# Post-Harvest Fish Losses: Physical and Quality Loss Assessment amongst Fish Traders in Main Markets of Juba, South Sudan

Johnson J. Balli* and John S. Benansio

[1] Department of Fisheries, School of Natural Resources and Environmental Studies
University of Juba, P.O. Box 82, Juba, Republic of South Sudan.

*Corresponding Author: j.jiribi@yahoo.com

**ABSTRACT**

This study was conducted in the main fish markets in Juba to examine post-harvest fish losses (PHFL) amongst the fish traders. The methodology used in the study was direct semi-structured interviews for collecting both qualitative and quantitative data. Findings of this study revealed that the factors which led to PHFL were the approximate fish quantities transported, methods used for fish transported, for preservation and for storage. For fresh fish traders, the average quantity (%) lost per load was positively correlated with methods of controlling losses (r=0.230) at 0.05 significance level but negatively correlated with methods used for preservation (r=-0.624) at 0.01 significance level. For dried fish, the approximate quantities transported indicated a positive correlation with the average quantity (%) lost per load (r=0.45) at 0.01 significance level. Generally for fresh fish, the percentage of traders who lost between 1-10% and 21-30% of the fish load per trip were recorded as 52% and 20% respectively. For the dry fish traders, were 55% and 11% respectively. The study recommended that the fish traders need to be trained and facilitated in terms of transportation, preservation and storage of fish so that customers are able to get high quality fish in the markets. The common fish genera were also categorized as 1st class (*Bangus, Tilapia, Lates*), 2nd class (C*laria, Heterotus, Mormyrus*) and 3rd class (*Polypetrus, Properus*) based on the preference by customers in the markets.

**Keywords:** Post-harvest loss, Fish traders, Markets, Variables.



## INTRODUCTION

South Sudan is a country richly blessed with fish resource in its riverine system and floodplains. Fish which is abundant and multispecies exist on which a large proportion of the population depend for their livelihood, food security and income. It was estimated that the dried and fresh fish consumption was 17.36kg/capita/year (CAMP, 2013). Post-harvest fish losses (PHFL) are important issues affecting the fisheries sector, especially in the developing and small scale fisheries. Post-harvest fish loss is defined as a reduction in quantity, quality or monetary value of fish in the supply chain (Ward and Signa, 2017). As a result of the losses the fish becomes nutritionally deficient reducing its economic value. PHFL is often caused by changes that occur in fish after death due to biochemical and microbiological spoilage (Tesfay and Teferi, 2017).

Losses can be categorized as physical, quality and market force losses. The occurrence of these losses often make fish operators (fishers, processors, traders, and other stakeholders) lose their potential income and reduce the amount of fish available to consumers or consumers are supplied with low-quality fish and fish products (Akande and Diel-Ouadi, 2010). Estimates of PHFL for developing countries, are put at 20 – 25% and sometimes as high as 50% in some African fisheries (Abelti, 2016).

This study was conducted with the objective of determining the factors leading to PHFL particularly physical and quality losses amongst the fish traders in the main markets of Juba. It was also aimed at finding out the reasons for selling fish at low prices and the prevailing methods for controlling losses. The study also determined the most preferred fish genera according to the fish traders in the main markets in Juba.

## MATERIALS AND METHODS

### Study area

This study was conducted for a period of two weeks in November 2016 in Juba, South Sudan. The main markets which were targeted were Gabat Fish landing site, Konyokonyo, Gudele, Custom, and Suk Libya markets.

The fish sold in these markets mostly originate from Terekeka, Bor and Shambe towns which are about 85, 190 and 260 kms respectively by road along the river Nile north of Juba. Jebel Ladu and Mobil are areas near to Juba which also provide limited supplies of fish to the markets in Juba.

### Study design and data collection

The study was conducted through a survey using an assessment questionnaire which was formulated and randomly administered to respondents who were fish traders (wholesalers and retailers) of both sexes from the main markets which were considered as one single homogenous unit. Boats regularly transport fish from Bor and Shambe to Gabat landing site. Fish from Terekeka, Jebel Ladu and Mobil are transported to the markets by motorcycles. Due to the absence of records, an estimated number of 300 traders were taken to have bought fish from Gabat in addition to 20 traders from other areas around Juba totaling to 320 fish traders per week who supplied fish daily or weekly to the various markets in Juba. Applying the formula for sample determination, a sample size of 175 respondents was taken for the study (Selvam, 2017). Data collection was done by the use of semi-structured questionnaires for collecting both qualitative and quantitative data randomly from the respondents in the main markets in Juba.

### Data analysis

Analysis of the data was conducted using SSPS software (vers. 23) and some of the important variables were selected and further analyzed for correlation coefficients to determine their relationships in terms of contributing to physical and quality PHFL. Descriptive statistics and percentages were used to determine the common trends practised by the fish traders and graphs were drawn using Microsoft Excel software.

## RESULTS

A total number of 175 respondents were interviewed who comprised of 104 fresh fish traders, and 71 dry fish (sundried, smoked and salted) traders of both wholesalers and retailers. There were 143 males(82%) and 32(18%) females sampled in the five main markets within Juba selling different fish species brought from near and far fishing areas. The fish supply to Juba markets originated from Bor (55%) and Terekeka (17%), Shambe (8%), Jebel Ladu (13%), Shambe (8%), Mobil (4%) and as far as Uganda (3%) especially for the dried salted fishes. Whereas the fresh fish traders were exclusively males, 45% of the dry fish traders were females.

According to the fish traders, the important variables which contributed to both the physical and quality losses were: approximate quantities transported, methods used during transportation, preservation and storage. In addition, the variables dealing with reasons for the sale of fish of low prices and methods of controlling losses were also studied. These variables are represented against the percentage of fish traders graphically to show the most prominent trends (Figures. 1 – 7).

### Quantities transported and transportation methods

The approximate quantities of fish transported depended on the capabilities of the traders which varied from 0-50kgs to 2000 - 4000kgs particularly for the wholesalers (Figure.1).Most fresh fish retail traders transported about 51-100kgs (37%) from the wholesalers per trip daily or weekly and other quantities were0-50kgs (31%), 151-200kgs (10%), 201-400kgs (9%), 2000-4000kgs (7%) and 101-400kgs (6%). For the dry fish traders, they mostly bought and transported about 51-100kgs (52%) per trip per week and other quantities were 0-50kgs (17%), 151-200kgs (14%), 101-150kgs (9%), and 201-400kgs (8%).

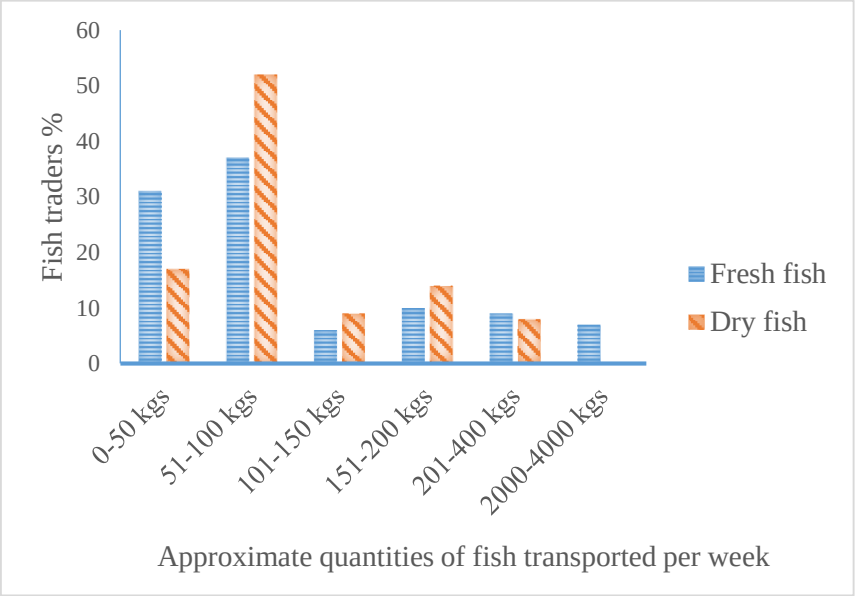


Figure 1. Approximate quantities of fish transported per week

It was found out that the fresh fish traders mostly used sisal sacks (61%) and the dry fish traders mostly used cartons (71%) for packing during transportation. For packing fresh fish the methods used were nylon bags (19%), freezer and sacks (14%) and wooden boxes (6%). For the dry fish, the traders also used wooden boxes (11%), cartons and sacks (10%) nylon bags (7%) and sacks (1%) as indicated in Figure.2.

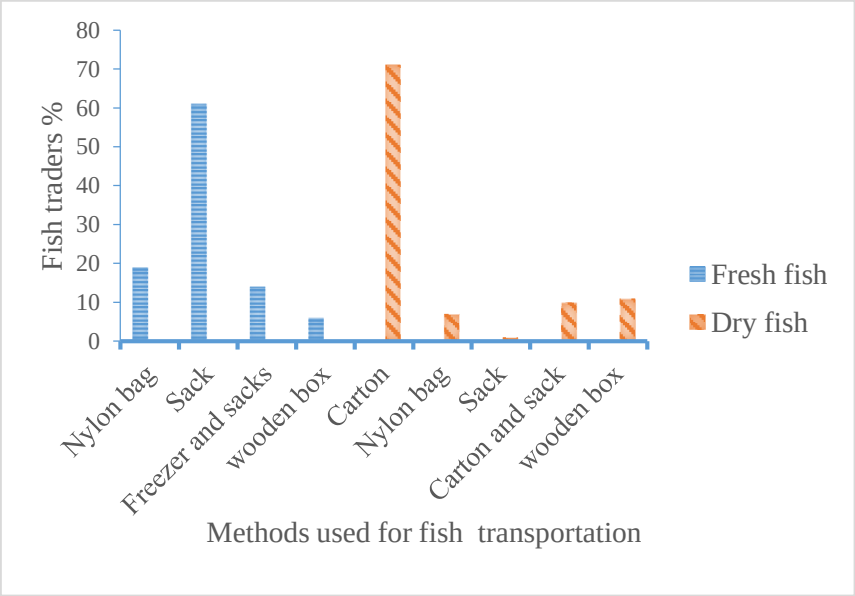


Figure 2. Methods used for packing fish during transportation

**Preservation and storage methods**

Various methods of fish preservation were used as shown in Figure.3. Most fresh fish retailers packed their fish in old deep refrigerators (47%) and other traders used ice directly (35%) and those who quickly sold all their fish without any preservation were 18%. For dry fish traders, those who mostly exposed their fish to sunlight were 61% and those who sun-dried in addition to fish smoking were 39%.

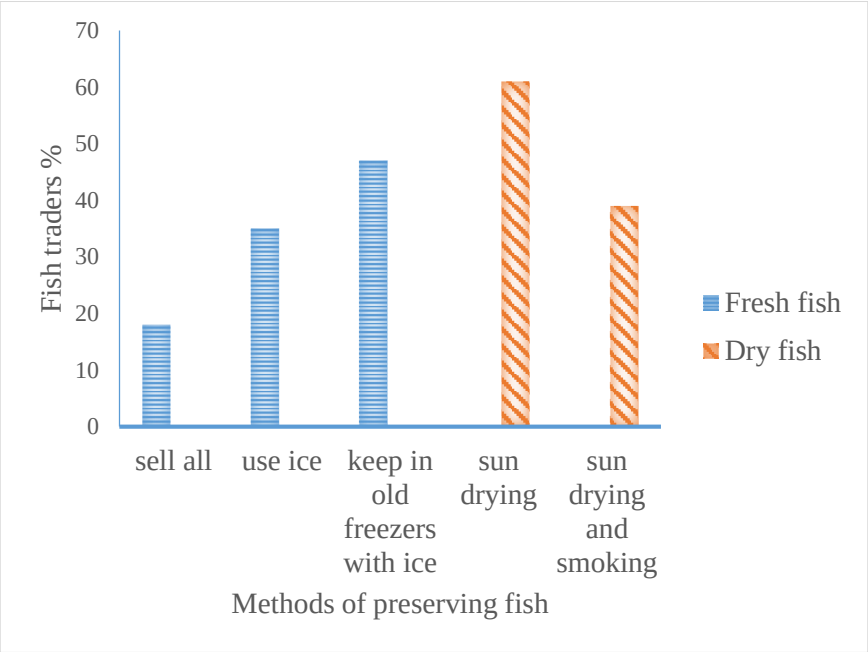


Figure 3. Methods used for preserving fish

It was found out that most fresh fish traders stored their fish in old deep freezers with ice (81%) and others used cool boxes with ice (19%). For the dry fish sellers, they mostly kept their fish in cartons (83%), sisal sacks (14%) and plastic sheets (3%) as shown in Figure 4.

**Selling fish at low prices, quantities lost and methods for controlling losses**

Fish traders at times sold their fish at low prices due to various reasons (Figure 5). The reasons given were mainly because of fish spoilage (67%), poor sale (17%) and presence of lots of fish in the market (16%). For the dry fish traders, the same reasons were given as fish spoilage (79%), poor sale (13%), and lots of fish (8%).

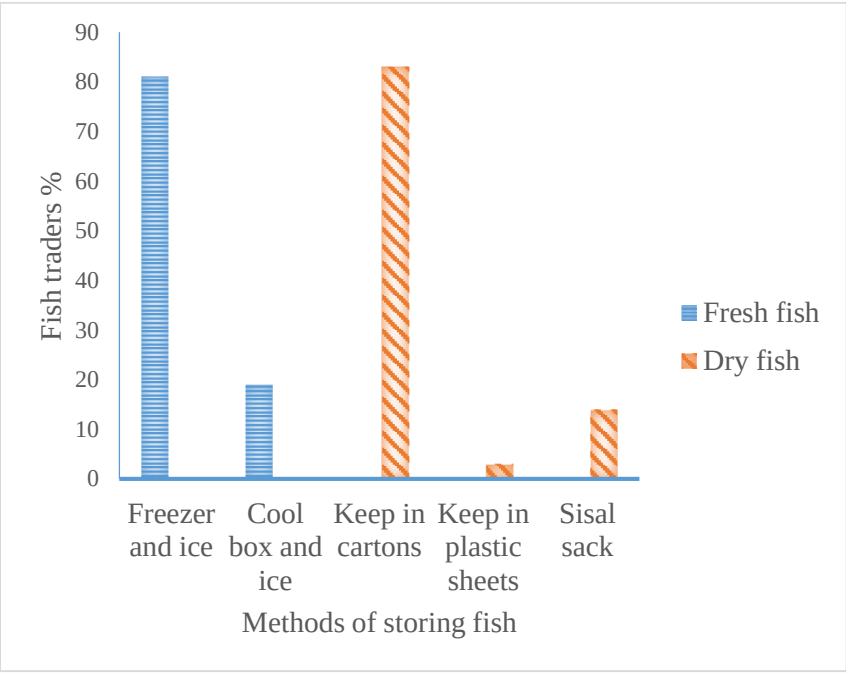


Figure 4. Methods of storing fish

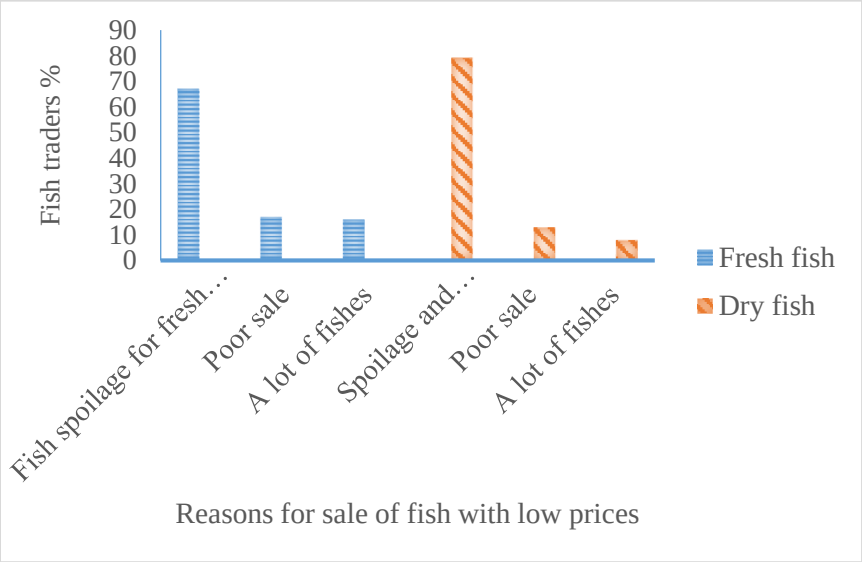


**Figure 5.** Reasons for sale of fish with low prices

The average fish quantities lost per load for the fish traders varied as indicated in Figure 6. For fresh fish, the majority of traders comprising 50% lost 1-10% of their fish while 18% of the traders did not incur any fish losses. Those who lost 11 – 20%, 11 – 30%, and 31 – 40% of their fish were 5%, 18% and 2%, respectively. In the case of dry fish traders, those who did not incur losses were 3% and those who incurred 1 – 105, 11 – 20%, 21 – 30% and 31 – 40%% losses were 53%, 29%, 10%, 0%, respectively.

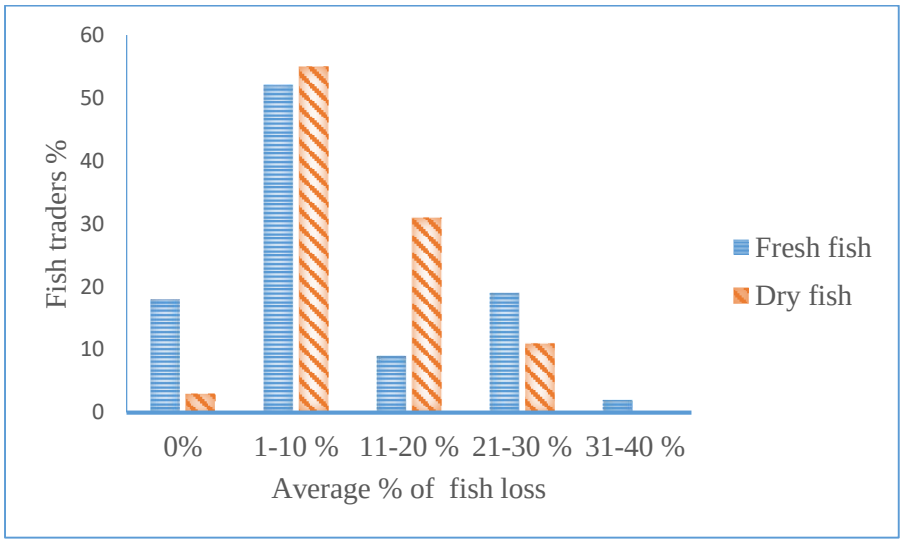


Figure 6. Average percentages of fish losses

The fish traders had different methods for controlling losses (Figure 7). It was found out that most fresh fish traders preferred to reduce prices (48%). Others bought less quantities for sale (35%), some used boats with good engine during transportation (11%) and few bought good quality fish (2%). For the dry fish traders, they mostly bought less fish quantities (55%) for sale. Others reduced fish prices (22%), some used proper storage methods (14%) and a few bought good quality fish (9%).

**Correlation of variables**

Some of the relevant variables were correlated using two-tailed Pearson's correlation coefficient and the strong relationships were shown in the following:

i. For fresh fish, the approximate quantities transported indicated a positive correlation with the methods used for transportation (r=0.50), for preservation (r=0.45) and of controlling losses (r=0.39) at 0.01 significant levels. The average quantity (%) lost per load was negatively correlated with methods used for preservation (r=-0.62) at 0.01 level of significance.

ii. For dried fish, the approximate quantities transported showed a positive correlation with the average quantity (%) lost per load (r=0.45) at 0.01 level of significance.

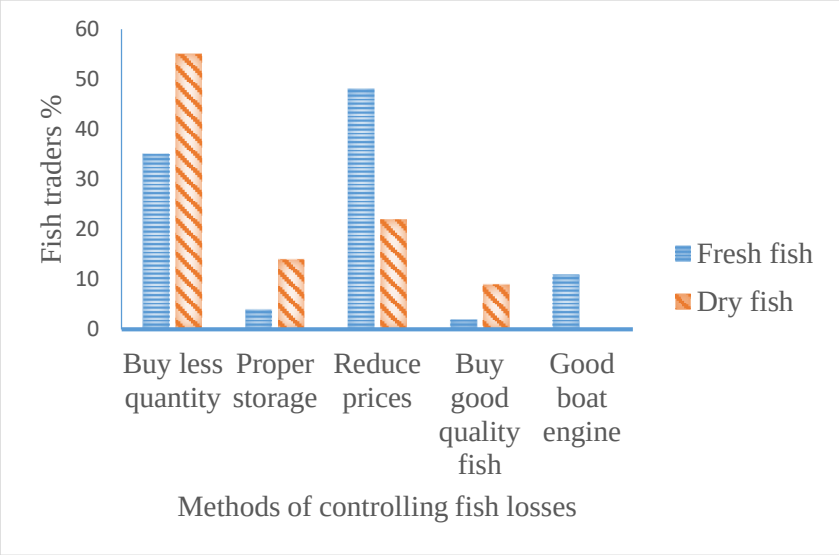


Figure 7. Methods of controlling fish losses

## DISCUSSION

The fish value chain starts from the fishers then moves to wholesalers then to retail traders and ends with consumers. However the chain is not strictly followed since it is common for fish traders or customers to buy fish directly from the fishers or wholesalers. The traders also supply a number of hotels and restaurants whenever needed.

### Quantities transported and methods used for transportation

The fish traders used different means of transportation which included boats, trucks and motorcycles from the production sites to the landing site and to reach the main markets in Juba. For the retail traders, the quantities transported differ daily, weekly or monthly. Thirty-five percent of fresh fish retail traders bought quantities about 51-100kgs from the wholesalers per trip daily or weekly according to the sales in the markets. For the dry fish traders, 52% bought about 51-100kgs per trip per week since keeping dry fish does not incur preservation expenses. The dried salted fish are usually brought by some traders on buses from Uganda.

The methods used during fish transportation was not hygienic since the fresh fish were exposed to sunlight and dirty environment which often led to faster spoilage. The fact that there are no refrigerated trucks for delivering fish to the markets, the various items such as sacks are not conducive for packing. Sixty-one percent of fish traders used sisal sacks for packing because it was cheaper and maintained moisture in the fish. Seventy-one percent of dry fish sellers used cartons since it was cheap and could maintain the fish in good form by reducing the breakage.

CAMP (2013) noted that fish traders transported fresh fish by boat from Bor to Juba in large insulated boxes or in old domestic freezers on trucks by road. Dried and smoked fish were also brought from Bor and Terekeka and distributed to the markets in Juba using motorcycles. As such Mungule (2011) observed that at the level of transporters of fresh fish mainly from Bor and Terekeka, the supply chain should be enhanced through improved capacity for suitable transportation, quality preservation and hygienic handling.

**Preservation and storage methods**

The fish traders used different fish preservation methods in the markets. Fresh fish is extremely perishable and can easily lose its nutritional value through spoilage. The spoilage can be slowed by mixing the fresh fish with small pieces of ice to keep the fish in a cold environment of low temperature. As such, 47% of the fish retailers packed their fish in old deep refrigerators and added more ice for preservation until all the fish were sold. For dry fish, the load was spread out and exposed to sunlight so as to kill all the insects and maggots that cause spoilage, stale odour and rancidity when exposed to high humidity thereby reducing its quality.

For storage, it was found that 81% of the fresh fish traders also packed their fish with ice in old deep freezers because it is the best method for keeping the fish fresh for long periods. For those who sold dry and smoked fish, 83% packed them in cartons to avoid breakage, which renders them unsellable.

CAMP (2013) observed that in the markets, the traders use old domestic freezers to keep the fish by buying ice from the local ice retailers. Also for the dry fish, drying can be a lengthy affair and that the processed fish are easily affected by beetles. Earlier, Krain and Otieno (2009) noted that the main challenges of the fish marketing in Juba were basically high costs of transportation and refrigeration for the fish traders, as such it is necessary to develop an efficient fishery value chain from the production to the marketing areas.

**Selling fish at low prices, quantities lost and methods for controlling losses**

It was found out that fish traders sold their fish at low prices and preferred to get little money than no money at all for different reasons. This happened to 67% of the traders when their fresh fish started to get spoiled and also for 79%of the traders when their dry fish was breaking and getting spoiled. Some of the other reasons given were due to the low purchasing power of the customers and at times due to high amount of fish during an active fishing season.

Fish traders generally incur loss which may be physical in terms of quantity lost and economic in terms of the monetary value lost. Fishers know that losses occur primarily when fish is caught and cannot be sold fresh or processed (dried) to customers which is wasted. For dry fish, the losses are mainly due to insect infestation and breakage. Adelaja, *et.al* (2017) noted that when fish undergoes microbiological decay, it leads to quality loss which results in depreciation in the market value, which also was observed in this study.

The average quantities lost per load varied where some small retail traders who bought smaller quantities and sold them all and in case of any left then gave it on loan to customers thereby incurring almost no loss. Other traders lost because they were unable to sell all their fish to the customers. Generally for fresh fish, the percentage of losses between 1-10% and 21-30% of the fish load per trip were recorded to be about 52% and 20% of fish sellers respectively. For the dry fish traders, the percentages recorded were 1-10% and 11-20% losses for 55%and 31%of the fish traders respectively. These losses were not far different from studies done in Sudan for dried unsalted fish which recorded about 15-30% and in Mali for dried smoked fish which recorded 40% losses (Kumolu-Johnson and Ndimele, 2011). In fact, Mungule (2011) earlier observed from an assessment of fish supply to Juba markets that, the fish supply chain showed a significant potential if developed especially for the fish capture, supply and marketing which would improve the livelihood and income of the fisher folks.

In terms of devising methods for controlling losses, the traders had different methods. Forty-eight percent of fresh fish traders preferred to reduce the prices so as to sell as many fish as possible from the load. For dry fish traders, 55% preferred to buy fewer quantities according to the demands of the market in order to ensure good sale in the market thereby reducing their losses. Other methods included buying good quality fish, proper storage and using boats with good efficient engines to avoid breakdowns during fish transportation. Ward and Signa (2017) recommended that PHFL can be reduced through education, raising awareness, improving skills and knowledge, strengthening the cold chain and the use of improved technology for traditional fish processing. CAMP (2013) also noted the importance of rapid movement of fish products from the production sites to the consumers would reduce the time of storage to the minimum, thus keeping the fish in good condition.

Getu, *et.al.* (2015), observed that the major factors affecting PHFL in small scale fisheries in tropical countries included a high ambient temperature, improper handling, inadequate preservation methods, markets affected by imbalance between supply and storage methods available. These factors were noted to concur with the results from this study which are the major causes of high PHFL amongst the fish traders in the markets of Juba.

**Correlation of variables**

The correlations of some of the variables, indicated that the quantities of fresh fish transported had direct positive relationships with the methods of transportation, for preservation and for controlling losses. This simply signified the fact that, as the fish traders dealt with bigger quantities, then they were able to follow better methods for the transportation, preservation and controlling losses of their fish load. This was observed during the study with the wholesale traders who bought enough ice for preservation unlike the retail traders who at times did not have enough ice for their fresh fish. This was also reflected in the percentage of the average quantity lost per load which increased when the preservation methods were not adequate. For the dried fish traders, the quantities transported was positively correlated with the percentages of the average quantities lost. This meant that dried fish being brittle, were easily broken into pieces during its package and transportation especially when in larger quantities which resulted into higher percentages of losses. This was also noted in the markets where the dry fish wholesale traders reported higher losses than the retail traders who transported their fish load in smaller quantities and well packed in order to minimize losses.

CAMP (2013) also observed that the availability of ice is very important for maintaining the quality of fresh fish and the dry smoked fish, when leaving Terekeka are of good quality but during transportation and storage suffers from breakages and beetle infestation which reduces both its aesthetic and nutritional values. In regard to reducing FPHL, Krain and Otieno (2009) who worked in Juba fish markets earlier noted that, the fisheries sector had opportunities for development which included improved production systems; increased investment in processing, value addition and distribution systems and expanded market access in local and regional markets.

**Consumer preferences of various fish genera**

All fish species whether fresh or dried are sold in the markets, according to their availability during different periods of the year. Some species become abundant at certain periods and then disappear as regulated by its breeding, feeding and migration behaviours. Based on the preference by customers, which was revealed by the fish traders, the following common fish genera found in the local markets were categorized as follows:

First class: include *Bagrus, Cintharinus, Gymnarchus, Lates, Labeo, Synodontis, Tilapia, Oreochromis, Distichodus.*

Second class: include: *Clarias, Alestes, Heterotus, Heterobranchus, Schilbe, Hydrocynus, Mormyrus, Malapterurus.*

Third class include: *Polypterus, Protopterus, Tetraodon*

Fish in the main markets of Juba have prices that differ from one market to the other and are sold in heaps of twos, threes or fours depending on their sizes and for bigger specimens like *Lates niloticus,* are usually cut into pieces and sold separately. Though fish should be sold in kilograms but generally most fish traders prefer to negotiate the prices with their customers for the sale to be completed. The prices generally are dependent on fish availability, type, sizes and condition of the fish.

The result of this study showed that the methods used by the fish traders in terms of transportation, preservation and storage is inadequate and inefficient in the main markets of Juba which was indicated in the high PHFL for both fresh and dry fish traders. The losses led the traders to sell their products at lower prices thereby affecting their incomes and slowing progress in their business. The study also noted that the traders do not have the financial capabilities to initiate better methods and equipment for reducing the PHFL. As such it is recommended that the fish traders need to be trained and supported in terms of means of transportation, preservation and storage of fish so that customers are able to get high quality fish in the markets. Such support and trainings can be from Non-Governmental Organizations and Government authorities.

Therefore better fish transportation, preservation and storage methods and facilities are required in order to reduce the high PHFL thereby increasing the traders' income, improve the food security base of their families and the consumers in the country.

## ACKNOWLEDGEMENTS

My sincere thanks and gratitude goes to all the data collectors who participated in this study in the main markets of Juba.

## REFERENCES

**Abelti, A. L**. (2016). Postharvest and nutritional loss assessment of fish at different handling stage from Genale River, South Eastern Oromia. *International Journal of Fisheries and Aquatic Studies.***4 (6)**: 263-266.

**Adelaja, O. A., Kamaruddin, R. B. and Chiat, L.W**. (2017). Ensuring food security by reduction of post –harvest fish losses in small scale fisheries, Nigeria. *International Journal of Environmental and Agricultural Research.* **3**(12). Open Access.

**Akande, G. and Diei-Ouadi, Y. (2010).** Post-harvest losses in small-scale fisheries. Case studies in five sub-Saharan African countries. *FAO Fisheries and Aquaculture Technical Paper No.* **550**. Rome.

**CAMP, (2013).** Comprehensive Agricultural Master Plan. Ministry of Agriculture, Animal Resources, Fisheries, Tourism, Cooperation and Rural Development. Ministry of Water Resources, dams and Electricity. Funded by JICA. Republic of South Sudan.

**Getu, A., Misganaw, K. and Bazezew, M. (2015).** Post-harvesting and major related problems of fish production. Review Article. Vol.**6**: Issue 4. Open Access.

**Krain, E. and Otieno, S. (2009).** Consultancy report on value chain development for the Fisheries Production and Marketing Project (FPMP), Sudan productive Capacity Recovery Programme (SPCRP). GIZ / IS – EU Funded. Juba.

**Kumolu-Johnson, C. A. and Ndimele, C. A**. **(2011).** A review of Post-harvest losses in Artisanal fisheries of some African countries. *Journal of Fisheries and Aquatic Science*. **6**(4): 365-378.

**Mungule, C. M**. **(2011).** Economic assessment for fresh fish in Juba/ Central Equatoria State. Sudan productive Capacity Recovery Programme (SPCRP), Fisheries Production and Marketing Project (FPMP). Consultancy report. GIZ / IS – EU Funded, Juba.

**Selvam, S.G. (2017).** Empirical Research: A study guide. Paulines Publications Africa. Nairobi, Kenya.

**Tesfay, S. and Teferi, M. (2017).** Assessment of fish post-harvest loss in Tekeze dam and lake Hashenge fisheries associations, Northern Ethiopia. *Agriculture and Food Security,* **6:**4.

**Ward, A. and Signa, D**. **(2017).** Reducing post-harvest fish losses for improved food security. Smart Fiche 17. FAO, .Smart fish programme.