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Survey on Nutrition and Feeding Practices of Fish by Farmers in Ondo State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author BSA read and approved the final manuscript.

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ABSTRACT

This study was carried out to examine the feeding practices adopted by fish farmers in Ondo State Nigeria. Specifically, the objectives were to describe their socio economic characteristics, evaluate the availability of feeds and feed ingredients in the study area, identify the type of fish farming practices and characteristics in Ondo state, determine the frequency and ingredients used to feed fish and identify the constraints to efficient use of feeds in the study area. A multi-stage sampling method was used to select fish farmers in the study area. The study was conducted using well-structured questionnaires, administered to respondents. Data were analyzed using descriptive statistics. The results showed that majority of the fish farmers in the area were male (81.1%). Most of them were married (62.5%) and they were mostly tertiary education certificate holders (52.2%). Higher proportions of the farmers were of the age range of between 30 and 40 years (43.3%); and most of them were full time fish farmers (57.8%). Most of the fish farmers cultured *Clarias gariepinus (*93.3%). Substantial number of the fish farmers use commercial feed rather than local feed. (78.8%), with majority of the fish farmers making preference of earthen ponds over other culture facilities (37.9 Significant percentage (37.5%) of the farmers used maize while those that use

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fishmeal accounted for 88.2% as the source of energy and protein respectively in compounding farm-made feed. Some of the major constraints faced by the fish farmers was high cost of feed (34.4%), which was ranked first, followed by scarcity of ingredients (13.3%), inadequate funding (11,1%) then high cost of transportation (1,1%).

Keywords: Aquaculture; feeding practice; feeding regimes; fish nutrition and local feed.

1. INTRODUCTION

Aquaculture production in Africa involves both intensive and semi-intensive system of production, which are daily gaining grounds in the continent. For any aquaculture venture to be viable and profitable, it must have a regular and adequate supply of balanced artificial diets for the cultured fishes. This is so because the dissolved nutrients that promote primary and secondary production in the natural environment are seasonal and might be insufficient or may not occur in required proportions to meet the nutritional demand of cultured fishes [1]. Therefore, there is a need to develop and encourage fish farmers to make use of ideal pond fertilization programs, non-conventional feed resources, feed stuff processing, refinement and formulations that take cognizance of the requirements of the various species and their stages [2]. Fish have a certain biological requirement for nutrients in order to have a healthy, vigorous growth and these nutritional requirements vary mainly depending on the species, its size / life stage and the environment [3]. Among non-conventional feed stuff incorporated into feeds are cocoa husk [4], sunflower and sesame seed meal [5] and plantain peels [6].

Fish farming is a profitable business, feeding being a major aspect of it. Feeding plays a major role in determining the success of any fish venture; therefore it is imperative that a survey of feeds used in fish farms in Ondo State be carried out. This is in other to have a reliable data on this important aspect of fish farming and also to be able to advise the farmer appropriately on the type, quantity and quality of the feed to be used to bring about profitable fish farming business as the major goal in any business is to make profit.

2. MATERIALS AND METHODS

2.1 The Study Area

This study was carried out in Ondo State situated in the South-Western Nigeria. Ondo State is one of the six states that made up South-western Nigeria. This State lies between longitude $4^0$20' and $6^0$05'E of the Greenwich Meridian and latitude 5^0 45' and $7^0$52'N of the equator. The state has a population of 3,441,024 (National Population Commission, 2006) and its land area is about 15,500 square kilometers.

2.2 Sampling Procedure

A multi-stage sampling technique was employed in selecting respondents for the study. The first stage involved the purposive selection of two major local government areas under each senatorial district which were Ondo central, Ondo north and Ondo south senatorial districts. Local governments selected in Ondo central senatorial district were Akure north and Akure south local government areas, Local governments selected under Ondo north senatorial district were Owo local government and Ose local government, local government and in Ondo south senatorial districts the selected local governments were Ilaje local government and Okitipupa local government areas. In the second stage, ninety (90) fish farmers were randomly selected in each of the senatorial districts. A total sample size of two hundred and seventy (270) respondents was therefore selected for the study.

2.3 Data Collection

The data for this study were collected through the use of structured questionnaire to obtain information from two hundred and seventy (270) fish farmers who were drawn from the three (3) senatorial districts in Ondo state.

The structured questionnaire targeted information on the demographic profile of the fish farmers, years of experience, culture facility used, size of farm, type of fish cultured, type of feed used as well as challenges faced with feeding and sourcing for feed.

The data collected through structured interview were extracted and recorded into Microsoft (MS) Excel sheet. Missing observations were considered when the respondents had problems

to recall given facts (e.g. fish catch or income) or straight refusal to answer given questions.

Secondary information was obtained from existing publications, Journals as well as other published and unpublished materials relevant to the study.

2.4 Analysis of Data

The data was analyzed using Statistical Package for Social Science students (SPSS). The data were represented using descriptive statistical analysis.

3. RESULTS AND DISCUSSION

3.1 Demographic Profile of Respondents

These characteristics included the background information, which are inherent attributes of the individual which are acquired as he grows [7]. The socio-economic variables considered in this section included; Gender, age, marital status, level of education, farming status of respondents.

3.2 Gender of the Respondents

Males accounted for 81.1% of the total respondents while women accounted for 18.9% of the total respondents which is quiet low when compared to the males.

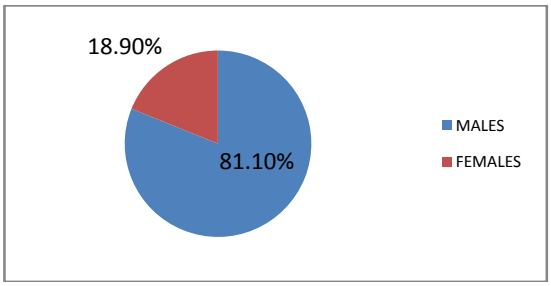

Fig. 1. Gender of respondents

The result implies that fish farming activities are dominated by males who have strength for the job. Gender plays a very important role in fish farming and agriculture, in terms of property acquisition, for example, fixed assets like land and machines. This result can be justified by the assertion of [8] that fisheries activities are mostly dominated by men.

This result implies that fish farming activities are dominated by people between 30-40years of age which is the more active age bracket who have both strength and a reasonable level of maturity. This age bracket is a productive age which portends better future for catfish production also considered as an economically active age [9]. This indicates that very few young and old people are involved in fish farming. This is because fish farming requires adequate attention and a lot of sense of responsibility. Studies have also shown that this category is the more preferred by informal and formal banking institutions for gaining loans [10].

Table 1. Age of respondents

Age	Frequency	Percentage
<30 years	57	21.1
30-40 years	117	43.3
41-50 years	60	22.2
>50 years	36	13.3
Total	270	100.0

3.3 Marital Status

This result implies that fish farming activities are dominated by people who are married. This suggests that fish farming is mostly a business for those who have the desire to provide some financial support towards the upkeep of their families and that there is quiet attractive financial gain for those who are yet to marry. [11] Pointed out that marriage in our society is highly cherished. This assertion was further confirmed by the report of [12] and [13] who assert that marriage confer some level of responsibility and commitment on individual who are married This is consistent with other fisheries studies.

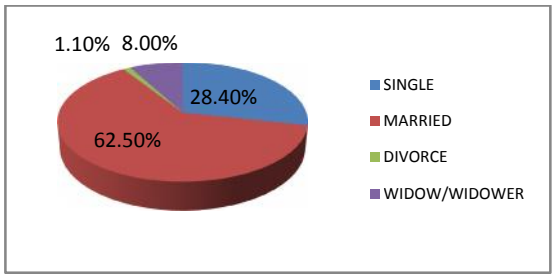

Fig. 2. Marital Status of Respondents

Fish farmers with tertiary education accounted for 52.2% of the total respondents, followed by those with secondary education which attracted 30.0%, followed by those with vocational education were estimated at 7.8% of the total respondents, closely followed by farmers with adult education which accounted for 6.7% of the

total respondents. Those with primary school leaving certificates were least and estimated at 3.3%.

Table 2. Educational status

Educational status	Frequency	Percentage
Primary	9	3.3
Secondary	81	30.0
Adult education	18	6.7
Tertiary	141	52.2
Vocational	21	7.8
Total	270	100.0

This result implies most of the people involved in fish farming in the state have one form of education. This means that fish farming is dominated by the educated class and mostly by those armed with high level of education. This is so because fish farming requires a lot of technical and scientific knowledge to be successfully undertaken. This is in agreement with [14] who observed that literacy level could have a positive impact on adoption of new innovations. Also [15] and [16] stated that educational level is one of the factors that influences adoption of new technology by farmers.

Table 3. Farming status

Farming status	Frequency	Percentage
Full-time	156	57.8
Part-time	114	42.2
Total	270	100.0

Full time farmers accounted for 57.8% of the total respondents while 42.3% were part time famers. This result implies most of the people involved in fish farming in the state have one form of education or the other Based on farmer's response during field survey, it was discovered that some of the respondents engaged in other occupation apart from fish farming. Occupation remains valid in our society as people have one or two things they engaged in which gives them sense of satisfaction and belonging in the society.

Those who had 1- 4 years of experience had the highest number and they were accounted for by 52.2%, followed by those who have between 5-9 years of experience and they accounted for 32.2% of the total population while those who had 10-15 years of experience 12.2%. Least represented were those who had above 15 years of experience which were accounted for by 3.3%. This is consistent with [17] who observed that most of the farmers have less than ten years of experience. High farming experience enables the farmers face production constraints [18].

Table 4. Years in fish farming

Years in fish farming	Frequency	Percentage
1-4 years	141	52.2
5-9 years	87	32.2
10-15 years	33	12.2
>15 years	9	3.3
Total	270	100.0

Table 5. Culture facilities used

Culture facilities	Frequency	Percentage
Earthen	99	37.9
Concrete tank	63	24.1
Plastic tank	45	17.2
Earthen/concrete	6	2.3
Earthen/fibre	3	1.1
Tarpaulin tank	3	1.1
Total	261	100.0

In the study area most fish farmers used earthen ponds, this was accounted for by 37.7% of the total respondents, closely followed by those who use concrete tanks which accounted for 24.1%, closely followed by those who used plastic tanks, and this was accounted for by 17.2%. Those who used both earthen ponds and fibre glass tanks accounted for 9.2% of the total respondents and next were those who used both earthen and concrete tanks; this was accounted for by 6.9% of the total respondents. Those who used only fibre glass tanks accounted for 2.3%of the total population least represented were those who used tarpaulins and those who used both concrete and fibre glass tanks this was accounted for 1.1% and .1.1% respectively.

The results showed that earthen ponds were the most used culture facility in the study area; this could be a result of high clay content in the soil which makes the soil able to retain water. The higher preference for earthen pond might be due to it being closest to nature and most times producing a better yield. This is similar to work of [19] in Ekiti state where a higher percentage of farmer also use earthen pond. This is however in contrast to findings of [20] and [21] that fish farmers prefer concrete tanks against earthen fish ponds.

Table 6. Species cultured

Species	Frequency	Percentage
Catfish	249	93.3
Bony tongue	6	2.2
Catfish/tilapia	12	4.5
Total	267	100

93.3% of the total respondents stocked only cat fish while 4.5% stocked both catfish and tilapia. And only 2.2% stocked bony tongue. Fish farmers in the study area preferred monoculture to polyculture system. This may be as a result of poor market price for tilapia. Majority of fish farmers adopt monoculture of African Catfish (*Clarias gariepinus).* This was also supported by [22] who observed that fishes grow better when cultured individually under monoculture system and also help the species to grow to its biggest size. Based on the types of species cultured, majority of the fish farmers in the study area cultured mainly catfish. Under the influence of high market price, greater demand preferences, hardiness of the stock, fast growth, high feed conversion ratio high survival rate under captivity. The reason could also be attributed to the fact that the species has a high market value and it can attain the market size under a few months of rearing. This supports the study of [20] and [21] that adoption rate of monoculture of *Clarias* sp. had replaced polyculture due to better market prices, greater demand preference, cultural preferences of most customers, hardiness of fish stock convenient for culture, presentation of fish live at sales point and relatively superior/timely growth performance.

Table 7. Type of feed used

Types of feeds used for feeding	Frequency	Percentage
commercial source	201	78.8
local feed source	12	4.7
Both	42	16.5
Total	255	100.0

Most of the fish farmers prefer commercial feed. This is a common practice of many fish farmers who believe that the imported feeds are high quality fish meal feeds with a complete nutritional profile for meeting the nutritional requirement of fish [23] and that it will give the specially young and vulnerable fingerlings a healthy start. This is consistent with [24] that an estimated 4000 tons of commercial feed is imported into Nigeria annually.

32.7% of the total respondents attributed the high use of commercial feed to the high quality of the feed while 34.5% attributed the reason the fast growth rate of fish achieved with commercial feed. 21.8% attributed this reason to the fact that commercial feed is readily available and the remaining 10.9% attributed it to the fact that it reduces cost in production. This is in agreement with [25] pointed out that the effectiveness of a feed is preferred as a determinant rather the cheapness.

Table 8. Reason for choice of feed

Reasons	Frequency	Percentage
Quality of feed	54	32.7
Achieve fast growth rate	57	34.5
Readily available	36	21.8
Reduction in cost of production	18	10.9
Total	165	100.0

Table 9. Source of protein

Source of required protein	Frequency	Percentage
Fishmeal	45	88.2
Earthworm meal	3	5.9
Fishmeal and blood meal	3	5.9
Total	51	100.0

From the result on source of required protein, it was observed that 88.2% of farmers in Ondo state prefer fishmeal while 5.9% uses either Earthworm meal or a combination of Fishmeal and blood meal. Fish meal is an excellent source of highly digestible protein, long chain omega-3 fatty acids (EPA and DHA) and essential vitamins and minerals [26]. Fish meal quality depends on the raw material used and on the processing method involved.

High percent of fishmeal addition to animal diets increases feed efficiency and growth through better food palatability, and enhances nutrient uptake, digestion, and absorption [5]. The balanced amino acid composition of fishmeal complements and provides synergistic effects with other animal and vegetable proteins in the diet to promote fast growth and reduce feeding costs. Fishmeal of high quality provides a balanced amount of all essential amino acids, phospholipids, and fatty acids (e.g., DHA or docosahexaenoic acid and EPA or eicosapentaenoic acid) for optimum

development, growth, and reproduction, especially of larvae and brood stock. The nutrients in fishmeal also aid in disease resistance by boosting and helping to maintain a healthy functional immune system. High-quality fishmeal also allows for formulation of nutrient-dense diets, which promote optimal growth [26].

Table 10. Source of energy

Source of required energy	Frequency	Percentage
Rice offal	12	25.0
Wheat offal	12	25.0
Maize	18	37.5
Maize and wheat	6	12.5
Total	48	100.0

Result of source of required energy in Table 10 above indicate that 25% of fish farmers use either rice or wheat offal as source of energy while a higher percentage of 37.5% of farmers utilize maize. This may be due to Maize being palatable and free from ant nutritional factors with high energy content [27].

Maize is usually used in finely ground form as an energy component in compound feeds. Normal pelleting processes only partially gelatinize the starch granules whereas total starch gelatinization occurs when the cereal is subject to high temperatures under moist conditions as in extrusion cooking. For channel catfish, such processing methods greatly increase the digestible energy value of maize, indicating the relatively low digestibility of raw starch for that species [28].

Table 11. Frequency of feeding

Frequency of feeding	Frequency	Percentage
Once a day	27	11.0
Twice a day	171	69.5
Three times a day	48	19.5
Total	246	100.0

The values recorded from Table 11 indicate that most farmers in Ondo state feed their fish twice daily. This is in agreement with the work of [29] and [30] who found feeding twice a day as the best feeding frequency for *Clarias gariepinus* and *Heterobranchus longifilis* fingerlings respectively. [31] Also found that feeding *Clarias gariepinus* fingerlings twice or thrice a day was effective for optimum result in growth. [32] and [33] however found that feeding *Clarias gariepinus* fingerlings thrice a day gave best results in terms of growth and economic profit. [34] Found that feeding *Heterobranchus bidorsails* once a day had the best result.

Table 12. Comparison between farm made and commercial feed

Response	Frequency	Percentage
Yes	42	22.6
No	144	77.4
Total	186	100.0

77.4% of the total respondents selected that they can't compare farm made feed with commercial feed why 22.6% selected that they could compare farm made feed to commercial feed nutritionally. This collaborated with the submission of [35] that the low quality of fish feed and its attendant high cost are the major factors limiting the development of aquaculture in Africa.

Table 13. Unconventional ingredient used

Unconventional ingredient	Frequency	Percentage
Bloodmeal	6	20.0
Feather meal	6	20.0
Earthworm meal	9	30.0
Others	9	30.0
Total	30	100.0

From the result, 30.0% of the total respondents used earthworm meal, 30.0% used other types of unconventional feed ingredients. 20.0% of the total respondents use blood meal while the remaining 20.0% used feathermeal. Unconventional fish feeds are potential feed ingredients, which have hitherto not been used in fish feed production for the reasons that; They are not well known or understood, No effective study of the method of production with a view to commercializing them, They are not readily available and They can be toxic or poisonous [27].

These feeds are generally referred to as non-conventional feed ingredients. They contain high quality feed ingredients that can compare favorably with conventional feed types. They are expected to be cheaper by virtue of the fact that there is no competition for human consumption. Unconventional fish feed can be of animal or plant source [36]. From the result in Table 8, earthworm meal is reported to be in great use by the farmers in Ondo state. Proteins and essential

amino acid content of earthworm have also been reported by [37] to be a good source.

Table 14. Constraints experienced

Constraints	Frequency	Percentage
1	30	11.1
1,2	9	3.3
1,2,3,4	12	4.4
1,3	33	12.2
1,3,4	15	5.6
2	36	13.3
2,3	15	5.6
2,3,4	6	2.2
3	93	34.4
3,4	18	6.7
4	3	1.1
Total	270	100.0

1: Inadequate funding
2: Scarcity of feed ingredients
3: High cost of feed
4: High cost of transportation

The result of the study in Table 14 revealed that the major problem militating against adequate feeding of fish is high cost of feed and ingredients constituting 34.4%, this may be due to lack of capital in procuring the feeds and the feed ingredients. This agrees with the work of [35] who reported that feed constitute about 60% of production cost. This is also similar with the work of [38] who observed that nutrients requirements and feed preference vary with rearing environment, water temperature and water quality. Obe and Omojola [19] also reported cost of feed as major constraint facing fish farmers in Ekiti state.

The results show that most of the fish farmers identified high cost of quality feed (34.4%), inadequacy of sufficient fund (11.1%); another major constraint was scarcity of feed ingredient (13.3%).

4. CONCLUSION

Fish farming in Ondo State is characterized majorly by semi-intensive system of aquaculture with the use of earthen pond and concrete tank with a higher preference for earthen pond facility and catfish species (*Clarias gariepinus*) being the major culture species. The type of feed used for feeding is majorly drawn commercially (imported feed) from the market, although some farmers manufacture their own feed but do not believe it can compare nutritionally with the commercial feed. Fishmeal is the major source of protein due to its nutritional superiority to other protein feed source and it is readily available, but, due to cost, some of the farmers make use of earthworm meal as an unconventional protein feed source.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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