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# Influence of fish species and pond types on prevalence of parasitic infections of farmed *Oreochromis niloticus* (tilapia) and *Clarius gariepinus* (catfish) in Nyeri County, Kenya

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**Abstract**
This study was done with the objective of determining the influence of fish species and pond management practice on prevalence of parasites of tilapia and catfish farmed in Nyeri County, Kenya.
One hundred and seventeen farmers were interviewed to evaluate types of ponds used, species of fish farmed, fish culture, source of water for fish ponds and whether farmers drained and treated their fish ponds after harvesting fish. It was observed that over 53% (n=117) of farmers were using earthen ponds, 62.4 % (n=117) preferred monoculture system. The most popular source of water to either fill or replenish their fish ponds was from a river while 76.9% (n=117) did not bother to drain ponds after harvesting fish.
Using seine nets 366 (89 catfish; 277 tilapia) live fish were caught from 15 fish farms.
Of the 366 fish, 158 originated from liner ponds with 108 from earthen ponds. Different fish organs including Intestines, Eyes, Stomachs, skins, muscles and gills were observed using dissecting microscope for different parasites.
The results indicated that 115 fish were infected with different species of ectoparasites or endo-parasite in the different examined organs, giving overall prevalence of slightly over 31%. Infestation with parasites was significantly higher ($p< 0.05$) in *Oreochromis niloticus* (67.8%) than in *Clarius gariepinus* (32.2%). No significant difference ($p > 0.05$) in parasitic infestation between earthen (52.2%) and liner (48.8%) ponds.
Among the 366 fish examined in the study, 57 had *Dactylogyrus* spp., 30 had *Clinostomum* spp. metacercariae in the muscles, 10 fish were observed to habour leeches on gills while 7 fish had their eyes infested with *Diplostomum* spp. There were other parasites also observed in this study in fish that included *Trichodina* spp. (4 fish), *Paracamallanus* spp. (1 fish), *Acanthocephala* spp. (2 fish) *Gyrodactylid* spp. (2 fish) *Contracaecum* spp. (1 fish) and Gyrodactylid spp. (1 fish).
This study therefore observes that fish pond management practice (types of ponds used, species of fish farmed, fish culture, source of water for fish ponds and whether farmers drained and treated their fish ponds after harvesting fish) and fish species influence prevalence of parasites in farmed fish. These ectoparasites and endoparasites may have both economic and public health implications and a further study on their control is indicated.

**Keywords:** Fish species, pond types, parasitic infections, farmed fish

## Introduction
Infection of fish with external and/or internal parasites is a major constraint to fish production among other factors. Fiovaranti and colleagues (2007) [1] in their study observed that poorly trained field staff, few extension staff as well as inadequate monetary support to the fisheries sector remained as major constraints to fish production. Fish parasitic infestations result in clinical or subclinical manifestations that may end up in economic losses evidenced by reduced production, mortalities and also cost of treatment incurred rises (Rhode 1993) [8].
In Kenya, studies undertaken to determine as well as document parasites infesting fish farms together with risk factors associated with occurrence of fish parasitism are very few.
Fish farmers from Nyeri County use water from the rivers to either feed or replenish their ponds therefore increasing the chances of introducing new parasites to the fish farm.

This study was therefore conducted to asses and determine prevalence together with factors that predispose occurrence of parasitism in catfish and tilapia fish cultured by fish farmers in Nyeri County.

## Materials and methods

### Study area

This work was done in two sub-counties (Nyeri Central and Tetu) of Nyeri County.

### Study design

A longitudinal study was done in 2015 where fish were bought from fish farmers in Nyeri County. Questionnaires targeting fish farmers were administered to asses and determine types of ponds used, species of fish farmed, fish culture, source of water for fish ponds and whether farmers drained and treated their fish ponds after harvesting fish.

### Questionnaire administration

Aquaculture experts were given an already designed questionnaire to ascertain content together with validity. The aquaculture expert views were then incorporated into the questionnaire. Pretesting was done and an updated final version of the questionnaire which included the pre-test results was produced. This final version is what was administered to farmers through direct interviews by four enumerators. One hundred and seventeen (117) farmers were interviewed in Nyeri Central and Tetu sub-counties.

### Study fish

Using seine nets, 366 fish were caught and preserved in a container that contained water from the same fish pond from which the fish was caught from. The fish were shortly examined to check and quantify lesions at the site of capture. The fish were then later transferred to a Veterinary Laboratory for postmortem examination.

### Postmortem examination, parasite characterization and identification

Live fish were stunned and their skin examined grossly to record ectoparasites seen. Thereafter a scrapping of the skin was done and the scrapings examined under a dissection microscope. The parasites seen were recorded. A postmortem examination of all fish was done, and all lesions and parasites noted were recorded. The recovery, characterization and identification of all parasites observed in the study was done according to earlier decscriptions by FAO (1996), Paperna (1995) [6] and Roberts (1989) [7].

## Results

### Risk factors associated with farmed fish parasites

### Fish holding structures used by fish farmers

Most farmers preferred to farm using the earthen type of pond (53.8%) in Nyeri County with 39.3% of the interviewed farmers reportedly using liner ponds, 4.3% concrete ponds and 2.6% using dams for fish farming.

### Fish species and culture method used

Avery significant number of fish farmers (70.9%) practised tilapia monoculture in Nyeri County. Another 24.8% practised tilapia/catfish polyculture while, 4.3% practised catfish monoculture.

### Source of water for fish ponds

Most fish farmers from Nyeri and Tetu sub-counties were using river water for their ponds (63.2%) and piped water (24.8%). Other sources of water were roof catchment water (7.7%), shallow wells (2.6%) and water pans (1.7%).

### Fish pond drainage after harvesting

It was observed that majority of farmers in Nyeri and Tetu sub-counties did not bother to drain the fish ponds post-harvest (76.9%). A small proportion of farmers (23.1%) were draining their fish ponds after harvesting fish through pond outlet (70.4%), pond dyke (7.4%), pumping (18.5%), or through siphoning (3.7%).

### Prevalence of catfish and tilapia parasites in Nyeri County

A total of 366 fish comprising of 277 (75.7%) tilapia and 89 (24.3%) catfish were purchased from farmers. Among the 366 fish examined in the study, 115 of them were infected with either ectoparasites or endoparasites found in muscles, gills, eyes, skin, or the intestines; an overall prevalence of 31.4%. It was observed during the study that 78/115 (67.8%) of the parasite infested fish were tilapia with the remainder 37/115 (32.2%) being catfish. Additionally, 60 (52.2%) of parasite originated from earth ponds with 55/115 (48.8%) coming from lined ponds.

### Prevalence of gill monogenean fluke (*Dactylogyrus* spp.)

The gill monogenean fluke (*Dactylogyrus* spp.) was found inhabiting the gills of tilapia and catfish whereby an overall prevalence rate of 14.8% was recorded during the study. This parasite had a scalloped head. Over 51% of fish infested with *Dactylogyrus* spp. were catfish while, 48.1% were tilapia. Forty-two (42/54; 77.8%) of the fish infested with this parasite originated from liner ponds with the remainder (22.2%) being sourced from earth ponds.

### Prevalence of skin monogenean fluke (*Gyrodactylid spp)*

Catfish were the only fish species from which *Gyrodactylid* spp (monogenean fluke) was recovered infesting the skin presenting with an overall prevalence rate of 2/366 (0.5%).

The morphological appearance of *Gyrodactylid* spp. presented with no eye spots, V-shaped head and a posterior anchoring structure called an opisthohaptor. Only 2/366 fish were infested by this parasite with 1 caught from a earthen pond and the other from a lined pond.

### Prevalence of *Clinostomum* spp

Tilapia fish were the only fish species infested by *Clinostomum* spp. presenting with a prevalence rate of 8.2% (30/366). These parasites were recovered from the skin (they appeared as white, yellowish or orange spots) or on the scales as well as in the muscles appearing as cysts.

### Prevalence of *Diplostomum* species

*Diplostomum* spp. (“eye flukes”) was recovered only on tilapia fish with 7/366 (1.9%) having the parasite. All the tilapia fish with this parasite were from earth ponds. The metacercariae of *Diplostomum* spp. were all recovered from the eye living freely in the vitreous humor.

### Prevalence of *Contracaecum* spp

Only 2 catfish (1 from liner pond and 1 from earthen pond) were infested with *Contracaecum* spp. presenting with a prevalence of 0.5% (2/366).

**Prevalence of *Paracamallanus* spp**

This tiny (<1mm) worm was recovered from the intestines of fish. Of the 2 fish with this parasite, 1 was tilapia (from earthen pond) and 1 catfish (from liner pond) with an overall prevalence of 0.5%.

**Prevalence of Acanthocephalan species**

These worms were only found infecting tilapia fish with all the 3/366 (0.8%) originating from earthen ponds.

**Prevalence of *Trichodinid* spp**

*Trichodinid spp*. were observed infesting skin of fish. These parasites often moved by exhibiting the characteristic scooting motion. Key morphological characteristics were possession of cilia for movement and spherical shape when observed from above the parasite (dorsally). They also possessed a ring and hook like denticles. Both fish species (tilapia and catfish) harbored *Trichodinid* spp and were observed to infest both fish species at a prevalence rate of 1.4% (5/366). Four out of 5 (4/5; 80.0%) of fish infested by this parasite were tilapia while 1/5 (20.0%) were catfish. All the 5 fish infested by this parasite were from earthen ponds.

**Prevalence of leeches**

Leeches infested the gills of both species of fish; catfish and tilapia. Out of 10 fish infested with this parasite, 70% were tilapia while, 30% were catfish.

**Discussion, conclusions and recommendations**

**Discussion**

This study observes that fish pond management practice (types of ponds used, species of fish farmed, fish culture, source of water for fish ponds and whether farmers drained and treated their fish ponds after harvesting fish and fish species influence prevalence of parasites in farmed fish. *Oreochromis niloticus* (tilapia) had higher number infested with parasites (67.8%) than *Clarius gariepinus* (catfish) (32.2%). This difference in prevalence rates was attributed to catfish having a slimy body while tilapia has scales. Parasites don't easily attach to the slimy body of catfish but can easily attach to the scales of tilapia fish. Presence of scales predisposes fish to trematode attachment.

Most fish farmers practiced tilapia monoculture and did not bother to empty their fish ponds after harvesting. Lack of emptying fish ponds after harvesting fish can be a predisposing factor for the infestation and re-infestation of fish by parasites. Pond emptying ensures that the life cycle of parasites is broken therefore preventing their further development.

The most popular source of water to either fill or replenish fish ponds in the two subcounties was from a river (63.2%). In Nyeri County, earthen ponds are constructed in such a way that a stream enters (inlet) and exits (outlet) the fish pond. This is a way to conveniently provide water to the earthen ponds. Lined ponds were either filled or replenished by use of tankers refilled with stream water. Untreated river water may carry with it infective stages of parasites. Effective and efficient fish farm management practices lead to improved water quality, reduced disease risk, fish quality and economic viability of farmers (Mohan *et al*., 2010).

There was no significant difference ($p>0.05$) between parasite infection rate between fish from earthen ponds (52.2%) compared to those from liner ponds (48.8%). The weeds growing in close proximity of ponds offers a favorable environment for snails (intermediate hosts of trematodes) to thrive and enhance trematode propagation

*Dactylogyrid* spp infestation rate (77.8%) of lined ponds was significantly higher than that of earth ponds (22.2%). Most monogeneans spread through releasing of eggs which hatch into free swimming larvae. These free-swimming infective larvae are abundant in liner ponds because their water is stagnant and allows multiplication and concentration. In Nyeri County, earthen ponds are constructed in such a way that a stream enters and exits the fish pond. The continuous flow of water through earthen ponds does not favour multiplication and concentration of infective larval stages since most might have been carried away by flowing water therefore less infestation rates in earthen ponds.

Only tilapia fish were infested with *Clinostomum* spp in the skin with catfish being not infested at all by this parasite with an overall infection rate of 8.2%. Abundance of common snails (intermediate hosts) around earthen ponds and higher stocking densities of earth ponds was probably the reason more tilapia than catfish were infested with this parasite. These parasites seemed to prefer infesting tilapia fish over catfish with their predilection site being encysting under the scales.

There was a significant difference between fish from earthen ponds infestation by *Clinostomum* spp. (90.0%) and liner ponds (10.0%). The weeds growing in close proximity of ponds offers a favorable environment for snails (intermediate hosts of trematodes) to thrive and enhance trematode propagation. A poor fish pond management practice allows a good environment for multiplication and concentration of the parasites.

*Trichodinid* spp was noted infesting tilapia and catfish in the skin presenting with an infestation rate of 1.4%. Earthen ponds had a higher infestation rate with this parasite compared to lined ponds. The higher parasite infection rate in earthen ponds was probably due to inadequate pond management which includes low pond water, non-emptying of ponds after harvesting, unfavorable environmental conditions and pollution which encourage propagation of parasites.

*Leeches* were recovered in gill chambers of tilapia and at an overall infection rate of 2.7% with tilapia having significantly higher prevalence rate (70%) than catfish (30%). The difference between tilapia and catfish could not be explained during this study.

*Diplostomum spp*. (digenean eye fluke) (*Diplostomum* spp.) only infested tilapia (Recovered in vitreous humour of eyes) but not catfish at an infestation rate of 1.9% (7/366). Occurrence and presence of *Diplostomum* spp. has a direct relationship with density of its intermediate host – the snail (Voutilainen *et al*. 2008) [9]. This parasites presence in tilapia was an attestation that the common snails (intermediate host) including *Bulinus, Melanoides* tuberculate and truncates *Lymnnae* were present close to ponds.

An observation was made that only fish from earth ponds harbored *Diplostomum* spp. Poor pond management which encourages propagation of these parasite could be the reason fish from earthen ponds had a higher infestation rate with this parasite

*Contracaecum* spp. larvae were observed infesting the abdominal cavity in catfish and non was recovered from tilapia with overall infection rate of 0.5%. Catfish are omnivores and majorly feed on a high number of intermediate hosts as well as other fish that are infested, in the event

accumulating more worms (Malvestuto and Ogambo-Ongoma 1978) [3]. Tilapia are more of herbivores and as such may not get infected or may not accumulate these parasites from the environment directly.

The *Paracamallanus* spp. infested the intestines of *Oreochromis niloticus* and *Clarius gariepinus* fish giving an overall infestation rate of 0.5%. Infestation with this parasite showed no significant in infestation rates among fish species and pond types.

**Conclusions**

1. Using earth ponds favors infestation by fish parasites.
2. Monoculture practices offer favorable conditions for the development and infection of fish by parasites.
3. Untreated river water may be a source of infective larvae for fish.
4. Un-emptying of ponds after harvesting exposes fish to parasitic infections.

**Recommendations**

1. Use of liner ponds reduces exposure to fish by parasites
2. Treat water for fish pond use to reduce exposure to fish parasite infection
3. Encourage emptying of ponds after harvesting of fish

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