Sanitation and Handling during Processing of Fish in Oguta Fishing Communities and Its Economic Implications

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Abstract: Structured questionnaire, semi-structured interview and field observation were used to assess the existing fish processing techniques employed by fishermen immediately fish is cropped up to the time it is sold off to the consumer by the traders alongside its economic implications. Level of personal cleanliness displayed by individual fishermen was impressive (3.2 ± 0.15), although when it came to those processing the fish, it was not so good (2.8 ± 0.19) as the nature of their job do not permit consistent cleanliness. Interestingly, due to the careful handling of fish at the site of investigation, fish handed down to the next level- from fishermen to processors, from processors to traders and from fishermen, processors or traders to consumers (3.2 ± 0.11, 4.3 ± 0.24, and 4.4 ± 0.13 respectively) was found to have very little bruises. This result is so revealing especially at the processing level where the fish after careful and controlled smoking appears very beautiful and tasty. Economically, the socio-economic practices ensure seldom loss, making fish and its products economically conserved.

Keywords: Economic implications, Fish handling, Fish processing, Sanitation, Oguta Lake,.

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1. Introduction

The Federal Department of Fisheries [1] reported that in the agricultural sector of the Nigerian economy which employs about 70% of the active labour force, fish occupies a unique position in that it is the cheapest source of animal protein consumed by the average Nigerian, accounting for up to 50% of the total animal protein intake. Owing to the fact that fish is susceptible to deterioration without any preservative or processing measure [2], proper processing techniques, packaging and careful handling during loading and offloading of boats and storage containers, and also preservation techniques are employed to prolong its shelf life so that it does not lose quality, taste, odour and nutritional value. Fish not consumed within 8 hours of being caught or adequately processed becomes decomposed/ spoiled rapidly such that it loses its flavour, taste, odour, nutritive value and the digestibility of their flesh. High ambient temperatures of the tropics spoil fish within (12) twelve hours if not quickly processed and will be unfit for human consumption within (24) twenty- four hours [3]. Products that are processed from low quality raw materials are not always a safety risk, but the quality (nutrition value) and shelf life is significantly decreased. Processing of spoilt fish at the end, affect the quality of the final product because a high quality fish product is dependent on the quality of the initial raw material. Proper handling, processing, preservation, packaging and storage measures are essential to improve its shelf life, ensure its safety, maintain its quality and nutritional attributes and avoid waste and loss [4].

Oguta Lake is of immense value to the people of Oguta, Orsu, Nkwesi, Awo communities and Imo state at large being a source of navigation and transportation, sightseeing and tourism, and a pool from which to obtain 80% safe and cheap animal protein and other indispensable nutrients for healthy living; thus contributing to the socio-economic development of the zone [5].The water volume increases tremendously during the rains; its maximum surface area being $2.48 Km^2$ with a depth of 9.30m [6]. Fishing at the lake is artisanal (small- scale fisheries where the fishers operate in small units [7]. The subsistent nature of operation by these fishermen and fish processors compounds the constraints imposed upon them in their operating environment. One of the main difficulties faced by these small-

scale fisheries that restrain their contribution to food security and poverty reduction is poor handling and conservation methods/ infrastructure of which causes high losses, low quality, and low prices and in the end lead to greater vulnerability of artisanal fisheries [8].

In Nigeria, a wide gap exists between fish production and the quantities that eventually reach the consumers fresh or processed [9]. Food loss has been an important topic on the development agenda since the 2008 food crisis and in the headlines for the past 3-5 years [4]. There are multiple root causes of post-harvest losses, which is even more complicated in rural fishing communities in Nigeria because these fishes are multispecies and catches lack uniformity in terms of composition, weight and shape. Processing methods generally in practise in Nigeria are traditional and consist of sun drying, salting and sun drying, smoke drying [9]. The recent increase in demand for fish products has been accompanied by growing interest in food quality and safety, nutritional aspects and wastage reduction. In order to maintain good quality of fish from fisheries, good handling practices must involve keeping the fish cool, fish undamaged and fish flesh clean. Despite the rudimentary nature of traditional processing methods, the lack of control over the drying rate, which sometimes results to under- or over-drying and exposure of fish to wind, dust, dirt, insect infestation and contaminants such as flies,these methods still remain predominant in Nigeria [10].

For sustained maximum production of these fisheries, in order to meet the demands of the ever-growing population of Nigeria, a crucial understanding of the handling and sanitary method employed in artisanal processing of fish for subsequent distribution to the market and to final consumers is necessary. The Government and development partners like Food and Agricultural Organisation (FAO) have extended both technical and monetary assistance to improve fish handling along the distribution and marketing chain [4]. While this assistance has had a significant impact in improving fish handling for the export market, sanitation in fishing communities has not improved appreciably.

2.0 Materials and methods

Area of study: Sample sites included Umuachisi, Ogiriuzo and Umusu fishing communities and their respective landing sites: Amaraocha, Afiafor and Ose Umuosu all of Oguta Local government area, Imo State, Nigeria. The lake, which is the largest natural lake in South Eastern Nigeria, is about linear in shape, located in Imo State lies approximately between Latitudes 5^0 41" and 5^0 44" North and Longitudes 6^0 50" and 6^0 45" East (Fig. 1). The Lake receives inputs from Rivers Njaba, Awbana and Orashi, while the fourth river, Utu flows in only during the rainy season (April to November) [6]. The fishing communities under the study were sampled between October 2015 and January 2016 at a period when maximum catch is obtained.
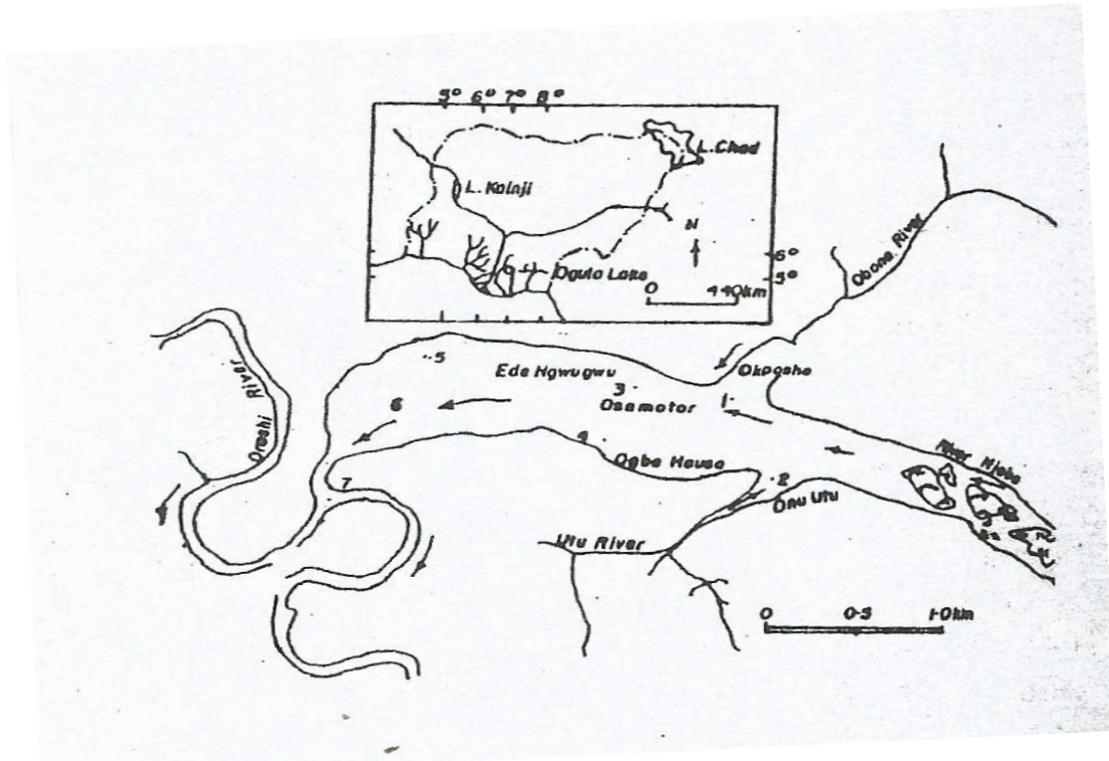
Fig 1. Map of Oguta Lake, South Eastern Nigeria

2.1. Data collection

Structured questionnaire, semi-structured interview and field observation were used to assess the existing fish processing techniques employed by fishermen immediately fish is cropped up to the time it is sold off to the consumer by the traders. An average of 24 questionnaires was administered in the communities and landing site. Six processing centres were visited. Data collection activities during these days included very early morning visits to waterside to observe, interview and distribute questionnaires to fishermen and individual traders; and evening visits to fishing communities where groups of fishermen and processors were interviewed and processors given questionnaires to answer under the guidance of the researcher. Parameters investigated included the socio-cultural practice of fishers, which impinges on sanitation and handling during artisanal fish processing. Processing of fish according to this research is every action or activity put in place to ensure that shelf life of fish is increased and value is added to the fish. This implies that immediately fish is caught, processing starts up until it is sold off. The fish processing technology, fish-processing equipment and the economic implication of such practices on fishers were investigated.

2.2. Statistical analysis

The analytical tools used include descriptive statistics (mean, percentage and frequency tables) and standard deviation of the average (SDA). Content analysis and observation rating following a 1-5 scale as abstracted from [11] and [12] was used to analyse qualitative data relating to the extent to which sanitation and care is employed during fish processing within the fishing communities. Values 1-5 were rated as Excellent =5, very good =4, good =3, fair =2, bad =1.

3.0 Result and discussion

Fish harvested from the Lake goes through several processes and handlers before it reaches its final consumer. This pathway can be long, comprising of from fisherman → wholesaler → consumer or long, comprising of movement from fisherman → wholesaler → processors→ retailers→ consumers. Any, which way the fish moves from harvest to consumption, processing is of essence to maintain its

freshness quality. At every stage of the pathway, a form of processing is employed starting from the harvester (i.e. fisherman) right down to the consumer. Results from the investigations on the path fish moves from the point of fish cropping to when it is sold out is represented in figure 2.
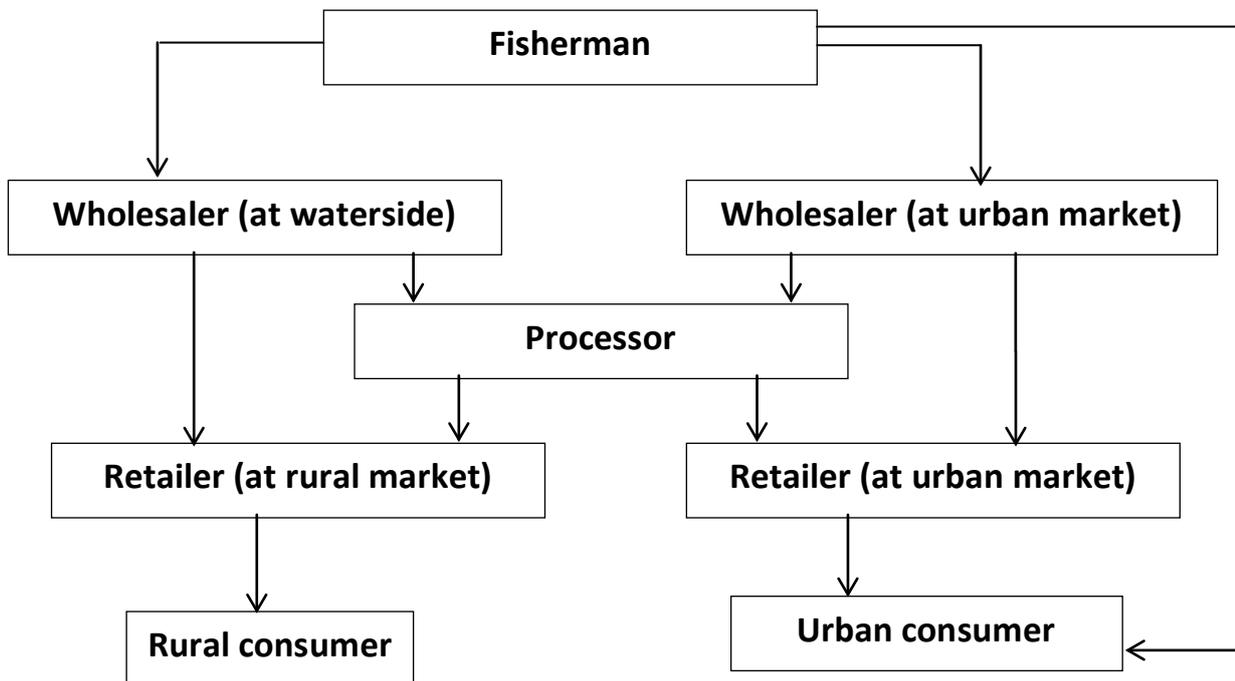
Fig 2. Flow channel of fish in the study area

3.1 Sanitary habit of fishers

Results from the investigation revealed that the sanitary conditions employed by fishers in general (from time of capture to sale/ consumption) when handling fish is impressive. Bearing in mind that the system of operation within these fishing communities and landing sites are artisanal, conscious effort is observed to be put into the level of cleanliness when handling fish. This may be due to the social and religious beliefs of the handlers who see cleanliness as being advanced and godly. Cleanliness of the environment also opens doors for outsiders (visitors) to comfortably visit such areas, and with such visits, buy fish and spread the good news of the resources in the community. Contamination of fish with dirty water in bottom of boat and unkempt fishing equipment was observed to be on a high side (2.9$\pm$0.22), the effect of which was made worse by the fact that most fishes caught had a form of blemish on them such as gaping wounds, broken fins or removed scales. Although, fish were caught in small batches to avoid spoilage of first set of caught fish, boat water was replaced with every set of catch reducing the lasting effect of fish contaminated with dirty boat water.

Fishers were found to have the habit of washing fish in polluted inshore water. Nevertheless, with the possession and use of toilet facilities at landing sites, the effects of human excrement in water are removed. This finding negates that of [13] who discovered that some fishers do not use or possess waste disposal sites. Baskets, bags or basins were used to hold fish at the landing sites but never kept on bare ground. Although fishers do not excrete into the water, fishers and community members were found at different locations washing in the water banks. Consequently, such sections do not have live fish in them due to the toxic nature of some of the detergents used. The possibility of chemical deposition on the flesh of fish is therefore a complete possibility. During processing, basins, trays, baskets and tables are equipment for handling fresh fish (plate 4). At other times when necessary, a sac is used to cover the fresh fish to shade it from direct sunlight. Level of personal cleanliness displayed by individual fishermen was impressive (3.2$\pm$0.15), although when it came to the processors, it was not so good (2.8$\pm$0.19) as the nature of their job do not permit consistent cleanliness. Hand gloves were not worn, apron were worn by only a few and the swaying flowing dresses worn by some processors on site at the time of investigation also presented the risk of carrying debris from place and disposing where they are unwanted. This situation was nowhere to be compared to the level of contamination with environmental contaminants at the processing site (4.0$\pm$0.10) as fish and the processes involved in

its processing was done under strict hygienic condition. Fish was prepared on a cleanly wiped table, washed properly with sufficient water (replaced with every separate preparation), and covered with a zinc shield while under the heat of smoke.

Fishing gear and craft used by fishers about level of cleanliness are rated by this investigation as fair because although they looked clean, yet they were only occasionally washed. Environment around the landing sites and processing environment were clean and void of litters. Equipment used by the processors had a fair rating (3.6 ± 0.16) because, although the working table are wiped clean with every set of preparation (scaling, gutting, beheading), yet, for each fish worked on to be properly certified as clean, it had to be handled on a separately cleaned work table which is not the case at the site of investigation. Waste parts left on table were pushed aside the table when another fish within its batch was to be worked on. Such wastes are left only until the processor had succeeded in getting a break from her activities (soaking in salt solution, placing the fish on fire to smoke).

At the market, the equipment used by the traders were seen to be the cleanest (3.6 ± 0.16) as they were conscious of the fact that this depended largely on the number and category of customer (buyer) that patronizes them. Display tables were consistently cleared of any thing not fish by wiping with a clean rag (for those selling smoked fish), water carrying live fish kept clean to enhance visibility of fish in the holding basin, refrigerator and work table in cold rooms kept clean and free of flies. It was disheartening to observe that fish carefully processed under strict hygienic conditions were left open on selling tables at the mercies of environmental contaminants like flies, dust and every naked hand touch of a potential buyer that sampled or measured the size of fish heap with his/her hand before buying. This resulted in a very low rating of sanitary condition of this factor.

3.2 Handling character of fishers

The investigation revealed that handling of fish by the fishermen was poor as fisher were seen throwing fish carelessly not paying attention to specie or size of fish with the exception of the large sized fish such as *Heterobranchus spp* (plate 1), that could stay alive for some time outside water or those with strong spines like *Bagrus sp.* Others large sized species that has high demand from restaurants such as *Heterotis niloticus* (plate 6) and *Tilapia spp* (plate 5) were also carefully handled as any blemish on them meant less money. Such exempted fish species are kept aside in the boat and consciously protected from suffocation and direct heat of sun thus, were not mishandled. Fish were not dragged along sandy beach, which ruled out the event of contamination of fish enhanced, by open wound. This was made possible because fish caught were not too numerous as to warrant the fish to be dragged on the ground. This negates the findings of [13] that discovered that fish were dragged on the ground due to massive catch. Onshore, ice was not entirely used (1.0 ± 0.17), blamed on the fact that fish were caught in small batches and brought to the shore early enough to be immediately bought off, and then a return again to fish was made if the need be. This results in most of the fishermen making two or more fishing trips per day. The cost of ice purchase and means of keeping it frozen up until time of use was also a discouraging factor. Ice was mostly used in the market by traders who sold fresh fish (2.1 ± 0.09), though not so randomly used as most fridges acting as cold rooms in the markets were mere cold boxes. It was also observed that most frozen fish on sale were imported and not locally produced from our inland waters.

S/n		Location		
		Onshore	During processing	At market
	Sanitary habit			
i.	Personal cleanliness	3.2 ± 0.15	2.8 ± 0.19	3.2 ± 0.22
ii	Cleanliness of equipment	3.8 ± 0.20	3.6 ± 0.16	4.2 ± 0.31
iii	Contamination of fish with environmental contaminants	2.9 ± 0.22	4.0 ± 0.10	2.2 ± 0.11
	Handling character			
i	Throwing of fish carelessly	2.9 ± 0.10	3.1 ± 0.32	3.3 ± 0.14

ii	Use of ice for initial preservation	1.0±0.17	1.8±0.02	2.1±0.09
iii	Bruising of fish before it is handed down	3.2±0.11	4.3±0.24	4.4±0.13

Table 1; Sanitation and handling ratings of fishermen, processors and traders when dealing with fish in the study area.

Interestingly, the careful handling of fish at the site of investigation, fish handed down to the next level- from fishermen to processors, from processors to traders and from fishermen, processors or traders to consumers (3.2±0.11, 4.3±0.24, and 4.4±0.13 respectively) was found to have very little bruises. This result is so revealing especially at the processing level where the fish after careful and controlled smoking appears very beautiful (plate 3) and tasty.

3.3. Post-harvest loss incurred by activities of participants in the study area (table 2)

Sources of loss   Proportion of loss per daily total catch

	Fishermen				Processors			
	N	S	M	C	N	S	M	C
On fishing ground	25%	40%	35%	-	-	-	-	-
At landing site	57%	33%	10%	-	-	-	-	-
Pre-processing stage	-	-	-	-	98%	2%	-	-
During smoking	-	-	-	-	56%	36%	8%	-
During transportation	-	-	-	-	60%	27%	13%	-
During marketing	88%	12%	-	-	64%	16%	20%	-
During storage	96%	4%	-	-	30%	50%	13%	7%

Source: Sample site (2015)
Key: N- None   S- Small   M- Many   C- Complete
Table 2. Degree of post -harvest loss in the study area

The study investigated the extent of fish loss after harvest up until it is sold to consumers. Sources of loss included losses on the fishing ground, at the landing site, during transportation, marketing and storage and at the preparatory stage of processing and smoking. The investigation revealed that fishermen incurred the most loss on the fishing ground with 40% small losses and 35% many losses. At the landing site, 33% small loss is recorded with as little as 12% and 4% small loss during marketing and storage respectively. The small record of loss during storage is because of the practice of selling off any dead fish, even if it is at a lower price and keeping the life ones alive in restricting baskets floating in the lake.
Processors however, incurred most losses during storage with 50% record of small losses, 13% many loss and even extreme case of 7% complete or total loss of fish stock (table 2). These losses are attributed to breakage/disintegration of fish due to poor stacking or over-drying of fish causing it to be brittle, insect infestation or spoilage due to presence of spoilage bacteria in the stored fish. Respondents mentioned that smoke dried fish is preserved until the next day merely by placing it on very lightly smouldering fire so as to continue drying and inhibit bacterial growth. This practice, though in itself

achieves its objectives, exposes the fish to over-drying and burning. Losses were also incurred during smoking with 36% small loss and 8% many losses. These are because of over-charring of fish, fish falling to the ground or into the fire when placing it on mesh or removing after smoking. The least loss gotten by processors is during the preparatory stage of processing i.e. gutting, beheading, scaling, washing and brining. The study revealed just 2% small loss. This is attributed to the fact that absolute care is put in the process alongside waste being very useful in the communities as intestines, head, other edible parts of big fish are converted as food, other fatty viscera are dissolved and used for cooking oil, and the inedible small remaining are thrown back into the lake as food for fish. On the long run, almost nothing is wasted.
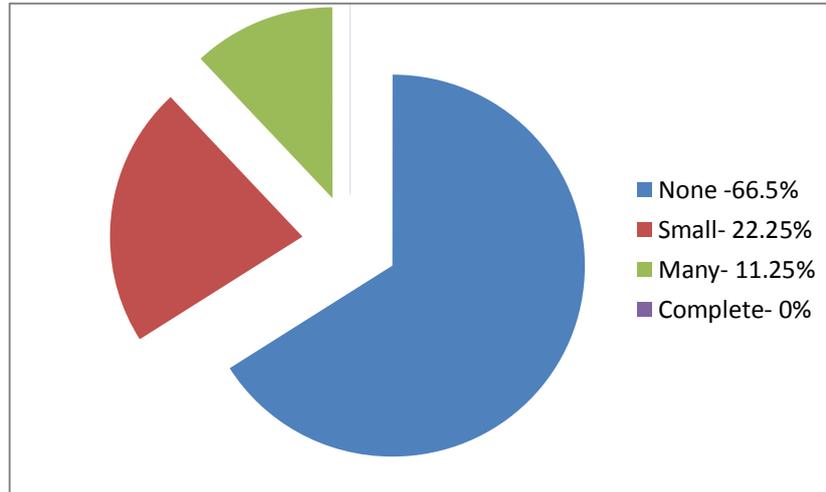
Figure 3. Post- harvest loss incurred by fishermen
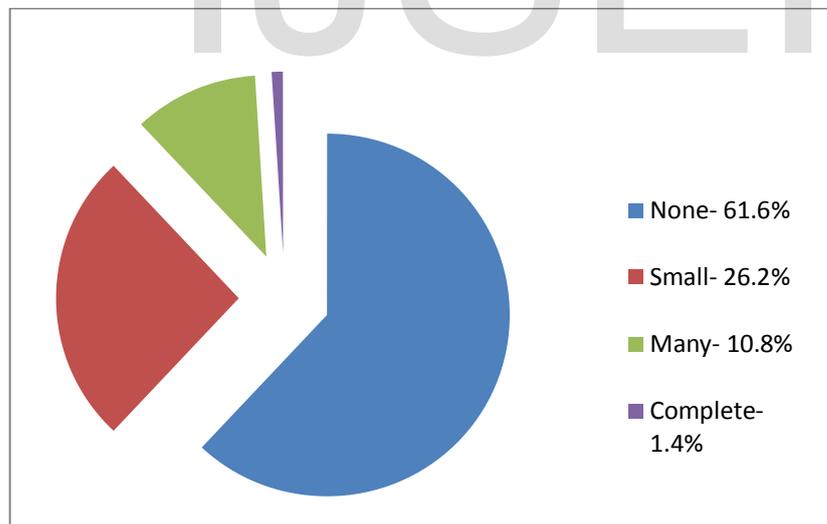
Figure 4. Post -harvest loss incurred by processors

Generally, post -harvest loss is more intense at the processing level than at the level of capture (fig 3 & 4). This is true because fish is easily disposed after capture (even at a price that is very cheap), preference of the consumer, and smoking as an alternative way of preservation, which in the end has left the domain of the fishermen and entered that of processors. Processing of fish itself, is a preservative measure after which nothing else can be done (with reference to the study area). Smoking, aside from its beneficial effects of flavour addition and preservation, exposes fish to quality reduction as it becomes prone to breakage due to dehydration and over charring during the smoking process. This agrees with the findings of [14].

Conclusion

In the fishing community, about 90% of the women engaged in fish processing and marketing [15]. These roles of women reduce poverty, promote food security and gender equality as well as empower them financially in income generation as well as dignify the economic status of women [16]. Fish landing under such good handling and hygienic conditions attracts environmental sustainability and economic growth by improving the living standards and environment conservation to sustain the living resources there. Badly wounded fish, broken parts of smoked fish (of several species and sizes), fish that has been infected with mould, fish that have fallen and contains sand and dirt, from interviews and observation, are not discarded as waste but put together and sold to the very poor folks that cannot afford the quality fish. Although the nutritional quality has been reduced and unwanted debris present in such fish, yet, cheap, quick protein has been provided and taste for food assured for the very poor folks.

Future research

The seasonality and shallowness of water level of lakes does not reduce the profitability of it contributing to socio- economic development of surrounding communities [17]. As such, drastic measures should be put in place to ensure that the diminishing stock of the lake is continually replaced, environment managed properly and best practices of preservation and processing employed to remove loss. Further studies should therefore be conducted on the micro-organism load on fish harvested using different handling and sanitary conditions.

Appendix 1

Pictorial representations:

Plate 1: *Heterobranchus spp* kept alive in a plastic basin

Plate 2: Scaling of fish (one of the processes undergone during processing)

Plate 3: Fish smoking at Oguta landing site

Plate 4: A glance at the processing and trading site at Oguta waterside

Plate 5: *Tilapia gariepinus*, a carefully handled and highly priced fish

Plate 6: *Heterotis niloticus* captured from the lake

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