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DETERMINANTS OF ADOPTION OF RECOMMENDED FISH PRODUCTION PRACTICES AMONG FARMERS IN SOUTHEAST, NIGERIA

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ABSTRACT

Fish farming is a critical sub-sector of agriculture in Nigeria, yet the adoption of recommended production practices remains low, contributing to a significant domestic supply deficit. This study analyzed the determinants of adoption of recommended fish production practices among farmers in Southeast Nigeria. A multi-stage sampling procedure was used to select 292 fish farmers from Ebonyi, Enugu, and Imo States. Primary data were collected using structured questionnaires and analyzed using descriptive statistics, mean scores from a 4-point Likert scale, and multiple regression analysis. The results showed that catfish (97.2%) and monoculture systems (75.7%) predominated. The average adoption level of recommended practices was 66.16%, with high adoption of record-keeping (96.6%) and disease control (96.2%), but low adoption of feed formulation (28.8%) and automated feeding systems (13.4%). Key factors influencing adoption included cost of feeding and other inputs (mean = 3.51), time savings (mean = 3.40), and cost of fingerlings (mean = 3.16). The regression results revealed that age ($p<0.05$), household size ($p<0.01$), annual income ($p<0.01$), years of experience ($p<0.01$), and membership in cooperative societies ($p<0.01$) had significant positive influences on adoption. The F-ratio (4.313, $p<0.01$) led to rejection of the null hypothesis, confirming that socioeconomic characteristics significantly influence adoption. The study concludes that while adoption of some practices is high, critical gaps remain. It recommends targeted extension training, strengthening of cooperative societies, and policies to reduce input costs to enhance adoption and productivity in the region.

Keywords: Adoption, determinants, fish production practices, recommended practices, Southeast Nigeria

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INTRODUCTION

Fish farming (aquaculture) is defined as the rearing of selected fish species under scientifically controlled conditions in enclosed water bodies such as ponds, where they feed, grow, breed, and are harvested for consumption or sale (Voluntary Service Overseas, 2022). As a branch of aquaculture, fish farming plays a critical role in enhancing food security, particularly in developing countries where animal protein intake often falls below the recommended 75g per person per day (FAO, 2018). In Nigeria, fish is a major source of dietary animal protein, obtained through capture fisheries, aquaculture, or importation of frozen fish (Boyd et al., 2020). However, capture fisheries—dominated by artisanal fishermen using traditional, labour-intensive methods—have reached production limits, making aquaculture a viable alternative for bridging the growing demand-supply gap.

Nigeria has substantial potential for fish production, with about 7,823 fish ponds and 8 lakes covering approximately 2,089.01 million cubic meters of water, particularly in the middle belt and coastal zones (Udoh and Nyienakuma, 2018). Despite this potential, fish farming remains relatively new in Nigeria, being only about 50 years old (Olukunle, 2014; Olagunju et al., 2017). The sector is particularly significant in Southeast Nigeria, including states such as Anambra, Imo, Abia, and Ebonyi, where favourable climate, abundant water resources, and high fish demand create ideal conditions for aquaculture. Fish farming offers substantial socioeconomic benefits, including job creation for the teeming youth population, improved livelihoods for farmers, and a significant contribution to the nation's Gross Domestic Product (GDP), with over six million people employed directly and indirectly.

Nevertheless, the adoption of recommended fish production practices among farmers remains unexpectedly low, given the sector's potential. Research institutes, state and federal ministries of agriculture, and other relevant organizations have introduced numerous fishery production practices and innovations over the years. However, farmers' response has been negligible. As Berdgue and Eswbar (2017) observed, the mere availability of appropriate production practices does not guarantee adoption; various constraints influence farmers' decisions to adopt or reject innovations. For instance, agricultural development programs and farming skill acquisition centres in Southeast Nigeria have long assisted fish farmers through training initiatives aimed at increasing production to meet animal protein demand. Yet, less attention has been given to systematically assessing the level of adoption and the specific problems farmers face in production.

The consequences of low adoption are evident in the production statistics. Despite the benefits associated with aquaculture, the local supply of fish amounts to only 0.55 metric tons, against a demand of 1.5 metric tons, leaving a deficit of 1.1 metric tons that is currently met through importation (Siyaiinbola et al., 2022). This shortfall underscores the urgent need to understand why farmers are not fully adopting recommended practices that could boost local production, reduce import dependency, and enhance national food security.

Several studies have examined adoption of improved fisheries production practices in different regions of Nigeria (Okunlola et al., 2017; Apata, 2018; Salau et al., 2021; Onuegbu, 2022). However, most of these studies focused on the extent of adoption rather than the determinants. Furthermore, past studies on determinants of adoption were conducted in other parts of Nigeria, with none specifically focusing on the Southeast region. This geographical gap is significant because the Southeast has unique socioeconomic, cultural, and agroecological characteristics that may influence adoption differently than other regions.

Therefore, this study became imperative to provide empirical evidence that fills this missing gap.

In light of the above, this study sets out to analyze the determinants of adoption of recommended fish production practices among farmers in Southeast Nigeria. Specifically, the study seeks to answer the following research questions: What are the fish species and production systems practiced by the farmers? What are the levels of adoption of recommended fish production practices among the farmers? What are the factors influencing the adoption of recommended fish production practices in the study area? The broad objective is to analyze the determinants of adoption of recommended fish production practices in Southeast Nigeria. The specific objectives are to: (i) determine the fish species and production systems practiced by the farmers; (ii) analyze the level of adoption of recommended fish production practices among the farmers; and (iii) determine the factors influencing the adoption of recommended fish production practices in the study area. The null hypothesis tested is that the socioeconomic characteristics of fish farmers have no significant influence on the adoption of recommended fish production practices.

The findings of this study will be of immense help to individuals, corporate bodies, non-governmental organizations, and government agencies in assessing the impact of identified determinants of adoption. By providing a framework for informed, evidence-based policies in the fishery subsector, this study aims to contribute to sustainable aquaculture development and improved food security in Southeast Nigeria and beyond.

METHODOLOGY

The study was carried out in Southeast, Nigeria. Southeast is one of the six geopolitical zones of Nigeria. The area is made up of five states which include, Anambra, Abia, Enugu, Ebonyi and Imo. The Southeast is approximately 17.2 Million people who are mainly Igbo speaking extraction. Here is the breakdown of the population of each state in the region: Abia State: 3.4 Million, Anambra State: 5.5 Million, Ebonyi State: 2.2 Million, Enugu State: 3.3 Million, Imo State: 3.8 Million. The region covers an area of approximately 29, 484 square kilometers (11,383 square miles), and is located between latitudes 4 and 7 degrees north of the equator and between longitudes 7 and 9 degrees east. Southeast is bounded in North by Benue and Kogi states, in the south by Akwa Ibom state, in the west by Delta and River States and in the east by Cross River State. (This was projected from National Population Commission of Nigeria, 2020).

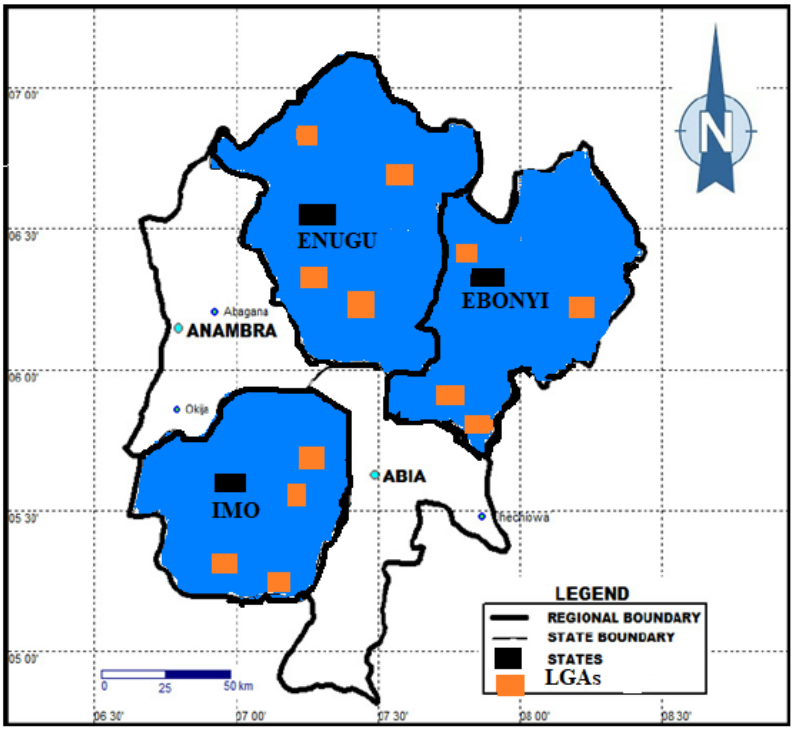


Figure 2: Map of Southeast of Nigeria showing the study area

Multistage sampling procedure was employed in selecting respondents for the study. In the first stage, three states that are known for fishing activities were selected purposively out of the five states in southeast Nigeria. The three states included: Ebonyi, Enugu and Imo as a result of fish farming prevalence in those states.

In the second stage, two zones from each of the state where fish farming are predominant were purposively selected. In the third stage, random sampling technique was used to select two Local Government Areas from each of the purposively selected six (6) zones of the three states. This gave a total of twelve (12) local government areas. The respondents were drawn from the list of registered fish farmers made available by the Ministry of Agriculture (Department of Fisheries) of the three states under study. Thus, the total number of 250 fish farmers are registered in Imo State, 150 registered in Ebonyi, and 200 fish farmers in Enugu State.

In the fourth stage, proportionate sampling technique was applied. 48.7% was applied proportionately in the selection of the 292 fish farmers that were used for the study. Proportionate sampling was used to ensure that there are equal chances for selection of respondents in the study area. The summary of the sampling procedure was presented in Table 2.

Data analysis

The study used primary data to analyze the stated specific objectives. The primary data were obtained from fish farmers who formed the respondents through the use of well-structured questionnaires. Data collected for the study were analyzed in line with the stated specific objectives of the study. Therefore, Objective iand ii were achieved using descriptive statistics such as percentages and frequency counts.Objective iii was achieved using multiple regression analysis and mean score ranking of a 4-point Likert type scale.

Model Specifications

Other factors influencing the adoption of recommended fish production practices were determined by a 4-point Likert type scale such as strongly agree, Agree, Disagree and Strongly disagree.

This was summarized with the equation $Xs = \frac{\sum fn}{nr}$

where,

Xs = mean score
Σ = Summation
f = Frequency
n = Scaling nominal value
nr = Number of respondents

$$\bar{x} = \frac{\Sigma x}{n} = \frac{1+2+3+4}{4} = \mathbf{2.5}$$

Multiple Regression Analysis

Y = f (X, X, X, X, X, X, X and X) ---------- implicit form
$Y = \beta_0 + \beta_1X_1 + \beta_2X_2, + \beta_3X_3, + \beta_4X_4, + \beta_5X_5, + \beta_6X_6, + \beta_7X_7 + \beta_8X_8 +$ et ------explicit form
Where Y = Level of adoption of recommended fish production practices
X_1 =Fish farming experience (years)
X_2= Age (years)
X_3= Sex (male = 1, female =0)
X_4= Education level (years)
X_5= Annual Income (N)
X_6= Strength of workers (number)
X_7= Household size (Number of persons that live and feed from the same pot in your house)
X_8= Pond size (m^2)
X_9= Marital status (dummy: married -1, single 0)
X_{10}= Membership of cooperative societies
X_{11}= Nature of production (fulltime -1, parttime-0)
β_0- β_8 = coefficients estimate
et = random disturbances

Hypothesis

Ho: The socio-economic characteristics of the fish farmers have no significant influence on the adoption of recommended fish production practices. The stated null hypothesis was tested using F-test.

RESULTS

The results of analysis of data collected from field survey in line with the specific objectives of the study were presented in this chapter. Results were presented under the following headings: fish species and production systems practiced by the farmers, level of adoption of recommended fish production practices among the farmers, and factors influencing the adoption of recommended fish production practices among the farmers

1 Fish species and production systems practiced by the farmers

Fish species and production systems practiced by the farmers were ascertained and result presented in Table 1.

Table 1: Fish species and production systems practiced by the farmers

Fish species and production systems practiced	Categories	Frequency (N = 292)	Percentage (%)
Species	Cat fish	284	97.2
	Mud cat fish	6	2.1
	Tilapia fish	3	0.7
Type of fish production	Poly culture	4	1.4
	Monoculture	221	75.7
	Integrated fish farming	67	22.9
Type of pond	Earthen pond	54	18.5
	Plastic pond	76	26.0
	Concrete pond	162	55.5
Reason for preference	Easy to manage	185	63.4
	Less expensive	99	33.8
	Scale of production	4	1.4
	Less laborious	4	1.4
Source of water	Borehole	162	55.5
	Well	75	25.7
	Rain	52	17.8
	Stream	3	1.0
Average weight of table size fish (kg)	1.5kg	25	8.5
	1.6kg	37	12.7
	1.7kg	48	16.4
	1.8kg	58	19.9
	1.9kg	75	25.7
	1	49	16.8
Age of table size fish (month)	5	80	27.4
	6	173	59.2
	7	39	13.4

Source: Field Survey, 2025

2 Level of adoption of recommended fish production practices among the farmers

Level of adoption of recommended fish production practices among the farmers were analysed and result presented in Table 2.

Table 2: Level of adoption of recommended fish production practices among the farmers

Recommended fish production practices	Frequency (N = 292)	Percentage (%)	Rank
pH testing	92	31.5	15th
Testing of oxygen (water quality)	101	34.6	14th
Disease control	281	96.2	2nd
Stocking density of 80 - 100 fingerlings per m^3 of pond.	208	71.2	10th
Feed formulation	84	28.8	16th
Bio-filtration of pollutants	104	35.6	13th
Floating fish feeds	264	90.4	5th
Automated feeding systems	39	13.4	17th
Use of dragnet	243	83.2	6th
Use of basket	223	76.4	9th
Regular changing of pond water	200	68.5	11th
Fingerlings production	158	54.1	12th
The pond water level not below 1m	225	77.1	8th
Fertilization of pond for proper growth of phytoplankton	231	79.1	7th
Construction of pond with relatively gentle sloppy topography	272	93.2	4th
Routine checking for blockages, damages, repair, pond walls, pond bottom, screen both inlet and outlet water supply structures	277	94.9	3rd
Keeping accurate records of fish farming activities	282	96.6	1st
Average Level of adoption		**66.16**	

Source: Field Survey, 2025

3 Factors influencing the adoption of recommended fish production practices among the farmers

Factors influencing the adoption of recommended fish production practices among the farmers were analysed and result presented in Tables 3 and 4.

Table 3: Mean Score Result of Factors Influencing the Adoption of Recommended fish Production Practices among the Farmers

Factors	Mean	Decision
Save time	3.40	Accepted
Size of pond constructed.	2.83	Accepted
Tenancy status.	2.70	Accepted
Cost of fingerlings.	3.16	Accepted
Complexity of the recommendation.	2.87	Accepted
Cost of feeding and other inputs.	3.51	Accepted
Using improved fish production practices lead to high production losses.	2.19	Rejected
Increases profit/improved income through higher yield/harvest.	2.99	Accepted
Availability of market.	3.11	Accepted
Improve quantity and quality of fish harvest.	3.16	Accepted
Skills required for the use of the improved production practices can be easily acquired.	2.69	Accepted
It gives me a sense of satisfaction.	2.72	Accepted
It is easy to manage the recommended fish production practices.	2.57	Accepted
Expected high profit.	3.08	Accepted
Availability of labour.	2.93	Accepted
Attendance to extension trainings.	2.99	Accepted
Mean of mean	**2.93**	

Source: Field Survey, 2025; Weighted mean = 2.5

Table 4: Regression Result of Socioeconomic Factors Influencing the Adoption of Recommended Fish Production Practices among the Farmers

Variables	Coefficients (β)	Std. Error	t-values
Sex	1.021	1.599	0.639ns
Age	0.167	0.075	2.225**
Marital status	-1.047	2.175	-0.481ns
Household size	0.251	0.035	7.171***
Educational level	-0.416	0.490	-0.849ns
Nature of production	3.303	2.288	1.444ns
Annual income	2.645E-6	0.000	4.801***
Pond size	-0.003	0.002	-1.635ns
Years of experience	0.835	0.274	3.053***
Number of workers	-0.656	0.393	-1.671ns
Cooperative society	2.691	0.497	5.414***
Constant	37.115	4.348	8.536***
R^2	0.745		
Adjusted R^2	0.711		
F-ratio	4.313***		

Source: Field Survey, 2025; *** and ** are statistically significant at 1% and 5% level of probability; ns means not statistically significant

The results of ordinary least square (OLS) multiple regression analysis in Table 4 showed that the coefficient of multiple determination (R^2) of the regression model was 0.745. This

indicated that seventy-five per cent (75%) of the variations in the dependent variable were accounted for by the independent variables or explanatory variables included in the model. The F-ratio of 4.313, which was significant at 1% probability level, showed that the coefficients of the explanatory variables included in the model were statistically different from zero; thus, the goodness-of-fit of the model and its explanatory power. Age, household size, annual income, years of experience and cooperative society bore positive coefficients with adoption of recommended fish production practices and were statistically significant at different levels of probability. Other variables were not statistically significant.

The null hypothesis which stated that socio-economic characteristics of fish farmers have no significant influence on the adoption of recommended fish production practices was tested. From the rule of thumb, reject null hypothesis if F-cal>F-tab, otherwise accept. Results showed that F-cal (4.313) > F-tab (2.94) thus, the null hypothesis which stated that the socio-economic characteristics of the fish farmers have no significant influence on the adoption of recommended fish production practices was rejected and the alternative accepted. Therefore, the socio-economic characteristics of the fish farmers had significant influence on the adoption of recommended fish production practices.

DISCUSSION

1 Fish Species and Production Systems Practiced by the Farmers

The majority (97.2%) of fish farmers in the study area engaged in catfish production, while a small proportion (0.7%) focused on tilapia fish production. This finding is consistent with the study of Adewolu and Adeoti (2010), which highlighted the popularity of catfish farming in Nigeria. The study also showed that monoculture (75.7%) was the dominant type of fish production system, while polyculture was practiced by a small proportion (1.4%) of farmers. This suggests that monocultures are mainly practiced in the area. This finding is in line with the findings of Osofero (2015), who reported that monoculture is a common practice in catfish farming due to its simplicity and ease of management.

The type of pond used by farmers varied, with concrete ponds (55.5%) being the most common, followed by earthen ponds (18.5%). A similar study by Adebayo *et al.* (2017) found that concrete ponds were preferred due to their durability and ease of maintenance. The major reason for preferring catfish production was its ease of management (63.4%), while the least cited reason was that it was less laborious (1.4%). This finding is in line with the study by Adewolu and Adeoti (2010), which reported that catfish farming is relatively easy to manage. The primary source of water for fish production was borehole water, while stream water was the least used. According to Ojo *et al.* (2016), borehole water is a reliable source of water for fish farming due to its consistency and quality. The average weight of table-size fish ranged from 1.5kg to 1.9kg, with the highest proportion (25.7%) of farmers reporting an average weight of 1.9kg. The average age of table-size fish ranged from 5 to 7 months, with the highest proportion (59.4%) of farmers reporting an average age of 6 months. These findings are consistent with the study by Adeyemo *et al.* (2018), which reported similar growth rates and harvesting ages for catfish.

2 Level of adoption of recommended fish production practices among the farmers

The results presented in Table 2 provide a comprehensive overview of the level of adoption of recommended fish production practices in the study area. The findings reveal a mixed picture, with some practices being widely adopted while others are less common. Notably, practices such as disease control (96.2%), keeping accurate records of fish farming activities

(96.6%), and construction of pond with relatively gentle sloppy topography (93.2%) have high adoption levels. These findings suggest that fish farmers recognize the importance of these practices in ensuring the health and productivity of their fish farms. On the other hand, practices such as pH testing (31.5%), feed formulation (28.8%), and automated feeding systems (13.4%) have lower adoption levels. This finding may indicate that farmers lack access to resources, training, or expertise in these areas, or that they perceive these practices as less critical to their operations. The relatively low adoption level of pH testing and feed formulation are particularly concerning, as these practices are crucial for maintaining water quality and ensuring the nutritional needs of fish are met. This disagrees with Kainga *et al.* (2016) that the adoption of water quality maintenance (pH testing) by fish farmers was high, while fewer (35.4%) not adopted the water quality test before stocking. This also agreed with Christian (2016) who reported that provision of extension services plays a crucial role in the development of aquaculture, providing farmers with information on production, value addition, access to finance, and marketing.

The average level of adoption of recommended fish production practices in the study area was 66.16%. This suggests that while farmers are adopting some best practices, there is still room for improvement. The findings highlight the need for targeted extension services and training programmes that focus on areas where adoption levels are low. Furthermore, the high adoption levels of practices such as floating fish feeds (90.4%), use of dragnet (83.2%), and fertilization of pond for proper growth of phytoplankton (79.1%) suggest that farmers are aware of the benefits of these practices. This finding can inform the development of extension programmes and training materials that build on existing knowledge and practices. This is not in line with the findings of Russell and Dobson (2009) which reported that farmers apply practices like stocking ponds, feeding fish, and water management based on Aquaculture Development programme recommendations, indicating a higher level of adoption in specific areas. This finding is also not in line with the findings of NARDTC (2014) which reported that some farmers still feel that the cost of fish stock is high, and lack knowledge on where to get quality fingerlings, affecting adoption.

3.1 Factors influencing the adoption of recommended fish production practices among the farmers

The result of mean score analysis provided valuable insights into the factors influencing the adoption of recommended fish production practices among farmers in the study area. The findings suggest that several key factors play a significant role in determining the adoption of these practices. For instance, the cost of feeding and other inputs ($\bar{X}$= 3.51) and the potential to save time ($\bar{X}$= 3.40) are among the most influential factors. This implies that farmers are more likely to adopt recommended practices if they perceive them as cost-effective and time-efficient. This finding is in line with Nwaneri (2015) who reported that the realization of full potentials of fish farming (culture) in Nigeria has been limited by expensive fish feed. Similarly, this finding is also in line with Agbamu and Orhorhoro (2007) who reported that inadequate fish production information and general cost of fish production decreased the production practices adoption.

Factors such as the size of the pond constructed, tenancy status, complexity of the recommendation, and availability of market, labour, and extension trainings all have a significant impact on the adoption of recommended fish production practices. These findings have important implications for policymakers, extension agents, and other stakeholders seeking to promote the adoption of improved fish production practices among farmers. This finding is line with the finding of Nwaneri, Chukwu, Aroh, Nwafor, Uka and Chukwu (2018)

who reported that factors that influence the adoption of recommended fish production practices as perceived by the farmers include, complexity of the recommended technology, availability of fish feed, cost of construction and preparation of pond and profitability of fish production.

The mean of mean score of 2.93 suggests that, on average, the farmers in the study area perceive the factors influencing adoption as moderately important and adopted at least three recommended fish production practices. However, the variation in mean scores across different factors suggests that some factors are more critical than others. For example, the relatively low mean score for "using improved fish production practices lead to high production losses" ($\bar{X}$= 2.19) suggests that farmers are aware that adopting new production practices cannot lead to potential losses that was why the item was rejected. This highlights the need for extension agents and other stakeholders to provide farmers with accurate information about the potential risks and benefits of improved production practices.

3.2 Socio-economic Factors influencing the adoption of recommended fish production practices among the farmers

Age: the coefficient of age was positive and significant at 5% level of probability implying that increases in the magnitude of age leads to a significant increase in adoption of recommended fish production practices. This implies that as fish farmers grows in age, experience increase leading to adoption of recommended fish production practices. The findings is in line with the study of Keremah and Esquire (2014) who argued that older farmers are not always enthusiastic about new farm production practices, especially if the benefits are not expected in the near future, but at the same time, farmers with advanced age are associated with more experience and thus likely to adopt recommended fish production practices than their younger counterpart.

Annual income: the coefficient of annual income was positive and significant at 1% level of probability implying that increases in the magnitude of annual income leads to a significant increase in the adoption of recommended fish production practices in the study area. Farmers with higher farm income adopted more of the recommended fish production practices than their counterparts with smaller farm income. The finding implies that farmers have a relatively high farm income. This is in line with the studies of Olaoye *et al.* (2013), who asserted that farmers with higher farm income will adopt recommended fish production practices than those with low farm income, since fish production requires a reasonable amount of funds.

Years of experience: the coefficient of experience was positive and significant at 1% level of probability, implying that increases in the magnitude of experience leads to a significant increase in adoption of recommended fish production practices in the study area. It is expected that higher years of experience will no doubt enhance their adoption of recommended fish production practices in the area. This finding agrees with the study of Obare *et al.* (2010) and Olasunkanmi (2012) who opined that farming experience had a positive and significant relationship with farmers' economic efficiency. This implies that the higher the level of experience of the farmer, the higher his adoption of recommended production practices will be. This finding also supports Chukwu (2014) who reported that farmers with more experience would be more efficient, have better knowledge of climatic conditions, better knowledge of efficient allocation of resources and market situation and are thus, expected to adopt more of the recommended fish production practices. The F-ratio (4.313) which determines the overall significance of the regression model is highly

significant at 1% level of probability implying that the regression model has very high explanatory power; hence, the study concludes that socio-economic characteristics of the fish farmers had significant influence on the adoption of recommended fish production practices in the study area.

Conclusion

The study also found that socioeconomic characteristics of fish farmers significantly influenced their adoption of recommended practices, while institutional, economic, managerial, and production constraints hindered the adoption process.

Recommendations

Based on the findings of the study, the following recommendations were made:

i. Identifying areas where adoption levels are low, policymakers and extension agents can design targeted interventions that promote the adoption of recommended fish production practices, ultimately improving the productivity and sustainability of fish farms in the region.

ii. Efforts should be made to establish and strengthen cooperative societies to enhance access to credit, inputs, and markets, and to promote knowledge sharing and collective bargaining power.

iii. Policymakers should organize regular training and capacity-building programmes for fish farmers to enhance their technical knowledge and skills in fish production, particularly in areas such as disease control, pond management, and record-keeping.

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