Predation And Its Associated Risk Factors In Fish Farms In Kirinyaga County, Kenya

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Abstract: Predators cause significant losses in farmed fish operations by directly feeding on the fish, causing injuries and spreading parasites and other diseases. This study assessed the type and extent of predation experienced by farmers, management practices and challenges that predispose fish farming to predation. Questionnaires were administered in October 2016 to 137 farmers in the five sub counties of Kirinyaga County. Tilapia (76%), catfish (21%) and ornamental fish (3%) were the main species of fish farmed with tilapia monoculture being dominant on earthen (56.2%) and plastic liner ponds (40.9%). Feed and water availability, predation and fish theft were production constraints while management constraints included overgrown vegetation, low water levels in ponds, and ineffective predator control. Predators were reported to cause fish loss and injuries to the fish. Piscivorous birds, otters, monitor lizards and snakes were the main predators encountered, with birds causing the greatest losses. Herons (43.8%), kingfisher (37.2%), ibis (29.3%) and hamerkop (29.3%) were the predatory birds of most concern followed by cormorants (11.7%) and egrets (11.7%). Fish predatory birds frequent the farms throughout the year and majority of the farmers (74%) reported to control them by chasing them away. Non-bird predators were controlled using fences in most areas. Knowledge on fish diseases and the role of fish predators in spreading disease and parasites is low among fish farmers and there is a need for capacity building in this regard.

Keywords: Fish farming, predators, cormorants, heron, hamerkop

I. INTRODUCTION

The government of Kenya, through the Fish Farming Enterprise and Productivity Program (FFEPP), invested heavily in the aquaculture sector between 2008 – 2011 by constructing fish ponds, providing fingerlings, fish feed and extension services. This was to increase total fish production as a means to achieve food security under vision 2030. The FFEPP increased small scale aquaculture farming in many regions of Kenya, but the economic returns are still not

realized due to low harvesting weights and other production challenges (Maina et al., 2014). Farmer management practices influence growth of the aquaculture sector and also the health of produced fish (Munguti, Kim, & Ogello, 2014). A profitability analysis study in Uganda (Hyuha, Bukenya, Twinamasiko, & Molnar, 2011) reported small profit margins from fish farms attributed to predation, lack of functional credit facilities, expensive feeds and poor quality of fingerlings. Low profitability has caused some farmers in Kenya to abandon fish farming with ponds becoming health hazards when not managed (Howard & Omlin, 2008).

Predators cause significant losses in farmed fish enterprises by feeding on the fish, causing injuries and act as intermediate or final hosts for parasites (Shitote, Wakhungu, & China, 2012). However, their erratic appearances from time to time, makes it is difficult to exactly quantify losses caused to aquaculture (Harris, Calladine, Wernham, & Park, 2008). Piscivorous birds like cormorants, kingfishers, herons, egrets and pelicans, for example, can remove large numbers of fish from aquaculture facilities and as they move from one pond to another can spread viral, bacterial and parasitic diseases (Barson & Marshall, 2004). Other predators of concern in fish farms include otters, monitor lizards, frogs and snakes that may be found near ponds. Theft and vandalism by humans can also cause alarming losses in aquaculture (Shitote et al., 2012).

Competition between birds and man in fish farming can be high when fish ponds are constructed near bird migratory routes and known flyways. Also, construction of ponds in isolated areas where birds get easy access to fingerlings and presence of vegetation and other perching, nesting and hiding structures for birds increases the level of predation. Removal of these structures and increasing pond shore depth to a minimum of 1 meter with steep banks reduces success of predation (AGRI-FACTS, 1999).

Studies on predator diversity in Kenyan fish ponds and the type of losses caused are few. A survey in coastal Kenya reported egrets, herons, storks, cormorants, ibises and kingfisher to be the major groups of birds visiting small scale fish farms in the region (Ogoma, 2012). Their roles in the life cycle of fish parasites and spread of other diseases have not been adequately established. In order to understand the type and extent of predation and other challenges experienced by fish farmers, it is also important to know how fish farms are managed in order to advise them correctly. The objective of the present study was to assess the type and extent of predation as experienced by fish farmers, and the farming practices that are risk factors to predation in Kirinyaga County, Kenya.

II. MATERIALS AND METHODS

STUDY AREA

This study was conducted in Kirinyaga County (100 km North East of Nairobi, altitude 1230 m, latitude 0°39'S and longitude 37°12'E) which has 1,376 fish farmers with 1,400 active fish ponds covering a total area of 342, 633 hectares (MinistryofFisheriesDevelopment, 2010). The study targeted farmers who owned or managed at least one active fish pond.

SAMPLING

Stratified random sampling was used. Farmers who participated in the study were drawn from the population of fish farmers in all sub counties of Kirinyaga County. A list of fish farmers was obtained from the County Fisheries Department. Those with active fish ponds were identified and chosen based on their availability for the interviews.

DATA COLLECTION AND ANALYSIS

A semi structured questionnaire with both closed and open ended questions was used as the survey instrument. It was used to evaluate the fish farm and owner data, challenges experienced by farmers, types of fish predators encountered and periods they were in plenty. The questionnaire was supplemented with direct visual observations by the interviewers. Global positioning system (GPS) co-ordinates were taken for each homestead included in the study to facilitate researchers to make a follow-up. Questionnaires were administered in October 2016 to 137 farmers from five sub counties of Kirinyaga County as follows; Kirinyaga East (35), Mwea East (34), Kirinyaga Central (29), Mwea West (22) and Kirinyaga West (17).

All the data were cleaned, edited, sorted and entered into the computer using Microsoft Excel 2016. Data were analyzed using the Statistical Package for Social Sciences (SPSS version 16.0) and Epi Info 7 software. Descriptive statistics consisting of frequencies were computed for different data categories to facilitate comparisons.

III. RESULTS AND DISCUSSION

FISH FARMS AND OWNERS' DATA

Majority of fish farmers in Kirinyaga County were male (82.3%), over 50 years of age (77.4%) of whom 74.9% had attained secondary school education and above. Day to day management was made by the owners (67%) and workers (15%) with a few by family members. Of those managing the fish farms, 58.4% reported to have attended some training in fish farming mainly in form of seminars. Of the interviewed farmers, 15.3% had been in operation for less than two years, 39.4% between 3-5 years, 38% between 6-10 years and 7.3% above 10 years. Most farmers (56.2%) had earthen ponds while 40.9% and 2.9% had plastic liner and concrete ponds respectively. Water used for fish farming was sourced from rivers (65.7%), tap water (20.4%), underground springs (7.3%) and boreholes (6.6%). It was also reported that most of the farmers (84%) got into fish farming as a business venture. Many fish ponds in the study area were observed to be poorly managed with overgrown vegetation, poorly fertilized and some with low water levels (Figure 1).

Figure 1: An earthen pond (A) with overgrown vegetation and a poorly managed liner pond (B)

Many fish ponds in Kirinyaga County were overgrown with vegetation which makes it easy for birds and other predators to hide and attack fish. It was also observed that the water level in many ponds was low due to either siltation or lack of frequent topping up. The recommended water depth in fish ponds is 1 meter (AGRI-FACTS, 1999; Ngugi, Bowman, & Omolo, 2007) which makes it difficult for non-swimming birds to land in water. However, in Kirinyaga, it was relatively easy for birds like herons, egrets and ibis to wade through the water hence the high incidences of predation. Scarcity of water in some areas like Mwea West and Kirinyaga West sub-counties also contributed to this problem.

TYPE OF FARMING SYSTEMS AND FUNDING

Tilapia, catfish and ornamental fish were the main species of fish farmed in Kirinyaga County as shown in Figure 2. The first stock of fingerings was sourced from government breeding farms by 66% of farmers and in private farms by 21%. However, 17% of farmers restocked from government farms, 27% from private farms while 40% left the fish to breed in their ponds.
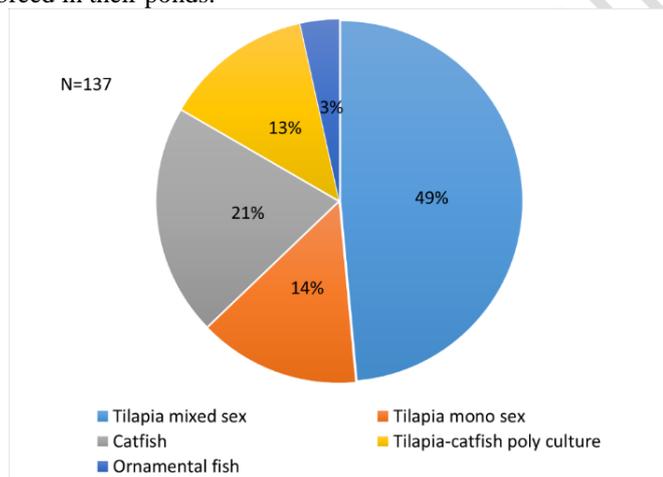

Figure 2: Type of fish species and farming systems in Kirinyaga County

Of the interviewed farmers, 56.2% got their start up capital from the Economic Stimulus Program (ESP), 42.3% were self-funded while 1.5% received funds from non-governmental organizations. Most of the farmers who reported fish farming to be unprofitable were funded by the ESP (Figure 3).
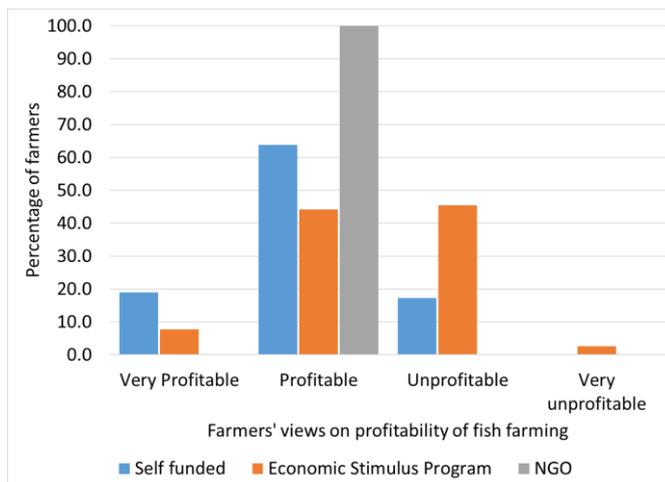

Figure 3: Farmers' views on profitability of fish farming based on source of startup capital. NGO= Non-Governmental Organisation

In agreement to previous studies (Maina et al., 2014; Ngwili, Maina, & Irungu, 2015), tilapia was the dominant species kept by the farmers under monoculture system in the study area. Fish in many areas were small (less than 200 grams) indicating poor management practices. Smaller fish are usually preyed on more by predators than larger fish (AGRI-FACTS, 1999). It was a concern that most farmers funded by the ESP put very little additional investment to the fish ponds. This has led to very low production with most of them viewing fish farming as unprofitable as opposed to those who were self-funded. Many ESP funded farmers are still expecting hand-outs from the government in form of feeds, fingerlings and liners for their ponds. There has been shortage of high quality fish feeds for aquaculture in Kenya hence the dependence on expensive imported feeds and low quality feeds like maize bran. However, with local companies entering the market, this is expected to change with time. Training of farmers and farmers' groups on homemade fish formulations would also be of great assistance.

CHALLENGES EXPERIENCED BY FARMERS

Farmers were asked to rank challenges experienced in fish farming as major, minor or no problem and it emerged that feed availability and predation were major constraints to fish production in all sub counties. Theft was also a major concern among most of the respondents since most fish ponds were constructed far from the homesteads. Mwea West and Kirinyaga West had notably higher concerns of water availability for fish farming than other sub counties. Availability of markets and low fish prices were also considered as major problems. It was evident that not many farmers had encountered diseases in their fish ponds and some were not aware of fish diseases and/or parasites (Table 1).

Challenges	Mwea East	Mwea West	Kirinyaga Central	Kirinyaga east	Kirinyaga West
Feed availability	+++	+++	+++	+++	+++
Predators	++	+++	++	++	++
Low market prices	++	+	+	+	+
Theft	+	+	+	++	+
Water	+	++	+	+	++

availability					
Diseases	+	+	-	-	-

Key: +++ = Major challenge (61-100%); ++ = Challenge (31-60%); + = Minor challenge (1-30%); - = Not experienced

Table 1: Some of the major challenges faced by fish farmers in Kirinyaga

Farmers were asked their suggestions on how to counter the constraints that have hindered maximum productivity in fish farming. The farmers in turn reported that they needed affordable quality feeds (57%), better organization of markets (30%), training on fish farming and management practices (29%), better breeds of fingerlings (17%), subsidies on fish farming inputs (13%), and provision of credit facilities (11%) among others.

TYPE AND EXTENT OF PREDATION

Farmers in various sub counties reported piscivorous birds, otters, monitor lizards, and snakes as the common predators. Among these, birds were of major concern due to their numbers and frequency in the ponds (Figure 4). Herons (43.8%) and kingfisher (37.2%) were the predatory birds of most concern to most farmers. Ibis and hamerkop, both at 29.9% were also reported to cause considerable loss to aquaculture followed by cormorants and egrets, both at 11.7%. Farmers reported that most of these fish predatory birds frequented the farms throughout the year.

Observations were made during the study period to try and identify different water birds that pose a threat to fish farming. Identifications of the species were made with the help of bird keys (Zimmerman, Turner, & Pearson, 2005). For avian fish predators, grey heron (*Ardea cinerea*), pied kingfisher (*Ceryle rudis*), great egret (*Ardea alba egretta*), little egret (*Egretta garzetta*), reed cormorant (*Microcarbo africanus*), sacred ibis (*Threskiornis aethiopicus*), hammerkop (*Scopus umbretta*), and giant kingfisher (*Megaceryle maxima*) were identified in the fishponds (Figure 4). Some farmers reported predation by riverine otters (*Lutrinae spp*) which can be very destructive. Otters attack ponds mainly at night and their presence such as droppings and walking paths were evident during farm visits.

Figure 4: A great egret (A), reed cormorant (B) and grey herons (C) hunting for fish in fishponds in Kirinyaga County

Majority of the farmers (92.7%) were in agreement that predation causes considerable loss to aquaculture facilities. A total of 43.8% of the interviewed farmers agreed that predators can spread diseases and parasites to fish while 41.6% did not know. On consuming raw fish, 51% of the farmers felt it was not right, or could affect a person, 36.5% did not know while 12.4% said there was no issue in consuming raw fish. Most of the farmers (46.7%) did not know if fish diseases can affect humans.

During the study period, we also observed injuries in fish caused by predatory birds while at times birds were seen taking fish from the fish ponds (Figure 5).

Figure 5: A. sacred ibis (Threskiornis aethiopicus) feeding on fish in a fish pond (arrow). B. tilapia fish with a bill wound (large arrow) and a tear on the dorsal fin (small arrow) inflicted by predatory birds. C. a grey heron (Ardea cinerea) with whole fish (white stars) in the stomach

Apart from directly feeding on fish, avian predators cause injuries to fish in case of unsuccessful predation(Reimchen, 1988). Fish may succumb to these injuries or heal with deformities. For food fish, such injuries reduce the value of the fish as they are less likely to be bought by consumers. Removal of fish from the ponds by avians and other predators reduces the profitability of fish farming enterprises. Presence of fish eating birds also completes life cycles of helminth parasites of fish. (Roberts, 2012; Woo, 2006). During the study period, largerfish farms had more water birds compared to smaller ones. Since it was a dry season, birds were migrating from other regions in search of water and food. The presence of the birds was reported to be a big challenge to aquaculture during this time. Mostly, the water birds were in high numbers early in the morning and late evenings.

PREDATOR CONTROL METHODS

Majority of the farmers (74%) reported to control predators by chasing them away when they visit the farms (Table 2). However, this method was not rated as efficient as using pond netting and barbed wire over the ponds to control predators. Pond nettings were reported to be expensive hence only 21% of farmers used them. Some farmers attempted to make nets by passing strings over the ponds. Majority of the farmers (65.7%) were in agreement that killing of the piscivorous birds would be harmful to the ecosystem. Fish ponds with overgrown vegetation and low water levels were more likely to face higher predation challenge than those that were well managed. Farmers had erected fences around their fish ponds in an attempt to control theft by humans and

predation by non-bird species like otters and monitor lizards (Figure 6). However, most of these fences were broken down hence ineffective.

Figure 6: Using pond netting (A, arrow) and fences (B) to control predators in fish ponds

Control method	% usage	Rated efficiency
Chasing away	74	+
Pond netting	21	+++
Guarding of ponds	12	++
Barbed wire	10	+++
Scare crows	6	++
Traps	2	+
Key: +++ = Very efficient; ++ = Moderate; + = Not efficient		

Table 2: Methods used to control predators in fish farms and their efficiency as rated by farmers in Kirinyaga County (N= 137)

Knowledge of farmers about the existence and spread of fish diseases was found to be low with many asking whether fish actually get sick. It will be crucial for fish farmers to be made aware of fish diseases due to the current trends of intensification in fish farming and also importation of brood stocks from other countries. This in due course is likely to introduce new pathogens in Kenyan fish ponds which may lead to devastating losses. Predator control should also be encouraged since some predators including birds spread diseases and parasites to fish (Barson & Marshall, 2004; Ortega-Olivares et al., 2008).

IV. CONCLUSIONS AND RECOMMENDATIONS

Despite the increased interest in fish farming due to the ESP, there are still very little profit margins from many fish farming ventures. Fish farming in many areas has been taken as a side-project rather than a business venture hence low returns. Piscivorous birds play a significant role in the profitability of fish farming but most farmers don't practice effective predator control methods. Knowledge of fish diseases and the role of fish predators in spreading disease and parasites is low among fish farmers in Kirinyaga County.

This study recommends that: Proper predator control methods should be undertaken in fish farms, farmers should be made aware of risks of fish parasitic infestations and other diseases and there is need to consult qualified health experts in such cases. Also, fish farming should be considered as a viable business venture viz side-projects in order to realize returns.

ACKNOWLEDGEMENTS

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