



Environmental health, ecological diseases and sustainable development of fish culture in Nigeria

¹ JA Opara, ² NE Okwodu, ³ SA Abere

¹ Department of Biological and Environmental Sciences, School of Engineering and Applied Sciences, Kampala International University, Kampala, Uganda

² Department of Integrated Science, Federal College of Education, Technical, Omoku-Rivers State, Nigeria

³ Department of Forestry and Environment, River State University of Science and Technology, Port Harcourt, Nigeria

Abstract

Although existing fisheries management systems have largely failed, the public and most scientists believe this failure is due to overfishing and that the solution includes the precautionary approach, marine protected areas and ecosystem management. The solutions commonly identified actually treat a symptom rather than the problem. Solutions do exist and have the common characteristics of changing the incentives to make what is good for an individuals or group good for society. Example already in place is the aqua-cultural development which has unveiled to an extent the degree to which fish farm can sustain the economy and provide the necessary protein need of the country. Fish farmer's sees their business as an answer to the ecological problems associated with over fishing in the wild state and other human impact on rivers. Ecological disease of fish culture caused by poor water quality has posed a serious threat to fishing industry in Nigeria. These stress factors in the environment has been magnified to catastrophic levels in recent times because of the rate of environmental degradation that has been going on unabated. Addressing ecological diseases of fish culture constitute one of the most important steps towards improvement and increasing productivity of fish culture establishment in Nigeria. It is apparent that ecological diseases of fish develop from human anthropogenic impacts on water quality and poor management of the system. Fish farmers can keep their fish in good physical condition and improve productivity by proper design of facilities, good management and good care.

Keywords: aquaculture, fisheries, disease, anthropogenic, environmental degradation, sustainable development, water quality

Introduction

Ecological disease is a departure from the typical normal state of health of fish or any animal resulting from stress factors in the environment. These stress factors are the unmanaged products of urbanization, industrialization, increasing population and several other human activities that has resulted to environmental degradation (Goudie 1990) ^[11].

In the wild state, fish are widely dispersed and diseases are often not noticed but under artificial condition, these diseases are found and may be magnified many times resulting to catastrophic loses.

That the world and Nigeria in particular is gradually but steadily approaching an environmental catastrophe at very fearful proportion is no longer news, what may be news and very saddening one is the fact that at the threshold of this imminent disaster, action to stop or at least check the rate of degradation of our environment has most often been ornamental and perfunctory at the very best and non-existent at the worst.

Man's creation of civilized culture through technology among other activities coupled with environmental illiteracy has affected aqua cultural management more negatively than positively. Industrial wastes, sewage, pesticide, gas flaring and oil spills from wells and tankers have become almost a regular source of water pollution in the Niger Delta.

The most important anthropogenic impacts on water quality, on a global scale are pathogens, suspended solids,

decomposable organic matters, eutrophication, Nitrate as pollutant, salinization, trace elements, organic micro pollutants, acidification and modification of hydrological regimes (Maybeck *et al.*; 1980) ^[13]. Polluted water has a high human health cost, at least one-tenth of the global burden of disease (measured in disability-adjusted life years) can be attributed to water sanitation, hygiene and environmental factors (Fewtrell *et al.*; 2007) ^[8]. Other pollution costs include clean up, additional treatment and damage to fisheries, ecosystems and recreation. Petit (1996) ^[17] states that in the next 25years, the world population would double and if it continues with the rate of garbage generation, the earth surface will not be enough to contain the population. These states of affairs apathy describe the danger of environmental degradation occasioned by human activities in Nigeria. Aquaculture is very important and is the fastest growing animal based food producing sector particularly in developing countries (FAO 2007) ^[7]. This sector contributes nearly a third of the world's supply of fish products. Nigeria is responsible for more than half the production in Sub-Saharan Africa and only six countries (Nigeria, Zambia, Madagascar, Togo, Kenya and South Africa) accounts for 89% of production. FNI (1980, FAO 1988) ^[9, 6] reported that production of fish in Nigeria stands at 11, 300 tonnes which represent 2.3% of world catch. Chile supplied over 100, 000 tonnes in 1999, putting it in third place behind Norway and the UK in second, which supplied some 125, 000 tonnes. Canada is a modest

fourth with about 50, 000 tonnes. The total world aquaculture production reached US \$45.4b (28.8m tones) of product in 1997. Aquaculture is important as foreign exchange earner, source of food, employment, aesthetic value etc.

Aquaculture produces proteins crops with more than 220 species unlike terrestrial farming which the bulk of production is starch based on limited number of species (FAO 1988) ^[6]. Aquatic organisms produced through aquaculture include fish, aquatic invertebrates, planktons and aquatic plants (seaweeds). Accurate information on the size of fish populations is hard to gather because ocean fish make long migrations or live too deep for proper counts to be made. Management for a sustainable yield is therefore, very difficult.

Improved technologies, changes in ocean current, human causes such as population and overfishing led to depletion of ocean stocks that gave way to the development of aquaculture. Aquaculture came as a solution to wild stock which are been depleted to meet the protein need of the rural population and to overcome the problems inherent in wild fisheries (Myers and Bovis 2003) ^[14].

Aqua- culturist are industrialist and no longer regarded as pleasant farmers of the wild approach.

Fishes are prolific and grow faster under aqua cultural condition than in wild state. A fish can lay up to one million eggs and under culture systems, the entire eggs may hatch, become fry and grow to maturity or table size within three months without loses (Okwodu, 2016) ^[16].

Therefore ultimate control of fishery production is found in aquaculture. Culture of local fishes can provide protein in many developing countries more efficiently and cheaply than fishing for wild fish.

Addressing ecological diseases is not only important in fish farm management but an aspect of sustainable fish farm development and solution to environmental degradation in Nigeria. Thus for a sustainable development of aquaculture, there must be a holistic and global consideration of population problems, resource utilization, depletion and environmental degradation.

Disease of fish culture has engaged the attention of aqua culturist throughout the world for over three quarters of the century. Although certain control measure has been carried out, ecological diseases remain a major health hazard today in fish cultures.

Diseases outbreak in fish culture system can be noticed through mortality patterns, behavioural changes and external appearance of the fish. These three factors will also provide clues in establishing the causes (s) of the disease. Fish disease may be classified as infectious when they are caused by micro-organism such as protozoa, bacteria, fungi and viruses.

Diseases not caused by micro-organism otherwise known as ecological diseases are of concern to us and are non-infectious but deadly and due to poor water quality. These include intoxication, anoxia, gas bubble disease, PH acidosis and alkalosis, thermal trauma etc (Brown *et al.* 1980, George 1983) ^[3, 10]. The stress factors and/or poor water quality, not only cause diseases but also subject the fish to secondary microbial infections by altering the resistance of the fish.

Intoxication are caused by toxic agents such as rubber tubing, cements from cemented walls, nitrogen compounds from food remain, rotten plants, ions in natural water and algal toxin, all

associated with fish culture.

Phenol is one of the most violent neurotoxins found in residue water and causes damages to reproductive system, gill epithelium and kidney, focal necrosis, odema, anaemia and death (Huet 1972) ^[12].

Anoxia is due to lack or deficiency of oxygen as a result of the standing crop of heterotrophic organisms, temperature, low water current, cloudiness and excess detritus.

Anoxia in fish culture can be noticed by musty odour of methane and hydrogen sulphide, colour of water, death of fish at down and the appearance of fish, snail and tadpoles at the surface of the water piping for air.

These can be controlled by three different ways:

- 1. Biological:** Involve the choice of proper combination of polyculture.
- 2. Physical:** Aeration by introducing air bubbles into the pond, addition of water from outside sources to the pond in order to enrich it with oxygen.
- 3. Chemical:** Application of a single super phosphate at a rate of 120-150 kg/ha and if fish are still in danger of suffocation, the application of up to 6ppm potassium permanganate also provide a temporary relief (George 1983) ^[10].

Gas bubble disease (Gas embolism) can occur in fish culture when there is an excess of gases in water. This arises from faulty water pumps with leaking gas kits, when a culture system has too much plants or where there is asphyxiating growth of algae and water bodies receiving heated effluent (Brown 1980) ^[3].

Gas bubble disease is characterized by appearance of observable gas bubble in body cavity behind the eye, within gill capillaries and hemorrhaging of the fins.

Diagnosis of gas bubble disease in fishes can be done by gross and microscopic examination of bubbles of gas behind eyeball; tissues and in circulatory system. Gas bubble diseases can be treated by changing the affected fish to normal water and strong aeration.

PH acidosis and alkalosis is caused by the quality of hydrogen ions in the water which determines if it is acidic or basic. A desirable P^H for freshwater fish is from 6.5-7.5. The P^H for marine fish is about 8.5, therefore fish can tolerate wide range of P^H from 5 to 9 depending on species. Acidosis can be found in fish which normally require neutral or alkaline P^H but is found in waters which are too acidic. Reverse is the case in alkalosis and may be caused by pollution and too fresh concrete tank. Mixed cultures are frequently the scene of death due to acidosis because species with different P^H and water hardness requirement are often kept together. The occurrence of these diseases can be noticed when fishes begin to show very rapid swimming movement, gasping and tendency to jump out of the water. The gills of the fish burn and their fins injured, showing dark grayish deposits. The fish may cough in attempt to clear their gills.

Environmental water P^H must be monitored, analyzed regularly and in the event of mortality, the P^H must be normalized by either liming the water, or addition of more water to dilute the pond.

Gill diseases are caused by environmental irritants resulting in derangement and damage of gill epithelium. These irritants include ammonia from fish metabolism or normal

decomposition process of protein (uneaten food), dead planktons, overcrowding of fish and rough handling of the fish during transportation.

The disease could be noticed if fishes are seen near the surface or edge of the pond and piping air, they swim aimlessly but slowly, gills appear swollen and reddish.

Gross appearance, microscopic appearance and histopathology of gill tissue can be used to diagnose gill disease. Water chemistry to determine the source of gill irritant may be helpful. The disease can be treated by relieving overcrowding, increasing water flow, using external disinfectants (Brown *et al.*; 1980) [3].

Thermal trauma- Changes in environmental temperature which occur rapidly or beyond the normal surviving range of fish as a result of effluent and gas flaring may cause thermal trauma or shock. Each species of fish has an inherent temperature range which it can survive, grow and reproduce. The temperature ranges from 27 to 33°C. This is the mesophilic range of temperature for Nigerian rivers, streams and water ways (Asonye *et al.*; 2007) [2].

Thermal trauma affects the cardiovascular system, Nervous

system, colloidal system of protein and reduction or cessation of enzymatic activity.

Diagnosis must be made primarily on records of water temperature. The temperature of a pond culture can be influenced by increasing the quantity of water (Asonye *et al.*; 2007) [2].

There are also many fish diseases directly related to nutritional deficiencies are excesses. Nutritional deficiencies are rare in wild fishes where ample natural food is available unlike fishes confined under intensive fish culture conditions or non-productive aquarium. These include protein and amino acid deficiency, fats and fatty acid deficiency, carbohydrate and mineral deficiency and vitamin deficiency. Nutritional deficiencies lead to reduced growth rate, poor reproduction, Affect biosynthesis of many nitrogenous compounds including enzyme, hormone etc and susceptibility to infectious disease. The diseases are characterized by swelling behind the lower jaw (Goitre), Intestinal tracts (belly), liver, other organs and diarrhea.

Various signs attributed to specific vitamin deficiency is shown in table 1

Table 1: Signs of Vitamin Deficiency in Fish

Vitamins		Signs
1		Water Soluble Vitamin
A	Ascorbic acid	Scoliosis, Lordosis, altered Cartilage, Capillary Fragility
B	Vitamin B12	Hematologic disorders, fragile erythrocyte, poor growth.
C	Biotin	Skin lesions, muscle atrophy, spastic convulsion, poor growth, fragile erythrocyte
D	Choline	Poor growth
E	Inositol	Poor growth, distended stomach, increase gastric emptying time.
F	Folic acid	Poor growth, lethargy, fragile caudal fin, dark coloration.
G	Niacin	Loss of appetite, lesion in rectum, muscle spasms while resting, anaemia and hemorrhage in skin.
H	Pantothenic acid	Clubbed gill filaments, hyperplasia, loss of appetite, poor growth.
I	pyridoxine	Nervous disorder (epileptic form of convulsions), anaemia, loss of appetite, rapid and gasping breathing.
J	Thiamin	Convulsion, edema, poor growth
2		Fat Soluble Vitamin
A	Vitamin A	Retinal alteration, poor growth
B	Vitamin D	No specific sign
C	Vitamin E	Muscle dystrophy, choroid in liver, kidney and spleen, edema, poor growth
D	Vitamin K	Reduced Blood clotting time

Source: George (1983) [10]; 199-247.

Diagnosis of malnutrition is extremely different because of the general alteration within the body. Clinical findings, gross sign, pathology, histopathology, examination of the ration formula and ration assay may be necessary for making a diagnosis.

During examination, the fish can be killed by a blow to the head or by pitching (severance of the spinal cord using needle, scalpel or scissors), over dose of common anaesthetic agents can be used (peter *et al.*; 2000) [18].

Discussion

The application of aquaculture has revealed to a large extent the degree to which fish farming can sustain the economy, provided employment and the necessary protein need of the country.

The management of aquaculture for fish production start from the setting up of the farm until the ponds begins to yield.

The major management problem of fishery conservation is

how to control both man and aquatic crops for the present and the future when the demand will probably be greater than now (brown *et al.*; 1980, Okwodu 2016) [3, 16].

Therefore disease prevention and control is an aspect of fish Farm management for optimum production and should be of great concern to all fish farmers. With regards to safe guarding the livelihoods of fisheries as well as the sustainability of both commercial catches and the aquatic ecosystems from which they are extracted. Fish farmer can keep their fish in good physical condition by proper design of facilities, good management and constant care. The population Nigeria has a major role to play in sustaining the fish farm. The present high rate of our population growth is already contributing substantially to the degradation of the ecology of the country. The balance between available resources and the population must be maintained.

The contamination of the atmosphere, land and water by undesirable and poisonous substance as a result of human

activities constitute pollution (Maybeck *et al.*; 1996) and should be well addressed by all fish farmers. Sustainable aquacultural development requires that the adverse impacts of the quality of air, water and other natural elements be greatly reduced such that the over integrity of the ecosystem could be maintained (Okwodu 2016) ^[16]. We should create this awareness starting in the family.

In Nigeria, the national policy on science and technology of 1986 clearly stated this concern in section 238 under environmental policy and policy objective thus:

Policy

The activities of the nation shall be conducted in a manner to ensure sound environmental management culture.

Policy objective

1. To protect the environment against harmful of human and other activities.
2. To preserve the nations ecological setting and ensure the protection of the health and well-being of the people, fauna and flora (NPST 1986 p.25) ^[15]. The above provisions in the national policy on science and technology clearly demonstrate the nations concern for the environment. To prevent too much influence of technology on the environment negatively the Nigerian Government established Federal protection Agency (FEPA) by decree 58, 1988 as a result koko toxic waste dumping episode.

Signs of fish diseases when observed served as a notice that a serious problem is impending and immediate measure should be taken. The fish farmer should immediately check the water quality, coupled with examination of the fish and feeding standard of the fish.

Awareness of diseases in fish has been increased by better techniques for rapid diagnosis, greater experience, better training and an increase in the number of specialist in fish diseases.

In fish farming, when submitting fish for diagnosis, it is desirable to submit a healthy life fish or those just showing the initial signs of diseases.

During examination, the fish can be killed by a blow in the head or by pitching (severance of the spinal cord using needle, scapel or scissors), overdose of common anesthetic agents can be used (peter *et al.*; 2000) ^[18].

The disease sign, gross appearance of the affected part, microscopic appearance of the part, histopathology and water chemistry when properly examined confirms the actual disturbance of the fish. The disease may be treated by individual injection of fish, adding chemical to the water, draining the pond, removing the fish and lime the bottom pond and by medication to diet.

These activities when properly executed will not only improve the health of the fish and pond but increase productivity of commercial fishery.

Therefore disease prevention and control is a very important aspect of fish farm management for optimum production and should be of great concern to all fish farmers. These will safeguard the livelihood of fisheries as well as sustains both commercial catches and the greater aquatic ecosystems from which they are extracted.

Fish farmer can keep their fish in good physical condition by

proper design of facilities, good management and constant care.

Conclusion

Addressing ecological diseases of fish culture constitutes one of the most important steps towards improvement and increasing productivity of the fish culture establishments all over the world. It is apparent that ecological diseases of fish develops from poor management of the system. Fish farmer can keep their fish in good physical conditions by proper design of facilities, good management and good care.

Recommendation

Disease prevention and control is an important aspect of fish farm management. Fish farmer can keep their fish in good physical condition by proper design of facilities, good management and constant care.

These can be achieved by the following ways

1. **Water supply:** All the culture water supply must be sufficiently abundant of good quality in order to avoid dangers of lack of oxygen and pollution. Water supply should either be from surface water (stream and rivers) or well waters not adjacent pond. Well water is the best because it is free from disease, parasite, predators and pesticides.
2. **Stocking:** Disease free fish should be stocked. Overcrowding, lengthy storage, poor handling and transportation should be avoided.
3. **Sanitation:** Stocking of fish should be done by cleaning and disinfection of the culture system. In pond cultures, draining and removal of organic "mock" followed by liming, disking and drying of pond will reduce acidity of water, control vegetation, increase dissolved oxygen and removes almost all parasites.
4. **Pollution control:** All factors such as untreated sewage, refuse, gas flaring, loading and offloading of tankers, excessive use of pesticides, herbicides, fertilizer etc that brings about pollution should be avoided.
5. **Monitoring of fish health:** A monitoring schedule will provide an early alert to potential problems and will allow preventive treatment to be carried out before serious problem arise.
6. **Nutrition:** Artificial feeds of various types are to be done economically. Prolong or improper storage may cause deterioration and hence malnutrition, growth of fungi etc. Excessive feeding of fish results to an increase demand for oxygen and ammonia levels. Monotonous feeding should be avoided as this will lead to nutritional deficiencies. Fishes of different feeding habits should be stocked (poly culture) to avoid competition and subsequent under feeding.
7. **Education:** A more ambitious task that faces Nigeria now is that of devising and putting into effect a type of education and training which will enable individual of all ages and from all backgrounds to assimilate the values, the basic concepts and the practical knowledge which will help the citizen to be aware of environmental problems, help them to adopt their everyday behaviour accordingly and thus make useful contributions to the joint effort to safe guard the environment. In this regard, environmental

education should be made compulsory at all level. Environmental education contributes to the upliftment of knowledge, acquisition of the right attitude and skill necessary for the preservation and improvement of the environment (Bewarang *et al.*; 1977).

Aquaculture should be included in the school curriculum in other to catch them young. It will also engender interest in fish farming business.

The objectives of the national policy on science and technology should be vigorously pursued.

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