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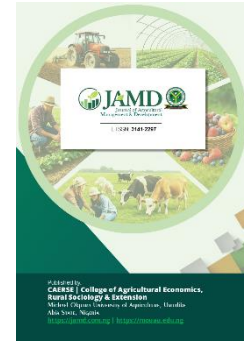
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Effect of Flooding on Rice Production in Ebonyi State, Nigeria

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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.

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. 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.

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.

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.

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.

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 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

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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Appendix**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.

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.

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%

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 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 inputs	96	80.0

Source: Field data, 2023. Multiple responses