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Eric M Kaindi
Department of Agriculture and
Veterinary Sciences, South-
Eastern Kenya University
P.O Box 170-90200, Kitui,
Kenya

Grace M Mutia
Department of Hydrology and
Aquatic Sciences, P.O Box 170-
90200, Kitui, Kenya

Titus Kanui
Department of Agriculture and
Veterinary Sciences, P.O Box
2525-90100, Machakos, Kenya

Corresponding Author:
Eric M Kaindi
South-Eastern Kenya University
Department of Agriculture and
Veterinary Sciences, P.O Box
170-90200, Kitui, Kenya

Effects of predation on aquaculture production in Kitui County, Kenya

Eric M Kaindi, Grace M Mutia and Titus Kanui

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Abstract

Fish farming has gained importance in the provision of dietary protein in Kenya. Many challenges have faced the sector from water to predation in semi- arid regions. This study therefore sought to assess the prevalence, the socio - economic impacts and control measures of predators in fish farming in Kitui County. Data was collected from 110 pounds in 7 sub-counties. Data collection involved questionnaires, key informant interviews and field observations. Collected data was analysed using both descriptive and inferential statistics whereby inferences were made informing the study objectives and making conclusions. The study found that fish predation is at 93% level, with major predators being birds followed by reptiles, domestic animals, and wild animals like raccoons. Birds were found to be the major predators at 87%. The study found that 86% of the fish farmers have various predator control measures in place. The various predator control measures employed are only 37.9% effective leading to 69.5% of the fish farmers experiencing financial losses. The study found that fish predation has a negative effect on the socio-economic conditions of farmers. The study recommends that Kitui County government should integrate predator control training or information in their extension programs. Predator control innovations should also be developed to reduce the costs of controlling fish predators in the region. Further study should be undertaken to allow generalization of the study outcomes in other counties in Kenya.

Keywords: Fish predation, Predator prevalence, Socio economic, impacts of predation, Major fish predators

Introduction

Fish farming has evolved into a profitable enterprise globally, providing sustenance and employment opportunities. In many developing countries, fish contributes significantly to animal protein supplies, with approximately 60% of the population deriving over 30% of their protein from fish. Conversely, most developed countries rely on fish for less than 20% of their animal protein supplies (FAO, 2022) ^[1].

Kenya holds significant potential for pond-based aquaculture, particularly for species such as *Oreochromis niloticus* (Nile Tilapia) and *Clarias gariepinus* (African Catfish). Despite an estimated annual harvest of 2 million metric tonnes of fish, accounting for 5% of global aquaculture production (Akoll & Mwanja, 2022) ^[2], this potential remained largely untapped as of 2008, despite approximately three decades of various aquaculture extension services (Ngugi *et al.*, 2017) ^[4].

In Kenya, it worth noting that fish farming has been spreading in non-traditional fish producing areas where high investment in pond construction and maintenance of the ponds has been done. Success in these ponds has been varied due to various factors despite financial and technical support from Government agencies and programmes. Fish farming activities and availability of fish in fish ponds has also brought a challenge of predation. Rothuis *et al.*, (2019) ^[5], noted that the controlled or semi controlled conditions are conducive to the survival of predators. The risk of losing profits due to predator attacks is already manifesting in many fish farms especially in areas where there is extensive fish farming and conditions where predators thrive are manifested (Akoll & Mwanja, 2022) ^[2]. Pemberton *et al.*, (2019) ^[6] undertook a study that looked at predators in marine fish farms in Tasmania. They discovered

that physically preventing predators from accessing the fish is ultimately the sole method to avert the loss of marine farmed fish. Certain bird species present a unique challenge to aquaculture due to their ability to travel vast distances between farms. This mobility increases the risk of spreading disease-causing organisms between geographically isolated farms or from wild animals to farm stock (Musyoka & Mutia, 2016) [8]. Akoll & Mwanja, (2022) [2] on the other hand observed that from their research carried out in Uganda, predators are the key transfer agents for infectious parasites and diseases which affect public and private fish farms. Bacterial pathogens (*Flavibacterium* sp, *Pseudomonas* sp. and *Aeromonas* sp.), were observed to be transferred between fish farms by the bird predators visiting the farms with those farms protected from bird predators being less affected by the disease than those that are not protected (Akoll *et al.*, 2022) [2].

Fish predators have both direct (such as instances where they attack and kill fish in the pond) and indirect (such as cases where they transfer diseases to the ponds) effects. Losses due to fish predator attacks is particularly high in the tropics where mitigative intervention is limited. The risk of losing profits due to predator attacks is already manifesting in many fish farms especially in areas where there is extensive fish farming and conditions where predators thrive are manifested (Akoll & Mwanja, 2022) [2]. Direct damage occurs when predators kill or severely injure fish or other cultured organisms, resulting in their loss from production. Indirect damage, on the other hand, encompasses a range of effects, including non-lethal wounds, chronic stress leading to reduced feeding efficiency or health, transmission of disease-causing organisms such as bacteria, viruses, and parasites, and potential damage to the animal enclosure system resulting in escape. Interestingly, indirect damage often outweighs direct damage in terms of economic loss.

Materials and Methods

The study integrated both observational and quantitative methods. By adopting this design, the researcher was able to

draw inferences of the status of predators' presence, their management and control practices within the study region; hence the mixed methods research design was the most appropriate. The sample size of this study was confirmed to be the entire 120 active polyethylene lined fish ponds under *O. niloticus* in the study region.

Data was collected using structured questionnaires administered to active pond owners. The respondents of the study were from within the Kitui Central, Kitui South, Kitui Rural, Mwingi West, Mwingi Central, Mwingi North Sub Counties, Fisheries extension staff from the county headquarters and the eight Sub Counties formed part of the information source through key informant interviews. 120 fish ponds formed the 110 households that were interviewed as respondents. The research was conducted in Kitui County, encompassing the seven sub-counties: Kitui Central, Kitui West, Kitui Rural, Kitui South, Mwingi North, Mwingi West, and Mwingi Central. Regression was used to determine the relationship between fish predation and socio-economic status of the farmers. Qualitative data on the other hand was analysed through content analysis and presented in prose or simplified tables.

Results

A look at the level of attack by predators presented revealed that majority of the farmers (59%) have experienced 1-10% losses from attack, while a further 36% have had 11-50% losses from predator attack. A further 1.05% experienced 51-70% losses from predator attacks. Incidences of predator attack were observed to be 93% of the fish farms in the county. The types of predators affecting fish farmers in Kitui county are wild birds (87%), domesticated birds (60%), reptiles (39%), domestic animals (36%), human (30%), wild animals (10%), and racoons (1%), ranked on the level of incidence within the farms.

According to majority of the fish farmers (86.4%) birds are the worst predators, with only a small proportion of the farmers indicating domestic animals, wild animals, and reptiles as the worst predators affecting their fish farms

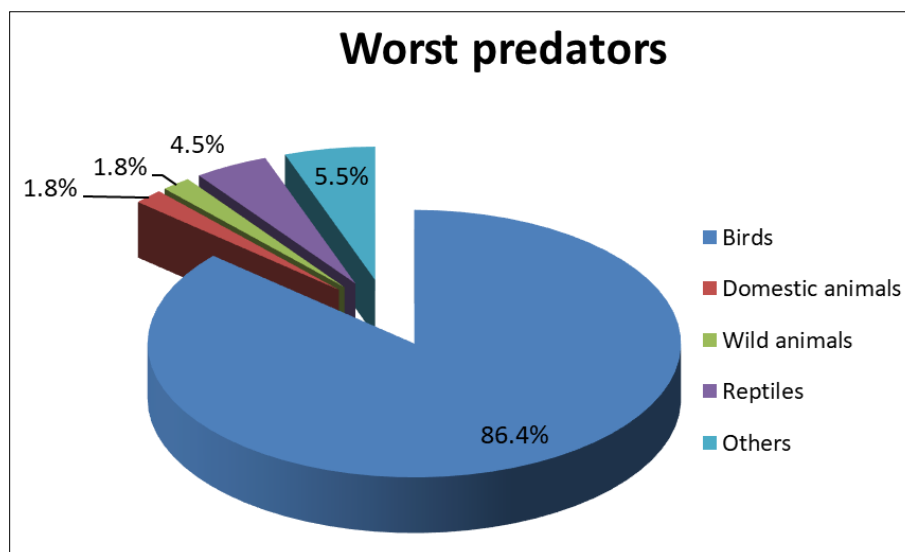


Fig 1: showing severity of predator attaches in fish ponds

According to a majority of the fish farmers (86%), have put in place various predator control measures while only a small proportion of the farmers (14%) have not instituted any predator control measures in their farms.

Investigation on the labour allocation in the fish farms within the county reveals that the control of the predators is left to men in majority of the fishponds (54.7%), with women, children, male and women workers having the predator control role in the rest of the farms. A small proportion of the

farmers have hired labour (15%) in their farms. A large proportion of the farms have males working in predator control (57%), but a significant proportion is female also control predation (43%), with fathers making labour allocation in most of the farms (72.6%).

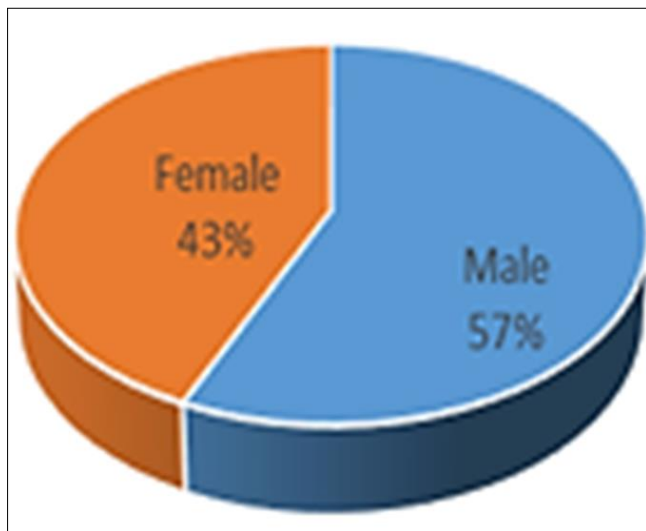


Fig 2: showing predator control undertaken by Gender

Majority of the farmers use a combination of predator control measures like Fencing/Overhead nets/Scare crows (30.5%). A further 22% use fencing combined with overhead nets, while 18% use fencing and scarecrows with a further 12.6% fencing the pond area. Use of overhead nets (8%) and scarecrows (2%) are used by very few farmers

It was observed that those farms that indicated that fish farming is profitable had higher initial investment directed towards predator control and slightly lower annual costs directed to predator control and lower estimated annual losses. Those that indicated that fish farming is not profitable had lower initial investments on predator control, higher annual costs on predator control and higher annual losses, hence their view about fish farming profitability has a direct linkage with fish predation and control activities.

Discussion

There is a very high level of prevalence of predator attacks in fish farming within Kitui County, with 93% of the fish farmers indicating that they have experienced a predator attack, from which they experienced significant losses in their production. The predators observed in the area include birds, reptiles, domestic animals, and raccoons, ranked high in occurrences, with birds being the most prevalent fish predator in fish farms in Kitui County.

It was found that birds caused the highest level of attack on fish farms in the region, with reptiles, wild-animals, and domestic animals having a low scale of attacks. Birds are considered the worst predators in Kitui County. The highest losses were linked to bird predation according to Murugami *et al.* (2018) [7] who observed that bird's litter on dykes of the ponds have been confirmed to play a possible role in the transfer of pathogens into aquatic life with piscivorous birds attacks linked to the transmission of fish parasites, for example digenean parasites, in Kirinyaga County. The results of the Chi-Square test revealed a notable distinction between fish farmers who experienced predation on their fish by predators and those who did not encounter such incidents. This discovery aligns with the research outcomes documented

by Kimathi *et al.* (2013) [11], Shitote *et al.* (2013) [12], and Maina *et al.* (2017), all of whom identified predation by birds and frogs as significant challenges in fish farming.

A large majority of the fish farmers have adopted predator control measures in their fish farms, with fathers having the highest predator control responsibilities while some farmers rely on hired labour to control predators. Various predator control measures are available to the farmers including use of fencing, overhead nets and scarecrows, though the most widely used is the combination of all three measures of fencing/overhead nets/scarecrows. A significant number of farmers use fencing and overhead nets to protect their ponds.

A look at the effectiveness of these measures revealed that use of the two measures together, fencing/overhead nets, has the highest level of effectiveness, followed by combining all the three measures fencing/overhead nets/scarecrows. Use of overhead nets is less effective than fencing the pond area, and use of scarecrows was observed to be the least effective control measure. According to David *et al.*, (2002), fish farming exclusion and barrier technique is the most effective solution for controlling predation. Installing fishnets and fencing the pond area Farmers were found to spend a significant proportion of their initial investment into predator control. Additionally, they indicated that they face significant annual losses due to predation as well as huge costs directed towards predator control and hiring labour committed towards predator management at the farm. It was found that farmers who spent a substantial amount at the initial stages of investment aiming at predator control later spend less in terms of costs towards predator control. This translated to lower losses due to predation, but all the farmers either incurred huge predator control costs or high losses due to attacks.

The study hypothesized that fish predation influences the socio-economic conditions of farmers in Kitui County. The study found that farmers have experienced significant losses to predators' attacks in fish farms and additionally faces major costs trying to control predators that attack their farms, both of which are activities that affect the actual productivity of the fish farm. Major farm activities are observed to be affected by the predation patterns observed in the farms, hence there was a need to confirm this effect and quantify it, which was achieved in this study. The study found that fish predation significantly correlates with the farmers' socio-economic conditions, with the study realizing that fish predation correlates negatively with farmers' socio-economic conditions. Further, fish predation level was found to have the ability to predict 40.7% of the variability in farmers' socio-economic conditions, which could be an indication that increase in fish predation level leads to a significant decline in the farmers' socio-economic conditions.

Conclusion

The study found that there are varying types of fish predators that attack fish and that bird predators are the worst with far reaching destruction of fish stock. The study therefore concludes that fish predation in fish farming within Kitui County is a major problem affecting farmers in Kitui county. It was found that farmers have been employing various mechanisms to control fish predation in their farms, with the combination of exclusion, barrier and deterrent methods (overhead-nets, fencing and use of scare-crows) being observed to have the best ability to control fish predators. However, Nzevu (2018) [9-14] observed that some predators like the Kingfisher damage the control measures destroying

the nets placed to control them before attacking the fish stock. The best control measures were also found to be linked to high initial investment and control costs, which eats into the profit margins for the farmers. Fish predation control was therefore found to be an expensive undertaking for the farmer, and similarly, failure to control predation was also found to lead to great losses in fish stocks for the farmers, thus similarly leading to major losses. Therefore, it is concluded that fish predator control activities adopted by fish farmers are costly but important activities among fish farmers in Kitui County. The study found that fish predation directly leads to decline in profitability of the fish farming ventures in Kitui County. Additionally, farmers were forced to invest time in controlling predation which could be invested elsewhere in the farm, or forced to hire labour to control predators. The farmers are also forced to redirect their funds on various predator control measures in the farm, lack of which would lead to significant losses in the fish stock of the farmer. The study therefore confirms that fish predation significantly affects the socio-economic conditions of the farmers, and fish farmers in the county are significantly affected by the level of fish predation in the area. The study concludes that fish predation is a major problem for fish farmers in Kitui County.

Conflict of Interest

Not available

Financial Support

Not available

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