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STATUS OF FISH FARMING IN KATSINA STATE, NIGERIA: THE CURRENT PRACTICES, OPERATION, MANAGEMENT AND CONSTRAINTS TO ITS DEVELOPMENT

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ABSTRACT

This study examined the status of fish farming in Katsina State with a view to understanding the current practices, management, operation, and constraints to its sustainable development. All the active and accessible fish farms in the state, thirty-two in number were visited and data was collected through the administration of structured questionnaires. The data were analyzed and presented using descriptive statistics; frequency and percentage. The result showed that most of the respondents were male (87.5%) with a mean age of 41 years. The majority of the respondents (59%) are graduates of higher institutions and married (75%) with a mean household size of nine. Most of the respondents (56.3%) were owners of the farms with the majority of them (59.4%) gaining knowledge of fish farming on the job. The production technique and species cultured indicated that monoculture of African catfish (*Clarias gariepinus*) accounts for 84.4% with concrete tanks being the most used culture facility (34.4%). The majority of the respondents (62.5%) had grow-out units with 68.8% of their culture system being stagnant renewal. Most of the respondents (90.6%) had two sources of water with 71.9% never carrying out any water quality management. The high cost of feeding was adjudged a major constraint by the respondents, while disease infestation, inadequate technical expertise, marketing, and inadequate capital were classified as minor constraints. There is a gradual development in aquaculture production in the state, especially in terms of practices, operation and management, although, the development appears to be at a slow pace.

Keywords: Constraints, development, fish farming, Katsina State, operation

INTRODUCTION

Fish is an excellent food of high-quality protein that is more favourably considered compared to both red and white meat, especially in the fast-growing aquaculture industry (Kari *et al.*, 2020). It is an important source of animal protein and has no religious taboo or any cultural limitation affecting its consumption, unlike pork and beef. It offers the quality and one of the cheapest sources of good quality protein, and macronutrients like vitamin A, iron, zinc, calcium, selenium, and essential fatty acids. It provides an important diet for Nigerians, especially those who live along the Atlantic coast and riverine areas (Adeogun *et al*., 2014). The inability of capture fisheries to meet global fish demands, especially due to the increase in population has buttressed the need for a sustainable protein supply. This has necessitated the development of the aquaculture industry and an increase in aquaculture production.

(Committee for Inland Fisheries and Aquaculture, CIFAA, 2017 and UN, 2017) According to FDF (2018), in Nigeria, fisheries contributed 0.88% of the 22% contribution of agriculture to the gross domestic product (GDP), and the sector provided 8.632 million direct jobs and 19.55 million jobs indirectly. Nigeria's population is about 200 million, with an estimated annual per capita fish consumption of 17.5 kg (FAOSTAT 2019). Nigeria's projected fish demand for 2018 was 3.6 million metric tons (Giwa, 2018) while the local production was just a little over 1 million metric tonnes. Nigeria is endowed with a suitable environment that supports a culture of various fish species. Aquaculture provides a good protein source in the human diet, employment, income generation, and a good return on investment to farmers (Okunade *et al*., 2023; Shava and Gunhidzirai, 2017; Onoja, 2005).

Aquaculture is gaining relevance in Nigeria and its growth is progressive though not evenly distributed across the country (Dauda *et al.*, 2017). The number of fish farms recorded according to Dauda *et al*. (2015) in Katsina state was 35 in 2014 compared to seven reported by AIFP (2004) which showed a progressive growth in aquaculture in the state. Aquaculture development in Katsina State has improved, though still shrouded with various problems and for food security in aquaculture, it is necessary to overcome these obstacles for sustainable development. Accordingly, Dauda *et al*. (2015) opined that resolving some of these problems (Disease, fish seed, feeds, etc) hampering the development of aquaculture in the State is pertinent as a concerted effort to its sustainability.

So, further research has always been encouraged to follow up with the status, understand the changes over time, and come up with adequate policy recommendations that can enhance the growth of the industry. This study therefore assessed the current aquaculture practices, management and operation pattern with a view to understanding the status, development, and constraints associated with the practice.

MATERIALS AND METHODS

Description of the Study Area

The investigation was carried out in Katsina state, Nigeria. The state is in the North-western part of the country, with a land mass of 24,192 km² and a population of 5,801,584 million (NPC, 2006). The state lies between Latitudes 11^0 to 13^0 N and Longitudes 07^0 to 8^0 30' E with about 40 Man-made reservoirs and the people of the state are majorly agrarians (Dauda *et al*., 2015).

Sampling Procedures

The research was designed to sample all the active fish farms in the state estimated to be between 50 and 60 as reported by the fish farmers' association but only 32 farms were accessible and sampled due to insecurity.

Data was collected using a structured questionnaire through face-to-face conversations with farm owners, managers, or dedicated farm workers. All of the distributed questionnaires were collected back and used for the analysis. The demography of the fish farmers, such as their sex, age, education level, marital status, and years of farming experience, are also recorded, along with management techniques like culture techniques and fish species, culture periods, water source, feed, and feeding practices.

The data on constraints to aquaculture development was collected using a four-point Likert scale, this includes not a constraint, not severe, severe, and very severe. The Likert scale was used as described by Tsado *et al*. (2012) and Dauda *et al*. (2015), 4 = Very severe, 3 =Severe, 2 = not severe, and 1 = not a constraint. The midpoints were summed up (1+2+3+4) to 10 and divided by 4 to obtain a mean of 2.5. Any constraint with a cut-off of 2.5 and above is regarded as a major constraint, between 1.5 and 2.4 is regarded as a minor constraint while below 1.5 is classified as not a constraint (Dauda *et al*., 2015).

Data Analysis

The data were analyzed and presented using descriptive statistics, frequency, and percentage and all analysis was done using Microsoft Excel 2013.

RESULTS AND DISCUSSION

Socio-economic characteristics of the fish farmers

The demographic characteristics of the respondents revealed that the majority of the respondents were male (87.5%) with an age range of 31 to 40 as the dominating age group (34.4%) and a mean age of 41 years. The domination of the respondents by males is consistent with the previous studies about fish farmers in the state (Dauda *et al*., 2015) and Lagos state (Okunade *et al*., 2023). Though the higher number of men compared to women can also be linked to the study area, however, there is an increase in active female participants, 12.5% as compared to 11.4% recorded by Dauda *et al.* (2015). The age group reflected active working years and this is a good indication for easy development of aquaculture activities in the study area, which is similar to the reports of Akarue and Aregbor (2015), Oluwasola and Ige (2015) and Okunade *et al*. (2023).

The majority of farmers were married (75%) with a mean household size of nine and a dominant group of 1 to 5 households representing 37.5%. Over 59% of the respondents are graduates and perhaps the level of education may be responsible for the small household size. The majority of farmers (59.4%) were trained on the job, and the higher participation of educated graduates in fisheries activities is a positive attribute as this can ease training to increase productivity and use of innovations which conforms with Onyenweaku *et al*. (2005) and Okunade *et al.* (2023). The year of experience of the respondents ranged from 1 to 20 years with only 37.5% having less than five years of experience. This is an improvement compared to Dauda *et al*. (2015) who reported over 62.9% of between 0 to 5 years. In contrast to this study with less than five years of experience as the dominant group, Okunade *et al*. (2023) reported 6 to 10 years as the dominating years of experience of the respondents in Lagos state. The mean number of personnel on the farms was five with 84.4% having 1 to 5 personnel working on the farms.

Table 1. Demographic characteristics of the respondents

Variables	Parameters	Frequency	Percentage	Mean± S.E
Sex	Male	28	87.5	
	Female	4	12.5	
Age	21 – 30	7	21.9	40.91±1.96
	31 – 40	11	34.4	
	41 – 50	9	28.1	
	51 – 60	5	15.6	
Marital Status	Single	6	18.8	
	Married	24	75	
	Divorced	2	6.3	
Household size	1 – 5	12	37.5	8.56±1.11
	6 – 10	10	31.3	
	11 – 15	4	12.5	
	16 – 20	6	18.7	
Educational status	Postgraduate	7	21.9	
	Graduate	12	37.5	
	Diploma	7	21.9	
	Secondary school	4	12.5	
	Quranic education	2	6.3	
Position in the farm	Owner	18	56.3	
	Farm manager	7	21.9	
	Member of staff	6	18.8	
	Consultant	1	3.1	
Experience in fish farming (years)	1 – 5	12	37.5	7.88±0.89
	6 – 10	11	34.4	
	11 – 15	7	21.9	
	16 – 20	2	6.2	
Knowledge of fish farming	Fisheries graduate	2	6.3	
	Graduate of Fisheries-related	4	12.5	
	Attended training programme on fish farming	6	18.8	
	Trained on the job	19	59.4	
	Others	1	3.1	
No of personnel	1 – 5	27	84.4	3.91±0.41
	6 – 10	4	12.5	
	>10	1	3.1	

Management practice and cultured species

The expertise of the farm manager and available resources influence the culture technique and operations of the farm (Akinwole *et al*., 2014). Monoculture of African catfish (*Clarias gariepinus*) was prevalent among the farms, accounting for 84.4% which was higher than the 80% recorded by Dauda *et al.* (2017) but aligned with the findings of Okpeke and Akarue (2015) in Delta State and Wuyep and Rampedi (2018) in Jos, Plateau State. While polyculture only was 12.5% (Table 2). Along with *Clarias gariepinus*, *Heterobranchus sp*, and *Tilapia sp* were also raised on the farms. The results may be due to market demand and consumer preference. The types of culture facilities available on the farms for fish culture varied from earthen ponds to concrete tanks to plastic tanks, raceways, collapsible tanks, and tarpaulin vats, with concrete tanks being the most common at 34.4% followed by raceway at 15.6% and collapsible tanks 12.5% (Table 2). This result is contrary to the findings of Akinwole and Akinnuoye (2012) who reported that earthen pond is the most commonly used culture facility in Nigeria. However, it is similar to the report of Okunade *et al*. (2023) and Adeogun *et al.* (2007) in Lagos State and it is consistent with the previous observation of Dauda *et*

al. (2017) in Katsina State. The higher frequency of concrete tanks may probably be due to the nature of the soil and the sighting of most of the farms within the towns. In terms of culture system, stagnant renewal (68.8%) was the dominant system, 12.5% were using a flow-through system while 18.88% used a combination of both. Grow-out is the most commonly practised production system (62.5%) and this is an indicator that most of the farmers might rely on fingerlings from other states.

Fish stocked for grow-out are dominated by juveniles (46.9%) while 18.8% stocked post-juvenile, the source of the fish seed is majorly commercial (75%) while only 18.8% rely on their broodstock bank for broodstock. This result reflects the possibility of low technical expertise in hatchery operation which might have arisen from inadequate knowledge of fish farming by the farmers. The results further confirm the observation of Dauda *et al.* (2015) who reported inadequate technical expertise as a constraint to aquaculture development in Katsina State.

Table 2. Production technique and Fish cultured

Variables	Parameters	Frequency	Percentage
Culture techniques	Monoculture	27	84.4
	Polyculture	4	12.5
	Monoculture and polyculture	1	3.1
Culture Facilities	Earthen ponds	2	6.3
	Concrete tank	11	34.4
	Earthen and Concrete	1	6.3
	Plastic tank	1	6.3
	Raceway	5	15.6
	Tarpaulin vat	1	3.1
	Collapsible tank	4	12.5
	Others	5	15.6
Culture System	Stagnant Renewal	22	68.8
	Flow through	4	12.5
	Stagnant renewal and flow through	6	18.88
Fish species cultured	*Clarias sp*	24	75
	Clarias sp and *Tilapia sp*	5	15.6
	Clarias sp, *Tilapia sp* and *Heterobranchus sp*	2	6.3
	Clarias sp and *Heterobranchus sp*	1	3.1
Production Systems	Hatchery	2	6.3
	Grow-out	20	62.5
	Hatchery and Grow-out	3	9.4
	Grow-out and Broodstock	1	3.1
	Hatchery, Grow-out and Broodstock	5	15.6
	Hatchery and Broodstock	1	3.1
Size of Fish stocked for grow-out	Fry	2	6.3
	Fingerlings	5	15.6
	Juveniles	15	46.9
	Post-juvenile	6	18.8
	Fry and Fingerlings	4	12.5
Source of fish seed	Commercial hatchery	24	75
	Personal hatchery	8	25
Sources of broodstock	Not applicable	21	65.6
	Fish market	3	9.4
	Personal brood stock bank	6	18.8
	Other broods stock bank	2	6.3

Source of water and management of water

The increase in aquaculture production could be accomplished either by increasing the cultured area or intensification of production, however, intensification is more practised and could have so many implications on the water and water quality management (Boyd, 2003; Piedrahita, 2003). As shown in Table 3, most of the respondents (90.6%) had two sources of water which is an improvement over 51.4% recorded by Dauda *et al.* (2017). These sources comprise boreholes (75%) which were similar to results by Okunade *et al*. (2023), deep wells (6.3%), municipal supply (3.1%), and reservoir (15.6%). The result is contrary to that of Shitote *et al.* (2013) who reported springs or streams as the major source of water for fish culture. It is likely that the geographical location influences the water source and management of water quality. The water parameters were poorly checked as 71.9% of respondents had never carried out any water quality management while for those that did 81.3% used visual methods which was similar to the findings of Dauda *et al*. (2017) in the study area. Only 9.4 % had test kits for personal checks while 3.1% used commercial laboratories. Conversely, results for the management of water quality are in line with the results from Okunade *et al*. (2023) who found that 72.22% of respondents do not bother about the state of the water quality and this can be attributed to factors responsible for disease infestation. These water quality management/treatments were routinely observed by 25% of the respondents before impoundment while 3.1% checked before the discharge of wastewater to the environment. The use of laboratory services is an indication of the level of technical expertise exhibited by the farmers who might not be able to analyse and interpret the water quality results on their own.

Table 3: Sources and management of water

Variables	Parameters	Frequency	Percentage
Number of water source	1	90.6	90.6
	2	9.4	9.4
A major source of water	Borehole	24	75
	Deepwell	2	6.3
	Reservoir	5	15.6
	Municipal supply	1	3.1
Water quality management	Visual/Sense organ	26	81.3
	Test kit	3	9.4
	Commercial laboratory	1	3.1
	None	2	6.3
Water treatment	Before pond impoundment	6	25
	Before wastewater is discharged into the environment	1	3.1
	Never	23	71.9

Feed and feeding practices

Table 4 shows that pelleted feed is being used by the majority of the farmers (71.9%) with 53.1% using imported floating pellets. Only 9.4% are using self-formulated feed while 71.9% rely on commercial feeds. These practices reflect undeveloped farming practices with attendants' high cost of production due to high reliance on imported feed. These results are similar to that of Akinwole *et al*. (2014) in the Ibarapa area of Oyo State, however, it is lower than the level of importation and commercial feed reliance in the same state in 2014 (Dauda *et al*., 2017)

Though reliance on commercial feed is high in the state, the phenomenon is not only in this region but in Nigeria as a whole and this has resulted in high costs associated with fish feeding. One of the major factors militating against the development of aquaculture in Africa is the high cost of feeding (Ragasa *et al*., 2022; Dasuki *et al*., 2014). The results from this study showed that respondents were more conversant with a feeding frequency of twice daily 43.8% while 15.6% were above three times daily, broadcasting is the most practised feeding method (81.3%). This result for grow-out is similar to that of Okunade *et al*. (2023) and Adeogun *et al*. (2007).

Table 4. Feed and feeding practice

Variables	Parameters	Frequency	Percentage
Type of feed	Pelleted	23	71.9
	Pelleted and Agro-wastes	8	25.0
	Agricultural by-products	1	3.1
Types of pellets	Sinking pellet	4	12.5
	Local floating pellet	11	34.4
	Imported floating pellet	17	53.1
Feed formulation	Self-formulated	3	9.4
	Commercial feed	23	71.9
	Both	6	18.8
Feeding frequency per day	Once	9	28.1
	Twice	14	43.8
	Three times	4	12.5
	Above three times	5	15.6
Feeding method	Point	6	18.8
	broadcast	26	81.3

Constraints to fish farming in Katsina State

The results of constraints to fish farming in Katsina State are shown in Table 5. The majority of the respondents referred to pest/predator attack (68.8%), theft (84.4%), water availability (87.5%), water quality management (78.1%), poor feed quality and (81.9%) and fish seed availability (78.1) as not a constraint and overall rating for these indices was also not a constraint. The response to disease infestation was dominated by not severe (43.8%) and the overall rating was a minor constraint. Inadequate technical expertise, marketing and inadequate capital were dominated by not a constraint as responses with 59.4%, 50% and 62.5% respectively and their overall rating was a minor constraint. The high cost of feed received severe constraint (46.9%) as the dominant response and the overall rating was a major constraint. Disease has been consistently identified as a constraint to aquaculture development by researchers (Dauda, 2020, Bondad-Reantaso *et al.*, 2005) and also in the study area by Dauda *et al*. (2017), who noted that disease is a major source of economic loss in aquaculture. Inadequate technical expertise can be associated with many of the farmers not having formal training in aquaculture before venturing into fish farming. However, the current result is better than the previous report in the study area in 2014 by Dauda *et al.* (2015). Marketing and inadequate capital listed as constraints are consistent with the position of Dalhatu and Ala (2015) and Dauda *et al.* (2015) respectively. Inadequate capital has always been a constraint to agricultural activities in the country considering difficulties in securing loans. The high cost of fish feeding is ranked as the highest and it is the only major constraint. This is not unexpected as fish feed and feeding is still a major problem to aquaculture development not only in Nigeria but across the globe (Ragasa *et al*., 2022; Munguti *et al*., 2021; Jimoh *et al*., 2019).

Table 5. Constraints to fish farming in Katsina State

Constraints	Not a constraint (%)	Not severe (%)	Severe (%)	Very severe (%)	Sum	Mean Score	Overall rating	Rank
Disease infestation	11(34.4)	14(43.8)	7(21.9)	0(0)	66	1.88	Minor constraint	3
Pest/Predator attack	22(68.8)	6(18.8)	4(12.5)	0(0)	46	1.44	Not a constraint	6
Theft	27(84.4)	4(12.5)	0(0)	1(3.1)	39	1.22	Not a constraint	8
Water availability(quantity)	28(87.5)	2(6.3)	1(3.1)	1(3.1)	39	1.22	Not a constraint	8
Water quality management	25(78.1)	7(21.9)	0(0)	0(0)	39	1.22	Not a constraint	8
Inadequate technical expertise	19(59.4)	10(31.3)	3(9.3)	0(0)	48	1.51	Minor constraint	5
High cost of feeding	7(21.9)	6(18.8)	15(46.9)	4(12.5)	80	2.5	Major constraint	1
Poor feed quality	26(81.3)	6(18.8)	0(0)	0(0)	38	1.19	Not a constraint	9
Marketing	16(50)	4(12.5)	10(31.3)	2(6.3)	62	1.94	Minor constraint	2
Inadequate capital	20(62.5)	8(25)	2(6.3)	2(6.3)	50	1.56	Minor constraint	4
Fish seed availability	25(78.1)	5(15.6)	2(6.3)	0(0)	41	1.28	Not a constraint	7

Mean score > 2..5 -major constraint, 1.5 to 2.4 – minor constraint, <1.5 not a constraint

CONCLUSION

The current practices revealed that the monoculture of African catfish in concrete tanks is still the dominant cultural practice while water sources are dominated by two sources signifying an improvement over the old practices. Water quality management is poorly done and water treatment either before or after the discharge of wastewater is rarely practised. Fish feeding is led by the use of pelleted feed, unfortunately, it heavily relies on commercial feed and this may be responsible for the high cost of fish feeding which was identified as a major constraint in the state. The most rated constraint to the sustainable development of fish farming in the state is the high cost of fish feed, followed by marketing, disease infestation, inadequate capital and inadequate technical expertise. The finding of this research is not far away from an earlier report of about a decade ago. However, there is considerable improvement in the production and management practices and the constraints to aquaculture development have been reduced. The high cost of fish feeding is the only major constraint, unfortunately, this constraint is not limited to the study area. Therefore, the fish farmers and scientists in the country have to be in contact for more robust research that can lead to the production of cheap and quality fish feed that can reduce the variable cost of production, also for regular training of the fish farmers on fish feed formulation using the locally available ingredient.

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