Communication in Physical Sciences, 2025, 13(1): 17-24

Empirical Assessment of Productivity and Profitability Responses to Cooperative-Based Institutional Support in Aquaculture Production Systems in Lagos State, Nigeria

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Received:29 November 2025/Accepted: 20 January 2026 /Published: 30 January 2025
https://dx.doi.org/10.4314/cps.v13i1.2

Abstract: *Aquaculture production in Nigeria has expanded rapidly in response to increasing demand for fish protein; however, the productivity and profitability of small- and medium-scale production systems remain constrained by limited access to quality inputs, credit, training, and organized markets. Cooperative-based institutional arrangements have been promoted as mechanisms for addressing these constraints, yet empirical evidence on their performance effects within high-cost urban aquaculture environments remains limited. This study examined the productivity and profitability responses of aquaculture production systems to cooperative-based institutional support in Lagos State, Nigeria. A cross-sectional survey design was employed, and primary data were collected from 120 aquaculture farmers comprising 111 cooperative members and 9 non-members selected through multi-stage sampling. Descriptive statistics, independent samples t-tests, and multiple linear regression models were used for data analysis. Composite indices were constructed for productivity and profitability. Results show that cooperative membership exerts a positive and statistically significant effect on productivity ($\beta = 0.46$, $p = 0.009$) and profitability ($\beta = 0.54$, $p = 0.007$). Cooperative members recorded higher technical efficiency, better input quality, reduced production costs, and improved return on investment compared to non-members. Socio-demographic variables such as age, education, and farming experience were not significant determinants of performance, indicating that institutional factors play a more dominant role. The findings demonstrate that cooperative-based institutional support functions as a productivity- and profitability-enhancing input within aquaculture production systems. Strengthening cooperative access to affordable credit, quality input supply, technical training, and organized marketing is therefore critical for improving system efficiency, enterprise profitability, and sustainable aquaculture development in Lagos State.*

Keywords: *Aquaculture; cooperative societies; productivity; profitability; institutional support*

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1.0 Introduction

Aquaculture is one of the fastest-growing food production systems globally and has become increasingly important for enhancing food security, generating employment, and improving household income in many developing economies. This growth has been driven by rapid population expansion, declining capture fisheries, and rising demand for affordable animal protein. Evidence from low- and middle-income countries indicates that well-designed aquaculture interventions contribute significantly to improvements in productivity, income, and livelihood outcomes (Parrao *et al*., 2021; Munthali *et al*., 2024).

Over the past decade, aquaculture production in Nigeria has expanded substantially, with Lagos State emerging as a major hub, hosting numerous pond- and tank-based enterprises producing primarily African catfish (*Clarias gariepinus*) and tilapia (*Oreochromis niloticus*). Despite this expansion, farm-level performance remains heterogeneous, and many production systems operate below technically efficient and economically optimal levels. Profit margins vary widely due to differences in cost structures, feed efficiency, management strategies, and access to input subsidies (Adelesi, 2022; Olaoye *et al*., 2020; Olagunju *et al*., 2024).

Structural constraints continue to limit aquaculture performance in Lagos State and similar urban production environments. These include limited access to affordable credit, high cost of quality feed and fingerlings, inadequate extension and training services, and weakly organized market channels. Such constraints restrict farmers' capacity to adopt improved technologies and optimize resource use, thereby suppressing productivity and profitability (Otufale, 2024; Obi *et al*., 2024).

Cooperative-based institutional arrangements have been widely promoted as mechanisms for addressing these structural challenges. Through collective action, cooperatives enable farmers to pool resources, reduce transaction costs, access credit, obtain quality inputs, participate in organized training programmes, and engage in collective marketing. Beyond simple membership, the specific services and support provided by cooperatives—such as access to credit, organized training, input supply, and market linkages—can be conceptualized as institutional inputs that directly influence farm performance. (Obi *et al*., 2024; Parrao *et al*., 2021).

A growing body of empirical literature demonstrates that cooperative participation is positively associated with improved farm income, productivity, and technical efficiency. Studies among aquaculture farmers show that cooperative members achieve higher profit and output levels than non-members due to better access to institutional services and production resources (Twumasi *et al*., 2021; Cai *et al*., 2022; Gichuki *et al*., 2024). Similar evidence from agricultural systems indicates that cooperative membership significantly enhances technical efficiency by facilitating technology adoption and improving input-use efficiency (Qu *et al*., 2020; Kehinde *et al*., 2025).

Productivity, defined as output relative to input use, represents the technical performance dimension of aquaculture production systems and is commonly assessed using technical efficiency indicators (Qu *et al*., 2020; Kehinde *et al*., 2025). Profitability, on the other hand, reflects the financial viability of production systems and determines farmers' ability to reinvest and expand operations. Empirical studies in Nigeria and other developing countries indicate that cooperative-supported farmers record lower unit production costs, higher gross margins, and improved return on investment compared to non-members (Dogbe *et al*., 2022; Otufale, 2024; Cai *et al*., 2022). Together, productivity and profitability provide a comprehensive measure of both technical efficiency and economic viability, reflecting the overall performance of aquaculture systems under cooperative-based support

Despite these insights, gaps remain. Most studies focus on income or welfare outcomes rather than jointly assessing productivity and profitability. Few explicitly treat cooperative services as institutional inputs, and recent empirical evidence from Lagos State—the country's most intensive aquaculture cluster is limited

This study therefore examines the productivity and profitability responses of aquaculture production systems to cooperative-based institutional support in Lagos State, Nigeria. Addressing these gaps, the present study evaluates how cooperative-based institutional support influences both productivity and profitability in urban aquaculture production systems By comparing cooperative members and non-

members and analyzing the influence of institutional support services such as credit access, input supply, training, and market linkage, the study provides empirical evidence on the extent to which cooperatives function as performance-enhancing institutional mechanisms within aquaculture production systems.

Findings from this study will provide actionable insights for policymakers, cooperative managers, and development agencies to strengthen institutional support mechanisms, enhance productivity and profitability, and promote sustainable aquaculture development in Lagos State and similar urban production systems

2.0 Materials and Methods

2.1 Study Area

This study was conducted in Lagos State, Nigeria, one of the major aquaculture production hubs in West Africa. Lagos State lies between latitudes 6°23′N and 6°41′N and longitudes 2°42′E and 3°42′E and is characterized by extensive lagoon systems, wetlands, and a humid tropical climate that supports year-round aquaculture production. The state hosts a large concentration of pond- and tank-based aquaculture enterprises producing mainly African catfish (*Clarias gariepinus*) and tilapia (*Oreochromis niloticus*). Ikorodu, Epe, and Badagry Local Government Areas (LGAs) were purposively selected due to their high intensity of aquaculture activities and the presence of registered fisheries cooperative societies.

2.2 Research Design

A cross-sectional survey design combined with a comparative analytical approach was adopted. This design enables the simultaneous assessment of cooperative members and non-members and allows estimation of differences in productivity and profitability attributable to cooperative-based institutional support. Quantitative methods were emphasized to permit econometric analysis of system response variables.

2.2.1 Population and Sampling Procedure

The target population comprised small- and medium-scale aquaculture farmers operating in Lagos State. Two strata were defined: (i) farmers who are registered members of fisheries cooperative societies and (ii) farmers who operate independently without cooperative membership.

A multi-stage sampling procedure was employed. In the first stage, Ikorodu, Epe, and Badagry LGAs were purposively selected. In the second stage, lists of cooperative members were obtained from cooperative offices and the Lagos State Department of Cooperatives. Non-member farmers were identified through snowball sampling within the same communities. In the final stage, random sampling was used to select respondents within each stratum.

A total of 120 farmers were surveyed, comprising 111 cooperative members and 9 non-members.

2.3 Data Collection

Primary data were collected using a structured questionnaire administered through face-to-face interviews. The questionnaire was organized into four sections, including (i) socio-economic characteristics of respondents, (ii) cooperative-based institutional support services (credit access, input supply, training, market linkage), (iii) productivity indicators and (iv) profitability indicators

Secondary data were obtained from cooperative records, government publications, and relevant literature.

2.4 Measurement of Variables

2.4.1 Dependent Variables

Two composite indices were constructed to measure farm performance. The **Productivity Index (PROD)** was calculated as the mean score of yield efficiency, technical efficiency, and input quality. The **Profitability Index (PROF)** was computed as the mean score of gross margin improvement, cost reduction, and return on investment.

2.4.2 Independent Variable

The main independent variable was cooperative membership (COOP), coded as a

dummy variable (1 = member, 0 = non-member).

2.4.3 Control Variables

Control variables included age (years), education (years of schooling), aquaculture experience (years), and farm size (stocking capacity).

2.5 Validity and Reliability

Content validity was ensured through expert review by specialists in fisheries economics and cooperative management. Internal consistency reliability was assessed using Cronbach's alpha coefficient, with values ranging from 0.54 to 0.81 across major constructs, indicating acceptable reliability for exploratory applied research. Although the lower bound of 0.54 is modest, it is considered adequate for the context of field-based applied research.

2.6 Analytical Techniques

Descriptive statistics (means, frequencies, percentages) were used to summarize respondents' characteristics and key variables. Independent samples t-tests were employed to compare productivity and profitability between cooperative members and non-members. Multiple linear regression models were estimated to determine the effect of cooperative membership on productivity and profitability while controlling for socio-economic factors, following approaches applied in cooperative-performance and aquaculture impact studies (Qu *et al*., 2020; Cai *et al*., 2022).

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2.7 Model Specification

Two regression models were specified as:

$$PROD_i = \beta_0 + \beta_1 COOP_i + \beta_2 AGE_i + \beta_3 EDU_i + \beta_4 EXP_i + \beta_5 FS_i + \varepsilon_i \quad (1)$$

$$PROF_i = \beta_0 + \beta_1 COOP_i + \beta_2 AGE_i + \beta_3 EDU_i + \beta_4 EXP_i + \beta_5 FS_i + \varepsilon_i \quad (2)$$

Where PRODi and PROFi represent the productivity and profitability indices of farmer *i*, respectively. COOPi denotes cooperative membership (1 = member, 0 = non-member), AGEi is the age of the farmer in years, EDUi is the education level in years of schooling, EXPi is years of aquaculture experience, and FSi represents farm size (stocking capacity). β0 is the intercept, β1–β5 are regression coefficients, and εi is the error term. All hypotheses were tested at the 5% level of significance.

2.8 Ethical Considerations

Participation in the study was voluntary. Respondents were informed about the purpose of the study and assured of confidentiality and anonymity. No personal identifiers were included in the data analysis. Ethical approval was obtained from the National Open University of Nigeria Research Ethics Committee.

3.0 Results and Discussion

Reliability of Measurement Scales

The internal consistency of the measurement scales was assessed using Cronbach's alpha coefficients. Cooperative services recorded a reliability coefficient of 0.75, indicating good internal consistency. Cooperative governance yielded a coefficient of 0.55, while productivity and profitability scales recorded coefficients of 0.54 and 0.62, respectively. The business growth scale recorded a high reliability coefficient of 0.81. Although cooperative governance (0.55) and productivity (0.54) scales showed moderate reliability, they remain acceptable for exploratory field research, confirming the instruments are suitable for further statistical analysis.

3.1 Socio-Demographic Characteristics of Respondents

Aquaculture production in the study area is dominated by males (72.5%), with most farmers falling within the economically active age group of 25–44 years (64.1%). Approximately 70.8% of respondents possessed at least secondary education, indicating moderate literacy levels that facilitate adoption of improved production practices. Most farmers (70.8%) had between one and ten years of aquaculture experience, while 50% operated farms with stocking capacities ranging from 1,000 to 5,000 fish. These characteristics reflect the predominance of small- and medium-scale semi-intensive aquaculture production systems in Lagos State. Respondents generally perceived cooperative services as effective, with enhanced bargaining power rated highest (3.92), followed by access to training (3.89) and subsidized inputs (3.86). This suggests that cooperatives serve as key institutional platforms for improving resource access and market participation, consistent with findings

3.2 Productivity and Profitability Indicators

High mean scores for productivity indicators, including input quality improvement (4.13), technical efficiency (4.10), and yield per unit of feed (4.02), suggest strong technical performance among respondents, particularly for cooperative members. Profitability indicators were also high, with improved return on investment (4.06), gross margins (3.97), and reduced production costs (3.90), indicating that cooperative-supported farmers achieve better financial performance,

These results indicate that aquaculture enterprises in Lagos State exhibit favourable technical and financial performance, particularly among farmers with access to institutional support. Comparable profitability patterns have been reported by Adelesi (2022) and Olaoye *et al*. (2020).

3.3 Comparison of Cooperative Members and Non-Members

Cooperative members recorded higher productivity and profitability scores than non-members (Table 1), demonstrating that cooperative participation provides measurable advantages in both technical and financial performance in both technical and financial performance. This pattern aligns with empirical evidence that cooperative membership improves aquaculture farm output and income (Cai *et al*., 2022; Gichuki *et al*., 2024).

Productivity Response to Cooperative Membership

Regression results show that cooperative membership positively and significantly affects productivity ($\beta = 0.46$, $p = 0.009$), indicating that cooperative-supported farmers achieve higher technical efficiency and yield performance than non-members, consistent with Cai *et al*. (2022) and Gichuki *et al*. (2024).

Table 1: Mean Performance Differences Between Cooperative Members and Non-Members

Performance Indicator	Members (n=111)	Non-Members (n=9)	Mean Difference
Profitability Index	3.98	3.31	0.66
Productivity Index	4.05	3.52	0.53

Other socio-demographic variables (age, education, experience, and farm size) did not exert statistically significant effects on productivity, suggesting that institutional support plays a more dominant role than individual characteristics. Similar patterns have been reported by Qu *et al*. (2020) and Kehinde *et al*. (2025).

This suggests that the availability and quality of cooperative-based institutional support outweigh the influence of individual socio-demographic characteristics in determining farm-level productivity

Table 2: Regression Estimates for Productivity

Variable	Coefficient	Std. Error	t-value	p-value
Constant	2.04	0.39	5.23	0.000
Cooperative membership	0.46	0.17	2.71	0.009*
Age	-0.01	0.02	-0.37	0.711
Education	0.05	0.04	1.19	0.240
Experience	0.04	0.03	1.27	0.210
Farm size	0.07	0.05	1.57	0.120

$R^2 = 0.39$; $F = 10.44$ ($p < 0.01$)

Profitability Response to Cooperative Membership

Cooperative membership positively and significantly influenced profitability ($\beta = 0.54$, $p = 0.007$), improving gross margins and return on investment through reduced input costs and enhanced market access, while socio-demographic factors remained non-significant. These results are consistent with Dogbe *et al*. (2022) and Cai *et al*. (2022). Socio-demographic variables were not statistically significant, reinforcing the conclusion that institutional factors dominate profitability outcomes.

Table 3: Regression Estimates for Profitability

Variable	Coefficient	Std. Error	t-value	p-value
Constant	1.82	0.45	4.04	0.000
Cooperative membership	0.54	0.19	2.79	0.007*
Age	-0.03	0.04	-0.81	0.421
Education	0.08	0.06	1.44	0.155
Experience	0.02	0.02	1.00	0.322
Farm size	0.06	0.05	1.29	0.201

$R^2 = 0.38$; $F = 9.12$ ($p < 0.01$)

The findings demonstrate that cooperative-based institutional support functions as a productivity- and profitability-enhancing input within aquaculture production systems. Cooperative membership exerts statistically significant positive effects on both technical and financial performance.

The dominance of institutional factors over individual socio-demographic characteristics highlights the importance of strengthening cooperative structures as pathways for overcoming structural constraints in small-scale aquaculture. By facilitating access to credit, bulk inputs, training, and markets, cooperatives reduce structural barriers and improve system-level performance (Obi *et al*., 2024; Parr ao *et al*., 2021).

Overall, the results provide robust empirical support for policies aimed at strengthening cooperative societies as part of sustainable aquaculture development strategies in Lagos State.

4.0 Conclusion

This study examined the productivity and profitability responses of aquaculture production systems to cooperative-based institutional support in Lagos State, Nigeria. Using farm-level survey data and multiple regression analysis, the study provides empirical evidence that cooperative membership significantly enhances both technical and financial performance of aquaculture enterprises.

The results demonstrate that cooperative-supported farmers achieve higher productivity through improved technical efficiency, better input quality, and enhanced yield performance compared to non-members. Cooperative membership also significantly improves profitability by reducing production costs, increasing gross margins, and enhancing return on investment. These findings confirm that cooperative-based institutional support functions as an

important performance-enhancing institutional input within aquaculture production systems.

Socio-demographic characteristics such as age, education, farming experience, and farm size were not significant determinants of productivity and profitability, indicating that institutional factors play a more dominant role in shaping aquaculture performance than individual attributes. This underscores the critical importance of strengthening cooperative structures as mechanisms for addressing structural constraints faced by small- and medium-scale aquaculture producers.

Overall, the findings provide robust empirical support for policies that strengthen cooperative societies, as they enhance access to credit, bulk inputs, training, and organized markets, thereby addressing structural constraints and promoting sustainable aquaculture development in Lagos State Strengthening cooperative access to affordable credit, quality input supply, technical training, and organized marketing systems is therefore essential for promoting sustainable productivity growth, improving farm profitability, and supporting long-term development of the aquaculture sector.

Acknowledgement

The authors sincerely acknowledge the cooperation of aquaculture farmers in Ikorodu, Epe, and Badagry Local Government Areas of Lagos State who willingly participated in this study and provided valuable information. Appreciation is also extended to the leadership of fisheries cooperative societies and officials of the Lagos State Ministry of Agriculture for their assistance during data collection. The authors further acknowledge colleagues who provided constructive comments during the development of this manuscript.

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Declaration

Conflict of interest

No conflict of interest declared by the authors.

Availability of Data

Data shall be made available upon request.

Ethical Consideration

Not applicable

Funding

The authors declared no source of funding

Availability of Data

Both authors contributed to all aspects of the work

Author Contributions

Samuel Awolumate conceptualized the study, designed the methodology, supervised field data collection, and led the statistical analysis and manuscript drafting. Joshua C. Ashiedu contributed to survey design, data collection, literature review, and interpretation of results. Both authors jointly revised the manuscript critically for intellectual content and approved the final version for publication and accountability.