

AN OBSERVATION ON THE ACQUISITION OR LOSS OF TREMATODE
(*Clinostomum tilapiae*) BY TILAPIA (*Oreochromis niloticus*)
IN CULTURE SYSTEMS

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Abstract

The acquisition or loss of *Clinostomum tilapiae* parasites by *Oreochromis niloticus* was studied. Four groups of 25 healthy fishes were stocked in the upper part of serial experimental ponds, while another four groups of 25 infected fishes were also stocked at the rear part of the serial experimental ponds. All the groups were fed at 3% body weight with the same compounded fish feed. Acquisition or loss of parasites and growth was monitored for a period of six months. The mean relative growth rate was 11.04kg/month for the healthy fishes and 5.62g/month for the infected fishes. The mean specific growth rate was 38.75% and 31.25% for the healthy and infected groups respectively. However the results were not statistically significant ($p > 0.05$). The Parasite did not multiply on the host body rather the infection rate reduced from 100% to between 44 and 78%, parasite burden was reduced from an average of 3 per fish to 2.25 while the healthy fish acquired the parasite and the average burden was 2.15. The mean values of the prevailing water quality parameters were within the optimum range acceptable in fish culture systems in the tropics.

Key words: Tilapia, Trematode, infection.

Introduction

In fish culture, the intensive system allows high standing crop biomass, which is highly prone to disease occurrence. Similarly, in the extensive system, especially in reservoirs and undrainable ponds, this unhealthy environment favours parasitic infections, which may greatly reduce yield and market value of harvested fish. It is therefore imperative to monitor fish health in any fish culture system for improved production. Digenetic trematodes particularly *Clinostomum tilapiae* has been known to infect tropical fish species and it is commonly recognized in the West African region (Okaeme 1991; Awa *et al* 1990; Adeyemo, 2001). The impact exerted by this parasite on different fish species could be mechanical, chemical or physical, which may predispose to other diseases sometimes responsible for massive fish losses. Infection by *Clinostomum tilapiae* is of economic and zoonotic relevance in confined fish populations because digenetic trematodes have epidemiological characteristics of being encysted in various intermediate hosts like domestic/wild animals or birds and sometimes man. (Chung *et al.* 1995). This study was carried out to ascertain the acquisition or loss of *Clinostomum tilapiae* within a single rearing period and growth of *Oreochromis niloticus* in ponds overgrown with weeds.

Materials and Methods.

Eight serial experimental ponds of 2.5m x 2.5m x 0.5m were used to conduct the study in the teaching and research farm of Department of Wild life and Fisheries Management University of Ibadan, Ibadan. These ponds were already silted and overgrown with weeds, a condition considered favourably to parasitic infection. The only management practices carried out was the clearing of the weeds inside and around the ponds and seining was done to get rid of adult fish. The ponds were thus impounded and the water analyzed (Boyd, 1979) and stocked with healthy fish at the upper part of the serial ponds and the infected *Oreochromis niloticus* at the lower part. The fish were fed with prepared feed at 3% body weight for 6 months. The caudal fins were nipped as a sort of tagging to avoid sampling stray fish. Sampling was done monthly till the end of the experiment. At the end of the experimental period, healthy fish were examined for parasite acquisition and the infected fish examined for loss of parasite. The relative and specific growth rate were determined (Brown and Gratzeki 1980).

Results and Discussion

The major factors influencing the occurrence of infection in rearing systems, especially earthen ponds include aquatic weed bloom and siltation (Hazen and Esch, 1978). These features were obvious in the serial experimental ponds during this study. This environmental condition favoured the infection of *Clinostomum tilapiae* because the healthy fish stocks were able to acquire the parasite as at the end of the rearing period. The establishment of helminthic infection was observed by within a growing season of rearing Rainbow trout (*Salmo gairdneri*) in cages. The healthy ones also lost attached parasites due to grooming, at the end of the experimental period, all the fish stock were carriers of the trematode at a parasite burden of 1.5 - 3 per fish (Table 1a and 1b). The rate of infection was between 15-57% for healthy stock and 44-78% for infected stock. Feeding is important in domestication, and if host diet contains adequate carbohydrate of useable type, during infection, the host may feed itself as well as the parasite without injurious effect (Chandler and Read, 1961) There was no weight loss in this study and the relative and specific growth rate of the healthy and infected stock were not statistically significant ($P > 0.05$). Specific growth rate was 38.75% and 31.25 for the healthy and infected fish stock respectively. Also reported no effect on nutrient absorption and growth of Rainbow trout infected by *Eubothrium crassum* and *Proteocephalus* sp. In disease studies, an account must be given to the surprising fact that in any community, a large percentage of healthy and normal individuals continually harbour potentially pathogenic microbes without suffering any symptoms; Fish may also develop resistance to the parasite or have enough nutrients to feed itself and the parasite. However, if a stock of fish is exposed to inadequate dietary and environment conditions, it readily becomes susceptible to disease. It can be inferred from the results that good feeding will enhance the growth and productivity of *Oreochromis niloticus* when essential nutrients are provided in the feed, even when infected by *Clinostomum tilapiae*, but aesthetic and market value may be greatly reduced. *Clinostomum tilapiae* infection can be prevented with good husbandry and fish pond management techniques like desiltation, total draining during harvest, liming and drying of ponds. Unhygienic habits of farm hands must be discouraged; while scaring away of suspected bird carriers early in the mornings and late in the evenings will go a long way in reducing infection.

TABLE 1a: Result of Parasitic Infection on Healthy *O niloticus*.

		1	2	3	4
a.	No of fish stocked	25	25	25	25
b.	No of fish cropped	25	20	22	14
c.	Survival (%)	100	80	88	56
d.	Initial mean weight	9	9.6	10	10
e.	Final mean weight(g)	125	91	119.60	130
f.	Total mean weight gain (g)	116	81.40	109.60	120
g.	Initial parasite Burden	0	0	0	0
h.	Final parasite Burden	2	1.5	2.1	3
i.	Relative growth rate (g/t)	12.8	8.4	10.96	12
j.	Specific growth rate (%)	44	27	41	43
k.	Initial no of fish infected	0	0	0	0
l.	Final no of fish infected	4	3	6	8
m.	Rate of infection at end of rearing period	16	15	27	57

TABLE 1b: Result of Parasitic Infection on Infected *O niloticus*.

		1	2	3	4
a.	No of fish stocked	25	25	25	25
b.	No of fish cropped	20	14	18	18
c.	Survival (%)	80	56	72	72
d.	Initial man weight	18	18	16	15
e.	Final mean weight(g)	115	126.80	100	93
f.	Total mean weight gain (g)	97	108.80	84	78
g.	Initial parasite Burden	4	3	2	3
h.	Final parasite Burden	2.5	3	2	1.5
i.	Relative growth rate (g/t)	5.38	6.04	5.87	5.20
j.	Specific growth rate (%)	31	32	32	30
k.	Initial no of fish infected	25	25	25	25
l.	Final no of fish infected	15	11	10	8
m.	Rate of infection at end of rearing period	75	78	55	44

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INVESTMENTS AND EMPLOYMENT OPPORTUNITIES IN THE AQUACULTURE SECTOR IN NIGERIA

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Abstract

Nigeria is a large fish consuming nation with a total consumption at more than 1.2 million tonnes, with fish imports making up about two thirds (700,000 t) of the fish supply. Although the contribution of fisheries to the Gross Domestic Product is only 3-4%, it occupies a very significant position in the primary sector providing employment for over a million people (FDF Statistics) and contributing about 50% of the animal protein intake of the population, particularly the resource poor (IFC, 2003). The estimated national demand for fish is estimated as high as 1.3 million metric tons with a wholesale value of more than \$US 1 billion. Of this, the Federal Department of fisheries (FDF) indicates 511,000 tones are provided domestically or only about one third of demand, with an estimated per capita fish consumption ranging from 7.5-12 kg. With the current policy thrust towards fisheries development, there is excitement among stakeholders in private sector fish farming as shown by the expansion and renovation of existing farms and investments in few fish farms and hatcheries. This has brought the industry to a retail production value of N180 million. This development is not however without some challenges. Fish producers have rushed ahead with the production without support of a developed values chain. This gap is providing an entry point for interventions to greatly facilitate expansion of services in the value chain for this exciting industry. This paper therefore seeks to provide guidance on how to strategically focus aquaculture activities to capitalise on opportunities for increased employment and incomes.

Introduction

Nigeria has the resource capacity (12 million ha inland water and aquaculture) to produce 2.4 million MT of fish every year, and yet the country is a large importer of some 648,000 MT of fish annually while domestic fish production is estimated at only 496,700 MT from all sources (National Fisheries Review (FAO, 2004 (FAO, 2004). Demand is estimated at 1.4 million MT and exceeds supply. Nigerian inshore (marine) fishery resources are clearly over-exploited, the single major indicator being the decreasing individual size of fish landed. Policy makers are therefore looking to aquaculture and inland water for increasing domestic fish production.

Fisheries contribution to GDP is about \$US1 billion, while agriculture in general is estimated at \$US20 billion (FAO, 2004). In general, fish marketing has a wholesale value of over \$1 billion per year (Dixie and Ohen, 2006). With demand for fish increasing, investment in commercial fish farming in Nigeria is rapidly expanding at 25-33% per year (Dixie and Ohen, 2006). This is remarkable growth in production capacity that requires a strengthened value chain to provide the framework for a strong industry.

Transport of Fish.

This could create jobs for few hundred workers; presently fish are transported only by the fish farmers themselves as no one is specialising in this area.

Water Quality and Fish Disease Management

Close monitoring of water chemistry and this could be a niche market to be filled by a few hundred technicians for quality control in fish feed production and basic fish disease.

Fish Feeds

Fish feed industry has a current value in sales of some \$US39 million annually. As much as 50% of this cost is for imported ingredients (fish meal, vitamins, concentrates) and the like.

Fish Meal Production

Although Nigeria produces much of the ingredients (cereals, oil seed cakes, etc) required for animal's feeds it has never developed a capacity for fish meal production which is a key ingredient in most feed formula. FAO estimates Nigeria water in the EEZ (Exclusive Economic Zone) offer promise of a large fish meal industry with an estimated annual yield of some 150,000 MT.

Fish Farm Employment

With the continued expansion of the aquaculture industry, this number could rapidly increase to the estimate provided by the National Fisheries Review (FAO, 2004) or more. In fact the USAID Markets study indicated some 52,000 jobs to be created by 2015 (Dixie and Ohen, 2006).

Ornamental Fish

Presently Nigeria export some \$US0.3 million of live indigenous fish to the ornamental fish/aquarium markets in Europe and America; some 40 species of exotic fish are involved in this trade. FAO (2004) indicates some 300 people are employed full time in this activity along with an estimated 3,000 part time artisanal fishermen who catch the fish.

Gear, Equipment and Supplies for Aquaculture

There is a need for well equipped suppliers of such gear, chemicals and equipment and this could employ perhaps 100 persons.

Embedded Extension Materials and Training

Extension and training could provide employment for up to 500 and be highly beneficial to the industry; present employment in this area is only about 150.

Fish Restaurants Employment

Perhaps 70% of the fresh catfish in the market are sold in such establishments. A USAID Markets study (Dixie and Ohen, 2006) indicated some 30,000 jobs are to be created in fish restaurants by 2015, up from some 10,000 at present (Dixie and Ohen, 2006).

Fish Processing

The World Bank indicated great promise for this with an estimated creation of some 15,000 jobs for fish processing alone. Presently there is very little significant fish processing with perhaps 500 jobs.

Smoked Fish Lake Chad Project.

A major concern in this area is the need to reduce post harvest loss of fish which may amount to 30,000 MT each year at a loss of some N6 billion (\$US46 million) to poor fishermen, processors and fish marketers. Processing, packaging and marketing are all areas in need of technical assistance. With practical training, significant impact could be achieved in this region which is the highest or second highest fish producing state (Borno) in Nigeria. This is also one of the poorest regions in the country and yet it supplies a substantial portion of the fish supply to the nation. Conditions could be improved for some 1,000 new jobs in this area with the training in value addition, improved packaging and marketing.

Rice-cum-Fish Farming.

Rice/fish integrated farming has been shown by the NCRI to increase rice production by 15 % in trials in Niger State. This increased production is accompanied by 300-400 kg/ha of fish which have high value at N300/kg. This could create employment for at least additional 20,000 farm workers.

Opportunities in the Aquaculture Industry

Aquaculture production has leaped from 30,000 MT in 2002 to 55,000 MT today and high demand for fish is expected to continue to grow. The number of fish farms is estimated at 2,600, however by all accounts the number is much greater; total area in fish ponds is estimated at 60,000 ha (FAO, 2004). Fish production systems range from traditional earthen pond to the more intensive recirculating systems with bio filtration for ammonia removal and to "flow-through" systems where large volumes of water are constantly available. All of this improved, intensified technology necessitates more skilled and unskilled employment and brings about increased incomes. The following therefore presents many of the investments and employment opportunities in the aquaculture industry.

Seed Production

The industry is addressing one of its major constraints with greatly increased fingerling production, which was estimated at 3 million in 2001, but with new, high producing hatcheries, capacity has increased to 55 million fingerlings per annum in 2006. Several modern fish hatcheries now produce more than 350,000 catfish fingerlings each month and production continues to increase with new hatcheries around the country. Two of these hatcheries supply almost 1,000 small to medium farms with high quality fingerlings between 2003 and 2004.

This segment of the value chain is proving to be successful as fewer fish farmers are buying fingerlings from the wild or from brood stock of unknown origins, which often have poor growth. There remains, however, much more unmet demand for fish fingerlings as Government has plans to stock many of the country's inland lakes through hatchery based inland fisheries development, which could be of great benefit to private fish hatchery operators. Nigeria could easily have the capacity to produce several billion fish fingerlings annually and employ several thousands workers.

Most of the fish fingerlings production is of *Clarias* or *Heterobranchus* catfish species or of a cross of these two called a "*Heteroclarias*". This has been demand driven favouring consumer preference for catfish. *Clarias* are preferred in the south-west, while the *Heterobranchus* are the preferred species in the south-south. The rest of the country seems to accept both species. However upper scale markets and large potential export market will bring about fingerling production of Tilapias, which are in high demand in European and American markets, often selling for double the price of catfish. Although there is much demand in the fish joints or "buka restaurants" for catfish, the hotels and upper scale restaurants may prefer tilapias for their international appeal. In view of this, several of the progressive hatcheries are already moving into all male tilapia production. Males grow twice as fast as females, hence the preference for monosex cultures.

Other species offer opportunities for Nigeria's aquaculture industry including several local species as well as the fresh water shrimp of the *Macrobrachium* species. A hatchery could be installed in coastal areas to have access to sea water and post larvae shrimp could be produced and shipped all over the country for production. These shrimp or prawns as are called have very high consumer appeal and fetch a premium price both locally and in the export market.

Management of fish and shrimp hatcheries require technically skilled staff and could employ up to 1,000 workers, if demand continues to increase as with the intensive production systems in use. An estimated 400 jobs are presently involved in fish hatcheries. Note that the production cycle of table size catfish has been reduced from 7-8 months to 4-5 months. This greater intensity of management favours increased employment of both skilled and unskilled workers.

Transport of Fish.

There is growing need for improved transport of live fish in Nigeria as methods used by many fish farms cause great stress and high mortalities of fish. Poor knowledge of fish transport has been a major constraint in the industry. Most fish farms transport live fish in plastic jerry cans or garbage cans in the heat of the day without aeration. Proper procedures for transport are largely ignored by most fish farmers with the resultant economic loss. Eventually there could be small enterprises specialising in live fish transport, who would guarantee high survival, This could create jobs for few hundred workers; presently fish are transported only by the fish farmers themselves as no one is specialising in this area.

Water Quality and Fish Disease Management

There is growing need for water quality technicians, which could be employed in the aquaculture value chain or as water quality specialist for companies to monitor pollution and the status of water chemistry as well as basic fish diseases. High tech recirculating aquaculture systems call for close monitoring of water chemistry and this could be a niche market to be filled by a few hundred technicians for quality control in fish feed production and basic fish disease.

Fish Feeds

High quality fish feeds are now being produced in the country, undercutting the high price of imported feeds, which totalled some 10,000 MT in 2005; one international supplier alone sold 6,000 MT and has now set up local production of high quality fish feed. Local fish feed production, both from feed mills and on-farm production is estimated at 75,000 MT; employment for fish feed production and marketing could equal 1,500 persons or more up from some 500 jobs at present. A USAID Markets study (Dixie and Ohen, 2006) on marketing of aquaculture products noted that the fish feed industry has a current value in sales of some \$US39 million annually. As much as 50% of this cost is for imported ingredients (fish meal, vitamins, concentrates) and the like.

The Aquaculture and Inland Fisheries Project (AIFP) inventoried more than 2,600 fish farms and 215 feed mills in the country with most being located in the south (Figures 1 and 2).

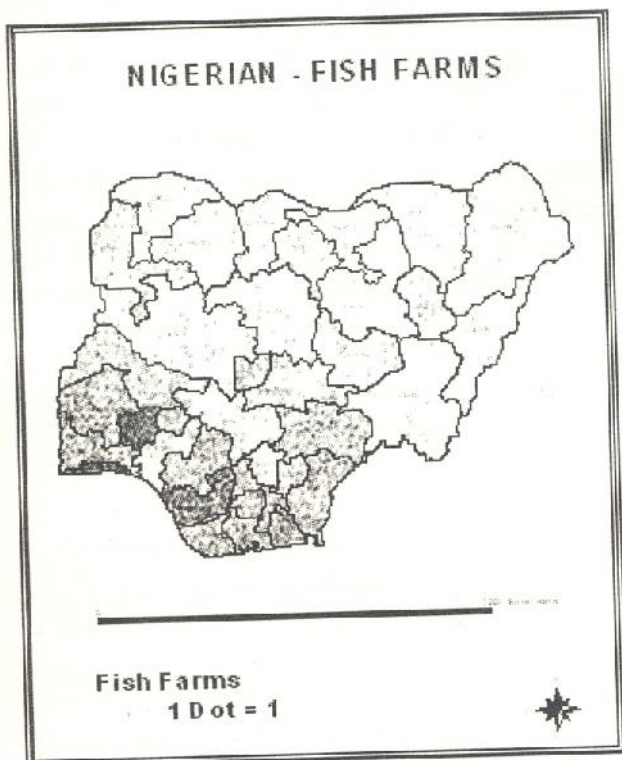


Figure 1: Nigeria Fish Farms Distributions

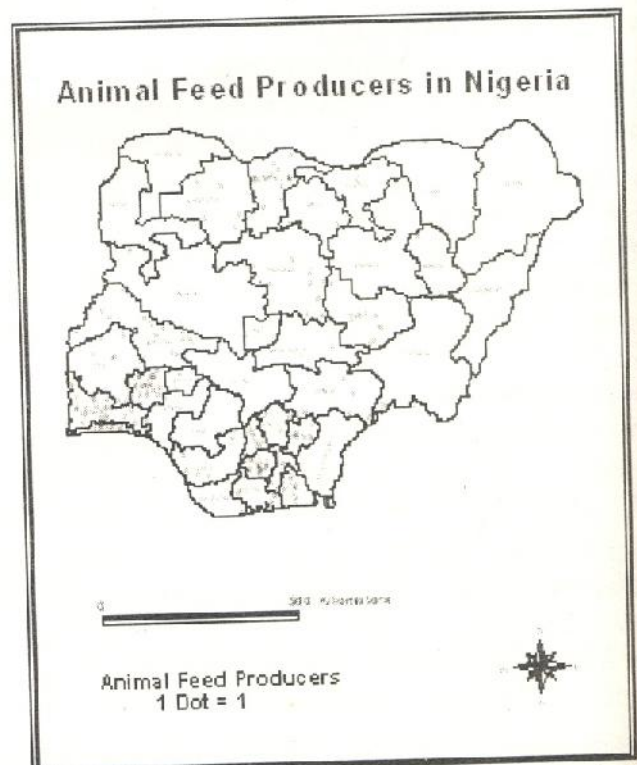


Figure 2: Animal Feed Producer Distribution.

Many of the country's feed mills operate at 30-40% capacity with poultry feeds making up to 80-90% of their production. Aquaculture feeds make up less than 3% of feed output from these mills. Animals feed production in Nigeria is estimated at 3.8 million MT per year, with much of this produced on-farm for poultry. With the rapid growth of industrial poultry production during the past 15 years, poultry farmers experienced poor quality control and inconsistency in proximate analysis of feeds from the major feed mills. The major feed mills therefore need to be revamped and upgraded to produce better quality feeds with consistent analysis parameters. Quality control issues should be tackled by the aquaculture professional organisations as a service to the feed industry and the fish farmers.

Fish Meal Production

Although Nigeria produces much of the ingredients (cereals, oil seed cakes, etc) required for animal's feeds it has never developed a capacity for fish meal production which is a key ingredient in most feed formulas. FAO estimates Nigeria water in the EEZ (Exclusive Economic Zone) offer promise of a large fish meal industry with an estimated annual yield of some 150,000 MT. This could come about through harvest of the mesopelagic lantern fish. However, investors have shied away from industrial fishing in Nigeria as the industry has been in decline for the past two decades due to low yield and high operating costs in hard currency.

Currently most feed mills source fish meal from Denmark or other European supplies at very high cost. In fact fish meal is the most costly ingredient in most animal feeds and makes up a major component in fish feeds for predaceous species such as catfish. Nigeria has other resources that could be tapped in this regard as with the pelagic sardine type (*Clupeids*) fish found in several inland lakes including Kainji and Jebba (Niger State) and Tiga in Kano State. This is currently tapped at a small scale, but could be expanded. Similar species are commonly harvested in East Africa at night with lift nets and lights to attract the schooling fish. Efforts should be made to commercially exploit this type of fishery in Nigerian lakes. The development of a *Clupeids* fishery for fish meal in Nigeria could create employment for perhaps 1,000 artisanal fishermen with several hundred other workers involved in the processing.

Fish Farm Employment

With the many fish farms and different types already described (ponds, recirculating and flow-trough systems); the sector has created considerable employment. The latest National Fisheries Review (FAO, 2004 for Nigeria counts 80,000 workers in this sub-sector including some 30,000 full time workers, 40,000 part time and 10,000 part time tertiary workers. This appears to be potential employment as current employment in fish farms in the country is not considered to be more than 20,000. With the continued expansion of the aquaculture industry, this number could rapidly increase to the estimate provided by FAO, 2004 or more. In fact the USAID Markets study indicated some 52,000 jobs to be created by 2015.

Ornamental Fish

Presently Nigeria export some \$US0.3 million of live indigenous fish to the ornamental fish/aquarium markets in Europe and America; some 40 species of exotic fish are involved in this trade. FAO, 2004, indicates some 300 people are employed full time in this activity along with an estimated 3,000 part time artisanal fishermen who catch the fish. This small industry is presently a capture fishery and should become an aquaculture industry to assure sustainability of the industry.

Gear, Equipment and Supplies for Aquaculture

Many fish farmers make their own nets and other gear used in managing fish ponds, but a number of supplies and equipment requires importation. There is a need for well equipped suppliers of such gear, chemicals and equipment and this could employ perhaps 100 persons.

Embedded Extension Materials and Training

Suppliers of fingerlings and feeds are already providing brochures and guidelines for feeding and management but provision of technical information needs to be greatly improved. As done in Europe and the USA, professional organisations need to become more involved in providing such technical assistance materials and training as government providing extension services are lacking. Some NGOs can also become involved but need to prove their technical competence in assisting farmers to make more profit. Training of the Trainers needs to be carried out by the markets Programmes to ensure provision of coherent, practical fish farming training course. Extension and training could provide employment for up to 500 and be highly beneficial to the industry; present employment in this area is only about 150.

Fish Restaurants Employment

With Nigeria's rapidly expanding urban population, many small restaurants called "bukas" have been established as fish and beer joint. Perhaps 70% of the fresh catfish in the market are sold in such establishments. A USAID Markets study (Dixie and Ohen, 2006) indicated some 30,000 jobs are to be created in fish restaurants by 2015, up from some 10,000 at present. This indirect sector offers the greatest growth for employment thanks to the popularity of these popular, relatively low-cost eating establishments.

Fish Processing

As the industry moves forward and consumer preference evolves, demand is growing for fast food fish dishes and the upper scale markets are calling for processed fish filets, etc. Presently the hardy catfish is largely sold as live fish and fish are often held live in tubs of shallow water till consumed. This will change to meet demands of the fast food and upper scale markets. Both tilapias and catfish can be processed on a commercial scale and this will start being a necessity for certain markets. The World Bank indicated great promise for this with an estimated creation of some 15,000 jobs for fish processing alone. Presently there is very little significant fish processing with perhaps 500 jobs at present.

Smoked Fish Lake Chad Project.

Another major fish supply comes from Lake Chad through a number of fishing communities located at or near Lake Chad. Several Fishermen's Cooperatives operate in this region which suppliers up to 90,000 MT (fresh weight) annually of fish to 10-12 major fish markets around the country. A major concern in this area is the need to reduce post harvest loss of fish which may amount to 30,000 MT each year at a loss of some N6 billion (\$US46 million) to poor fishermen, processors and fish marketers. Processing, packaging and marketing are all areas in need of technical assistance. With practical training, significant impact could be achieved in this region which is the highest or second highest fish producing state (Borno) in Nigeria. This is also one of the poorest regions in the country and yet it supplies a substantial portion of the fish supply to the nation. Conditions could be improved for some 1,000 new jobs in this area with the training in value addition, improved packaging and marketing.

Rice-cum-Fish Farming.

This activity is ongoing in a number of states through the efforts of the AIFP project and the National Special Programme for Food Security (NSPFS) with the Chinese assistance. Rice/fish integrated farming has been shown by the NCRI to increase rice production by 15 % in trials in Niger State. This increased production is accompanied by 300-400 kg/ha of fish which have high value at N300/kg. If 100,000 ha of this could be integrated into rice/fish farming, then 35,000 MT of fish could be produced. Having a value of N 7 billion. This could create employment for at least 20,000 farm workers.

A summary of employment opportunities in aquaculture and fisheries is presented on the table below. This indicates present employment at 36,600 with a potential employment at an estimated 125,900 for a 243% increase.

Table 1: Summary of Employment Opportunities in Aquaculture and Fisheries in Nigeria

Area	Present Employment	Potential Employment	No. Increase	% Increases
1. Fish Hatcheries	400	1,000	600	150
2. Fish Transport	0	200	200	200
3. Water Quality	0	200	200	200
4. Fish Feeds	300	1,500	1,200	400
5. Fish Meal	0	1,000	1,000	1,000
6. Fish Farms	20,000	50,000	30,000	150
7. Ornamental Fish	3,300	4,000	700	21
8. Gear and Equipment Suppliers	50	100	50	100
9. Extension Training	150	500	350	233
10. Fish Restaurants	10,000	30,000	20,000	200
11. Fish Processing	500	15,000	14,500	2,900
12. Fish Smoking	1,400	2,400	1,000	71
13. Rice/Fish	500	20,000	19,500	3,900
Total	36,600	125,900	89,300	243

Reference:

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