IJAAR PUBLISHING®

International Journal of Advanced Academic Research | ISSN: 2488-9849
Vol. 12, Issue 5 (2026) | www.ijaar.org

ANALYSIS OF SOCIO-ECONOMIC FACTORS, INFORMATION ACCESS, AND ADOPTION CONSTRAINTS IN RECOMMENDED FISH PRODUCTION PRACTICES IN SOUTHEAST, NIGERIA

Umeh, G. N. and Ekpe, G. S.

Department of Agricultural Economics, Management and Extension,
Faculty of Agriculture and Natural Resources Management,
Ebonyi State University, Abakaliki
*Corresponding Author's Email: idikedickson@gmail.com; Tel.: +2348138197594

ABSTRACT

Fish farming is a vital economic activity in Southeast Nigeria, contributing significantly to food security and rural livelihoods. However, the adoption of recommended fish production practices among farmers remains low, limiting productivity and income generation. This study analyzed the socio-economic factors, information access, and adoption constraints influencing 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 (frequencies, percentages, and means) and factor analysis. The results showed that the majority of fish farmers were male (65.4%), married (74.7%), aged 31–40 years (35.6%), with a mean age of 38 years, and had an average household size of 4 persons. Most farmers (36.6%) held a Bachelor's degree, while 87.3% engaged in part-time fish farming. The average annual income was ₦442,417.81, and the average pond size was 9.29 sq. m. The most prominent sources of information on recommended practices were extension services (73.3%), input marketers (70.2%), and cooperative societies (53.4%). Factor analysis identified four principal constraints to adoption: institutional constraints (poor extension delivery, absence of cooperative societies, cultural beliefs, ineffective policy support), economic constraints (inadequate finance, high cost of feed, lack of preservation facilities), managerial constraints (poaching/predators, water shortage during dry season, inadequate processing facilities), and production constraints (high cost of quality fish stock, disease and pest infestation, limited access to information). The study concludes that socio-economic characteristics, information access, and multi-dimensional constraints significantly influence adoption of recommended fish production practices in Southeast Nigeria. Recommendations include strengthening extension services, providing affordable credit and subsidized inputs, implementing supportive policies, and enforcing the land use act to improve access to land for fish farming.

Keywords: Socio-economic Factors, Information access, Adoption Constraints, Recommended Practices, Fish production Southeast Nigeria

https://doi.org/10.46654/apc1vd42

INTRODUCTION

Fish farming is a significant economic activity in Southeast Nigeria, particularly in states such as Anambra, Imo, Abia, and Ebonyi. The region's favourable climate, abundant water resources, and high demand for fish make it an ideal location for fish farming. Common fish farming activities in Southeast Nigeria include catfish farming (*Clarias gariepinus*), fingerlings production, feed formulation, and pond construction and management. Tilapia is another widely farmed species due to its fast growth rate and high market demand. Fish farming plays a vital role in food security and economic development in Nigeria, contributing significantly to the agricultural sector and the livelihoods of rural communities.

Despite the potential benefits of adopting recommended fish production practicessuch as improved productivity, enhanced product quality, and increased profitability, the adoption rate among farmers in Southeast Nigeria remains low (Okonkwo, 2017). Recommended fish production practices include the use of quality fish stock, appropriate pond construction and management techniques, optimal feeding practices, disease prevention and control measures, and proper water quality management (Akinbile *et al*., 2020). The lack of adoption of these practices can be attributed to various factors, including limited access to information and technical knowledge, inadequate training and extension services, high input costs, cultural beliefs and preferences, and ineffective policy implementation. Limited awareness and knowledge of recommended practices contribute to farmers' inability to understand the potential benefits of adopting them and their unawareness of improved techniques and production practices available (Kingsley et al., 2022). Addressing the determinants of adoption of recommended fish production practices in Southeast Nigeria is crucial to unlocking the sector's potential for increased productivity, income generation, and sustainable development (Mukaila et al., 2023).

There is a steady increase in human population in Nigeria which has not been matched with a corresponding increase in food production (Clavelle et al., 2019). As human population growth rises at a rate of about 4–5%, livestock production trails behind at a rate of 2–3% (Amosu et al., 2017). This shows a gap between supply and demand of animal protein in Nigeria, making it impossible for many Nigerians to meet their animal protein needs. Thus, there is need to explore alternative ways of accessing animal protein, which could be achieved through exposing farmers to adopt various recommended innovations in fish farming. Alternatively, fish imports should be substituted with domestic production to create employment and reduce poverty in rural areas where 70% of the population live in abject poverty (Islam et al., 2022).

According to FAO (2018), protein intake in poor nations like Nigeria is lower than the recommended 75g per person per day. Fish has long been recognized as a major source of dietary protein (Bradley et al., 2020). Fish farming has the potential to create jobs for the nation's teeming youth population, improve farmers' socioeconomic standing, significantly boost Nigeria's GDP, and employ over six million people directly and indirectly. However, due to a lack of knowledge about enhanced technologies required to increase fish output in both urban and rural sections of the nation, aquaculture growth has been at a low ebb in several regions of the country for many years (Dauda et al., 2019; Amirzadeh et al., 2020).

The adoption of recommended strategies and production practices by fish farmers is very important for aquaculture. For quite some time, numerous fishery production practices have been introduced by research institutes, state and federal ministries of agriculture, and other related organizations concerned with fishery innovations, but the response of farmers has

been negligible. It has been noted that people do not just adopt a production practice because it is available to them. Berdgue and Eswbar (2017) reported that even when production practices are available and appropriate, some constraints tend to exert influence on farmers' decisions to adopt or not. For example, agricultural development projects and farming skill acquisition centres in the agricultural development programmes of Southeast Nigeria have long assisted fish farmers on how to develop fish farming and increase production using modern recommended fish production practices. To this effect, various training programmes have been conducted, but less attention has been given to assessing farmers' socio-economic characteristics, their sources of information, and the constraints they face in production. Thus, it becomes necessary to study the determinants of adoption of recommended fish production practices in Southeast Nigeria.

The adoption of recommended fish production practices may depend on the level of awareness of the existence of such practices. Thus, limited awareness and knowledge of recommended fish production practices in Southeast Nigeria may have hindered their adoption and implementation, leading to suboptimal production levels and reduced income opportunities. Adequate access to numerous recommended fish production practices is necessary for improved production and the development of fishing industries in Southeast Nigeria. However, inadequate access to technical support, training, and extension services seems low and might impede farmers' ability to adopt and effectively implement these practices. Similarly, the high cost and limited availability of inputs required for recommended practices, such as quality fish feed and suitable pond construction materials, may deter farmers from adopting these practices (Olutumise, 2023).

The people's socio-cultural beliefs, attitudes, and traditional practices within fish farming communities in Southeast Nigeria often seem to discourage the adoption of recommended fish production practices, leading to stagnation in the industry and missed opportunities for sustainable development. Moreover, inadequate policy support and institutional frameworks for promoting and incentivizing the adoption of recommended practices may create a challenging environment for fish farmers, limiting their motivation and ability to adopt these practices and hindering overall sector growth.

Several studies have been carried out on 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 of improved fisheries production practices, with less stress on the determinants of adoption. Moreover, past studies on determinants of adoption of fish production practices were conducted in other parts of Nigeria; none seems to have been conducted in Southeast Nigeria. Specifically, no known study has comprehensively examined the socio-economic characteristics of fish farmers, their sources of information on recommended practices, and the constraints affecting adoption in this region. Hence, this study became imperative to provide answers that will fill this missing gap.

The specific objectives are to: describe the socio-economic characteristics of fish farmers in the study area; ascertain the sources of information on recommended fish production practices available to the farmers; and analyze the constraints to the adoption of recommended fish production practices among the farmers. Introduction and adoption of improved practices of fish farming is one of the major determinants of improved fish production. Hence, this research goes a long way in solving the problems posed by these challenges. This in turn would result in high productivity, high economic gain, and an improved standard of living for fish farmers in Southeast Nigeria and the nation as a whole.

The outcome of the study would also motivate local government areas, state and federal governments to respond to fish farming as an agricultural subsector that needs urgent transformation to ensure safe and nutritious food security and reduce the depth of poverty in the country, in line with the policy direction of the government.

METHODOLOGY

Study Area

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).

Southeast is located within the rainforest and derived Savannah regions of Nigeria and it is characterized with two major seasons. The rainy season which last from April to October with July and September as peak and the dry seasons which set in November and lasts until March. Atmospheric temperature in the area varies from 18^0 C to 34^0 C within the year (Geohive Nigeria geographic information, 2020). The area is agrarian states endowed with abundant natural resources with fertile land for growing of not only variety of both cash and food crops like yam, rice, cassava, cocoyam, groundnut, oranges, mango, pear among others, but also with animal husbandry such as rearing of sheep, goats and native cattle. There is additional endowment of rivers which surround the states which if effectively and systematically harnessed for irrigation will distinctly place southeast as a renowned area in agricultural production and industrialization. Furthermore, fishing activities are predominantly in all the states (Ekpe *et al.*, 2005).

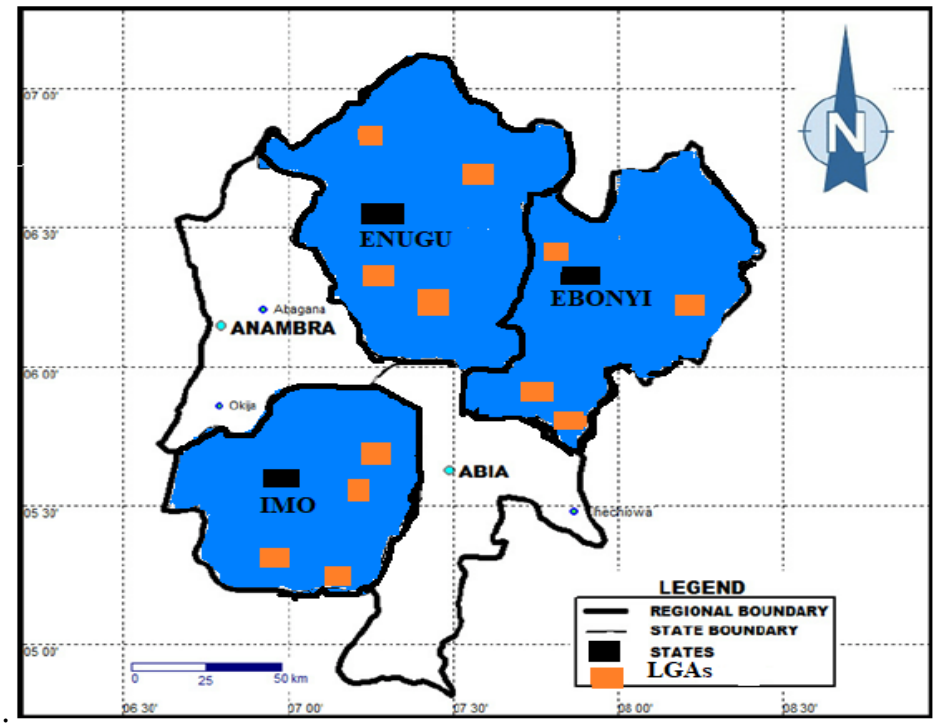


Figure 1: Map of Southeast of Nigeria showing the study area

Sampling Technique

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.

Data Collection

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. The questionnaire was structured in line with the stated specific objectives of the study in sections. The questionnaires were administered to the respondents with the aid of enumerators, who are extension agents of the state's agricultural development programmes (ADPs).

The questionnaire was made up of six (6) sections. Objective one (1) which is section one, examined the socio-economic characteristics of fish farmers in the study area. Section two focused on the fish species and production systems practiced by the farmers. Section three; focused on sources of information on recommended fish production practices available to the

farmers. Section four; analyzed the level of adoption of recommended fish production practices among the fish farmers. Section five; determined the factors influencing adoption of recommended fish production practices in the study area. Section six; analyzed the constraints to the adoption of recommended fish production practices among the farmers.

Analytical Technique

Data collected for the study were analyzed in line with the stated specific objectives of the study. Therefore, Objective I and II were achieved using descriptive statistics such as percentages and frequency counts. Objective III was achieved using Factor analysis.

Factor Analysis

Factor analysis was used to analyse the constraints to the adoption of recommended fish production practices among the farmers in the study area. In the analysis of factors, the Principal Component Analysis (PCA) or factor loading were used as developed by Kothari (2004). The Principal Component Analysis is built on the assumption that: the error terms (e_i) are independent of one another, such that $\sum (e_i) = 0$, and $Var(e_i) = \boldsymbol{\delta_i^2}$, thus, each e_i is an outcome of a random draw with replacement from a population of $e_i$values having means of zero (0) and certain variance, $\boldsymbol{\delta_i^2}$

The observable factors F_j are independent of one another and the error term such that $\sum (F_j) = 0$ and Vari $(F_j) = 1$. Therefore, each observable variable or factor Y_i is linear function of independent factors, F_i and error term (e_i). Using the assumptions of PCA, factor isolation was based on Kaiser's rule of thumb of ≥0.4 variable values as a minimum loading weight for isolating a factor as being positive to the attribute in question. Quantitatively:

$Y_i = \alpha_{i0} + \alpha_{i1}F_1 + \alpha_{i2}F_2 + \alpha_{i3}F_3 + \alpha_{i4}F_4 + \alpha_{i5}F_5 + \alpha_{i6}F_6 + \text{---------} + \alpha_{in}F_n + e_i$

where,

α_i = Parameters or Loadings. Thus, $\alpha_1 _ \alpha_n$ is the loading of variable Y_i on factors F_n.

Y_i = Dependent variables

F_i = Independent variables

From the rule of thumb as developed by Kaiser with 10% overlapping variance as applied by Nwibo and Okorie (2013), variables with a minimum loading of ≥0.4 can be isolated as being positive (constrained) to the attribute in question.

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: socioeconomic characteristics of fish famers in the study area, sources of information on recommended fish production practices available to the farmers, and constraints to the adoption of recommended fish production practices among the farmers.

Socioeconomic Characteristics of Fish Famers in the Study Area

Socioeconomic characteristics of fish farmers in the study area were examined, and the results are shown in Table 1.

Table 1: Socioeconomic Characteristics of Fish Famers in the Study Area

Socio-economic variables	Category	Frequency (N = 292)	Percentage (%)	Mean $\bar{X}$
Sex	Male	191	65.4	
	Female	101	34.6	
Age (years)	≤ 30	82	28.1	
	31 – 40	104	35.6	
	41 - 50	59	20.2	38
	51 - 60	30	10.3	
	Above 60	17	5.8	
Marital status	Single	74	25.3	
	Married	218	74.7	
Household Size	≤ 5	217	74.3	
	6-10	71	24.3	4
	Above 10	4	1.4	
Education attainment (years)	No formal education	4	1.4	
	Primary Education	35	12.0	
	Secondary education	43	14.7	
	OND/NCE	52	17.8	
	HND	41	14.0	
	Bachelor	107	36.6	
	Master degree	10	3.4	
Nature of production	Part-time	255	87.3	
	Full time	37	12.7	
Annual income (₦)	≤ 200,000	93	31.8	
	200,001 - 400,000	103	35.3	
	400,001 - 600,000	39	13.4	442,417.81
	600,001 – 800,000	23	7.9	
	Above 800,000	34	11.6	
Overall Size of pond (Sq. m.)	≥ 9.290	92	31.5	
	9.38 – 18.58	19	6.5	
	18.67 – 27.87	37	12.7	405.50
	27.87– 37.16	30	10.3	
	37.25 – 46.45	63	21.6	
	Above 46.45	51	17.5	
Fish farming Experience (years)	≤ 5	196	67.1	
	6-10	71	24.3	5
	11-15	23	7.9	
	Above 15	2	0.7	
Number of workers	≤ 5	208	71.2	
	6-10	84	28.8	
Membership of cooperative society	Yes	128	43.8	
	No	164	56.2	

Source: Field Survey, 2025

Result of analysis of sex of the fish farmers as presented Table 1 showed that majority (65.4%) of the fish farmers were male while, 34.6% of the fish farmers were females. The analysis of age of the fish farmers showed that the majority (35.6%) of respondents were between 31 – 40 years, while very few (5.8%) were 60 years and above. The mean age of the fish farmers was 38 years. Result further showed that the majority (74.7%) of the respondents

were married, while 25.3% were single. Furthermore, results showed that the majority (74.3%) of the respondents had a household size of less than or equal to five (5) persons, while very few (1.4%) had 10 persons or above. The average household size of the respondents was 4 persons.

The result of educational attainment revealed that 36.6% of the respondents were B.Sc holders, while very few (1.4%) had no formal education. The average years of fish experience of the respondents was 5 years. Majority (67.1%) of the respondents had experience of 1 - 5 years, while 0.7% of the respondents had 15 years or more of experience in fish farming. The average annual income of the respondents was ₦442,417.81k. Majority (35.3%) of the respondents earned between ₦200,001 and ₦400,000 annually, while few (7.9%) earned between ₦600,001 – ₦800,000. Majority of the fish farmers did not belong to a cooperative society, as justified by 56.2%, while 43.8% of the fish farmers belonged to a cooperative society. Furthermore, majority (87.3%) of the respondents were part-time fish farmers, while few (12.7%) of the respondents were full-time fish farmers. Majority (71.2%) of the fish farmers employed less than or equal to 5 workers, while 28.8% of them employed 6 – 10 workers. The average overall size of the fish pond was 9.29 Sq.m. which Majority (31.5%) of the respondents had, while 6.5% of the respondents had 9.38 – 18.58 Sq. m. pond size.

Sources of information on Recommended fish production practices available to the farmers

Sources of information on recommended fish production practices available to the farmers were assessed and result presented in Table 2.

Table 2: Sources of information on Recommended fish production practices available to the farmers

Sources of information	Frequency (N = 292)	Percentages (%)
Local fish farms	94	32.2
Online platforms	20	6.8
Colleges	139	47.6
Associations	70	24.0
Research institutes	107	36.6
Radio	32	11.0
Television	41	14.0
Social media	119	40.8
Cooperative societies	156	53.4
Universities	131	44.9
Extension service	214	73.3
Input marketers	205	70.2
Neighbours	86	29.5

Source: Field Survey, 2025

Result of the analysis presented in Table 2 showed that extension service (73%), Input marketers (70.2%), Cooperative societies (53.4%), colleges service (47.6%), Universities (44.9%), social media (40.8%), Research institute (36.6%), Local fish farms (32.2%), Neighbours (29.5%), Associates (24.0%), Television (14.0%), Radio (11.0%) and Online platforms (6.8%) were the sources of information on recommended fish production practices available to the farmers.

Constraints to the adoption of recommended fish production practices among the Farmers

Constraints to the adoption of recommended fish production practices among the farmers were analysed using factor analysis, and the results are presented in Table 3.

Table 3: Varimax Rotated Component Matrix on Constraints to the adoption of recommended fish production practices among the Farmers

Constraints	Institutional constraints	Economic constraints	Managerial constraints	Production constraints
Poor extension delivery	**0.764**	-0.047	-0.138	0.031
Preservation/storage facilities	0.010	**0.661**	0.010	0.082
Inadequate motivation of extension officers	**0.563**	-0.159	0.193	0.233
Inadequate finance	-0.410	**0.520**	0.026	0.276
Absence of cooperative society	**0.724**	-0.330	-0.050	-0.184
High cost of quality fish stock	0.014	0.173	-0.112	**0.570**
Poaching/predators	-0.085	-0.149	**0.579**	-0.002
High cost of feed	-0.460	**0.491**	0.009	0.239
Market price fluctuation	0.148	-0.666	0.009	0.198
Water shortage during dry season	-0.109	0.300	**0.477**	-0.139
Disease and pest infestation	-0.022	-0.128	0.271	**0.722**
Land acquisition	**0.508**	-0.097	-0.330	0.075
Inadequate processing facilities	0.066	0.247	**0.681**	0.127
Limited access to information	0.079	-0.227	-0.266	**0.454**
Lack of technical knowledge	**0.447**	-0.130	0.277	-0.060
Cultural beliefs and preferences	**0.740**	-0.034	-0.235	0.113
Ineffective policy support	**0.632**	0.026	0.079	-0.023

Source: Field Survey, 2025

The result in Table 3 showed the result of the varimax rotated component matrix on constraints to the adoption of recommended fish production practices among the farmers in the study area. Kaiser's (1958) rule of thumb (0.3) with 10% overlapping variance or more loading was used in naming a factor (Nwibo and Okorie 2013). Based on items that clustered and loaded high, four (4) factors were identified and extracted, namely; institutional, economic, managerial and production. These four components represent the principal factors and constraints to the adoption of recommended fish production practices among the farmers

in Southeast, Nigeria. Each factor was given a denomination that best described or characterized the set of variables contained in it.

From the result, variables constituting institutional factors constraining the adoption of recommended fish production practices among the farmers in the study area were: poor extension delivery (0.764), inadequate motivation of extension officers (0.563), absence of cooperative society (0.724), land acquisition (0.5080), lack of technical knowledge (0.447), cultural beliefs and preferences (0.740) and ineffective policy support (0.632). The economic constraints to adoption of recommended fish production practices among the farmers were: preservation/storage facilities (0.661), inadequate finance (0.520) and high cost of feed (0.491). The managerial related constraints to the adoption of recommended fish production practices among the farmers were: poaching/predators (0.579), water shortage during dry season (0.477) and inadequate processing facilities (0.681). Finally, the production constraints to the adoption of recommended fish production practices among the farmers include: high cost of quality fish stock (0.570), disease and pest infestation (0.722) and limited access to information (0.454).

DISCUSSION

Socioeconomic characteristics of fish famers in the study area

Majority (65.4%) of the farmers were males. The finding implies that both sex are involved in fish farming and adoption of recommended production practices, but males are more in number in the area. The implication of males greater proportion may be that technical efficiency and productivity are expected to be higher because males have the tendency to be more labour efficient (Esiobu, 2019).

With the majority (35.6%) of respondents between the age of 31 – 40 years, and the average age of 38 years, it shows that farmers in the area are vibrant, young and still in the active age. Fish farming is strenuous. The implication is that younger farmers are more likely to withstand the stress and strain involved in fish production in the area. Younger farmers are also more likely to adopt recommended fish production practices than their older counterparts. The result is in agreement with the study of Keremah and Esquire (2014), who reported that younger farmers normally dominate such strenuous ventures as old farmers are more likely to apply different practices in increasing output and income in fish farming.

The majority (84.44%) of the respondents were married. The finding implies that fish production is an enterprise of married individuals who are expected to be responsible according to societal standards. This finding supports the result of Olawunmi *et al.* (2010) who reported that married farmers tend to have easy access to production variables such as land and large family size which are traditionally owned and provided by household heads (husbands) to compliment family labour to enhance production, reduce the cost of hired labour and resource use efficiency of the household farmers.

The household size of fish farmers as recorded in this study was between 1 – 5 household members, which is 74.3% of the respondents. This relatively small household size could imply that fish farmers may rely more on hired labour, increasing production costs. Larger household sizes (6-10 persons) are often desirable in rural areas, as family members can contribute to farm activities, reducing labour costs. The household size can affect labour costs and adoption of recommended fish production practices. With smaller household sizes, fish farmers may face increased production costs due to hired labour, potentially reducing their profit margins. Conversely, larger household sizes can provide a readily available workforce, enhancing productivity and reducing costs.

A greater proportion (36.6%) are Bachelor's degree holders. The finding implies that most of the fish farmers had formal education, which is expected to increase their level of understanding and decision-making on the adoption of recommended fish production practices in the area. This assertion supports the finding of Olalekan *et al.* (2014), which reported that a higher level of education determines the quality of skills of farmers, performance and profitability of their fish production enterprise.

The study revealed that the majority (87.3%) of the respondents were part-time fish farmers, while a smaller proportion (12.7%) were full-time fish farmers. The dominance of part-time fish farmers implies that many respondents may not have the requisite expertise, resources, or commitment to optimize their fish farming operations. This could lead to reduced productivity, efficiency, and profitability in the industry. As a result, the fish farming sector may struggle to meet the growing demand for fish and fish products in Nigeria, ultimately affecting food security and the livelihoods of those dependent on the industry. This finding is consistent with the findings of Adebayo *et al.* (2018), which reported that many fish farmers in Nigeria engage in fish farming as a secondary occupation.

The average annual income of the respondents was ₦442,417.81. The relatively low average annual income implies that many fish farmers may struggle to make a decent living, potentially leading to reduced adoption of recommended practices, investment, decreased productivity, and increased poverty. This finding is consistent with previous studies (Oluwatayo and Ojo, 2016; Adeyonu *et al.*, 2017). The low-income levels may have long-term consequences for the sustainability of the fish farming industry. Adeyonu *et al.* (2017), and Oluwatayo and Ojo (2016) support this finding, highlighting the need for interventions to enhance the profitability and sustainability of fish farming in Nigeria.

With an average pond size of 37.67 square meters, the findings suggest that fish farming operations in the area are relatively small-scale. The majority (31.5%) of respondents had a pond size of ≥ 9.290 sq. m., further supporting this, indicating that most fish farming operations in the study area are small-scale. Small pond sizes can limit productivity and profitability, affecting fish farmers' livelihoods and adoption of recommended fish production practices. This finding is supported by Oluwatayo and Ojo (2016), who reported that small pond sizes can lead to constraining of fish production and income, making it challenging for farmers to achieve economies of scale and adoption of recommended fish production practices. This highlights the need for strategies to support small-scale fish farmers in increasing their productivity and income.

It revealed that 67.1% had fish farming experience ranging between 1 – 5 years, while 0.7% had 15 years or more years of experience. As a result, the respondents with the highest number of years of experience should have good skills and better approaches to the fish farming business. The respondents with longer years of experience were also able to forecast a market situation in which they would sell their products at higher prices and thus could help the farmers in the adoption of recommended fish production practices. Those with fewer years of experience, especially those with less than 5 years, faced many risks in the early days of their fish farming business. According to Ekanem *et al.* (2015), the years of farming experience of a farmer enable him to acquire practical and relevant farming knowledge, which drives his ability to efficiently utilize available resources with discretion, which is lacking among most fish farmers.

The study revealed that the majority (71.2%) of fish farmers employed fewer than 5 workers, while 28.8% employed between 6-10 workers. This suggests that most fish farming

operations in the study area are small-scale, labour-intensive, and likely family-managed. The small workforce may be due to the limited scope of operations, financial constraints, or the nature of fish farming itself. This is in line with the findings of Adeyonu *et al.* (2017), which reported that small-scale fish farmers often rely on family labour and may face challenges in expanding their workforce due to financial constraints. This limited workforce may impact the productivity and efficiency of fish farming operations, potentially affecting the level of adoption of recommended fish production practices.

Cooperative society is a social participation that helps farmers to pool their resources in order to have access to fisheries inputs and to have insights into their fishing issues. Membership of cooperative society is also a factor that influences the adoption of improved fisheries production practices and poverty alleviation. This shows that the majority (56.2%) of the respondents in the study areas do not belong to any cooperative society, which may be a result of lack of awareness and interest. Hence, being a member of an association group could create peer pressure for farmers to adopt new recommended fish production practices. This is in line with the findings of Ekong (2004), who observed that groups ensure that members derive benefits from the groups in which they cannot derive individually if they were acting alone.

Sources of information on recommended fish production practices available to the farmers

The result presented in Table 5 provide valuable insights into the diverse sources of information on recommended fish production practices available to farmers. According to the analysis, the most prominent sources of information include extension service (73.3%), input marketers (70.2%), and cooperative societies (53.4%). This finding suggests that farmers rely heavily on extension services, input suppliers, and cooperative societies for information on best practices in fish production. The significant role of extension services and input marketers as sources of information highlights the importance of extension agents and industry stakeholders in disseminating knowledge to farmers. The prominence of cooperative societies also underscores the value of collective action and peer-to-peer learning in the dissemination of best practices. These findings have implications for the design of extension services and knowledge dissemination strategies, suggesting that leveraging these channels could be an effective way to reach farmers. Similarly, the farmers utilize a range of other sources, including research institutes (36.6%), universities (44.9%), and social media (40.8%). The relatively high percentage of farmers accessing information through social media is notable, suggesting that digital platforms are becoming increasingly important for knowledge dissemination in the agricultural sector. This finding has implications for the development of digital extension services and online platforms for farmers.

The results also show that some sources, such as local fish farms (32.2%) and neighbors (29.5%), play a moderate role in providing information to farmers. In contrast, radio (11.0%) appears to be less prominent source of information. This finding suggest that farmers may prefer more personalized and localized sources of information, and that there may be opportunities to strengthen the role of radio in disseminating knowledge to farmers. However, these findings highlight the diversity of sources of information available to farmers and the importance of leveraging multiple channels to disseminate knowledge on best practices in fish production. By understanding the sources of information that farmers rely on, policymakers and extension agents can design more effective strategies for knowledge dissemination and capacity building, ultimately enhancing the adoption of recommended fish production practices. This is in line with the findings of Ifejika Oladosu, Nwosu, Ayanda, Asodu and Olowosegun (2009) on influence of information sources on aquaculture

production practices adoption and reported that input marketers, cooperative societies, research institutes, universities and social media were the major sources for information on recommended fish production practices.

Constraints to the adoption of recommended fish production practices among the farmers.

Institutional Constraints

The study highlights several institutional constraints to the adoption of recommended fish production practices, including poor extension delivery (0.764), inadequate motivation of extension officers (0.563), absence of cooperative society (0.724), land acquisition (0.5080), lack of technical knowledge (0.447), cultural beliefs and preferences (0.740), and ineffective policy implementation (0.632). This finding suggests that institutional factors play a significant role in hindering the adoption of best practices among farmers.

The poor extension delivery and inadequate motivation of extension officers imply that farmers may not be receiving the necessary support and guidance to adopt recommended practices. This is in line with Davis (2008) who reported that effective extension services are critical in promoting the adoption of agricultural production practices. Similarly, the finding agrees with Anderson and Feder (2007) who emphasized the importance of well-trained and motivated extension officers in facilitating the adoption of recommended fish production practices.

The absence of cooperative societies and ineffective policy implementation are also constraints to adoption. Cooperative societies can provide farmers with access to resources, markets, and information, while effective policy implementation can create an enabling environment for farmers to adopt best practices. This finding agrees with Bijman and Wollni (2008), who reported that absence of cooperative societies can hinder the promotion and the adoption of sustainable agricultural practices.

Economic Constraints

The study identifies economic constraints to adoption, including preservation/storage facilities (0.661), inadequate finance (0.520), and high cost of feed (0.491). This finding suggests that economic factors are significant barriers to the adoption of recommended fish production practices.

The lack of preservation/storage facilities and inadequate finance imply that farmers may not have the necessary resources to invest in the best fish production practices. Similarly, the high cost of feed can limit farmers' ability to adopt recommended feeding practices. This finding is in line with the findings of Awotide, Abdoulaye, Alene and Manyong (2016) which reported that lack of access to finance is a critical factor that hinder adoption of agricultural production practices. The studies of Keremah and Esquire (2014) opined that high cost of feed is one of the problems of livestock production in Nigeria. Adeogun *et al.* (2007) also reported inadequate finance as one of the problems affecting aquaculture in Lagos State, Nigeria. In a similar way Nwosu and Onyeneke (2013) reported that inadequate finance is the bane of pond fish production in Imo State, Nigeria.

Managerial Constraints

The study identified managerial constraints to adoption, including poaching/predators (0.579), water shortage during dry season (0.477), and inadequate processing facilities (0.681). The findings suggest that managerial factors are important constraints to the adoption of recommended fish production practices. The presence of poaching/predators and water

shortage during the dry season imply that farmers may face significant challenges in maintaining optimal production conditions. This agrees with Adewolu and Adeoti (2010), who reported that ineffective management of water resources is detrimental in fish farming. Similarly, the lack of processing facilities can limit farmers' ability to add value to their products. This finding agrees with Oluwatayo and Ojo (2016) who reported that inadequate access to processing facilities can hinder the profitability of fish farming.

Production Constraints

The study identifies production constraints to adoption, including high cost of quality fish stock (0.570), disease and pest infestation (0.722), and limited access to information (0.454). This finding suggests that production-related factors are significant constraints to the adoption of recommended fish production practices. The high cost of quality fish stock and disease and pest infestation imply that farmers face significant challenges in maintaining the health and productivity of their fish. The use of quality fish stock is critical in fish farming. Similarly, limited access to information can limit farmers' ability to adopt production practices. This is in line with the findings of Awotide *et al.* (2016) which reported that lack of access to information, disease and pest infestation and high cost of quality fingerlings are critical factors that hinder the adoption of recommended fish production practices.

Conclusion

The study revealed that fish farmers in the area were predominantly male, married, and had a moderate level of education, with an average annual income of ₦442,417.81. The adoption of recommended fish production practices was influenced by factors such as cost of inputs, market availability, and extension services, with an average adoption of 66.16%.

Recommendations

i. Government and non-governmental organizations should strengthen extension services by increasing the number of extension agents, providing adequate motivation and incentives, and ensuring regular visits to fish farmers to promote the adoption of recommended fish production practices.

ii. Financial institutions and government agencies should provide affordable credit facilities and subsidized inputs, such as quality fish stocks and feeds, to fish farmers to reduce the economic constraints to adoption of recommended fish production practices.

iii. Policymakers should develop and implement effective policies to support fish farming, including providing infrastructure, improving access to markets, and addressing production constraints such as disease and pest infestation, to create an enabling environment for fish farmers to thrive.

iv. Government should ensure implementation of land use act of 1978 to reduce bureaucratic bottleneck and to ensure that farmers can easily get access to land.

v. Farmers should provide closed circuit television (CCTV) and modern gadgets, to enhance surveillance within and outside the farm.

REFERENCES

Adebayo, I. A., Omitoyin, B. O., and Ajani, E. K. (2017). Pond type and fish production in Nigeria. *Journal of Aquaculture Research and Development*, 8(2), 1--6.

Adeogun, O. A., Ogunbadejo, H. K., Ayinla, O. A., Oresegun, A., Oguntade, O. R., Tanko, A., and Williams, S. B. (2007). Urban aquaculture: Producer perceptions and practices in Lagos State, Nigeria. *Middle-East Journal of Scientific Research*, 2(1), 21--27.

Adewolu, M. A., and Adeoti, A. J. (2010). Effect of stocking density on the growth and survival of *Clarias gariepinus* (Burchell, 1822) fingerlings. *Journal of Fisheries and Aquatic Science*, 5(2), 114--121.

Adeyonu, A. G., et al. (2017). (Cited in discussion on income and workforce).

Akinbile, C. O., Ogunmola, O. O., Abolude, A. T., and Akande, S. O. (2020). Trends and spatial analysis of temperature and rainfall patterns on rice yields in Nigeria. *Atmospheric Science Letters*, 21, e94410.

Amirzadeh Moradabadi, S., Ziaee, S., Mehrabi Boshrabadi, H., and Keikha, A. (2020). Effect of agricultural sustainability on food security of rural households in Iran. *Journal of Agricultural Science and Technology*, 22(2), 289--304.

Amosu, A. O., Hammed, A. M., Togunde, K. A., Olabode, J. O., and Adeyemi, A. (2017). Possible aquaculture development in Nigeria: Evidence for commercial prospects. *Journal of Agricultural Science and Technology*, 7(B), 194--205.

Anderson, J. R., and Feder, G. (2007). Extension service and rural development: An overview. *World Bank Research Observer*, 22(1), 1--24.

Apata, O. M. (2018). Awareness and adoption of fish production technologies in South Western Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS)*, 3(5), 819--822.

Awotide, B. A., Abdoulaye, T., Alene, A. D., and Manyong, V. M. (2016). Impact of improved agricultural technologies on household income and poverty in Nigeria. *Journal of Agricultural Economics*, 67(2), 323--341.

Berdgue, J. A., and Eswbar, D. (2017). Rural diversity, agricultural innovation policies and poverty reduction. Argen Network Papers No. 122. P.66

Bijman, J., and Wollni, M. (2008). Producer organizations and sustainable agriculture: A review of the literature. *Journal of Rural Studies*, 24(4), 412--423.

Bradley, B., Byrd, K. A., Atkins, M., Isa, S. I., Akintola, S. L., Fakoya, K. A., Ene-Obong, H., and Thilsted, S. H. (2020). Fish in food systems in Nigeria: A review (Programme Report: 2020-06). WorldFish.

Clavelle, T., Lester, S. E., Gentry, R., and Froehlich, H. E. (2019). Interactions and management for the future of marine aquaculture and capture fisheries. *Fish and Fisheries*, 20(2), 368--388.

Dauda, A. B., Ajadi, A., Tola-Fabunmi, A. S., and Akinwole, A. O. (2019). Waste production in aquaculture: Sources, components and managements in different culture systems. *Aquaculture and Fisheries*, 4(3), 81--88.

Davis, K. E. (2008). Extension in Sub-Saharan Africa: Overview and assessment of past and current models, and future prospects. *Journal of International Agricultural and Extension Education*, 15(3), 15--28.

Ekanem, E., Cynthia, A., and Augustine, A. (2015). Determinants of poverty status of fish vendor households in Lower Cross River Basin. *Nigerian Journal of Economics and Sustainable Developments*, 6(14), 50--59.

Ekpe, I. I., Agim, L. C., and Nkwopara, U. N. (2005). Physico-chemical properties of four ultisols under different vegetation cover in south eastern Nigeria. *Journal of Science of Agriculture, Food Technology and Environment*, 5, 74--78.

FAO (Food and Agriculture Organization). (2018). *The state of world fisheries and aquaculture 2018*. Rome.

Ifejika, P. I., Ayanda, J. O., and Nwabeze, A. A. (2009). Influence of information sources on aquaculture technologies adoption in Oyo State, Nigeria. *Nigerian Journal of Fisheries*, 6(1 and 2), 352--366.

Islam, M. J., Kunzmann, A., Bögner, M., Meyer, A., James, G. G., and Slater, M. J. (2022). Responses of aquaculture fish to climate change induced extreme temperatures: A review. *Journal of the World Aquaculture Society*, 53, 314--366.

Keremah, I. R., and Esquire, J. (2014). Comparative assessment of growth performance and economics of production of *Clarias gariepinus* fingerlings in ponds and tanks. *Greener Journal of Agricultural Sciences*, 4(2), 34--38.

Kingsley, E. N., Nwadinigwe, C. A., and Omitoyin, B. O. (2022). Potential contribution of selected wild fish species to the minerals intake of pregnant and lactating women, children and adults in rural riverine communities of Edo State. *Measurement in Food*, 8, 1--7.

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. (Cited in factor analysis section).

Mukaila, R., Ukwuaba, I. C., and Umaru, I. I. (2023). Economic impact of disease on small-scale catfish farms in Nigeria. *Aquaculture*, 575, 73977.

Nwibo, S. U., and Okorie, A. (2013). Determinants of adoption of improved fish production technologies in Anambra State, Nigeria. *Journal of Agricultural and Veterinary Sciences*, 5(1), 1--9.

Nwosu, C. S., and Onyeneke, R. U. (2013). Effect of productive inputs of pond fish production on the output of fish in Owerri Agricultural Zone of Imo State, Nigeria. *Global Advanced Research Journal of Agricultural Science*, 2(1), 23--28.

Okonkwo, E. C., Ohajianya, D. O., and Henri-Ukoha, A. (2017). Socio-economic analysis of fish farming in Anambra State Nigeria. *Journal of Fisheries and Aquatic Science*, 12(2), 123--132.

Oluwatayo, I. B., and Ojo, A. O. (2016). Analysis of the profitability of fish farming in Nigeria. *Journal of Aquaculture Research and Development*, 7(3), 1--6.

Olutumise, A. I. (2023). Impact of relaxing flood policy interventions on fish production. *Aquaculture International*, 31, 1855--1878.

Onuegbu, C. (2022). Determinants of value addition initiatives use by fish farmers in Kwara and Kogi States. *ResearchGate Publication*, 1(2), 12--18.

Salau, E. S., Lawee, A. Y., and Idowu, S. D. (2021). Adoption of improved fisheries technologies by fish farmers in Nasarawa State, Nigeria. *Journal of Agricultural Extension and Rural Development*, 6(11), 342--349.