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KENYA Aquatica

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KMFRI

Editorial

Editorial: Kenya Aquatica Journal Vol 10(1) – A Showcase of KMFRI's Pioneering Research in Freshwater Ecosystems

The latest edition of Kenya Aquatica Journal, Vol 10(1) showcases pioneering research by KMFRI scientists on Kenya's freshwater ecosystems. This edition, supported by KMFRI and WIOMSA, covers ecological, socio-economic, and environmental challenges, providing valuable insights into sustainable management practices.

One notable study investigates disease surveillance and antimicrobial resistance in fish from lacustrine caged farms, emphasizing responsible antibiotic use to maintain fish health. Another study explores the impact of organochlorine pesticides on macroinvertebrates in Lake ecosystems, advocating for Rhagovelia spp. as a bioindicator for pesticide monitoring across food webs.

Research on Lake Baringo's small-scale fishery assesses the catch and effort composition, stressing the need for regulatory enforcement to avoid overfishing and advocating for capacity building among stakeholders for sustainable management. Additionally, a study on wild fish kills in Lake Victoria focuses on eutrophication and pollution, recommending integrated watershed management to protect the lake's fisheries and local livelihoods.

A comprehensive study on Lake Elementaita – one of Kanya's flamingos' sanctuaries, combines water quality, fisheries studies, and community surveys, calling for integrated watershed management, conservation, and sustainable agriculture. Research on fisheries co-management in Lake Baringo highlights the importance of local community involvement and sustained achievements in ecosystem management, despite challenges in law enforcement.

An article on the socio-economic dynamics of Lake Victoria proposes establishing a regulatory framework incorporating citizen science to manage the lake's resources for long-term sustainability. Addressing plastic pollution in Lake Turkana, a study recommends waste management solutions, public awareness, and better enforcement of regulations to tackle the issue.

The journal also features research on antimicrobial resistance (AMR), with a review exploring Kenya's aquatic biodiversity for potential novel antimicrobial agents. A genetic research study evaluates freshwater fish populations, identifying gaps and proposing future directions for conservation and management.

Lastly, the journal presents an evaluation of fish market dynamics in Lake Naivasha, recommending infrastructure development like fish markets and hatcheries to support the region's fishery sector.

This edition of Kenya Aquatica Journal provides crucial insights into Kenya's freshwater ecosystems, covering a wide range of research on sustainable management, environmental challenges, and the socio-economic factors influencing aquatic resources. The research highlights KMFRI's ongoing contributions to understanding and addressing these issues, fostering a deeper understanding of Kenya's aquatic biodiversity.

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About
Kenya Aquatica

Kenya Aquatica is the Scientific Journal of the Kenya Marine and Fisheries Research Institute (KMFRI). The aim of the Journal is to provide an avenue for KMFRI researchers and partners to disseminate knowledge generated from research conducted in the aquatic environment of Kenya and resources therein and adjacent to it. This is in line with KMFRI's mandate to undertake research in "marine and freshwater fisheries, aquaculture, environmental and ecological studies, and marine research including chemical and physical oceanography", in order to provide sci entific data and information for sustainable development of the Blue Economy.

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Submitting Articles

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Featured front cover picture: Researcher sampling surface plankton in the Kerio River inlet to Lake Turkana. (Photo credit: Mr. John Malala)

Featured back cover picture: Chair of KMFRI Board of Management Amb. Dr. Wenwa Akinyi Odinga Oranga (seated middle), on her right, Ag. KMFRI CEO Dr. James Mwaluma, flanked by KMFRI Heads of Sections: Front (L-R) Dr. Victoria Tarus, Ms Caroline Mukiira, Dr. Jacob Ochiewo, Dr. Irene Githaiga, Mr. Abraham Kagwima. Back (L—R) Mr. Paul Waluba, Ms Jane Kiguta, Dr. Gladys Okemwa, Dr. Eric Okuku, Dr. Joseph Kamau, Mr. Isaac Kojo, Ms Joan Karanja, Mr. Milton Apollo. (Photo credit KMFRI)
Research Vessel MV Mtafiti in the background

The efficacy of fisheries co-management amidst the impacts of climate change: A case of Lake Baringo Beach Management Units (BMUs), Kenya

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Abstract

There is a common agreement that establishment of co-management through the Beach Management Units (BMUs) is beneficial to the fisher community and other stakeholders as regards promoting their participation in sustainable fisheries resource exploitation. This study evaluated the efficacy of co-management amidst climate change impacts on the Lake Baringo fishery. Information and data were collected through site observations, and questionnaire-led interviews involving the key informants and BMU members. Hydrological and fisheries production (total biomass and fish composition) data were accordingly, obtained from the Water Resources Authority (WARA) and Kenya Fisheries Service (KeFS). The impact of climate change, mirrored by fluctuations in Lake water level was positively correlated to the fishery productivity based on reported fish landings. With regard to fisheries co-management, the study reported corruption among BMUs (61%), lack of awareness on BMU regulations (16.8%), limited enforcement (MCS) (16.7%) and inadequate BMU member welfare (1.1%) as the mains factor underpinning BMUs managing deficit resulting to co-managements inefficacy. However, despite the described inadequacy, there is need to sustain the achievements so far attained in promoting co-management and ecosystem sustainability, as enforcement of laws and regulations can be a challenging undertaking without government support. Therefore, the national and county governments should ensure the provision of financial and material support to enhance the BMUs' capacity to effectively undertake co-management functions.

Keywords: Lake Baringo, co-management, BMU, climate change, fisheries

Introduction

The Kenyan fisheries sector plays a significant role in employment and income generation. During the year 2021 the sector supported a total of 65,000 people directly as fishermen and 70,000 fish farmers with 149,000 stocked fish ponds (FAO, 2022). In 2021, the total fish production was 163,702 metric tonnes worth 30.38 billion Kenya shillings (KNBS, 2022). This represented an 8.2% increase in production compared to 151,289 tonnes worth 26.25 billion Kenya shillings landed in 2020 (KNBS, 2022). The increase in the value was mainly due to catches from industrial vessels and the increase in prices based on the demand and supply impacts on the fish prices. As has been the trend with Kenyan fishery in the past, most of the production was from inland capture fisheries, amounting to 115,353 metric tonnes, with an ex-vessel value of Ksh. 17.4 billion. The principal inland fishery contributor was Lake Victoria, followed by lakes Turkana, Naivasha and

Baringo (KeFS, 2022).

Despite fisheries production reported from Kenyan inland waters, numerous challenges including climate change, pollution and common property utilisation ascribed to unlimited access management are deemed as to contributors to the loss of the lake's biological wealth (Ochieng *et al.,* 2013). Lake Baringo fishermen have been reported to have a varying degree of involvement in the fisheries sector, where some fish only as part-time or on a seasonal basis, while others are full-time fishermen (Walumona *et al.,* 2024). Issues observed to be of immediate concerns to Lake Baringo fisheries are: non-compliance to fisheries regulations, use of illegal fishing gears and methods, increasing fishing efforts due to open access, declining stocks and biodiversity, conservation of the resource and environmental and socio-economic issues such as cross border fishing and fish trade (Nyakeya *et al.,* 2020).

Originally, fisheries management in Kenya (including Lake Baringo) was centralized under the national government (Imende *et al.,* 2005). However, due to an increase fishing effort and rise in illegal practices to meet the demand for fish as well as increasing population in the lake's basin, the central management approach was reported to be unsustainable and uncontrollable (Odoli *et al.,* 2022). Involvement of all stakeholders was deemed necessary as had earlier been witnessed around other Kenyan lakes (i.e., establishment of BMUs along Lake Victoria from 1998 to 2000) and the Kenyan coast, occasioning the establishment of Beach Management Units (BMUs) as a co-management approach to fisheries management (Imende *et al.,* 2005; Obiero *et al.,* 2015).

The main objective of co-management was to give all stakeholders a platform for a collaborative and cooperative partnership for the sustainable fisheries management and improved livelihoods of fishing communities (Ojwang *et al.,* 2009). According to harmonized standards structure and operating manual for the BMU's, the BMU is composed of a BMU assembly, a BMU executive committee and various sub-committees. The BMU is headed by an executive committee that is composed of a Chairman, Assistant /Chairman or Vice Chairman, Secretary, Assistant Secretary, Treasurer and committee members.

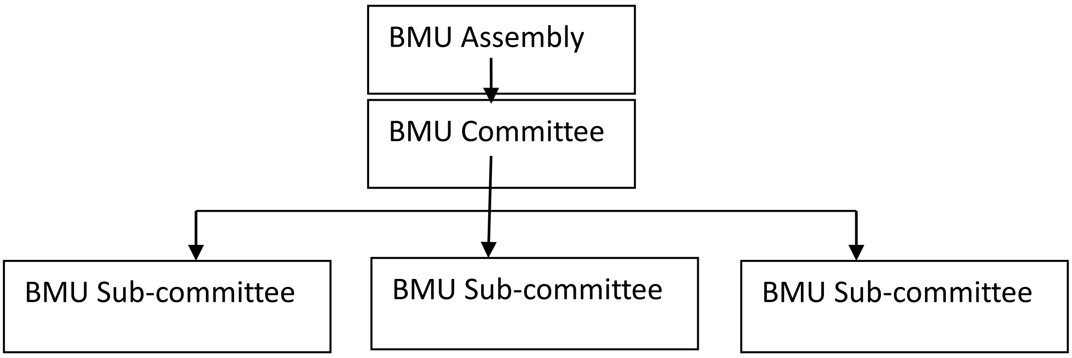

Figure 1. Schematic diagram representing BMU structure.

Since the BMUs establishment, it has had successes with regards to awareness creation, training, cross border lessons and networking (Obiero *et al.,* 2015). However, serious challenges underlay implementation of the co-management mandate where communities do not prioritize the bottom up (down-top) control measures in the fisheries sector as opposed to meeting their immediate needs (Kolding *et al.,* 2014). As opposed to the BMUs being an instrument for implementing fisheries policies, it has been observed that the fishers consider it an instrument for conflict resolution and solving local problems (Odoli *et al.,* 2022). Lately, the BMU's role has now been reduced to price regulation, securing access to shared fishing grounds, markets and financial assistance, and pretty much not at all involved in dealing with illegal fishing activities ascribed to corruption (Kolding *et al.,* 2014). To date, compliance to regulations on fishing gears and legal fish sizes has not been resolved by co-management in Lake Baringo (Pers. Comm. CFO, 2024). Co-management runs a greater risk of failure if the bottom-up regulations and enforcement cannot be understood and supported by the fishers (Odoli *et al.,* 2022).

There is lack of information on the capacity, commitment and willingness of the fisher folk to participate effectively in fisheries management and development activities. Several studies assessed the extent of community involvement in fish management, and perceptions towards fisheries regulations and constrains (Obiero *et al.,* 2015; Odoli *et al.,* 2022). Considering the impacts of climate change and declining Lake Baringo fishery, this study was designed to assess the efficacy of co-management in Lake Baringo amidst climate change impacts.

Materials and methods

Study Area

The study was conducted along Lake Baringo, a shallow freshwater lake in the Eastern Rift Valley of Kenya. Its fishery has been reported to be poor, comprising of three commercially important species (*Oreochromis niloticus baringoensis*, *Clarias gariepinus* and *Protopterus aetiopicus*) while *Barbus* spp. *and Labeo* spp. rarely appear in the catches. The decreased fish diversity is thought to be due to overfishing and limnological changes (Hickley *et al.,* 2004)

The lake surface has previous been reported to cover slightly over 130 km^2, with wide fluctuations as a consequence of Lake water level fluctuations due to climatic influences (Kallqvist, 1987; Hickley *et al.,* 2004; Omondi *et al.,* 2013). However, it has recently been reported to be approximately 250 km^2 during the highest water level reported in early 2020 (Nyakeya *et al.,* 2020). The catchment area is about 6820 km^2 and includes a large part of the Western escarpment of the Kenyan Rift Valley where most of the water is sourced (Ondiba *et al.,* 2018). This study focused mainly on three main fish landing sites namely Kambi Ya Samaki, Kokwa and Loruk in 2022 (Fig. 2) and data obtained from the Water Resources Authority (WARA) and Kenya Fisheries Service (KeFS).

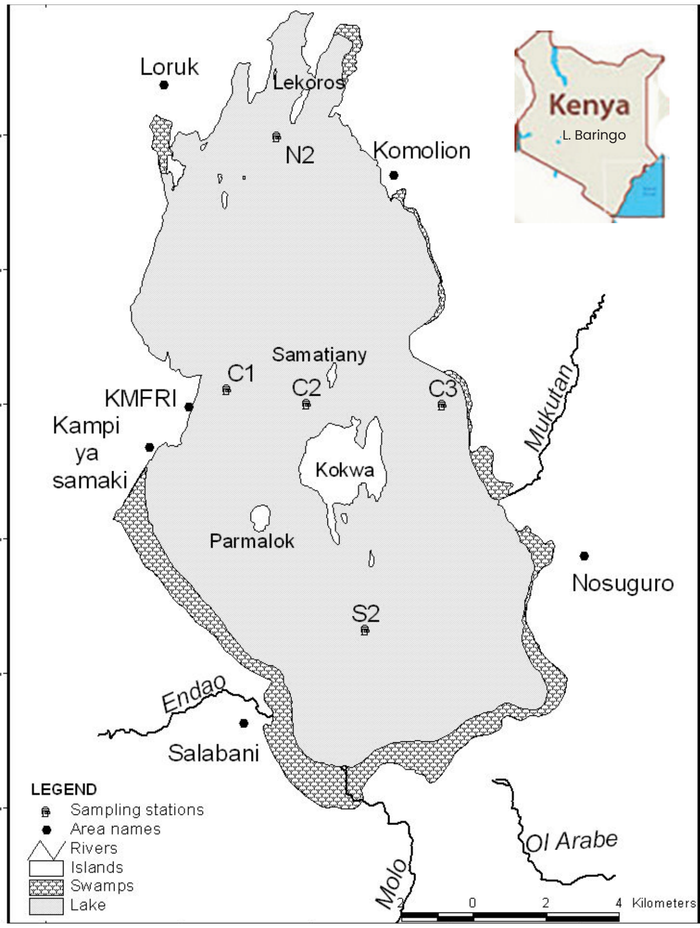

Figure 2. Map of Lake Baringo depicting the three main landing sites/BMUs where the study was undertaken (Source: Authors)**.**

Sampling

The study population comprised of fisheries resource user groups directly involved in capture fisheries, fish trade and fisheries management. A multi-stage sampling approach was adopted where large clusters of the population were divided into smaller clusters in several stages in order to make primary data collection more manageable. Respondents were selected randomly from among the fisheries resource user groups at each landing site.

Primary data collection

Primary data was collected by a team of 5 personnel who were introduced and guided at the chosen landing sites by respective BMU executive officials present. The Beach Management Unit (BMU) officials aided the research team in identifying and assembling together BMU members for the questionnaire led interviews. The questionnaires, which targeted mainly BMU members (active fishers, boat owners, boat crew, traders and processors) were administered in either Kiswahili or English, since these were the most favorable dialects of interaction. Key informant interviews were administered only to BMU officials. Relevant secondary information utilized included information from key informants and published journal papers or technical reports to triangulate results.

Direct observation mainly entailed examination of the lake and surrounding environment, fishing and trading infrastructure and activities, familiarization with dominant fish species landed at the study sites, and filming of spectacular and relevant scenery and activities at the landing sites. At the end of each study site visit, a recap session was held to deliberate on progress made, difficulties encountered and team member experiences during the interview process.

Hydrological and fisheries data collection

Hydrological data were obtained from the Water Resources Authority (WARA) in Rift Valley Basin in the form of daily lake level recordings that were averaged on a monthly and annual basis for the period from 1956 - 2018.

Collection of fisheries data (total biomass and fish composition) was done every month and focused on three landing sites which are considered major in the area covering the Northern, Central and Southern sides of the lake to allow the coverage of the whole lake. Lake Baringo fisheries data used in this study included fisheries yield and value data from 1995 to April 2021 and growth data, in particular condition factors (total length and weight) for 1995 - April 2021. Data on species composition of yield (2008 – 2020) The relative condition factor (Kn) was estimated for each species for the same period following Cren's equation (Cren, 1951) modified and adopted by Ondhoro *et al*. (2016).

Data Analysis

The raw information and data collected was pooled, entered, cleaned and stored electronically using statistical packages (Microsoft Excel and SPSS Version 20), before descriptive data analysis, graphical representation and interpretation.

Results

Study sample statistics

The percentage composition of the respondents was 58% men and 42% women. The age ranged from 18 to 71 years, with 63% being below 50 years while 47% were above 50. 67% of the respondents were owned at least one boat. The fishermen used gillnets (GN) and longline (LN) for fishing. The longline was the most commonly used gear with 39%, trailed by gillnets at 22%, while 39% were using both gillnets and longlines (Fig. 3).

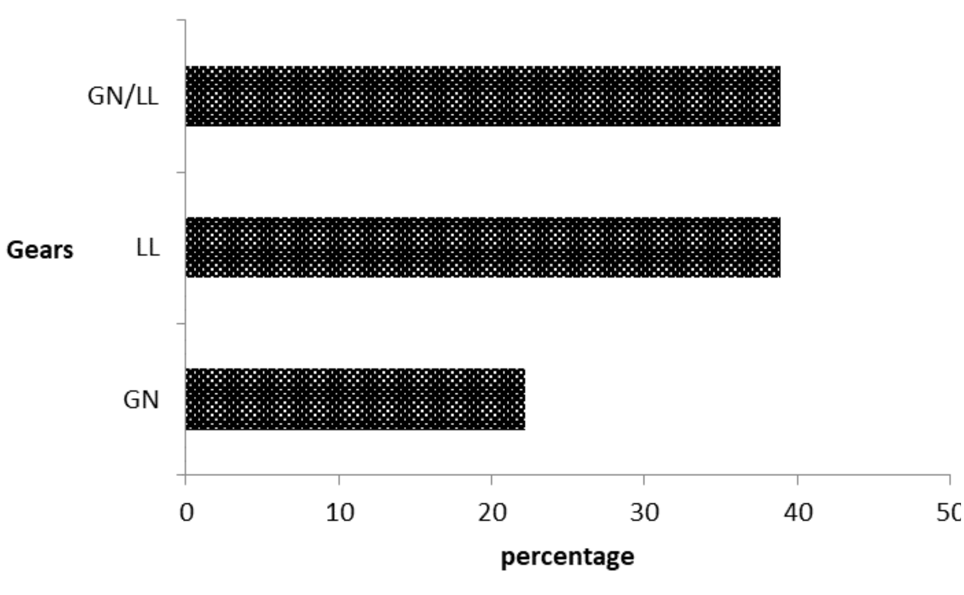

Figure 3. Percentage of gear types used by fishermen.

Majority of the fishers, 53% were educated to primary level whereas, 26% had secondary level education and 11% had attained tertiary education. Eleven percent (11%) had not gone to school (Fig. 4).

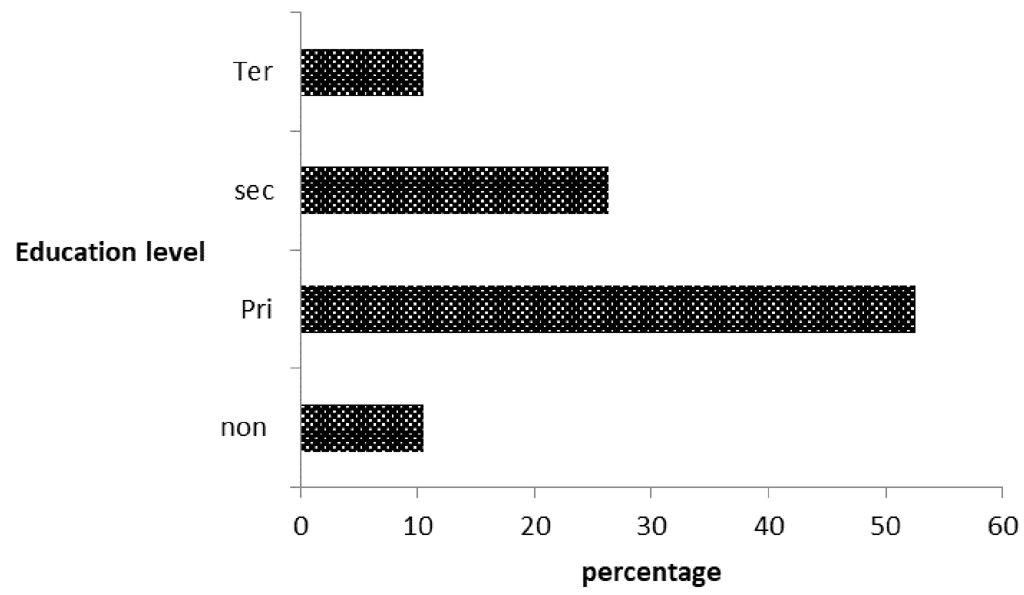

Figure 4. Education level of the fishers in Lake Baringo, Kenya.

The key respondents' information is shown in table 1.

Table 1. Key informants' data collected from the BMUs at three landing sites/beaches

Management Committee issues	Kambi Ya Samaki	Kokwa Island	Loruk
Key departments	Health, education, social, patrol & welfare	Health, education, boats, gears & boats gears & nets, welfare,	Sanitary, education, security, patrol, welfare, planning, finance, development, infrastructure
		Marketing & price, MCS & banda,	Infrastructure
Last management meeting	Apr-2020	May-2020	Feb- 2020
Frequency of BMUs meeting	Weekly meetings	Weekly meetings	Quarterly
Key discussions	Health, welfare, patrols,	Boats & nets; reshuffling & patrols	Development, education
Actions difficult to implement	Control bad fishing practices	None	Members migration
Frequency of general assembly	After 3 months	Twice a week	Anytime depending as need arises
Do you have a patrol boat/engine	Yes	Yes but no engine	Yes
Frequency of patrols	Anytime as need arise	Weekly	Rarely but in collaboration
Last patrol date	1 Week back from today	1 Week back from today	2 months from today
Any collaborators during patrols	Fisheries	None	None
Aware of breeding or fishing grounds	Yes	Don't know	Yes
Awareness on climate change issues	No	No	No

Key issues affecting BMUs operations

Key issues affecting the BMUs at surveyed landing site were assessed and tabulated as depicted in Table 2 below. Majority of the respondents perceived fish price fluctuations as the key issue or challenged faced by respondents at most landing sites. The other key issues reported were the declining fish landings, insecurity, post-harvest losses and illegal fishing methods. Issues of lesser concerns to respondents included pollution, conflict over fishing grounds and lack of funds for monitoring control and surveillance (MCS).

Table 2. Key issues affecting the landing sites.

Key issues	Percentage and frequency of respondents			
	Overall %	Frequency in BMU sites		
		K-Samaki	Kokwa	Loruk
Fish price fluctuations	34.5%	7	20	3
Decline in fish landings	16.1%	2	7	5
Insecurity	14.9%	4	6	9
Post-harvest losses	12.5%	8	1	2
Illegal fishing methods	8%	1	3	3
Pollution	4.5%	2	1	1
Conflict over fishing grounds	4.6%	1	0	3
Lack of funds to purchase fuel for MCS	3.4%	1	0	2
Poor road network	1.1%	0	1	0

* MCS= Monitoring control and surveillance.

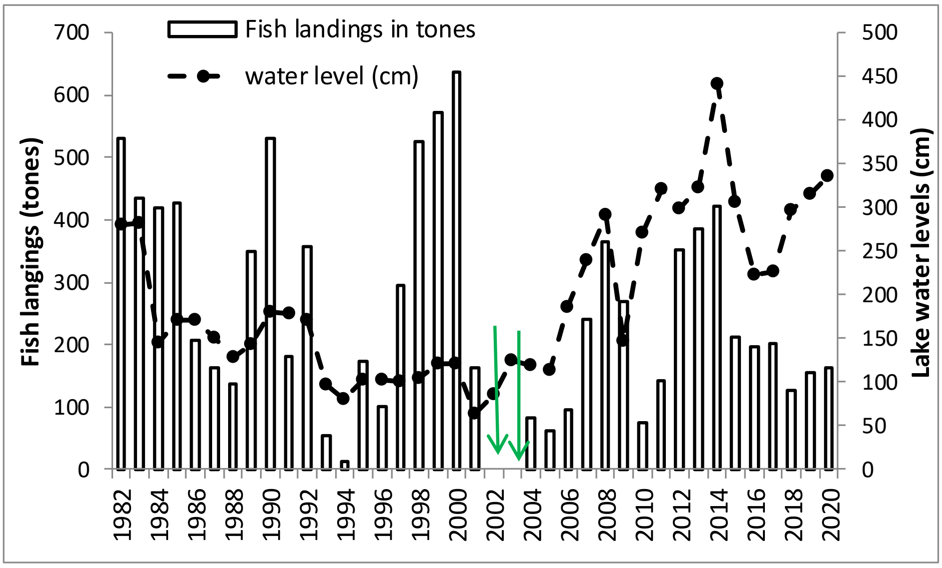

Figure 5. Lake Baringo fishery yield in metric tonnes and Lake water levels (WL).

Fisheries productivity and hydrological indices relationship

Annual fisheries yield in Lake Baringo from 1982-2020 has fluctuated greatly from approximately 8 metric tonnes in 1994 to 465 metric tons in 2000, averaging close to 187 metric tonnes (Fig. 5). These results indicate that the water level change is the main driver of fluctuations in fish species biomass in the lake. Average monthly fishery yield from 1995-2020 showed seasonality in fishery yield, an indication that the lake is more productive from April to August where its fishery peaks and later reduces from early September to March

Only two species out of the four species show a positive correlation between condition factor and lake levels (*B. intermedius*) and between the condition factor and the max annual lake water level amplitude (*O. niloticus*). This result shows a kind of biological dependency of *B. intermedius* and *O. niloticus* on the water level in the lake, while *C. gariepinus* and P. *aethiopicus* do not show a clear biological dependency on the hydrological regime. (Table 3)

Table 3. Pearson correlation coefficient between mean annual condition factor and the five hydrological indices of the four most important fish species caught at Lakeside station.

V1	v2	r	n	prob	SS
O. niloticus					
condiction factor (Kn)	MA lake level	-0.045	13	0.884	NS
condiction factor (Kn)	Delta level	-0.260	13	0.390	NS
condiction factor (Kn)	Max annual amplitude	0.691	13	0.009	**
condiction factor (Kn)	ΔLev(y)+ ΔLev(y-1)	-0.121	13	0.693	NS
condiction factor (Kn)	WLs (WLamp + Wldelta)	0.143	13	0.640	NS
P. aethiopicus					
condiction factor (Kn)	MA lake level	-0.478	13	0.099	NS
condiction factor (Kn)	Delta level	0.098	13	0.750	NS
condiction factor (Kn)	Max annual amplitude	0.084	13	0.785	NS
condiction factor (Kn)	ΔLev(y)+ ΔLev(y-1)	-0.073	13	0.813	NS
condiction factor (Kn)	WLs (WLamp + Wldelta)	-0.043	13	0.890	NS
C. gariepinus					
condiction factor (Kn)	MA lake level	-0.454	13	0.119	NS
condiction factor (Kn)	Delta level	0.158	13	0.607	NS
condiction factor (Kn)	Max annual amplitude	-0.148	13	0.630	NS
condiction factor (Kn)	ΔLev(y)+ ΔLev(y-1)	0.275	13	0.364	NS
condiction factor (Kn)	WLs (WLamp + Wldelta)	0.226	13	0.458	NS
B. intermedius					
condiction factor (Kn)	MA lake level	0.811	13	0.0008	***
condiction factor (Kn)	Delta level	0.154	13	0.615	NS
condiction factor (Kn)	Max annual amplitude	0.228	13	0.453	NS
condiction factor (Kn)	ΔLev(y)+ ΔLev(y-1)	-0.349	13	0.242	NS
condiction factor (Kn)	WLs (WLamp + Wldelta)	-0.272	13	0.369	NS

SS: Statistical significance, 'y' in subscript parentheses gives, if any, the time lag between variables. NS, not significant, *** is significant at 0.1% level, and ** is significant at 1% level.

Assessment of BMUs performance in co-management of lake fisheries

Record keeping

In this study BMUs were found to maintain registers of members, boats and catches landed (Table 4), but with poor records of gears and revenue collected, although a significant group of respondents (12.6%) weren't sure. Most of the respondents (40.2%) reported awareness of the inventory of existing infrastructures within the BMU. During the assessment, the beach registers were cross checked to confirm existence and frequency of records updating.

Table 4. Types of register and records maintained by BMUs.

Types of register and records	Percentage and frequency of respondents			
	Overall %	Frequency in BMU sites		
		K-Samaki	Kokwa	Loruk
Member's register	40.2%	12	12	11
Boat register	21.8%	6	11	2
Catch records	14.9%	4	2	7
Don't Know	12.6%	1	10	0
Gear's register	3.4%	1	0	2
BMU members, boat and gears	3.4%	0	3	0
Visitors book	2.3%	2	0	0
Revenue records	1.1%	1	1	0

BMU efficacy

According to the respondents (Table 5), welfare needs, conflict resolution, enforcement and awareness creation ranked as the best performed roles by the BMUs, although they perceived corruption within the BMUs as an issue of concern. Generally, the respondents still considered the BMUs as the best channels (33.8%) through which arising conflicts are resolved, besides the use of the area chiefs (4.9%) and courts (2.5%) (Data not provided). This could be due to the acceptance by the respondents of the existence of several BMU by-laws complementing the prescribed BMU guidelines.

Table 5. Roles adequately / inadequately addressed by BMUs.

	Roles adequately addresses by BMU				Roles inadequately addresses by BMU				
	Percentage and frequency (freq) of respondents					Percentage and frequency of respondents			
	Overall %	Freq. in BMU sites				Overall %	Freq. in BMU sites		
		K-Samaki	Kokwa	Loruk			K-Samaki	Kokwa	Loruk
Enforcement	17.6%	3	7	2	Limited enforcement	16.7%	3	0	0
Welfare	35.5%	5	12	7	Inadequate welfare	5.6%	1	0	0
Awareness creation	13.2%	2	6	1	Awareness creation	16.8%	1	2	0
Conflict resolution	33.8%	7	9	7	BMU are corrupt	61.1%	3	5	3

Discussion

The percent composition of the respondents was majorly men who are mainly fishermen (upstream value chain) with women (minority) gainfully engaged in the downstream value chain activitie,s specifically processing and marketing nodes. Studies have revealed women, and particularly in developing nations to be participating in the downstream fisheries sector (constitute 47% of fisheries workers) (Wamukota, 2009; Mills *et al.,* 2011). A majority of Lake Baringo fishery value chain actors were less educated to primary school level, with a marginal constituent having attained tertiary education. This could be because fishing and fisheries business in the artisanal setup, as is the case of Lake Baringo, isn't considered lucrative and thus unattractive to the educated class (Oloko *et al.,* 2022).

The roles of BMU's have continued to evolve from being localized and welfare-based to networked and harmonized roles so as to meet the changing environmental, political and socio-economic needs in the fishery sector (Odoli *et al.,* 2022). The roles are more focused on the sustainable management of the fishery resource. This study points to some of the underlying challenges towards the progressive growth of the BMUs, especially with regard to execution of their mandates. Fish price was identified as the most challenging aspect for the BMUs to control (34.5%), while poor road network and interference from revenue collection officers, though present, were amongst others, the least of BMUs' concern. The growing demand for fish has led to an increase in prices (Odoli *et al.,* 2019), where under such conditions, every fisherman strives to maximize his or her benefit oblivious to the damages caused to the future fisheries stock. This notwithstanding, fishermen along Lake Baringo sell fish to agents who are also the boat owners, depriving them of the bargaining power and thus they sell fish at low prices.

Overfishing reported in Lake Baringo is ascribed to the propensity to use illegal gears (below recommended or legal mesh sizes of 5"), indiscriminate gears, outlawed fishing techniques and mass–target fishing methods (Nyakeya *et al.,* 2020; Walumona *et al.,* 2023).

The results on the relationship between fishery productivity and hydrological indices showed good associations between Lake water level and yield, after correlation analysis. These relations depict positive impact of hydrological variables especially rising Lake Baringo water levels on the fisheries productivity. Studies have shown that seasonal fluctuations in water level are related to fluctuations in fish productivity (Junk *et al.,* 1989; Kolding and Zwieten, 2012). The higher the water level in an ecosystem, the higher the fisheries productivity (Kolding *et al.,* 2016). Changes in the littoral habitat of Lake Baringo influences ecological functions that boost fishery production in a semi-arid area where fishing is the principal activity for the riparian communities. Decline in lake level leads to large losses of the open water habitat reducing the carrying capacity of species that dominate its pelagic habitat. According to Anton (2016) and Karp and others (2019), the higher the average change in lakes water levels, the higher the fisheries production or yields. The effects of habitat variations and their distribution on the fisheries of Lake Baringo are also functional of human population densities around the lake. However, the study notes that riparian communities' livelihoods depending on activities along the shores such as community resident areas, pasture etc., were negatively impacted or affected by the lake rising water levels, but this was not within the scope of the current study.

In regard to co-management efficacy, all stakeholders appreciate that regulations are important, but the compliance system with fisheries regulations on the lake is currently low as illustrated by high non-compliance noted by stakeholders and observed at the landing sites. To date, compliance to regulations such as banned use of illegal gears and post-harvest management (loss mitigation) remains a challenge to BMUs and policy makers. This necessitates the need to increase illegal fish gears detection rates by increasing surveillance. Therefore, BMU's need to be developed to the level where they have the capacity to work and conduct their co-management functions.

Conclusion and recommendations

This study has shown that climate change as depicted by the fluctuations in the Lake Baringo water level are interrelated with fluctuations in fish productivity, where a rise in water level leads to an increase in fish catches. During the sustained rainy years, the size of the lake was observed to increase leading to more habitats and refugia suitable for breeding of fish, especially *O. niloticus.* More so, the findings show high variations in expected BMUs performances among the landing sites, but sharing similar challenges. The BMUs perform a very vital role but cannot match to the expectations due to declining fishery resource, ascribed to high fishing pressure which ideally should be the BMUs mandate, and climate change variables, especially fluctuations in Lake water level. Therefore, the main threats to Lake Baringo fishery are overfishing and use of illegal gears, as well as climate change impacts.

There is need to prioritize support towards the urgent needs emerging from the BMUs interviewed, especially with regards to enforcement of fisheries regulations. Therefore, the National government through KeFS and County government should provide financial and material support in expanding the capacity of BMUs to perform and promote sustainable fisheries management.

Acknowlegements

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