KENYA MARINE AND FISHERIES RESEARCH INSTITUTE

FRESHWATER SYSTEMS

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A TECHNICAL REPORT ON CATCH ASSESSMENT SURVEY (CAS) FOR LAKE NAIVASHA TO INFORM MANAGEMENT



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1. Introduction

Monitoring the exploitation of fish stocks and fishing efforts are important attributes to achieving sustainable management of many fishery resources. Despite significant contribution of fisheries to livelihoods, employment, and income, many of the global fish stocks have been declining drastically. Overfishing has been identified as a major global threat to most fish stocks and with adverse consequences on biodiversity, ecosystem functioning, food security and the livelihood of people dependent on the resources (Russo et al., 2020). To ensure a sustainable fishery key management advice for the fish stocks on major water bodies anywhere is generated from fisheries monitoring studies including fishery independent gillnet, trawl and acoustic surveys, and the fishery dependent frame and catch assessment surveys (CASs). Important information on fishing activities and their impacts on a resource is determined using catch data as a fishery-dependent variable (Dennis et al., 2015). However, catch data in most fisheries are often under-reported and/or inconsistently collected. Catch assessment surveys (CAS) are aimed at bridging the data gaps and providing important fisheries indicators that help in developing management policies for small-scale fisheries (Temple et al., 2019). Catch Assessment Surveys (CASs) aim at the harvest sector to generate information relating to both fish catches and fishing effort. The information generated delivers indicators to support decision-making in the context of policy and development planning and management plan evaluation.

Lake Naivasha is one of the most important fishing areas in Kenya, after Lake Victoria and Lake Turkana in that order. Its fishery plays an important role in the Kenyan economy by providing food and nutritional security, generating employment and income. In the last 10 years, Lake Naivasha's fishery output has increased from approximately 680 tons in 2008 to 3400 tons in 2019 (Njiru et al., 2017; Nyamweya et al., 2021). The current management concerns are about the state of fish stocks in Lake Naivasha in view of the existing fishing pressure, changing environmental and climatic conditions. These stocks need to be reviewed by examining their trends in biomass, total catches, and catch per unit effort (CPUE) to inform management for sustainable exploitation of the fishery. Changes in the fish supply chain around Lake Naivasha are not well documented, and very little is known about the value of fish and market variations at the landing beaches. The present study seeks to determine the size and distribution of fishing localities, fishers, fishing crafts and fishing gears and assess the catch composition, species abundance, distribution, diversity and the current fish yields. The study will also look at the fish prices landed at the landing beaches and compare prices for major species caught by fishers at different landing beaches in Lake Naivasha. Throughout data collection

vital information about small-scale, or artisanal, fisheries which might not usually be readily available in official records will be acquired from the memory of resource users, which is gaining more attention in fisheries research (Johannes et al. 2000).

The overall objective of this study was to conduct CAS and compare it with CAS conducted previously on the fishery resource of Lake Naivasha

The specific objectives were:

i. To describe the demographic structure of fishers in Lake Naivasha
ii. To assess species composition from the fish landings
iii. To determine the daily fishing effort and estimate catch per unit effort (CPUE)
iv. To determine the size structure of the fish species landed

2. Methodology

The CAS was conducted in the five landing beaches along the shores of Lake Naivasha, namely, Central, Karagita, Kamere, Tarambeta and Oloidien (Figure 1). Data were collected from each fishing vessel landed using structural questionnaires and interviews with some randomly selected fishers for the CAS survey. Total count and recording of all the fishing boats, fishers, and fishing equipment operating on the boat were made. During the catch assessment, fishers' catches at all landing sites were assessed and whenever a fisherman landed with a canoe, the fish caught were identified using an identification manual and sorted according to species and the gear type used. They were counted, and their weights were taken using a weighing balance, which was recorded on the datasheet.

Data collection forms were designed, harmonized, enumerators trained, and supervised to ensure effective data capture. The following information on the fishery was recorded: fishing area, fishing time, type of fishing vessel, gear used, and number of crew, including demographic information. Total weight per species per boat and morphometric measurements for fish landed were taken, i.e., total length (cm), body depth (cm), and total individual weight (g).

Data was compiled, disaggregated by landing beaches, and subjected to various statistical methods using MS Excel for analysis. Fish catches per boat were sorted out according to species and total weight recorded to the nearest 0.1g

for each species, as well as total price per boat. Catch per unit effort (CPUE) was determined using the following formula:

CPUE = Catch/Effort

Catch = Total weight in Kilograms (kg) of all fish species landed that day

Effort = Total number of boats landed that day

3. Key Results

Demographic information of the fishermen

Fishing has become an important occupation to many fishers in Lake Naivasha. Results of the CAS indicated that Lake Naivasha fishery continues is dominated by youth between the ages 18 -35 years, contributing to over 61% (Table 1).

Table 1: Percentage Age of respondents

Age group (yrs)	%
18-25	11.8
26-35	40.3
36-45	33.9
46-55	10.8
>56	3.2
n= 186	100.0

The study found that the number of fishers with less than 10 years of fishing experience in the industry was about 75% implying that there is a high number of new entrants in the fisheries sector (Table 2). This high number of new entrants could be attributed to the profitable nature of the business, and therefore attracting many new players. It

could also be a result of the increase in landing beaches around the lake, creating more opportunities for employment and other auxiliary activities.

Table 2. Years of experience of fishers in Lake Naivasha

Experience (yrs)	%
0-5	47.85
6-10	27.96
11-20	18.28
>20	5.91
n = 186	100

Mode of fishing

The most common fishing vessels in Lake Naivasha were the sesse canoes made of wood or fibre. The boats were either propelled by paddles or motors. The majority of the fishing boats were using outboard engines as a mode of propulsion and gillnets were frequently used as fishing gear (Table 3). Overall, motorized boats comprised over 85% of all the fishing vessels in Lake Naivasha.

Table 3. Number and mode of propulsion of fishing vessels at various landing sites

	2021		2022		2024		This study	
Landing beach	Motor	Paddle	Motor	Paddle	Motor	Paddle	Motor	Paddle
Central	35	3	25	5	25	3	25	2
Kamere	50	0	74	2	30	0	72	1
Karagita	60	0	48	0	31	0	33	0
Tarambete	30	1	37	6	28	1	29	9
Oloidien	10	16	6	18	3	18	1	14
Total	185	20	190	31	117	22	160	26

Although previous studies had also shown an increasing trend of motorized boats being used by fishers in the lake (Muchiri & Hickely, 1991; Morara et al., 2021), there is a remarkable decrease in the number of motorized boats during this study. An increase in motorized boats in the past years might have led to overfishing with serious implications for the fishery of Lake Naivasha. This decrease in motorized boats can also be attributed to the high cost of fuel in recent years.

Catch, Effort, and CPUE

During this study, the total catch of fish landed at all five landing beaches around Lake Naivasha was 3784 kg. Kamere beach recorded the highest catch (1306 kg), followed by Tarambete (1241 kg), while Oloidien beach had the least recorded catches (295kg). The catch per unit effort (CPUE) did not vary much among the 4 landing beaches, i.e. Central, Kamere, Karagita, and Oloidien recording (Table 4). However, Tarambete recorded the highest CPUE of 27.9 kg/boat/day. The mean CPUE (20.6 ±9.6) for this study was lower compared to the years 2021, 2022 and 2025 which were (30.1 ±16.7), (23.7±7.6) and 28.1±14.8 respectively. This decrease in CPUE might be a result of an increase in fishing effort and declining stocks.

Table 4. Total catch, effort, and CPUE of Lake Naivasha fishery

Landing Beach	Total Catch (Kg)	Effort (No. of boats)	CPUE (Kg/boat/day)
Central	490.23	27	18.16
Karagita	633.5	33	19.2
Tarambete	1058.95	38	27.87
Oloidien	295.1	15	19.7

Fish catch composition

Total landings were dominated by three species, namely C. *carpio*, *O. niloticus,* and *C. gariepinus,* during the CAS survey. Nile tilapia dominated the catch (79 %) followed by Common carp (12%) and Catfish 9% (Figure 3).

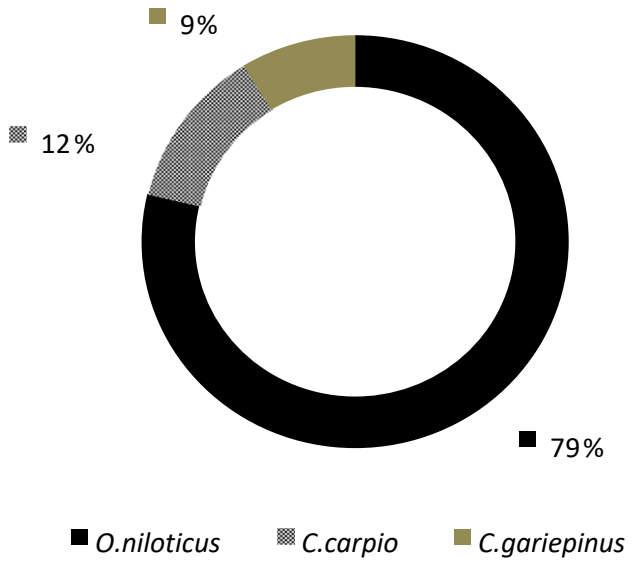


Figure 2. Percentage fish catch composition in Lake Naivasha

Other fin fish species (*O. leucostictus, C. zilli, M. salmoides*), which previously dominated in the landings, were not found during this survey. The crustacean species (*P. clarkii*) was also not found. The study confirmed that the fish catch composition of Lake Naivasha has considerably changed over the years. The three commercially important species reported previously (*O. leucostictus, C. zilli, M. salmoides*) contribute dismally to the total landings in Lake Naivasha. This situation can be attributed to factors such as fish species introductions, the effect of overfishing, and changes in the habitat condition within the lake (Njiru et al., 2017; Waithaka et al., 2019; Morara et al., 2022).

Size structure of various fish species

The size range mode and mean of the three major species is shown in Table 5. Also, the size structures (length frequencies) of the three fish species recorded during the survey are shown in figures (3 – 5).

Table 5. The size range mode and mean of the three major species found during the CAS of 2025

	2021			2022			2025		
Species	Range	Mode	Mean	Range	Mode	Mean	Range	Mode	Mean
O. niloticus	16.5-66	24	25.6±5.8	15-49	22	23.1±2.7	10-35.5	19	20.5±2.3
C. carpio	18.1-77.5	49	45.8±8.9	20-84	30	36.8±10.1	16.9-73.9	27	31.8±8.5
C. gariepinus	27.2-106	41	48.5±10.2	29.5-94	44	47.4±9.9	12.0-98	40	41.2±10.4

The mean lengths of fish landed at the five landing beaches, reduced in size compared to the previous CAS conducted in 2021 and 2022. The mean size of Nile tilapia dropped from 25.6 cm in 2021 to 23.1 cm to 20.5 in 2022 and 2025 respectively. Common carp dropped from 45.8 cm to 36.8 cm to 31.8 cm in 2025. Lastly, catfish mean lengths decreased from 48.5 cm to 47.4 cm to 41.2 cm total length. In summary, there was a large proportion of small undersized fish in the total landings. The predominance of small sized fish species with little economic importance over large-sized fish species with high economic importance suggests a likelihood of overexploitation in the lake. The deterioration of fish sizes could also be attributed to laxity by law enforcement agencies manning the lake.

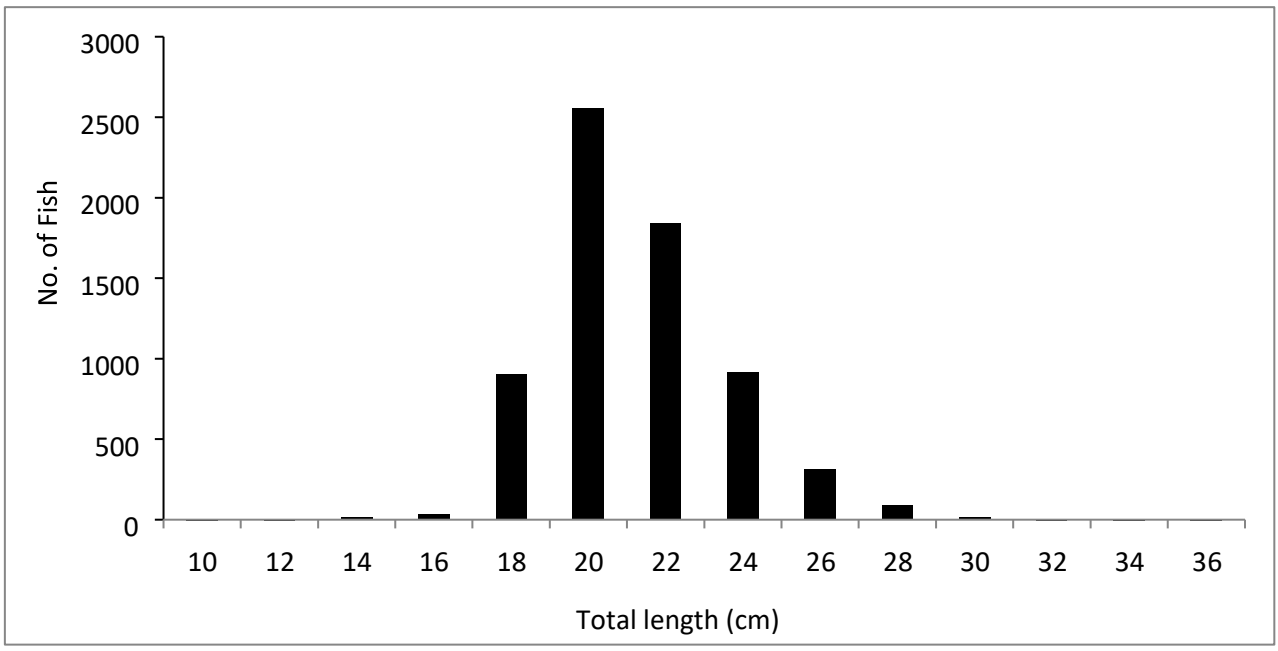


Figure 3. Size structure of *O. niloticus* (n = 6699)

Mean length *O. niloticus* was 20 cm. This implies that fishermen were using nets of 2 inch mesh size therefore most of the Nile tilapia landed were undersize given that they mature at 22 cm. Also there seems to be some laxity by law enforcement agencies.

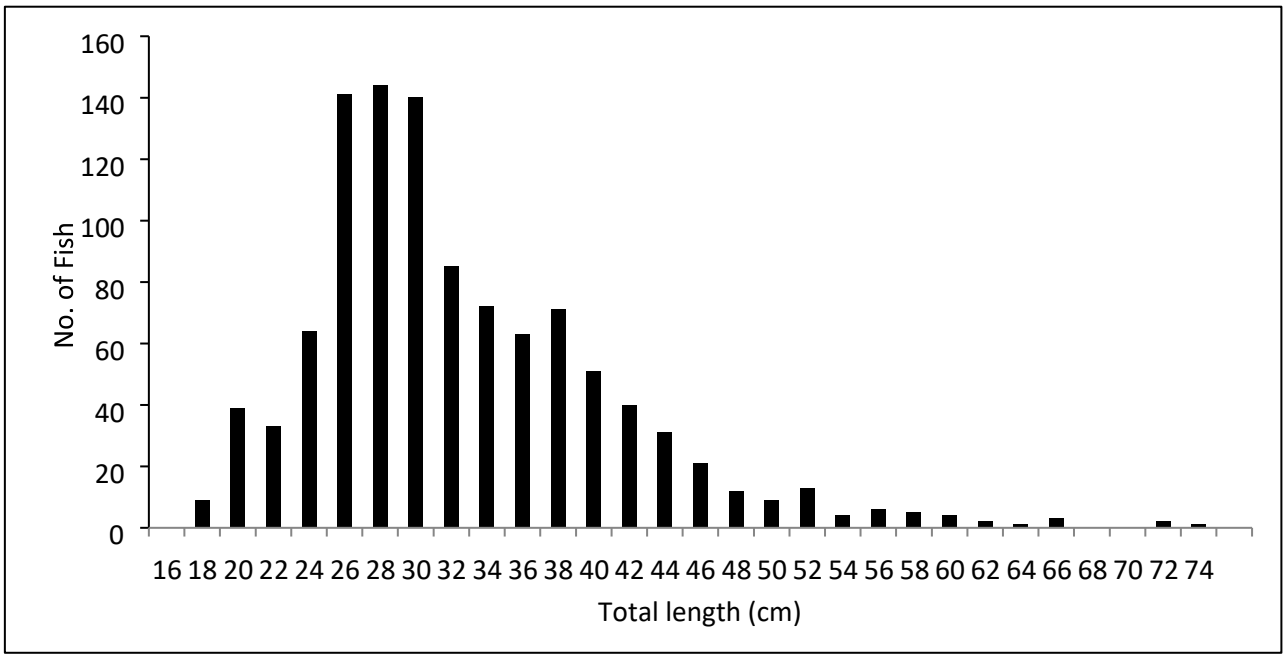


Figure 4. Size structure of *C. carpio* (n=1066)

Mean length *C. carpio* was 28 cm. This implies that fishermen were catching the right sizes of common carp since they mature at 27 cm. For the common carp species there seems to be no danger in overfishing and its population can be sustained in the lake.

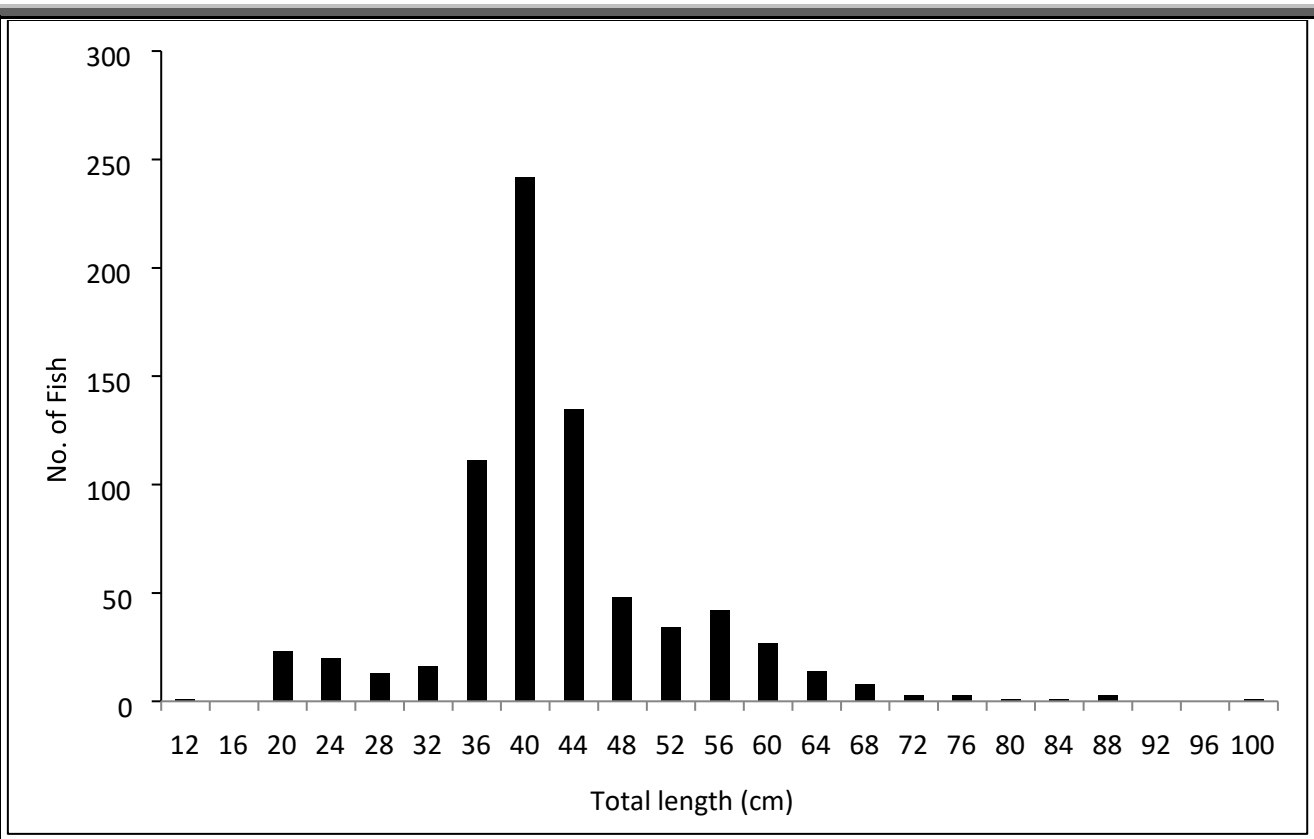


Figure 5 Size structure of *C. gariepinus* (n=746)

Mean length *C. gariepinus* was 40 cm. This implies that fishermen were catching the right sizes of catfish since they mature at 32 cm. For the catfish species there seems to be no danger in overfishing and its population can be sustained in the lake.

4. Conclusion and Recommendations

Conclusions

From this study, it can therefore be concluded that artisanal fishery is a very profitable venture supporting a substantial number of people around Lake Naivasha. Majority of the sampled fishers in the study area were young and agile and with less than 10 years into fishing industry. This might be attributed to the profitability of the business and also lack of jobs in the formal sector. Female boat ownership in Lake Naivasha has gradually increased over time with more women moving from marketing roles to other serious roles in fishery sector. Also, the results gotten from the study revealed that majority of the respondents had some basic education. The study showed that a large percentage of the respondents were using of motorized boats as their most preferred mode of propulsion. The most dominant species in the lake were found to be *O. niloticus*, *C. carpio* and *C. gariepinus*. It was also observed that CPUE and mean sizes of fish landed has remarkably reduced which is a sign of overexploitation. Oloidien landing beach was still supporting a substantial fishery though there are signs of overfishing due to its extremely low CPUE. Most of the fish from Lake Naivasha were sold fresh and over 92% of fish landings were transacted at the landing

beaches an indication of either high demand or lack of alternative markets of their catch. Nile tilapia (*O. niloticus*) is the most valuable species in the lake.

Recommendations

It is pertinent at this point to recommend that relevant government agencies and non-governmental organizations should organize programmes that will improve artisanal fishery in Lake Naivasha. The carrying capacity of Lake Naivasha should be properly researched in order to provide better estimates on the production capacity of the lake and how much fish can be harvested without adverse effects to the fishery. Also, there should be an ecosystem-based approach to fisheries management of the lake that holistically takes into account, the whole lake basin into consideration, with relevant stakeholders involved in the formulation and implementation of the decisions to manage the fishery. There should be increased surveillance and monitoring of the fishery due to the illegal, unregulated and unreported fishing activities. These serve to allow for obtaining accurate catch estimates of the production of Lake Naivasha fishery resources and protection of important fish breeding and nursery grounds that will allow for and enhance the recovery of the fish stocks. There should be regular restocking of *O. niloticus* which has proofed very successful in recent past to boost the recovery of the fish stocks in Lake Naivasha. Fishing in Oloidien lake should be closely monitored to avoid overfishing from the lake and were necessary the fishermen being allowed to fish in the main lake. Also, awareness should be created on the formation of better organized fish marketing cooperative societies through which Lake Naivasha fish can be sold to fetch better prices. Credit facilities should be made available by credit institutions and agencies to improve fish marketing. Also, sophisticated storage facilities/cold rooms should be provided by the government in order to have easy storage of fish awaiting customers.

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About KMFRI Naivasha:

Kenya Marine and Fisheries Research Institute Naivasha is research station hosted by the State Department of Fisheries and the Blue Economy at Karagita centre. Our role is to carry out aquatic research on Lake Naivasha and its environs with an aim of advising management and guide in policy formulation on the sustainable management of the resources.



KMFRI Naivasha is currently focusing on:

- Assessing the impact of protection on the fishery of Lake Naivasha.
- Monitoring water quality parameters and possible sources of pollution on Lake Naivasha.
- Assessing fish stocks, distribution and abundance and factors influencing productivity on the fishery in order to inform management and policy formulation.