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FISH DISEASES: A MAJOR HINDERANCE TO REALIZATION OF "FISH FOR ALL"

By

Professor Godfrey Nnamdi Onyenoro Ezeri, (FFS)
(Professor of Fish Pathology and Health)

Department of Aquaculture and Fisheries Management
College of Environmental Resources Management (COLERM)
Federal University of Agriculture, Abeokuta, Nigeria.

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Professor Olusola B. Oyewole
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Professor Godfrey Nnamdi Onyenoro EZERI
B.Sc. (Nig.) M.Sc., Ph.D. (Jos)
(Professor of Fish Pathology and Health)

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The Vice-Chancellor,
Deputy Vice-Chancellor (Academic),
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Other Deans and Directors,
Ag. Head, Department of Aquaculture and Fisheries Management,
Members of Senate and Other Colleagues,
My Lords: Spiritual and Temporal
Members of my Immediate and Extended Families
Distinguished Fellows/Members of Fisheries Society of Nigeria
Distinguished Ladies and Gentlemen,
Gentlemen of the Press,
Great FUNAABITES!

1.0 PROLOGUE

I want to express my profound gratitude to God who has kept me alive to see this day. I feel honoured to be called upon to give the 44th Inaugural lecture of our Great University, being the second from the Department of Aquaculture and Fisheries Management, College of Environmental Resources Management.

An Inaugural lecture is an academic exercise to specifically mark the appointment of a University Professor. This is an academic obligation for all professors in the course of their academic career to showcase their achievements/contributions to knowledge in order to solve the myriads of problems facing the society or humanity at large.

This exercise gives me the privilege to share my 31 years of experience in the world of academics as I stand before you today. I joined this university in 1983 as a pioneer staff and survived all its metamorphosis from Federal University of Technology, Abeokuta (FUTAB) where I served as the pioneer Acting Head of Department (Staff-in-Charge), Department of Biological Sciences, to College of Science and Technology, Abeokuta (COSTAB), then University of Lagos, Abeokuta (ULAB), and finally to Federal University of Agriculture, Abeokuta (FUNAAB).

2.0. THE TITLE OF MY LECTURE as advertised Mr. Vice Chancellor Sir, is **"FISH DISEASES: A MAJOR HINDRANCE TO ACTUALIZATION OF FISH-FOR-ALL"**

2.1. FISH: MAJOR SOURCE OF PROTEIN/ HEALTH ADVANTAGES

Fish is becoming increasingly important in the diet of a large percentage of the populace worldwide because of its availability, palatability and health provisions (Azam *et al*., 2004). It also accounts for 40% of animal protein consumed in Nigeria and 16% of consumed animal protein worldwide. Approximately one billion people across the world rely on fish as the primary source of animal protein (Olatunde, 1989; Adeleke, 1999 and Knibb, 2002).

Fish is a heavily traded food commodity and fastest growing agricultural commodity in international markets. Commercially valuable species have been over-fished and smaller fish species are being captured daily. The beneficial health bonus of fatty fish consumption, especially those involving the Omega–3 polyunsaturated fatty acid found in fish such as salmon, mackerel, eel and tuna, is without doubt a further incentive for the upward movement of the index of demand for fish as food. Fatokunbo (2006) stated that fish contribute immensely to enhancement of national health as it contains Omega-3 fatty acids that reduce cardio-vascular disease and hypertension. Nimatu (2007) reported that Omega–3 fatty acids have positive effect on heart rhythm, reduces the incidence of the most common type of stroke and play a role in preventing macular degeneration which is a common form of blindness. Nimatu

(2007) also reported that women who ate fatty fish (salmon and tuna) while pregnant will give birth to children with better visual development and that babies of mothers who have significant levels of Docosahexaenoic acid (a-type of Omega-3 fatty acid) in their diets while breastfeeding, will experience faster than normal eyesight development. Ruxton (2003) reported that the brain needs correct levels of Docosahexaenoic acid (DHA: 22:6n – 3) to function properly and that a deficiency may trigger memory problems and even permanent brain damage.

World fish production was estimated at 142 million metric tonnes in 2008 and is on the increase because it accounts for over one fifth ($^1/_5$) of the world total animal protein supply. It is cheap compared to beef or pork and the knowledge of its rearing and management has been acquired through scientific research putting an end to the unsavoury outbreak of anaemia, kwashiorkor etc. (FAO, 2010; Eyo, 2001). The harvesting, handling, processing and distribution of fish provide livelihood for millions of people as well as foreign exchange earnings to many countries (AL-Jufaili and Opara, 2006), with an estimated 44.9 million people engaged in capture and culture fisheries in 2008 (FAO, 2010).

Fish is now a major source of animal protein in most African and Asian countries. African fisheries and aquaculture are at a turning point. The fisheries sector makes a vital contribution to the food and nutritional security of 200 million Africans and provides income for over 10 million engaged in fish production, processing and trade. Moreover, fish has become a leading export commodity for Africa with an annual export value of US$ 2.7bn. Yet, these benefits are at risk, as the exploitation of natural fish stock is reaching its limit and aquacultural production is yet to fulfill its potentials.

2.2 FISH: CHEAP SOURCE OF ANIMAL PRO TEIN

In Nigeria, the short supply of animal protein together with the increasing human population, have raised the cost of animal protein to a level almost beyond the reach of the low income groups. As a result, there is a considerable increase in the demand for fish, being the cheapest source of animal protein in Nigeria (Ladipo *et al*., 1981). Other natural occurrences, such as drought in the Sahelian region of the country have also reduced the cattle population, the traditional source of animal protein in Nigeria (Mabawonku, 1980). According to Areola (2007), Bankole *et al*., (2003) and Jamiu and Ayinla (2003), fish production through capture fisheries from inland water bodies in Nigeria is faced with the problem of over exploitation and yields are almost stagnant. This occurs to the extent that the Total Allowable Catch (TAC) has always exceeded the Maximum Sustainable Yield (MSY) levels

(Adekoya, 1998; Olaniyi, 1998).

2.3. AQUACULTURE: THE ALTERNATIVE TO SUSTAINABLE FISH SUPPLY

The only alternative source of constant fish supply is AQUACULTURE. Aquaculture remains the most renewable, sustainable and cost-effective alternative of fish production that can assure our fish self-sufficiency quest, it was reported that produced 3%, compared to 38% worldwide (Dugan, 2005). The total aquaculture production in Sub-Saharan Africa was only 117,000 tonnes in 2000, which is 0.4% of the population of the world production (Moehl, 2001). Aquaculture supplies less than 2% of fish production in Sub-Saharan Africa (Dugan, 2005). The potential for substantial growth to reach the levels such as those in Asia is extremely high. FAO projections show that with just 5% of the suitable areas being used, Africa could meet its' fish production target. The task remains enormous. Based on 1997 levels, aquaculture would have to increase by 26.7% by 2020 to maintain the current fish consumption level in Africa (Delgado *et al.*, 2003).

FAO (2003) reported that aquaculture is the fastest growing food-producing sector in the world. It is the most efficient husbandry for animal protein production than all other forms. It is capable of earning substantial foreign exchange through exportation of aquacultural products including ornamentals. It is an increasingly important contributor to national economic development, the global food supply and food security. It will dominate fish supplies by 2050 and less than half of the fish consumed is likely to come from capture fisheries.

2.4. NIGERIA:- HIGHEST – SINGLE FISH CON SUMER IN AFRICA

Nigeria has a population of approximately 140.7 million and 3.2% annual growth rate (2006 Census). Despite the abundant fisheries resources and relatively high consumption of fish in Nigeria, and being rated as the largest single consumer of fish and fish products in Africa (FDF, 2005b; 2008); Nigeria's domestic output of 0.62 million metric tonnes, still falls short of demand of 2.66 million metric tonnes per-annum (FDF, 2008).

A deficit of 2.04 million metric tonnes is required to meet the ever increasing demand for fish in Nigeria. This large deficit between the demand and supply of fish is augmented by massive importation of frozen fish and its consequent effect on the foreign exchange of the National economy.

The quantity of fish imported, rose from 557,884.00 tonnes to 739,666.12 tonnes between 2000 and 2007. The amount of foreign exchange expended on fish importation also rose from US$241,066.54 million in 2000 to US$593,373.69 million in

2007. Nigeria is a large importer of fish with official records indicating 681,000 MT while export in 2007, was 0.005 million metric tones, valued at US$ 38.3 million. The local supply between 2000 and 2008 consist of productions from artisanal (89.5% - 82.5%), industrial (5% - 4.5%) and aquaculture (5.5% - 17.8%) subsectors (Adepegba, 2007; FDF, 2009) (Table I) (FDF 2011, FIG. 1). However, it has been shown that Nigeria can substitute fish importation with domestic production to create jobs, reduce poverty in rural and semi–urban areas where 70% of the population live and ease the balance of payments deficits (Areola, 2007; FDF, 2005, 2008). Cameron (2002) stated that due to the increasing world population and supply by well improved technological know-how of modern world, there has been a significant increase in fish production from capture fisheries sector in the last 100 years. This according to him, has seriously threatened the ability of wild stocks (both fin and shell fish) for sustainable productivity as most species are speedily moving towards extinction.

Table 1: Nigeria fish supply by sectors (2000 - 2008) in tonnes

Sectors / Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
ARTISANAL: SUB TOTAL	418,069.4	433,537	450,965	446,203	434,830	490,594	518,537	504,227	511,382
Coastal & Brackish water	236,801	239,311	253,063	241,823	227,523	259,831	269,878	260,099	264.988
Inland: Rivers & Lakes	181,268	194,226	197,902	204,380	207,307	230,763	248,659	244,128	246,394
% CONTRIBUTION	89.5	89.2	88.1	87.4	85.4	84.7	81.4	81.9	82.5
Aquaculture (fish farm)	25,720.1	24,398	30,664	30,677	43,950	56,355	84,533	85,087	143,207
% CONTRIBUTION	5.5	5.0	6.0	6.0	8.6	9.7	13.3	13.8	17.8
INDUSTRIAL (COMMERCIAL TRAWLER)	23,308.3	28,378	30,091	33,882	30,421	32,595	33,778	26,193	29,986
% CONTRIBUTION	5.0	5.8	5.9	6.6	8.0	5.6	5.3	4.3	4.5
Fish (Inshore)	13,877.3	15,792	16,065	17,542	16,063	19,724	19,129	18,040	18,585
Shrimp (Inshore)	8,056	12,380	12,979	11,416	12,469	10,946	13,767	5,995	9,881
EEZ (OFFSHORE)	1,375	206	1,229	4,924	1,889	1,925	882	2,158	1,520
DISTANCE WATER	557,884	468,197	681,252	663,179	648,033	611,220.5	646,484	739,666	937,428
GRAND TOTAL	**1,024,982**	**1,134,510**	**1,192,872**	**1,173,942**	**1,157,234**	**1,191,064.5**	**1,283,332**	**1,355,173**	**1,622,033**

The trend and fear of overfishing, supported by shortfall in supply in the face of increasing demand, has led to a dramatic growth in aquaculture over the last few decades. Fortunately, aquaculture has the potential to produce large quantities of aquatic animals without negative environmental impacts on the rivers and oceans. This is capable of ensuring a more environmentally sustainable effort for food production in perpetuity (Sherman *et al.*, 2000).

In developing countries however, aquaculture is being widely promoted as a production system for poverty alleviation, thereby improving the livelihoods of the poor farmers.

Developing countries have a record of the highest aquaculture production globally (Cameron, 2002). However, expansion of the aquaculture industry is faced with a lot of setbacks amongst which disease outbreak is a major issue.

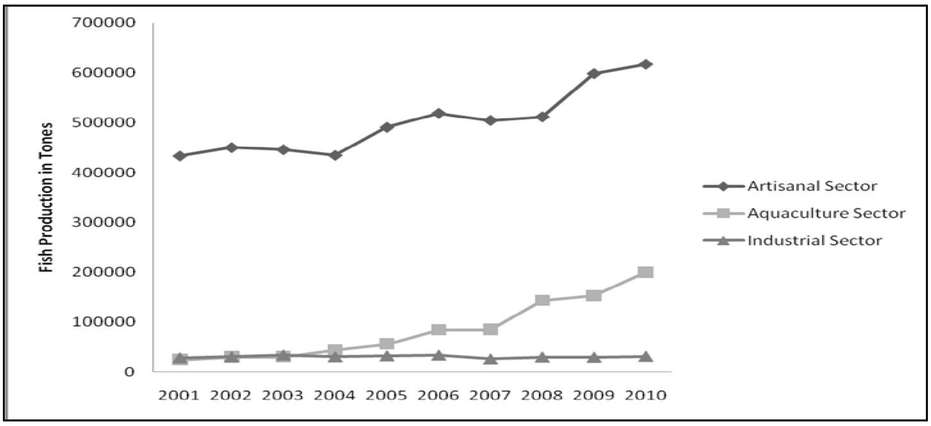

Fig 1: Trends in National Fish Production (2001-2010)
Source: FDF, 2011

2.5. **Setback to Aquaculture Industry**

According to Hudson (1990) disease occurrence in aquatic animal production is beginning to show a significant impact on yield. As aquaculture is intensified, necessitating fast movement of aquatic species in association with their pathogens, disease levels have been triggered (Olufemi, 1998).

The increasing importance in commercial pisciculture for food and sports involves greater stocking densities and addition of supplementary feed as well as application of fertilizers. The resulting close contact between fish of various sizes, increases the risk of spread of infections and evasive diseases. The introduction of large quantities of concentrated feeds and mineral fertilizers brings about environmental changes that may be stressful to fish. Stress condition lowers the resistance of fish to infectious diseases (Wedemeyer, 1970) and environmental stress triggers outbreak of infectious diseases. According to Roberts (1978), bacterial diseases are responsible for heavy mortality in both wild and cultured fish and a significant number of bacterial diseases of fish involve micro-organisms which are components of the normal flora of their guts or integuments. The actual role of these micro-organisms may vary from that of a primary pathogen to that of an opportunist invader of a host rendered moribund by some disease process. The micro-organisms become pathogenic as a result of environmental degradation caused by changes such as a rapid alteration of temperature, pollution, dietary or hormonal deficiencies.

The relationship between a pathogen and the host causes serious losses only when fish (i.e the host) and pathogen are present in an environment which favours the disease (Snieszko, 1973; Wood 1974). Fish diseases do not occur as a single caused event but are the end result of interactions of the etiological (disease causing) agent, a susceptible fish and a predisposing environmental condition. These three factors must occur concurrently in order for an infectious disease outbreak to occur. Experienced fish farmers take precautions to prevent the concurrent occurrence of all three factors and this is regarded as "Preventive medicine" in fish husbandry operations.

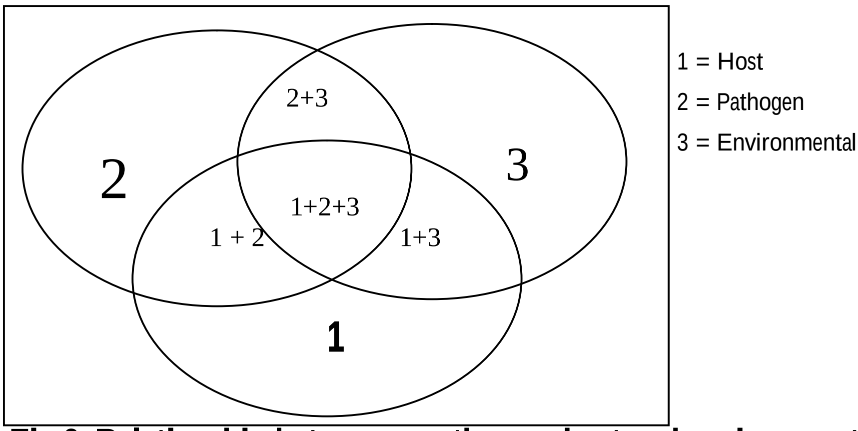

Fig 2: Relationship between a pathogen, host and environment

Serious losses only occur when factors (1+2) are present in an environment (3) which favours the disease (i.e. 1+2+3). When there is no-favourable environment (i.e. 1+2) no disease outbreak occurs, when there is no pathogen i.e. (1+3) and when there is no fish in the pond, (i.e. 2+3) no disease outbreak occurs. Apart from these three main conditions for occurrence of disease, the spread of disease could be caused by:

(i) Uncontrolled transport of fish from one place to another
(ii) Violation of Quarantine rules and bad management.

3.0 TYPES AND CAUSES OF FISH DISEASES

For the fact that disease organisms are nearly always present in water, ever ready to become problem-causing pathogens especially when fishes are weakened by stress. Variations in normal water parameters would make the aquatic environment conducive for fish to contact disease. Holding stress within the tolerance limit of a particular fish species that is being cultured is a part of good management.

Fish diseases are broadly classified as:

(i) Infectious (Virus, bacteria, fungi and less frequently by algae)
(ii) Non – infectious (Nutritional, Physical, Chemical Abnormalities)
(iii) Parasitic (Protozoa, helminths and parasitic crustacea)
(iv) Diseases of unknown aetiology {proliferation of mono-

cytes in spleen, kidney, liver (Hudson, 1990)}.

3.1. SOME SYMPTOMS OF FISH DISEASES

Diseased fish usually exhibit noticeable signs which are either physical or behavioural in nature. Fish could exhibit both physical and behavioural signs which would indicate that the fish is infested with disease or parasite which would eventually cause serious disease to the host. Moore *et al*., (1984) stated that behavioural signs or symptoms can be helpful to identify or suspect the occurrence of diseases in fishes, but the signs could also be misleading. In most cases, an accurate evaluation could be made only in a diagnostic laboratory.

The following behavioural signs indicate that certain diseases may be present in fish.

a) Failure to feed: many diseases can cause the fish not to feed or take food in the pond.
b) Swimming weakly, lazily, erratically or in spirals. This could also be caused by many diseases.
c) Scratching, flashing or rubbing against objects in the pond. This type of behavior could be caused by external parasite on the fish.
d) Failure to flee when exposed to fright stimuli. Low oxygen consumption, metabolic factors and many diseases could be responsible for this behavior.
e) Crowding or gathering in vegetation, shallow water, or at

water inflow, hiding under objects to avoid light as a result of low oxygen, toxins and many.

f) "Topping" or "Piping" at water surface; floating head-up, moribund (dying) could result from low oxygen; toxins, external parasites and bacterial infection could cause such behavior (Moore *et al*., 1984)

Some physical signs that suggest the presence of disease in fish or pond water are often associated with the following:

(i) Dead or dying fish. Many diseases could be responsible.
(ii) Open lesions or sores, bloody or reddened areas; leading to secondary bacterial/parasitic infections and infestation by external parasites and toxins.
(iii) Gaping mouths: richly from low oxygen and diseased gills could cause this.
(iv) Scale loss: i.e. *Myxobolus notemigoni* (milk scale disease) as a result of external parasites, fighting, predation and rough handling.
(v) Pale gills: eroded puffy, bloody, brown gill or flared covers, anaemia, vitamin deficiency, gill disease, environmental stress, toxins, external parasites; Brachiomyces (fungus), *Flexibacter columnaris* (bacterium).
(vi) Bleached skin colour due to Vitamin E deficiency and low oxygen intake.
(vii) Other diseases could result in Clamped fins, heavy breathing, inactivity, scratching against tanks, pond walls

etc, scales pointing outward like a pine cone, bloated belly, loss of colour, stringy or cotton patches on the body, staying in vertical position and mutilated barbels.

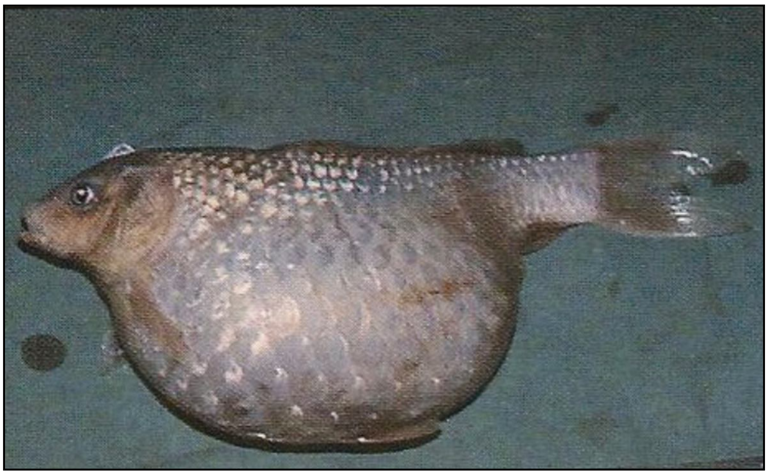

Plate 1: Dropsy (Gross enlargement of the abdomen)
***Source*: Butcher 1992**

3.2. DIAGNOSIS OF FISH DISEASES

Before the fish farmer would make attempt to treat his fish which are observed with disease symptoms, he must try to diagnose the disease to ensure an accurate evaluation of the disease problem. To do this, the fish farmer must provide the diagnostician with specimens and necessary information as regards the fish farm or pond in which the fish is being cultured. He can do this by selecting 10 sick or dying fish that are exhibiting one or more diseases symptoms from his pond and taking them for diagnosis. Dead fish samples are of little value in diagnosis. The fish should not be medicated before they are collected for diagnosis operation because pre-treatment may reduce or eliminate the disease causing organism and thereby confuse the diagnostic results. The following information could be helpful in disease diagnosis.

a) Area and depth of the pond and recent management history.
b) Origin/source of fish, estimated organic concentration of plankton (use of secchi disk reading).
c) The depth of detritus at the bottom.
d) Previous diseases and treatments.

e) Information about possible pesticides and herbicides used in the area.

f) Disease signs observed in sick or dying fish and also the number of fishes involved and rate and duration of mortality (Moore et al., 1984). Fish are often submitted for diagnosis live, iced, frozen or preserved. Live fish are preferred by most diagnosticians. Live fish should be transported in containers of sufficient size to maintain good water quality and supplied with oxygen by aeration or with agitators. If the fish are transported in plastic bags the amount of water and oxygen must be adequate to support the fish during transit period. The bag should be labeled "biological specimens – perishable" and should be transported very fast to the receiving laboratory which should be notified when the specimen is expected to arrive. In advanced countries, some facilities provide free diagnosis in fish disease identification, while others charge for their services.

g) **Water information:** Because fish are totally dependent on water and also because the pathogens would not necessarily cause diseases to the fish except the environment is conducive enough for the fish to contact the disease, it is therefore necessary for the culturist or fish farm manager to know as much as possible about the characteristics of this complex environment. These include source of water and volume for each pond, dissolved oxygen (DO_2) concentration, total hardness, pH, alkalinity, nitrite, ammonia content and temperature. They need to be closely monitored because variation of any of these factors could cause environmental disease and affect the health of fish.

Stress caused by extremes in environmental conditions plays an important role in fish diseases. Low oxygen composition in water is known to be a major cause of stress in fish which is subsequently considered to be a major cause in the outbreaks of *Aeromonas spp.* which is a bacteria pathogen and Channel Catfish Virus Disease (CCVD) during summer. Also, *Flexibacter columnaris*, a bacterial pathogen is associated with stress due to high water temperature and organically rich water (Moore *et al*., 1984). Overcrowding of fish is common and associated with many bacterial and protozoan diseases (Moore *et al.,* 1984). For the fact that disease organisms are nearly always present in water, ever ready to become problem causing pathogens when weakened by stress, variations in any of the water parameters listed above would make the aquatic environment conducive for the fish to contact this disease. Therefore, holding stress within the tolerance limit of a particular cultured fish species being reared is a role of good management. The profit motive of any fish farm often over rules good management techniques, consequently coping with a host of problems caused by poor water conditions is often considered a necessary headache.

h. **Pesticide poisoning**: Pesticide problems may be suspected if fish act especially nervously and exhibit convulsive behavior when no obvious water problems or pathogens can be identified. Possibility of a potential poisoning incident e.g. agricultural or industrial should be considered. Fish and sometimes water can be tested if a particular toxicant is suspected. Broken back or spinal curvature often associated with a vitamin C deficiency can also be caused indirectly by toxic substance (notably toxaphene) in water. The available vitamin C in fish serves to detoxify absorbed pesticides rather than to maintain bone structural integrity. This shunt in vitamin C use can result in broken head and back bones, even in fish fed diets with high vitamin C content.

Algal toxicity: This sometimes occurs during blooms of certain blue-green algae. Low oxygen and high pH, hydrogen sulphide, ammonia and nitrite are water quality parameters that can cause environmental diseases in fish.

i) NUTRITIONAL DISEASES

Apart from the environment which aid the pathogens to cause disease outbreaks, nutrition also play a vital role. The absence or deficiency of essential food ingredients can cause nutritional diseases. Signs of Vitamin deficiency may be similar to many of the infectious disease signs. A reduced rate of weight-gain and low food consumption are signs common to both infectious diseases and poor nutrition. Signs of pantothenic acid deficiency can result in bulging eyes. (Exophthalmia or pop-eye).

Plate 2: Exophthalmus (pop eye)
***Source*: Butcher 1992**

Deficiencies of vitamin C are probably best known because some of the disease signs are obvious e.g. reduced growth; crooked back or spinal curvature, pop eye, bloated belly, excess accumulation of fluid in the body tissues that causes swelling blood kidney; discoloration or bleached colour and death. Some of the deficiency signs of water soluble vitamins include;

a). Water soluble vitamins:

i). Thiamin – Reduced weight gain, lethargy, difficulty in maintaining equilibrium.

ii). Riboflavin – opaque lens of one or both eyes, weight loss.
iii). Pantothenic acid – flabby body tissues, mummy textural skin, excessive mucus on gill tissue etc.

b) Fat soluble vitamins.
i) Vitamin A – Ascites, Exophthalmia, hemorrhagic kidney.
ii) Vitamin E – Exophthalmia.
iii) Vitamin K – Excessive haemorrhage resulting in death. In addition to causing direct growth development problems. Vitamin deficiencies often increase the susceptibility of fish to infectious diseases (notably by *Aeromonas hydrophyla* and probably external parasites) (Moore *et al.*, 1984).

Plate 3.0. Silver perch suffering poor nutrition and showing harves
Source: Read *et al.*, 2007.

j) PARASITIC DISEASES

Parasitic diseases are caused by protozoans, helminthes and parasitic crustaceans. The result of parasitic infections is often quite visible to the fish farmer than the organism causing the infections. These visible symptoms or characteristics normally aid in the identification of the infective pathogen, but they are not positive proof that a certain pathogen is present. The following are some parasites that cause diseases that could result in signs visible to the unaided eye; Protozoa, Trematodes, Cestodes, Crustaceans, Leaches and Fungi.

k) BACTERIAL DISEASES

Bacteria are pathogenic organisms that cause infectious disease in fishes. For instance, *Flexibacter columnaris* is the most significant stress related warm water fish pathogen which cause the popularly known columnaris diseases in fish. The symptom of this disease is seen on scaled fish as dull patches on the sides with some scale loss, and most often the fins particularly the caudal fins are badly frayed. When it is very severe, the caudal fin is lost and the musculature is eroded to the bone. In the sun fishes, a lesion often appears behind the pectorial fin and frayed fins, which are common on scaleless fish such as catfishes, the lesions appear as dull patches caused by lack of mucus which often pass under the belly or over the back, giving a saddle-back appearance. For instance in Channel cat fish, the fin and barbels become badly eroded and sometimes yellowish line is seen on the mouth. The organism causes disease problems throughout most part of year but it is always at its peak in summer (Moore *et al.,* 1984). Other bacterial disease causing pathogens in fish are *Edwardsiella tarda, Edwardsiella ictaluri, Aeromonas hydrophilla and Aeromonas salmonicida.*

Plate 4.0: Ulceration of skin on a barramundi (*Lates calcarifer*) caused by mycobacteriosis.
Source: Read *et al.,* (2007)

l) FUNGAL/ALGAL DISEASES

Fungi and algae cause infectious diseases in fish, but the latter seldom or less frequently cause disease outbreak. The most important fungi that cause disease in fish is called Saprolegnia, which usually have tiny motile spores and are problems to fingerlings or frys in the hatcheries (Moore *et al.,* 1984).

In fishes, Saprolegnia is an external fungus which appears in the form of fuzzy gray white or dirty brown patches on the body. Fungal infections cause significant losses in most fish production facilities. Their problems normally follow a primary bacterial or parasitic infections or a mechanical injury or other trauma, thus they are usually secondary invaders, although some species are pathogenic enough to initiate infections. Such infections are usually preceded by presence of a strong environmental stressor such as low oxygen or contaminant in the water.

Plate 5.0: The fungus, *Saprolegnia parasitica*, growing on large silver perch.
Source: Read *et al.,* (2007)

The lesions occur almost anywhere on the body of the fish, often appearing "dirty" because they collect debris from the pond. It is a very difficult disease to treat because mycelium (mature part of the fungus) cannot be killed or removed; therefore the zoospores (free-living unit) must be killed. Branchioyces is another fungus that occasionally occurs in fresh water fish and is responsible for one type of gill rot. Portions of the gill appear brown and decayed. The affected areas die and decay hence "gill rot". The disease is most commonly seen in rich organic ponds. No known effective drug exist to treat the disease but can be controlled by reducing the organic load (adding more water), liming frequently, and drying out pond after harvest. This fungus is distributed worldwide and could probably infect all species of fresh water fish (Moore *et al.,* 1984).

Plate: 6.0: The fungus, *Aphanomyces invadans*,
causing EUS (red spot disease) on silver perch.
Source: Read *et al.,* (2007)

Plate 7.0: Saprolegniasis of the gill tissue; mycelium contaminated with organic matter.
Source: Read et al., (2007)

m) PROTOZOAN DISEASES

a) ***Ichthyophthirius***: Is a protozoic pathogen that infects Ich parasite on fish especially Channel cat fish. Ich, has one major visible sign which is a tiny white spot on the fins and skins.

These are noticeable after the parasite has reached the matured stage. When they become numerous, the spots are so close together that they form whitish patches on the fish. Ich is not visible in the infective (theronts) stage but infected fish could be seen flashing in the pond. Ich as a parasite is very difficult to treat because the organism burrows into the surface tissue of the host fish; however the theronts can be killed, since they are free in the water before they infect the host.

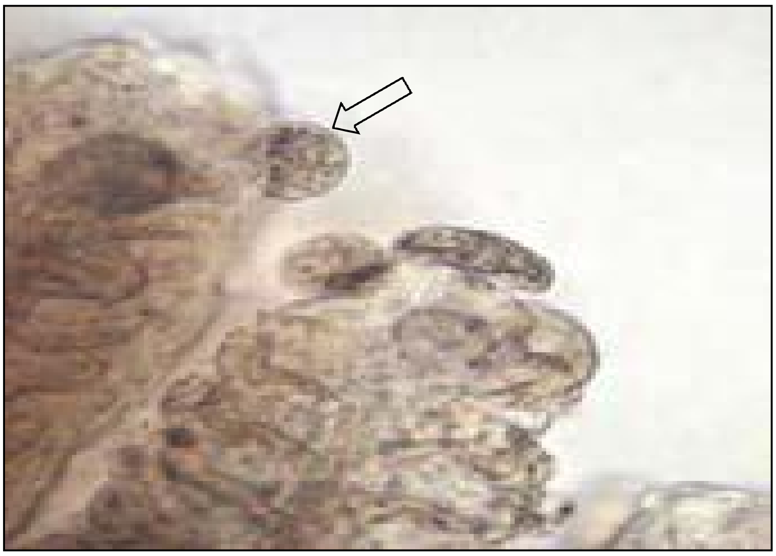

Plate 8.0: Chilodonella hexasticha 'grazing' [arrow] on gill lamellae (×200 mag.).
Source: Read *et al.,* (2007)

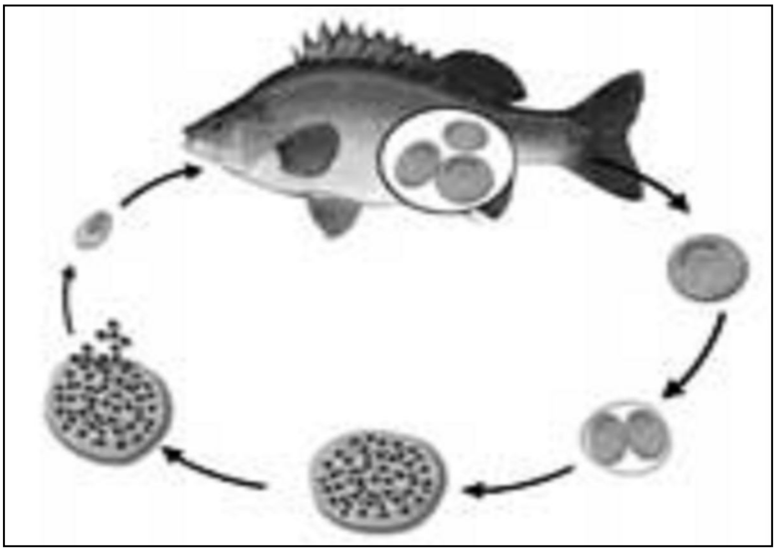

Plate 9.0: Diag. rep. of the life cycle of the parasitic protozoan *Ich-Thyophthirius multifiliis*;
1 and 2 – trophonts; 3 – tomont; 4 – tomites; 5 – tomites released; 6 – theronts.
Source: Read *et al.,* (2007)

Other protozoan parasites which are microscopic in nature are *Trichodina, Ambiphrya, Chilodonella, Ichthyobodo (Costia), Trichophrya, Henneguya, Pleistophora, Ovariae, Trematodes* and *cestodes* as well as *sporozoans.*

n) HELMINTHIC DISEASES:

Trematodes and *Cestodes: Diplostomulum spathaceum* is a trematode pathogen with larval digenetic stage that develops in the lens of the eye of channel catfish and other warm water fishes. The visible sign of the eye fluke is an opaque white lens. It hardly causes economic loss but heavy infection could cause blindness in fish.

Liquila intestinalis is a cestode pathogen in form of a large visceral tapeworm which is commonly found in pond cultured fish and some wild population of fish including the flat head minnow. The symptom is a greatly swollen belly.

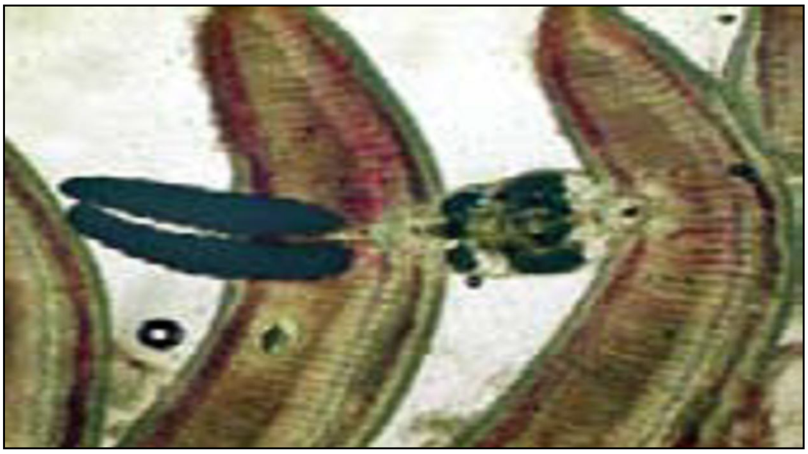

Plate 10.0: *Ergasilid* sp. [arrow] attached to gills.
Source: Read *et al.,* 2007

Plate 11.0: Nematode (species unknown) protruding from the anus of a silver perch.
Source: Read *et al.,* 2007

Some Trematodes are internal macroscopic parasite and species of these parasites are *Clinistomium complanalum* (previously known as *C. marginalum and Posthodiplostomum minimum.* The former is a yellow grub, which embeds itself in the flesh, visceral cavity, sometimes the gill of fish, and form large, cream coloured cysts. These larval flukes become adults in the intestine of birds that eat infected fish. They seldom cause problems except when enmass in the masculature of the young fish. No practical treatment is available; however, some control can perhaps be achieved by reducing the numbers of snails, an intermediate host of the parasite.

o) VIRAL DISEASES

Viruses are the major cause of untreatable disease in fish. To control viral disease in fish is as good as to prevent the spread or render the virus in-active (deactivation of virus).

- The following are the diseases caused by viruses:
- Infectious Pancreatic Necrosis (IPN)
- Viral Haematopoietic Septicaemia (VHS)
- Spring Viraemia of Carps (SVC)
- Infectious Haematopoietic Necrosis (IHN)
- Channel Catfish Virus Disease (CCVD)
- Electron Microscope Virus Disease (Moore *et al.,* 1984)

The Channel Cat Fish Virus Disease affects only the fingerlings of Channel catfish and Blue catfish. Visible signs include pop eye, bloated abdomen and a redness on the ventral surface (belly) and at the bases of the fins. Sometimes these signs are not evident, but rapid and high mortality occurs. No treatment exists for Channel cat fish viral disease or any other viral fish disease. Management practices involve disinfection and the use of carrier–free brood stock, obtained from virus–free stocks.

3.3. TREATMENT OF FISH DISEASES (GENERAL)

The treatment of fish diseases is not as easy as treating the disease of other animals, rather it is complex and a complicated process. The complexity is attributed to the aquatic environment in which the organisms live. Despite the difficulties and complexity of the process, the treatment of fish diseases is possible as a result of research and scientific development in fish disease control and prevention, as well as management techniques.

After obtaining an accurate result of the diagnosis of the fish samples, the culturist now selects the proper chemical for the treatment of the identified disease. Before he treats the fish with the selected chemical, he has to consider the following points or questions:

i. Is the treatment economically feasible?
ii. Are the fish strong enough to withstand treatment stress?
iii. What application alternatives are available (injections dipping, flushing)?
iv. Are there complicating factors (algal bloom, high or low temperatures, low oxygen, cloud cover)?
v. Is this disease contagious to fish in other ponds?
vi. Is it a treatable or untreatable disease (e.g. viral disease)
vii. If it is a treatable disease (such as bacterial, protozoan/fungi), what are the chances of the treatment being successful?

After consideration of the questions and having decided to treat, the fish culturist should be aware of several factors that could cause variations in the effectiveness of the treatment. He should also bear in mind that a fish farmers' favourite treatment may not work for another and also what was effective last year may be waste of time and money this year. The reasons for such differences in the treatment are not far-fetched. At least, there are five major reasons for such differences and a working understanding of them can help eliminate much of the variations. The major reasons that could cause differences in the treatment effectiveness of fish diseases are; Environmental, Chemical, Disease, Fish species, age, and Human factors. For instance to help prevent the outbreak of parasitic diseases such as *Epistylis,* the fish farmer should first avoid excessive crowding and high organic levels in the ponds and race ways. Also, to treat *Flexibacter columnaris* in fish is to feed the fish with medicated feeds and any fish that does not eat will receive no medication. The treatment of these infections should be started as soon as possible to provide medication for the fish that are still feeding.

3.4. THERAPEUTIC TREATMENTS FOR CONTROLLING PARASITES AND DISEASES IN CULTURED FISHES

The treatment of fish diseases with various medication and chemotherapeutic agents is only to some extent, and for the purpose of holding the disease organisms in check, retard their growth or even kill the pathogen, but cannot eliminate

100% of disease causing organisms present in the pond water. If the treatment or cure of fish disease is to be successful, it is the protective mechanisms of the fish that must overcome the disease producing organism.

Parasites and diseases are listed below in alphabetic order with some of their therapeutic treatments.

i. *Aeromonas hydrophylla* and other bacteria. Medication: Chloramphenicol, Combiotic, Furnace, Furazolidone, Kanamycin, Oxytetracycline, Streptomycin, Sulfamerazine.
ii. *Aeromonas salmonicida* of Gold fish
Medication:-Betadine, injection of Chloramphenicol, Furacine, Furnace, Furazolidone.
iii. *Argulus*
Medication:-Baytex, Malathion, Masoten.
iv. *Edwardsiella* spp.
Medication - Oxytetracycline
v. Egg Disinfection
Treatment:-Betadine , Formalin , Furacin , Methylene blue .
vi. *Epistylis*
Medication:- Table salt
vii. *Flexibacter columnaris* and other external bacteria.
Medication:-Acriflavine, Copper sulfate, diquat, Furacin, Furnace, Hyamine 3500, Potassium permanganate ($KmnO_4$) Oxytetracycline, Roccal.
viii. Fungus:

Medication:- Copper sulfate , Potassium permanganate ($KmnO_4$)

ix. Leaches:-

Medication:-Baylex, Masoten, Table salt in tanks

x. *Trichodina, Ambiphrya, Chilodina*

Treatment:- Copper sulfate, Formalin, Methylene blue, Metronidazole , Potassium permanganate ($KmnO_4$).

xi. *Trichophrya:-*

Medication:- Copper sulfate (pond, tank and equipments), house bleach, hydrated lime.

Table 2: FISHERY CHEMICAL DRUG, TREATMENT RATES AND DISEASES

S/N	Chemical or drug	Dosage/Rate	Duration of use	Disease or condition treated
	Acetic acid, glacia	DIP: 1:500 2.6ft0_2/10gal	30 seconds	Ichtyobodo
	Acrifalvine x or trypaflavine x	3 ppm (11mg/4,5L) 0.402/100gal or 3.02/1,000ft$_3$ Tank Trt& hauling 2tons/acre	-	External bacteria & hauling prophylaxis
	Burnt lime (calcium oxide) quicklime	Calcium oxide becomes hydroxide when added to H_2O	-	
	Copper sulfate $CuSO_4$	General pond Treatment: The effectiveness of $CUSO_4$is related to the water in which it is used. The amount of $CUSO_4$ applied should be used when total alkalinity exceeds 40ppm. Its effectiveness may be limited in water in which total alkalinity exceeds 250ppm.	-	External Parasites and External Bacterial
	Erythromycin x	Feed application: mix antibiotic with feed at the rate of 5.50z/100K ( ) and offer at the rate of 3% of body weight per day to 14days		Internal bacterial
	Diquat (25% active)	Water treatment in tanks apply 2 to 4 ppm (8 to 1Ib OZ/1000ft^3		*Flexibacter columnaris* and other external bacterial.

Table 3: CHEMOTHERAPEUTIC AGENTS

A. ANTIBIOTICS; DOSAGE AND DURATION

S/N	Drug	Dosage/Rate	Duration of use	Recommendation usage
	Oxytetracycline	55mg/kg of fish per day.	10days	Columnaris disease, Furunculosis, Ulcer.
	Teramycin	55mg/kg of fish per day.	10days	Other disease gram negative bacteria
	Aureomycin	55mg/kg of fish per day.	10days	Disease of Aeromonas and Pseudomonas
	Furazolidone	35mg/kg of fish per day	21 days	Furunculosis
	Furanace	0.5 – 1.0g/kg of diet	10 - 14 days	Vibrosis and Aeromonas species infection.
	Furanace	0.26g/kg of fish per day followed by 0.15g/kg of fish		Many disease of gram-negative bacteria pathogen of fish.
	Sulfamethazine	Rate of 0.13g per kg of fish/ day		Furunculosis and other bacteria disease with septicaemia
	Sulfamearazine			And alimentary bacteramia

B. ANTIPROTOZOA

S/N	Drug	Dosage/Rate	Duration of use	Recommendation usage
	Epsom salt	3.0% diet	2 – 3 days	Infection of intestinal protozoa
	Enhepton	0.1 % of diet	3 days	‘’
	Garbasone	0.2 % of diet	3 days	‘’

C. ANTIHELMINTHIC

S/N	Drug	Dosage/Rate	Duration of use	Recommendation usage
	Di-N-Butyltin oxide	250 mg/kg of diet	3 days	Cestode (Tapeworm) (flukeworm) infection
	Phenothiazine	0.1%kg of diet	3 days	Nematodes (hook worm) infections of fishes

D. DISINFECTANTS

S/N	Drug	Dosage/Rate	Duration of use	Recommendation usage
	Acetic acid	5% solution	1minute	Bactericide, parasiticide
	Acriflavin	500 mg/L	20minutes	Bactericide for fish egg dis-infection
	Chlorine	10mg/L	30minutes	For hatchery tanks and utensils
	Copper sulphate crystal	1-4mg/L	1 hour	Bactericide, parasiticide
	Violet	5mg/L	1 hour	Fungicide
	Formalin	250mg/L	-	Fungicide parasiticide, protozoacide
	Hyamin			
	10%	20mg/L	-	General
	50%	4mg/L	-	Bactericide
	100%	2 mg/L	-	-
	Malachite			Fungicide/parasiticide
	Green	5mg/L	Hour	
		66.7mg/L	10 – 30secs.	
	Potassium permanganate ($KMnO_4$)	4mg/L	1 hour	Bactericide
	Roccal			
	10%	20mg/L	1 hour	General bactericide
	Sodium chloride	3 – 5%	1 – 2minutes	Selective bactericide
	Sodium chloride	1 – 1.5%	20 – 30minutes	Fungicide/parasiticide

Source: (Moore *et al.*, 1984)

4.0 IMPLICATION OF FISH DISEASES:

The socio-economic implication of fish diseases include:-

Heavy mortalities of both wild and cultured fish

- Economic loss to the farmer and the nation.
- Loss of job/retrenchment of employees.
- Market access or market share
- Poor fish supply to the populace
- Malnutrition
- Zoonosis: - possibility of infecting humans.
- Industry failure or closure of business.
- Cost of investment in fish diseases and other management programmes.

The impact of key diseases e.g. Infectious Salmon anaemia, cost the Scottish farming industry (US$ 20 million in 1998/1999 outbreak and resulted in a continued animal cost to the Norwegian and Canadian industries of US$ 11 and US$14 Million respectively.

5.0THERAPEUTIC TREATMENT/LIMITATIONS:

The treatment of fish diseases is relatively unsophisticated. Administration of drugs may be by solution in water, incorporation in feed or by injection. Many of the drugs used are traditional remedies although antibiotics and anaesthetics are being increasingly employed. The efficacy of the drugs may be affected by various environmental factors such as pH, presence of organic matter and temperature. Some of the drugs may themselves affect the environment by destroying plants or bacterial fitters.

Antibacterial chemotherapy has been applied in aquaculture for over 50 years (Inglis, 1996). The habitual use of antibiotics can lead to problems with bacterial resistance and unacceptable residues in aquaculture products and environment. The resistant bacterial strains could have a negative impact on the therapy of fish disease or human diseases and the environment of fish farms. (Smith *et al*., 1994).

6.0 UNORTHODOX FISHING METHODS:

According to (Sylvia, 2003), it is no longer possible to obtain enough fish from our natural water bodies by artisanal fishermen and trawling fishing companies, because capture fisheries has become very competitive coupled with the fact that stocks in the water bodies are over-exploited and not being replenished. Many of the pesticides currently in use have high mammalian toxicity and necessitate considerable precautions in their application (Saeed *et al.,* 2005). Most fish farmers resort to unconventional use of unregistered fish toxicants such as agro-pesticides of sodium cyanide because of their quick action or ready availability in the market (Agaman *et.al.,* 2004). These chemicals may have negative effects on the environment of fish farmers and health since they accumulate in the tissues and degrade over a long period. In Nigeria, local fishermen use various kinds of fishing gears including pesticides for catching fish. The continuous use of some of these chemicals especially by our local fishermen on our water bodies as a means of fish capturing, has reduced our water bodies to poison depot threatening aquatic life (Abubakar, 2013).

Application of herbicides to water bodies can also cause fish kills coupled with the fact that the broken down dead plants, organic matter and food component require utilization of oxygen in water bodies, thereby suffocating the fish. Repeated exposure to sub-lethal doses of some pesticides can cause physiological and behavioural changes in fish leading to reduced populations through abandonment of nests and broods, decreased immunity to disease and increased failure to avoid predators. Application of herbicides to water bodies can kill off plants on which fish depend for their habitat. Pesticides can accumulate in water bodies to levels that kill off zooplankton, the main source of food for young fish. Pesticides kill off the insects on which some fish feed, causing fish to travel further in search of food and exposing them to greater risk from predators. The use of sniper 1000Ec (DDVP) which is a toxicant by our local fishermen to kill fish has led to their common saying that, "when sniper and mussels struggle inside water, it is the local fishermen that smile home" (*Abubakar, 2013)*. This is without considering the implication of their action on human health.

7.0. HEALTH EFFECTS OF POLLUTION:

Foreign substances, generally called "Pollutants", have become a major concern in recent years. Pesticide contamination at sublethal levels constitutes a poorly understood hazard to fish health. The recent elucidation of the role of toxophene in causing broken back syndrome in catfish represents but "a tip of the iceberg" in the area of physiological stresses caused by environmental contaminants. Certain pesticides can also remain in the tissues of apparently healthy fish and under stress conditions, may be released to the blood stream causing toxicosis or resulting in increased disease susceptibility. It is also known that multiple contaminations e.g. mixing of certain pesticides greatly increase their lethal effect.

Pesticides are implicated in a range of impacts on human health due to pollution. Pesticides can enter the human body through inhalation of aerosols, dust and vapour that contain pesticides; through oral exposure by consuming food and water and through dermal exposure by direct contact of pesticides with the skin. Insecticides targeted to disrupt insects can have harmful effects on the nervous systems of mammals, due to basic similarities in system structure. Yolande (1986), emphasized that pesticides can accumulate and persist in adipose tissue within the body. It metabolizes slowly in the liver and is excreted in the urine, bile, faeces and milk. Drug residues may be found in milk, eggs and meats for many months or even years after ingestion, depending on the animal species, the amount of fatty tissue and the dose received. NAFDAC (2004) described "Pesticides", to include herbicides, insecticides, rodenticides, fungicides, molluscicides, nematicides, repellants, attractants, insect growth regulators, fumigants, and plant growth regulators. Bernard (2009) said a lot of chemical substances (pesticides inclusive) which are detrimental to public health and have driven some species to the brink of extinction were being imported into the country on a daily basis. The current massive and unregulated pesticide dumping in water is dangerous and could have tragic consequences in Nigeria where the level of illiteracy is still very high. Alex (2008), called on the Federal Government to re-enforce its ban on all dangerous chemicals freely used by fish farmers in the country. He stated that the continuous use of chemicals such as Gammalin, Otapiapia and others to catch fish posed great danger to human health.

8.0. FISH DISEASE CONTROL

The key to disease control lies in the reduction of stress factors. Stress is controlled through a program of good management and preventive medicine. Management begins with "MAN" i.e. the hatchery or farm manager is the focal point in the successful production of healthy fish.

The principle of fish disease control is all round prophylaxis. "Prevention is better than treatment". In the event of an outbreak of disease, fish should be treated in the early stages. However, because of the difficulty in observing the activities of the fish, it is difficult to correctly diagnose and treat an infection in its early stages. In addition because many diseases severely interfere with the feeding process, orally administered drugs may be ineffective; however, deep treatments are confined to small containers or spread measures to ponds. This type of treatment is impracticable for large lakes, rivers and reservoirs. So, prevention is the key to disease control.

8.1. SIGNIFICANCE AND PRINCIPLES OF FISH DISEASE CONTROL.

The prevention of fish diseases is essential for the betterment of the fishery industries, the improvement of farm production and the increase in fish resources. Because of the complexity of the environment, fish are susceptible to viral, bacterial, fungal and parasitic infections which adversely affect their growth and development and a serious infection can be fatal. An outbreak of disease jeopardizes regular aquaculture and threatens fish yield. Therefore, controlling disease is one of the most vital tasks in fish culture.

8.2. PREVENTIVE MEASURES FOR FISH DISEASE CONTROL.

It is difficult to identify the appearance of disease in its initial stage on account of the gregarious nature of fish in water which causes difficulties in observation, diagnosis and timely treatment. Apart from this, some effective drugs and measures to cure certain fish diseases are still not well known. Therefore perfect measures for fish disease control must be taken since this is a key link in fish disease control.

8.3. GENERAL PREVENTIVE MEASURES

1. Increasing the internal resistance of fish is important in the prevention of diseases.
2. Selection of healthy fish seed.
3. Proper stocking density and rational culture.
4. Careful management e.g. quarantining of fish
5. Qualitative ration and fresh food
6. Maintaining of good water quality
7. Prevention of mechanical injury to the fish
8. Abolishing pathogens and controlling its spread.

(Agropedia.litk.ac.in/node. 29820, 18 Dec. 2012).

8.4. SOME CONTROLLING MEASURES.

Existence of pathogens is one among three facts (Host, causative agents and Environment) in fish diseases outbreak as earlier stated. Some controlling measures will include:-

1. Thorough pond cleaning and disinfection e.g. by the use of chlorinated lime (Bleaching powder) at the rate of 50ppm in the pond.
2. Use of malathion in nursery and rearing ponds at the rate of 0.25ppm for 4-5 days prior to stocking of fish seeds.
3. Disinfection of appliances e.g. nets, gears, plastic wares and hapas should be sun-dried or immersed in disinfectants.
4. Disinfection of fingerlings and feeding platform with mild concentration of potassium permanganate solution during the transfer of the fingerlings to stocking tanks.
5. Proper feeding – fixed quality, quantity time and place have to be followed for proper feeding.
6. Segregation of year class fish population, as brood and older fish may serve as carriers of disease causing organisms without exhibiting any clinical symptoms. To avoid this, young fish should be segregated from the brood and older fish.
7. Spot removal of dead fish from the hatchery tank or ponds
8. Chemoprophylaxis: effective and inexpensive prophylactic measures against a wide range of parasitic and microbial diseases are advisable chemoprophylaxis.
9. Occasional pond treatment with potassium permanganate (2-3ppm) or dip treatments at the rate of 500 – 1000ppm for 1 -2 minutes or short bath in 2 – 3% common salt solution is safe.

10. Immunoprophylaxis:
Immunization programme:- this is gradually emerging as one of the most important preventive measures. Vaccines against different fish diseases including bacterial and viral diseases are now being tried on a large scale. (FAO www.Fao.rg//ac264e/07.htm)

9.0 MY ACADEMIC CONTRIBUTIONS TO FISHERIES DEVELOPMENT

Mr. Vice-Chancellor Sir, distinguished ladies and gentlemen, I want to humbly discuss some of my contributions to the actualization of "**fish for all**" despite all the hindrances I have earlier enumerated. My specialization has taken me from nutrition of fishes to fisheries management, genetics/fish reproduction, preservation, pollution effects on fish production and principally on parasites and bacterial diseases that hinder the actualization of "**fish for all**".

9.1 CAPACITY BUILDING

I have actively been involved in teaching and the development of curricular for teaching of Fisheries in some universities including our great university at the undergraduate and postgraduate levels. Many of our products are already working in Federal and State Ministries, Research Institutes and many reputable fish farms all over the country while many are owners of viable fish farms.

Secondly, I have been a Resource Scientist to some ADP'S, National Agricultural Extension and Research Liason Services (NAERLS), National Land Development Agency (NALDA), National Agricultural Research Project (NARP) and also Man and Biosphere (MAB) for partnership.

9.2. Design and Construction of the two existing FUNAAB dams with assistance from my departmental and IFSERAR staff for teaching/research and commercial production of fish.

Plate 12: Construction of Monk at Opeji
Courtesy: Prof. G.N.O. Ezeri *et.al.* (2010)

Plate 13.0: Construction of IFSERAR 3 Hectare darm at Opeji
***Source*: Prof. G.N.O. Ezeri *et.al.* (2010)**

9.3. Design and construction of fish ponds in States like Bauchi, Ogun, Delta and in Kogi (Macks farm along Okene – Lokoja road).

Plate 14.0: Construction of Integrated Fish / Poultry Farm (OX Farms) in Koko Port, Delta State.
***Courtesy*: Prof. G.N.O. Ezeri (1987)**

Plate 15.0: Feeding by fish on poultry droppings in Integrated Fish/ Poultry Farm (OX Farms) in Koko Port Delta State.
Courtesy: Prof. G.N.O. Ezeri (1987)

9.4. Production and supply of fingerlings to many fish farms in Nigeria.
9.5. Supervision of over fifty undergraduates, Seven Masters, Six Ph.D's (with three on-going).
9.6. Research contributions on fish.

9.6.1. Nutrition

One of the initial problems that faced aquaculture in Nigeria was nutritional problems. I worked on "Effects of fishmeal, cow blood meal and sorghum diets on food utilization and growth of cage-cultured *Oreochromis niloticus.*

Plate 16.0: Feeding of experimental fish in FGGC Bauchi pond
Source: Ugwuzor and Ufodike (1985)

This research suggested 40% and 60% cow blood meal inclusion to replace the scarce/costly fish meal in supplemental diet of cage-cultured *Oreochromis niloticus* (Ufodike and Ugwuzor (now Ezeri), 1985). Other works on nutrition of fishes included the "Growth response of *Clarias gariepinus* (♀) x *Heterobranchus bidorsalis* (♂) hybrid fed housefly (*Musca domestica*) larvae (maggots) and this revealed that there is a limit to the inclusion level of maggots in the diet of the hybrid (Ezeri, 2003). A study was also carried out on comparative efficiency of agricultural waste-based diets on the growth and survival of *Oreochromis niloticus* in net hapas (Ezeri, 2007).

To obtain optimum yields from any aquaculture enterprises, balanced and adequate feeds are indispensible. Feed may account for more than 50% of the running cost of such enterprise. Protein from animal sources (mostly fishmeal) employed in formulating fish diets has been the main contributor to this high cost (Hardy and Tacon, 2001) and hence the need for alternative unconventional cheap sources of protein that can partially or wholly replace fishmeal (Koskela & Vice/ma, 2000).

Two experimental diets having blood meal (BM) and soya bean meal (SBM) as main sources of protein when compared with Pfizer commercial fish pellets, performed comparably well on them and therefore serve as alternative cheap sources of protein in the diets of fish.

9.6.2. Research on fish parasites and bacteria.

Since diseases are a major hindrance to actualization of "**fish for all"**, the survey of helminthic parasites in Imo River led to the discovery that about 7.7% belonging to fourteen genera were infected with various species of helminth parasites which included *Weyonia virilis Kainji, Procamallanus laeviconchus, Spironoura congolis, Cucullanus species, and Seradacnitis serra*ta. The research further revealed that age and sex influenced the degree of helminth infection in fishes (Ugwuzor, 1987).

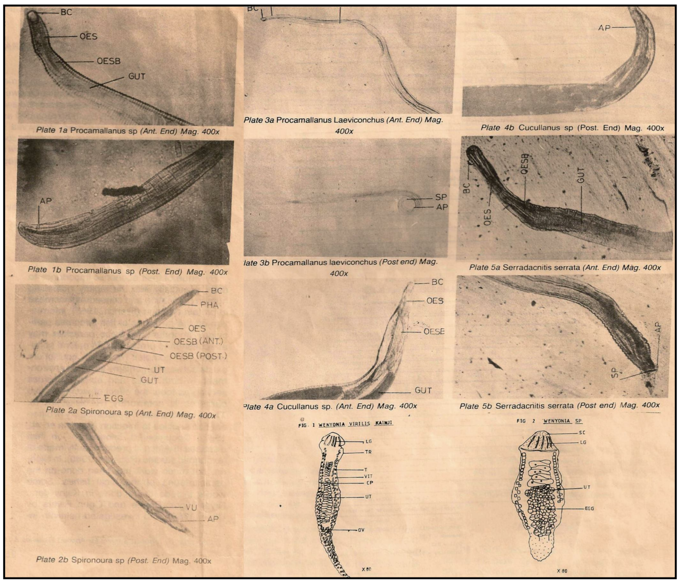

Plate 17.0: (Helminth parasites recovered from fishes in Imo river)
***Source:* Ugwuzor (1987)**

Since bacteria pathogens have been known to cause mass mortalities in fish farms, there is need to isolate, identify and test them for pathogenicity and to screen them for antibiotic susceptibility (Davis and Hayasaka, 1983). Most bacterial pathogens of fish belong to the genera, *Pseudomonas, Aeromonas and Vibrio* (Bullock, 1964). These genera also include species that are pathogenic to man. The aetiological agents of the eye, ear, nose and throat, gastro-intestinal and genito-urinary infections in man which could be fish or water borne, are seldom identified accurately and more rarely traced to their source. These human infections could therefore result from swimming in water contaminated with fish-borne pathogens or from handling of an infected fish (Ugwuzor, now Ezeri, 1991). In my research on fish pathogens in Ogun-Osun River Basin Authority Headquarters, farm complex and Rock water fish farm, Jos, *Pseudomonas fluorescens* was isolated from infected *Clarias gariepinus* among others. A few experimental and natural disease studies, have shown that fish can be infected with or serve as an important vector of human bacterial pathogens which could be dangerous to public health. Other bacterial organisms studied on, included four Gram-positive bacteria associated with cold-smoked fish in two Local Government Areas of Ogun State, namely *Bacillus spp., Micrococcus spp., Staphylococcus aureus* and *S. epidermidis,* and four Gram negative bacteria, *Escherichia coli, klebsiella spp. Proteus morgani and Pseudo-*

monas spp. The moulds included *Aspergillus spp., Penicillum sp.* and two yeast strains, *Candida sp. and Rhodotorula spp.* These microbial isolates and their bacterial count are of food poisoning and food spoilage significance (Ezeri, Bankole and Akinyemi, 2001). Other works on fish bacteria included, "*Pseudomonas* infection of catfishes of the genus *Clarias gariepinus* (Ugwuzor, Anadu and Ejike, 1990), Tumor and other epidermal anomalies of *C. gariepinus* (Ezeri, 2007).

Plate 18: Tumor and other epidermal anomalies of *Clarias gariepinus*
Source: Ezeri *et. al.* (2007)

The pathogenicity of *Pseudomonas fluorescens* was assessed by injecting healthy *Clarias gariepinus* and albino winstar rats with bacteria suspended in Ringer's solution. This work revealed 40% and 80% mortality among rats injected 8.025 x 10^3 and and 1.605 x 10^6 number of bacterial cells while no mortality occurred in control rats injected Ringer's solution only.

The necrosis which eroded into musculature of *Clarias gariepinus* with 60% mortality, confirmed the pathogenicity of *P. fluorescens* (Ugzwuzor, 1991). Isolation and characterization of gliding bacteria in Rockwater fish farm in Jos was also carried out during the coldest period of the year with mean temperature of 21^{0}c and 23^{0}c in the fish tanks and fish ponds respectively. The organisms *cytophaga sp* and *flesibacter columnaris* were only recovered from the skin and slime, while none were observed from the internal organs (Liver, gonads, Kidney and blood from the heart). Amend (1970) stated that gliding bacteria are rarely isolated from internal organs while Pacha and Ordal (1970) stated that Myxobacteria which are grain negative organisms that are characterized by gliding mortality and that some members are important agents of disease of fish. According to Robert (1978), they are single or filamentous rods which are characteristically motile by gliding movement. They were sensitive to Chloramphenicol, Kanamycine, Tetracycline, Teramycin but resistant to streptomycin and Erythromycin (Table 4)

Table 4.0: Sensitivity of gliding bacteria isolated from skin of *Clarias gariepinus* to six antimicrobial agents.

S/N	Type of antibiotic used	Disc content (µg)	Bacteria species and zones of inhibition (mm)	
			Cytophaga Species I	Cytophaga Species II
	Chloramphenicol (CM)	5	18(S)	22(S)
		10	22(S)	24(S)
		30	30(S)	29(S)
	Erythromycin (EM)	0.5	0(R)	0(R)
		2	18(S)	19(S)
		10	30(S)	30(S)
	Kanamycin (KM)	5	18(S)	21(S)
		10	21(S)	24(S)
		30	25(S)	29(S)
	Tetracycline (TC)	5	20(S)	22(S)
		10	22(S)	24(S)
		30	26(S)	30(S)
	Terramycin (TC)	10	27(S)	14(S)
		25	35(S)	24(S)
	Streptomycin (SP)	10	0(R)	0(R)
		20	0(R)	0(R)
		100	0(R)	0(R)

(R) = Resistant; (S) = Sensitive; µg = Microgram; mm = Millimeter

Source: Ugwuzor (1997)

Other works on bacterial studies on fish included micro-organisms associated with milt (spermatozoa of cultured *Clarias gariepinus* broodstock in fish hatchery systems (Akinyemi, *et.al.,* 2010) Micro-organisms associated with eggs of cultured *Clarias gariepinus* broodstock in fish hatchery systems (Akinyemi, Ezeri, Obasa and Bankole, 2009).

9.6.3. Environmental studies.

I have contributed knowledge with regards to environmental impact on health status of cultured fish and also provided baseline information on haematological parameters of the most cultured fish species in Nigeria in order to serve for diagnosis of diseases in fish. Many workers have stressed the need for establishment of normal haematological values in fish species which could be used as important diagnostic tools for monitoring fish health under culture conditions. Deviations from such values could then be used as a standard for assessing the health of fish species.

A study was carried out to compare the effect of source (wild & culture), sex and acclimation on some haematological parameters of *Clarias gariepinus*. Results showed that sex and source of fish did not have significant effects on the haemoglobin (Hb), packed cell volume (PCV), white blood cells (WBC), erythrocyte sedimentation rate (ESR), lymphocyte and monocyte values of the fish although there were wide variations in the neutrophil and lymphocyte values of males and females. Acclimated fish had significantly higher values of WBC, neutrophil and lower hymphocytes than non-acclimated fish. This indicates that acclimation exerts some level of stress on the acclimated fish. This should be reckoned with when collecting fish blood for analysis if appropriate values are to be obtained and used for diagnosis of disease condition in fish. (Ezeri, Gabriel and Opabunmi, 2004).

Proxone, also called paraquat (1,1-dimethyl-4,4-bipyridinum dichloride) is widely used for broad weed control, It is also being used as an aquatic herbicide (Extoxnet, 1996). The use of haematological techniques in fish culture is growing in importance for ecotoxicological research, environmental monitoring and fish health condition (Mulcalhy, 1975). Haematoxicity of proxone to juvenile *C. gariepinus* under laboratory conditions was studied. Results from the study suggested that brief exposure of juvenile *Clarias gariepinus* to proxone could cause some level of stress as manifested by changes in some of the haematological parameters of the fish studied (Gabriel *et.al*, 2006).

Pollution from crude and refined oil is common place world over and particularly endemic in countries whose economies are dependent on the oil industry. Haematology and histopathological changes in fish exposed to pollutants have been used as sensitive biomarkers for assessing the effects of several environmental contaminants including petroleum products (Heath 1990, Bennett *et.al,* 1990). The research on "Haematology and gill pathology of *C. gariepinus* exposed to refined petroleum oil, kerosene under laboratory conditions, revealed that haemoglobin (Hb), haematocrit (Ht), Mean Corpuscular Volume (MCV) and WBC values declined with increase in the concentration of the toxicant. Secondary lamellae of gills of exposed fish were hypertrophic, necrotic and suffered different levels of curving, blunting and fusion. (Gabriel, Amakiri and Ezeri, 2007). (Plate 18)

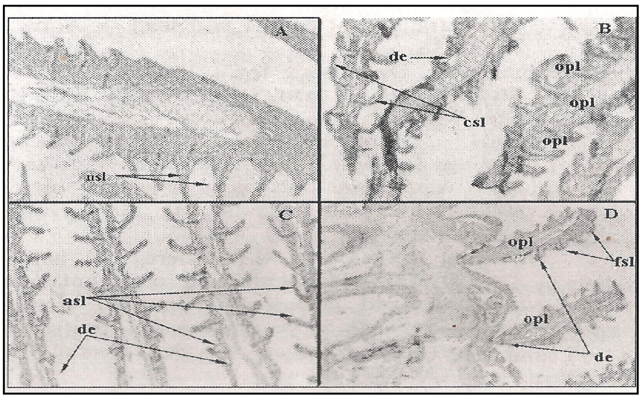

Plate 18.0: sections of gills of *Clarias gariepinus* exposed to various levels of kerosene for two weeks (A) control (B) 70ppm, (C) 150ppm and (D) 300ppm. Nsl-normal Secondary lamella, asl-atrophied secondary lamella fsl-fused secondary, de- dequamated epithelia from primary lamella, opl-odomatous primary lamella. H & E 200x

Source: Gabriel *et. al (*2007)

Working with Gabriel and Amakiri, Investigation of the liver and kidney histopathology: biomarkers of No. 1 fuel toxicosis in African catfish, *C. gariepinus* we discovered that the results of pathology of the liver and kidney of *C. gariepinus* could be a good biomarker for the assessment of light fuel toxicosis. Exposed fish showed an increased glomerular cellularity or tubules with infiltration of few neutrophils. There was exclusive necrosis with the majority of the neoplastic tubules in the nephroblastoma stage at the highest concentration. In the sections of the liver of exposed fish, there was degeneration of cords of hepatocytes and severe necrosis of hepatocytes, pykinosis and karyolysis of hepatocellular nuclei as well as hyalination of hepatocytes with narrowing of the liver sinusoids channels. (Gabriel, Ezeri and Amakiri, 2007). (Plate 19

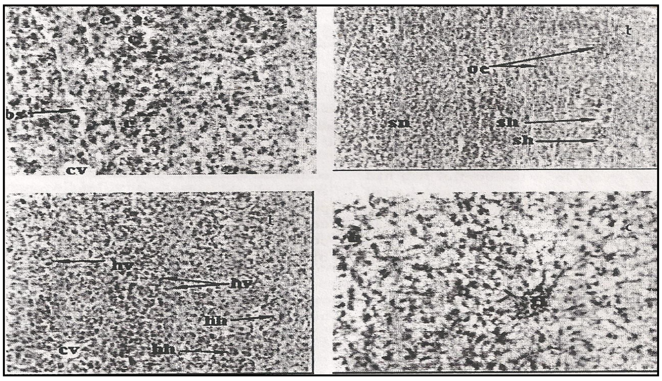

Plate 19.0: cross section of liver from *Clarias gariepinus* exposed to various levels of kerosene for two weeks. (a) control (b) 75ul (c) 150uLL^{-1} and (d) 300uLL^{-1}. A (Control) –hepatocytes in cords (c) blood sinus (bs) and central vein (cv).
Source: Gabriel *et. al (*2007)

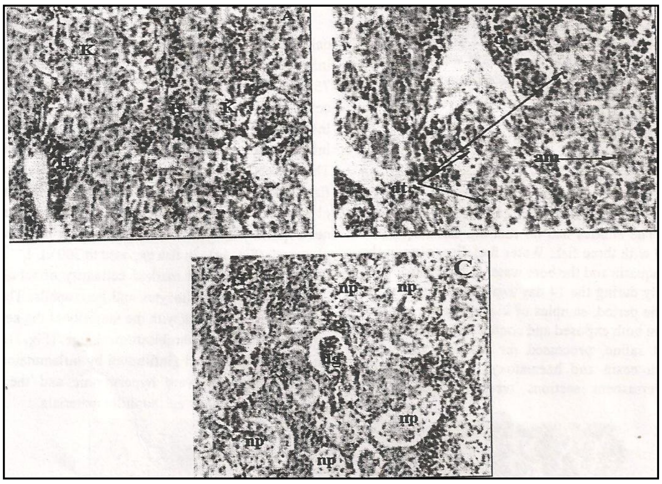

Plate 20.0: Sections of kidney from *Clarias gariepinus* exposed to various level of kerosene for weeks. (a) Control (b) 75uL^{-1} and (c) 300uLL^{-1}
Source: Gabriel *et. al (*2007)

Other researches included, "Effects of partial shading by water lettuce (*Pistia stratiotes*) on growth of tank cultured *Oreochromis niloticus* (Ezeri *et.al*, 2003). The Herbicidal control of water hyacinth *(Eichhornia crassipes)* since its arrival into the Nigerian freshwater lagoon system in 1984, has been a subject of three control methods; mechanical, chemical and biological, being one of the most noxious and prolific weeds (Akinyemi and Imevbore, 1990). It's infestation has been known to obstruct waterways, preventing fishing, navigation, water transportation, post harvest activities of women-in-agriculture, communal washing needs, recreation and other social uses. {Adekoya, Ugwuzor and Olurin (1992)}. A herbicidal control of water hyacinth in Ere channel, Ogun State was carried out with a team of scientists by applying roundup i.e glyphosate containing 360g/l glyphosate in the form of 480g/l isopropylamine salt at the rate of 2.16kg active ingredient (ai/ha) by a fixed wing AG-CAT Schweizer plane. A total of 6,676 (7.4%) number of fish were caught prior to herbicidal treatment while a total of 82,943 fish (92.54%) were caught after treatment. (Ezeri, 2002).

Plate 21.0: Herbicidal control of water hyacinth team (Ezeri arrowed)

***Source:* Ezeri (2002)**

Apart from diseases, predators contribute to non-realization of "fish for all". Working with Onadeko and Shotuyo, a survey of wildlife predators in some ponds in Ogun State was carried out. Thirteen wildlife species from four classes were identified and included water snakes (*Grayia smithii*), Black cobra (*Naja melanoleuca*), Monitor lizard (*Varamus niloticus*), soft-shelled turtle *(Trionyx senensis),* Grey heron *(Adea cinerea),* Wild duck *(Anas platyrhynchos),* African darter *(Achinga rufa rufa),* Shinning blue kingfisher *(Alcedo quadribrachys),* Pied kingfisher *(Cerylerudis rudis),* Kingfisher *(Alcedo anthis),* Crabs *(Cancer sp),* Frogs *(Rana spp.)* and Toads *(Bufo regularis).* The kingfishers and grey heron (Plate 22) were observed in all the ponds daily. The soft-shelled turtle was the least sighted species. Predation occurred both in the day and night. (41%) early in the morning; (22%) in the afternoon and only (5%) at night. Predatory activities were more pronounced during the dry season (41%) than rainy season (31%). The most preferred prey sizes appeared to be fish fingerlings which were consumed wholly. Predatory activities do not appear to be wanting, since prey was sought and killed only for food and not for sport.

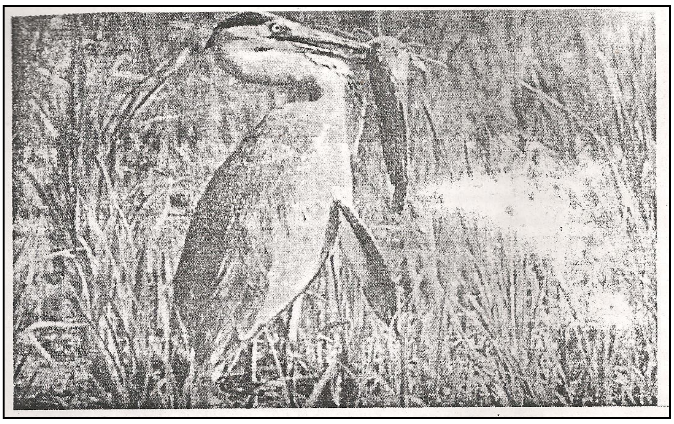

Plate 22.0: Piscivorous Grey Heron carrying *Clarias spp.*
Source: Onadeko, Ezeri and Shotuyo 2000

9.6.4. Fish reproduction/genetics:

Potency of crude pituitary extract from round up (Glyphosate exposed donors in induced breeding of *Clarias gariepinus* was studied. Results seem to suggest that although induction of oocyte maturation, ovulation, spawning and survival of fry may not be negatively influenced by the use of crude pituitary extract of exposed fish, however, such fry may have poor conversion ratio and hence poor growth performance (Ezeri, Gabriel and Sorroh, 2006).

Other works on fish reproduction/genetics included, Growth and survival of diploid and triploid *Heterobranchus bidorsalis* reared in indoor tanks (Agbebi, Olufeagba, Ezeri and Ozodje, 2009), and factors determining fish hatchery operations in Ogun State (Olaoye, Idowu, Omoyimi, Ezeri and Oke, 2011)".

9.6.5. Fish processing and preservation:
In order to ensure that fish gets to consumers, a comparative study of different storage methods on shell-life of smoke-cured fish was carried out (Agbon, Ezeri, Ikenweiwe, Alegbeleye, Oke and Akomolade, 2002) and Studies on micro-organisms associated with smoke-cured fish in two L.G.A.'s of Ogun State (Ezeri, Bankole and Akinyemi, 2003) as well as Factors affecting farmed fish production and marketing in Abeokuta agricultural extension zone of Ogun state (Olaoye, Akintayo, Udolisa, Ezeri and Ogunride, 2010). Promoting backyard or homestead fish farming in Ogun State was also carried out to encourage fish production in Ogun State (Agbede, Adeyemo and Ezeri, 1998). A comparative assessment of the methods of control of water Hyacinth infestation with regards to fish production was also carried out (Adekoya, Ugwuzor, Olurin, Sodeinde and Ekpo, 1992).

9.6.6. Current areas of Research interest.
Plants have been used to treat infectious disease throughout the history of mankind. Over the years there have been reports of multiple drug resistance in medically important strains of strains of bacteria and fungi (CDC, 1995, Ozumba, 2003).

The continuous evolution of bacteria resistant to currently available antibiotics has necessitated the search for novel and more effective antibacterial compound. Efforts in this regard have focused on plants because of their use historically and the fact that a portion of the world's population, particularly in developing countries rely on plants for the treatment of infections and non – infectious diseases. (Martinez *et.al,* 1996).

The results of antibacterial properties of some orthodox antibiotics were compared with plant extracts on fish bacteria. Results revealed effectiveness of the plant extracts' higher inhibition zones from some of the plant extracts than the antibiotics.

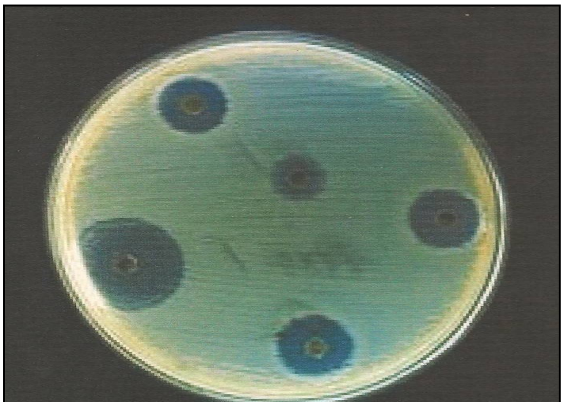

Plate 23:Paper disc impregnated with plant extracts showing zone of inhibition on sterilized Mueller – Hinton agar plates inoculated with bacteria suspension.
Source: Awe (2012)

Table 4.0: Mean differences of the diameter zones of inhibition of antibiotics and plant extracts against Gram – negative bacteria.

Diameter of inhibition zone (mm)									
Path. bacteria	Antibiotics					crude plant extracts (100%)			
	AUG	CRO	GEN	COT	AMX	A	S	P	L
Kleb. sp.	$0.0 \pm .00^{b}$	$0.0 \pm .00^{b}$	0.9 ± 0.06^{a}	$0 \pm .00^{b}$	$0 \pm .00^{b}$	$0.5 \pm 0\ .06^{a}$	$0.5 \pm 0\ .06^{a}$	$0.0 \pm .00^{b}$	$0.95 \pm .01^{a}$
Enter. aer	$0.5 \pm .0.06^{a}$	$0.0 \pm .00^{b}$	$0\ .9 \pm 0.06^{a}$	1.2 ± 0.06^{a}	1.2 ± 0.06^{a}	0.5 ± 0.06^{a}	$0 \pm .00^{b}$	$0.5 \pm .06^{a}$	$0 \pm .\ 00^{b}$
E.coli	$0.0 \pm .00^{b}$	$0.6 \pm .06^{a}$	0.9 ± 0.06^{a}	$0 \pm .00^{b}$	$0 \pm .00^{b}$	0.5 ± 0.06^{a}	$0 \pm .00^{b}$	$0.0 \pm .00^{b}$	$0 \pm .00^{b}$

Mean values bearing different superscripts (a, b, c) in the same column are significantly different but with the same superscripts are not significantly different ($p<0.05$)

AUG = Augmentin, CRO = Ceftriazone, GEN = Gentamycin, COT = Cotrimozazole, AMX = Amoxycillin. S=Sena alata, P= Peperomia, L =Leucaena and A=Acalypha

Source: Awe (2012)

Table 5.0: Mean differences of the diameter of zones of inhibition of antibiotics and plant extracts against Gram – positive bacteria

Diameter of inhibition zone (mm)

Pathogenic bacteria	Antibiotics						crude plant extracts (100%)			
	AMX	CHL	GEN	PEF	CPX	COT	Acaly	Sena	Pep	Leuc.
Strep. sp.	1.2 ± 0.06^a	$0.4 \pm .06^b$	$0.7 \pm .06^a$	$0.2 \pm .06^b$	$1.0 \pm .06^b$	$0.6 \pm .06^a$	$0.75 \pm .01^a$	$0 \pm .00^a$	$0 \pm .00^a$	$0 \pm .00^a$
Bac. cereus	$0 \pm .00^b$	0.6 ± 0.06^a	$0 \pm .00^b$	$1.1 \pm .00^a$	1.2 ± 0.06^a	$0 \pm .00^b$	0.6 ± 0.10^b	$0 \pm .00^a$	$0 \pm .00^a$	$0 \pm .00^a$

Mean values bearing different superscripts (a, b) in the same column are significantly different but with the same superscripts are not significantly different ($p<0.05$)

AMX = Amoxycilline, CHL = Chloramphenicol, GEN = Gentamycin, PEF = Pefloxacin, CPX = Ciprofloxacin, COT = Cotrimoxazole. Sena = Sena alata, Pep = Peperomia, Leuc = Leucaena and Acaly = Acalypha

Source: Awe (2012)

10.0 CONCLUSION AND RECOMMENDATIONS

Before the outbreak of serious disease in the Nigerian fish farming industry as it happened to the Scottish, Norwegian and Canadian fish farming industries, I wish to advice that the new **"FISHERIES COMMISION ACT OF 2014"**, now under consideration for the final approval of the National Assembly, should include what I call, "**FISH HEALTH MANAGEMENT PROGRAMME (FHMP)".** This should be located in the State ADP's for overall cost effectiveness and sustainability, through which other stakeholders: State Ministries of Agriculture (Fisheries Departments), Veterinary Departments, Universities, Research Institutes, NGO's etc can appropriately participate.

The Fish Health Management Programme should feature the following:-

1. That the imported fish stocks should be Fish Health Certified by Fish Health Specialists alongside the customs authorities at the boarders.
2. The fishes and fish eggs being imported into the country should be granted Fish Health Certificates.
3. That Universities and Research Institutes accessible to every State Committee of the FHMR should be provided a laboratory for fulfilling the necessary support activities.
4. That State Committee of the FHMP should be enabled to intervene on disease outbreaks, contaminated products etc

reported to it under appropriate field surveillance activities.

5. Appropriate budgetary provisions should be made at National State and Local Government levels for supporting the operation/implementation of the FHMP.
6. Formal registration of fish farms, coldrooms and other fish production/management facilities i.e. advised to monitor/supervise all fisheries stakeholder activities/data collection in every State.
7. Appropriate National and State level control of the importation of the exotic fish species particularly through our research inter participation, should be strengthened and maintained for the best national interests.
8. There should be the strengthening of the networking opportunities between Policy Management (especially emanating from the FDF, SMOA, LGs, etc), the Research emanating from the Universities, Research Institute etc) and Extension (as provided by the State ADPs, NGOs, etc); farmers and input providers as PREFILS (Policy Research Extension Farmers Inputs Linkage System) for overall sustainability of the implementation of the FHMP.
9. Finally, there is need to observe adherence to International Fisheries regulations, laws, acts etc as often specified by the FAO on Responsible Fisheries in order to enable Nigeria to participate appropriately in both fish import and Fish exports within acceptable Fish Helath Management horizons.

I wish, at this stage, to appreciate the Federal Government of Nigeria under the able leadership of President Goodluck Ebelle Jonathan, and especially the current Minister of Agriculture, Dr. Akinwunmi Ayo Adesina who recently ensured that registered farmers at the grassroot, got a largeese of 500 juveniles and five bags of floating feeds. More of such programmes should be sustained. In the past, billions were voted for agriculture and siphoned through so-called fertilizer supply to farmers which never got to the grassroot farmers.

11.0 ACKNOWLEDGEMENTS

Mr. Vice-Chancellor Sir, ladies and gentlemen, I wish to use this opportunity to appreciate and thank the Almighty God who made me to survive what would have been a ghastly motor accident on Ijebu-ode road in the year 1996. He has made this day possible despite all the arrows of the enemy upon me and my family. Father, I say, May all Honour, all Glory and all Adoration be unto your holy name in Jesus name. I wish to thank Him for taking me from the lowest rung of the academic ladder to a professorial level. It was not by dint of my hardwork but as a result of His grace upon my life.

I wish to also thank God for bringing me into the fisheries profession. It is a business that God is interested in. When Jesus wanted to start his ministry, he recruited many fishermen. When they needed to pay tax to Caesar, he commanded fish to

be caught and money was retrieved from its stomach to pay their tax, and I quote, *"Notwithstanding, lest we should offend them, go thou to the sea and cast an hook, and take up the fish that first cometh up; and when thou hast opened his mouth, thou shalt find a piece of money; that take, and give unto them for me and for thee"* (Mathew 17 : 27). He told those He called that I will make you fishers of men and no wonder in the year 1994, I was called to be the pioneering Cordinator/Pastor of the first Igbo Church of the Deeper life Bible Church, Abeokuta, Ogun State. He has seen me through in both assignments.

I wish to acknowledge the love, support and encouragement I received from my late father, Chief John Ugwuzor Ezeri, whose penchant for education made him to assure me he was ready to sell all he had if only to ensure that I got the highest degree in the land having he suffered under his bosses who had better education than him. He instilled in me the virtues of discipline, hardwork, good morals and fear of God (May his soul rest in peace). I also want to thank my dear mother, Mrs. Margaret Ezeri whose love and care saw me through my days of education. Mama had to sell some of her wrappers to ensure I had some pocket money. She gave me some to make dresses especially after the Nigerian/Biafran civil war. Mama you are a "Sweet mother". To my siblings Mr. Chijindu Ezeri and Mr. Samuel Ezeri, I say thank you for your love. To Messers Mgbechinyere and Emmanuel Ezeri who are presently in the United States of America, I say thank you and pray you achieve your desired goals over there.

I want to acknowledge the role my paternal uncle, Colonel Daniel Ugwuzor (Rtd) played in my life. As the last Quarter-master General in the defunct Biafran Army, he ensured that I was withdrawn from 15 Battalion at Umunna Okigwe to Army Headquarters (TAC) in Isu, Nkwere L.G.A. and this contributed to my surviving the war. Sir, I thank you for all your encouragements and love.

I am also grateful to my maternal uncles, Chief Charles Nwankwo, Mr. Ifenkwe Ogbonna and my late grandmother, Mrs. Nwabekee Nwankwo for their love and support to me. I want to appreciate my paternal Uncle, Mr. Jacob Ogbonnaya (Late), Engineer Onyekachi Ehiemere and Chief Marcus Mpamugo for being a source of encouragement from my youthful days till date.

I want to appreciate my other relations, Mr. Chibuike Agaruwa, Prince Eboh Kanu and many others who have impacted upon my life. To my secondary school friends, Architect Sunday Onwuchekwa, Arch-Bishop Chile Okenwa and others, I say thank you. Also to my secondary school teachers, Mr. M.F.U. Orji, my late principal, Mr. H.C. Ogbonna, Mr. Eleazu my English teacher whose prowess in the subject enabled me to make A1 in the English language and Grade I in WASC examination in 1970 after the Civil war. May God reward you all.

I want to at this stage remember the pioneering Vice-Chancellor of the former Federal University of Technology, Abeokuta that metamorphosed to Federal University of Agriculture, Abeokuta, Professor Chimere Ikoku (Late) who was murdered by assassins in Enugu, for appointing me as pioneering "Staff-in-charge" as we were called then of the Department of Biological Sciences (Plate 24). Thank you for the confidence and encouragement you gave. How I wish you are here to witness this day. May I request that we stand for a one minute silence in honour of this great man?

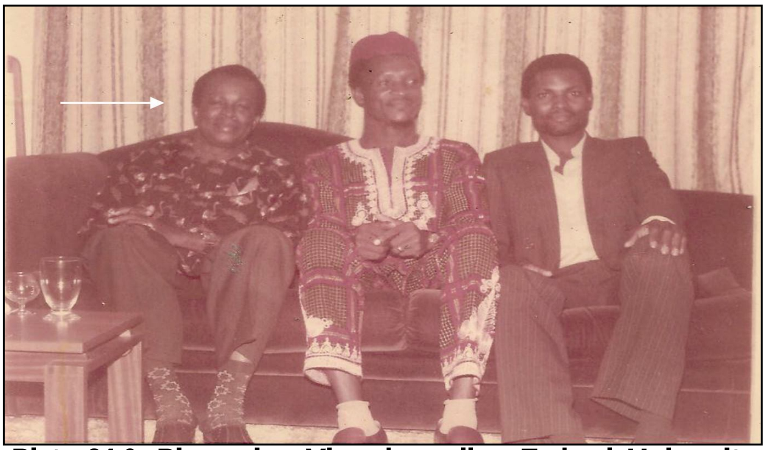

Plate 24.0: Pioneering Vice-chancellor, Federal University of Technology, Abeokuta (Professor Chimere Ikoku arrowed).
Source: Ezeri (1984)

I want to also appreciate my teachers during my undergraduate and post-graduate days at the University of Nigeria, Nsukka and University of Jos. First, I want to thank the major supervisor for my Ph.D. in UNIJOS, Professor Chiweyite Ejike, former Dean, Faculty of Natural Sciences, UNIJOS and former Vice-Chancellor, Enugu State, University of Technology, Enugu for imparting to me a solid memorable academic foundation. Other lecturers that impacted on my academic life included, Professor Anya O. Anya, Late Professor I. Okpala, Late Professor J.B.E. Awachie, Dr. N. M. Inyang, Prof C. O. E. Onwuliri (Late), Professor Moses Iwuala, Prof. A.B.C. Nwosu, Professor E.B.C. Ufodike, Professor F.D. Sikoki, Dr. Don. Anadu (my Ph.D. co-supervisor), to you all, I say thank you for contributing in one way or the other to my academic enrichment.

I also want to appreciate my undergraduate and post-graduate friends/classmates. Dr. Felix Oguzie (my bosom friend), Prof. Joe Chidobem (former VC, ESUT), Prof. Chike Ofojekwu etc.

I am so grateful to my in-laws who gave me my darling wife that stood by me in sunshine and in the rain. Especially, I want to appreciate my late father-in-law Pa Clifford Adiole whose love and humility challenged me in life. Papa, I say rest in peace. I also thank my mother-in-law, Mrs. Jiuliana Adiole, my brothers-in-law, Messers Daniel Adiole and Barington Adiole for their love and support.

I want to also thank my incumbent Vice-Chancellor, Professor O. B. Oyewole for his support for this inaugural lecture. They always say, "The young shall grow. Thank God you made it. I pray that the Lord will help you to take this university to a world class status. The signs are already showing. I say a big CONGRATS once more. My deep appreciation goes to all the past Vice-Chancellors of this great university with whom I had the privilege to work with, namely Professor N. O. Adedipe, Professor Julius Okojie, Professor I. F. Adu, Professor Ishola Adamson, and Professor O. O. Balogun.

I want to appreciate the Deans/Directors I worked with namely Professor Ola. Adams who searched me out from Department of Biological Sciences and ensured I was appointed the pioneering Acting Head of Department of Aquaculture and Fisheries Management. Sir, I thank you. My other former deans, Prof. O. Martins, Prof. T. A. Arowolo, Prof. M. O. Adedire, Prof. Ishola Adamson and my present dean, Prof C. O. Adeofun, thank you for your love. Thanks to former directors of INHURD, Prof. S.T.O. Lagoke and IFSERAR, Professor O. A. Osinowo for your able leadership and the cordial relationship I had working with you. I cannot forget to thank Professor G. M. Babatunde, my Dean in Faculty of Agriculture, Bendel State University, Ekpoma. Sir, you took me as a son. I appreciate you.

I want to acknowledge my spiritual fathers, Pastor W. F. Kumuyi, the General Superintendent of the Deeper Christian life Ministry, under whose ministry I gave my life to Christ, my State Overseers, Pastor Egunjobi, Pastor Shola Odumosun, and to my present State Overseer, Pastor Micheal Aruleba, your undiluted ministrations has kept me in the faith.

To all members of the Deeper Life Bible Church and especially the Igbo districts, I say thank you for your fellowship of love. To all members of Fisheries Society of Nigeria and especially to my Co-fellows of Fisheries Society of Nigeria which include the President of the Federal Republic of Nigeria, Dr. Ebelle Goodluck Jonathan, I say thank you for being in the struggle for "Fish for all Nigerians".

I wish to thank all members of Catfish Farmers Association of Nigeria, Ogun State branch. I also wish to thank Professors M. O. Bankole and Sylvia Uzochukwu. You are ladies of Honour in my life. Thanks for your encouragements, spiritually and otherwise, and to my brother in the Lord, Professor B. A. Adewunmi, I say thank you for your love.

To my colleagues in the College of Environmental Resources Management and Department of Aquaculture and Fisheries

Management, it's been wonderful working with you. To all my former HODs Professor S. O. Otubusin, Professor Yemi Akegbejo – Samsons, Professor I. T. Omoniyi, Professor W. O. Alegbeleye, Dr. Obasa, Dr. (Mrs) F. A. O. George and my present HOD, Dr. N. Bolatito Ikenweiwe, thanks for your support.

To all the students I supervised or co-supervised both at the Master/doctoral levels, I appreciate your hardwork and success. Kindly stand up for recognition if present. Dr. Andrew Agbon, Dr.(Mrs) George, Dr. O. Olaoye, Dr.(Mrs.) O. T. Agbebi, Dr. Abubakar, Idio– Ogede, Dr. A. A. Akinyemi, Mr. Awe Adekunle. To all the undergraduate students of my department. I appreciate you all.

To Messers Bamidele Nathanael A. and Makinde Yusuf O. (FUNAABITES) my good friends who assisted me in no mean way in the production of this presentation, I say thank you very much.

At this stage, I want to specially thank my darling wife, Mrs. Bernice Ezinwa Ezeri. I cannot thank you enough for the love and care you have showered on me and my family this thirty-two years of our marriage. I thank you Benny. May the Lord continue to keep you for me and my family.

I also want to appreciate our four wonderful children namely, Mrs. Margaret Famuyiwa (Ex-Funaabite), Mr. Obinna Ezeri (in Canada) but ably represented by his fiancée, Miss Ronke Cole, Mrs Jessica Ozobu, and the baby-in-the-house, Miss Emmanuella Ezeri, our grand children, Derek and Kamtonna and my sons-in-law, Engineer Opeoluwa Famuyiwa and Mr. Kingsley Ozobu. I love you all.

Mr. Vice-Chancellor Sir, Ladies and gentlemen, thank you for listening. I wish you to join me to thank God as we sing;

TO GOD BE THE GLORY
To God be the glory, great things He hath done;
So loved He the world that He gave us His son
Who yielded His life an atonement for sin,
And opened the life gate that all may go in
Refrain
Praise the Lord, praise the Lord,
Let the earth hear His voice,
Praise the Lord, praise the Lord,
Let the people rejoice;
O come to the Father, through Jesus the Son,
And give Him the glory, great things He hath done.

Great things He hath taught us, great things He hath done,
And great our rejoicing through Jesus the Son;

But purer and higher, and greater will be
Our wonder, our transport, when Jesus we see.

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