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Article

Opportunities and Challenges in the Lake Turkana Fishery: Building a Sustainable Fisheries Sector

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Abstract: Turkana County's fisheries sector, which is entirely dependent on Lake Turkana, is vital to the county's economy. The Fisheries Sector in the County supports 1,500 households directly and 1,100 households indirectly. Despite its economic and social importance, the sector faces numerous challenges such as high post-harvest fish losses, uncoordinated development approaches, over-exploitation of some lake areas and weak links between research, management, and other sector players. Furthermore, since the start of devolution in 2013, the sector has been operating without an overall policy and legal framework. The primary goal of the study was to identify important challenges in the management of the fisheries sector in Turkana County that would lead the successful and coordinated growth of the fisheries industry. To capture their perspectives on the problems and potential in the usage of Lake Turkana's fisheries resources, semi-structured questionnaires and Key Informants interviews were used to collect primary data from the sector's fisheries actors. A total of 60 people were interviewed, and their responses were recorded in the Kobo Collect toolbox for later analysis. Secondary data was also gathered from numerous national policy declarations, guidelines, and legislation that have been used to manage Lake Turkana's fishery resources. The findings indicate that a policy directing the exploitation and development of fisheries is required in order to fully realize the potential of fisheries and aquaculture in the County. The development of the policy will lay a solid foundation for the creation of a legal framework to strengthen the sector in Turkana County, which is a necessary step toward achieving sustainable development and management of fisheries in accordance with national, regional, and international frameworks. By leveraging the role of the County Directorate of Fisheries and Beach Management Units in the sectors' monitoring, management, and development, the policy will also promote effective coordination of stakeholders at all levels.

Keywords: Lake Turkana Fishery; fishery policy

1. Introduction

The fisheries industry is vital to the world economy. In Kenya, the fisheries and aquaculture sector contributes roughly 0.8 percent of the Gross Domestic Product (GDP), employing over 500 000 people directly and indirectly supporting over two million people. The overall worth of fish output is estimated to be around KShs 24 billion (KNBS, 2019). Fish output from Lake Turkana, a transboundary resource shared internationally by Ethiopia and Kenya, as well as locally by Turkana, Marsabit, and Samburu Counties, is currently valued at 13,130 metric tons, or around KShs 1,177,193,000 at ex-vessel price (Kibunja, 2022). Over 80% of total production is accounted for by annual landings along the western side of the lake (Turkana County) (Malala et al, 2018).

The Fisheries Sector in the County supports 1,500 households directly and 1,100 households indirectly (Kibunja, 2022). Earnings from the fishery is projected to rise if untapped regions like capture fisheries, aquaculture, and the blue economy are tapped. The blue economy is concerned with the sustainable use and management of aquatic resources

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— oceans, seas, lakes, and rivers – in order to generate economic growth, improve livelihoods, and create jobs while protecting our environment, cultural values, and biodiversity (HLPSOE, 2020).

A unified national policy framework has organized and purposefully steered the growth of fisheries and aquaculture (FDMA, 2016; FDMA, 2019). The most recent policy shift was the transfer of fisheries control from the state to the county government structure. This occurred due to the adoption of Kenya's 2010 constitution. Kenya's constitution created 47 counties, each with its own administration (CoK, 2010). The objectives of devolution of government include, among other things, granting people self-governing powers, increasing their participation in decision-making, and promoting social and economic growth as well as the provision of nearby, conveniently available services (CoK, 2010).

The aggregate management of the national fisheries and aquaculture industry is showing signs of degradation in the post-devolution era. Due to changes in the management and reporting structure, the gathering and aggregation of national fisheries and aquaculture data has mostly been done by the national directorate (FDMA, 2016). The reporting of county fisheries offices ends at the county executive offices. This may represent a problem in the future, especially when comparing the sector's national performance to the high expected sector contribution to the country's development plan. This reduction could be attributed to a lack of a defined policy framework to guide the sector nationally in collaboration with devolved county governments (Turkana County Fishery and Aquaculture Policy, 2022).

Capture fisheries in Lake Turkana is the most important component of Turkana County's fisheries industry (Kibunja, 2022). The lake's annual fish production fluctuates between 7,000 and 10,000 metric tonnes (Bironga et al, 2019), but it once peaked at 17,950 metric tonnes (AFSB, 1976). Currently, the sector accounts for 10% of the county's revenue (Kibunja, 2022). Because of the artisanal nature of the fishery, the Lake Turkana capture fishery is currently underutilized. The lake has the capacity to produce more than 30,000 metric tonnes of fish worth more than KShs 2 billion (Kibunja, 2022; Malala et al, 2018). Because of a variety of circumstances, capture fishery in Turkana County remains mainly underdeveloped (Turkana County Fishery and Aquaculture Policy, 2022).

Aquaculture is a key fisheries sub-sector with the potential to considerably contribute to food security, poverty reduction, job development, and pressure reduction on capture fisheries (FAO, 2016). Furthermore, it is a business that may be easily integrated into small-holder farming systems. Aquaculture can be promoted as a major commercial enterprise as opposed to a subsistence one. Lack of an elaborate infrastructure and support services system, including inadequate input supply and efficient production of high-quality seed; competitive and high-quality feeds; efficient storage, processing, and marketing; credible quality control; comprehensive extension and information service; and organization for fish farmers, have hampered the commercialization of aquaculture (FAO, 2016). Aquaculture output has been limited throughout the years by a lack of adequate technologies, fish feed, fish seeds, and weak extension services. The deployment of cages in Lake Turkana, the Turkwel River, and numerous dams has huge potential for increasing the capacity for fish feed and fish seed production (Kasuti et al, 2019).

Despite its economic and social importance, Turkana County's fisheries and aquaculture sectors confront a variety of issues. Uncoordinated development approaches, low investment, over-exploitation of some areas of Lake Turkana, under-utilization of some fisheries resources, high post-harvest fish losses, low aquaculture development, and weak links between research, management, and other public and private players are examples of these (TCG, 2016; Turkana County Fishery and Aquaculture Policy, 2022). Furthermore, the fisheries sector has not reached its full potential due to problems such as poor beach infrastructure, a lack of human capital, insufficient finance, environmental deterioration, and evolving market access issues. Furthermore, since the start of devolution in 2013, the sector has been operating without an overall policy and legal framework (Turkana County Fishery and Aquaculture Policy, 2022).

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The County has relied on a number of national policy statements, guidelines, and regulations. Although these documents have been utilized to govern the county fisheries sector, they do not fully explain the overarching policy and legislative framework required for effective, efficient management and development of the fisheries sector.

2. Methodology

2.1. Study Area

The survey was carried out at seven different locations in Turkana County (Lodwar, Kakuma, Kerio, Eliye Springs, Kalokol, Kataboi and Todonyang) (Fig. 1). Turkana County is Kenya's second-largest county, containing more than 13% of the country's total land area. It is bounded on the west by Uganda, on the north and northeast by South Sudan and Ethiopia, and on the east by Lake Turkana. Lodwar is its capital and major city. Turkana County has a population of 926 976 people, according to the 2019 census (KNBS, 2019).

With a surface size of approximately 7 560 km2, Lake Turkana is the world's largest permanent desert lake and Kenya's largest inland lake. It is a transboundary resource in the Arid and Semi-Arid Lands (ASAL) in northwestern Kenya and is shared by three Kenyan counties: Turkana, Samburu, and Marsabit. The northern end of the lake, dominated by the Omo Wetland, is shared with Ethiopia and is the most productive area of the lake. The Omo River, which originates in the Ethiopian highlands, supplies approximately 90% of the lake's water, with the remainder coming from the Turkwel and Kerio rivers, as well as smaller seasonal rivers in Kenya (Keyombe et al, 2019).

The lake contains approximately 48 fish species, with a dozen supporting various commercial fisheries. Commercially important species include Nile perch (*Lates niloticus*), Nile tilapia (*Oreochromis niloticus*), Catfish (*Clarias gariepinus*), *Synodontis schall*, *Hydrocynus forskalii*, Momyrus spp., *Labeo horie*, Bagrus spp., *Distichodus niloticus*, Citharinus spp., and Citharus spp (Malala et al 2018; Ojwang et al 2016). The fishery is characterized by decadal boom and bust cycles in fish landings, which are linked to oscillations in lake levels caused by the dynamics of climatic conditions, particularly precipitation, which causes the Ferguson's gulf to fill and dry out. The filling of Ferguson's gulf is related with an increase in fish catches, particularly tilapia (Kolding, 1995; Muska et al 2012).

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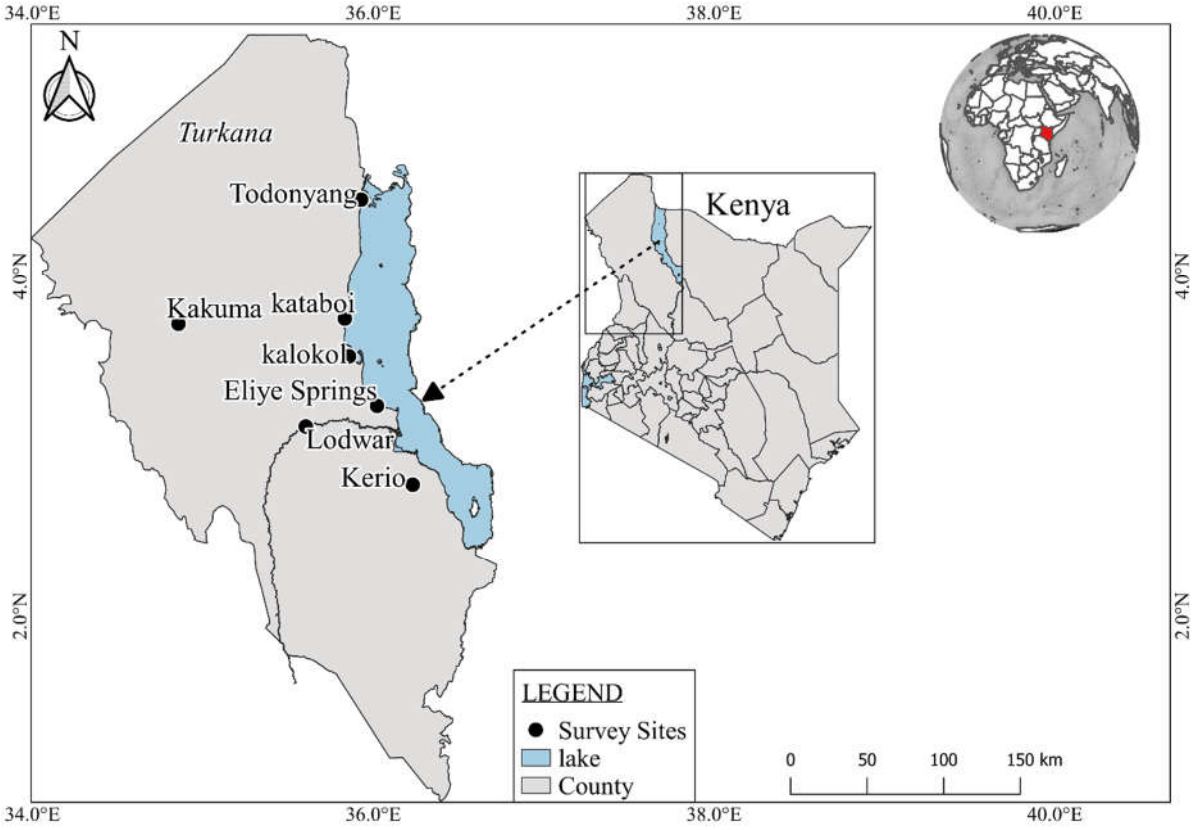

Figure 1. A map showing the data collection sites.

2.2. Data sourcing

Socioeconomic parameters were collected in the towns of Lodwar, Kakuma, Kerio, Eliye Springs, Kalokol, Kataboi, and Todonyang. Simple random sampling was used to choose respondents from the sites visited. To obtain information on various aspects of the study, the study used a mixed-method approach that comprised both quantitative and qualitative data collection techniques. Prior to collecting primary data, a desk study of relevant national policies, reports, and publications was conducted. The main data gathering strategies utilized were semi-structured questionnaires with fish value chain actors and Key Informant Interviews with stakeholders in the fisheries sectors. The tool was administered electronically using the Kobo collect app and Google forms. This module enhanced data capture accuracy and real-time data transfer.

2.3. Data Analysis

Survey data which was stored within the Kobo database from the online submissions were retrieved into Ms. Excel files for descriptive analyses. The dataset was subjected to various rounds of cleaning for an error-free, internally consistent dataset. Descriptive analyses were conducted in order to establish important associations within the variables of the study. Qualitative data was analyzed thematically using deductive and inductive coding as described by Braun and Clarke (2006). A series of responses to the various indicators were measured on a five-point Likert scale. Thereafter, frequencies for different agreement levels were obtained and multiplied by their respective weights for every indicator under investigation. The quantitative findings have been presented in the form of tables and graphs where appropriate. Most of the qualitative data were used to provide detailed explanations of results, general attitudes, and tones of survey participants.

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3. Results and Discussion

3.1. Key Institutions supporting the fisheries sector

In terms of institutional frameworks, fisheries as a sub-sector has been governed by no less than thirteen Ministries at various periods since 1963. These included the Ministries of Information and Tourism, Natural Resources, Tourism and Wildlife, Environment and Natural Resources, Regional Development, Water, Irrigation, and Land Reclamation, Agriculture and Rural Development, and Livestock and Fisheries Development. This type of movement stifles a sector's progress because its strategic goals are rarely sufficiently planned and funded (Turkana County Fishery and Aquaculture Policy, 2022).

The Kenyan government recognized the essential significance of fisheries and aquaculture in food and nutrition security, job creation, rural development, and other economic benefits to individuals involved in the business. In this regard, the government formed a full-fledged Ministry of Fisheries Development in 2008, and the State Department for Fisheries (SDF) (currently known as State Department for Fisheries, Aquaculture and Blue Economy, SDFABE) as one of the state agencies under the broader Ministry of Agriculture, Livestock, and Fisheries (MoALF) (NOFP, 2008). County governments have their own agencies and organizations that deal with fisheries.

The SDFABE is Kenya's key governance institution for the development and management of fisheries resources. It is the fishery management authority that plans fisheries resource management. The Cabinet Secretary and the Directorate of Fisheries are legally responsible for Kenya's fisheries. The Kenya Marine and Fisheries Research Institute (KMFRI) was founded as a state organization under the Science and Technology Act, Cap 250, to conduct fisheries research. KMFRI has continued to carry out its fishery research mandate in collaboration with SDFABE, the principal fishery management authority. Regional development authorities (RDAs), the Ministry of Environment and Natural Resources (MENR), universities, and public laboratories are among the other public institutions engaging in fisheries activities. Institutions such as the Beach Management Units, Aquaculture Association of Kenya, and Association of Fish Processing and Exporters of Kenya promote successful engagement in fisheries and aquaculture management and growth in the private sector (NOFP, 2008; Turkana County Fishery and Aquaculture Policy 2022).

3.2. Actors along the Fish Value Chain in Lake Turkana Fishery

Fish production, fish post-harvest handling, fish transportation, and fish marketing are the four primary processes along Lake Turkana (Bironga 2019). Table 1 summarizes these steps. Women are involved in a variety of facets of the Turkana Lake fisheries. Family units are frequently involved in artisanal fishing (father, mother, and children). In all the seven towns towns of Kalokol and Lodwar, practically all commercial fish fryers are women.

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Table 1. Fish Production in Lake Turkana.

Actors	Technical aspects	Supplies & equip	Infrastructure and services	Partnerships and institutions
Boat builders BMU Staff Fishers	Boat building Engine mechanics Fisheries technology	Fibre, Resin, Timber, Fabrics, Ice, Nails, Paint Hooks and line	Financial services Telecom services Market intelligence Weather information	Research, Resource Managers NGOs, Quality managers, Extension services
Fish Post Harvest Handling				
Actors	**Technical aspects**	**Supplies & equip**	**Infrastructure and services**	**Partnerships and institutions**
Fish processors Fish Traders BMU Staff	Proper fish handling practice Fisheries technology	Salt, Firewood, Smoking kiln, Drying racks, Ice Refrigerated storage Solar energy	Access roads, Electricity Financial services, Telecom services, Market intelligence, Weather information	Research, Resource Managers NGOs, Quality managers, Extension services
Fish Transportation				
Actors	**Technical aspects**	**Supplies & equip**	**Infrastructure and services**	**Partnerships and institutions**
Fish transporters	Good practices	1. Mode of transport: Bicycles, Pickups, Trucks, boats 2. Storage: Ice, Insulated containers, Refrigerated storage	Access roads, Electricity Financial services, Telecom services, Market intelligence, Weather information	Research, Resource Managers NGOs, Quality managers, Extension services
Fish Marketing				
Actors	**Technical aspects**	**Supplies & equip**	**Infrastructure and services**	**Partnerships and institutions**
Fish wholesalers Fish retailers Market staff	Good practices	Ice, Cold storage facilities, Display tables	Financial services Telecom services Market intelligence Weather information	Research, Resource Managers NGOs, Quality managers Extension services

3.3. Socio-demographic characteristics of the fisheries actors

The majority of fish value chain actors (n= 26, 43%) are under the age of 25, followed by those aged 25-36 (n=15; 27%), the most productive age group in Kenya's public workforce. The majority (n= 27, 44%) had a primary level education and moderate knowledge and skills in fishing and other fishery-related activities. This was followed by secondary level education (n=18, 30%). Only (n= 2; 3%) of the actors had a university education, with around 15% having no formal education, implying that fishing and related fishery operations are not a professional occupation for the people.

The fish value chain was dominated by women (n=35; 57%), with the highest proportion being married (n=43; 71%). The primary actors were fish traders (n=27; 44%), fish processors (n=14; 23%), and fishermen (n=13; 21%), all of whom had 1-5 years of experience in the industry. Monthly income varied among the actors, with the majority earning between KShs. 5000-10000 (n=31; 51%) and having no other sources of income (n=60; 98.4%) (See Table 2).

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Table 2. Socio-demographic characteristics of respondents (N = 61).

Indicator	Variable	Statistics
Age (Yrs.)	<=25	43%
	26-35	28%
	36-45	18%
	46-55	11%
Gender	Male	43%
	Female	57%
Marital Status	Married	71%
	Single	21%
	Separated	5%
	Divorced	3%
Education	Primary	44%
	Secondary	30%
	Tertiary	8%
	University	3%
	None	15%
Main Occupation	Fish Processor	23%
	Fish Trader	44%
	Fisherman	21%
	Input supplier	5%
	Transporter	5%
	Other	2%
Monthly Income	<5000	28%
	5000-10000	51%
	10,000-20,000	15%
	>20,000	6%

3.4. The main fisheries issues of Lake Turkana

The Beach Management Units (BMU), which include fishermen, fish sellers, and processors, are the primary fisheries stakeholders in Turkana (65%), followed by the County Fisheries Department (31%). Other stakeholders were Coast Guards (2%) and Kenya Maritime Authority (2%), which conduct patrols and regulatory oversight of the lake, respectively. The lake has faced challenges that have hampered its full economic growth and equitable resource utilization. The top challenges identified were resource management and environmental concerns (41%), policy issues (21%), socioeconomic issues (15%), fisheries institutional issues (13%), and fisheries industry issues (10%).

Illegal, unreported, and unregulated (IUU) fishing was identified as the most significant challenge to resource management, aided primarily by fishermen (77%) who break the law in order to catch more fish, taking advantage of the commercial fishing industry's uneven regulation and poor enforcement at the lake. Fish bycatch was also mentioned as a resource management issue, with the majority of respondents (91.8%) agreeing that it contributes to resource depletion in the lake. However, the majority of respondents (75.4%) were unaware of any legislation or guidelines prohibiting bycatch trade, with some citing more generalized limitations such as size limits imposed on fishermen by the national government.

The government has developed forums in which it formally meets with fishermen to address concerns of fisheries resource management, which occurs once or twice a year. Despite such forums, the actors noted insufficient ties between the fisheries department and Beach Management Units, as well as other fisheries stakeholders, providing a barrier to the resource's sustainable exploitation. Few players (n=11,18%) also expressed worry about resource use conflicts in the lake between different types of fisheries, such as beach seiners, long liners, and gillnetters. The government's intervention in conflict resolution among resource users was similarly ineffective, compromising the lake's ecosystem's viability.

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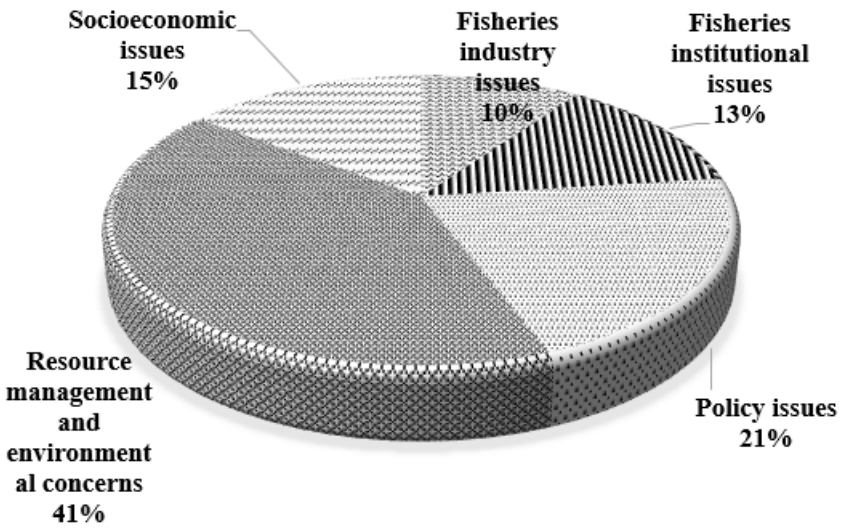

Figure 2. Challenges of Turkana Fisheries.

3.5. The fishery budget allocation

The majority of value chain actors (n=54; 89%) reported being under-informed about fisheries resource allocation concerns due to a lack of involvement in budget planning, writing, or execution (n=53; 87%). Only (n=6;10%) of actors said that fishery funds were constrained, impeding the sector's blue development. The consultative budgeting method is an important management strategy that can directly contribute to better governance by allowing for public participation, monitoring, and performance. As a result, the Turkana County administration should reconsider how its people might influence policy decisions for improved investment and service delivery within Lake Turkana's riparian communities.

3.6. Regulations

The majority of the actors (n=58; 95%) were aware of the licenses and certificates required in the fisheries sector, including licenses on fish trading, fish movement, and fish health for fish traders and processors, as well as vessel registration and crew licenses for boat owners and fishermen. Within the fisheries industry, levies include county revenues (market fee) and cess (inter-county fee) collected at markets and county borders (n=38; 62%). However, the local community indicated that the levies were too high (n=34; 56%), and requested that some levies, such as cess, be combined with the trade license and movement permits to reduce the cost of business operation.

Other actors requested the County Government to provide sufficient training and education to fish value chain actors about the necessity of levies and revenue collection for proper business planning. Other regulations regarding rules on procedures to be granted license within the fisheries sector by the County Government were reported to be clear, including rules on fishing, processing, trading, and commercial license, though the majority (n=40; 66%) were unsure whether the licensing processes were subject to published fisheries policies and laws. According to the actors, the rule of law applied to fishers and traders was medium for both local fishers and foreign traders (n=46, 75.4%) and (n=29, 47.5%), respectively.

3.7. Access to information

Because the majority of the actors were illiterate (n=45; 74%), they were unaware of any publicized fisheries licenses or revenues that are available to the public or on the internet. They do, however, advocate having a centralized administration system for all

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fisheries revenue (n=47; 77%), in order to decrease conflicts during revenue collection and improve accountability and transparency.

3.8. Data Collection

The majority of the actors (n=60; 99%) were aware of the data collected by the fisheries department to support lake resource management and supported a central data repository system for data management (n=59; 97%). All of the actors agreed on the establishment of a quality assurance unit to inspect the quality of fish consumed locally and sold regionally in order to improve food and nutritional security in the region.

3.9. Investment and blue economy

The actors are eager to invest in cage farming (n=45; 74%), both to provide jobs for the community's vulnerable and marginalized people, such as youths and women, and to relieve strain on wild catch fisheries. Cage culture has not been adopted as a feasible business prospect by Turkana locals due to a lack of information about such enterprises. They proposed that the county government and other Lake Turkana stakeholders offer training and awareness on cage culture investment potential inside the county in order for them to enter the industry. However, a small number of actors (n=16; 26%) expressed concerns about cage culture investment in the lake, citing resource use conflicts and interference with the lake ecosystem as potential issues if the cages are not correctly constructed.

4. Conclusion

One of the primary sectors considered as a good contributor to Turkana County's economic development is fishing. However, the productivity of Lake Turkana's fishing resources has been diminishing due to environmental degradation and insufficient natural resource management. The aquaculture subsector is similarly undeveloped due to a lack of support channels for technology and information transfer. The importance of the fisheries and aquaculture sectors in Turkana County has been highlighted by this study. If well-coordinated, managed, and properly utilized, it will not only help to boost employment opportunities, but it will also encourage fish intake for enhanced nutritional benefits. Evidence also suggests that with adequate infrastructure and resources, the sector has enormous economic, employment, and revenue production potential.

In the past, the absence of a coherent policy framework resulted in underfunding, understaffing, and underestimation of statistics in the industry. The fact that Turkana County has yet to domesticate the National Fisheries Management and Development Act (2016) has further denied the county access to proper governance regimes for optimal fisheries exploitation.

5. Recommendations

The following recommendations are made by the study in order to fulfill the maximum potential of Turkana's fishing sector;

- Adopting the draft fisheries and aquaculture policy and establishing a fisheries and aquaculture bill to encourage investments, improve partnerships, conserve fish stocks, safeguard the lake's ecology, assure fishing's economic viability, and offer consumers with high-quality food.
- Increasing culture fisheries incentives in an environmentally sound manner to lower demand for capture fisheries while filling supply gaps for the county's fisheries requirements. In a changing climate, cage culture is a viable fish production option. It would aid in protecting the country's fisheries-based food, protein, and nutritional security from the uncertainties of national supply chain needs and the perils of extreme weather events associated to climate change.
- Improving ecosystem approaches to fishery management to enable for the use of fisheries while preserving the natural structure, balance, and functioning of Lake

Turkana's ecosystems and significant species, as well as protecting critical fisheries habitats.

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