Review On *Capillaria* And *Camallanus* Nematode Parasites Of Fresh Water Fish In Ethiopia

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Summary: Ethiopia is a country in the horn of Africa endowed with numerous aquatic resources, including over 20 natural lakes, 12 large river basins, over 75 wetlands, and 15 reservoirs. Lake Tana is the largest lake in the country and the source of the Blue Nile River which is stocked with various species of fishes. Fish are a huge group of animals, represented by over 28 000 different species. They are the oldest as well as the largest group of vertebrates. They are characterized by being almost exclusively aquatic throughout their lives. They are limbless, but have two sets of paired fins as well as a variety of single fins. Nematodes are commonly known as roundworms as they are slender, unsegmented worms and round in cross section, nematodes are an amazingly abundant and successful animal group, particularly in the aquatic environment. *Camallanus* and *Capillaria* are the most common nematodes affecting fishes. The genus *Camallanus* is smooth, cylidrical and relatively short round worms than the *Capillaria* worms. Whereas Capillaria is characterized by smooth, cylindrical, large and relatively long roundworms commonly found in the gut of the fish and it is often recognized by its double operculated eggs in the female worm. Nematodes are frequently regarded as one of the most important and harmful worm parasites deprive their host of food and can feed on host tissues, sera and blood causing emaciation and anaemia the two most common clinical signs in fish. Diagnosis or identification of nematode parasites of fish can be made by complete necropsy of a representative sample of the affected population or by biopsy of external lesions. The paikilothermic nature of fish and the variability of the aquatic habitat cause important environmental effect on the physiology and disease process of fish. These same variables frequently have directly effect on the use of chemotherapeutic agent against fish disease. Prevention is always the best option, especially against those species of nematode that infect areas other than the gastrointestinal tracts of fish.

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Introduction

In a world where more than 70% of the planet is covered with water from that 97.5% water on earth is salt water and only2.5% is freshwater.98.8% of that water is in ice and ground water. Less than0.3% of all freshwater is in rivers, lakes, and the atmosphere (Bibi *et al*., 2015).

Ethiopia is a country in the horn of Africa endowed with numerous aquatic resources, including over 20 natural lakes, 12 large river basins, over 75 wetlands, and 15 reservoirs. Micro and macro-dam construction and river impoundment have created innumerable large and small water bodies. Both inland capture fisheries and aquaculture activities are concentrated around the many lakes and rivers in the Rift Valley, as well as around the Blue Nile, which supplies water to the country's largest water body, Lake Tana (Yalew *et al.*, 2015). Most of the lakes are located in the Ethiopian Rift Valley depression, which is part of the Great East African Rift Valley system. However, Lake Tana, the largest lake in the country and the source of the Blue Nile River, is located in the northwest plateaux outside the Rift Valley. These lakes and rivers are stocked with various species of fish (Abdurhman, 2002).

Fishes are the major sources of food accounting from some 25% to 30% of the total animal protein consumed. Even when consumed in small quantities, fish often comprises a nutritionally important part of many people's diets in developing countries. It is a vital source of protein and micronutrients, and improves the quality of protein in largely vegetable and starch-based diets by providing essential amino acids (Tadlo, 2017).

Aquaculture is growing rapidly worldwide than all other food animal producing sectors. The production has increased from representing 9% of the fisheries resources in 1980 to a current 43%, actually and, it is thought that production will need to double in the next 25 years. It promotes not only for being an important source of money, but also for its great contribution to food security and social development of many countries (Muktar *et al*., 2016).

The aquaculture farms in Ethiopia are small-scale, subsistence-oriented and only to a certain degree commercial. It is estimated that there are more than 1300 subsistence fish farmers in Ethiopia with a pond size of about 100–300 m². The main species farmed is tilapia. Most pond fish farmers combine fish farming with irrigation, crop farming and horticulture. Candidate species for aquaculture include tilapia (*O. niloticus*) and the African catfish (*Clariasspp*) (Yalew *et al.*, 2015).

Now a day one of the greatest challenges in our world is providing adequate food for a rapidly increasing human population. The problem is particularly acute in countries like Ethiopia where, besides population explosion, natural and manmade calamities have aggravated the problem. In addition to increase food production from land agriculture, it is necessary to sustainable exploit the aquatic ecosystem to contribute towards the effort of food security by virtue of their high productivity. Ethiopian's fish resources could undoubtedly offer one of the solutions to the problem of food shortage in the country (Tadlo, 2017).

The fish sector makes a vital contribution to the food and nutritional security of 200 million Africans and it provides income for over 10 million people engaged in fish production, processing and trade. However, fish diseases are very important aspects of modern fish farming given the enormous impact on profitability and also cause of human diseases in many areas of the world (FAO, 2003).

The occurrence of a wide variety of fish diseases remains a major constraint to successful economic development. Diseases of fish are known to cause productivity losses from high mortality, both in aquaculture and extensive inland fisheries aside from being causes of human diseases in many areas of the world. Fish parasites are among the major pathogens, which cause fish diseases and spoil the appearance of fish thus resulting in consumer rejection (Gulelat *et al*., 2013).

The appearance and development of a fish disease is the result the interaction among pathogens, host and environment. Therefore, only multidisciplinary studies involving the characteristics of potential pathogenic microorganisms for fish, aspects of the biology of the fish host as well as a better understanding of the environmental factors affecting such cultures, will allow the application of adequate measures to prevent and control the main disease limiting fish production (Muktar *et al*., 2016).

Several groups of parasites belonging to helminths, arthropods, protozoans and other groups of miscellaneous taxa are known to infect fish and produce harmful effects on their hosts. Parasitic Nematode worms are large group of parasites, being mostly encountered in marine fish. Some nematode species infest fish as adults, while others as larvae; for the latter, the final hosts are various fish-eating vertebrates (predator fish, amphibians, reptiles, birds, mammals). Fish are either the intermediate host of nematodes, or the secondary and accumulation host (Aurelia *et al*., 2013).

The fish infected with nematode parasites do have atrophied gonads and distended abdomen that might contribute to poor swimming then ultimately to high chance of predation. Fish parasites have direct impact on the fish population dynamic because they render reproduction, predation and competition within and between species. Nematodes also cause an economic threat to the market value of fish, through consumer attitudes towards the presence of these parasites within food products. Infected fillets are rejected and can increase production costs (Leela and Rama, 2014).

Therefore the objective of this seminar paper is:-

- ❖ To review the common nematode parasites of fresh water fish in Ethiopia.
- ❖ To highlight the control and prevention options of the nematode parasites.

Litrature Review

Fish

Fish are a huge group of animals, represented by over 28 000 different species. They are the oldest as well as the largest group of vertebrates. They are characterized by being almost exclusively aquatic throughout their lives. They are limbless, but have two sets of paired fins as well as a variety of single fins. They breathe predominantly by using organs known as gills. They are cold - blooded (poikilothermic), which means their body temperature varies with that of their surroundings. Their skin is usually covered with scales. Most temperate freshwater fish are called teleost (true bone) fish, which means that they have a bony skeleton. The only fish found in temperate freshwater that do not belong to this group are the sturgeons and the lampreys. Neither of these groups is found commonly in still - waters, although a few species of sturgeons have been introduced into still - waters in recent years (Ashley and Robin, 2010).

Anatomy of fish

The operculum or gill cover provides physical protection for the gills but is also an actual component of the respiratory mechanism. Foreshortened opercula are a problem in many species and can be either genetic or environmental in origin (Hamish, 2010).

The fish gill is a multipurpose organ that, in addition to providing for aquatic gas exchange, plays dominant roles in osmotic and ionic regulation, acid-base regulation, and excretion of nitrogenous wastes. Thus, despite the fact that all fish groups have functional kidneys, the gill epithelium is the site of

many processes that are mediated by renal epithelia in terrestrial vertebrates. Indeed, many of the pathways that mediate these processes in mammalian renal epithelial are expressed in the gill, and many of the extrinsic and intrinsic modulators of these processes are also found in fish endocrine tissues and the gill itself (Evans *et al*., 2005).

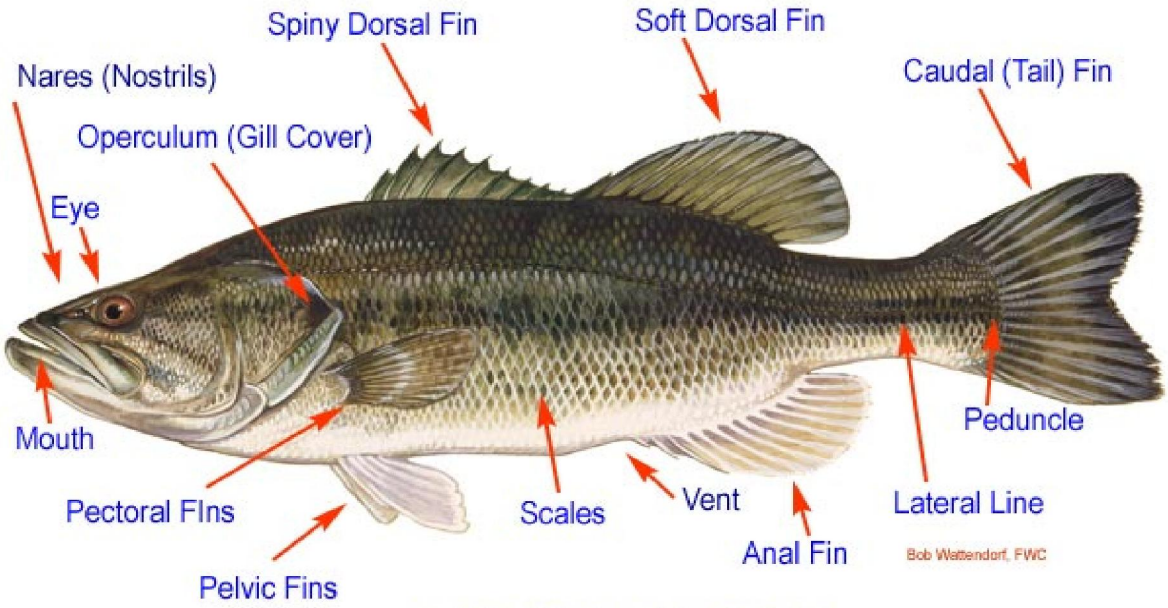

Figure 1: External anatomy of fish (Jennifer, 2008)

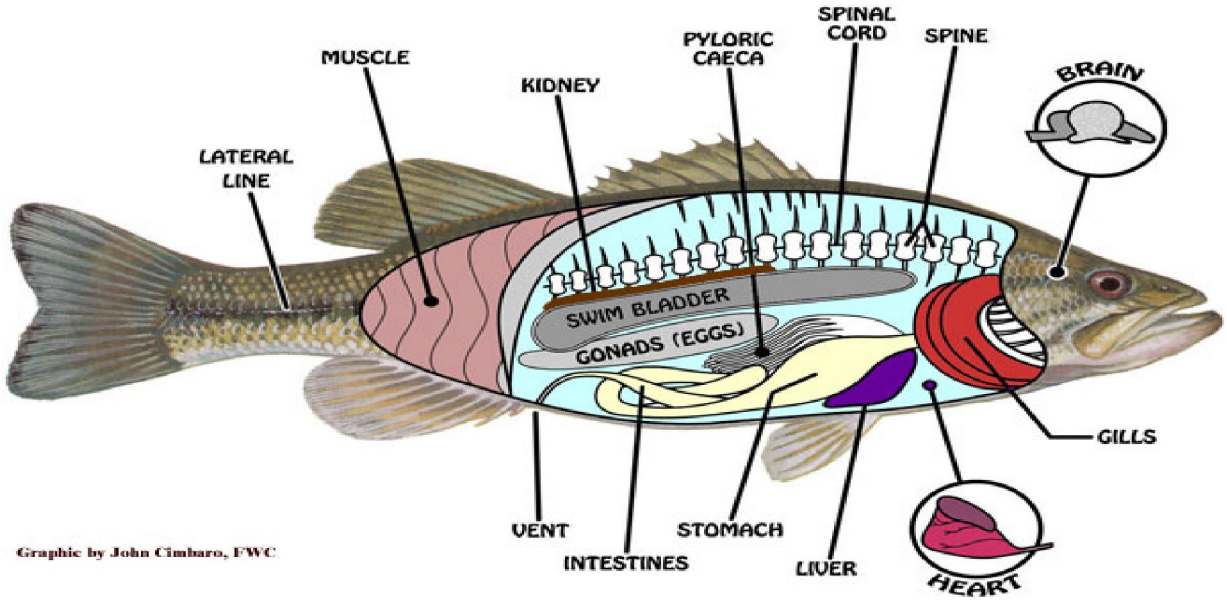

Figure 2: Internal anatomy of fish (Jennifer, 2008)

Most fish use fins for movement and have a streamlined body for navigating through water. Often, their skin is covered with protective scales. Fish have well-developed sensory organs allowing them to see, taste, hear, smell and touch. In addition, most fish have lateral lines, which sense pressure differences in the water. Some groups can even detect electrical fields, such as those created by heartbeats of prey species. However, their central nervous system is not as well developed as in birds or mammals (David, 2011).

Fish have almost the same organs as terrestrial animals; however, they also possess a swim bladder. The swim bladder is a flexible-walled, gas-filled sac

located in the dorsal (top) portion of a fish's body cavity. It is an internal organ that contributes to the ability of a fish to control its buoyancy, to stay at a chosen water depth, ascend, or descend without having to waste energy. It is also a weightless, or buoyant, body requires a minimum of energy to keep it at a given depth, and because a weightless body requires less energy than a weighted body to move at a given speed, many fishes have evolved a swim- bladder (Jennifer, 2008).

The lateral line is the main vibration sense organ running down the length of a fish's body. It is made up of a series of microscopic holes located just under the scales of the fish. One of the fish's primary sense organs, the lateral line can sense low vibrations in the water, and is capable of determining the direction of their source (Diane, 2013).

Physiology of fish **.**

The majority of fish species uses the gill as the primary site of aquatic respiration. Aerial breathing species may use the gill, swim bladder, or other accessory breathing organs (including the skin). The fish gill evolved into the first vertebrate gas exchange organ and is essentially composed of a highly complex vasculature, surrounded by a high surface area epithelium that provides a thin barrier between a fish's blood and aquatic environment (Abdurhman, 2002). The entire cardiac output perfuses the branchial vasculature before entering the dorsal aorta and the systemic circulation. The characteristics of the gill that make it an exceptional gas exchanger are not without trade-offs. For example, the high surface area of the gills that enhances gas exchange between the blood and environment can exacerbate water and ion fluxes that may occur due to gradients between the fish's extracellular fluids and the aquatic environment (Evans *et al*., 2005).

Almost all female fish lay eggs that develop outside of the mother's body. Male and female fish both release their sex cells into the water. Some species like tilapia maintain nests and provide parental care and protection of the eggs, but most species do not attend the fertilized eggs which simply disperse into the water column. Fish pass through the life stages of egg, larvae, fry and fingerling, juvenile and adult fish (Guimaraes *et al*., 2005).

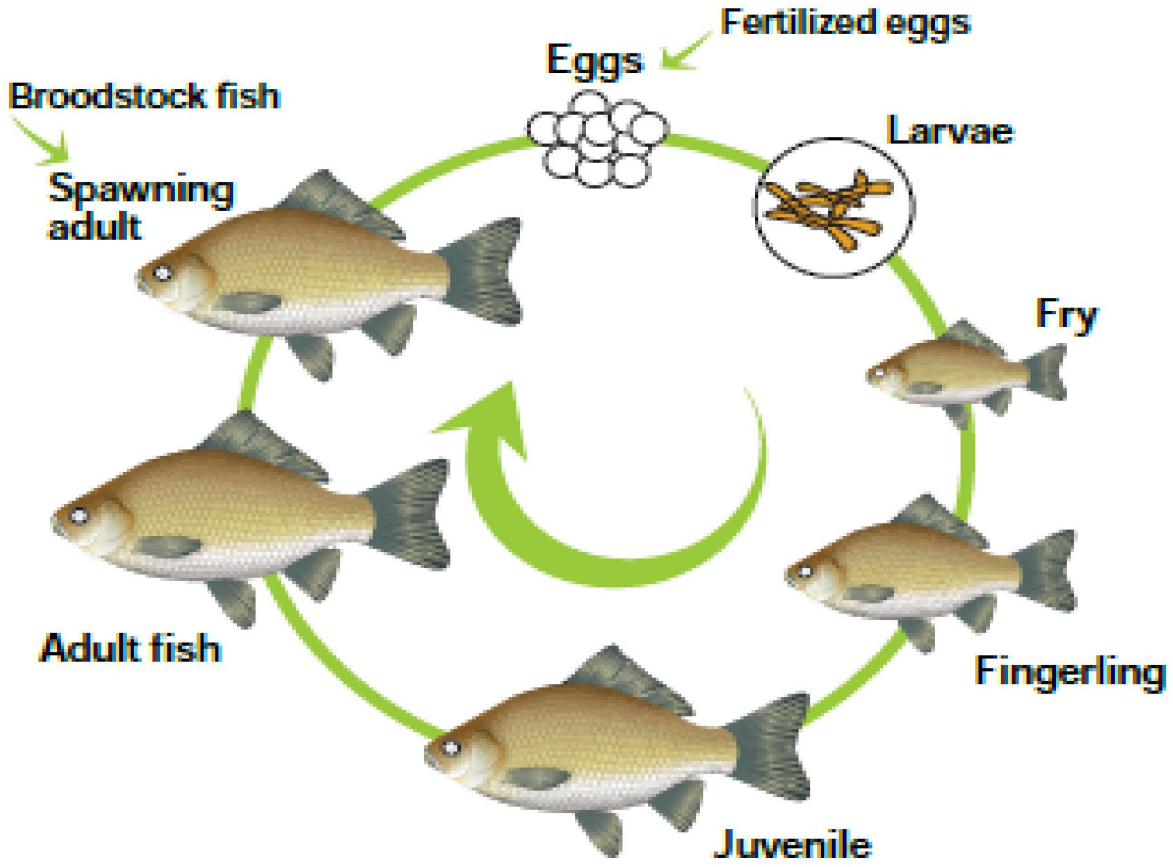

Figure 3: reproduction cycles of fish (Prosser, 1991)

Capillaria and Camallanus Nematode Parasites Fish:

Fish helminthes parasites are generally found in all freshwater fishes. The parasite prevalence and intensity depend on many factors like parasite and its life cycle, host and its feeding habits and the physical factors of water body where the fish inhabit (Bibi *et al*., 2015). The parasitic diseases, either alone or in conjunction with other environmental stresses, may influence weight or reproduction of the host, alter its population characteristics or affect its economic importance. Parasites occupy a definite position in the animal kingdom for their remarkable adaptations and damaging activities to host. The importance of parasite is related directly to the fish that may affect the general public health (Leela and Rama, 2014).

Nematodes are commonly known as roundworms as they are slender, unsegmented worms and round in cross section, nematodes are an amazingly abundant and successful animal group, particularly in the aquatic environment. They tend to be small and a similar colour to their environment and are therefore often overlooked. They have a firm outer skin, which means their movements have a characteristic thrashing motion (Ashley and Robin, 2010).

They are very distinctive in shape, with a solid cuticle. Because of their resistant cuticle these worms last longer than flatworms in post-mortem conditions. Most adult forms are large enough to be visible to the naked eye (Abowei, 2011).

Nematodes are the most common parasites found in marine fishes. Potentially all freshwater and brackish water fish may be affected, with heavier infections in predatory fish, particularly in species also utilizing fish as intermediate or transient hosts. Forty (40) species of adult nematodes, representatives of families from fish in Africa, have been reported. The majority occur in the alimentary system and only few enter tissues or inner cavities (Philometridae and Anguillicola, occur in the swim bladder) (Anthony *et al*., 2014).

Camallanus and *Capillaria* are the most common nematodes affecting fishes. The genus *Camallanus* is smooth, cylidrical and relatively short round worms than the *Capillaria* worms. They are easily recognized as a small reddish thread-like worm protruding from the anus of the fish.

Whereas *Capillaria* is characterized by smooth, cylindrical, large and relatively long roundworms commonly found in the gut of the fish, often recognized by its double operculated eggs in the female worm (Kelvin, 2015).

Distribution

Nematodes have been shown in fish stock in Africa, North America, South America, Europe and Russia**.** *Procamallanus laevionchus* and *Paracamallanus cyathopharynx* are parasitic on *Clarias*gariepinus and also occur in the same host in the Near East *Capillaria* larvae often develop in oligochaetes (tubificids) and may also be transmitted via a parataenic piscine host. Larvae of some species (*Capillaria pterophylli*) infecting several South American cichlids will, however, reach their definitive hosts without an intermediate (Moravec, 1987).

Pathogenesis

The severity of disease in fish will vary depending upon: the life stage, species, and number of nematodes present; age and species of infected fish; and the sites of infection. Nematode parasites frequently occur within the viscera and body cavity of fish especially intestine, therefore, they usually damage the gastrointestinal tract (Trusfied, 2005). Mechanical damage to the mucosa and submucosa by nematode migration and proteolytic damage from nematode enzymes are common. *Capillaria* which attach to and feed on the intestinal mucosa causes massive infections or extensive inflammation of the mesentries. Infections by *Camallanus* are abundant and heavy particularly in the stomach (mucosa of stomach) due to the presence of buccal capsule used for firm attachment (Leela and Rama, 2014).

Life cycle:

Sexual maturity of the nematodes is reached through a complicated multi-host life cycle. Any disruptions to these cycles prevent the development of the adult nematodes. Life cycle differ depending upon the species of nematode. There are two major categories of nematode life cycles. These are direct and indirect life cycle. *Capillaria* species possess direct life cycle (the infection can spread directly from one fish to another by ingestion of infective eggs). In the case of *Camallanus* species indirect life cycle is common (needs an intermediate host of crustaceans and the fish act as a final host) (Roy, 2104).

Clinical sign:

Nematodes are frequently regarded as one of the most important and harmful worm parasites deprive their host of food and can feed on host tissues, sera and blood causing emaciation and anaemia the two most common clinical signs in fish. Clinical signs of nematode infestation vary and can range from deformed body shape, haemorrhage, mortality, traumatic enteritis, loss of balance through damage to their swim bladder, reduced swimming performance, lethargy, reduced sexual display rate, ulceration of gill cover, fraying of fins, large nodules on the ventral surface of the skin, atrophy or destruction of gonads, ascites, distension of the abdomen, and fish can be seen swimming or floating on their sides. Infected fish can be more susceptible to decreased oxygen content in the water ((Leela and Rama, 2014).

Diagnosis

Diagnosis or identification of nematode parasites of fish can be made by complete necropsy of a representative sample of the affected population or by biopsy of external lesions. An alternative to necropsy for identification of intestinal infections is collection of fresh fecal samples followed by microscopic evaluation for presence of nematode eggs, larvae, or adults (Zhokhouv and Mironovsks, 2007). Feces to be examined must be absolutely fresh, since feces that have been in a tank for even just a few minutes may contain free-living nematodes that are not parasitic and are not a concern for fish health. Even though periodic checks of brood stock and juveniles can be made by examining fresh fecal matter for the presence of nematode eggs or larvae, the sacrifice and necropsy of a small representative group of fish is the most informative method (Roy, 2014).

Control and prevention:

To take the necessary controlling measures, on the fish parasites of the fish stock. It is extremely important to achieve early discovery of what type of parasites are available, what is their magnitude and impact on the fish stock (Edward, 1999). The principles of disease control in fish are basically similar to those applied to higher vertebrates. The paikilothermic nature of fish and the variability of the aquatic habitat cause important environmental effect on the physiology and disease process of fish. These same variables frequently have directly effect on the use of chemotherapeutic agent against fish disease (Woo, 1995).

Prevention and control of fish diseases in Aquaculture is high priority in aquaculture industry. Unlike treating human or other animal diseases, few drugs are available for treating diseases in fish. Therefore, Control of diseases in aquaculture and fish farms relies on a combination of good management practices, use of the few approved and commercially available drugs and vaccines and prevention of infection (Muktar *et al*., 2016).

Destruction or reduction of a link in the transmission cycle used to control infectious disease of fish to a limited extent when involving animal parasites. Each stage of development in each host offers a possible means of disrupting the transmission of the parasite. However, eliminating a link in the transmission cycle may not be feasible, because it may mean the elimination of protected animlas or birds or of a crustacean or mollusk which cannot be eliminated. So destruction or reduction of life cycle of fish pathogen should always be considered when methods of disease control are being judged (Post, 1987).

Prevention is always the best option, especially against those species of nematode that infect areas other than the gastrointestinal tracts of fish. Ponds that have not been cleaned or sterilized prior to restocking are at greater risk of harboring large numbers of intermediate hosts. So cleaning and sterilizing ponds is an effective way of reducing the numbers of the intermediate hosts of some nematode species (Edward, 1999).

Conclusion And Recommendations:

Ethiopia is a country in the horn of Africa endowed with numerous aquatic resources, including over 20 natural lakes, 12 large river basins, over 75 wetlands, and 15 reservoirs. Lake Tana is the largest lake in the country and the source of the Blue Nile River which is stocked with various species of fishes. The appearance and development of a fish disease is the result the interaction among pathogens, host and environment. Therefore, only multidisciplinary studies involving the characteristics of potential pathogenic microorganisms for fish, aspects of the biology of the fish host as well as a better understanding of the environmental factors affecting such cultures, will allow the application of adequate measures to prevent and control the main disease limiting fish production. Sexual maturity of the nematodes is reached through a complicated multi-host life cycle. Any disruptions to these cycles prevent the development of the adult nematodes. Life cycle differ depending upon the species of nematode. Nematodes are frequently regarded as one of the most important and harmful worm parasites deprive their host of food and can feed on host tissues, sera and blood causing emaciation and anaemia the two most common clinical signs in fish. The principles of disease control in fish are basically similar to those applied to higher vertebrates. The paikilothermic nature of fish and the variability of the aquatic habitat cause important environmental effect on the physiology and disease process of fish. These same variables frequently have directly effect on the use of chemotherapeutic agent against fish disease. Therefore, based on the above conclusion the following recommendations are forwarded:

- ❖ Strategic control measures targeting to break the lifecycle of nematode parasites should be designed and applied in the study area.
- ❖ Presence of nematode parasite from fish indicates pollution of the Lake so that sanitary measures around the Lake should be taken by the concerned authorities and organization,
- ❖ Husbandry practice (water quality assessment and feed and feed delivery management) and health management should be also performed.
- ❖ Further detailed studies should be conducted on the epidemiology and ecology of nematode parasite.

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