



## **KENYA MARINE AND FISHERIES RESEARCH INSTITUTE**

### **FRESH WATER SYSTEMS**

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**Conduct post-harvest losses assessment of one major commercial fish in Lake Turkana, prepare a technical report and share the findings to inform management**

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### **TECHNICAL REPORT**

**KMF/GOK/2021/C8213(3)**

**May 2021**

## DOCUMENT CERTIFICATION

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### Certification by Director FWS

I hereby certify that this report has been done under my supervision and submitted to the Director.

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**Signature:** 

**Date:** 17<sup>th</sup> May 2021

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**Cover photo:**

Tilapia fish hanged on ropes to drain awaiting deep frying process at Naparipari Kalokol ward

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## **ACKNOWLEDGEMENT**

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## **EXECUTIVE SUMMARY**

One of the development goals of fisheries sector is to curb post-harvest losses, since it leads to loss of income and valuable protein (FAO 2011). Lake Turkana fishery has been associated with heavy fish losses arising from use of traditional and rudimentary fish handling material and equipment. Recent report (KMFRI technical report, 2017) estimated fish losses arising from physical, quantity, quality and of market forces at over 35% and above mainly attributed to poor fish handling during and after catch. A number of fish handling equipment mainly solar dryers and smoking Kilns have been introduced by KMFRI and other stakeholders in various landing sites to mitigate the fish losses. As these technologies are being introduced, the need to assess the fish losses to understand the status after the introduction of the technologies along the Lake was necessary. It was in this context that this assessment was undertaken with emphasis on Tilapia value chain. Tilapia is one of the five important fish among the 23 species considered as commercial fishes in Lake Turkana (Hopson *et al*, 1982). Tilapia (genus of cichlid fishes) is found in fresh water habitats. Lake Turkana has recorded 60 species of fish species so far of which Tilapia forms one of them (Froese and Pauly, 2013) .The fish is landed in most of the landing sites and commands good Market appeal. During loss assessment of this key commercial fish, Questionnaire loss assessment (QLAM) method was used in the data collection with the same being administered on the fishermen, BMU officials and other stakeholders to estimate the losses along the seven selected BMUs in Lake Turkana. BMU records were also used as source of information. Stakeholders such as village administrators were also incorporated as key informants for the study. After the analysis of the data, the results showed that the youth were the majority amongst the fishermen. Gillnet was the most dominant fishing gear for the entire area of assessment with traditional fish handling being practiced dominantly. No preservation of fish was being practiced with many fishermen and processors practicing sun drying and salting as the main processing method. The fish are dried on the ground with some placing the fish on palm tree leaves with very little care of the hygiene and hence potentially compromising the fish quality. Most fishermen target Tilapia due to market demand. However, due to poor handling especially at the production value chain node, the losses are still highly experienced. Post-harvest losses along value chain of Tilapia was estimated at 34% with production node alone contributing about 18% of the total losses reported. These values are high hence the need for quick intervention. Introduction of cold chain preservation methods during catch and use of raised racks, dryers and smoking kilns would be

appropriate if these losses were to be reduced. As a first measure, it would be appropriate to ensure that every landing beach construct raised racks appropriate for the fish landed in their area. On the other hand it would be important to reduce the time between setting gill nets and collection of catches to reduce the losses during catch. Public-private-partnership in upscaling the improved fish handling equipment and capacity building is therefore encouraged as the Lake is vast and hence appreciable resources are required to ensure significant reduction in postharvest losses.

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## 1.0 INTRODUCTION

Post-harvest fish losses (PHL) are defined as a reduction in quantity, quality or monetary value of fish in the supply/value chain. Lake Turkana fishery has been associated with heavy fish losses arising from use of traditional and rudimentary fish handling material and equipment. These losses threaten food security and contribute to increased poverty levels of the Lake region. Recent report (KMFRI technical report, 2017) estimated fish losses arising from physical, quantity, quality and of market forces at over 35% and above mainly attributed to poor fish handling during and after catch. One of the development goals of fisheries sector is to curb these losses, since it leads to loss of income and valuable protein (FAO 2011). A number of fish handling equipment mainly solar dryers and smoking Kilns have been introduced by KMFRI and other stakeholders in various landing sites to mitigate the fish losses. As these technologies are being introduced, the need to assess the fish losses to understand the status after the introduction of the technologies along the Lake was therefore necessary. It is in this line that we undertook a post-harvest loss assessment on one of the commercial fish in Lake Turkana to understand the current status for purposes of informing the management. On the other hand, Lake Turkana has been reported to be a home of at least 60 fish species (Froese and Pauly 2013) of which 12 are endemic. However Hopson A.J. (1982) identified 48 ichthyofauna species in the Lake as opposed to 60. The commercial fishery however is based on 23 species out of which five contribute to over 80% of the annual total landings. The five species with a large market appeal and currently support the commercial fishery are; *Oreochromis niloticus* (L.), *Labeo horie* (Heckel), *Lates niloticus* (Linn.), *Alestes baremose* (Boul.), and *Distichodus niloticus* (L.). These species are widely distributed within the lake (Froese and Pauly 2013). *Oreochromis niloticus* (genus-Cichlid) general known as Tilapia was identified as one major commercial fish in this assessment for consideration. Having large market appeal, it is one of the most landed fish by the fishermen in Lake Turkana. The fish is mainly caught by gillnetting with some few fishers using beach seine to harvest the same though in isolated cases. After the catch, fish is mainly preserved by slitting the body open, salting and then sun drying in the open sun. Most of the cases the fish are sun sundried on the ground or places on dry doom palm leaves (Figure 1).



*Figure 1: Tilapia Sun drying on mat and on palm tree leaves at Longech landing site L. Turkana*



*Figure 2: Fish placed on racks awaiting sales (left) Tilapia hanged on ropes to drain for deep frying and /smoking (right)*

Few fishermen do have drying racks where dried fish are placed awaiting collection by traders (Figure 2). Those who opt to deep fry or smoke the fish do hang them on ropes to draining. Taking in consideration that there are no cold preservation (ice) nor cooler boxes for fishermen to utilize, fish spoilage do occur. These post-harvest activities associated with poor handling results into fish losses therefore forms also the basis of this assessment.

**1.1 General Objective**

The main objective of undertaking the study was to assess the post-harvest losses of one of the commercial fish along Lake Turkana in order to determine the losses for effective management.

## **1.2 Specific objectives**

- i. To determine the characteristics of the fisher along Lake Turkana
- ii. To quantify the fish landings and handling along Lake Turkana with major emphasis on Tilapia
- iii. To quantify the post-harvest intervention status along the Lake
- iv. To estimate the losses of major commercial fishes with emphasis on Tilapia

## **2.0 MATERIALS AND METHODS**

### **2.1 Study Area**

Lake Turkana, is lying within the Great Rift Valley Northern Kenya. The Lake is 250 km long, having an elevation of 360 m above sea level and a maximum depth of 120 m. It has a surface area of 7,500 km<sup>2</sup> making it the largest Lake in Kenya. The study area is situated 04° 15.504 N, 035° 55.705 E and 03° 15.104 N, 036° 54.440 E. Fishery is the major activity for those inhabiting the shore of this Lake. One of the commercial fish that was identified for the purpose of this study was Tilapia. Due to vast area of the Lake, the Lake zone ward, Kalokol and Kangatotha ward were identified as the sampling areas with Kalokol being the main tilapia landing zone while Lake Zone and Kangatotha partly contributing to Tilapia fish landings. This study area covered Seven BMUs (Nariokotome, Nachukwi, Kangaki, Narengewoi Lomekwi Kataboi) in the Lake zone ward, Nariemet in Kalokol ward, Eliye in Kangatotha ward and Kerio BMU in Kerio ward respectively. Nariemet draws most of its fish from the gulf and has good fish landing compared to the other landing sites under this consideration. The gulf is protected from the main Lake wind turbulence creating a good habitat for fish especially Tilapia hence high fishing activity in the area.

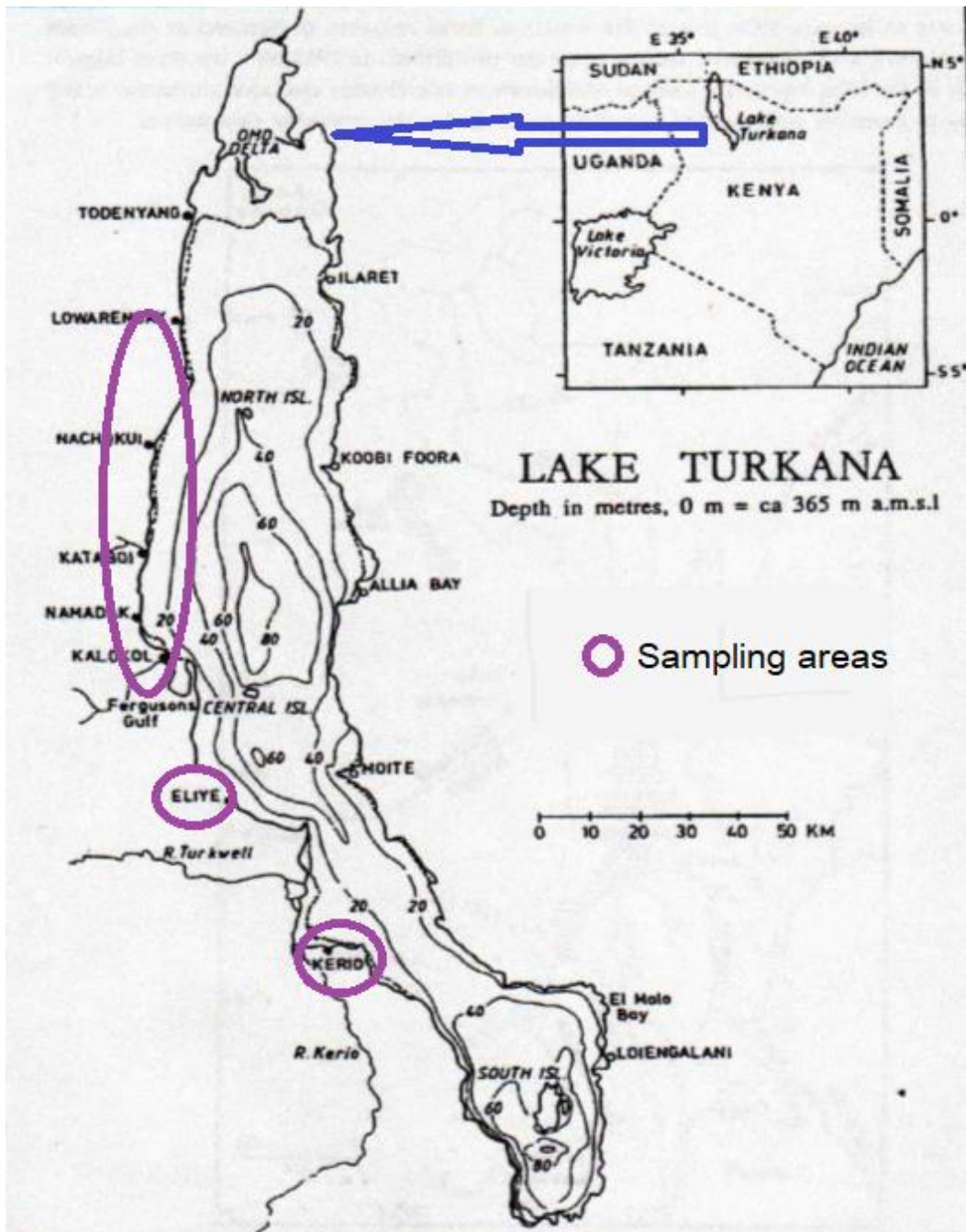


Figure 3: Map of Lake Turkana showing sampling areas

## 2.2 Data Collection and Analyses

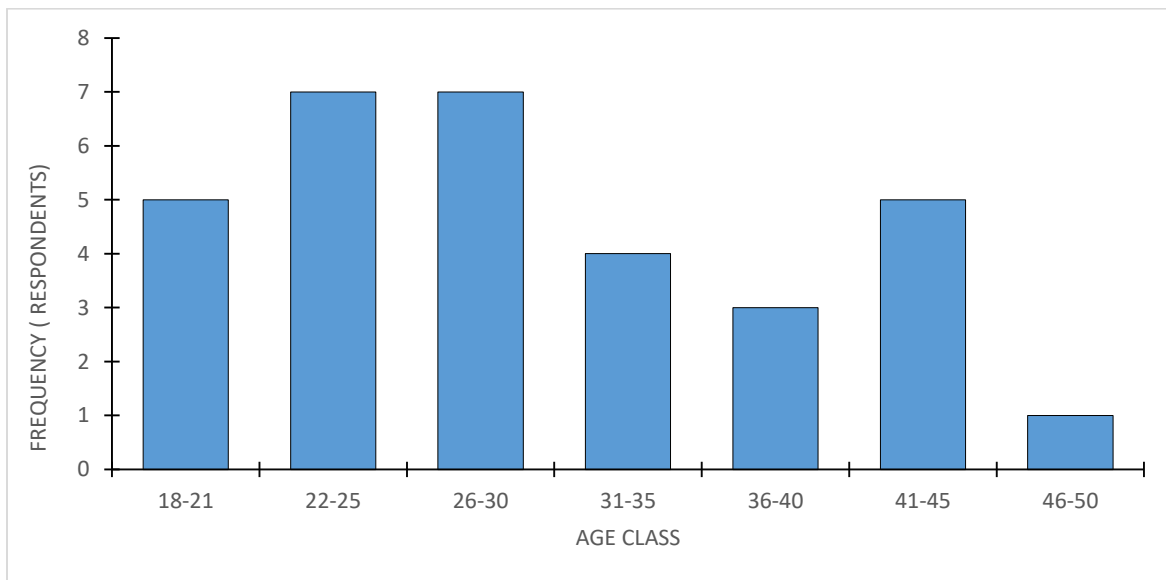
The Post-harvest loss assessment were undertaken using structured questionnaires. Questionnaire loss assessment method (QLAM) was used in data collection. Administration of questionnaires was conducted amongst the fishermen fish handlers, processors, traders, transporters and retailers who happen to be members of the respective BMUs. Secondary data from BMU office records were also captured during the assessment. Individual BMU members and

BMU officials amongst other stakeholders were identified and targeted for interviews. With prior arrangements, KMFRI staff and some locals were trained on the administration of questionnaires and the same used as interviewers in the field. The field work covered several BMUs (Nariokotome, Kangaki Nachukwi, Lomekwi, Kataboi Narengewoi, Nariemet, Eliye and Kerio) along the Lake. Those targeted in the data collection included the fishermen, processors, transporters and store owners. Other targeted group were the BMU officials for purposes secondary data as well as well as key informants. The data collected were input in Excel for further analysis. Graphs, pie charts and tables were used in the presentation of the results

### 3.0 RESULTS AND DISCUSSION

#### 3.1 Characteristic of the fishers in Lake Turkana

The results (Figure 3) reflects the active age group in fishing activities. The dominant age group was the youth group (between 22- 30 years) with the highest frequency of occurrence. The fishing activity was therefore seen to attract the most active members providing the very important income and labor to the youth.



*Figure 4: Age class frequency of respondents from the selected BMUs along Lake Turkana*

In all the Landing site targeted (Table 1), fishing takes place on a daily basis with most of the fishers setting off for the activity at about 4.00 pm daily while the landing done at between 7 am and 9.00 am in the morning of the following day. This period of about 14 hours could be a

contributing factor to fish spoilage during catch. Almost every fishermen in the targeted areas use gillnets with very few cases using hook and line. Although some few cases of beach seining and purse seine was observed in Longech area and Kerio respectively, most of the fishers use gillnet in the area under study. Most of the fishers target three major fish species mainly the Tilapia, Alestes and Labeo. However, Tilapia was seen to be a dominant targets in the areas studied. This could be attributed to market demand for the three fish species. Gillnet fishing which is also the dominant fishing methods in this area also favor the catch of these fishes.

*Table 1: Fishing activities in the selected areas along Lake Turkana*

BMU	Frequency of fishing	Type of gear	Target fish	Remarks
Narengewoi	Daily	Gillnet	Alestes	
Nariokotome	Daily	Gillnet	Juse Tilapia	A few use hook and line
Nachukwi	Daily	Gillnet	Alestes, Tilapia	
Lomekwi	Daily	Gillnet	Alestes Tilapia	
Kangaki	Daily	Gillnet	Alestes	
Kataboi	Daily	Gillnet	Labeo Tilapia	
Nariemet	Daily	Gillnet	Tilapia	Use of beach seine observed
Eliye	Daily	Gillnet	Tilapia	
Kerio	Daily	Gillnet	Tilapia&Labeo	Purse seine use is also reported

### **Fishing boats**

Nachukwi BMU leads in the number of fishing boats amongst the BMUs visited (Figure 5). However this values did not include the traditional crafts used by some fishermen in the areas under consideration. Most boats which were dominated by wooden boat type use paddles/sail for propulsion. This limits their use during strong wind forcing the fishermen to wait for the wind to subside before venturing in back to the lake to collect their catch. The delay in catch collection due to strong wind barrier causes spoilage at the catch. It was reported that those who use purse



seine do not incur any fish loss during catch. This could be due to short fishing period associated with this fishing method

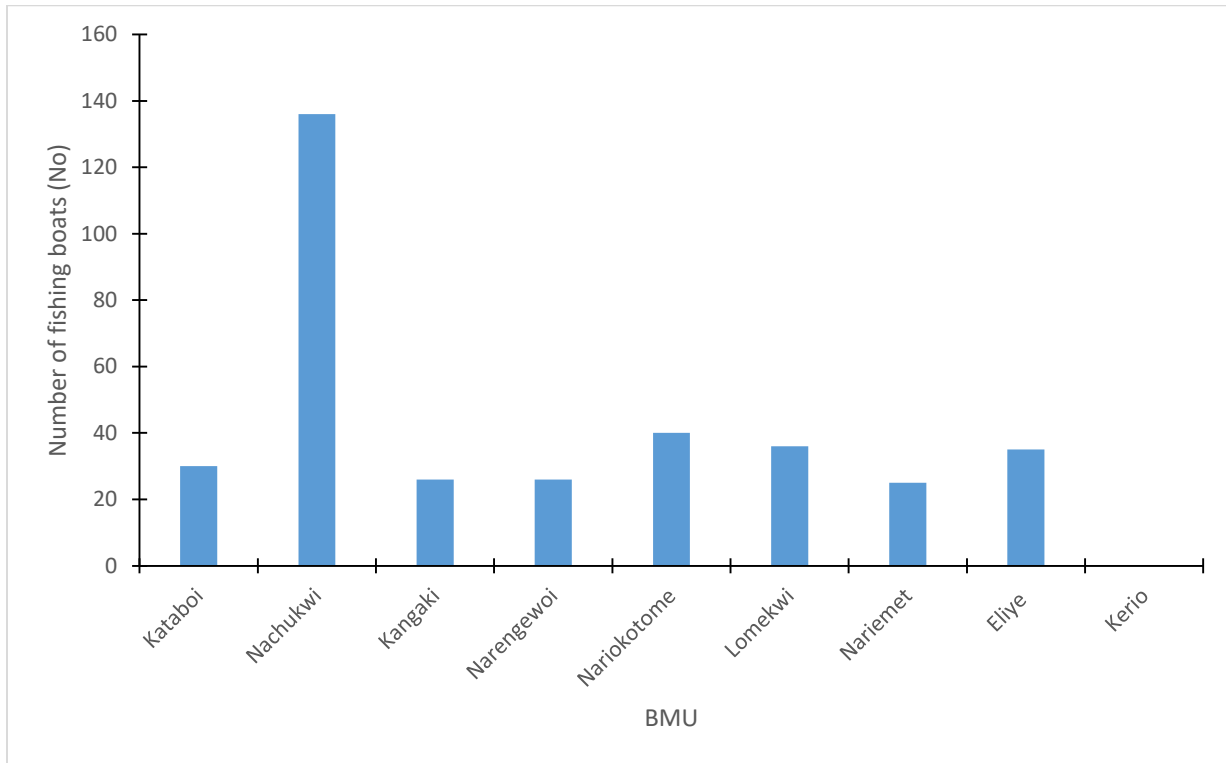


Figure 5: Number of fishing boats in the respective BMUs along Lake Turkana

### 3.2 Fish landing and handling in Lake Turkana

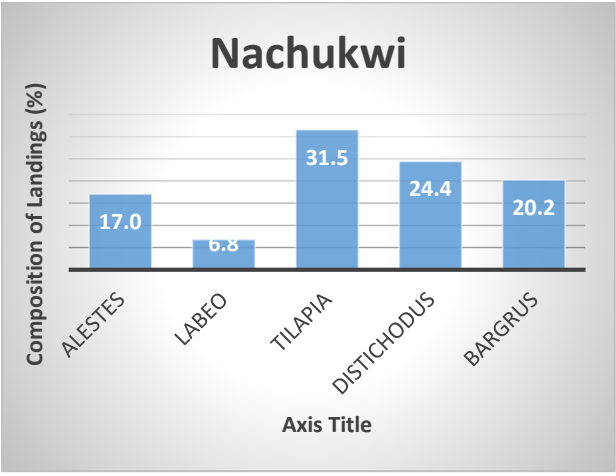
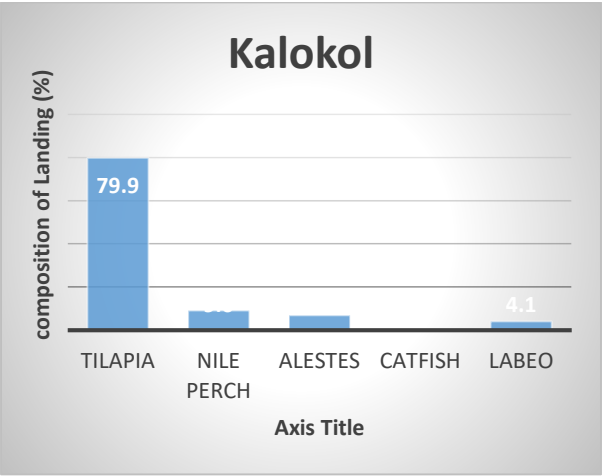
High annual fish landing were recorded in Nariemet BMU (Table 2) in contrast to the number of boats which were highest in Nachukwi (Figure 5) suggesting that the landing do not correspond to the number of boats directly. Lomekwi BMU was second followed by Nachukwi BMU in that order. The three BMUs form 97% of the landings recorded in the areas under study. On the other hand, Nariemet was the most dominant BMU in fish landings amongst the BMUs that were studied (91.9%). Eliye and Kerio BMUs were not capture in the landing records due to lack of the statistical landing records.

Table 2: Landings in respective BMUs along Lake Turkana

Name of BMU	Annual Landings (MT)	Landing Contribution (%)
Kataboi	14.4	0.2

Nachukwi	153.2	2.2
Kangaki	50.7	0.7
Narengewoi	89.4	1.3
Nariokotome	52.4	0.8
Lomekwi	202.3	2.9
Nariemet	6,378.2	91.9
<b>Total</b>	<b>6,957.1</b>	<b>100.0</b>

Four of the nine BMUs had records of fish landed to species level (ie Nachkwi, Narengewoi, Lomekwi and Kalokol). Results (Figure 6), showed that Tilapia dominated the catch except for Narengewoi where Tilapia was not dominant and hence considered amongst other fish in the records. Kalokol, Nachukwi and Lomekwi recorded high Tilapia landings compared to other catches. However, Nariemet had the best Tilapia landing of the three BMUs.



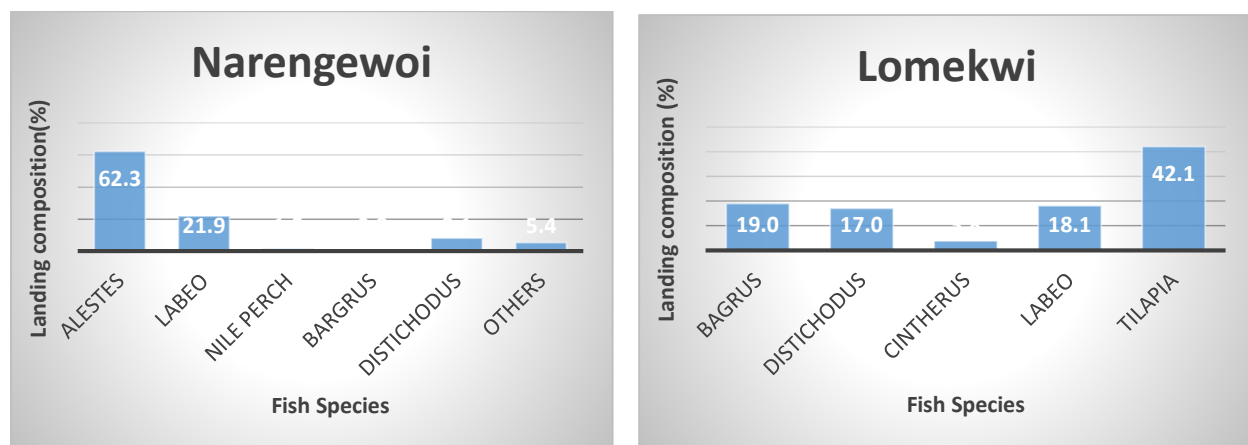


Figure 6: Annual fish landings of key commercial species in different BMUs along Lake Turkana  
 Apart from Tilapia landings, Narengewoi exhibited higher landings of Alestes species amongst the five species recorded. Other wise, Tilapia Alestes, Labeo Distichodus Bargrus and Nile perch remains the major commercial fishes along selected areas of this study.

### 3.3 Post harvest interventions

A number of solar dryers has been installed in various landing sites with the aim of reducing post harvest fish loss. However traditional methods of drying fish still seem to dominate the processing stage of fish handling.

Table 3: Post harvest handling and interventions in place

BMU name	Preservation methods	Solar dryers	Smoking Kilns	Processors	Traders	Stores
Kataboi	Sundrying, salting & deep frying	6	0	8	10	1
Nachukwi	sundrying	6	0	10	10	20
Kangaki	sundrying/salting	20	0	3	6	26
Narengewoi	sun drying, salting	10	0	56	0	6
Nariokotome	Sundrying /powder	11	0	8	10	7
Lomekwi	Sundrying/salting	1	0	6	4	4
Nariemet	sundrying, deep frying freezing	0	0	60	60	2
Eliye	Sundrying, salting & deep frying	0	0	20	20	1
Kerio	Sundrying, salting & deep frying	0	0	50	20	3
<b>Total</b>		<b>54</b>	<b>0</b>	<b>221</b>	<b>140</b>	<b>70</b>

The results (Table 3) showed that majority of the fishers use sundrying/salting as their preference method. Sun drying involves splitting the fish open, sprinkling it with salt and spreading the same in the sun to dry. In other cases where the market demands, the salting is left out otherwise the fish is just split open and sundried. The drying is mainly done at the beaches either on the ground or on doom palm leaves. However this practice has been seen to reduce fish quality since it does not consider the unhygienic conditions of the beaches as well as physical contaminants like sand and solid wastes in the landing areas. Of the the nine BMUs, only Nariemet, Kataboi Eliye and Kerio reported deep frying as a processing/ preservation method for commercial purposes. Observations done during this assessment showed that other fishers in the seven areas studied do deep frying but mainly for home consumption other than commercial. It was realized that most fishers do sun drying/salting mainly as a traditional method. Of the 9 BMUs, only Nariemet had freezers for cold storage.

### **Drying facilities**

Use of improved methods of drying has been reported to improve fish quality and enhance drying of fish (Oduor-Odote *et al.* 2008). This includes use of raised drying racks, solar dryers and smoking kilns for areas that lack electricity. There were about 54 solar dryers distributed amongst the 9 BMUs assessed. Kangaki had the highest number of solar dryers followed by Narikotome and Narengewoi being third respectively. These numbers however are still low compared to landings considering the fact that there were 221 processors against 54 solar dryers in the area under consideration of which majority of the processors undertake sun drying as the preferred method. Smoking of fish in the areas under consideration showed that the practice was still not appreciated in the areas under consideration. However in Kalokol ward, two were already put in place but not under the management of Nariemet BMU. Results (Table 3) showed no existence of smoking kilns amongst the nine BMUs assessed. This was because some of the BMUs considered under this assessment did not include those that had benefitted in the eight smoking kiln KMFRI had installed in the area. The areas that already have smoking Kilns includes, Namakoo (Longech), Kalokol market, Napeget, Kalimapus, Lobolo, Emnyen, Nateria and Napucho. Although smoking is not embraced so much in these areas under study, introduction of the same for fish processing is essential, especially areas with high tilapia fish production, followed by sensitization and capacity building. This would improve the quality of fish products and boost the smoked fish availability in the market.

## **Fish Grading**

Grading of fish is done according to where the fish are landed and species. Alestes are graded into two; Big and small. The grading is done mainly for pricing purpose, otherwise quality of fish is not a consideration in this case. Tilapia on the other hand is graded in to three or five categories mainly; Big, Medium and Small or Big, Medium, Small, Very small and Very-very small. For Tilapia, small, very small and very-very small normally have market in Congo.

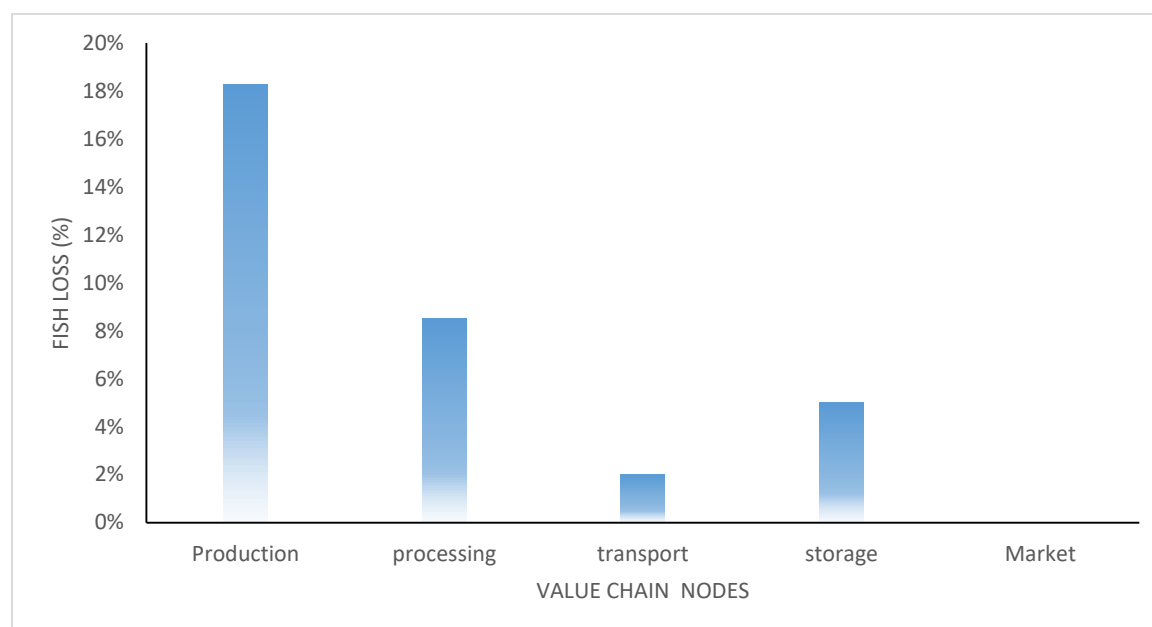
## **Traders**

About 140 traders were found to undertake fish trading as their occupation. However, it was also found that most of these traders double as processors and traders as well. Some traders are also agents buying fish from fishermen and sells as wholesalers to other traders. Kangaki BMU were seen to have the majority of the store in the seven BMUs assessed. This was so because majority of the store were owned by individual fishermen mainly for their catch. This scenario is also replicated in Nachukwi. Otherwise stores owned by the BMUs owned were one each, apart from Nariemet which has two.

## **Marketing**

Busia is the main Market for the sundried fish. However, Kitale and Kisumu also enjoy this products to a significant level. A few traders target local small Markets like Lodwar, Kaloboyei, Kakuma and even Eldoret. Otherwise majority of fresh fish market for Tilapia remains Lodwar and Kalokol due to lack of cold chain facilities. The fresh fish are deep fried in Kalokol and Lodwar (Natogo Fish market) and then transported to Kitale and Busia markets among others. Natogo Market receives about 1700 MT to 3000 MT of fresh Tilapia annually. However, lack of cold chain facilities limits the sale of the fresh fish of which could fetch more income if the same could be made to reach far off markets like Kitale and Busia in their fresh state. Other challenges that were cited in Natogo fish Market include few toilets (only two available) and Freezers.

### 3.4 Post-harvest losses estimates



*Figure 7: Tilapia post-harvest losses along the value chain nodes*

From the respondent responses, major loss of tilapia occur at production, followed by processing and storage. Transport on the other hand contribute minimally. Most Tilapia fish are processed in nearby areas. Mostly, the deep fried and smoked are processed in Kalokol or Lodwar (Natogo fish Market). This distance has favored the low losses experienced during transport. However, the high losses in the production category could be attributed to delay in catch collection, lack of preservation method and fishing method employed. Gutting at the landing sites also cause delay hence the high spoilage at processing stage. Dry fish being stored are normally attacked by insects especially in stores where bulk storage of dried fish are done. Total fish landed was about 7,000 metric tons of which Tilapia constituted about 83% (5870 MT) of the same All these areas of high losses need intervention if the losses are to be reduced. The loss at production of about 18% was considered high taking in consideration that the total annual Tilapia production of over 5850 metric tons were recorded in the seven BMUs assessed. This loss translates to about 1056 metric tons on production alone. Considering all the supply chain nodes, an estimated Tilapia loss of about 2000 (34%) metric tons in the area under consideration could be lost. These losses do not include Market losses during sales in far off Markets such as Kitale and Busia as we could not explore this areas effectively during this study. Market like Kitale Busia are far off and expected to contribute to this loss considering the distance.

## **4.0 CONCLUSION AND RECOMMENDATIONS**

### **4.1 Conclusion**

Considering the results that were observed in this study, it was concluded that;

- Tilapia fish is a key commercial fish in Lake Turkana targeted by majority of the fishermen and also has wide market appeal.
- Finally infrastructure for handling fish are still insignificant in numbers to effectively reduce post harvest losses
- Tilapia post-harvest losses still remain high at 34% overall due to lack of fish handling infrastructure
- Traditional sun drying is the most widely used method in fish processing in Lake Turkana

### **4.2 Recommendations**

It was therefore recommended that ;

- Capacity building need to be upscaled to enable the community embrace good fish handling practices
- Gillnet need to be set for an optimal period to avoid fish spoilage during catch
- Introduction of transport boat that help in transporting fish to landing beaches in time need to be encouraged
- Use of raised racks need to be made mandatory as a first measure to improve fish quality and reduce post harvest losses
- Investment on cold chain facilities, Dryers and smoking Kiln need to be upscaled through public –private partnership
- Further assessment for the remaining areas of the Lake need to be undertaken to give a holistic picture on the losses incurred.

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**Proposed Budget to conduct post-harvest loss assessment – Lake Turkana**

**1. Staff allowances**

S/No	Name	Designation	Responsibility	Rate/day	No of days	Amount
1	John Malala	Research	Head of the activity	8400	2	16,800.00
2	Maurice Obiero	Research Scientist	Questionnaire administration	7000	2	14,000.00
3	James Last Keyombe	Research Scientist	Questionnaire administration	7000	2	14,000.00
4	Casianes Olilo	Research Scientist	Questionnaire administration	7000	2	14000.00
5	Chadwick Bironga	Research Scientist	Questionnaire administration	7000	2	14,000.00
6	Mathew Moruesse	Lab Technician	Questionnaire administration	4200	2	8,400.00
7	Vitalis Omire	Media Technician	Questionnaire administration	4200	2	8,400.00
8	Abraham Onchari	Driver	Questionnaire administration	4200	2	8,400.00
	<b>Total</b>					<b>98,000.00</b>

**2. Field Requirements**

S/No	Item	Unit	Qty req.	Price/unit	Amount
1	Fuel (Vehicle)	Itr	70	115	8,050.00
2	Stationeries	No.	1	1000	1,000.00
	Sanitizers	No.	10	100	1,100.00
	Face Mask	Box	1	1000	1,000.00
	Liquid Detergent	No.	3	250	750.00
3	Print Cartridges	No	4	1500	6,000.00
4	Community participation	4 members	4	4000	4,000.00
	Security	Days	4	1500	6,000.00
	Water	Bales	4	400	1,600.00
	<b>Total</b>				<b>29,500.00</b>
	<b>Grand Total</b>				<b>127,500.00</b>

**QUESTIONNAIRE**  
**POST-HARVEST LOSSES ASSESSMENT OF ONE MAJOR COMMERCIAL FISH IN**  
**LAKE TURKANA**

This interview is being conducted by Kenya Marine & Fisheries Research Institute (KMFRRI) to assess post-harvest losses in various locations/fish value chain nodes to establish post-harvest status along Lake Turkana with specific emphasis to Tilapia

All information given will be treated with utmost confidentiality and strictly used for the purpose of this study. Your cooperation in this study is therefore highly appreciated. Thank you in advance for agreeing to this interview.

<b>Questionnaire No.:</b>	
<b>Interview Date:</b>	
<b>Enumerator's Name:</b>	
<b>Respondent's Name:</b>	
<b>Respondents Age (Yrs.)</b>	
<b>Respondent's Gender</b>	
<b>Sub-County:</b>	
<b>Location:</b>	
<b>Name of landing beach</b>	
<b>Name of BMU:</b>	

**PART A: (To be filled by fishers)**

- 1) When was the last time before today you went fishing-----
- 2) What type of gear/vessel do you use? Gear \_\_\_\_\_ vessel \_\_\_\_\_
- 3) Type of fish targeted \_\_\_\_\_
- 4) Quantity of targeted fish averagely landed per day? (Start with Tilapia)

Spp	Unit (Kg)	Units (Pieces)
1. Tilapia		
2.		
3.		
4.		
5.		
6.		

- 5) (a) Do you throw away any fish due to spoilage? 1= [Yes] 2= [No]
- (b) If yes, how many/what (Targeted fish)
  - [i] Units/Pieces All types \_\_\_\_\_ Tilapia \_\_\_\_\_
  - [ii] Reason \_\_\_\_\_

**Fill the table**

Fish species	Qty-Kg	Qty-Pieces	Reasons for throwing	Nature of spoilt fish
Tilapia				

6) How often do you throw away fish during your fishing trip? 1=Never 2=Once  
3=Twice 4=More than twice

7) What quantity is lost during offloading at the landing site from boat to Banda  
[Unit-Kg] \_\_\_\_\_ (Number /Pieces) \_\_\_\_\_

Spp	Unit (Kg)	Unit (Pieces)	Reasons for loss
Tilapia			
Others			

[Reason for loss]

[1]=Falls into water [2] =Squashed in the boat [3] =Stolen [4] =given to BMU/gift

8) Do you do fish Grading? 1. Yes 2. No

9) If Yes, What are the grade types of fish landed at this beach: [1] Grade A [2] Grade B [3] Grade C [4] Any other (Specify)

10). What is the quantity of each grade landed

Grade A  
Fish type \_\_\_\_\_ Kgs \_\_\_\_\_ Price \_\_\_\_\_  
Grade B  
Fish type \_\_\_\_\_ Kgs \_\_\_\_\_ Price \_\_\_\_\_  
Grad C -----Kgs  
Fish type \_\_\_\_\_ Kgs \_\_\_\_\_ Price \_\_\_\_\_

For those who recorded fish losses only

11) In your opinion what is the best way to ensure no fish loss? \_\_\_\_\_

12) If any, have you tried any? 1. Yes 2. No

13) What is the best way to address the same? \_\_\_\_\_

**PART B. (To be filled by processors)**

Name: \_\_\_\_\_

Gender: \_\_\_\_\_

Age: \_\_\_\_\_

Location: \_\_\_\_\_

Phone no. \_\_\_\_\_

14). What quantity of fish do you purchase/receive per day for processing

Spp	Unit (Kg)	Units (Pieces)
Tilapia		
Others		

15) Do you process all the fish received/ purchased 1.Yes 2.No

16). a) Do you lose any fish in between purchase and processing time? 1. Yes 2. No.

b) If Yes, what quantity (approx.)

Spp	Unit (Kg)	Unit (Pieces)	Reasons for loss
Tilapia			
Others			

(Specify reason) \_\_\_\_\_

[1]=Falls into dust [2]=squashed in the vehicle [3]=Stolen [4]=given to BMU/gift [5] Other

17) Do you grade fish after processing 1. Yes 2. No

18) If Yes how do you grade them? \_\_\_\_\_

Attach each grade and their price per Kg /pieces

Grade quality \_\_\_\_\_ Ksh. \_\_\_\_\_ Kg/piece  
Grade quality \_\_\_\_\_ Ksh \_\_\_\_\_ Kg/Piece  
Grade quality \_\_\_\_\_ Ksh \_\_\_\_\_ Kg/Piece

19) What challenges do you experience as a processor? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**PART C. (To be filled by transporter)**

Name: \_\_\_\_\_

Gender: \_\_\_\_\_

Age: \_\_\_\_\_

**Location:** \_\_\_\_\_  
**Phone no.** \_\_\_\_\_

20) What type of transport do you use? 1. Motor bike 2. Pick up 3. Lorry  
4. Others (Specify) \_\_\_\_\_

21) Do you use any form of preservation? 1. Yes 2. No

22). What quantity of fish do you transport at a time from the fishers/trader

Spp	Unit (Kg)	Units (Pieces)

23) How many times do you collect fish to the market/agent  
1. Daily 2. Weekly 3. monthly 4 Others (specify) \_\_\_\_\_

24) How long do you take to reach your destination?  
1. Less than a day 2. A day 3 Two Days 4 More than two days

25). What quantity of fish is lost during transportation from Banda to factory/market

Spp	Unit (Kg)	Unit (Pieces)	Reasons for loss
Tilapia			

(Specify reason) \_\_\_\_\_

26) Do you pay for any loss incurred? 1. No 2. Yes

If yes, what is the average quantity lost Kg \_\_\_\_\_ Pieces

27) Which challenges do you have as a transporter \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**PART D. (To be filled by traders/agents)**

**Name:** \_\_\_\_\_  
**Gender:** \_\_\_\_\_  
**Age:** \_\_\_\_\_  
**Location:** \_\_\_\_\_

Phone no. \_\_\_\_\_

28). What quantity of fish do you purchase/receive per day?

Spp	Unit (Kg)	Units (Pieces)
Tilapia		
Others		

29) a) Do you store your fish before selling? 1. Yes 2. No

b) If yes, how long do you take to sell all your fish? 1. One day 2. Less than 3 days  
3. Less than one week 4. More than one week

30). a) Do you lose any fish before the period stated above? 1. Yes 2. No.

b) If Yes, what quantity (approx.)

Spp	Unit (Kg)	Unit (Pieces)	Reasons for loss
Tilapia			

(Specify reason) \_\_\_\_\_

31) Do you grade them before sale? 1. Yes 2. No

32) If yes, how do you grade them? \_\_\_\_\_

Attach each grade and their price per Kg /pieces

Grade quality \_\_\_\_\_ Ksh. \_\_\_\_\_ Kg/piece  
Grade quality \_\_\_\_\_ Ksh \_\_\_\_\_ Kg/Piece  
Grade quality \_\_\_\_\_ Ksh \_\_\_\_\_ Kg/Piece

Indicate the percentages given above in terms of total fish received or purchased

Grade \_\_\_\_\_ % Grade \_\_\_\_\_ % Grade \_\_\_\_\_ %  
Grade \_\_\_\_\_ %

33) Which markets do you sell your fish ( specify Tilapia)?

\_\_\_\_\_  
\_\_\_\_\_

34) a) Do your customers complain of fish losses (either in quality or quantity)? 1. Yes 2.No

b) If Yes, state the complain \_\_\_\_\_  
 \_\_\_\_\_

35) In your opinion, what do you think should be done to address the problem?

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

36) What challenges do you experience? \_\_\_\_\_

\_\_\_\_\_

---

**Statistical information from Key Informants**

The key informant (mostly BMU official) be asked for the following parameters in respective BMUs. The data should be( if possible) the most recent (2019). Where this is not possible then 2018 would be appropriate

			Comments
1	Name of interviewee		
2	Name of BMU		
3	No of fishers	Male:                      Female:	
4	Total fish landings /year		Indicate year
5	Total Tilapia landings		
6	No of fishing boats		
7	No of transport boats		
8	Types of fish processing		
9	Types of fish preservation used		
10	No of solar dryers		
11	No of smoking Kilns		
12	No of processors		
13	No of traders		
14	No of stores		
15	No of transporters		

Any other relevant information \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



*Appendix 3: Forwarding letter by station coordinator to director fresh water systems*

**KENYA MARINE AND FISHERIES RESEARCH INSTITUTE**

**TURKANA STATION**

TEL: +254 710 487 520

FAX:

E-mail: kmfriturkana@yahoo.com

**When replying please quote**

**Ref: no.  
and date**

If calling or telephoning ask for

**Please address your reply to  
STATION COORDINATOR**



**P.O. Box 205**

**LODWAR 30500**

KMF/TUR/CON/AD/44/

14<sup>TH</sup> MAY 2021

The Director General,  
KMFRI,  
P.O. Box 81651,  
**MOMBASA.**

THROUGH  
The Director (Fresh Water Systems),  
KMFRI,  
P.O. Box 1881-40100,  
**KISUMU.**

**RE: SUBMISSSION OF 2020/2021 REPORT ON PERFORMANCE CONTRACT  
TARGET NO. C13 (II) FOR LAKE TURKANA**

Sir, please find attached progress report on the implementation of above referred target category on Improvement and Transfer Innovative Technologies Developed to Reduce Fish Postharvest Losses titled: **“Conduct post-harvest losses assessment of one major commercial fish in Lakes Victoria and Turkana, prepare a technical report and share the findings to inform management”** for your information and further attention.

Thank you

A handwritten signature in blue ink, appearing to read "J. Malala", is written over a faint circular stamp.


**John Malala  
Station Co-ordinator  
KMFRI – TURKANA.**

Appendix 4: Forwarding letter by Director Fresh water systems to the Director General

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**KENYA MARINE AND FISHERIES RESEARCH INSTITUTE**

TELEPHONE: KISUMU 254770567443  
E - mail: [kmfkisumucentre@yahoo.com](mailto:kmfkisumucentre@yahoo.com)  
When replying please quote  
Ref. No. KMF/RS/2020-21/ C13.ii  
If calling or telephoning ask  
For: Dr. Aura  
Please address your reply to  
DIRECTOR GENERAL



KISUMU CENTRE  
P.O. BOX 1881  
KISUMU  
KENYA  
DATE: 17/05/2021

**The Director General**  
Kenya Marine and Fisheries Research Institute  
Headquarter and Mombasa Centre  
P.O. Box 81651 080100  
**MOMBASA**

**RE: SUBMISSION OF TECHNICAL REPORT FOR PC PERIOD 2020-21**


The above refers,

KMFRI Freshwater systems (FWS) have successfully implemented the 2020-2021 PC on "the post-harvest losses assessment of one major commercial fish in Lakes Victoria and Turkana".

Herein attached is the technical report and fact sheet, which highlights activities involved.

We therefore submit this report and fact sheet for your perusal and dissemination to the relevant stakeholders. Your support is highly appreciated.

Thank you.

  
Dr. Christopher M. Aura (PhD)  
**Ag. Director - FWS**

*Dr. Director FWS  
Disseminate  
as appropriate  
20/5/2021*



## **KENYA MARINE AND FISHERIES RESEARCH INSTITUTE**

### **FRESH WATER SYSTEMS**

*Conduct post-harvest losses assessment of one major commercial fish in Lake Turkana, prepare a technical report and share the findings to inform management*



Tilapia fish is a key commercial fish in Lake Turkana. However, high post-harvest losses remain one of the challenges experienced in this fishery



#### **AUTHORS**

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## Background information

- The commercial fishery in Lake Turkana is based on 23 species out of which five contribute to over 80% of the annual total landings. The five species with a large market appeal and currently support the commercial fishery are; *Oreochromis niloticus* (L.), *Labeo horie* (Heckel), *Lates niloticus* (Linn.), *Alestes baremose* (Boul.), and *Distichodus niloticus* (L.). These species are widely distributed within the lake (Froese and Pauly 2013). *Oreochromis niloticus* (genus-Cichlid) generally known as Tilapia was identified as one major commercial fish for purposes of post-harvest assessment.
- Lake Turkana fishery has been associated with heavy fish losses arising from use of traditional and rudimentary fish handling material and equipment. Traditional methods of fish handling still remains a dominant practice here with sun drying being majorly done on the ground.
- Earlier reports indicated that Lake Turkana experience fish post-harvest losses of about 35% and above (KMFRI Technical report 2017). Tilapia being a major commercial fish in this Lake is potential victim of these losses. Some improved fish drying structures had been introduced like solar dryers and a few smoking kilns to mitigate these losses though they were limited in number.
- . This inadequate number of improved fish handling equipment coupled with limited capacity building on good fish handling practices and hygiene contributes to these high post-harvest losses



**Figure 1: Tilapia Fish being sun dried on mats (left), palm tree leaves (middle) others tied on ropes to drain awaiting deep frying/smoking (right) in Lake Turkana**

- These losses are a threat to food security and contributes to increased poverty levels of the fishers and the Country for that matter.
- This study was therefore conducted to assess the post-harvest levels of one major commercial fish with a focus on Tilapia fishery. Specifically, it was to determine the characteristics of the fisher, quantify the fish landings, including post-harvest

interventions in place and to estimate the post-harvest losses of Tilapia as one of the major commercial fish in Lake Turkana.

- The assessment covered 9 BMUs from the Lake Zone, Kalokol, Kangatotha and Kerio wards namely Nariokotome, Narengewoi, Nachukwi, Lomekwi, Kangaki, Kataboi, Nariemet, Eliye and Kerio. Questionnaire Loss assessment Method (QLAM) was used for purpose of data collection. Fishermen, BMU officials, traders, processor and transporters were interviewed at various levels to provide information during this study. BMU records were also used as sources of information. Market information was mainly from Natogo Fish Market in Lodwar. Interviews were conducted in cooperation of some locals together with KMFRI staff for ease of data collection. The data collected were analyzed and the information presented in graphs, tables and charts.

### **Results**

- Results arising from the assessment indicated that fishing activities were attracting the youth and that it is no longer a preserve of the old. Something that should be embraced taking in consideration that youth are active and can readily adopt new methods.
- Fishing was found to be a daily activity with most fishermen using gillnetting as the most preferred one. Majority of fishermen target Tilapia, Alestes and Labeo spp. as their priority. This is specifically due to their appeal in the market coupled by the fishing method used by the fishers.

*Table 1: Fishing activities in the selected areas along Lake Turkana*

BMU	Frequency of fishing	Type of gear	Target fish	Remarks
Narengewoi	Daily	Gillnet	Alestes	
Nariokotome	Daily	Gillnet	Alestes, Tilapia	A few use hook and line
Nachukwi	Daily	Gillnet	Alestes, Tilapia	
Lomekwi	Daily	Gillnet	Alestes Tilapia	
Kangaki	Daily	Gillnet	Alestes	
Kataboi	Daily	Gillnet	Labeo Tilapia	
Nariemet	Daily	Gillnet	Tilapia	Use of beach seine observed
Eliye	Daily	Gillnet	Tilapia	
Kerio	Daily	Gillnet	Tilapia, Labeo	Purse seine practiced

- Tilapia was found to be a dominant target by majority of the BMUs assessed.
- However, fish handling methods were not seen to be improving as most of the fishers and processors were still practicing the traditional methods of gutting and sun drying fish on the ground. High annual fish landing were recorded in Nariemet BMU (Table 2) in contrast to the number of boats they possess. High number of boats were recorded in Nachukwi BMU. The landings therefore did not depend on the number of boats possessed. Lomekwi BMU had the second landing records followed by Nachukwi being third in number. The three BMUs in actual fact landed 97% of the total landings recorded in the BMUs under study. Meanwhile, Nariemet was the most dominant BMU in fish landings amongst the seven out of nine BMUs that were studied (91.9%).

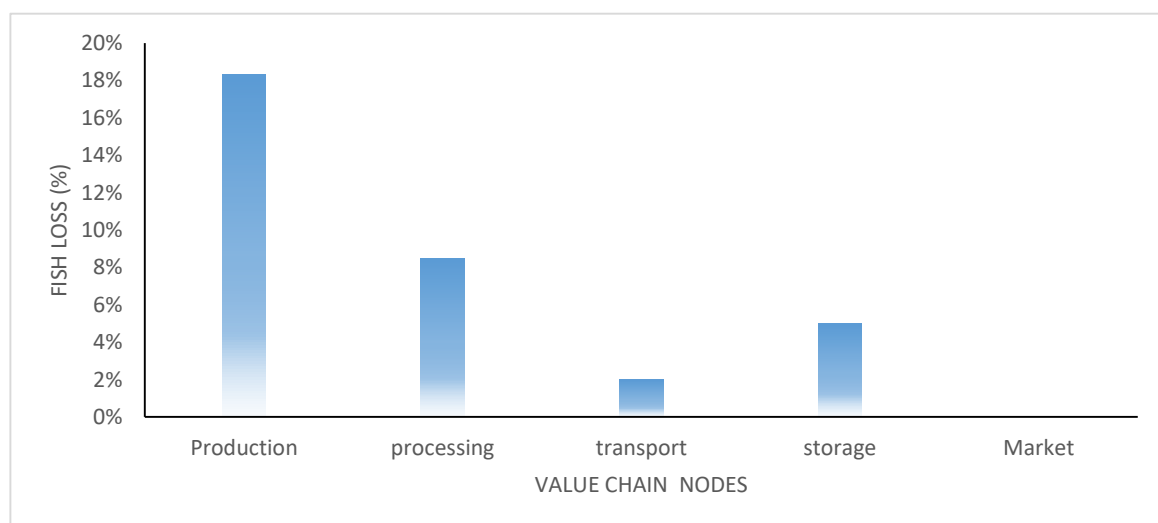
### ***Species Landings***

- Of these catches Tilapia dominated the Catch with Nariemet producing about 80% of Tilapia dominated annual catch out of the five key commercial fishes landed by fishermen. Lomekwi followed by 42% Tilapia dominated catch while Nachukwi had about 32% Tilapia dominated catch. Narengewoi however did not record Tilapia but group the same under others as the Tilapia catch was insignificant. Nariokotome, Kangaki and Kataboi only recorded annual landings, while Elgey and Kerio BMUs had no landing records.

### ***Post-harvest handling***

- There were 54 solar dryers in the 9 BMUs assessed with no smoking kiln recorded. This was because the BMUs assessed were not amongst the BMUs who benefited from the 8 smoking kilns installed along the Lake. The Number of Processors, Trades, and stores were 221,140 and 70 in number respectively.

### ***Tilapia post-harvest losses along the Value Chain nodes***



*Figure 2: Post harvest losses of Tilapia at different value chain nodes*

- It was established that major loss of tilapia occur at production, followed by processing and storage. Transport on the other hand contribute minimally. Loss at the market was insignificant because most say that they do reject spoilt fish and hence the loss is on transporter or owner of the fish. Transport node was minimal since fresh tilapia are sold in the nearby local markets. However, the high losses in the production category was attributed to delay in catch collection, lack of preservation method and fishing method (gear) employed. Gutting at the landing sites also cause delay hence the high spoilage at processing stage. Dry fish being stored are normally attacked by insects especially in stores where bulk storage of dried fish are done. With a total fish landings of about 7,000 MT, Tilapia constitutes about 5870 MT. The loss at production was about 18%. Considering all the supply chain nodes, a total loss of about 34% was estimated. This percentage loss (34%) translates to about 2000 MT of Tilapia in the study area alone. These high losses have significant impact on the fishers' income hence concerted effort for intervention is required.

### ***Conclusion***

- ❖ Tilapia fish is a key commercial fish in Lake Turkana targeted by majority of the fishermen and also has wide market appeal.
- ❖ Infrastructures for handling fish are still insignificant in numbers to effectively reduce post-harvest losses
- ❖ Post-harvest losses still remain high (34%) with Sun drying being the most widely used method in fish processing in Lake Turkana

### ***Recommendations***

- ❖ Capacity building need to be up scaled for the community to embrace good fish handling practices including eradication of insecticide powder (Dudu dust)
- ❖ Gillnet need to be set for an optimal period to avoid fish spoilage during catch
- ❖ Introduction of transport boat that help in transporting fish to landing beaches in time need to be encouraged
- ❖ Use of raised racks need to be emphasized as a first measure to improve fish quality and reduce post-harvest losses
- ❖ Investment on cold chain facilities, Dryers, and smoking Kiln need to be up scaled through public private partnership
- ❖ Further assessment need to be undertaken to estimate post-harvest losses of the whole Lake.

**KENYA MARINE AND FISHERIES RESEARCH INSTITUTE**

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and date:  
If calling or telephoning ask  
For:  
Please address your reply to:  
The DIRECTOR



**HEADQUARTERS**  
**P.O. Box 81651**  
**MOMBASA**  
**KENYA**

**KMF/RS/2021/ B2. (i)**

**Date: 22<sup>nd</sup> May 2021**

**To: County Director of Fisheries**  
**Turkana County**

**Dear Sir/Madam,**

**RE: SHARING 2020-21 FY FACT SHEET/BRIEF**

Kenya Marine and Fisheries Research Institute (KMFRI) is a state corporate body, established in 1979 under the Science and Technology Act (Cap 250), which has since been repealed by the Science, Technology and Innovation Act No. 28 of 2013. KMFRI is under the Ministry of Agriculture Livestock and Fisheries. The institute is mandated to carry out research in marine and freshwater fisheries, aquatic biology, aquaculture, environmental chemistry, ecological, geological and hydrological studies, socio-economics as well as chemical and physical oceanography.

In this regard, KMFRI conducted a number of research expeditions in 2020-2021 financial year on *“Conduct post-harvest losses assessment of one major commercial fish in Lake Turkana, prepare a technical report and share the findings to inform management”* and came up with technical report and Fact sheet/brief.

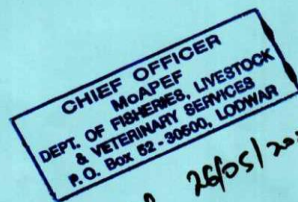
The purpose of this letter is to share the findings in a summarised fact sheet/brief as information for possible management and conservation measures of the aforementioned systems.

Attached herewith please find the technical reports and Fact sheet/brief for your perusal and further action.

Yours Sincerely,

Dr. Christopher M. Aura (PhD)

**For: Director/CEO, KMFRI**



Received 26/05/2021  
Afusif



KENYA MARINE AND FISHERIES RESEARCH INSTITUTE



LAKE TURKANA STATION  
P.O. BOX 205-30500  
LODWAR

DIRECTOR OF FISHERIES  
TURKANA COUNTY GOVERNMENT  
31 MAY 2021  
MINISTRY OF LIVELIHOODS, EMPLOYMENT & FISHERIES  
P.O. Box 52-30500, LODWAR

MEETING: Dissemination of Post target C.I.S.I.D. Conduct Post Harvest Loss assessment  
DATE: 26<sup>th</sup> May 2021  
VENUE: Fisheries office Turkana County

	NAME	ORGANIZATION	DESIGNATION	PHONE NUMBER	SIGNATURE
1.	<u>Abdullahi Yusse Ahmed</u>	<u>TGG member co. Rus</u>	<u>CO-OPS</u>	<u>072-226720</u>	<u>[Signature]</u>
2.	<u>ESTER KIMUT EVERLINE</u>	<u>FISHERIES DEPARTMENT</u>	<u>INTERAN</u>	<u>0702184307</u>	<u>[Signature]</u>
3.	<u>CHADWICK BIEOTGA</u>	<u>KMFRI</u>	<u>A.R.S</u>	<u>0700086192</u>	<u>[Signature]</u>
4.	<u>MAURICE O. ENJERO</u>	<u>KMFRI</u>	<u>RS</u>	<u>0719577205</u>	<u>[Signature]</u>
5.	<u>Purity Mera</u>	<u>TGG Fisheries</u>	<u>FO</u>	<u>0713191415</u>	<u>[Signature]</u>
6.	<u>Gasignes O. Ollho</u>	<u>KMFRI</u>	<u>RS</u>	<u>0721413208</u>	<u>[Signature]</u>
7.	<u>James Last Keyowase</u>	<u>KMFRI</u>	<u>RS II</u>	<u>0723303373</u>	<u>[Signature]</u>
8.	<u>John O. MARECA</u>	<u>KMFRI</u>	<u>SRS</u>	<u>0710487520</u>	<u>[Signature]</u>
9.	<u>NANWATA DAVID</u>	<u>TGG FISHERIES</u>	<u>DDDF</u>	<u>0716686351</u>	<u>[Signature]</u>
10.					
11.					

## KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

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Ref: no:  
and date:  
If calling or telephoning ask  
For:  
Please address your reply to:  
The DIRECTOR



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MOMBASA  
KENYA

Received  
ASSISTANT DIRECTOR OF FISHERIES  
TURKANA REGIONAL OFFICE  
P.O. BOX 4771 BOBWADIT

KMF/RS/2021/ B2. (i)

Date: 22<sup>nd</sup> May, 2021

To: Kenya Fisheries Service (KeFS)

Dear Sir/Madam,

**RE: SHARING 2020-21 FY FACT SHEET/BRIEF**

Kenya Marine and Fisheries Research Institute (KMFRI) is a state corporate body, established in 1979 under the Science and Technology Act (Cap 250), which has since been repealed by the Science, Technology and Innovation Act No. 28 of 2013. KMFRI is under the Ministry of Agriculture Livestock and Fisheries. The institute is mandated to carry out research in marine and freshwater fisheries, aquatic biology, aquaculture, environmental chemistry, ecological, geological and hydrological studies, socio-economics as well as chemical and physical oceanography.

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The purpose of this letter is to share the findings in a summarised fact sheet/brief as information for possible management and conservation measures of the aforementioned systems.

Attached herewith please find the technical reports and Fact sheet/brief for your perusal and further action.

Yours Sincerely,

Dr. Christopher M. Aura (PhD)

**For: Director/CEO, KMFRI**

KENYA MARINE AND FISHERIES RESEARCH INSTITUTE



LAKE TURKANA STATION  
P.O. BOX 205-30500  
LODWAR

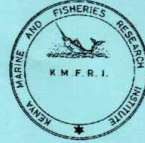
ASSISTANT DIRECTOR OF FISHERIES  
TURKANA REGIONAL OFFICE  
P.O. BOX 47 LODWAR

MEETING: Dissemination of PC target C13ii Fact sheet on Post harvest assmt  
 DATE: 31/05/2021  
 VENUE: Kenya Fisheries Office Lodwar - Turkana

	NAME	ORGANIZATION	DESIGNATION	PHONE NUMBER	SIGNATURE
1.	JOSEPH WASATI	Kenya Fisheries Service	PCO	0721356590	<i>[Signature]</i>
2.	MURICE O. OBIERO	KMFR I	AS II	0719577205	<i>[Signature]</i>
3.	CHADWICK BIRONGA	KMFR I	ARS	0700086192	<i>[Signature]</i>
4.	JOHN MACAEA	KMFR I	SRS	0710483520	<i>[Signature]</i>
5.	James East Kagamba	KMFR I	AS II	0723303372	<i>[Signature]</i>
6.	Casians D. Dileo	KMFR I	AS I	0721413728	<i>[Signature]</i>
7.					
8.					
9.					
10.					
11.					

**KENYA MARINE AND FISHERIES RESEARCH INSTITUTE**

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When replying please quote  
Ref: no:  
and date:  
If calling or telephoning ask  
For:  
Please address your reply to:  
The DIRECTOR



**HEADQUARTERS**  
P.O. Box 81651  
MOMBASA  
KENYA

**KMF/RS/2021/ B2. (i)**

**Date: 22<sup>nd</sup> May, 2021**

**To: Beach Management Unit (BMU) Chairman  
Lake Turkana Region**

**Dear Sir/Madam,**

**RE: SHARING 2020-21 FY FACT SHEET/BRIEF**

Kenya Marine and Fisheries Research Institute (KMFRI) is a state corporate body, established in 1979 under the Science and Technology Act (Cap 250), which has since been repealed by the Science, Technology and Innovation Act No. 28 of 2013. KMFRI is under the Ministry of Agriculture Livestock and Fisheries. The institute is mandated to carry out research in marine and freshwater fisheries, aquatic biology, aquaculture, environmental chemistry, ecological, geological and hydrological studies, socio-economics as well as chemical and physical oceanography.

In this regard, KMFRI conducted a number of research expeditions in 2020-2021 financial year on *“Conduct post-harvest losses assessment of one major commercial fish in Lake Turkana, prepare a technical report and share the findings to inform management”* and came up with technical report and Fact sheet/brief.

The purpose of this letter is to share the findings in a summarised fact sheet/brief as information for possible management and conservation measures of the aforementioned systems.

Attached herewith please find the technical reports and Fact sheet/brief for your perusal and further action.

Yours Sincerely,

Dr. Christopher M. Aura (PhD)

**For: Director/CEO, KMFRI**



KENYA MARINE AND FISHERIES RESEARCH INSTITUTE



LAKE TURKANA STATION

P.O. BOX 205-30500

LODWAR



MEETING: Sensitization of BMU in Lake Turkana on Post Harvest Losses for Small

DATE: 28/05/2021

VENUE: Impressa beach

	NAME	ORGANIZATION	DESIGNATION	PHONE NUMBER	SIGNATURE
1.	JOHN O. MACARA	KMFR1	SRS	0710487520	<i>[Signature]</i>
2.	James Loist Kiyembe	KAFRI	RSII	0723303373	<i>[Signature]</i>
3.	Maurice O. Obiero	KMFR1	RESEARCH STAFF	0719377205	<i>[Signature]</i>
4.	Stephen Okel Okuon	Bmu's Network Turkana	Chairman	0713358561	<i>[Signature]</i>
5.	John Regge	Impressa Bmu member	Member	071358561	<i>[Signature]</i>
6.	Benson Okuon	Impressa Bmu	Member	0745506149	<i>[Signature]</i>
7.	CASIMUS O. OILIO	KMFR1	RSI	0721413728	<i>[Signature]</i>
8.	Clairine Biranga	KMFR1	ARS	0700086192	<i>[Signature]</i>
9.					
10.					
11.					