SOME POTENTIAL OCCUPATIONAL AND ENVIRONMENTAL HAZARDS ASSOCIATED WITH FISH POND PRODUCTION IN NIGERIA.

BY

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ABSTRACT

The paper highlights the concept of information and the significance of environmental and occupational hazards associated with pond fish production in Nigeria and discuss the possible options for the ways forward. The major raw material used in fish production system is the organic manure (cow dung, poultry droppings, porcine manure e.t.c.) that serves as substrate for heterotrophic production of bacteria and protozoa which act as food for zooplankton and the fish. The pathogenic organisms (viruses, bacteria, protozoans, and parasites), are noted for the potential hazard to the fish handlers and consumers. Nine species from seven genera of bacteria associated with fish diseases are found to have association with diseases of human such as typhoid fever, bacillary dysentery and other gastrointestinal tract related problems. Also the environmental contaminants in pond fish production become important because of its significance to consumers' acceptance of the fish products.

INTRODUCTION

There has been increased interest in the culture of fish as a rapid economic way of raising protein level. Inorder to accelerate fish production and increase the level of much needed protein for the teeming population in Nigeria ailing economy, aquaculture products especially fish is a cheaper animal protein alternative to meat (SEAFDEC 1999) in the rural areas where about 70% of population dewels (Subasinghe and Bernoth, 2000).

The primary objectives of pond culturist are to produce fish. Farming in an aquatic environment presents unique challenges to the farmer and to the veterinarian, but it will quickly be realized that most health problems have their origin in faulty management and the intensive nature of most commercial operators. (Andrew, 1993). However, the target of every farmer is to produce a wholesome fish of high quality and aesthetical to the eyes with high yield and economic value towards profit maximisation thereafter. This therefore involves every means to increase yield by fertilizing the ponds that have low natural food productivity with organic manure to stimulate and improve the primary and natural food production. Although organic manure play a greater role in pond fish production the potential health hazard associated with it should not be under estimated. Several authors have reported hazard associated with fish production and the manure commonly used for fertilization (Ogbodeminu and Okaeme, 1985; Ogbondeminu and Okaeme 1986; Okaeme *et.al.* 1992, Ogbondeminu *et. al.* 1994).

The aim of this review paper is to analysed and create the awareness of the occupational health hazard associated with fish pond production.

TYPES OF HAZARDS

Hazards are activities that could put the life of individuals directly or indirectly at risk or dangers. Hazard assessment in fish production system is therefore a process designed to determine whether activities involved in fish production system constitute hazards of any kinds. The hazards in pond fish production may be grouped into:- Pathogenic and non pathogenic agent-borne hazards.

Pathogenic Agent-borne Hazard

Pathogenic agent-borne hazard are those due to agents in the water and or in the fish causing infection in fish that are capable of causing disease not only to the fish but also can expose the farmers or those involved in fish handling to hazards. The pathogenic organisms like viruses, bacteria, protozoa and parasites present in the aquatic environment are noted for the potential hazard to fish and consumers.

Several authors cited by Ogbondeminu (1993) reported the evidence that fish can act as vector of enteropathogenic bacteria. And they proved that out of the 35 species of bacteria from nine genera isolated from or associated with diseased fish in various parts of the world, 9 species from 7 genera have been detected in association with bacteria diseases of human. Some of these organisms may not be pathogenic for fish, but when consumed by man, infection may occur causing diseases like paratyphoid fever, bacillary dysentery, cholera ,gastroenteritis, infectious hepatitis and other bacterial food-poisoning (Ogbondeminu (1993). Ibiwoye (1994) added that some of these diseases are a potential health hazard to human because of the risk they present through handling and/or eating of inadequately cooked fish.

Fish are prone to various infections just like livestock that hampers their reproduction, growth, appearance which affect their wholesomeness. The treatment of fish with antimicrobial agent may pose a potential hazard to handlers and consumers, with this reason Ogbondeminu (1993) indicated that the public health significance of fish contamination lies not only in their ability to cause disease, but also their possible role in the transfer of antibiotic resistant strains with R-plasmid to other common pathogens for homeothermic and poikilothermic animals.

Though there is lack of much information on cultured fish and their environment as a probable source of human enteropathogenic bacteria. Ogbondemin (1994) in a study confirmed that fish from tropical aquaculture system can habour a variety of gram-negative bacteria in their intestinal tract. He then stated that the majority of bacteria, that are carried in the gastro-intestinal tract of fish, are of primary significance as a source of occupational hazard to the handlers.

The causes of pathogenic agent-borne hazard.

Infectious diseases due to bacteria, fungi, viruses protozoa and helminths can be accidentally transmitted to farmers as a result of association with aquatic environment or handling the fish or eating improperly cooked fish.

Ogbondeminu and Okaeme (1985) isolated about 13 bacterial species associated with organic manure and water Table 1 and reported

Table 1a: Frequency of isolation of bacteria species from water samples

Species isolated	No. of isolate	No. of sample from which batcteria are isolated	No. of sample treated.
Klebsiella aerogenes	8	4	32
Enterobacter hafniae	5	6	42
E. agglomaraus	2	6	42
E. aerogenes	2	6	42
Pseudomonas aeruginosa	6	10	36
p. fluorescens	10	10	36
Escherichia coli	7	12	50

Citrobacter diverus	12	14	25
Proteus mirabilis	4	12	30
Streptococcus fecalis	9	10	50
Aeromonas putrefaciens	2	6	20
Acinetobacter anitralum	1	7	11
Staphylococcus spp	2	6	21
Salmonella*	1	-	62
*Salmonella sp isolate not found			

Table 1b: Frequency of isolation of Bacterial species from fish tissues

Species isolated	No. of isolate	No. of sample from which bacteria were obtained	No. of sample treated
Escherichia coli	8	10	10
Enterobacter aerogenes	2	3	10
Aeromonas anitratum	1	5	10
Pseudomonas aeruginosa	6	5	10
P. fluorescens	4	4	10
Aeromonas liquefaciens	2	4	10
Campylobacter diverus	2	6	10
Staphylococcus epidemidis	8	6	10
Streprococcus fecalis	8	6	10
Proteus mirabilis	1	5	10

Source. Ogbondeminu and Okaeme 1985.

that the presence of *Pseudomonas*, *Escherichia*, *Aeromonas* and *Staphylococus species* are of public health significance because of their primary role in occupational disease of fish handlers. However, Okaeme *et. al.* (1992) isolated about 9 species of fungi from 8 different samples of animal dropping commonly used for fertilization Table

Table 2: % prevalence of fungi growth associated with animal dropping utilized in the fertilization of homestead fish pond.

	Animal faeces and percentage prevalence.							
	Local chicken	Guinea fowl	Cow	Goat	Sheep	Horse	Donkey	pig
Rhizopus sp	100	25	58.33	16.67	25	8.33	50	100
Mucor sp.	100	10	100	75	33.33	16.67	16.67	83.33
Absidia sp	0	0	8.33	0	0	33.33	0	25
Aspergillus sp	33.33	83.33	75	58.33	16.67	0	0	41.67
Trichophyton sp	0	0	8.33	0	25	16.67	0	0
Penicullum sp	0	0	0	33.33	0	0	0	0
candida albican	16.67	50	66.67	33.33	25	50	16.67	0
Cryptococcussp	0	0	25	0	0	33.33	16.67	0
Unidentified	0	0	41.67	0	0	25	25	8.33

Out of the 9 species *Aspergillus species*, *Mucor species*. and *Candida albican* have beer reported to cause clinical disease in fish and shell fish and all of them are of public health significance because they cause disease of humans.

The presence of salmonella group in manure or human waste is risky because it has several serotypes which are pathogenic to man and animals. It is worthy to note that pig is wel known reservoir of pathogenic salmonella so using porcine manure for fertilization should be with care. Furthermore the occurrence of Salmonella sp and *Klebsiella pneumonia* are common and are known to have the ability cause variety of human disease (Ogbonderminu *et. al.*, 1992) which then give the evidence that bacterial contamination of pond with these may have potential human epidemiological hazard. Human consumption and processing of fish grown in the waste-fed pond system increase the possibility of transfer of parasite (e.g. *Haplorchis pumilis*) or pathogens to human. Parasite is deeply embedded in the dermis or musculature of fish and cause severe necrotic ulcerative granulomatois response. (Ibiwoye *et. al.* (1996) added that the lesions render the fish unmarketable and very sceptical to consumers. However protozoa (*Ichthyophthirius multifilis)*, Helmmth (cestodes, trematodes and nematodes) has been reported. Other parasites such as *Argulus sp, Ergasilis sp*, and *Lernea sp* are common (Ibiwoye *et al.* 1996). Encysted worm through out the muscle can be zoonotic by eating improperly cooked fish.

Although fish are rarely consumed in a raw state, the exposure of fish growers to the infected fish and their culture water may be a predisposing factor in the transmission of potentially enteropoathogens to man. Some of these conditions caused by infectious agent include swimmer itches, schistosomiasis; fasciolasis, salmonellosis, leptospirosis, aspergulosis, candicdiasis, helminthiasis etc. Virtually fish production and hazard are interwoven. No wander Jansen 1970 cited by Ogbendimu (1993) postulated that the etiological agents of infection of the eye, ear, nose, throat, gastrointestinal tract and urinary tract in human could be of water-bone, but the sources of infection are rarely traced and need to be traced.

Table 3 shows some fish pathogen of public health significance.

Table 3: Fish pathogen of public health significance.

Pathogen	Manifestations in human	Sources
Haplorchis pumilis	Infarction due to eggs in the blood circulatory system	Ibiwoye (1994)
Diplostomum sp (so-called eye fluke)	Total blindness due to large number of metacercariae in the eye	
Eimeria tarda	Enteric fever	
Mycobacterium sp	Tuberculosis	
Salmonella sp	Several serotypes are pathogenic to man and animal	Ogbodeminu and Okaeme (985)
Enterobacteria sp	Have association with disease condition of man and animal	
Escherichia coli and *salmonella species*	Gastroenteritis.	
Eugostrongylids species	Severe abdominal pain Septicaemia due to perforation of digestive of the tract	Ibiwoye (1996).

Non pathogenic agent-borne hazards.

The non-pathogenic hazard are restricted to general management of the pond and possible implication by chemicals.

Potential hazard in Management practices.

i) Siting of pond

Siting is an important factor to note while constructing a pond for fish production. Some safety cautions must be considered before sitting of ponds. It is tempting to think that one can simply dig a large hole in a ground fill it with water to grow fish and quickly make a hansom profit, but of course this is not the case. The management of water quality is the single most important factor in productive fish farming. Water quality management is an on going never-ending process, which requires a certain amount of diligence from the fish farmer. Daily monitoring of the pond's condition and fish behaviour, long with accurate record keeping, allow the farmer to recognise and prevent deleterious environmental conditions in the pond and thereby maximizing his production and profit (Sophin 2001).

The pond should therefore not to be located directly to run-off of rain flowing directly into the pond, because the flood may contain waste from human, animals and debris of various kinds that may harbour pathogenic organisms or parasite that may in turn pose public health risk. Michael (1988) observed that pond should not be located close to power station or industrial installation to avoid toxic chemical run off in the pond after heavy down pour of rains.

ii) Hazard associated with management

Aquaculture generally like any other production system may expose farmers to some health hazard. It is therefore worthy to note of the existing hazard associated with the profession especially those of public health concern. These occupation hazards include drowning; break in dams, flood disasters, injuries from the use of equipments, nets sunburns and exposure to radiation. Possible exposure to pollution of hydrocarbons or heavy metals, toxic waste and gas emission may cause chemical injuries. Poisonous stings from scorpions and insect, bites from snakes, reptiles and fishes are possible. Attack from large mammals is common outdoor nuisance observed.

Depending on the site of pond, the environmental management, strict sanitary level of the fish pond, farmers and or attendants may be exposed to hazard to some extent. If sanitary level is not satisfactory in fish pond environment ecosystem may be established which create a good breeding place for animals and other organisms which may expose farmers, attendant visitors to environmental hazard. For example unwanted snails, toads and frogs, snakes, insects, birds, etc may full the environment, posing hazard to both fish and man.

Snails of various species (which are believed to play an important role in the life cycle of some animal and human diseases) can inhabit the place. According to Churchill Livingstone (pocket medical dictionary) freshwater snails are intermediate host for *schistosomiasis (bilharziasis). Schistosoma spp* are human blood fluke which are water bone and can enters via skin or mucous membranes. Edward (1994) reported also that snails serve as intermediate host for parasites like eye fluke *(Diplostomum sp),* predators like birds, heron in particular and other birds found in the environment may not only predate fish but can introduce parasite such as eye fluke (Edward , 1994) to the pond.

Poisonous and non-poisonous snakes found in environment with no proper sanitation can expose the farmer attendant and visitors to hazard of snake bite. Insects also which are important in the ecosystem play an important role as potential hazard e.g. tsetse flies (*Glossina sp*) found in the riverine area are known as vector for animal and human diseases causing sleeping sickness in man and somorin, chaga disease, etc in animals. Malaria is another disease of hazard caused by mosquito associated with unsanitized environment.

Long standing and contaminated water provide breeding place for leeches. They are believed to serve as vector for trypanasomiasis and they suck blood directly from fish and human. An experienced field worker reported by Ibiwoye (1994) that two ponds heavily infested by Leeches that even prevented the harvesting of the pond for 6 years, causing stress and mortality in fish. Maintenance of environmental sanitation to the standard including water quality will check this problem.

iii) Hazards associated with husbandry practices.

The traditional principles of livestock husbandry cover in general terms, handling of the stock with minimum stress, management of accommodation and environment, feeding, prevention of disease and harvesting (Andrew 1994). Appropriate use of equipment are essential aid to good husbandry. These principles also apply to pond fish farming.

The potential hazards from husbandry practices do not spare either the farmer, attendant nor the fish themselves. The farmer and the attendant using instrument in handling the fish are possible to sustain injuries exposing the wound to contamination and consequently to secondary infection. For example Newman (1993) reported the possibility of accidental injection in the cause of treatment or vaccination by injection as a result of struggling by the fish. The accidental injection can cause anaphylaxis. Nets or metallic instrument use in handling or catching fish may injure them and expose them to secondary infection by parasites, bacteria or protozoa that are potential hazard.

iv) Personal observations

Many other environmental factors can be economic imporant to fish production systems. Some involve material introduced into the water supply. Fish pond located close to residential area most atimes serve as collection site for harmful object like, broken plates and bottles, spoons, nails, old bicycle parts, etc. These object are very hazardous to farmer during test cropping or during harvest of the pond.

v) General environmental issues.

Most fish live their entire lives in water. However water as the universal solvent makes prevention and control of physical and chemical contamination of water body much more difficult. Fish can be affected by such contaminants arriving from outside their normal habitant and also arriving from their own activities.

The quality of the water in which fish are contained is therefore very important to their livelihood. Though according to Branson (1993) different species of fish can tolerate different level of contamination, adverse environmental parameters can have direct and indirect effect. Since the main objective in any fish pond production should be to create and maintain water quality within the tolerance limit of fish, it is important to maintain a stable environment.

Oxygen content of water is very import because fish like terrestrial animal require adequate supply of dissolved oxygen. The level of dissolved oxygen content in the water depends on the temperature of the water and varies from specie to species. Another gas of economic importance is carbondioxide ($C0_2$), which is very essential for plants growth usually present as free gas or bicarbonate, carbonate or in organic form. Its high level interferes with oxygen uptake causing nephrocalcinosis which has no treatment (Brown 1983). Other gases of economic importance are chlorines, ammonia and nitrites other important water parameters are pH., hardness, temperature. The optimum pH for fish as reported by many authors is between 6.5 and 9 and live below and above this range has effect.

b Hazards Associated With Chemical Contaminants .

The main source of chemicals in fish production system is agricultural runoff and some times inclusive waste. N'Daw (1991) reported that pesticides pollution result mainly from wide spread use in agriculture and vector control campaign conducted near fish farms, since the pesticide can enter aquatic environment directly by their introduction to attack particular organisms or directly through atmospheric precipitation and land runoff. Pesticides widely used include DDT, lindane, methylparathion, carbofuran, endosulphan and diazinon. While some common pesticides used in vector control campaign to curb such endemic diseases such as malaria, onchacerciasis (river blindness) schistosomiasis (bilharziasis) and trypanosomiasis (sleeping sickness), include temphos, chlorphoxin, permetrim, diflametrin, nichlosamide, DDT, carbosulfan, fenitrothion and fenthion (N'Daw 1991).

Chemicals used in fish treatment purposes are formalin, malachite green, chloramin, dylox, methyleneblue, etc (Ibiwoye 1994). Edward (1993) observed that most chemicals used in fish treatment purposes are lethal and if applied wrongly could be toxic to fish. Causing direct damaging effect on the gills and causing respiratory distress if over used. Despite the emphasis on the monitoring of chemical contaminant in the environment, the ultimate consequences of pollution are biological. The effect on fisheries may be direct arising from the toxicity of pollutants or indirect as a result of ecosystem modification or reducing the resistances of fish to infection of pathogens by public significance.

Management related agents caused hazards.

For a long time Africa at large was thought to be safe from aquatic contaminations. However in the recent times as a result of high population growth, accompanied by intensive urbanization, increase industrial activities and high exploration of natural resources including culturable land there has been a steady increase in the quantity and diversity of discharges that reach important aquatic environment especially pond. Fish cultured in water heavily contaminated by pesticide, industrial, domestic or animal waste are not only subject to the direct effect of the contaminants but also become more susceptible to disease in the generally crowded condition of a fish pond. Though some waste however can be beneficial to fish production, for example animal manure and crop residues can increase the productivity of fish pond.

Currently receiving world attention is the utilization of organic materials based on the assumption that organic matter of the organic manure provides a source of reduced carbon for heterophic grazing while mineral fraction of the manure is used by both autotrophy and microbial heterotrophs. While organic manure is very important in pond fish production it has also proved by many authors (Okaeme *et. al.* 1992, Ogbondeminu *et. al.* 1992,; Ogbondeminu and Okaeme, 1985) that it is a source of contaminants to the aquatic environment and source of organism that may not only stand a potential hazard to fish and consumers but also affect the production quality of fish.

Fertilization of pond with stale manure pile is preferred to the use of wet and fresh manure Okaeme *et. al.* (1992). This is because fresh manure has high coliform count with high incidence of undesirable bacteria, protozoa, viruses and helmith of public health significance (Okaeme, 1990). Thus he recommended that manure be stored in pile for several weeks (2 weeks minimum) before application.

Fish as the essential commodities when come down with infection from organism of various kinds found in contaminated environment deserved treatment with antimicrobial agents and other chemicals to restore the fish its normal health. Ogbondeminu and Olayemi (1993) observed that the indiscriminate use of antimicrobial drugs and other synthetic chemotherapeupants to treat fish has resulted in an increased in population of antibiotic resistant bacteria as well as resistance R-plasmid in food producing animals. The potential for transferability of antibiotic resistant plasmid in resistant bacteria isolates from fish and aqueous

environment is of public health significant. For example tetracyclines are known to induce plasmid encoded drug resistance in different species of bacteria, which are pathogenic to fish. It is because this kind of hazard, that Shepherd and Bromage (1992), reported that in many countries of the world, antimicrobial drugs are closely controlled by the authorities and can only be prescribed by a veterinarian who has satisfy himself that their use are justified. In U.K. the tretraclines antibiotics are classed as prescription-only-medicine (POM) and can not be purchased without prescription signed by a Veterinarian or a Medical Doctor.

TREATMENT AND CONTROL STRATEGY OF THE CAUSAL AGENTS

1 Infectious cause.

(a) Bacterial causes:- Avoid over crowding by stocking at the proper rates NIFFR extension guide series No.6. Don't over fertilize the pond to avoid excessive algal bloom and the consequent depletion of dissolved oxygen practice feeding at the recommended rates. NIFFR Ext. Guide No.4.

(b) Fungal causes:- Practice good pond sanitation. Ensure regular feeding proper stocking and pond fertilization to prevent bacterial and fungal disease that could promote viral disease. Feed with balanced ration (NIFFR Ext. Guid. Series Series NO. 4. Ensure good pond sanitation.

(c) Viral causes:- Practice good pond sanitation. Ensure regular feeding, proper stocking and pond fertilization to prevent bacterial and fungal disease that could promote viral diseases.

(d) Parasitic causes. Prevent pond being overgrown with weeds; predators of fish can easily gain access to pond that are bushy. Control predators by killing, remove carcass from pond promptly. Apply lime at recommended rates. (Lime are excellent disinfectant).

2 **Management Related Causes**

Those occupational hazards whose occurrences are prompted any art of mismanagement on part of the fish farmers. Such acts result nutritional problems poor water quality and low dissolved oxygen availability.

Seek technical assistance of extension workers on pond management problem. Ensure proper feeding, fertilization and liming. Follow recommended rates NIFFR extension Guide Series No. 3 and 4.

CONCLUSION

The major raw materials in fish production is organic manure which is one other way of introducing micro-organism and parasite into pond exposing those involved to occupational hazard.

With this review it seems fish farming is full of hazard but it is not restricted to fish farming only. The aim of this review paper is not to discourage fishermen, fish mongers, attendants and consumers from going into fish and fish farming business. But this is to create awareness of the potential occupational hazards involved in the profession so that those involved in it will do them with care since prevention is always better than cure.

Recommendations

For public health consideration pathogen indicators should be used to determined the presence of disease causing organism from sewage or manure before use for fertilization Ogbondemin *et. al.*, (1994) suggested waste water treatment through stabilization should be developed before discharge into natural water being the most effective method of sewage treatment in hot climate.

The use of fresh or wet manure should be discouraged Manure be dried or stored in pile for several weeks before application.

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