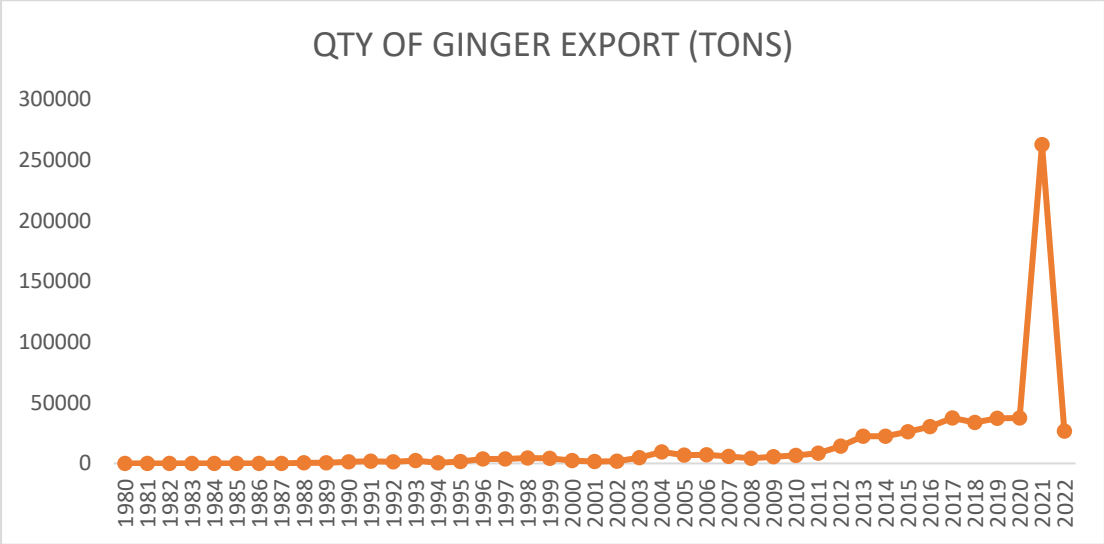

Figure 4: Trend in Ginger Export in Nigeria from 1980 to 2022

This remarkable growth trajectory positions ginger export as a promising enterprise with significant potential to contribute to national economic development. With sustained investment, value addition, and supportive government policies, the ginger value chain can further boost foreign exchange earnings, create employment opportunities, and enhance the livelihoods of rural farming households across the country.

Acceleration, Deceleration or Stagnation in COEX, CAEX, GIEX and SEEX in Nigeria (1980-2022)

The emphasis of the quadratic trend result is on the value of the coefficient of squared time variable (β_2) which authors including Onyenweaku (2004), Nnamerenwa (2012) and Onu *et al,* (2018) all agree best predicts the nature of growth in a given time series. To investigate for the existence of acceleration, deceleration or stagnation in growth of COEX, CAEX, GIEX and SEEX in Nigeria (1980-2022), the quadratic equation in the time trend variable was fitted accordingly.

Table 4.2 Estimates of quadratic equation in time trend variable for COEX, CAEX, GIEX and SEEX in Nigeria for the period under study

Dependent Variable	β_0	β_1	β_2	R^2	F-ratio
Cocoa Export	6.445474	0.426597	0.125463	0.886721	145.452***
	(23.51245)***	(12.20110)***	(22.221210)***		
Cashew nut Export	8.587854	0.011254	0.0025420	0.916546	530.524***
	(54.01248)***	(2.754213)***	(3.542139)***		
Ginger Export	-5.732345	0.447821	-0.005248	0.884111	171.624***
	(-16.82145)***	(11.95674)***	(-3.837845)***		
Sesame Export	1.003000	0.4941001	0.0240022	0.921222	458.888***
	(3.24700)	(8.519011)***	(9.092010)***		

Source: Computed from time-series data, 1980-2022 Note: *** = significant at 1%, alpha level.

The quadratic term β_2 allows for the possibility of acceleration, deceleration or stagnation in the growth process. The statistically significant positive value of the coefficient of time variable (β_2) for volume of cocoa export (β_2= 0.125463), volume of cashew export (β_2= 0.0025420 and volume of sesame export (β_2 = 0.0240022 showed acceleration in the growth rates thus, indicating that their growth rates increased at an increasing rate. On the other hand, volume of ginger export (β_2= -0.005248) exhibited decelerative growth during the study period implying increase at a decreasing rate. This implies that ginger export in Nigeria needs to be stepped up through the implementation of relevant policies that would help boost agricultural exports as a whole. This finding is in tandem with Alabi *et al.* (2021) who examined the factors influencing export performance of ginger (*Zinbiger Officinale*) in Nigeria.

CONCLUSION AND RECOMMENDATIONS

The study showed significant variations in the export volumes of cocoa, cashew, sesame, and ginger over the years. Cocoa remained the most exported commodity, with fluctuations influenced by government policies such as the Cocoa Re-birth Programme and the Structural Adjustment Programme. Cashew export started in 1988 and showed a general increasing trend despite some fluctuations, notably a decline in 2020 due to the COVID-19 pandemic. There was a positive relationship between time and the volume of cocoa, cashew, and sesame exports, indicating that their growth rates increased over the study period, while ginger export showed a negative relationship with time, reflecting a decelerating growth trend. These variations points to the influence of economic policies, global demand, and external shocks on Nigeria's agricultural export performance.

Based on the findings and conclusion of this study, the following recommendations were proffered;

i. The government should enhance policies that support agricultural export growth by investing in modern processing facilities, efficient transportation systems, and storage infrastructure. This will help reduce post-harvest losses and improve the competitiveness of Nigerian agricultural exports in the global market.
ii. The government and private sector stakeholders should actively explore new export markets through trade agreements and partnerships.

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