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# Operational Constraints Associated with Artisanal Fisheries Value Chain along Ogun River Basin, Ogun State, Nigeria

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**Abstract**
Artisanal fish production and marketing constitute the major business activity of the fish communities of Ogun River in Ogun State Nigeria. This study profiled the revenues and constraints of the value chain actors along the Ogun River basin, Ogun State. A two-stage multi-sampling procedure was adopted in selecting 86 fishers, 29 fish marketers and 36 fish processors from five fishing communities (Oyan, Alamutu, Lafenwa, Oriyanrin, and Akomoje). Data were collected with an interview schedule and analyzed using frequency, percentage, mean and analysis of variance. Results revealed that more than two-thirds (67.4%) of the fishers made use of gillnets, followed by cast net (50.0%), hook and line (41.9%) and gura net (38.4%). The mean annual revenue of fishers was N5,996,083.72 while the fish marketers and fish processors earned average revenues of N1,015,040.00 and N587,241.38 respectively. The most severe constraints faced were lack of funding for business expansion, lack of modern equipment and inadequate preservation facilities. The difference in total revenues of value chain actors was significant ($F = 28.730$, $p<0.01$). The mean difference in revenue of fishers and marketers was significant (mean difference = N5009239.28, $p<0.01$), and the difference in mean revenue of fishers and fish processors was significant (mean difference = N5408842.34, $p<0.01$). It was concluded that artisanal fishing has constrained value chains, the fishers earned higher revenues from fishing activities than the other value chain actors. It was then recommended that educated persons especially young graduates are encouraged to engage in fisheries enterprises such as actual fishing, processing and marketing of fish, improved fisheries technologies, diversification as well as non-fisheries related enterprises by fisher folks should be adopted by the value chain actors. This could minimize the risks associated with over-dependence on nature-based occupations which are easily affected by changes in weather conditions.
***Keywords: Artisanal fisheries, Fish processing, Fish marketing, Operational constraints, Value chain analysis***

## Introduction

Fisheries is an important sub-sector of the agriculture sector contributing significantly to household income, food and nutrition security, and national development. Domestic fish supply, which is far below the demand for fish in Nigeria, is largely from the sanal, aquaculture and industrial fishing (Olaoye and Ojebiyi, 2018). Artisanal fishing, though dwindling, constitutes the bulk of the domestic fish supply (Olaoye and Ojebiyi, 2018). According to scholars (Bolarinwa, 2014.), the artisanal fishery is characterized by low capital outlay, low operational costs, low technology application and is labour intensive. Additionally, the fish supply remains lower than the demand due to post-harvest losses and inefficient marketing systems. This indicates that all the actors in the fisheries value chain (fishers, processors,

marketers) are important in ensuring that fish gets to the consumer's tables. Artisanal fish production, processing and marketing constitute the major business activities in fishing communities of Ogun River in Ogun State Nigeria. Analyzing the artisanal fishery value chain provides an understanding of the business activities and livelihood impact of the people. It has also provided insight into various employment opportunities that remain untapped in the fisheries sector (Kaplinsky and Morris, 2000). There is hardly an empirical study that investigates the different links in the fisheries value chain, especially with laws and regulations guiding fishery resources. Though there are literature reviews on policy formulation and implementation on fisheries resources, there is also information on the information on primary stakeholders, (such as artisanal fishers, fish processors and marketers). Where studies exist on policy formulation concerning fisheries resources, Ogun River has never been paid attention to, despite its enormous relevance and importance to fish production in Ogun State.

According to the Food and Agriculture Organization - FAO (2012), the concept of value chain focuses on the private and public actors and the sequence of value-adding activities involved in bringing a product from production to the consumer. The fisheries value chain is the process of bringing fish from harvesting through different phases of processing and delivery to the consumer (Abasilim *et al.*, 2020). This process involves various economic utilities such as form, place, time and possession, which have attracted various actors and stakeholders such as governments, international agencies and credit institutions as a strategy of mobilizing economic resources to promote small-scale traders and improve livelihood. At the fishing community level, these actors could be primarily limited to the fishers, fish processors, fish traders and marketers.

The actors involved in the value chain of fishery products appear to be on the increase as a result of an increase in population and therefore, demand tends to be high. Also, despite the nutritional and commercial values of fish and fish products, the production and marketing remain low in Nigeria when compared to other nations of the world (FAO, 2012). Furthermore, due to the cumbersome nature of the fish distribution channel, the local fish seller is faced with the problem of profit maximization (Magudu and Edward, 2011). However, irrespective of the great opportunities embedded in fisheries activities, a lot of the fish resources are being discarded daily due to an unorganized or uncoordinated distribution channel (Aihonsu and Shittu, 2008). This study enables us to gain knowledge of the issues, challenges and prospects in the artisanal fisheries of the Ogun River. This study was conducted to assess the fisheries practices of fishers, processors and fish marketers (the actors) involved in the fish value chain, examine the preservation methods used by the fishers, processors and retailers, determine the revenue of the fishers, fish processors and fish marketers, and identify the operational constraints facing value chain actors in the study area. The tested hypotheses in the study were:

**$H_0$1**: There is no significant difference in the revenues of the fisheries value chain actors.

**$H_0$2**: There was no significant relationship between the socio-economic characteristics of the value chain actors and operational constraints in the fish value chain.

## Materials and Methods

### *Study Area*

This study was conducted among fisher folks in Ogun River, Ogun State, between February and October 2020. Ogun River is one of the major rivers in the Southwestern part of Nigeria with a total area of 22.4 $km^2$ and a fairly large flow of about 393/$m^3$sec/$G^1$ during the wet season. It is located between longitude 3°25'E - 3°28'E and latitude 6°35'N -8°41'N between Lagos and Oyo states in Lagos State where it enters the Lagos lagoon (Osunkiyesi, 2012). The water is used for agriculture, aquaculture, transportation, human consumption, various industrial activities and domestic purposes.

### *Data collection and sampling procedure*

The interview schedule served as the primary research instrument for this study. The study population consists of all the fisher folks in the artisanal fishery in Ogun River. The sampling frame was 301 and a sample size of 50% (151) was administered the interview guide. A two-stage sampling procedure was adopted in this study. The first stage entailed the purposive sampling of five fishing communities (Oyan, Alamutu, Lafenwa, Oriyanrin, and Akomoje) in the study area along the Ogun River basin, based on the intensity of involvement in different fishery value chains. Figure 1 shows the map of the study locations. The second stage involved the use of simple random sampling in the selection of 50 percent of the fishers, fish marketers, processors, and retailers as the core fisheries value chain fisher actors. The sampling frame was obtained through the compilation of the value chain actors (fishers, fish marketers, fish processors and retailers) in the selected fishing communities with the help of fisheries extension personnel. This resulted in the sampling of 86 fishers, 29 fish marketers, and 36 fish processors.

### *Methods of data analysis*

The data obtained from the administered interview guide were coded and entered into the Microsoft Excel software package before onward exportation to the Statistical Package for Social Sciences (SPSS 20.0) for analysis. Descriptive statistics such as frequency counts, percentages, mean and standard deviation were used to analyse the collected data. Inferential statistics such as Analysis of Variance (ANOVA) was used to inferentially test the study hypothesis at a 5% level of significance.

## Results and Discussion

### *Results*

#### *Fisheries practices of value chain actors*

This section covers the results of artisanal fisheries practices of the fishers, fish marketers and fish processors.

#### *Fishery practices of artisanal fishers*

The distribution of artisanal fishers by their fishing practices is presented in Table 1. It reveals that more than two-thirds (67.4%) of the fishers made use of gillnets as fishing gear. This was followed by the use of cast net (50.0%), hook and line (41.9%) and gura net (38.4%). Table 1 reveals further that the fish species with the highest demand was Tilapia Spp. (84.9%), followed by *Chrysichthys nigrodigitatus* (46.5%), *Clarias gariepinus* (45.3%) and *Lates niloticus* (20.9%). The purpose of fishing for almost all (97.7%) of the fishers was both commercial and consumption. About 54.7% and 34.9% of the fishers practised fishing on small and medium scales respectively while only 10.5 percent claimed their scale of production was large. The majority (84.9%) observed a decline in fish catch. More than half (52.3%) of the fishers indicated that their fish catch did not meet the demand. Close to two-thirds (66.3%) of the fishers spent 1-5 hours per fishing trip while 30.2 percent spent 6 - 10 hours per fishing trip. The mean fishing duration per trip was 4.93±2.58 hours. Table 1 further indicates that the majority (86.0%) of the fishers went fishing in the morning while very few went fishing in the afternoon (11.6%), evening (12.8%) and overnight (11.6%). More than half (53.5%) employed the use of self-labour while 22.1 and 24.4 percent of the fishers used family and hired labourers respectively.

#### *Fishing practices in wet and dry seasons*

As shown in Table 2, close to half of the fishers did not make use of any crew member during the wet (48.8%) and dry (47.7%) seasons while 46.5% and 48.8% had 1-5 crew members in wet and dry seasons respectively. The majority of the fishers went fishing 6-10 times per week in wet (77.9%) and dry season (79.1%). The mean fish catches per trip were 29.79±18.21kg and 16.27±11.67kg for wet and dry seasons respectively.

#### *Processing activities and characteristics of fish processors*

The fish processing practices of the processors are presented in Table 3. It revealed that 100 percent of the fish processors were full-time processors, similar studies (Ojebiyi, 2019; Ikeweinwe *et al*., 2011; Odediran and Ojebiyi, 2017) reported that smoking was practised by the majority of the fish handlers in fishing communities in Ogun and Lagos States. Being full-time fish processors whose livelihoods depend greatly on fish processing, the fish processors' contribution to fisheries policy formulation and implementation will go a long way in improving the fisheries industry. Close to two-thirds (65.5%) of the fish processors had 1-10 years of fish processing and the mean fish processing experience was 12.90±7.66 years. All (100.0%) of the fish processors sourced fresh fish directly from fishermen and processed fish using the smoking method. About 37.9% and 55.2% of the fish processors operated on small and medium scales respectively. All (100.0%) of the fish processors employed the traditional method of processing. Salting was a means of adding value in fish processing employed by all (100.0%) of the fish processors. the use of traditional methods calls for urgent attention to introducing modern/improved fish processing technologies to the fish processors as traditional equipment could not produce high-quality processed fish, especially in terms of minimal moisture content. This agrees with the submission of George *et al*. (2014) that some traditional processing methods are associated with contaminations which may be injurious to consumers. This could further lead to a high deterioration rate of processed fish thereby resulting in post-harvest fish losses. Table 3 further shows that the majority (75.9%) of the fish processors were selling processed fish directly to consumers while 37.9% were selling to retailers. All (100.0%) of the fish processors were able to meet the demands of their customers. The majority (72.4%) of the fish processors carried out their activities for 4-6 days per week and the mean quantity of fish processed was 34.08±16.52 kg per time. Other studies (Ikeweinwe *et al*., 2011; Ojebiyi, 2019) also found that higher proportions of fisher folks sell their products directly to consumers. All (100.0%) of the fish processors considered offals as waste generated from fish processing and this was usually disposed of as waste, this is an indication that they lack the knowledge of value addition which could convert fish offals into an additional source of revenue in the fish processing business. This could be linked to the low educational attainment and lack of formal training on fish processing by the fish processors.

#### *Marketing practices of fish marketers*

The marketing practices of the fish marketers are presented in Table 4. It showed that 100 percent of the fish marketers engaged in fish marketing on a full-time basis. The highest proportion (36.1 %) of the fish marketers had 1-10 years of experience while 33.3% and 25 % of the fish marketers had 11-20 years and 21-30 years of fish marketing experience respectively. The mean fish marketing experience was 16.83±9.98 years. The majority (80.6%) sourced fish directly from fishers while 19.4 percent sourced fish from wholesalers/dealers. All (100.0%) of the fish marketers indicated that they sold their products (fish) fresh. The icing was the major value addition employed by the majority (75.0%) while 25 percent added no value. About three-fifths (61.1%) of the fish marketers sold fish 4-6 times per week while 27.8% sold their fish 1-3 times per week. Almost all (94.4 %) of the fish marketers sold their fish in central market stores. The majority (80.6%) of the fish marketers spent between one and two hours before the fish was sold to the next value chain actors. Also, the road was the means of transportation for all (100.0%) of the fish marketers. The majority (83.3%) also indicated that fish were sold to consumers while 25.0% sold to retailers. The mean quantity of fish sold per time was 25.54±11.45 kg and all (100.0%) of the fish

marketers were able to meet the demands of their customers.

***Annual revenues generated from fishers, fish marketers and fish processors***

The revenues generated from the different fisheries value chains per annum are presented in Table 5. It reveals that annual revenue ranged from N572,000 –N32,032,000 for fishers, N78,000 –N4,056,000 for fish marketers and N338,000 –N1,196,000 for fish processors. About 66.7% and 93.1% of the fish marketers and fish processors, respectively earned total revenue of less than N1,000,000 while 54.7% and 41.9% of the fishers earned N1,000,000 -N5,000,000 and greater than N5,000,000, respectively. The mean annual revenue of the fishers was N5,996,083.72 while the fish marketers and fish processors earned average revenues of N1,015,040.00 and N587,241.38 respectively.

***Fisheries preservation among value chain actors***

Preservation practices of fish among the different value chain actors are presented in Table 6. It revealed that while all (100 %) of the fishers preserved fish by keeping caged fish in water, all (100 %) of the fish marketers and fish processors preserved fish by icing. This implies that both the marketers and processors of fish will expend a great deal on fueling electricity power generators in cases of epileptic power supply. Keeping fish in water by the fishers could only be effective for a short period and only for live fishes, hence, explaining why the fishers had to sell immediately at landing sites to available buyers. The highest proportions of the fishers (58.1 %), fish marketers (72.2 %) and fish processors (89.7 %) recorded no loss while 27.9 % and 22.2 % of fishers and fish marketers recorded between 10 and 30 percent. This could be connected to the fact that fishers had only relied on using water to preserve live fish while both the processors and marketers were icing their fish with refrigerators. In terms of frequency, 62.1 percent of the fish processors sometimes record fish loss, and 45.3 percent of the fishers rarely record fish loss (Table 6). The majority (80.6 %) of the fish marketers spent 1-3 hours before selling fish to the next value chain actors while 69.8 % and 62.1 % of the fishers and fish processors respectively spent less than 1 hour before selling to the next value chain actors.

***Operational constraints to artisanal fisheries value chain actors***

The operational constraints to fishers, fish marketers and fish processors are presented and discussed under the following subheadings.

***Operational constraints to fishing***

Table 7 showed that the highest proportions of the artisanal fishers responded that lack of access to modern fishing facilities (62.8 %), lack of access to adequate health care services (41.9 %), lack of management practices/enforcement (41.9 %), funding and support from the government (66.3 %), electricity (41.9 %) and water availability (38.4 %) were very severe constraints to fishing as a value chain. The majority of the fishers submitted that declining fish catch (45.3%), poaching (47.7%), pollution (77.9%), preservation/storage facilities (39.5%), and climate change (75.6%) were moderately severe constraints to fishing. The mean values of the operational constraints ranged from 1.15 to 3.53. Earlier empirical studies had identified the severity of most of these constraints. For instance, inadequate funds, social amenities, transportation and fish spoilage were considered severe operational constraints for fishermen, fish processors and middlemen in coastal area fish value chain development (Odebiyi *et al*., 2013).

***Operational constraints to fish marketing***

The operational constraints confronting fish marketing are presented in Table 8. It revealed that more than half (58.3 %) of the fish marketers identified currency depreciation as a moderately severe constraint to fish marketing. Other listed items were considered by most of the fish marketers as either not severe or not problems. The mean values of the severity of the constraints ranged from 1.00 - 2.19.

***Operational constraints to fish processing***

Results on the operational constraints facing fish processing are presented in Table 9. It showed that the highest proportions of the fish processors identified fuel scarcity (41.4%) and communication (41.4%) as very severe constraints to fish processing while the remaining constraint items were perceived as either not severe or not problematic. The mean values of the severity of constraints ranged from 1.00 - 2.83.

***Results of the tested hypothesis***

***Hypothesis one: There are no significant differences in the revenues of the different value chain actors***

Differences in the total revenues of the three fisheries value chain actors (fishers, fish marketers and fish processors) were tested using the analysis of variance technique and the results are presented in Table 10. It showed that the differences in the total revenues of the value chain actors were significant ($F = 28.730$, $p<0.01$). Further comparisons revealed that the mean difference in the total revenue between the fishers and marketers was significant (mean difference = N5009239.28, $p<0.01$) (Table 11). Table 11 also shows that the difference in the mean revenue of fishers and fish processors was significant (mean difference = N5408842.34, $p<0.01$). However, no significant difference was found in the mean revenue of fish marketers and fish processors (mean difference = N399603.07, $p>0.05$).

***Discussion***

According to the findings from this study, gillnets, cast nets, hook and line and gura nets were the most commonly used fishing gears among artisanal fishers. Fishes were caught for both consumption and commercial purposes. This implied that net revenue from artisanal fishing was dependent on the fish consumption level of fishing households. The

consumption level was in turn a function of the household size. According to the findings from this study, most of the fishers operated either the small or medium scales of production. Based on the scale of production, the daily catch of the fishers was unable to meet the demand for fish. Another possible reason for this was the declining fish catch observed by the majority of the fishers. It could also be attributed to high consumption of fish by family members. The inability of the fishers to meet the fish demand by consumers is also a result of the relatively short fishing duration per trip as the fishing duration for most of the fishers was 1-5 hours with a mean fishing duration of 4.93±2.58 hours per fishing trip. Fishing was done mostly in the morning with some few fishers also engaging in fishing in the afternoon, evening and overnight. Fishing was a full-time occupation for all the fishers. This contradicted the findings of Olaoye (2010) who observed that there were more part-time than full-time fishers in Ogun State and that fishing was not the major livelihood of the people in Ogun State. On the other hand, this support report by Omitoyin and Fregene (2012) that fishing was the permanent occupation of the majority of the artisanal fishers in Lagos State. Labour for fishing was mainly from the fishers themselves and some of their family members such as spouses and children. Findings from previous studies also indicated that hired labourers were spouses employed by fisher folks (Olaoye *et al*., 2017a) and that self and family members were the most common source of labour to fisher folks in Lagos and Ogun States (Olaoye, 2010; Olaoye *et al*., 2017b). There was not much difference in the numbers of crew members and fishing frequency of the fishers during the wet and dry seasons but fishers seemed to catch a higher quantity of fish per trip during the wet than in the dry season.

As revealed from this study, all of the fish processors processed fish on a full-time basis, sourced fresh fish from fishers and used smoking as a processing method with the traditional type of equipment. In addition, salting was the only means of adding value to purchased fish. Although smoking was not practised by all the fish handlers, similar studies (Ojebiyi, 2019; Ikenweiwe *et al*., 2011; Odediran and Ojebiyi, 2017) reported that smoking was practised by the majority of the fish handlers in fishing communities in Ogun and Lagos States. It was recommended that the full-time fish processors whose livelihoods depend greatly on fish processing, the contribution of the fish processors to fisheries policy formulation and implementation will help in improving the fisheries industry. Urgent attention in introducing modern/improved fish processing technologies to the fish processors is required, as traditional equipment could not produce high-quality processed fish, especially in terms of minimal moisture content. This agrees with the report of George *et al*. (2014) that some traditional processing methods are associated with contaminations which might be injurious to consumers. This could further lead to a high deterioration rate of processed fish thereby resulting in post-harvest losses.

The majority of the fish processors selling directly to the consumers could explain why they could meet the fish demand of their customers despite processing an average of 34.08kg of fish per time for 4-6 days per week. Other studies (Ikenweiwe *et al*., 2011; Ojebiyi, 2019) also found that higher proportions of fisher folks sell their products directly to consumers. The consideration of offals as waste by the fish processors was an indication that they lack the knowledge of value addition which could convert fish offals into an additional source of revenue in the fish processing business. This could be linked to the low educational attainment and lack of formal training on fish processing by the fish processors. As full-time fish marketers, their livelihood depended primarily on the marketing of fish as well as the availability and abundance of fish caught by the fishers. Hence, the contribution of the fish marketers to policies guiding fisheries activities would immensely constitute a means of sustainably improving artisanal fisheries. The fish marketers sold their fish mostly in fresh form without adding any value other than icing (Salau *et al.,* 2014). The fish marketers also had substantial experience in fish marketing. This level of experience could be utilized in formulating and implementing/enforcing fisheries development policies. The fish marketers primarily sourced fresh fish directly from the fishers and not through any dealer thereby reducing the acquisition cost of fish. This further implied that the marketers still need to undergo some fish handling activities such as transportation, sorting and preservation before selling to their customers. The fish marketers would incur some additional costs which could explain why fish purchased from marketers could be costlier than those purchased directly from artisanal fishers. The fish marketers also sell directly to the consumers and neither to the wholesalers/dealers nor were the retailers implying that fish could get to the consumers at cheaper prices than if the fish passed through some intermediaries.

Distribution of the fisheries value chain actors by annual revenue indicated that the fishers were the highest earners followed by the fish marketers and then the fish processors who earned the least revenue. Odebiyi *et al*. (2013) also reported that fishermen had the highest revenue followed by fish marketers and then fish processors. The analysis indicated that the revenue of the fishers was significantly higher than that of the fish marketers and processors while the revenue of the fish marketers was not significantly higher than that of the fish processors. In terms of revenue generated, fishers would be willing to participate in enforcing existing policies that could optimize their fish catch and revenue. In the preservation of fish to reduce post-harvest losses, while fishers kept fish in water, both the fish processors and marketers preserved fish by icing. This implied that both the marketers and processors of fish would be spending more capital on fueling electricity power generators in cases of epileptic power supply. Keeping fish in water by the fishers could only be effective for a short period and only for live fishes, hence, explaining why the fishers had to sell immediately at landing sites to

available buyers. Minimum loss of fish was recorded across the fisheries value chains although the fishers recorded the highest loss when compared with fish marketers and processors. This could be connected to the fact that fishers had only relied on using water to preserve live fish while both the processors and marketers were icing their fish with refrigerators.

Operational constraints to fisheries development vary by value chains as reflected from the findings of this study. For instance, while up to twelve (12) of the constraints were categorized as severe by the fishers, only one of the constraints was considered severe among the fish processors, and none of the constraints was considered very severe by fish marketers. The severe operational constraints among the fishers are lack of access to modern fishing facilities, declining fish catch, poaching, use of worn-out gears, lack of access to adequate health care services, pollution, lack of management practices/enforcement, funding and support from government, preservation/storage facilities, electricity, access to fishing input and climate change. The lack of modern facilities was the only severe operational constraint to fish processing in Ogun River. Earlier studies had identified the severity of most of these constraints. For instance, inadequate funds, social amenities, transportation and fish spoilage were considered severe operational constraints for fishermen, fish processors and middlemen in coastal area fish value chain development (Odebiyi *et al*., 2013).

**Conclusion**

Following the outcome of this research, it is important to affirm that all three fisheries value chain actors (fishers, fish processors and fish marketers) individually and collectively play meaningful roles in fisheries value chain development. It was deduced from this research that the different value chain actors had substantial experiences in their chosen chains. It was concluded that though artisanal fishing was the most constrained chain, the fishers earned higher revenues from fishing activities than the other value chain actors.

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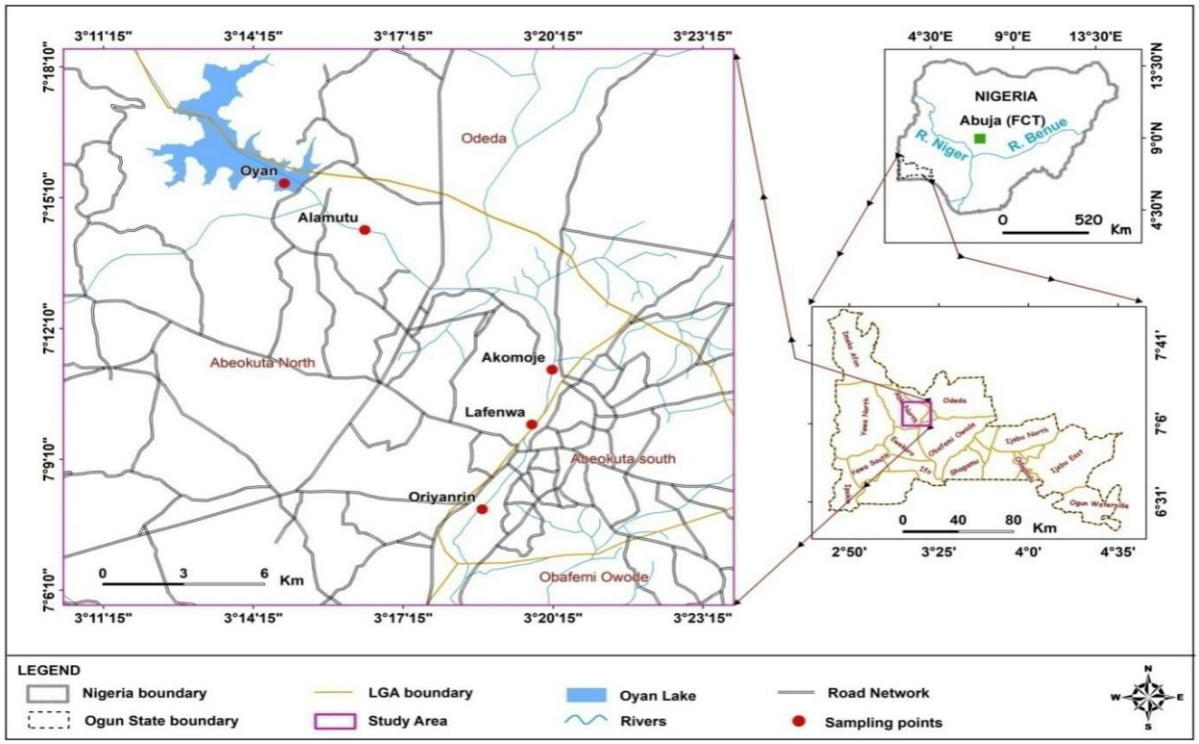


***Figure 1: Map showing study locations in Ogun River***

**Table 1: Distribution of fishers by their fishing practices (n = 86)**

| Fishing practices | Frequency | Percentage |
|---|---|---|
| **Fishing gears*** | | |
| Gillnet | 58 | 67.4 |
| Dragnet | 13 | 15.1 |
| Hook and line | 36 | 41.9 |
| Cast net | 43 | 50.0 |
| Gura net | 33 | 38.4 |
| Wire cage | 15 | 17.4 |
| Bamboo trap | 12 | 14.0 |
| **Species with the highest demand*** | | |
| *Gymnarchusniloticus* | 7 | 8.1 |
| *Tilapia* | 73 | 84.9 |
| *Clariasgariepinus* | 39 | 45.3 |
| *Heterotisniloticus* | 3 | 3.5 |
| *Chrysichthysnigrodigitatus* | 40 | 46.5 |
| *Latesniloticus* | 18 | 20.9 |
| *Momyrus sp.* | 1 | 1.2 |
| *Synodontis* | 1 | 1.2 |

| | | |
|---|---|---|
| **Purpose of fishing** | | |
| Consumption | 1 | 1.2 |
| Commercial | 1 | 1.2 |
| Both | 84 | 97.7 |
| **Scale of production** | | |
| Small scale | 47 | 54.7 |
| Medium scale | 30 | 34.9 |
| Large scale | 9 | 10.5 |
| **Observed decline in fish catch** | | |
| Yes | 73 | 84.9 |
| No | 13 | 15.1 |
| **Daily catch meeting fish demand** | | |
| Yes | 41 | 47.7 |
| No | 45 | 52.3 |
| **Fishing duration per trip (hours)** | | |
| 1-5 | 57 | 66.3 |
| 6-10 | 26 | 30.2 |
| 11-15 | 3 | 3.5 |
| mean±SD | 4.93±2.58 | |
| **Period of fishing*** | | |
| Morning | 74 | 86.0 |
| Afternoon | 10 | 11.6 |
| Evening | 11 | 12.8 |
| Overnight | 10 | 11.6 |
| **Source of labour** | | |
| Self | 46 | 53.5 |
| Family | 19 | 22.1 |
| Hired | 21 | 24.4 |

***Multiple responses***

***Source: Field Survey (2020)***

**Table 2: Fishing practices in wet and dry seasons (n = 86)**

| | Wet season | | Dry season | |
|---|---|---|---|---|
| | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| **Frequency of fishing per week** | | | | |
| 1-5 | 19 | 22.1 | 18 | 20.9 |
| 6-10 | 67 | 77.9 | 68 | 79.1 |
| mean±SD | 5.99±1.34 | | 6.07±1.24 | |
| **Number of crew members** | | | | |
| 0 | 42 | 48.8 | 41 | 47.7 |
| 1-5 | 40 | 46.5 | 42 | 48.8 |
| 6-10 | 3 | 3.5 | 3 | 3.5 |
| >10 | 1 | 1.2 | 0 | 0.0 |
| mean±SD | 1±2 person | | 1±1 person | |
| **Quantity of fish catch per trip (kg)** | 59 | 68.6 | 78 | 90.7 |
| ≤30 | 21 | 24.4 | 8 | 9.3 |
| 31-60 | 6 | 7.0 | 0 | 0.0 |
| >60 | 29.79±18.21kg | | 16.27±11.67kg | |
| mean±SD | | | | |

***Source: Field Survey (2020)***

**Table 3: Fish processing practices of processors (n = 29)**

| Processing characteristics | Frequency | Percentage |
|---|---|---|
| **Mode of processing** | | |
| Full time | 29 | 100.0 |
| Part-time | 0 | 0.0 |
| **Processing experience (years)** | | |
| 1-10 | 19 | 65.5 |
| 11-20 | 6 | 20.7 |

| | | |
|---|---|---|
| 21-30 | 4 | 13.8 |
| mean±standard deviation | 12.90±7.66 | |
| **Source of fresh fish** | | |
| Directly from fishermen | 29 | 100.0 |
| From other fish processors | 0 | 0.0 |
| **Processing method** | | |
| Smoking | 29 | 100.0 |
| Frying | 0 | 0.0 |
| **Scale of operation** | | |
| Small scale | 11 | 37.9 |
| Medium scale | 16 | 55.2 |
| Large scale | 2 | 6.9 |
| **Type of equipment** | | |
| Traditional | 29 | 100.0 |
| Modern | 0 | 0.0 |
| **Value addition** | | |
| Salting | 29 | 100.0 |
| Pepper coating | 0 | 0.0 |
| Sun drying | 0 | 0.0 |
| **Who do you sell processed fish to?*** | | |
| Consumers | 22 | 75.9 |
| Retailers | 11 | 37.9 |
| **Does your processed fish meet demand?** | | |
| Yes | 29 | 100.0 |
| No | 0 | 0.0 |
| **Frequency of processing per week (in days)** | | |
| 1-3 | 6 | 20.7 |
| 4-6 | 21 | 72.4 |
| 7 | 2 | 6.9 |
| **Quantity processed per time (kg)** | | |
| ≤20 | 8 | 27.6 |
| 21-40 | 14 | 48.3 |
| >40 | 7 | 24.1 |
| mean±standard deviation | 34.08±16.52 | |
| **Consideration as waste*** | | |
| Offals | 29 | 100.0 |
| Scales | 1 | 3.4 |
| **What do you do with waste?** | | |
| Disposed | 29 | 100.0 |

***Multiple responses were allowed***
***Source: Field Survey (2020)***

**Table 4: Marketing practices of fish marketers (n = 36)**

| Marketing characteristics | Frequency | Percentage |
|---|---|---|
| **Mode of fish marketing** | | |
| Full time | 36 | 100.0 |
| Part-time | 0 | 0.0 |
| **Fish marketing experience (years)** | | |
| 1-10 | 13 | 36.1 |
| 11-20 | 12 | 33.3 |
| 21-30 | 9 | 25.0 |
| >30 | 2 | 5.6 |
| mean±standard deviation | 16.83±9.98 | |
| **Source of fish** | | |
| From fishers | 29 | 80.6 |
| Wholesalers/dealers | 7 | 19.4 |
| **How fish is sold** | | |
| Fresh | 36 | 100.0 |
| **Value addition to fish** | | |
| Icing | 27 | 75.0 |

| | | |
|---|---|---|
| Packaging | 0 | 0.0 |
| None | 9 | 25.0 |
| **Frequency of marketing fish per week** | | |
| 1-3 | 10 | 27.8 |
| 4-6 | 22 | 61.1 |
| 7 | 4 | 11.1 |
| **Marketing methods** | | |
| Hawking | 1 | 2.8 |
| Neighbourhood store | 2 | 5.6 |
| Central market store | 34 | 94.4 |
| **How long to transport fish to the next value chain actor?** | | |
| 1-2 hours | 29 | 80.6 |
| 3-4 hours | 7 | 19.4 |
| **Means of transportation** | | |
| Road | 36 | 100.0 |
| **Who do you sell to?** | | |
| Other wholesalers | 2 | 5.6 |
| Consumers | 30 | 83.3 |
| Retailers | 9 | 25.0 |
| **Enough fish to meet customers' demand?** | | |
| Yes | 36 | 100.0 |
| No | 0 | 0.0 |
| **Quantity bought per time (kg)** | | |
| ≤20 | 18 | 50.0 |
| 21-40 | 15 | 41.7 |
| >40 | 3 | 8.3 |
| mean±standard deviation | 25.54±11.45 | |

***Source: Field Survey (2020)***

**Table 5: Total revenue of fisheries value chain actors**

| Revenue | Fishers (n = 86) | Fish marketers (n = 36) | Fish processors (n = 29) |
|---|---|---|---|
| **Revenue categories (₦'000,000)** | | | |
| <1 | 3 (3.5) | 24 (66.7) | 27 (93.1) |
| 1-5 | 47 (54.7) | 12 (33.3) | 1 (6.9) |
| >5 | 36 (41.9) | 0 (0.0) | 0 (0.0) |
| **Minimum revenue** | 572,000.00 | 78,000.00 | 338,000.00 |
| **Maximum revenue** | 32,032,000.00 | 4,056,000.00 | 1,196,000.00 |
| **Mean revenue** | 5,996,083.72 | 1,015,040.00 | 587,241.38 |
| **Standard deviation** | 544,005.00 | 126,230.00 | 215,358.45 |
| **Standard error of the mean** | *57,042.16* | *27,270.70* | *39,991.06* |

***Source: Field Survey (2020)***
***Figures in parentheses are expressed as percentages of respective sample sizes***

**Table 6: Fish preservation practices among fisheries value chain actors**

| | Fishers (n = 86) | | Fish marketers (n = 36) | | Fish processors (n = 29) | |
|---|---|---|---|---|---|---|
| | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** |
| **Fish preservation method between purchase and processing** | | | | | | |
| Keeps caged fish in water | 86 | 100.0 | 0 | 0.0 | 0 | 0.0 |
| Icing | 0 | 0.0 | 36 | 100.0 | 29 | 100.0 |
| **Percent of fish loss (%)** | | | | | | |
| No loss | 50 | 58.1 | 26 | 72.2 | 26 | 89.7 |
| <10 | 10 | 11.6 | 2 | 5.6 | 0 | 0.0 |
| 10-30 | 24 | 27.9 | 8 | 22.2 | 3 | 10.3 |
| >30 | 2 | 2.3 | 0 | 0.0 | 0 | 0.0 |
| **Frequency of recording fish loss** | | | | | | |
| Sometimes | 9 | 10.5 | 0 | 0.0 | 18 | 62.1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Rarely | 39 | 45.3 | 12 | 33.3 | 2 | 6.9 |
| Never | 38 | 44.2 | 24 | 66.7 | 9 | 31.0 |
| **Fish preservation method between purchase and processing** | | | | | | |
| Reheating | - | - | - | - | 29 | 100.0 |
| **Holding time between chain actors** | | | | | | |
| <1 hour | 60 | 69.8 | 7 | 19.4 | 18 | 62.1 |
| 1-3 hours | 26 | 30.2 | 29 | 80.6 | 11 | 37.9 |
| >3 hours | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |

**Source: Field Survey 2020**

**Table 7: Operational constraints of artisanal fishers (n =86)**

| S/N | Constraints | VS | MS | NS | NP | mean±SD |
|---|---|---|---|---|---|---|
| 1 | Lack of access to modern fishing facilities | 54 (62.8) | 21 (24.4) | 11 (12.8) | 0 (0.0) | 3.50±0.077 |
| 2 | Declining fish catch | 29 (33.7) | 39 (45.3) | 18 (20.9) | 0 (0.0) | 3.13±0.079 |
| 3 | Lack of patronage | 0 (0.0) | 1 (1.2) | 39 (45.3) | 46 (53.5) | 1.48±0.057 |
| 4 | Minimal profit | 0 (0.0) | 0 (0.0) | 54 (62.8) | 32 (37.2) | 1.63±0.052 |
| 5 | Competition among fishers | 1 (1.2) | 8 (9.3) | 9 (10.5) | 68 (79.1) | 1.29±0.068 |
| 6 | Poaching | 39 (45.3) | 41 (47.7) | 4 (4.7) | 2 (2.3) | 3.36±0.074 |
| 7 | Use of worn-out gears | 34 (39.5) | 4 (4.7) | 36 (41.9) | 12 (14.0) | 2.70±0.123 |
| 8 | Fish species acceptability | 21 (24.4) | 0 (0.0) | 6 (7.0) | 59 (68.6) | 1.80±0.138 |
| 9 | Lack of access to adequate health care services | 36 (41.9) | 6 (7.0) | 14 (16.3) | 30 (34.9) | 2.56±0.145 |
| 10 | Illegal fishing | 29 (33.7) | 3 (3.5) | 25 (29.1) | 29 (33.7) | 2.37±0.136 |
| 11 | Shortage of skilled labour/ manpower | 0 (0.0) | 0 (0.0) | 13 (15.1) | 73 (84.9) | 1.15±0.039 |
| 12 | Pollution | 5 (5.8) | 67 (77.9) | 7 (8.1) | 7 (8.1) | 2.81±0.071 |
| 13 | Damming | 13 (15.1) | 24 (27.9) | 29 (33.7) | 20 (23.3) | 2.35±0.108 |
| 14 | Transportation/Non-accessible roads | 0 (0.0) | 4 (4.7) | 46 (53.5) | 36 (41.9) | 1.63±0.062 |
| 15 | Tough competition | 0 (0.0) | 15 (17.4) | 34 (39.5) | 37 (43.0) | 1.74±0.080 |
| 16 | Lack of management practices/enforcement | 36 (41.9) | 27 (31.4) | 9 (10.5) | 14 (16.3) | 2.99±0.118 |
| 17 | Funding and support from government | 57 (66.3) | 21 (24.4) | 5 (5.8) | 3 (3.5) | 3.53±0.082 |
| 18 | Preservation/ storage facilities | 32 (37.2) | 34 (39.5) | 11 (12.8) | 9 (10.5) | 3.03±0.104 |
| 19 | Erratic electricity supply | 36 (41.9) | 35 (40.7) | 13 (15.1) | 2 (2.3) | 3.22±0.085 |
| 20 | Water availability | 33 (38.4) | 0 (0.0) | 27 (31.4) | 26 (30.2) | 2.47±0.138 |
| 21 | Access to fishing input | 33 (38.4) | 0 (0.0) | 36 (41.9) | 17 (19.8) | 2.57±0.129 |
| 22 | Access to fishing ground | 0 (0.0) | 4 (4.7) | 40 (46.5) | 42 (48.8) | 1.56±0.063 |
| 23 | Climate change | 7 (8.1) | 65 (75.6) | 5 (5.8) | 9 (10.5) | 2.81±0.078 |
| 24 | Lack of training | 12 (14.0) | 30 (34.9) | 5 (5.8) | 39 (45.3) | 2.17±0.125 |

***Figures in parentheses ( ) are expressed as percentages***
***VS = Very severe, MS= moderately severe, NS= not severe, NP= not a problem, SD= standard deviation***
***Source: Field Survey 2020***

**Table 8: Operational Constraints Facing Fish Marketing**

| S/N | Constraints | VS | MS | NS | NP | mean±SD |
|---|---|---|---|---|---|---|
| 1 | High cost of transportation | 1 (2.8) | 10 (27.8) | 2 (5.6) | 23 (63.9) | 1.69±0.98 |
| 2 | High cost of packaging materials | 0 (0.0) | 0 (0.0) | 5 (13.9) | 31 (86.1) | 1.14±0.35 |
| 3 | Minimal profit | 0 (0.0) | 0 (0.0) | 28 (77.8) | 8 (22.2) | 1.78±0.42 |
| 4 | Specie availability | 0 (0.0) | 1 (2.8) | 12 (33.3) | 23 (63.9) | 1.39±0.55 |
| 5 | Fuel scarcity | 0 (0.0) | 0 (0.0) | 0 (0.0) | 36 (100.0) | 1.00±0.00 |
| 6 | Currency depreciation | 0 (0.0) | 21 (58.3) | 1 (2.8) | 14 (38.9) | 2.19±0.98 |
| 7 | Access road networks | 0 (0.0) | 4 (11.1) | 28 (77.8) | 4 (11.1) | 2.00±0.48 |
| 8 | Water availability/supply | 0 (0.0) | 0 (0.0) | 7 (19.4) | 29 (80.6) | 1.19±0.40 |
| 9 | Storage | 0 (0.0) | 0 (0.0) | 0 (0.0) | 36 (100.0) | 1.00±0.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | Land accessibility | 0 (0.0) | 0 (0.0) | 3 (8.3) | 33 (91.7) | 1.08±0.28 |
| 11 | Manpower | 0 (0.0) | 0 (0.0) | 2 (5.6) | 34 (94.4) | 1.06±0.23 |

***Figures in parentheses ( ) are expressed as percentages***
***VS: very severe, MS= moderately severe, NS= not severe, NP= not a problem, SD= standard deviation***
***Source: Field Survey (2020)***

**Table 9: Operational Constraints Facing Fish Processing**

| S/N | Constraints | VS | MS | NS | NP | mean±SD |
|---|---|---|---|---|---|---|
| 1 | High cost of transportation | 0 (0.0) | 12 (41.4) | 10 (34.5) | 7 (24.1) | 2.17±0.805 |
| 2 | Scarcity of raw materials (fish) | 12 (41.4) | 0 (0.0) | 0 (0.0) | 17 (58.6) | 2.24±1.504 |
| 3 | Minimal profit | 0 (0.0) | 0 (0.0) | 0 (0.0) | 29 (100.0) | 1.00±0.00 |
| 4 | Health risks /challenges | 0 (0.0) | 12 (41.4) | 17 (58.6) | 0 (0.0) | 2.41±0.501 |
| 5 | Lack of modern facilities | 12 (41.4) | 0 (0.0) | 17 (58.6) | 0 (0.0) | 2.83±1.002 |
| 6 | Fuel scarcity | 12 (41.4) | 0 (0.0) | 7 (24.1) | 10 (34.5) | 2.48±1.353 |
| 7 | Lack of preservation/storage facilities | 0 (0.0) | 0 (0.0) | 0 (0.0) | 29 (100.0) | 1.00±0.00 |
| 8 | Electricity | 0 (0.0) | 12 (41.4) | 0 (0.0) | 17 (58.6) | 1.83±1.002 |
| 9 | Communication | 12 (41.4) | 0 (0.0) | 7 (24.1) | 10 (34.5) | 2.48±1.353 |
| 10 | Tough competition | 0 (0.0) | 0 (0.0) | 17 (58.6) | 12 (41.4) | 1.59±0.501 |
| 11 | High operational cost | 0 (0.0) | 0 (0.0) | 10 (34.5) | 19 (65.5) | 1.34±0.484 |
| 12 | Shortage of skilled labour/ manpower | 0 (0.0) | 0 (0.0) | 0 (0.0) | 29 (100.0) | 1.00±0.00 |
| 13 | Lack of funds | 0 (0.0) | 0 (0.0) | 0 (0.0) | 29 (100.0) | 1.00±0.00 |
| 14 | Location | 0 (0.0) | 0 (0.0) | 0 (0.0) | 29 (100.0) | 1.00±0.00 |
| 15 | Lack of demand | 0 (0.0) | 0 (0.0) | 0 (0.0) | 29 (100.0) | 1.00±0.00 |
| 16 | Economic fluctuation | 0 (0.0) | 0 (0.0) | 10 (34.5) | 19 (65.5) | 1.34±0.484 |
| 17 | Lack of formal education | 0 (0.0) | 0 (0.0) | 12 (41.4) | 17 (58.6) | 1.41±0.501 |
| 18 | Fish spoilage | 0 (0.0) | 0 (0.0) | 0 (0.0) | 29 (100.0) | 1.00±0.00 |
| 19 | Water availability/supply | 0 (0.0) | 0 (0.0) | 10 (34.5) | 19 (65.5) | 1.34±0.484 |
| 20 | inadequate/lack of training | 0 (0.0) | 0 (0.0) | 10 (34.5) | 19 (65.5) | 1.34±0.484 |

***Figures in parentheses ( ) are expressed as percentages***
***VS: very severe, MS= moderately severe, NS= not severe, NP= not a problem, SD= standard deviation***
***Source: Field Survey (2020)***

**Table 10: ANOVA results of the difference in total re venues of value chain actors**

| | Sum of Squares | df | Mean Square | F | p-value |
|---|---|---|---|---|---|
| Between Groups | 998784279275080.10 | 2 | 499392139637540.06 | 28.730 | 0.001 |
| Within Groups | 2572585257676444.00 | 148 | 17382332822138.14 | | |
| Total | 3571369536951524.00 | 150 | | | |

***df= degree of freedom***

**Table 11: Results of posthoc test using LSD on multiple comparisons of means**

| (I) Value chain actors | (J) Value chain actors | Mean Difference (I-J) | Std. Error | p-value | 95% Confidence Interval Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| Fishers | Marketers | 5009239.27649* | 827624.75041 | 0.001 | 3373751.3909 | 6644727.1620 |
| Fishers | Processors | 5408842.34162* | 895271.43150 | 0.001 | 3639676.3279 | 7178008.3553 |
| Marketers | Processors | 399603.06513 | 1040304.45801 | 0.701 | -1656165.9746 | 2455372.1048 |

****. The mean difference is significant at the 0.01 level.***