



JAMD

Journal of Agricultural
Management & Development



E-ISSN: 3141-2297
Volume 1 Issue 1, April, 2026

ISSN 3141-2297



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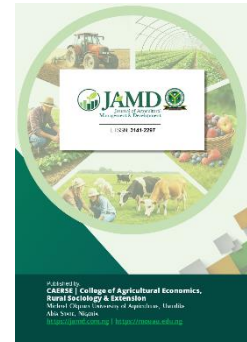
Published by:
**CAERSE | College of Agricultural Economics,
Rural Sociology & Extension**
MICHAEL OKPARA UNIVERSITY OF AGRICULTURE, UMUDIKE
ABIA STATE, NIGERIA

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Journal of Agricultural Management & Development

E-ISSN: 3141-2297
Volume 1 Issue 1, April, 2026



Financial Investment, Climate Variability and Fishery Enterprise Performance Nexus in Southern Nigeria: Two-Stage Least Squares (2SLS) Approach

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ARTICLE INFO

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Keywords:

Financial Investment, Climate Variability,
Fishery Enterprise Performance.



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Journal homepage: www.jamd.com.ng

ABSTRACT

This study examined the nexus between financial investment, climate variability, and fishery enterprise performance in Southern Nigeria using the Two-Stage Least Squares (2SLS) approach. Primary data were collected from 105 fishery enterprise operators using a structured questionnaire. Descriptive statistics, cost and return analysis, and the Two-Stage Least Squares regression technique were used for data analysis. The results showed that temperature change ($\bar{X} = 4.19$), flood occurrence ($\bar{X} = 4.07$), rainfall variability ($\bar{X} = 4.05$), drought frequency ($\bar{X} = 3.94$), and storm/wind effects ($\bar{X} = 3.81$) were the major climate-related challenges affecting fishery enterprises. The average current capital investment among fish farmers was ₦730,476.69, indicating moderate financial capacity. Cost and return analysis revealed that fish farming is profitable but highly cost-intensive, with feed accounting for 72.63% of total production costs. The net farm income per production cycle was ₦425,636.44 with a productivity index of 1.11 and a return on investment of 0.149. The first stage of the 2SLS results showed that market access ($p < 0.05$), training ($p < 0.10$), farm size ($p < 0.10$), return on sales ($p < 0.10$), and input cost ($p < 0.10$) significantly influenced financial investment among fish farmers. In the second stage, rainfall variability ($p < 0.01$), drought frequency ($p < 0.01$), education level ($p < 0.01$), farm size ($p < 0.01$), and seasonal variability ($p < 0.05$) positively influenced fishery enterprise performance, while storm and wind effects had a negative and significant influence ($p < 0.01$). The study concludes that financial investment and climate variability significantly influence fishery enterprise performance in the study area. The study therefore recommends improved access to credit facilities, promotion of climate-smart aquaculture practices, and policies that support local production of fish feed and improved market access to enhance the resilience and sustainability of fishery enterprises in Southern Nigeria.

Introduction

Financial investment plays a crucial role in enhancing the growth and performance of fishery enterprises. Adequate investment facilitates the adoption of modern technologies, improves production efficiency, and strengthens the fishery value chain (Akanni, 2008). Investment in fish farming infrastructure, hatcheries, feed production, processing and preservation facilities, storage systems, and research and development is essential for increasing productivity and ensuring the sustainability of the fishery sector (Abdullah, 2023). Despite its importance, many fishery entrepreneurs, particularly small-scale operators, face severe financial constraints due to limited access to credit facilities, high cost of capital, and inadequate institutional support (Olaoye et al., 2021). These financial limitations restrict their capacity to expand production, adopt improved technologies, and implement sustainable fishery management practices.

Fisheries encompass all activities related to the production, harvesting, processing, and distribution of fish and other aquatic resources primarily for human consumption, although other objectives such as recreation, ornamental trade, and extraction of fish by-products like fish oil are also possible (Fletcher et al., 2002). Globally, fisheries consist of both capture fisheries and aquaculture systems operating in marine and freshwater environments. Freshwater fisheries contribute approximately 10 percent of the global fish catch, while marine fisheries account for about 90 percent (OECD, 2020; Abdullah, 2023). The sector remains an important source of employment and livelihood, with more than 10 percent of the world's population depending directly or indirectly on fisheries for income and food security. In Nigeria, particularly in the Southern region, the fishery sector significantly contributes to rural livelihoods, employment generation, and nutritional security (Rotowa et al., 2019).

However, the performance of fishery enterprises is increasingly threatened by climate variability and climate change. Climate change influences fisheries through several channels, including fluctuations in water temperature, irregular rainfall patterns, flooding, coastal erosion, and changes in aquatic ecosystems. These environmental changes affect fish growth, reproduction, migration patterns, and overall fish stock availability (Brander et al., 2003; Beaugrand et al., 2002). In addition, climate change may influence the economic outcomes of fisheries through changes in fish prices, harvest volumes, fishing costs, fishers' income, profitability of fishing firms, and the overall economic rent generated by the sector (Sumaila et al., 2011).

African countries are particularly vulnerable to the impacts of climate variability due to heavy dependence on climate-sensitive sectors such as agriculture and fisheries, widespread poverty, weak infrastructure, and limited adaptive capacity. Southern Nigeria represents one of such vulnerable regions where the livelihoods of many households depend heavily on natural resources. Climate variability affects aquatic biodiversity and ecosystems in multiple ways. Rising temperatures may force aquatic species to migrate to more suitable habitats, while sea-level rise can lead to saltwater intrusion into freshwater ecosystems, thereby altering ecological balance and potentially causing the extinction or relocation of some species. Such environmental disruptions reduce fish availability and threaten the sustainability of fishery enterprises.

The fishery sector in Southern Nigeria therefore faces a dual challenge: inadequate financial investment and increasing climate variability. Limited financial resources reduce the capacity of fishery entrepreneurs to adopt climate-smart technologies such as improved pond management systems, water recirculation technologies, temperature regulation systems, and improved feed management practices. At the same time, climate variability directly affects fish production and enterprise performance through environmental shocks. The interaction between these two factors creates complex dynamics that influence productivity, profitability, and long-term sustainability of fishery enterprises in the region.

Understanding the nexus between financial investment, climate variability, and fishery enterprise performance is therefore essential for developing effective policies and strategies aimed at strengthening the resilience of the sector. However, empirical analysis of this relationship may face econometric challenges such as endogeneity between financial investment and enterprise performance. For instance, while financial investment may improve fishery performance, profitable enterprises may also attract more investment. To address this issue, this study employs the Two-Stage Least Squares (2SLS) estimation technique to provide consistent and unbiased estimates of the relationship between financial investment, climate variability, and fishery enterprise performance in Southern Nigeria.

Methodology

The study is conducted in Southern Nigeria. Southern Nigeria encompasses the southern portion of the Federal Republic of Nigeria, lying roughly between latitudes 3°N to 7°N and longitudes 2.5°E to 9.7°E. It is bounded to the south by the Atlantic Ocean, to the north by the Middle-belt region, to the west by Benin Republic, and to the east by Cameroon. The region includes states in the South-West, South-South, and South-East geopolitical zones. The terrain in Southern Nigeria consists of coastal lowlands, swamp forests, mangrove zones, freshwater bodies, estuaries, and tropical rainforests. Inland from the coast, there are freshwater swamp forests, mangroves, and derived rainforest, gradually transitioning toward less dense forest or savanna in the northern fringes of the region (FAO, 1979; FAO, 2024). The climate is tropical, humid, and characterised by well-defined wet and dry seasons. Southern Nigeria experiences high annual rainfall, generally ranging from about 1,500 mm to over 4,000 mm, with coastal areas, especially in the Niger Delta, receiving the highest amounts. Temperature is relatively stable, often averaging between 26°C and 32°C in many locations. Humidity is high, especially along the coast, due to proximity to the Atlantic Ocean and the influence of maritime tropical air masses. Southern Nigeria comprises multiple states within the South-West, South-South, and South-East zones, including Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Lagos, Ogun, Ondo, Abia, Ebonyi, Anambra, Enugu, and Rivers States. The region is densely populated, with rapid urban growth and significant rural populations involved in agriculture, fishing, trade, and other small-scale enterprises. Data for this study were cross-sectional and collected from primary sources.

Budgetary Techniques

The budgetary techniques is given as:

$$NR = TR - TC \tag{1}$$

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

$$TC = TVC + TFC \tag{2}$$

Total revenue is the total amount of money that a farmer received from the sale of fish;

$$TR = \sum P_x Q \tag{3}$$

$$GP = TR - TVC \tag{4}$$

$$R/N = \frac{GP}{TC} \tag{5}$$

$$\text{Gross Ratio (GR)} = TC/TR \tag{6}$$

Where,

P = price per kg of fish (₦)

Q = quantity of sold (kg)

GP = Gross profit (₦)

R/N = Return per naira invested

Two stage least square regression model (2SLS)

Stage 1: Determinants of Financial Investment

Financial investment (FI_i) is influenced by socio-economic and operational factors:

$$FI_i = \alpha_0 + \alpha_1 LN_i + \alpha_2 ROS_i + \alpha_3 EDU_i + \alpha_4 EXP_i + \alpha_5 FS_i + \alpha_6 DEP_i + \alpha_7 LAB_i + \alpha_8 TRAIN_i + \alpha_9 MKT_i + \alpha_{10} IC_i + \alpha_{11} RISK_i + \mu_i \tag{7}$$

Where,

FI_i = Financial investment by fish farmer

LN_i = Amount of loan

ROS_i = Return on sales

EDU_i = Level of education

EXP_i = Experience

FS_i = Farm size

DEP_i = Depreciation of farm equipment

LAB_i = Labour force

$TRAIN_i$ = Training received

MKT_i = Market access

IC_i = Input cost

$RISK_i$ = Risk attitude

This stage generates predicted financial investment (\widehat{FI}_i) for use in Stage 2.

Stage 2: Relationship Between Financial Investment and Perceived Climate Variability

$$Y_i = \beta_0 + \beta_1 \widehat{FI}_i + \beta_2 TEMP_i + \beta_3 RAIN_i + \beta_4 FLOOD_i + \beta_5 DROUGHT_i + \beta_6 WIND_i + \beta_7 SEASON_i + \beta_8 EXP_i + \beta_9 FS_i + \beta_{10} LAB_i + \varepsilon_i \quad (8)$$

Where,

Y_i = Fishery enterprise performance (define equation)

\widehat{FI}_i = Predicted financial investment from Stage 1

$TEMP_i, RAIN_i, FLOOD_i, DROUGHT_i, WIND_i, SEASON_i$ = Climate variability variables

EXP_i, FS_i, LAB_i = Control variables

Results and Discussion

The findings in Table 1 reveal that temperature change recorded the highest mean score of 4.19, showing that it is the most influential climatic factor affecting the enterprises. This suggests that rising water temperatures directly alter fish metabolism, oxygen solubility, and reproductive behavior, leading to reduced yields and higher mortality rates. According to Oluowo (2017), increased water temperature causes physiological stress in fish, making them more susceptible to diseases and parasites, while Olu et al. (2023) further explained that temperature fluctuations disrupt the balance of aquatic ecosystems, affecting both capture and aquaculture fisheries. Similarly, Nwuba *et al.* (2022) observed that the current warming trends in Nigeria’s coastal and inland water bodies have reduced the productivity of small-scale aquaculture operations due to higher evaporation and poor water quality. The high perception of temperature impacts among respondents thus underscores the urgent need for adaptive water management and species diversification to maintain production stability.

Rainfall variability, with a mean score of 4.05, ranked second among the climatic challenges. Irregular rainfall patterns often result in either excessive flooding or insufficient water levels, both of which disrupt fish production. Odioko and Becer (2022) emphasized that unpredictable rainfall alters pond hydrology and nutrient balance, leading to either overflows that wash away fish stock or low water volumes that compromise growth conditions. In agreement, Oladapo and Ibrahim (2018) noted that rainfall inconsistency has become a major determinant of fish pond productivity, especially among farmers relying on natural water sources. Thus, the finding that rainfall variability has a high effect supports the view that climate-induced hydrological shifts pose one of the greatest operational risks in Nigeria’s aquaculture sector.

Flood occurrence followed closely with a mean score of 4.07, reflecting its destructive influence on fishery enterprises. Floods can cause total loss of stocked fish, destruction of ponds and cages, and contamination of water sources with pollutants. Nwokedi et al. (2020) documented similar findings, explaining that recurrent floods in Nigeria’s riverine and deltaic regions have been responsible for substantial economic losses in the fishery sector. The authors noted that these flood events are intensified by both climate change and anthropogenic factors such as poor drainage and deforestation. Omorodion (2020) also stressed that flooding leads to significant habitat degradation, particularly for inland fisheries, reducing biodiversity and the overall sustainability of aquatic ecosystems. Therefore, the high perception of flood impact among respondents suggests that flood mitigation infrastructure and early warning systems are vital for sustaining fishery productivity in vulnerable areas.

Drought frequency, with a mean score of 3.94, was also perceived as a major constraint. Droughts limit water availability, reduce the number of production cycles per year, and increase feed and operational costs. This finding aligns with Olaoye et al. (2016), who reported that prolonged dry spells negatively influence pond recharge rates and water quality, making small-scale aquaculture unsustainable without artificial water supply. Similarly, OECD (2020) emphasized that droughts not only affect physical water access but also disrupt the timing of fish breeding and harvesting cycles, thereby threatening food security and income stability among rural fish farmers.

The effect of storms and wind, with a mean score of 3.81, was also rated high, showing that intense weather events such as storms and strong winds damage ponds, fishing nets, and cages, leading to significant stock losses. Ofanson and Nitonye (2018) observed that storm surges and wind turbulence in coastal Nigeria have increased in recent years, causing mechanical damage to fishing infrastructure and contributing to high production costs. Nwokedi *et al.* (2020) also highlighted that coastal aquaculture systems, particularly those in open waters, are increasingly exposed to wind-induced waves and tidal variations that compromise their stability.

The distribution of current capital investment in the fishery enterprise, as presented in Table 2, reveals considerable variation in working capital among fishery operators in the study area. The largest proportion of respondents (29.5%) maintained current capital between ₦200,001 and ₦400,000, reflecting moderate financial capacity sufficient for routine operational needs such as purchasing feed, paying labor, and maintaining equipment.

Conversely, 12.4% of enterprises operated with less than ₦200,000, indicating that some small-scale operators have limited liquidity, which may constrain production efficiency and the ability to scale operations. This aligns with findings by Egwenomhe *et al.* (2022), who noted that limited working capital among small-scale fish farmers in Delta State negatively affected operational growth and adoption of improved aquaculture technologies.

Higher current capital levels were observed among a significant proportion of respondents: 14.3% had ₦800,001–₦1,000,000, 9.5% had ₦1,800,001–₦2,000,000, and 8.6% had more than ₦2,000,000. These higher investments were generally associated with medium- to large-scale enterprises or operations engaged in both aquaculture and capture fisheries, which require substantial inputs and labor. This finding corroborates Elezuo *et al.* (2024), who highlighted that larger or integrated fishery enterprises in Nigeria often sustain higher working capital levels, enabling them to adopt modern technologies, maintain regular production cycles, and respond more effectively to environmental and market fluctuations.

The mean current capital of ₦730,476.69 indicates that, on average, fishery enterprises have a moderate level of liquidity to sustain production activities. Adequate working capital is critical for mitigating risks associated with climate variation, feed shortages, or operational disruptions, which have been reported to impact fishery productivity and health in Rivers and Imo States (Chikaire *et al.*, 2016). The findings also suggest that enterprises with higher current capital are more likely to participate in growth-promoting initiatives, such as government empowerment programs or access to microfinance facilities, which have been shown to improve the growth and sustainability of aquaculture businesses in Nigeria (Egwenomhe *et al.*, 2022).

The overall cost structure and return of an average fishery enterprise in Southern Nigeria, as presented in Table 3, reveals that fish farming in the region is a profitable but cost-intensive venture. The total cost of production per batch amounted to ₦4,039,042.67, out of which the total variable costs (TVC) accounted for ₦3,885,566.00, representing 96.2% of the total production cost. This indicates that the bulk of expenses incurred by fish farmers are operational and directly related to production inputs. The cost of feed, amounting to ₦2,933,500.00, constituted 72.63% of the total production cost, signifying that feed remains the most significant cost component in fish farming. This finding corroborates that of Oni (2017) and Odioko and Becer (2022), who both identified feed cost as the dominant expenditure in aquaculture enterprises, accounting for over 70% of total variable costs. This high feed cost has been attributed to the dependence on imported raw materials and limited availability of locally produced alternatives, which raises input costs and affects profitability.

This was distantly followed by labour (₦296,000; 7.33%), water/electricity (₦198,050; 5.03%), and fuel (₦156,000; 4.90%). The relatively high labour cost reflects the labour-intensive nature of aquaculture production, which requires regular feeding, water quality monitoring, and pond maintenance. Similarly, the cost of water and electricity underscores the infrastructural challenges fish farmers face in maintaining optimal pond environments. The findings of Olaoye *et al.* (2016) and Nwuba *et al.* (2022) also support this, showing that energy and labour are crucial operational components that directly influence the productivity and sustainability of fish farms. Fuel expenses, on the other hand, are driven by frequent power outages and the need for generators to pump water and aerate ponds, a problem emphasized by Olu *et al.* (2023), who

observed that inadequate electricity supply and high fuel prices significantly reduce aquaculture profitability in coastal Nigeria.

Other variable cost items such as transportation (₦107,450; 2.66%), medication (₦122,845; 3/04%), and poultry manure (₦10,707; 0.27%) accounted for smaller proportions of total costs. These expenses, though modest, play essential roles in ensuring fish health and facilitating market distribution. Effective disease control and transportation management have been linked to reduced mortality and improved returns, as noted by Nwokedi et al. (2020), who reported that disease outbreaks and poor market access remain critical barriers to aquaculture efficiency in Nigeria.

The fixed costs (₦153,476.67), which accounted for 3.8% of total costs, included rent (₦114,700; 2.84%) and depreciation (₦38,776.67; 0.96%). The low proportion of fixed costs suggests that many fish farmers either operate on owned land or lease space at low cost. However, the depreciation figure indicates gradual wear and tear of production facilities and equipment, which may require future reinvestment. According to Omorodion (2020), neglecting maintenance and equipment renewal can lead to long-term productivity decline and increased operational costs, emphasizing the need for regular reinvestment in farm assets.

In terms of financial performance, the total revenue (TR) recorded was ₦4,464,679, while the gross profit (TR – TVC) and net farm income (TR – TC) were ₦579,113.11 and ₦425,636.44, respectively. The positive net farm income indicates that fish farming is profitable in the study area, as the total revenue exceeded total costs. A gross ratio (GR) of 0.904 implies that 90.4% of the total revenue was used to cover production costs, leaving a profit margin of approximately 9.6%. The return per naira invested (0.149) shows that for every ₦1.00 invested, the farmer realized a return of ₦0.15, demonstrating moderate profitability.

Furthermore, the productivity index of 1.11 implies that fish farmers in the study area generated ₦1.11 in output for every ₦1.00 invested, confirming operational efficiency but also highlighting a thin profit margin. This narrow margin indicates vulnerability to cost shocks such as rising feed prices, fuel scarcity, or inflationary pressures. As noted by Odioko and Becer (2022), the profitability of aquaculture enterprises in Nigeria is sensitive to fluctuations in input markets and energy costs.

In the first stage, market access, training, farm size, return on sales, and input cost emerged as significant determinants of financial investment among fish farmers. Market access had a positive and significant coefficient ($t = 2.01^{**}$), indicating that fish farmers with better access to input and output markets tend to invest more capital in their businesses. This result aligns with Rotowa et al. (2019), who observed that improved access to markets enhances profitability and encourages reinvestment in productive assets. Efficient market structures also reduce transaction costs, stabilize prices, and enable farmers to reinvest in critical production infrastructure such as ponds, feeds, and storage facilities. Likewise, training was positive and significant ($t = 1.70^*$), suggesting that capacity-building efforts and exposure to extension services motivate fish farmers to increase financial investment. Training enhances managerial competence, encourages innovation, and improves financial planning (Ozigbo, Anyadike, & Awotide, 2020). According to Rabo et al. (2014), training programs also strengthen farmers' understanding of sustainable aquaculture techniques and equip them with adaptive knowledge to respond to changing environmental and market conditions.

The coefficient for farm size was positive and significant ($t = 1.85^*$), implying that larger fish farms are more likely to attract and commit greater financial investments. This is consistent with the findings of Aminu et al. (2017), who reported that scale of operation determines investment capacity and resilience to external shocks in agricultural enterprises. Larger farms often have better collateral for credit access, higher turnover, and greater capacity to absorb risks associated with climatic or economic volatility. Return on sales ($t = 1.67^*$) was also positively significant, showing that profitability stimulates reinvestment decisions. Enterprises that experience higher returns are more confident in channeling additional resources into production, which fosters a positive feedback loop between profit and investment (Ozigbo et al., 2020). On the other hand, input cost had a negative and significant coefficient ($t = -1.98^*$), indicating that high production costs, especially feed, fuel, and fingerlings, discourage investment. This finding corroborates the assertions of Rabo et al. (2014) and Ozigbo et al. (2020), who emphasized that rising input prices remain one of the major constraints to aquaculture growth in Nigeria. High input costs not only reduce margins but also limit the ability of farmers to expand or modernize their operations.

The second stage of the 2SLS model assessed the effect of perceived climate variability on fishery enterprise performance. The results show that rainfall variability, drought frequency, farm size, education level, and storm/wind effect were statistically significant determinants of fishery performance. Rainfall variability had a positive and highly significant coefficient ($t = 4.12^{***}$), suggesting that moderate fluctuations in rainfall patterns can enhance pond water availability and nutrient circulation, thereby improving fish yield. This agrees with Schallenberg, Hall, and Burns (2003), who found that controlled hydrological variations could stimulate nutrient mixing and biological productivity in aquatic ecosystems. However, excessive or erratic rainfall may have destructive effects, leading to flooding or pond overflow. As such, the observed positive relationship likely reflects adaptive responses among farmers who have developed effective water management strategies.

Similarly, drought frequency was positive and significant ($t = 2.75^{***}$), implying that farmers' awareness of increasing drought conditions may motivate them to adopt adaptive practices such as water recycling, integrated irrigation, and pond shading. Robert et al. (2019) reported that fish farmers in the Niger Delta region of Nigeria have adopted several adaptive measures to cope with prolonged dry seasons, including improved pond lining and water storage systems. This finding aligns with Pandey and Jha (2012), who emphasized that vulnerability to climate hazards stimulates adaptive behavior when communities have sufficient awareness and institutional support.

The level of education of fish farmers had a positive and highly significant coefficient (10,043.401) at the 1% level, indicating that educated farmers perform better under changing climatic conditions. Education enhances technical skills, risk assessment, and the ability to interpret climate information. As noted by Ozigbo et al. (2020) and Sarkar, VanLoon, and Watson (2019), human capital development is essential for building resilience in the agricultural and fishery sectors. Educated farmers are more likely to access extension services, utilize weather forecasts, and implement sustainable aquaculture practices that improve productivity.

The farm size variable was also positive and significant ($t = 4.12^{***}$), confirming that larger fish farms tend to perform better than smaller ones under variable climatic conditions. Larger farms have more diversified production systems, better infrastructure for water management, and greater access to financial resources to buffer against climatic shocks. According to Rotowa et al. (2019), economies of scale enhance cost efficiency and allow larger farms to invest in adaptive technologies such as aerators, water pumps, and storage facilities. Conversely, the storm/wind effect had a negative and highly significant coefficient ($t = -2.84^{***}$), showing that strong winds and storms disrupt fishery operations by causing structural damage to ponds, nets, and storage facilities. These findings mirror the observations of Robert et al. (2019), who noted that severe storms lead to fish mortality, reduced feeding activity, and post-harvest losses, thereby undermining productivity and profitability.

Conclusion and Recommendations

The study examined the nexus between financial investment, climate variability, and fishery enterprise performance in Southern Nigeria using the Two-Stage Least Squares (2SLS) approach. The findings revealed that climate variability, particularly temperature changes, rainfall variability, flooding, drought, and storms, significantly affects fishery production and enterprise stability in the region. The results also showed that fish farming is profitable but highly cost-intensive, with feed accounting for the largest proportion of production costs. Furthermore, factors such as market access, training, farm size, return on sales, and input costs significantly influenced financial investment among fish farmers, while rainfall variability, drought frequency, education level, and farm size positively affected enterprise performance. However, storm and wind effects negatively impacted productivity.

Based on the findings, government and financial institutions should improve fish farmers' access to affordable credit and investment support to enable expansion and adoption of improved technologies. There is also a need to strengthen extension services and training programs to promote climate-smart aquaculture practices such as improved pond management, water conservation, and the use of climate-resilient fish species.

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Appendix

Table 1: Climate variability affecting the enterprises in the study area

| Climatic Variable | N | Grand Total | Mean | Decision |
|---------------------------------------|-----|-------------|------|----------|
| Temperature change/effect | 105 | 235 | 4.19 | High |
| Rainfall variability/effect | 105 | 200 | 4.05 | High |
| Flood occurrence/impact | 105 | 210 | 4.07 | High |
| Drought frequency/effect | 105 | 170 | 3.94 | High |
| Effect of storms/wind | 105 | 145 | 3.81 | High |
| Unpredictable seasonal changes/effect | 105 | 130 | 3.69 | Moderate |

Source: Field survey (2025) Decision rule: any mean response ≥ 3.0 was adjudged accepted while any mean responses < 3.0 was adjudged rejected.)

Table 2: Level of Current capital investment in the fishery enterprise

| Current capital | Frequency | Percentages |
|-----------------------|-------------------|-------------|
| < 200,000 | 13 | 12.4 |
| 200,001 – 400,000 | 31 | 29.5 |
| 400,001 – 600,000 | 13 | 12.4 |
| 600,001 – 800,000 | 10 | 9.5 |
| 800,001 – 1,000,000 | 15 | 14.3 |
| 1,200,001 – 1,400,000 | 2 | 1.9 |
| 1,400,001 – 1,600,000 | 1 | 1.0 |
| 1,600,001 – 1,800,000 | 1 | 1.0 |
| 1,800,001 – 2,000,000 | 10 | 9.5 |
| >2,000,000 | 9 | 8.6 |
| Total | 105 | 100.0 |
| Mean | 730,476.69 | |

Source: Field Survey data (2025)

Table 3: Performance of an average fishery enterprises in the study per batch

| Variable | Unit cost (₦) | Qty | Amount (₦) | % of TC |
|-----------------------------------|---------------|------------|---------------------|---------------|
| Total Revenue | 2,195.24 | 2033.8kg | 4,464,679.00 | |
| Variable Costs: | | | | |
| Fingerlings | 30 | 2540 unit | 61,014 | 1.51 |
| Feeds | 14500 | 195 bags | 2,933,500 | 72.63 |
| Labour | 15500 | | 296,000 | 7.33 |
| Fuel | 600 | 260 liters | 156,000 | 3.86 |
| Water/Electricity | - | - | 198,050.00 | 4.90 |
| Transportation | - | - | 107,450.00 | 2.66 |
| Medication | - | - | 122,845.00 | 3.04 |
| Poultry mature | 1784.5 | 6 bags | 10707 | 0.27 |
| Total Variable Costs (TVC) | | | 3,885,566.00 | 96.20 |
| Fixed Cost | | | | |
| Rent (month) | 10000 | | 114,700.00 | 2.84 |
| Depreciation | | | 38,776.67 | 0.96 |
| Total Fixed Cost (TFC) | | | 153,476.67 | 3.80 |
| Total Cost (TVC + TFC) | | | 4,039,042.67 | 100.00 |
| Gross profit = TR – TVC | | | 579,113.11 | |
| Net Farm Income = TR – TC | | | 425,636.44 | |
| Productivity Index | | | 1.11 | |
| Return/naira invested = GP/TC | | | 0.149 | |
| Gross Ratio (GR) = TC/TR | | | 0.904 | |

Source: Field survey (2025)

Table 4: Two-Stage Least Squares (2SLS) Regression Results on relationship between financial investment and perceived climate variability on fishery enterprises

| Variables | Stage 1 (Determinants of Financial Investment) | | Stage 2 (Effect of Climate Variability on Fishery Enterprise Performance) | |
|-------------------------|--|----------|---|----------|
| | Coef. | t-value | Coef. | t-value |
| Constant | 562.276 | 11.74*** | 1098181.575 | 6.25*** |
| Amount of Loan | -524.538 | -0.77 | -3.622 | -0.86 |
| Return on Sales | 0.366 | 1.67* | -8.986 | -2.84*** |
| Level of Education | -280.255 | -0.51 | 10043.401 | 2.75*** |
| Experience | 254.222 | 1.00 | 4835.698 | 1.91* |
| Farm Size | 0.376 | 1.85* | 242.385 | 4.12*** |
| Depreciation | 1531.589 | -1.75* | -4384.802 | -1.02 |
| Labour Force | 2717.241 | 1.14 | -3.741 | -0.22 |
| Training | 1106.723 | 1.70* | 4835.698 | 1.61 |
| Market Access | 843.157 | 2.01** | 1814.748 | 1.20 |
| Input Cost | -968.432 | -1.98* | -25744.344 | -3.07*** |
| Risk Attitude | 427.615 | 1.22 | 2065.075 | 0.30 |
| Temperature Effect | | | 21.473 | 1.29 |
| Rainfall Variability | | | 242.385 | 4.12*** |
| Flood Impact | | | -4168.969 | -0.78 |
| Drought Frequency | | | 10043.401 | 2.75*** |
| Storm/Wind Effect | | | -8.986 | -2.84*** |
| Seasonal Variability | | | 16955.806 | 2.10** |
| R ² | 0.683 | | 0.727 | |
| Adjusted R ² | 0.626 | | 0.529 | |
| F-statistic | 10.976*** | | 5.873*** | |
| N | 105 | | 105 | |

Source: Survey data, 2025* = significant at 10%, ***= significant at 1%, **= significant at 5%,