BADEGGI JOURNAL OF AGRICULTURAL RESEARCH AND ENVIRONMENT, 2024, 06(02), 44-58

NCRI Press

Available online: www.ncribjare.org
ISSN: 2695-2122, e-ISSN: 2695-2114
DOI: https://doi.org/10.35849/BJARE202402/170/005
Journal homepage: www.ncribjare.org

Research Article

Socio-economic Characteristics and Farming Practices of Fish Farmers in Kumbotso Local Government Area of Kano State

Abdul-Azeez, H[1]., Muhd, T[1]., Suleiman, A. M[1]., Aminu, M.U[1]., Muhd, I. U[1]., Mudi, Z. R[1]. and Oyinloye, R[2].

[1]Department of Fisheries and Aquaculture, Bayero University, Kano, PMB 3011, Kano state, Nigeria.

[2]Department of Agricultural Extension and Management, Federal College of Agricultural Produce Technology Hotoro, PMB 3013, Kano State, Nigeria.

Correspondence e-mail: habdulazeez.fac@buk.edu.ng

Abstract

This study investigated the socio-economic characteristics, farming practices and challenges limiting success of fish farming in the study area in order to proffer appropriate recommendations. The study area was selected purposively, and data were collected from twenty-six randomly selected fish farmers through questionnaires. Results of the study indicated that majority of the fish farmers are male (100%), married (80.77%), and aged between 31 and 50 years (65.38%). Majority of the fish farmers (69.23%) also have at least a secondary education, six years of experience in fish farming (57.90%) and considered fish farming as their primary occupation (73.06%). Concrete ponds are predominantly used for fish culture (53.85%), while a significant portion of farmers (30.76%) utilize earthen ponds. African catfish (*Clarias gariepinus*) is the most farmed species in the study area while yield of nearly all the farmers (92.31%) was less than 10 tonnes per production cycle. A critical examination of the information regarding fish farmers and their activities in the area suggest that the farmers are not fully utilizing their energy and educational potentials to enhance their technical knowledge of the enterprise. Major challenges identified in the area were security, market instability, cold season influence on fish growth, expensive feed and poor road network. Most effective and the immediate measure that should be embarked upon is formation of cooperative societies that would unite efforts of the fish farmers towards overcoming most of the challenges confronting their businesses. Doing this would also provide enabling environment for other stakeholders to easily recognize the farmers' plight and be willing to offer their contributions.

Keywords: *Aquaculture, Catfish, Farm, Pond, Production*

Introduction

Aquaculture encompasses the cultivation of various aquatic organisms, including shellfish, fin fish, crustaceans, amphibians, and aquatic plants (Madu, 2016). The rise of aquaculture stemmed from the declining productivity of the fisheries sector due to unsustainable fishing practices, coupled with the geometric increase in the human population. These factors highlighted the limitations of capture fisheries (Omeje *et al.*, 2020). As a result, aquaculture has evolved as the fastest-growing sector within the global food economy. Its annual growth rate exceeds 10%, and it presently constitutes over 30% of the world's total fish consumption (FAO, 2022).

However, the rapid growth in the global aquaculture industry witnessed in the 1980s and

Received on 16th May, 2024; Revised on 27th July, 2024; Accepted on 11th August, 2024 and Published on 30th August, 2024

1990s (11.3% and 10.0%, respectively) has slowed since the beginning of the 21st century (FAO, 2018). Despite this slow down, aquaculture still outpaces other major food production sectors, albeit at a reduced average annual growth rate of 5.8% from 2000 to 2016. Nevertheless, some countries, particularly in Africa, continued to experience double-digit growth rates, especially from 2006 to 2010 (FAO, 2018; Tacon, 2020).

Many studies have highlighted the socio-economic dimensions of fish farming across various African countries (Amachree *et al.*, 2019). In Rwanda, fish farming has been identified as one of the most profitable agricultural enterprise while in Kenya, the sector holds many untapped potentials (Gachucha *et al.*, 2014; Nathanael *et al.*, 1998). Similar studies in Nigeria have focused on different states, unveiling diverse socio-economic factors influencing fish farming (Akarue and Aregbor, 2015; Kudi *et al.*, 2008; Ogunmefun and Achike, 2017; Olaoye *et al.*, 2013). These factors include age, household income, farm size, education level, and access to credit and extension services. Understanding these socio-economic characteristics is necessary to address the challenges faced by fish farmers. By identifying these factors, stakeholders can develop targeted interventions to enhance fish farming productivity and sustainability (Wuyep and Rampedi, 2018).

Effective fish farming management requires a comprehensive understanding of various techniques and adequacy of their applications (Omitoyin, 2007). The growth performance of cultured fish is directly influenced by the quantity and quality of feed, as well as the timing of feeding (Iruo *et al.*, 2018). Additionally, pond maintenance plays a critical role, with options ranging from earthen ponds to concrete tanks, especially in urban settlements where land is limited (Ifeonu *et al.*, 2019). The common fish farming systems-extensive, semi-intensive and intensive- each have unique characteristics and demands. proper understanding of these systems is vital for addressing challenges and ensuring successful operations, ultimately improving productivity and economic outcomes for fish farmers (Ogunmefun and Achike, 2017).

The dearth of comprehensive information on the activities of fish farming in Kumbotso Local Government Area of Kano State underscores the urgency and importance of this research endeavour. This study focuses on Kumbotso Local Government Area, a major hub of fish farming in the state. It explores the socio-economic profiles of local fish farmers, their main farming techniques, and the primary challenges facing the industry. The study aims to provide crucial insights to stakeholders, enabling them to develop effective solutions and recommendations for enhancing the sector's development.

Materials and Methods

The study was conducted in Kumbotso Local Government Area, Kano State, Nigeria. Kumbotso Local Government Area is situated between latitudes 11.88806° N and longitude 8.50278° E. It has an area of 158 km² and a projected 2022 population of 484,200 (www.citypopulation.de/). It falls within the Kano settlement zone, bordered to the north by Gwale, Dala and Tarauni, to the east by Dawakin kudu, and to the south by Madobi Local Government Area. Additionally, it shares boundary with Rimin Gado, Tofa, and Warawa Local Government to west (Yelwa *et al.*, 2015). The study area falls within the Guinea Savanna climate, characterized with two distinct seasons; dry and wet seasons (Aliyu *et al.*, 2020).

Kumbotso Local Government Area was purposively selected due to the concentration of fish farmers therein. A Sample size of twenty six was calculated based on an estimated total of 77 private fish farms in the area, a population proportion of 2.44%, a margin error of 5% and confidence interval of 95%. Subsequently twenty-six farmers were randomly selected for data collection.

Well-structured questionnaires were used as means of primary data generation. The questionnaires were designed to collect comprehensive information on the socio-economic characteristics, fish farming activities, and challenges confronted by the farmers. These questionnaires were administered to each of the respondents and oral interviews were casually interjected for clarity and accuracy of information. Descriptive statistics in the form of frequencies and percentages were employed to explore the data. This is to facilitate a clear understanding of

the distribution of responses. The results were presented using different data visualization methods such as tables, bar charts, and pie charts.

Results and Discussion

The socio-economic characteristics of fish farmers in Kumbotso Local Government Area are summarized in Table 1. Majority of the fish farmers (65.38%) were between 31 and 50 years old, and all surveyed farmers were male, with fish farming being their primary occupation. This predominance of male and youth participation aligns with findings from a similar study in Taraba State where most of the catfish farmers were also predominantly males (Ukpe *et al.*, 2017). Omeje *et al.* (2020) attributed male dominance to the labour-intensive nature of fish farming, involving activities such as pond digging, harvesting, and weed control, which demand physical strength. The significant involvement of youth suggests a positive outlook for the expansion of fish farming in the area, as young people have the potential to drive rapid development (Wuyep and Rampedi, 2018).

Additionally, 80.77% of the respondents were married, and nearly half (46.15%) had attained tertiary-level education. The high proportion of married individuals among the fish farmers indicates that the business is managed by responsible individuals capable of investing resources into the business, reflecting societal values that esteem marriage as a symbol of responsibility (Olaoye *et al.*, 2013). The notable level of education among the farmers enhances their capacity to adopt improved farming practices and technologies, consistent with another findings in Imo State (Nwosu and Onyeneke, 2013).

Figure 1 illustrates the years of experience among the respondents in fish farming, showing that 47% have 6-10 years of experience. Experience in any field is strongly correlated with an individual's ability to effectively handle tasks and achieve success (Olaoye *et al.*, 2013). Thus, farmers with longer experience are expected to have a better understanding of market conditions and effectively manage the associated risks in fish farming.

Figure 2 presents the sources of labour for fish farming activities, indicating that the combined use of family and hired labor is the most common practice (57%). The reliance on family labour, supplemented by hired labour, reflects traditional farming practices in Africa. In many Nigerian societies, household members are the primary labour source for small-scale farming (Olaoye *et al.*, 2013). Hired labour is often necessary for specialized tasks such as borehole repair, machinery maintenance, or fish pond/tank repair.

Respondents were also asked about essential factors for successful fish farming operations in the study area. Most fish farmers rated accessible roads (100%), quality water and electricity (95%), and security (89%) as crucial for their business's success. Other important factors include the availability of quality fingerlings, feed, and a suitable market (Figure 3). The high demand for quality water, electricity, roads, and security highlights the critical importance of these factors. Access to sufficient quality water at minimal cost influences profitability, while good roads facilitate smooth operations and security ensures business survival. It is noteworthy that feeding costs typically account for 60% of recurring expenditure in fish farming (Eriegha and Ekokotu, 2017). Therefore, the opinions expressed by the farmers reflect their understanding of the key determinants of success in the fish farming business.

The mode of fish farming operation in the study area is shown in Table 2. About 54% of fish farmers use concrete ponds, while 31% use earthen ponds. This predominance of concrete ponds contrasts findings from another study who found that most fish farmers in New Bussa used earthen ponds (Omeje *et al.*, 2020). This difference may be due to the characteristics of Nigerian cities like Kano, where access to sufficient land for earthen pond fish farming is typically challenging (Ifeonu *et al.*, 2019).

The majority (80.77%) of fish farmers uses boreholes as a water source, and 84.62% source their fingerlings from private hatcheries. The reliance on boreholes may be due to their consistent supply and disease-free nature (Amachree *et al.*, 2019). In terms of stocking density, 63.39% of fish farmers stock their ponds at 10-20 fingerlings/m^3, while 7.69% stock less than 10 fingerlings /m^3 and 26.92% stock more than 20 fingerlings /m^3. The prevalent stocking rate of 10-20 fingerlings/m^3 indicates a degree of intensive aquaculture, which is typically feasible in artificial culture systems like concrete ponds

(Mustapha, 2017).

In terms of water renewal, 53.85% of fish farmers perform daily water renewal, while 34.62% do it weekly. Additionally, 63% of fish farmers monitor water quality based on fish behaviour and pond water condition, 7.69% use water testing kits, and 11.54% rely on routine water renewal intervals without specific monitoring methods. The reliable borehole water supply may explain the prevalence of daily water renewal, though this is typically feasible only at partial replacement levels. While monitoring water quality through observation is useful, it would be more accurate and professional for farmers to use water testing kits (Tamim *et al.*, 2022).

Furthermore, it can be observed that the majority of cultured fish in the study area is African catfish (84%), with a few farmers cultivating both tilapia and catfish (Figure 4). The prevalence of catfish farming can be attributed to its favorable qualities for aquaculture, such as hardiness, fast growth, high feed conversion ratio, and general acceptability among most people in Nigeria (Amachree *et al.*, 2019).

Table 3 outlines common feed and feeding practices among fish farmers. The majority (84.64%) use commercial feeds, with Blue Crown being the most popular brand (73.08%). This indicates a general unfamiliarity among farmers with the use of local feed, which has the potential to minimize production costs and thereby increase profit margin (Ahmad and Ibrahim, 2016). All fish farmers hand-feed their fish, indicating their small scale of production. Interestingly, 50% recognize the importance of delaying morning feedings until the weather warms during the cold season. However, 42.31% do not adjust feeding times during the harmattan period. Most farmers feed their fish twice a day, while fewer feed once (23.08%) or three times (11.54%) a day.

Table 4 provides insights into the quantity, size, and quality of fish produced. It indicates that 34.62% of fish farmers harvest their fish at 4 months, with the majority (57.69%) harvesting at an average weight of 1.5 kg. This finding aligns with the expected average catfish weight at harvest (Onyekuru et al., 2019).

Smoking fish emerges as the dominant preservation method, with 57.69% of farmers practicing it to maintain the wholesomeness of their fish and prevent losses. This practice is typical in areas with limited access to modern storage facilities (Akankali and Jamabo, 2011). Other preservation methods used by some farmers include chilling (3.85%), freezing (11.54%), and salting (15.39%), while a few (7.69%) do not engage in any form of fish preservation after harvest.

The fish production and marketing information are presented in Table 5. Majority of the fish farmers (53.85%) have two production cycles per year, while others have one (7.69%) or three (38.46%) cycles. Half of the farmers (50.00%) produce less than 5 tonnes per cycle, and many (42.23%) yield between 5-10 tonnes. These yields indicate that fish farming is predominantly small-scale (Bouelet *et al.*, 2018). Most fish farmers (58.00%) market their fish locally, with 26.92% selling directly on the farm. The predominance of local market sales is typical for small-scale producers in Nigeria, suggesting limited access to larger, more lucrative markets due to transportation, storage, and market information constraints (Adeoye *et al.*, 2012). However, with the advent of advanced marketing channels and strategies such as e-commerce platforms, digital marketing, and cooperative marketing efforts, there is potential for these farmers to reach broader markets and improve their profitability Reddy (Reddy, 2021).

Figure 5 illustrates the opinions of respondents on the challenges faced by fish farmers in the study area. The most significant challenge identified is security (34.62%), followed by market instability (19.23%), climate/weather-related issues, fish seed availability, and feed accessibility (15.38% each). Power supply and water availability for fish farming were also mentioned as significant challenges. Omeje *et al.* (2020) support these findings, noting that the high cost of feed and poor pricing significantly hinder the success of fish farming.

The security challenge identified in this study as a major constraint to the successful operation of fish farming businesses in the area aligns with the findings of other researchers (Adeoye *et al.*, 2012). The constraint posed by climate and weather conditions revolves around the extensive period of harmattan experienced in Kano State. The state encounters months of cold seasons with ambient temperatures reaching 16°C (Rabiu *et al.*, 2018). This weather condition affects fish feed

intake and other physiological activities due to their cold-blooded nature (Alawode and Ajagbe, 2020). Since fish farming in the study area is typically conducted in open environments, these climatic conditions can reduce fish growth (Jiao *et al.*, 2020), leading to losses for the farmers.

Table 6 presents suggestions from fish farmers regarding crucial support needed to enhance production activities. A significant majority (50.00%) emphasized the necessity of financial aid for improvement, with 26.92% advocating for infrastructure development. Concerning training, 53.85% identified the need for education on local fish feed formulation to reduce production costs, while others highlighted training in fish health management (19.23%) and standard business practices (15.39%). In terms of infrastructure, 69.23% prioritized electrical power supply, while 15.39% preferred the establishment of fish processing facilities. Regarding inputs, the most critical requirement based on the farmers' opinion was fish feed (57.69%), although some farmers also highlighted the need for quality fingerlings and drugs (15.39% each). These insights underscore the diverse needs of fish farmers in the study area and underscore the importance of targeted support to address their specific challenges and enhance productivity.

Conclusion

Based on the findings from this study, majority of fish farmers in the area are male, married, and aged between 31-50 years, reflecting a demographic that is actively engaged in fish farming as a primary occupation. Education levels are notably high, with many farmers having attained at least secondary education, which likely contributes to their ability to adopt improved farming practices and technologies.

The prevalence of African catfish, alongside some cultivation of tilapia, underscores the predominant use of concrete ponds with borehole water supplies in fish farming operations. Practices such as daily water renewal and behavioral monitoring reflect common strategies for maintaining water quality. The widespread use of commercial feeds, coupled with multiple daily hand-feedings tailored to weather conditions, highlights the adaptive farming practices aimed at optimizing fish growth and health under variable environmental conditions. These findings underscore the resourcefulness and adaptability of fish farmers in Kumbotso Local Government Area. They emphasize a proactive approach to managing production challenges and enhancing sustainable aquaculture practices.

Despite these practices, the average yield per production cycle remains modest, with most farmers harvesting less than 10 tonnes. The primary challenges identified include security concerns, market instability, high costs of feed and fingerlings, unreliable power supply, and the impact of cold seasons on fish health and growth. These findings underscore the urgent need for targeted support in infrastructure development, financial aid, and training programs. Specifically, there is a need for training in local feed formulation and business management. These measures are crucial to enhance productivity and sustainability in fish farming within the study area. Addressing these challenges effectively could significantly improve the economic viability and resilience of fish farming ventures in Kumbotso Local Government Area of Kano State.

This study hereby provides suggestions to solve the main problems facing fish farming in the area. To make real progress, all stakeholders needed to contribute their best efforts for the success of the business and the community. Farmers especially have to fulfill most of the requirements before others like the government, NGOs, and financial institutions can support them effectively.

Forming strong associations among fish farmers can effectively address various challenges. Cooperatives, for instance, can coordinate training sessions on producing quality, affordable feed, conduct workshops on best business practices, and share effective fish farming techniques. Additionally, these associations can secure financial support from stakeholders and oversee fish marketing activities.

Declaration of Competing Interest

The authors have no relevant financial or non-financial interests to disclose

Authors' contribution

Abdul-Azeez, H: Conceptualization, data analysis and writing original draft.

Muhd, T: Conceptualization, project administration and writing original draft.
Suleiman, A. M: Conceptualization, supervision, writing review and editing.
Aminu, M.U: Conceptualization, writing review and editing.
Muhd, I. U: Conceptualization, writing review and editing.
Mudi, Z. R: Conceptualization, writing review and editing**.**
Oyinloye, R: Conceptualization, writing review and editing. All authors have approved the final article.

References

Adeoye, D., Akegbejo-Samsons, Y., Omoniyi, T. & Dipeolu, A. (2012). Challenges and investment opportunities for large-scale aquaculture farmers in NIgeria. *IIFET 2012 Tanzania Proceedings*, 1–12.

Ahmad, M. k. and Ibrahim, S. (2016). Local fish meal formulation : Its principles , prospects and problems in fishery industry. *International Journal of Fisheries and Aquatic Studies*, *4*(1), 276–279.

Akankali, J. A. and Jamabo, N. A. (2011). A review of some factors militating against sustainable artisanal fisheries development in Niger Delta, Nigeria. *Asian Journal of Agricultural Sciences*, *3*(5), 369–377.

Akarue, O.B. and Aregbor, O. E. (2015). Socio- economic analysis of catfish farming in Uvwie Local Government Area, of Delta State, Nigeria. *Int. J. Innovative Agric. Biol. Res.*, *3*(3), 33–43.

Alawode, O. O. and Ajagbe, S. O. (2020). Profitability of small-scale catfish production in southwest Nigeria: The challenges. *Economic Engineering in Agriculture and Rural Development*, *20*(3), 77–88.

Aliyu, Adamu Gaddafi, Jamil, N. R. B., Adam,M. B.. & Zulkafeel, Z. (2020). Spatial and seasonal changes in monitoring water quality of Savanna River system. *Arabian Journal of Geosciences*, *13*(55), 1–13.

Amachree, D., Jamabo, N. & Joseph, D. E. (2019). Socio-economic characteristics of small-scale catfish farming enterprise in Obio / Akpor Local Government Area , Rivers State , Nigeria. *International Journal of Fisheries and Aquaculture*, *11*(3), 62–71.

Bouelet N., Tambe, I. S., Tsafack, B. A., Medoua, T. J. J., Nama, G. &, & Kansci, G. (2018). Characteristics of fish farming practices and agrochemicals usage therein in four regions of Cameroon. *Egyptian Journal of Aquatic Research*, *44*(2), 145–153.

Eriegha, O. J. and Ekokotu, A. P. (2017). Factors Affecting Feed Intake in Cultured Fish Species : A. *Animal Research International*, *14*(2), 2697–2709.

FAO. (2018). *The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals.*

FAO. (2022). The State of World Fisheries and Aquaculture 2022. In *The State of World Fisheries and Aquaculture 2022* (p. Rome). https://doi.org/10.4060/cc0461en

Gachucha, M., Njehia, B. & Mshenga, P. (2014). Opportunities in adoption of commercial fish farming as a new enterprise for small scale farmers in Kisii County, Kenya. *Journal of Advanced Botany and Zoology*, *1*(1), 1-5.

Ifeonu, C. F., Chukwuemeka, V. and Agwu, E. A. (2019). Challenges of Youths Involved in Fish Farming in the Federal Capital Territory, Abuja, Nigeria. *Journal of Agricultural Extension*, *23*(3), 156–171.

Iruo, F. A., Onyeneke, R. U. , Eze, C., C., Uwadoka, C. &, & Igberi, C. O. (2018). Economics of Smallholder Fish Farming to Poverty Alleviation in the Niger Delta Region of Nigeria. *Turk. J. Fish.&*

Aquat. Sci., *19*(4), 313–329.

Jiao, S., Nie, M., Song, H., Xu, D., & You, F. (2020). Physiological responses to cold and starvation stresses in the liver of yellow drum (Nibea albiflora) revealed by LC-MS metabolomics. *Science of the Total Environment*, *715*, 136940.

Kudi, T.M., Bako, F.P., & Atala, T. . (2008). Economics of fish production in Kaduna State, Nigeria. *Asian Research Publishing Network (APRN)*, *3*(5/6), 17-21.

Madu, C. T. (2016). *Introducing fish farming/ aquaculture and the entrepreneurial opportunities-an overview. In Madu C.T. (Ed.), Fish Farming: The Value Chain Approach (1st ed.),Palmgrove: Lagos, Nigeria: In Him Resources Ltd* (pp. 1–2).

Mustapha, M. K. (2017). Comparative Assessment of the Water Quality of Four Types of Aquaculture Ponds under Different Culture Systems. *Advanced Research in Life Science*, 1(1), 104–110.

Nathanael, H., Maria, T., David, B., Carole, E. & Curtis, J. (1998). *Small-scale fish farming in Rwanda: economic characteristics. CRSP Research Reports*.

Nwosu, F. M. and Onyeneke, R. U. (2013). Effect of climate change on fish production in Oguta, Imo State, Nigeria. *Agricultural Science Research Journals*, *3*(7), 195–201.

Ogunmefun, S.O. and Achike, A. I. (2017). Socioeconomic characteristics and constraints of pond fish farmers in Lagos State, Nigeria. *Agric. Sci. Res. J.*, *7*(10), 304–317.

Olaoye, O. J., Ashley-Dejo, S.S., Fakoya, E.O., Ikeweinwe, N. B., Alegbeleye, W. O., Ashaolu, F.O. & Adelaja, O. A. (2013). Assessment of Socio-Economic Analysis of Fish Farming in Oyo State, Nigeria. *Global Journal of Science Frontier Research: Agriculture and Veterinary*, *13*(9), 1–10.

Omeje, J. E., Sule, A. M., & Aguihe, E. O. (2020). An Assessment of Aquaculture Table-Size Fish Farmers Activities in Kainji Lake Basin , Nigeria National Institute for Freshwater Fisheries Research , New Bussa , Niger State , Nigeria Assessment of Aquaculture Table-Size Fish Farmers Activities in Kainji . *Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension*, *19*(2), 36–40.

Omitoyin, B. O. (2007). *Introduction to Fish Farming in Nigeria. Ibadan University Press, Ibadan, Nigeria.*

Onyekuru, N. A., Ihemezie, E. J. & Chima, C. C. (2019). Socioeconomic and profitability analysis of catfish production: a case study of Nsukka Local Government Area of Enugu State, Nigeria. *Agro-Science-Journal of Tropical Agriculture, Food, Environment and Extension*, *18*(2), 51.

Rabiu, H. D., Umar, L. M., Sulaiman, I., Madina, M. ; &, & Abubakar, A. I. (2018). Assessment of the Water Quality of Watari Dam, Kano State Using Selected Physicochemical Parameters. *International Journal of Advanced Academic Research | Sciences*, *4*(5), 2488–9849.

Reddy, T. S. (2021). The Impact Of Digital Marketing On Agricultural Business In India. *Nat. Volatiles & Essent. Oils*, *8*(4), 426–437. www.yoururl.com

Tacon, A. G. J. (2020). Trends in Global Aquaculture and Aquafeed Production: 2000–2017. *Reviews in Fisheries Science and Aquaculture*, *28*(1), 43–56.

Tamim, A. T., Begum, H., Shachcho, S. A., Khan, M. M., Yeboah-Akowuah, B., Masud, M. & Al-Amri, J. F. (2022). Development of IoT Based Fish Monitoring System for Aquaculture. *Intelligent Automation and Soft Computing*, *32*(1), 55–71.

Ukpe, U.H., Audu, N.D., Djomo, C. R. F. & Akise, O. G. (2017). Economics of

catfish farming in selected Local Government Areas of Taraba State, Nigeria. *Innovative Techniques Agric.*, *23*, 376–382.

Wuyep, S. Z. and Rampedi, I. . T. (2018). Fish Farming Nigeria : Contributions towards Employment Opportunities , Income Fish Farming in Jos , Nigeria : Contributions ds Employment Opportunities , Poverty Alleviation for Income towards Employment Poverty Alleviation for Improved Livelihoods Gener. *Agriculture*, *8*(110).

Yelwa, N.A., Hamidu H., Kana, M. A. and Madabo, I. M. (2015). Groundwater prospecting and Aquifer Delineation using Vertical Electrical Sounding (VES) method in the Basement complex terrain of\nKumbotso Local Government Area of Kano State Nigeria. *IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG)*, *3*(1), 01–06.

Table 1: Socio-economic characteristics of fish farmers

Variable	Category	Frequency	Percentage
Age	18-30	2	7.69
	31-50	17	65.38
	61-70	7	26.92
	Total	26	100.00
Gender	Male	26	100.00
	Female	0	0.00
Marital status	Single	4	15.38
	Married	21	80.77
	Divorced	1	3.85
	Widow	0	0.00
	Total	26	100.00
Educational status	Primary	5	19.23
	Secondary	6	23.08
	Tertiary	12	46.15
	Qur'anic	3	11.54
	Total	26	100.00
Primary occupation	Civil service	1	3.85
	Fish farming	19	73.08
	Poultry farming	2	7.69
	Trading	4	15.39
	Total	26	100.00
Secondary occupation	Crop farming	2	7.69
	Fish farming	12	46.15
	Trading	12	46.15
	Total	26	100.00

Source: Field survey, 2024

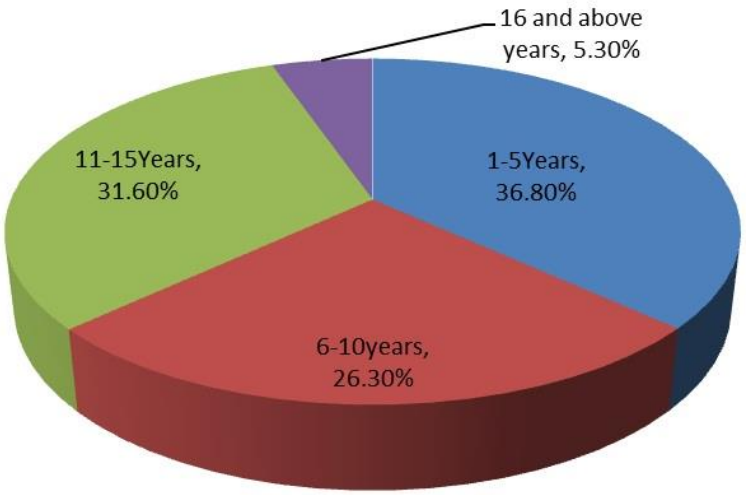

Figure 1: Years of experience of the respondents in fish farming

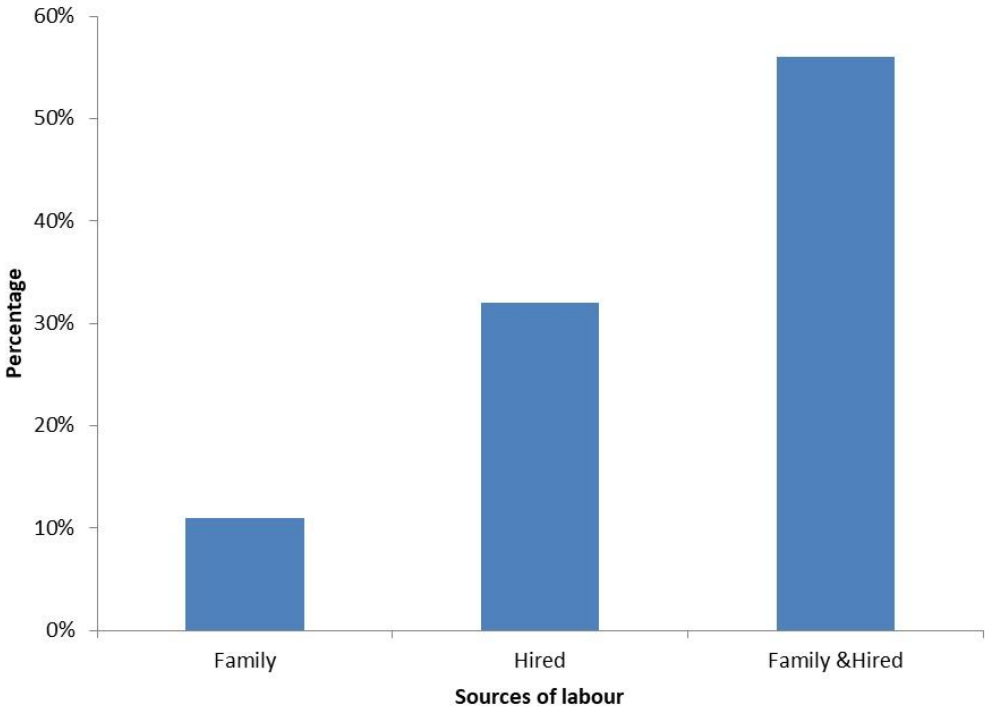

Figure 2: Sources of labour for fish farming activities

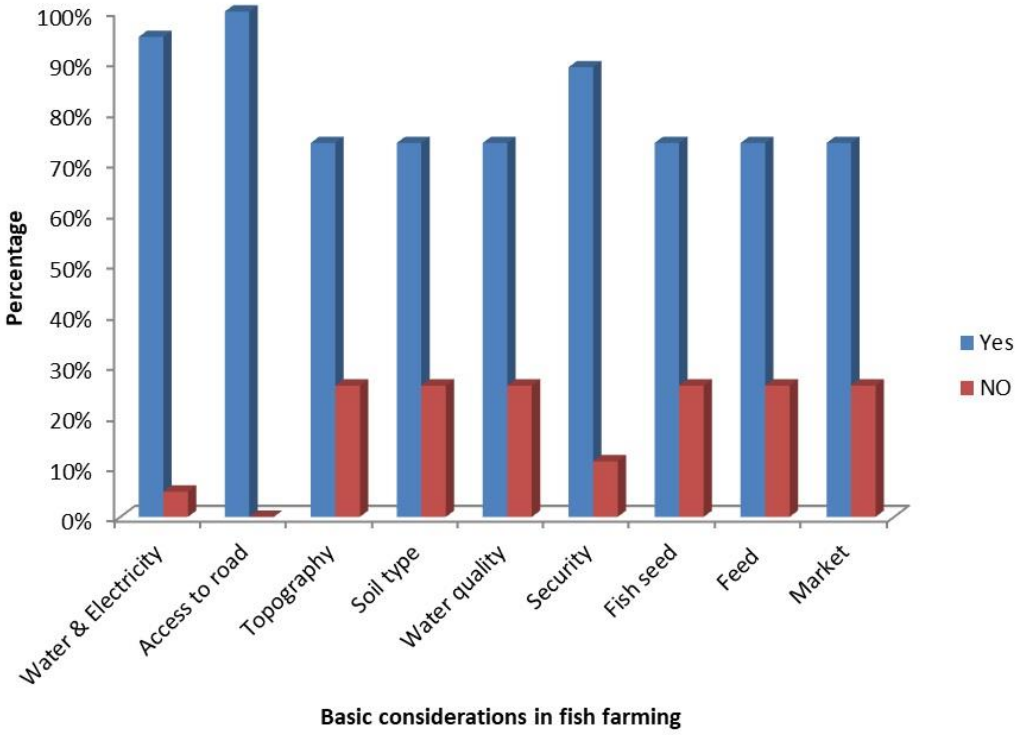

Figure 3: Response of respondents to their considerations of basic factors in fish farming

Table 2: Mode of fish farming operation in Kumbotso Local Government Area

Variable	Category	Frequency	Percentage
Type of fish farming method	Earthen Pond	8	30.76
	Concrete pond	14	53.85
	Plastic tanks	4	15.36
	Total	26	100.00
Source of water	Borehole	21	80.77
	River	4	15.39
	Other	1	3.85
	Total	26	100.00
Source of fish seed	My hatchery	3	11.54
	Other Hatchery	22	84.62
	Wild	1	3.85
	Total	26	100.00
Stocking density level	Less than 10fish/m^3	2	7.69
	10-20fish/m^3	17	65.39
	>20fish/m^3	7	26.92
	Total	26	100.00
Frequency of water	Daily	14	53.85

renewal			
	Weekly	9	34.62
	Only at harvest	3	11.54
	Total	26	100.00
Method of monitoring water quality	Test Kit	4	15.39
	Lab. Test	2	7.69
	Fish & water observation	17	65.39
	No idea	3	11.54
	Total	26	100.00

Source: Field survey, 2024

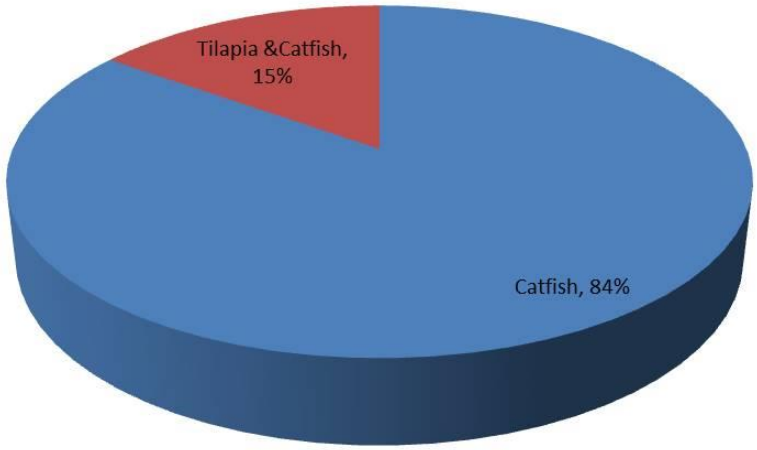

Figure 4: Most common cultured fish species

Table 3: Common feed and feeding practices among fish farmers

Variable	Category	Frequency	Percentage
Type of fish feed	Locally formulated	1	3.85
	Commercial feed	22	84.62
	Domestic & Agriculture by-product	3	11.54
	Total	26.00	100.00
Commercial feed used	Aller Aqua	4	15.39
	Blue Crown	19	73.08
	Top feed	3	11.54
	Total	26	100.00
Method of feeding	Hand feeding	26	100.00
	Automated	0	0.00

Time of first feeding/day	Early morning	18	69.23
	Sun rise to 9 am	5	19.23
	9am to 12noon	3	11.54
	Total	26	100.00
Basis of change of feeding time	No change	11	42.31
	Earlier in hot season and later in Harmattan	13	50.00
	Later in hot season and earlier in Hammattan	2	7.69
	Total	26	100.00
Feeding frequency/day	Once	6	23.08
	Twice	17	65.39
	Three times	3	11.54
	Total	26	100.00

Source: Field survey, 2024

Table 4: Information on Value, size and quality of fish produced

Variable	Category	Frequency	Percentage
Harvesting age of fish	3 months	2	7.69
	4months	9	34.62
	5months	8	30.77
	6 months	7	26.92
	Total	26	100.00
Average harvesting weight of fish	1kg	10	38.46
	1.5kg	15	57.69
	2kg	1	3.85
	Total	26	100.00
Fish handling/preservation method	Chilling	1	3.85
	Freezing	3	11.54
	Salting	4	15.39
	Sun drying	1	3.85
	Smoking	15	57.69
	None	2	7.69

Source: Field survey, 2024

Table 5: Production and marketing information of fish farmers

Variable	Category	Frequency	Percentage
Production cycle/year	1 Cycle	2	7.69
	2 Cycles	14	53.85
	3 Cycles	10	38.46
	Total	26	100.00
Yield per production cycle	Less than 5 tones	13	50.00
	5-10 tones	11	42.31
	More than 10 tones	2	7.69
	Total	26	100.00
Trend of production in the last 5years	Increasing significantly	9	34.62
	Slight increase	15	57.69
	Constant	1	3.85
	Decreased	1	3.85
	Total	26	100.00
Marketing place/route	Local market	14	53.85
	Restaurant	1	3.85
	Fish processors	4	15.39
	On the farm	7	26.92
	Total	26	100.00

Source: Field survey, 2024

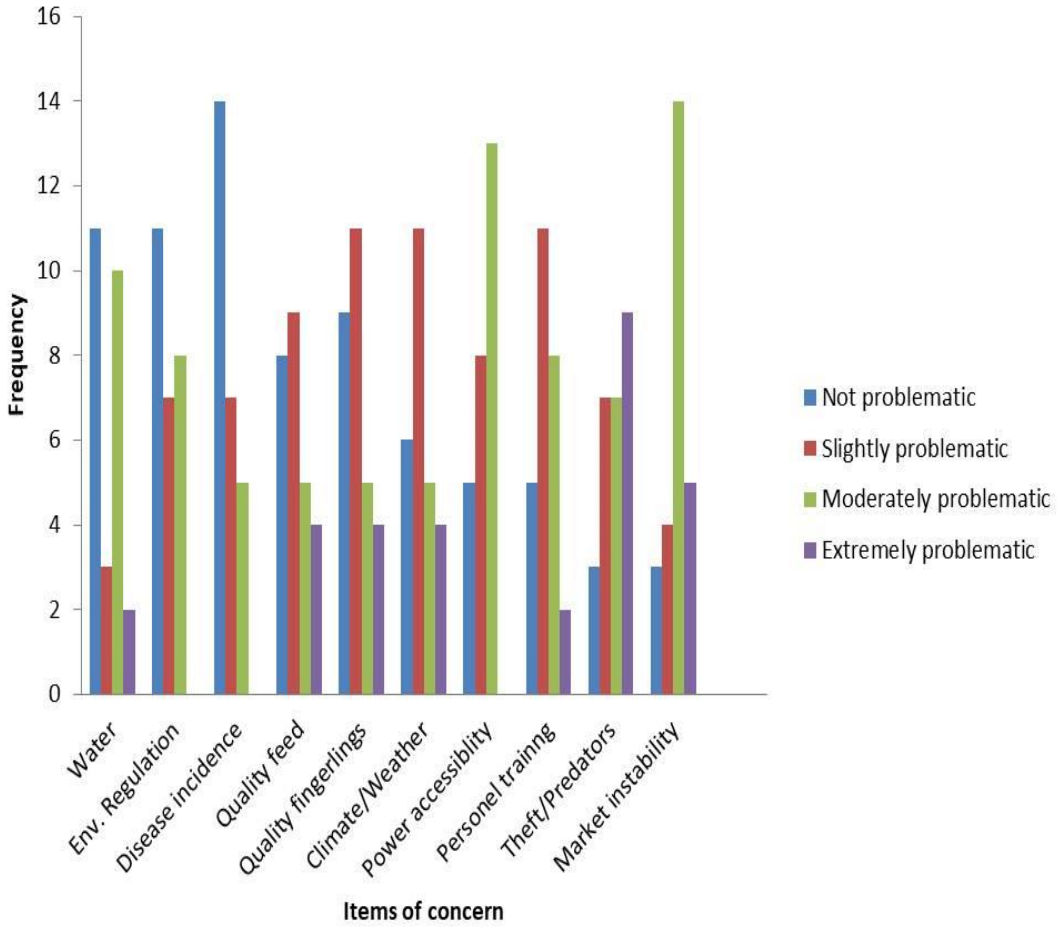

Figure 5: Opinion of respondents on level of Challenges faced on some basic requirements

Table 6: Opinion of respondents on type and form of support needed to enhance fish farming

Variable	Category	Frequency	Percentage
Top needs	Access to finance	13	50.00
	Technical training	2	7.69
	Infrastructure	7	26.92
	Inputs	4	15.39
	Total	26	100.00
Type of training needed	Pond construction	3	11.54
	Feed formulation	14	53.85
	Fish health management	5	19.23

	Business management	4	15.39
	Total	26	100.00
Most needed infrastructure	Road	2	7.69
	Electricity	18	69.23
	Water supply	2	7.69
	Processing facilities	4	15.39
	Total	26	100.00
Most needed inputs	Feed	15	57.69
	Fingerling	4	15.39
	Drugs	4	15.39
	Equipments	3	11.54
	Total	26	100.00

Source: Field survey, 2024