Exploring the Challenges and Opportunities of Fish Farming for Improved Livelihoods of Local Communities in Ikolomani Sub-County, Kenya

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ABSTRACT

Fish farming has gained significant attention in Asia and Africa as a sustainable solution to meet the rising demand for fish while improving livelihoods and reducing poverty in rural communities. In Kenya, Vision 2030 aims to transform the country into a newly industrialized, middle-income nation by improving the quality of life for all citizens. As part of this initiative, food security has been prioritized under the socio-economic development pillar. Similarly, the County Government of Kakamega has incorporated aquaculture into its development plans, and made significant investments in the sub-sector to support rural livelihoods. However, despite these efforts, fish production in Kakamega County remains low. This study explores the impact of production costs on fish farming, the role of market conditions in fish production, and local attitudes toward fish consumption in Ikolomani Constituency, Kenya. A descriptive study design was used, targeting approximately 300 fish farmers in the constituency. A total of 60 fish farmers and 12 key informants were randomly and purposively sampled respectively. Data was collected through questionnaires and in-depth interviews and analyzed using descriptive statistics and content analysis respectively. Findings indicate that the high cost of fish feed and fingerlings is the most significant barrier to fish farming in the constituency. Additionally, rural fish consumption remains low due to deep-rooted traditional attitudes. However, increased interest from the county government and a growing demand for fish—particularly in urban areas—present promising investment opportunities in the sector. The study recommends that the County Government of Kakamega continues raising awareness about the benefits of fish farming for food security and household income. Furthermore, addressing the high production costs, particularly the expensive fish feed and limited availability of fingerlings, will be crucial in encouraging more farmers to adopt fish farming as a sustainable livelihood option.

Keywords: Socio-economic Factors, Fish Farming

INTRODUCTION

Fishery resources are classified into four main groups based on habitat: freshwater fish, marine fish, brackish water fish, and diadromous fish. Fish and fish products are vital food sources due to their high protein and lipid content. Fish proteins are well-balanced, containing essential amino acids necessary for human health. Fish meal, a key product of the processing industry, is in high demand as a supplement for poultry, swine, and other livestock feed, especially in scientifically managed rearing and fattening programs.

Kenya boasts a rich diversity of marine and inland water resources. Its marine resources include an extensive coastline along the Indian Ocean, while inland water bodies consist of large lakes, rivers, and wetlands. The fisheries sector is vital to Kenya's economy, providing livelihoods for over 0.7 million people (Ministry of Mining, Blue Economy and Maritime Affairs, 2023) and significantly contributing to food security and economic development. Marine fisheries are concentrated along the Indian Ocean coastline and consist of artisanal, industrial, and recreational fishing. Meanwhile, inland fisheries revolve around lakes, rivers, and dams, with Lake Victoria being the most significant.

The country has been working on expanding its industrial fleet, currently operating twelve longliners, two pot vessels, six purse seiners, and six trawlers in its Exclusive Economic Zone (EEZ). Despite the artisanal sector dominating inland and marine fish catches, the commercial potential of Kenya's EEZ remains largely underexploited, with an estimated capacity of 150,000 to 300,000 metric tones (Ministry of Mining, Blue Economy and Maritime Affairs, 2023). The fisheries subsector is a crucial component of the national economy, providing financial stability to many communities. Aquaculture is the most significant area of fisheries development in the county, predominantly practiced at a subsistence level, though some commercial fish farms exist. Fish farming can easily be integrated into household farming systems and holds immense potential due to the county's abundant water sources and favorable warm-water aquaculture conditions.

Despite the many ecological and market related (Njeru, 2013) and socio-economic (Maina et al., 2014) challenges facing the subsector, commercial aquaculture enterprises are on the rise, marking a shift from traditional subsistence fish farming. Due to aggressive extension services, aquaculture production has quadrupled in a short time, making it the fastest-growing production subsector in the county, deserving continued support and attention. The sector contributes to the local economy by creating jobs, generating income, reducing poverty, and enhancing food security. With a growing population and increasing health-conscious dietary choices, demand for fish is rising. Given its cholesterol-free white meat, fish provides an excellent nutritional profile. In 2022, the industry directly employed approximately 65,000 fishermen and 70,000 fish farmers, with a total of 149,000 stocked fish ponds (Ministry of Mining, Blue Economy and Maritime Affairs, 2023). Overall, the sector supports around 1.5 million people, including traders, processors, suppliers, merchants of fishing accessories, and their dependents (Ministry of Mining, Blue Economy and Maritime Affairs, 2023). In addition to being a rich protein source, especially for riparian communities, the fisheries sector is also a key driver of economic growth

In Kakamega County, aquaculture is the most sustainable source of fish and has significant growth potential in the county, thanks to an abundance of water sources, including rivers, springs, dams, and rainfall. The land suitable for other agricultural activities in the county is also ideal for aquaculture, including swampy and marshy areas. Currently, the county has 6,300 farmers managing 6,900 fish ponds, producing 700,000 kg of fish valued at Ksh. 140 million (Ministry of Mining, Blue Economy and Maritime Affairs, 2023). In the County, fish farming is primarily done on a small scale for domestic consumption and local markets, gradually fostering commercialization. According to the current Integrated County Development Plan (ICDP) 2023-2027, the Department of Fisheries has been developing policies to ensure sustainable fish production (ICDP, 2023). These policies include awareness campaigns aimed at encouraging residents to consider fish farming as a viable business alternative to failed agricultural ventures among others. The county government initiative has also attracted development partners such as USAID and Collaborative Research Support Programs (CRSP) to support awareness efforts and boost farmer capacities in the County.

Local fish production in Ikolomani Constituency has gained increasing prominence, bolstered by the County Government efforts, and a central government grant in 2009 under the National Economic Stimulus Programme to boost rural aquaculture for agricultural and economic development (GoK, 2009; Manyala, 2011). Aquaculture farmers primarily use earthen-bottom ponds to raise fish most of which is sold in local Markets (Nyandat & Owiti, 2013). Thanks in part to the government’s economic stimulus, fish farming and consumption have increased in Ikolomani Constituency, mirroring trends across Kenya, creating further opportunities for aquaculture expansion (Mucai et al., 2013; Nyandat &Owiti, 2013; Rothuis et al., 2011). Due to high population density in the constituency and the county, land availability for livestock farming is limited, making fish an increasingly important alternative protein source. Farmers have highlighted this shift in dietary preference during pre-study conversations.

Despite the government's efforts to enhance fish production through the Economic Stimulus Programme (ESP) which aims to improve farmers' nutritional status and create employment by funding fish pond construction and subsidizing the costs of feeds and fingerlings, the country's aquaculture production remains insignificant (GoK, 2009; Manyala, 2011), Rothuis et al., 2011). This is despite the presence of governmental infrastructure supporting the aquaculture sub-sector, including training programs, research farms, and extension officers (Hino, 2011). In Kakamega County, some of the challenges hindering aquaculture development include inadequate infrastructure such as fish hatcheries, poor-quality fish seed and feed, insufficient hygienic

facilities, a lack of market information, fluctuating demand, limited aquaculture research, inadequate extension services, weak links between production and marketing, and the absence of clear aquaculture extension guidelines and baseline data for investment (ICDP, 2023).

Purpose

Therefore, there study sought to explore the effect of cost of production, market availability and attitude of local residents towards fish consumption on fish farming in Ikolomani Constituency, Kenya

Specific objectives

i. To examine the effect of cost of production on fish farming in Ikolomani Constituency, Kenya.

ii. To determine effect of market availability for fish on fish farming in Ikolomani Constituency, Kenya.

iii. To establish the effect on local peoples' attitude towards fish consumption on fish farming in Ikolomani Constituency, Kenya.

LITERATURE REVIEW

Introduction

This section synthesizes information from various sources, including library references and e-resources, to provide a comprehensive understanding of aquaculture. It examines both theoretical and empirical literature relevant to aquaculture in different contexts.

Theoretical Framework

Livelihood Theory (LT)

The Sustainable Livelihoods Framework (SLF), developed by the UK's Department for International Development (DFID, 1999) and the United Nations Development Programme (UNDP, 2017), provides a structure for understanding key factors affecting livelihoods including the physical and human assets including vulnerabilities in this case the vulnerabilities to fish farming as a livelihood; transforming structures and processes, such as the role of institutions like county governments, governance systems, and policies governing the aquaculture sub-sector; livelihood strategies, which encompass the choices and activities individuals engage in to sustain their livelihoods, such as fish farming; and livelihood outcomes, such as increased income, well-being, and food security.

This Theory is widely used in poverty alleviation, rural development and development studies, and to analyze how communities, households and even individuals sustain themselves through social, economic, and environmental means. In this theory, a livelihood is defined as the combination of capabilities, assets (both material and social), and activities necessary for a means of living, and can be considered sustainable if it can withstand and recover from stresses and shocks while maintaining or enhancing its capabilities and assets without depleting natural resources (UNDP, 2017).

This theory is crucial for understanding fish farming productivity, rural resilience, coping mechanisms for climate change, and interventions that improve access to fish farming assets as part of poverty reduction efforts in Ikolomani Constituency, Kakamega County.

Development Theory (DT)

John Friedman, a key proponent of this theory, argued that past economic development efforts had largely failed and proposed an alternative economic development model centered on inclusivity. His approach does not seek to replace traditional development models but rather advocates for transformation, ensuring that all individuals, including the economically disadvantaged, can actively participate in economic and political

processes. This theory promotes a bottom-up development approach, prioritizing human welfare over profit-driven models.

Development Theory also informs this study by emphasizing human welfare and economic development through alternative approaches. It challenges the notion that economic failure in one sector equates to the collapse of livelihoods (Martinussen, 1999). The theory critiques conventional modernization models, which have struggled to address issues such as environmental sustainability and widespread poverty.

Empirical literature

Introduction

Aquaculture, or fish farming, has rapidly emerged as a major industry worldwide. In Kenya, it was introduced in 1890 as a form of sport fishing. Over time, small-scale farmers adopted fish farming, and by the 1960s, it was commercialized through the Kenyan government's 'Eat More Fish' program (Rothuis et al., 2011). Several factors have contributed to the growth of aquaculture, including the increasing demand for seafood as a health food, its role as a valuable source of foreign exchange, and its position as a critical sub-sector in food production.

Cost of Production and Fish Farming

Despite its growth, fish farming in Kenya faces numerous socio-economic challenges. Key obstacles include poor infrastructure, outdated processing technologies, unfavorable climatic conditions, a shortage of trained personnel, regulatory hurdles, financial constraints, limited market access, and inadequate inputs such as feeds and fingerlings. Nevertheless, the Kenyan government supports fish farming as a means to enhance food security and provide income to rural communities (GoK, 2009; Rothuis et al., 2011).

The high cost of fish farming hinders its expansion. Site selection and pond construction require significant investment, compounded by land ownership challenges. MacPherson & Agyenim-Boaten (2001) highlight that in areas without formal land registration, land tenure disputes often arise, escalating the cost of acquiring land for fish farming. Additionally, site selection must ensure the availability of adequate water quality and quantity for sustained operations (Carballo et al., 2008). Accessibility to transportation routes is another crucial factor in site selection (Njeru, 2013).

The cost of acquiring fingerlings and feeds significantly affects fish farming sustainability. A study in Ghana by Quansah et al., (2007) found that certain feeds and organic fertilizers contained harmful pathogens, posing risks to aquatic ecosystems. Additionally, small-scale farmers struggle to afford necessary equipment such as all-terrain vehicles for pond maintenance, trailers for transporting feed, and tractors for clearing vegetation (Carole & Stone, 2007).

Financial limitations prevent small-scale farmers from expanding their operations. To mitigate this, many farmers form cooperatives to pool resources. A study in West Africa found that 53% of fish farmers were cooperative members, while 34% joined fish farmers' associations (Ofuoko, 2008). In Kenya, informal networks such as community self-help groups play a crucial role in supporting fish farmers. These grassroots efforts, based on the Swahili concept of harambee (community self-help), provide financial assistance and promote economic development (Freeman et al., 2004).

Although community-based initiatives offer financial support, international development agencies have been slow to recognize their economic potential. These groups, however, complement bottom-up development strategies, addressing government failures and fostering local economic growth (Snow & Buss, 2001).

Market availability and Fish Farming

Understanding consumer preferences is essential for developing the fish farming sector. Kundu (2010) emphasizes that factors such as religious beliefs, age, education level, gender, and occupation influence fish consumption patterns. Additionally, planners must assess market dynamics, price competition, feed and

fingerling quality, availability of technical labor, and financial accessibility (Ridler & Hishamunda, 2004). Estimating capital and operational costs is crucial for determining the affordability of fish products to consumers. Expanding aquaculture can significantly improve household food security and economic well-being (Ahmed & Lorica, 2002).

Kakamega County has favorable conditions for fish farming, making it a vital source of protein for local communities. However, challenges such market access and addressing declining production must be addressed to enhance food security. The government's Economic Stimulus Program (ESP) aimed at boosting fish production by subsidizing pond construction, feeds, and fingerlings (GoK, 2009; Manyala, 2011). Despite these efforts, limited government infrastructure, inadequate research, and a lack of extension officers hinder the sector's growth (Hino, 2011; Rothuis et al., 2011; Mwenesi, 2014).

Knowledge, Skills, and Attitude in Fish Farming

The success of aquaculture depends on adequate knowledge, skills, and a positive attitude among farmers. In rural Côte d'Ivoire, aquaculture projects failed due to a disconnect between ownership and management, as farmers lacked the necessary skills and commitment (Ridler et al., (2014); Hishamunda, 2001). Similar failures have been documented due to a lack of entrepreneurial dedication among salaried managers (Satia, 1991).

Commercial aquaculture requires both technical feasibility and economic viability; failure in either aspect leads to project collapse. Limited technical expertise at farm and national levels has further impeded aquaculture development. This underscores the need for comprehensive training programs and effective aquaculture advisory services to facilitate technology transfer and support at all levels (Corbin & Young, 1997).

Mwangi (2008) observed that Kenya's low number of trained extension staff with practical aquaculture skills remains a significant constraint to commercial fish farming. In the 1980s, the number of fish ponds declined, primarily due to inadequate extension services, poor-quality fingerlings, and insufficient farmer training (Ngugi et al., 2007). Until the mid-1990s, fish farming in Kenya resembled that of many other African nations, characterized by small ponds and subsistence-level management with low productivity (FAO, 2013b; Mwenesi 2014).

Small-scale farmers, who dominate Kenya's fish farming sector, often lack exposure to modern technologies. Limited access to training and education further exacerbates their challenges (Carbalo et al., 2008; Ndu, 2006). Nouaga et al. (2012) argue that farmers' attitudes, coupled with a lack of education and training, significantly impact fish productivity.

Conclusion

While aquaculture in Kenya holds significant potential, several socio-economic and financial challenges hinder its full development. Addressing issues such as infrastructure, technical expertise, and market access can enhance fish farming productivity. Strengthening community-based initiatives, improving extension services, and fostering knowledge transfer will be crucial for sustainable aquaculture growth in Kenya.

METHODS

Study area

The study was conducted in Ikolomani Constituency in Kakamega County, Kenya. Descriptive research design was employed in the study. Kakamega County (see Figure 1) is situated in the western part of Kenya, bordering Vihiga County to the south, Siaya County to the west, Bungoma and Trans Nzoia Counties to the north, and Nandi and Uasin Gishu Counties to the east. The county spans an area of 3,051.3 km². Kakamega has a tropical climate, characterized by year-round rainfall, primarily influenced by the presence of the Kakamega Rainforest—the only remaining tropical forest in Kenya. Annual rainfall in the county ranges from 1,280.1 mm to 2,214.1 mm, with a fairly even distribution throughout the year. The heaviest rains typically occur between March and July, while the lightest rains fall between December and February (ICDP, 2023).

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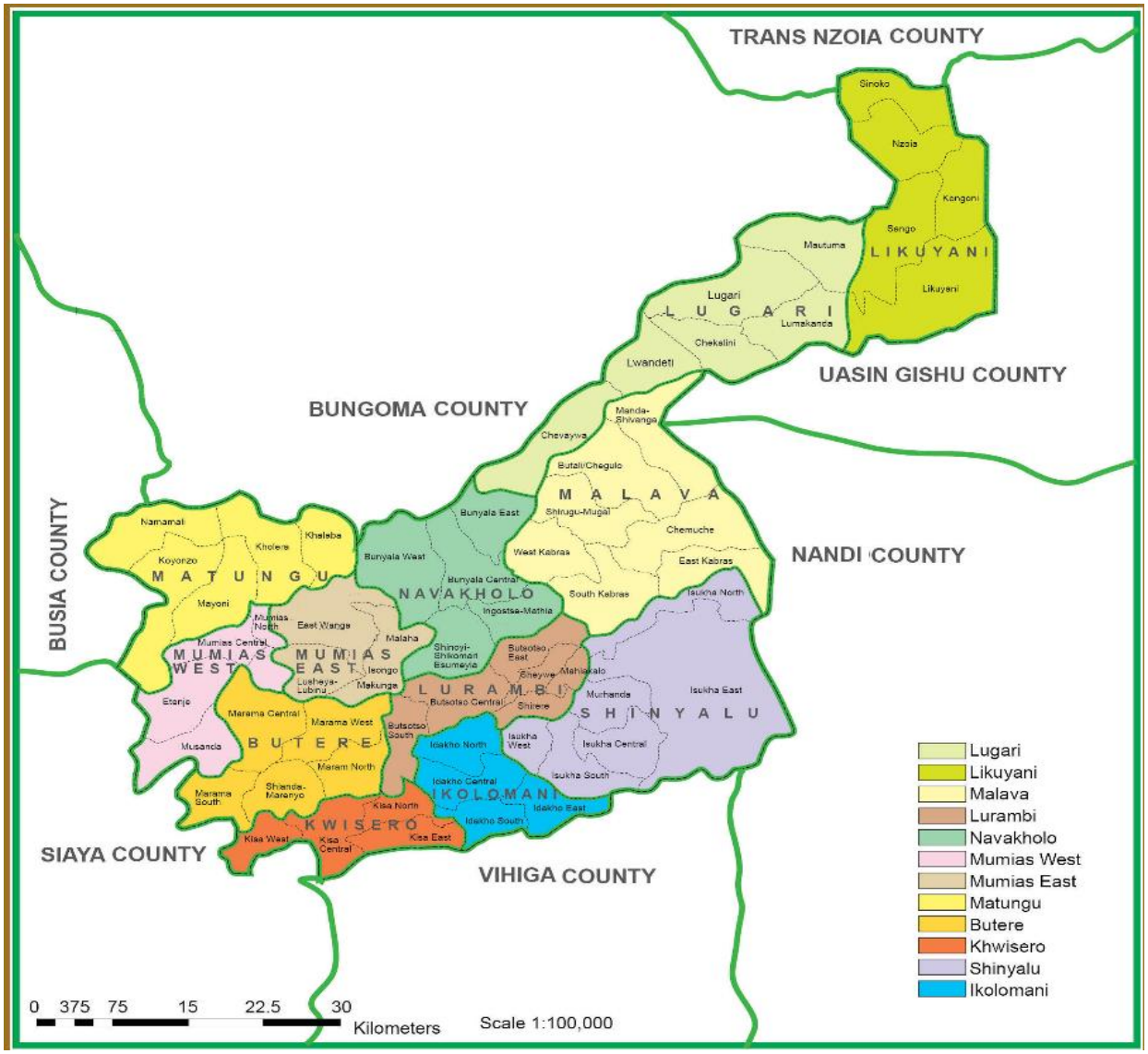
Figure 1: Map of Kakamega showing Ikolomani Constituency (shaded blue)



Source: Adopted from County ICDP, 2023-2027

According to the 2019 Kenya Population and Housing Census Report (KNBS, 2019), Kakamega County had a population of 1,867,579, comprising 897,133 males and 970,406 females, representing 48% and 52% of the population, respectively. This makes it the fourth most populous county after Nairobi, Kiambu, and Nakuru. With an inter-censal population growth rate of 1.2%, the county's population was projected to reach 2,072,565 by 2025 and 2,138,415 by 2027 (ICDP, 2023). The majority of the county's inhabitants, particularly in Ikolomani Constituency, belong to the Luhya ethnic group. The increasing population continues to exert pressure on the county's limited resources, underscoring the need for strategic planning and the development of alternative livelihood opportunities.

Ikolomani Constituency (marked in blue in Figure 1) covers an area of 146.2 km², with more than three-quarters of the land being arable. According to the 2019 census, the constituency had a population of 111,743, with a density of 764 people per km² (KNBS, 2019).

As outlined in the 2023-2027 Integrated Development Plan (ICDP), the primary economic activity in Ikolomani is smallholder farming, with most farmers cultivating food crops. A small portion of the land is dedicated to cash crop farming, mainly tea and sugarcane. The local economy is largely driven by subsistence farming, with maize being the staple crop grown for both consumption and sale. In addition to agriculture, gold mining is a notable economic activity in the constituency. However, it is primarily carried out using traditional, rudimentary tools, limiting productivity and earnings. Other income-generating activities include small-scale

trading enterprises such as shop-keeping, cereal and vegetable sales, and the matatu (public transport) business. The constituency lacks major industries, with only a few informal *Jua Kali* workshops operating in local marketplaces (ICDP, 2023).

The fisheries and aquaculture sub-sector in the county targeted to increase the amount of fish production from 99.28 tonnes to 2,177 tonnes (ICDP, 2023). However, only 1,245.6 tonnes were produced resulting into a 57% achievement (ICDP, 2023). The interventions that enhanced fish production were distribution of 9,534 (25kg) bags of fish feeds and 2,113,000 fingerlings to farmers. The sector also constructed and rehabilitated 727 fishponds and operationalized Lutonyi Fish Factory through the Development of Aquaculture Support (DAS) Group. In addition, 37 fish farming field schools were established, 73 seine nets supplied and 24 PVC liners provided to increase productivity (ICDP, 2023). Though these were commendable efforts by the County Government, they fell short of the growing demand for fish farming in the County and particularly in Ikolomani Constituency. Consequently, the supply of fish is still very low rendering the factory grossly underutilized.

Research design

According to Kothari (2004), a research design is the organization for gathering and analysis of data in a way that aims at achieving relevance and to meet objectives of the study. The research design was considered suitable for this study because it would help describe the state of fish farming in the study area highlighting the experienced challenges and existing opportunities for improved livelihoods of the local communities.

Sample and sampling procedure

The study relied on Mugenda & Mugenda, (2003) who argues that in cases where the target population is small, a sample range of between 10-30 percent would suffice for a study. The study picked a sample of 60 (20%) fish farmers from the target list of 300 fish farmers in the Constituency. Simple random sampling without replacement was used to pick 15 famers from each of the four wards in the Constituency since the population of fish famers was almost evenly distributed in the four wards. A sample of 12 key informants, three from each ward including farmer group leaders, farming community based organizations, local administration/agricultural officers were purposively sampled for in-depth interviews.

Data collection

Questionnaire with both closed and open-ended questions, and in-depth interview guide were used to collect data from the sampled respondents. Questionnaires were used to collect data from 60 sampled fish farmers while 12 in-depth interviews were conducted among the 12 sampled key informants spread across the constituency. This study was conducted between September and November, 2024 in Ikolomani Constituency in Kakamega County, Kenya.

Data analysis

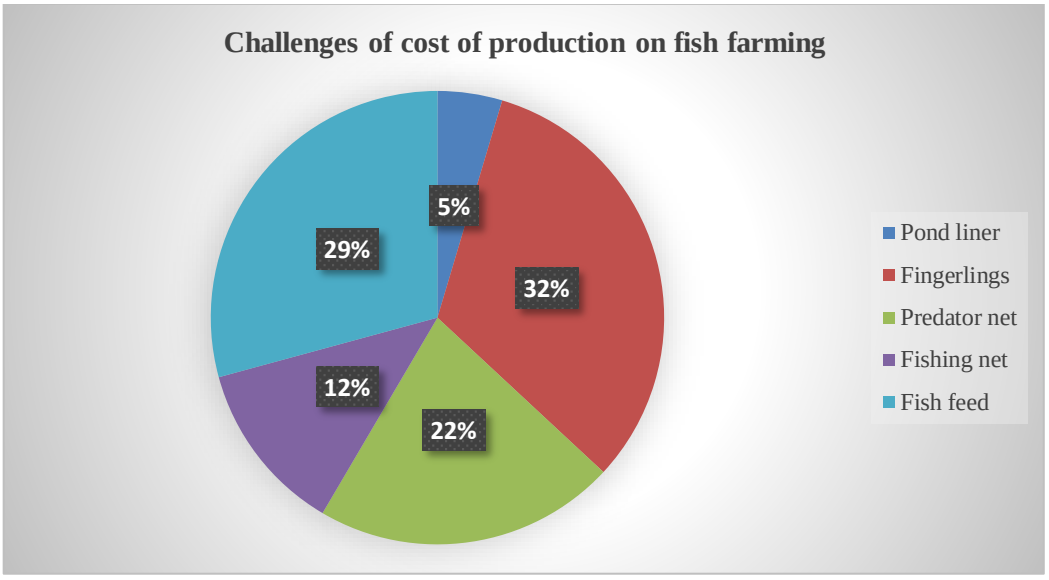
Descriptive statistics was used based on Statistical Packages for Social Sciences (SPSS) software, and results presented using a frequency distribution table to enhance interpretation of data. The qualitative data from in-depth interviews was analyzed by use of content analysis and results used to validate results from the quantitative data.

RESULTS AND DISCUSSIONS

The effect of cost of production on fish farming

The first objective looked at the impact of cost of fish production on fish farming Ikolomani Constituency, Kenya. On ranking their multiple responses, it was found that cost of fingerlings 32.0% and fish feed 29.0% were the most key factors affecting fish farming in the constituency. Other factors included cost of predator net 22.0%, fishing net 12.0%, and pond liner 5.0% as shown in Figure 2.

Figure 2: Cost of production on fish farming



In the in-depth interviews, informants identified the high cost of fish feeds, construction of fish ponds particularly for those who were left out in the initial government programme, unavailability of quality fingerlings and invasive bird pests as the key hindering cost of production factors to fish farming in the constituency. This is happening despite the potential role of fish farming in improving local fish farmer livelihoods (GoK, 2009; FAO, 2017; Oru, 2023). They further urged the County Government to establish easily accessible cooling plant in the constituency for harvested fish to avoid losses. According to Hishamunda & Ridler, (2004) quality feeds and fingerlings, technical labour availability, water resources or reservoirs and financial accessibility are necessary costs to consider in fish farming.

The effect of market availability for fish on fish farming

In examining the effect of market availability on fish farming in Ikolomani Constituency, Kenya, the majority of fish farmers 86.6% pointed out that there is a big market for fish in the County, only 13.4% reported otherwise. This is confirmed in the ICDP 2023-2027 where it was reported that the market for fish is on steady growth in the County (ICDP, 2023).

Figure 3: Modern fish market in Kakamega town

Source: County ICDP, 2023-2027

During in-depth interviews, it emerged that fish farming though has low but growing market in the local rural communities, Kakamega town and other urban centres in the County and beyond present a huge market for fish farmers as fish is a key delicacy among the cosmopolitan town dwellers. This growing market informed

the County Government's decision to establish modern fish market (See Figure 3) for fish farmers and traders, equipped with cooling facilities and a fish factory (ICDP, 2023). Hishamunda & Ridler, (2004); Laube et al., (2008); Kudi et al., (2008) had emphasized the need for planners to assess the market and price competition keenly since fish is a perishable good. The interviewees reportedly urged the County government to sensitize the locals to embrace fish farming since it's a viable source of livelihood and employment for local communities.

Effect of local people's attitude towards fish consumption on fish farming

The third study objective was to assess the effect attitude of local people towards fish consumption on fish farming in Ikolomani Constituency, Kenya. In a 'yes' or 'no' response, fish farmers response to this question was summarized and represented in the table 1.

Table 1: Effect of local people's attitude towards fish consumption

Response	Frequency	Percentage
Yes, if affects	34	56.7 %
No, it doesn't	26	43.3%
Total	**60**	**100 %**

Source: Field data, 2023

Opinion was divided on the effect of local people's attitude towards fish consumption on fish farming in the constituency. It was found that 56.7% of residents believed that negative attitude of locals towards fish consumption had negative effects on fish farming in the area. A significant 43.3% thought otherwise. In the in-depth interviews, the respondents indicated that the Constituency is dominated by highland farmers of Bantu origin who traditionally have limited interaction with fish as a source of food lending to generally low consumption rate in the rural villages where fish farming takes place. A comment on this by one of the key informants (fish farmer representative) from Idakho South puts into perspective:

As farmers we are really trying (to improve fish output) but a number of our people here have other ideas about fish. We would benefit more if our people buy our fish so that we don't have to travel all the way to town (Kakamega Town) to sell.

This could explain the low up-take of fish farming in the Constituency and indeed the larger Kakamega County despite massive investment under the Economic Stimulus Package Programme by the national government. Nouaga (2012) identified negative attitude, lack of training and education as key factors affecting engagement in fish farming. A sizable number of informants explained that the generally negative attitude to fish farming in the area is due to low returns, and cultural orientation of the locals. But the demand for fish is rising owing to the growing population and the changing feeding habits of the local people (ICDP, 2023; Olu, 2023).

CONCLUSIONS AND RECOMMENDATIONS

Introduction

This section gives a summary of the main findings, conclusions and recommendations drawn from the study findings.

Conclusions

Fish farmers decried high cost of production particular of key in-pus such fingerlings and feeds as a key impediment to fish farming in the constituency. Despite low fish consumption in the rural villages, the fish market is big and growing steadily particularly in the more cosmopolitan urban centers in the County and beyond. It is interesting to note that more and more residents believe that fish is a key source of livelihood whose consumption at the local level should be encouraged.

Recommendations

The study recommends that the County government should continue to sensitize locals to change their attitude about fish farming and to appreciate the importance of fish farming in improving food security and household incomes. High cost of fish production brought about by high cost of fish feeds and unavailability of fingerlings should be addressed by the County Government to improve fish farming uptake. Fish farmers should take advantage of the huge fish market in the urban centres around the county to enhance production of fish

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