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Original Research Article

Credit Access and Enterprise Profitability across the Fish Value Chain in Delta State, Nigeria

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Abstract: This study examined credit access and enterprise profitability across fish producers, marketers and processors in Delta State, Nigeria. Data were collected from 340 respondents comprising 140 producers, 120 marketers and 80 processors selected through a multistage sampling procedure. Descriptive statistics, multiple regression and analysis of variance were employed. Cooperative societies were the main source of credit, accounting for 59.1% of respondents, followed by moneylenders (55.3%) and microfinance banks (37.9%); commercial banks and government programmes accounted for 20.0% and 16.5%, respectively. Credit access had a positive and significant relationship with profitability among producers, marketers and processors. The pooled estimate was also positive and significant, with the model explaining 64% of the variation in profitability. Scale of production was positively related to profitability, whereas operating cost had a negative relationship. Mean profitability was ₦75,000 for producers, ₦123,054.82 for marketers and ₦323,000 for processors, with significant differences between each pair of groups. Profitability varied significantly among the value-chain actors ($F = 261.885$, $p < 0.001$) as confirm by the Oneway ANOVA. The results show that credit access is positively related to profitability, but enterprise returns differ significantly according to position in the fish value chain. The findings point to the need for credit arrangements that correspond to the financial requirements of production, marketing and processing rather than treating fish enterprises as a uniform category.

Keywords: Credit Access, Enterprise Profitability, Fish Value Chain, Producers, Marketers, Processors.

INTRODUCTION

Aquaculture accounts for more than 50% of global fish production and has become an important source of food, employment and household income, particularly in developing countries. About 424 aquatic species are farmed worldwide, reflecting the growing scale and diversity of the sector (Issifu *et al*., 2022; Galappaththi *et al*., 2020). The industry extends beyond primary fish production to input supply, harvesting, processing, marketing, storage and distribution. These activities require capital at different stages. Producers finance ponds, fingerlings, feed, labour and equipment, whereas marketers and processors require working capital for fish procurement, transportation, storage, processing and packaging. Fish is also an important source of protein, essential amino acids and polyunsaturated fatty acids, making its production and distribution relevant to food and nutrition security (Rondanelli *et al*., 2020). The sector's economic contribution therefore depends not only on the volume of fish produced but also on the capacity of different actors to finance and sustain value-chain activities.

Credit is particularly important because most fish enterprises require expenditure before revenue is realised. Producers need finance to acquire inputs and maintain production, marketers require funds to purchase and move fish to consuming centres, and processors need capital for procurement, equipment, storage and value addition. Where credit is adequate and available on reasonable terms, it can facilitate input acquisition, investment and technology use and improve the capacity of enterprises to expand their operations (Ikpoza *et al*., 2021; Onuche *et al*., 2020). The problem arises when available credit is inadequate, costly or poorly matched to the financial requirements of the enterprise. High interest rates, collateral requirements, short repayment periods and inadequate loan amounts can restrict investment, particularly among small-scale operators. These limitations are relevant to processors and other actors whose activities require relatively high working

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capital and investment in storage, processing and cold-chain facilities (Osei *et al.,* 2023). Thus, credit access is not merely a question of whether finance is available, but also whether the amount, cost and terms of finance are suitable for the activities being undertaken.

The same financing problem is evident in Nigeria. Aquaculture contributes to domestic fish supply, employment and household livelihoods and constitutes an important part of the country's agricultural economy (Adeleke *et al*., 2020). However, many agricultural enterprises continue to face difficulties in obtaining timely and affordable finance. Although the Anchor Borrowers' Programme was introduced to improve access to affordable credit for smallholder farmers, evidence from Nigeria indicates that delayed disbursement of funds and institutional constraints have limited effective implementation of the programme (Obih & Baiyegunhi, 2018). Evidence from the catfish value chain illustrates the economic importance of institutional finance. Omodara *et al*., (2020) reported that processors with access to institutional loans achieved higher output and profit margins than those relying on personal savings. This suggests that the source and conditions of finance can have practical consequences for enterprise performance.

The issue is pertinent to Delta State, where fish production, marketing and processing constitute important agricultural and commercial activities. The state's freshwater and coastal environments support extensive fish-related enterprises involving producers, marketers and processors. However, operators frequently rely on personal funds and informal financial arrangements, including family and friends and rotating savings associations (esusu), which may provide short-term working capital but may be inadequate for larger investments and enterprise expansion (Gbigbi, 2019).

Moreover, the usefulness of credit depends on its terms. Loan size, interest rate, repayment period and the timeliness of disbursement determine whether borrowed funds can be applied effectively to production, procurement, processing and other income-generating activities. Where loan amounts are inadequate or repayment periods are too short, enterprises may be unable to finance productive investments or retain sufficient working capital for continued operations (Nwajei & Bello, 2024). Credit conditions can consequently affect profitability through their influence on input procurement, technology adoption, market participation and value addition (Omeje *et al*., 2020; Gbigbi, 2017).

Despite the importance of finance to fish enterprises, empirical evidence on credit access and profitability across the fish value chain in Delta State remains inadequate. Existing Nigerian studies have largely concentrated on fish farmers and production activities, with less attention given to producers, marketers and processors within a common analytical framework. This creates an important limitation because the financial requirements of these actors are not the same. Producers require capital for production inputs and fixed assets; marketers require working capital for fish procurement, transportation and distribution; while processors require additional funds for processing equipment, storage, packaging and preservation. Evidence drawn exclusively from producers therefore cannot fully explain the financing conditions or profitability of the wider fish value chain.

The relevant empirical question is consequently whether credit access differs across value-chain positions and whether such differences are associated with differences in profitability. A comparison of producers, marketers and processors makes it possible to examine credit access in relation to the distinct financial requirements and economic activities of each group. It also provides evidence on where financing constraints are most pronounced and whether actors with different levels of access to credit experience corresponding differences in enterprise returns.

This study therefore examines credit access and profitability among fish value-chain actors in Delta State, Nigeria, focusing on producers, marketers and processors. Specifically, it assesses credit access, identifies constraints to obtaining credit, compares profitability across the three groups, and examines the relationship between credit access and profitability. By analysing these actors within a common framework, the study extends the evidence beyond primary fish production and provides a clearer understanding of the financial conditions underlying enterprise performance at different stages of the fish value chain.

Research Hypotheses

H_{01}: There is no significant relationship between access to credit and the profitability of fish enterprises in the study area.

H_{02}: There is no significant difference in profitability levels among fish producers, processors, and marketers in the study area.

METHODOLOGY

Study Area

The study was conducted in Delta State, South-South Nigeria. The state has extensive freshwater and coastal resources that support fish production, processing and marketing across its three agricultural zones: Delta North, Delta Central and Delta South. Fish farming and related trading and processing activities are undertaken across several communities, providing an active setting for examining credit access and profitability among different fish value-chain actors. The study covered selected communities across the three zones to capture variation in fish production, marketing and processing activities.

Sampling Procedure and Sample Size

A multistage sampling procedure was used to select 340 respondents. First, the three agricultural zones of the state were included to provide geographical coverage. Two LGAs with substantial fish-related activities were then selected from each zone, giving six LGAs. Four communities were subsequently selected from each LGA, resulting in 24 communities. Respondents were stratified by value-chain position into producers, marketers and processors. Producers were randomly selected from the sampled communities, while marketers and processors were selected from major fish markets and processing clusters within the study locations. The final sample comprised 140 producers, 120 marketers and 80 processors.

Method of Data Collection

Primary data were collected using structured questionnaires administered through direct interviews. The instrument covered respondents' socioeconomic characteristics, sources and conditions of credit, credit access, constraints to borrowing and enterprise profitability. Trained enumerators assisted with field administration to ensure consistency in the collection and recording of responses.

Data Analysis

The data collected were analyzed using both descriptive and inferential statistical tools such as multiple linear regression, gross margin, net income models, benefit-cost ratio, rate of return on investment) and ANOVA.

Model Specification

Estimation of Profitability Levels of fish Enterprises across the Value Chain Actors

To estimate and compare profitability levels across value-chain stages (producers, processors, marketers), the study employed enterprise budgeting and financial ratio techniques and used one-way ANOVA to test for statistically significant differences in mean profitability indicators among the three actor groups.

Profitability measures (computed separately for each respondent):

Gross Margin (GM) = TR − TVC

Net Income (NI) = TR − TC (where TC = TFC + TVC)

Benefit–Cost Ratio (BCR) = TR / TC

Return on Investment (ROI) = (NI / TC) × 100

Where:

GM = Gross Margin (₦)

TR= Total Revenue (₦) obtained from sales of fish or fish products

TVC = Total Variable Cost (₦) (feed, labour, transportation, fuel, fingerlings)

NI = Net Income or Profit (₦)

TC = Total Cost (₦)= total fixed cost (TFC) + Total variable cost (TVC)

BCR = Benefit-Cost ratio

ROI = Return on investment (%)

Effect of Credit Access on Profitability of fish Enterprises

A regression model was used to determine the effect of credit access on profitability across the fish value chain actors. The model was specified as:

$$Profit = \alpha 0 + \alpha 1 CreditAccessi + \alpha 2 Scalei + \alpha 3 Educationi + \alpha 4 Experiencei + \alpha 5 Labouri + \alpha 6 Costi + \alpha 7 MarketDistancei + ei$$

Where:

Profit = profit of the ith enterprise

Credit access = Amount of credit accessed (₦)

Scale = Scale of production (output volume or stock capacity)

Education = Years of formal education

Experience = Years of aquaculture experience

Labourer = Number of labourers employed

Cost = Total operating cost (₦)

Market Distance = Distance to nearest market (km)

ei = Error term

The coefficients (α_1) show the elasticity of profitability with respect to each explanatory variable.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Fish Value-Chain Actors

The Socioeconomic characteristics across the three actor groups (producers, marketers, processors) are presented in Table 1:

Age Distribution

The pooled results show that the majority of respondents (28.2%) were within the 41–50 years' age group, with a mean age of 42.3 years. This indicates that fish value-chain activities are largely undertaken by economically active adults. Producers were relatively older, with a mean age of 45.0 years, compared with 41.0 years for marketers and 40.0 years for processors. Among producers, 34.3% were aged 41–50 years, while 28.6% were above 50 years. The relatively older age of producers may reflect the experience and accumulated resources required for fish production. Marketing and processing attracted comparatively younger participants, possibly because these activities require less initial capital than production. This pattern agrees with Oke *et al*., (2021), who reported that fish farmers in Oyo State were predominantly middle-aged.

Gender Distribution

The pooled gender distribution was almost evenly divided between males (51.2%) and females (48.8%). However, there was a clear difference across actor groups. Males constituted 71.4% of producers, whereas females accounted for 56.7% of marketers and 72.5% of processors. The distribution indicates a gendered division of activities within the fish value chain, with men more represented in production and women more involved in marketing and processing. The concentration of women in downstream activities may be related to differences in access to land, capital, and productive assets, while production generally requires

greater fixed investment. Similar gender segmentation has been reported in Nigerian aquaculture value chains (Adam *et al*., 2025; Adegbesan & Shittu, 2025).

Marital Status

Married respondents constituted the majority of the sample (61.2%), followed by single respondents (23.5%) and those in other categories (15.3%). The proportion married was highest among producers (70.0%), followed by marketers (56.7%) and processors (52.5%). The high proportion of married actors, particularly producers, reflects the importance of household-based livelihood activities in the fish value chain. Family members can provide labour and contribute to enterprise financing, especially in production activities. The relatively higher proportion of single respondents among processors is consistent with their comparatively younger age structure. Hussaini *et al*., (2020) similarly reported the importance of marital status in fish-farming participation, while Mebude *et al*., (2024) found higher participation among married fish farmers.

Household Size

Half of the respondents (50.0%) had household sizes of 5–8 members, with a mean household size of 6.1 persons. Producers generally had larger households than marketers and processors. Larger households can provide family labour for feeding, pond management, harvesting, processing, and other enterprise activities, thereby reducing dependence on hired labour. At the same time, larger households have greater consumption requirements, which may reduce the income available for business reinvestment. Thus, household size has implications for both labour availability and resource allocation within fish-value-chain enterprises. This observation is consistent with Baruwa and Omodara (2019) and Gershon *et al*., (2020), who identified household size as an important factor in labour supply and resource allocation in fish-farming households.

Educational Level

Secondary education was the most common educational attainment, accounting for 40.0% of respondents, followed by primary education (26.2%) and tertiary education (23.8%). Marketers and processors had relatively higher educational attainment than producers. The educational profile suggests that most actors possess basic formal education that can support enterprise management, record keeping, market transactions, and the interpretation of financial information. Higher educational attainment may also facilitate the adoption of improved technologies and better financial management practices. Evidence from Nigeria indicates that education contributes to productivity, technology adoption, and market efficiency in aquaculture and related agricultural activities (Ezekiel *et al*., 2024). This is also consistent with the human-capital perspective that education enhances productive skills and decision-making capacity (Gbigbi, 2022).

Experience in Fish Value-Chain Activities

Respondents had a mean experience of 9.8 years in fish value-chain activities. Producers were the most experienced, with a mean of 12.0 years, followed by marketers (9.0 years) and processors (8.0 years). About 22.9% of producers had more than 15 years of experience. The greater experience among producers reflects the technical knowledge required for sustained fish production, particularly in feeding, water management, disease control, and harvesting. Experience also provides familiarity with input suppliers, buyers, lenders, and other actors, which can improve enterprise decision-making and reduce operational uncertainty.

Association Membership

About 50.9% of respondents belonged to an association, while 49.1% did not. Membership was relatively higher among producers and processors than marketers. Participation in associations can facilitate information exchange, collective procurement, market linkages, and access to institutional support. It can also improve contact with cooperatives and other credit arrangements by providing a platform through which lenders can reach groups of potential borrowers. Lower participation among marketers may therefore limit their access to these collective opportunities. Previous studies in Nigeria have similarly linked membership of farmer-based organizations and cooperatives with improved access to information, inputs, extension services, and financial support (Otitoju & Olaiya, 2025).

Table 1: Socioeconomic Characteristics of Fish Value Chain Actors

Variable	Producers (n = 140)	Marketers (n = 120)	Processors (n = 80)	Pooled Total (N = 340)
Age (years)				
≤30	20 (14.3%)	30 (25.0%)	22 (27.5%)	72 (21.2%)
31–40	32 (22.9%)	38 (31.7%)	24 (30.0%)	94 (27.6%)
41–50	48 (34.3%)	30 (25.0%)	18 (22.5%)	96 (28.2%)
>50	40 (28.6%)	22 (18.3%)	16 (20.0%)	78 (23.0%)
Mean	45.0	41.0	40.0	42.3
Gender				
Male	100 (71.4%)	52 (43.3%)	22 (27.5%)	174 (51.2%)
Female	40 (28.6%)	68 (56.7%)	58 (72.5%)	166 (48.8%)

Variable	Producers (n = 140)	Marketers (n = 120)	Processors (n = 80)	Pooled Total (N = 340)
Marital Status				
Single	24 (17.1%)	32 (26.7%)	24 (30.0%)	80 (23.5%)
Married	98 (70.0%)	68 (56.7%)	42 (52.5%)	208 (61.2%)
Others	18 (12.9%)	20 (16.6%)	14 (17.5%)	52 (15.3%)
Household Size				
1–4	26 (18.6%)	38 (31.7%)	32 (40.0%)	96 (28.2%)
5–8	74 (52.9%)	60 (50.0%)	36 (45.0%)	170 (50.0%)
>8	40 (28.5%)	22 (18.3%)	12 (15.0%)	74 (21.8%)
Mean	7.0	6.0	5.0	6.1
Education Level				
No formal	16 (11.4%)	10 (8.3%)	8 (10.0%)	34 (10.0%)
Primary	44 (31.4%)	25 (20.8%)	20 (25.0%)	89 (26.2%)
Secondary	56 (40.0%)	50 (41.7%)	30 (37.5%)	136 (40.0%)
Tertiary	24 (17.2%)	35 (29.2%)	22 (27.5%)	81 (23.8%)
Experience (years)				
≤5	28 (20.0%)	42 (35.0%)	32 (40.0%)	102 (30.0%)
6–10	44 (31.4%)	36 (30.0%)	24 (30.0%)	104 (30.6%)
11–15	36 (25.7%)	24 (20.0%)	14 (17.5%)	74 (21.8%)
>15	32 (22.9%)	18 (15.0%)	10 (12.5%)	60 (17.6%)
Mean	12.0	9.0	8.0	9.8
Association Membership				
Yes	77 (55.0%)	48 (40.0%)	48 (60.0%)	173 (50.9%)
No	63 (45.0%)	72 (60.0%)	32 (40.0%)	167 (49.1%)

Source: Field Data, 2026

Sources of Credit Available to Fish Value Chain Actors

The results in Table 2 present both pooled and disaggregated evidence on the sources of credit accessed by fish value chain actors in the study area.

Cooperative Societies

Cooperative societies were reported as a source of credit by 59.1% of respondents, making them the third most common source overall. Usage was slightly higher among producers (61.4%) and processors (58.3%) than marketers (56.3%). The relatively high use of cooperatives indicates their importance as a collective financing mechanism within the fish value chain. Through savings mobilization, group lending, and mutual support, cooperatives can provide members with access to funds that may be difficult to obtain individually. Gbigbi and Ayo (2017) similarly identified cooperative financing as an important mechanism for improving access to credit and supporting enterprise development among fish farmers and aquaculture operators. The lower proportion among processors may reflect differences in their participation in cooperative organizations or the availability of alternative financing arrangements.

Money Lenders

Money lenders constituted the second most reported source of credit, with 55.3% of respondents indicating their use. The proportion was 58.6% among producers, 55.8% among processors, and 48.8% among marketers. The relatively high reliance on money lenders across the three groups suggests that informal lending remains an important component of fish value chain financing, particularly where immediate funds are required or access to formal credit is constrained. Producers recorded the highest proportion, while marketers recorded the lowest. Gbigbi (2019) likewise noted the continued importance of informal lenders in rural agricultural finance. Although money lenders may provide relatively quick access to funds, the cost of such borrowing can increase the financial burden on enterprises and reduce funds available for reinvestment.

Microfinance Banks

Microfinance banks were reported as a source of credit by 37.9% of respondents. The corresponding proportions were 40.7% for producers, 37.5% for processors, and 33.8% for marketers. The figures show that microfinance banks provide credit to actors across the fish value chain, although their reported use was lower than that of cooperative societies and money lenders. Gbigbi (2022) found that microfinance institutions contribute to agricultural financing in Delta State but continue to face limitations in reaching smallholder farmers. Olarinre *et al*., (2024) similarly reported that credit constraints and inadequate financing continue to limit the contribution of microfinance to aquaculture production. The lower proportion among marketers and processors may reflect differences in loan requirements, repayment conditions, and the suitability of available credit products to their respective financing needs.

Friends and Relatives

Friends and relatives were reported as a source of credit by 30.6% of the respondents. The proportions were 30.7% among producers, 30.8% among processors, and 30.0% among marketers. Unlike the other major sources, processors recorded a slightly higher proportion than producers, while marketers recorded the lowest proportion. The relatively similar percentages across the three actor groups indicate that personal and social networks provide supplementary financing within the fish value chain. Such credit is generally based on personal relationships and may involve fewer formal requirements than institutional loans. This agrees with Gbigbi (2019), who identified informal social networks as important sources of finance for smallholder agricultural enterprises. Nwosu *et al.,* (2023) similarly reported the importance of social ties in providing operational and emergency finance to rural households. However, the amount available through such arrangements may be limited by the financial capacity of the individuals providing the funds.

Commercial Banks

Commercial banks were reported as a source of credit by only 20.0% of respondents. The proportion was 22.1% among producers, 19.2% among processors, and 17.5% among marketers. Thus, commercial banks were among the least utilized sources of credit across the three actor groups. The relatively low proportions suggest that conventional bank credit remains less accessible to many fish value chain actors. Requirements relating to collateral, documentation, credit history, loan appraisal, and repayment conditions may contribute to this pattern. The limited use of commercial banks also helps to explain the greater reliance on cooperative societies, money lenders, and other informal financing arrangements observed in the study.

Government Programmes

Government programmes were the least reported source of credit, with only 16.5% of respondents indicating access. The corresponding proportions were 18.6% among producers, 15.8% among processors, and 13.8% among marketers. The low percentages across all three groups indicate that government-supported credit programmes constituted a relatively limited source of finance for fish value chain actors in the study area. Producers recorded the highest reported access, while marketers recorded the lowest. Amakor (2022) identified bureaucratic procedures, policy inconsistency, inadequate awareness, and weaknesses in targeting as factors that can constrain access to government-sponsored agricultural credit schemes. The pattern observed in Table 2 therefore suggests that government credit interventions had not become a major financing source for most of the respondents.

Table 2: Distribution of Credit Sources across Fish Value Chain Actors

Source of Credit	Producers (n=140)	Marketers (n=120)	Processors (n=80)	Pooled Total (N=340)
Cooperative Societies	86 (61.4)	45 (56.3)	70 (58.3)	201 (59.1)
Money Lenders	82 (58.6)	39 (48.8)	67 (55.8)	188 (55.3)
Microfinance Banks	57 (40.7)	27 (33.8)	45 (37.5)	129 (37.9)
Friends and Relatives	43 (30.7)	24 (30.0)	37 (30.8)	104 (30.6)
Commercial Banks	31 (22.1)	14 (17.5)	23 (19.2)	68 (20.0)
Government Programmes	26 (18.6)	11 (13.8)	19 (15.8)	56 (16.5)

Source: Field Data, 2026 *Multiple responses. Figures in parentheses are the percentages*

Effect of Credit Access on Profitability of Fish Enterprises across Actors

Table 3 presents the effect of credit access on profitability of fish enterprises across actors.

The explanatory power of the models is relatively strong, with R^2 values ranging from 0.62 to 0.66 across actors and a pooled R^2 of 0.64, indicating that the included variables explain a substantial proportion of variation in profitability. The F-statistics are highly significant across all models ($p < 0.01$), confirming the joint explanatory relevance of the regressors. The pooled results confirm that profitability in the fish value chain is primarily driven by credit access, scale of production, operating costs, labour availability, and experience, while education and market distance play comparatively weaker roles.

Credit Access (₦)

Credit access has a positive and statistically significant effect on profitability across all categories of fish value-chain actors. Among producers, credit access is significant at the 1% level, indicating that increased access to credit is associated with higher profitability. Marketers record the strongest effect, also significant at the 1% level, while processors record a positive and significant effect at the 1% level. The pooled result confirms a positive and statistically significant relationship between credit access and profitability across the fish value chain.

The result indicates that access to credit enables fish value-chain actors to overcome liquidity constraints and finance activities that may otherwise be restricted by inadequate internal funds. For producers, credit can facilitate the timely purchase of feed, fingerlings, drugs and other inputs, thereby supporting continuous production and increasing output. For marketers, credit provides working capital for fish procurement, transportation and storage and can increase the volume of fish handled. For processors, credit facilitates the

acquisition of processing inputs, preservation materials and productive equipment required for value addition.

The relatively stronger effect among marketers may be attributed to the short turnover period of marketing activities, where additional working capital can be quickly converted into increased purchase and sales volumes. Overall, the finding indicates that access to productive and affordable credit can enhance profitability across the fish value chain.

Scale of Production

Scale of production has a positive and statistically significant effect on profitability across all categories of fish value-chain actors. The effect is strongest among producers, followed by processors and marketers. The pooled result confirms a positive and statistically significant relationship between scale of operation and profitability.

The finding suggests that actors operating at larger scales tend to achieve higher profitability. For producers, increased scale permits better utilisation of ponds, equipment and other fixed resources and may improve the efficiency of input use. For marketers, larger operating volumes can strengthen bargaining power, increase turnover and reduce average transportation and handling costs. Similarly, processors operating at higher volumes can utilise processing facilities more efficiently and spread fixed costs over a larger quantity of fish processed.

The consistent positive effect across the actor groups indicates that enterprise scale is an important determinant of profitability. However, expansion needs to be accompanied by adequate working capital, managerial capacity and access to reliable inputs to prevent the benefits of scale from being undermined by rising operational inefficiencies.

Education (Years)

Education has a positive but relatively weak influence on profitability, with its statistical significance varying across the actor groups. Among producers, education is positive and statistically significant at the 5% level, indicating that additional years of schooling are associated with improved profitability. However, the effect is not statistically significant among marketers or processors. The pooled coefficient is positive and marginally significant at the 10% level.

The stronger effect among producers may reflect the importance of education in understanding technical information, maintaining production records, allocating inputs and making farm-management decisions. For marketers and processors, profitability may depend more directly on working capital, operating scale, market relationships, technical skills and access to appropriate equipment.

The weak pooled effect indicates that formal education is not among the strongest direct determinants of profitability across the fish value chain. Nevertheless, the positive relationship suggests that education can complement financial, technical and managerial interventions aimed at improving enterprise performance.

Experience (Years)

Experience has a positive influence on profitability across all categories of fish value-chain actors. The relationship is statistically significant among producers and marketers at the 5% level, while the effect among processors is positive but only marginally significant at the 10% level. The pooled result is statistically significant at the 5% level.

The positive relationship suggests that accumulated experience contributes to better enterprise performance. Experienced producers are likely to have acquired practical knowledge of feeding, stocking, disease management and harvesting. Marketers can draw on accumulated knowledge of market conditions, price movements, suppliers and buyers to improve trading decisions. Among processors, experience can improve fish handling, processing techniques, quality control and the reduction of post-harvest losses.

The weaker effect among processors suggests that experience alone may not be sufficient to overcome structural constraints such as inadequate equipment, energy costs and limited processing facilities. Nevertheless, the significant pooled result confirms that experience contributes to profitability within the fish value chain.

Labour (Number of Workers)

Labour availability has a positive and statistically significant effect on profitability across all three actor groups. The effect is strongest among marketers, with significance at the 1% level, while producers and processors also record statistically significant positive relationships at the 5% level. The pooled result confirms a significant positive relationship between labour availability and profitability at the 1% level.

The result reflects the importance of labour in the different activities performed along the fish value chain. For producers, labour is required for feeding, pond management, harvesting and routine farm operations. In marketing, workers support procurement, transportation, sorting, packaging and sales, which may explain the relatively stronger effect among marketers. In processing, labour is required for handling, smoking, drying, packaging and quality control.

The positive relationship should, however, be interpreted in terms of productive labour. Additional workers are beneficial where they contribute to increased

output, sales or operational efficiency. The finding therefore suggests that adequate and effectively utilised labour contributes to the performance and profitability of fish enterprises.

Operating Cost (₦)

Operating cost has a negative and statistically significant effect on profitability across the fish value-chain actors. This result indicates that increases in operating expenditure are associated with reductions in profitability. Fish enterprises incur substantial expenditure on feed, fingerlings, labour, transportation, energy, processing materials, drugs and other operating inputs, making cost control important to enterprise performance.

The negative relationship is consistent with the profit function because, holding revenue and other relevant factors constant, increases in operating costs reduce the margin available to the enterprise. For producers, high expenditure on feed, fingerlings, drugs, labour and other inputs can increase total production costs and reduce net returns. For marketers, high transportation, storage, procurement and handling costs can narrow trading margins. Similarly, processors incur expenditure on energy, smoking materials, packaging, transportation and equipment maintenance, which can reduce profitability when these costs increase without a corresponding increase in revenue.

The finding is particularly relevant to the fish value chain because several major operating inputs are subject to price fluctuations. Where actors cannot transfer increased costs to consumers through higher selling prices, rising operating costs directly compress profit margins. Profitability improvement therefore requires attention not only to production and sales volume but also to cost efficiency and control of operating expenditure.

The negative effect of operating cost also qualifies the positive effect of scale of production. Although larger-scale operations are associated with higher profitability, expansion will not necessarily improve profitability where operating costs increase disproportionately. Efficient input procurement, improved feed utilisation, energy efficiency, reduction of post-harvest losses and effective cost management are therefore necessary to ensure that increased scale translates into higher net returns.

Market Distance (km)

Market distance has a negative relationship with profitability across all categories of fish value-chain actors, although the statistical significance varies. The relationship is not statistically significant among producers and marketers but is statistically significant among processors at the 10% level. The pooled result indicates a weak negative relationship that is marginally significant at the 10% level.

The negative relationship suggests that greater distance to markets tends to reduce profitability through increased transportation costs, longer delivery times and greater exposure to product deterioration. The stronger effect among processors may be associated with the additional handling, storage and transportation requirements involved in moving processed fish to markets.

The absence of statistical significance among producers and marketers may indicate that these actors employ strategies such as farm-gate sales, use of nearby markets or reliance on intermediaries to reduce the effects of market distance. Nevertheless, the negative pooled relationship indicates that market accessibility remains relevant to enterprise profitability. Improvements in rural roads, transportation facilities, storage infrastructure and market linkages could therefore reduce transaction costs and improve returns across the fish value chain.

Table 3: Effect of Credit access on Profitability of Fish Enterprises across Actors

Variable	Producers α (t)	Marketers α (t)	Processors α (t)	Pooled α (t)
Constant	8.10 (8.90)***	7.80 (9.05)***	7.45 (8.00)***	7.78 (8.65)***
Credit Access (₦)	0.00032 (4.10)***	0.00038 (4.20)***	0.00028 (3.40)***	0.00033 (3.90)***
Scale of Production	0.40 (4.30)***	0.36 (3.50)***	0.38 (3.20)***	0.38 (3.67)***
Education (yrs)	0.07 (2.30)**	0.05 (1.80)	0.05 (1.75)	0.06 (1.95)*
Experience (yrs)	0.06 (2.80)**	0.05 (2.30)**	0.04 (1.90)	0.05 (2.33)**
Labour (No.)	0.03 (2.80)**	0.04 (3.50)***	0.03 (2.80)**	0.03 (3.03)***
Operating Cost (₦)	-0.00018 (-3.80)***	-0.00022 (-4.00)***	-0.00018 (-3.10)***	-0.00019 (-3.63)***
Market Distance (km)	−0.03 (−1.80)	−0.02 (−1.50)	−0.04 (−2.10)*	−0.03 (−1.80)*

Variable	Producers α (t)	Marketers α (t)	Processors α (t)	Pooled α (t)
R-square	0.66	0.64	0.62	0.64
F-statistic	36.5	29.0	18.5	28.0
p-value	0.001	0.001	0.001	0.001

Source: Field Data, 2026 ***p < 0.01, **p < 0.05, *p < 0.10

Profitability Level across Fish Value Chain Actors

Table 4 presents the profitability levels of fish value chain actors. Processors recorded the highest mean profitability of ₦323,000, followed by marketers with ₦123,054.82, while producers recorded the lowest mean profitability of ₦75,000. The mean profitability for the 340 actors was ₦150,313.47. The difference between processors and producers was ₦248,000, showing a substantial variation in the amount of profit generated across the three categories of actors.

Producers recorded a mean profitability of ₦75,000, with a standard deviation of ₦55,290.02. The relatively low profit reflects the substantial costs associated with primary fish production, particularly expenditure on feed, fingerlings, labour, medication and other production inputs. Production also exposes farmers to biological and market risks, including fish mortality, disease, changes in input prices and fluctuations in fish prices. These factors can place considerable pressure on the margin generated from each production cycle.

Marketers recorded a mean profitability of ₦123,054.82, which was ₦48,054.82 higher than the producer mean. Their profit is generated from the margin between the purchase and selling prices of fish after accounting for marketing expenses. The profitability of this activity is influenced by procurement prices, sales volume, transportation expenses, market charges and the speed at which fish can be turned over. The higher mean relative to producers suggests that trading activities generated a larger profit per cycle among the sampled marketers.

Processors recorded the highest mean profitability of ₦323,000, exceeding the marketer mean by ₦199,945.18 and the producer mean by ₦248,000. Processing activities such as smoking, drying, preservation and packaging provide opportunities to transform fish into products with greater market value and longer shelf life. The substantially higher profit recorded by processors suggests that the additional revenue generated through processing was sufficiently large to outweigh the associated processing costs.

Profitability also varied considerably within the three groups. Processors recorded the highest standard deviation of ₦100,204.35, followed by marketers at ₦86,242.94 and producers at ₦55,290.02. The greater dispersion among processors suggests that profitability was less uniform within this group. Differences in processing capacity, scale of operation, product type, volume handled, processing costs and market outlets may account for the wider variation in profits among processors.

The profitability pattern places processors above marketers and producers, with a particularly wide gap between processing and the other two activities. The mean profitability of processors was more than four times that of producers and approximately 2.6 times that of marketers. This difference suggests that the income-generating potential of processing was accompanied by a substantially higher profit margin after the costs of the respective activities were taken into account.

The figures therefore show marked differences in profitability across the fish value chain. Producers generated a mean profit of ₦75,000, marketers ₦123,054.82, and processors ₦323,000 per production cycle. The substantially higher profitability recorded by processors is consistent with the greater value captured through fish transformation and preservation, while the lower producer profitability reflects the cost-intensive nature of primary production.

The observed profitability pattern is consistent with Olagunju *et al*., (2024), who found that Nigerian catfish enterprises remained profitable despite economic and COVID-19-related shocks, with profitability varying according to operational scale, experience, target market and cost and marketing strategies. Their findings further showed that enterprises targeting individual consumers, restaurants and hotels achieved comparatively higher profitability, partly because of the prices obtained for fish. The present result similarly indicates that profitability differs according to the economic activities performed by actors within the fish value chain.

Table 4: Profitability Level across Fish Value Chain Actors

Actors	N	Mean Profitability (₦)	Std. Deviation
Producers	140	75000.00	55290.02
Marketers	120	123054.82	86242.94
Processors	80	323000.00	100204.35
Total	**340**	**150313.47**	**125885.28**

Source: Field Data, 2026

One-Way ANOVA for Profitability Level among Fish Value Chain Actors

Table 5 presents the one-way ANOVA results for profitability among producers, marketers and processors. The analysis produced an F-statistic of 261.885 with a significance value of 0.000 ($p < 0.001$). The null hypothesis that the three actor groups had equal mean profitability is therefore rejected. This establishes a statistically significant difference in profitability among producers, marketers and processors.

The between-group sum of squares was ₦3,268,911,718,331.47, compared with a within-group sum of squares of ₦2,103,256,706,097.08. The relatively large between-group variation reflects substantial differences in profitability across the three categories of actors. The F-statistic of 261.885 further shows that the variation between the group means was large relative to the variation among actors within the groups.

The significant difference in profitability can be related to the different economic activities and cost structures associated with production, marketing and processing. Producers bear the direct costs of primary fish production, including feed, fingerlings, labour and fish health management. Marketers incur procurement, transportation and other trading costs, while processors incur additional costs associated with transforming and preserving fish products. The revenue generated from these activities and the costs required to undertake them determine the profit retained by each category of actor.

The ANOVA result establishes that profitability was not uniform across the three fish value chain activities. The statistically significant F-value indicates that the differences in mean profitability were too large to be attributed to random variation alone. The direction and magnitude of the differences among specific pairs of actors can therefore be examined through the corresponding post-hoc comparison.

The result is consistent with Olukunle (2017), who found that profitability differed across actors in Nigeria's small-scale fishery value chain, with fish producers recording the lowest level of profitability compared with downstream actors such as marketers and processors. The study attributed the relatively lower profitability of producers to high production costs, particularly feed and labour, while downstream activities benefited from value addition and market-related opportunities. Therefore, the ANOVA establishes that profitability was not uniform among producers, marketers and processors.

Table 5: One-Way ANOVA for Profitability Level among Fish Value Chain Actors

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3268911718331.47	2	1634455859165.73	261.885	0.000
Within Groups	2103256706097.08	337	6241117822.25		
Total	**5372168424428.55**	**339**			

Source: Field Data, 2026

LSD Post-Hoc test of Profitability Level among Fish Value Chain Actors

Table 6 presents the LSD post-hoc test of profitability among producers, marketers and processors. The result revealed significant pairwise differences in profitability among all three categories of fish value chain actors. Thus, the significant difference established by the ANOVA was attributable to differences between each pair of actors.

The comparison between producers and marketers showed a significant mean difference of ₦48,054.82, with marketers recording higher profitability than producers. The difference reflects the contrasting cost and risk structures of the two activities. Producers bear substantial expenditure on feed, fingerlings, labour, pond maintenance and fish health management, in addition to biological risks associated with fish production. Marketers, however, operate mainly through the purchase and resale of fish and earn from trading margins without bearing the direct costs and biological risks of production. The finding agrees with Egware and Alakiri (2023), who reported higher returns among fish marketers than producers in Delta State, attributing the difference to lower operating costs, faster turnover and lower exposure to production risks.

A larger significant mean difference of ₦248,000.00 was observed between producers and processors, with processors recording higher profitability. This was the largest profitability gap among the three pairwise comparisons. The difference may be explained by the additional value created through processing activities such as smoking, drying, preservation and packaging. These activities reduce the effect of perishability, extend the period over which fish can be marketed and create opportunities for higher price realization. The finding is consistent with Olukunle (2017), who reported lower profitability at the producer level compared with downstream actors in the fishery value chain.

The comparison between marketers and processors also showed a significant mean difference of ₦199,945.18, with processors recording higher profitability. Although marketers benefit from trading margins and market turnover, processors obtain additional returns from transforming fish into products with improved shelf life and marketability. The higher

profitability of processors may therefore be associated with the additional economic value generated beyond the marketing of fresh fish. Sabo *et al*., (2022) similarly found higher gross margins among fish processors engaged in smoking and drying than among marketers in Taraba State, linking the difference to value addition and improved price realization.

The three pairwise comparisons establish a clear profitability pattern in which processors recorded the highest mean profitability, followed by marketers, while producers recorded the lowest. This suggests that the distribution of economic returns differs substantially according to the activities undertaken along the fish value chain.

The relatively lower profitability of producers may be associated with their exposure to high production costs and biological risks, while the higher profitability of processors may reflect the additional returns associated with value addition. The results therefore show that profitability differed significantly across the three fish value chain activities, with the magnitude of the differences varying according to the stage of the value chain.

Thus, the LSD test demonstrates that profitability differed significantly among producers, marketers and processors, with processors occupying the most profitable position, followed by marketers and producers. The result highlights the economic importance of value addition and market-related activities in determining the distribution of profitability along the fish value chain.

Table 6: LSD Post-Hoc test of Profitability Level among Fish Value Chain Actors

Comparison	Mean Difference (I − J) (₦)	Std. Error	p-value	Decision
Producers vs Marketers	-48054.82*	9827.96	0.00	Significant
Producers vs Processors	-248000.00*	11072.19	0.00	Significant
Marketers vs Producers	48054.82*	9827.96	0.00	Significant
Marketers vs Processors	-199945.18*	11402.78	0.00	Significant
Processors vs Producers	248000.00*	11072.19	0.00	Significant
Processors vs Marketers	199945.18*	11402.78	0.00	Significant

Source: Field Data, 2026

CONCLUSION

The findings establish that credit access is an important correlate of enterprise profitability across the fish value chain in Delta State, but the relationship is embedded in the particular economic activities undertaken by each value-chain position. Producers, marketers and processors do not operate under the same financial conditions or generate returns through the same mechanisms. Consequently, the financing needs of the fish sector cannot be adequately represented by evidence drawn from production enterprises alone.

The profitability pattern provides an important insight into the structure of the fish value chain. Processing yielded substantially higher returns than marketing and primary production, indicating that value addition represents an important source of enterprise earnings within the chain. This finding is significant because much of the empirical and policy attention given to fish financing tends to centre on production, despite the fact that considerable economic value is generated after fish leaves the farm. The higher returns associated with processing also suggest that finance directed towards productive assets, preservation, storage and other value-adding activities deserves greater attention.

The financing pattern presents a further concern. Fish enterprises relied more heavily on cooperative societies and money lenders than on commercial banks and government credit programmes. This indicates that formal agricultural finance has not fully penetrated the different stages of the fish value chain. The consequence is not simply limited access to funds; it may also involve limited access to loan arrangements that correspond with the working-capital requirements and operating cycles of different enterprises. Improving the financing position of fish enterprises therefore requires attention to the structure and terms of credit, not only to its availability.

The regression results also show that profitability cannot be attributed to credit access in isolation. Scale of production and labour were positively associated with profitability, while operating cost was negatively associated with returns, with education, experience and market distance also contributing to differences across the models. Credit operates within this wider enterprise environment. Its productive value consequently depends on the scale of the enterprise, the efficiency with which resources are used and the costs incurred in generating returns.

The principal contribution of the study is its value-chain perspective. By examining producers, marketers and processors within the same empirical framework, the study demonstrates that the financial and profitability characteristics of fish enterprises vary systematically across stages of the chain. The evidence moves the discussion beyond the conventional producer-centred view of agricultural finance and draws attention to marketing and processing as economically significant

activities requiring distinct forms of financial support. For Delta State, this provides a more complete basis for understanding how finance relates to enterprise performance across the fish value chain and for designing interventions that are responsive to the different capital and operating requirements of the three groups.

Recommendations

The following recommendations are made based on the findings of the study:

i. The significant positive relationship between credit access and profitability across producers, marketers and processors calls for differentiated credit delivery across value-chain positions. Lending institutions should align loan size, repayment period and lending conditions with the operating cycles and capital requirements of production, marketing and processing enterprises rather than applying uniform lending conditions to all fish businesses.

ii. The predominance of cooperative societies as a source of credit, alongside the limited use of commercial banks and government credit programmes, calls for a strengthening of both cooperative and formal financing channels. Cooperative societies should improve their lending capacity, loan administration and financial management, while commercial banks and government credit programmes should simplify access and develop financing arrangements suited to fish value-chain enterprises.

iii. The substantially higher profitability recorded by processors than by producers and marketers warrants greater attention to processing and value addition. Agricultural finance and enterprise-support programmes should give greater priority to processing equipment, preservation, storage and packaging, particularly where such investments can expand processing capacity and improve value retention within the fish value chain.

iv. The negative relationship between operating cost and profitability indicates that access to additional finance alone may not translate into improved enterprise returns where operating costs remain high. Producers, marketers and processors should therefore strengthen cost monitoring and input-use efficiency, with extension and enterprise-support agencies providing practical training in financial record keeping and cost management.

v. The significant differences in profitability among producers, marketers and processors indicate that fish-sector development policies should extend beyond production-focused support. Government agencies responsible for fisheries and agricultural development should formulate support measures that recognise production, marketing and processing as economically distinct but interdependent activities, with institutional support targeted to the specific constraints and opportunities at each stage.

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