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Some Issues in Culture Fisheries Management and Practices

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Abstract: Some issues in culture fisheries management and practices were reviewed to enlighten fish culturist. Fish culture like other agricultural practices encounters several problems. The various land tenure systems encourage land fragmentation, which hinders an intensive fish culture. Lack of good roads and transport facilities for the transportation of fish from rural to urban areas, lack of government assistance to fish farmers to established fish farms is also not out of place. Pest, predators, competition and disease hinder fish culture practices. The production system also presents risks to public health. The closed nature of a fishpond system, associated industries and the introduction of non-endemic species into natural water arising from their inadvertent release from aquaculture facilities is considered a serious environmental threat. These and others are some issues in culture fisheries management and practices. The key areas discussed are: Land tenure system, fish farming infrastructures, the culture system, hazards and risks, environmental pollution, habitat modification, food safety and public health hazards, fish diseases, competition, health implications, population migration, agricultural development projects and human diseases.

Keywords: Competition, diseases, environmental pollution, hazards and risks, infrastructure, land tenure system

INTRODUCTION

Fish culture like other agricultural practices encounters several problems (Yates and Wolstenholme, 2004). The various land tenure systems encourage land fragmentation, which hinders an intensive fish culture in developing countries (John, 1990). Interested culturists have the knowledge but neither have the resources to acquire land nor own any land. While most land owners are not interested in culture fisheries. Fish farm tools used in most fish culture practices are very crude and primitive.

Lack of good roads and transport facilities for the transportation of fish from rural to urban areas and Government assistance to fish farmers to established fish farms is also not out of place are issue in culture fisheries. Pest, predators, competition and disease hinder fish culture practices. Pest, predators, competition and disease all interfere with culture fish health. Fish pest, constitute a nuisance in fish culture and if not checked can pose serious management problems. Fish predators do not only reduce total fish production, but also serves as intermediate host to fish disease. In the fish culture media, organisms compete with one another for food, space, light, nutrients, oxygen and nesting site. Intra specific competition within individuals of the same species and inter specific competition refers to competition between different species. Both types of competition can affect the stocked fish adversely. Fish yield can also be reduced.

This situation is compounded by the closed nature of a fishpond system. Associated industries are involved in manufacturing equipment used in Culture fisheries. These include nets, fertilizer plants, biofilter media, drugs, fiber glass tanks, etc., Fin fish, shell fish and other farmed aquatic organisms are produced in freshwater, brackish water and marine environment. The culture system also matters. Hazards and risks related to aquaculture can are occupational, environmental, food safety and public health (WHO, 1999a). Each of the different types of hazards has other components: Physical, biological and chemical.

The introduction of non-endemic species into natural water arising from their inadvertent release from aquaculture facilities is considered a serious environmental threat. The introduced species may carry diseases and parasites alien to the native with disastrous consequences. Instances abound where exotic fish species wiped out native stocks. The Introduced species may have the tendency of out-competing the native stock partly because they do not have natural predators, parasites and pathogens in their new environment. This trend creates biodiversity loss in natural waters. The introduction of genetically modified organisms such as transgenic fish is considered hazardous to the environment (Kapuscinski and Hallerman, 1990;

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Hallerman and Kapuscinski, 1999). Such fish would pose ecological or genetic risks when they escape from production facilities (Muir and Howard, 1999).

The production system also presents risks to public health (Wolstenholme and Rogers, 2005). The major health risks of aquaculture products are biological especially for the organisms produced in waste water or water receiving animal and human wastes (Rodgers, 2004; Uronu and Lekei, 2004). The pathogenic, entero-bacteria (from the human digestive tract), have been found in fish guts. Food borne trematodes such as *Clonorchis sinensis* and *Opisthorchis viverrini* are known to cause diseases particularly among Asians that eat their fish raw or poorly cooked (Harder, 2002). Enteric diseases caused by trematode parasites have been reported in Egypt and Republic of Korea. Fish borne nematodiases have also been reported as incidental infections (Johnson, 2000). There are hazards associated with human pathogenic bacteria in finfish and crustaceans. These bacteria are partly the indigenous flora and partly a consequence of contamination through human or animal waste.

Other sources of contamination include postharvest handling and processing. Aquatic microorganisms such as algae and detritus produce toxic compounds, which can present significant human health risks (WHO, 1999b). Fishponds can also pose health hazards. Although the increased agricultural and power potential created by dams ought to lead to improved health and well being in the human population living around them, millions of people are suffering today from diseases associated with the development of manmade lakes. The irrigation canals have invariably provided suitable breeding sites for the intermediate host snails and other disease vectors. Land tenure system, fish farming infrastructures, the culture system, hazards and risks, environmental pollution, habitat modification, food safety and public health hazards, fish diseases, competition, health implications, population migration, agricultural development projects and human diseases are key issues discussed in this study.

Land tenure system: Land tenure is the name given, particularly in common law systems, to the legal regime in which land is owned by an individual, who is said to "hold" the land (the French verb "tenir" means "to hold"; "tenant" is the present participle of "tenir"). The sovereign monarch, known as The Crown, held land in its own right. All private owners are either its tenants or sub-tenants. The term "tenure" is used to signify the relationship between tenant and lord, not the relationship between tenant and land. Over history, many different forms of land ownership, i.e., ways of owning land have been established. A landholder or landowner is a holder of the estate in land with considerable rights of ownership or, simply put, an owner of land (John, 1990).

There are a great variety of modes of land ownership and tenure:

Traditional land tenure: For example, most of the indigenous nations or tribes of North America had no formal notion of land ownership. When Europeans first came to North America, they sometimes simply disregarded traditional land tenure and simply seized land; more often, they accommodated traditional land tenure by recognizing it as aboriginal title. This theory formed the basis for (often unequal and often abused) treaties with indigenous peoples.

Ownership of land by swearing to make productive use of it: In several developing countries as Egypt and Senegal, this method is still presently in use. In Senegal, it is mentioned as "mise en valeur des zones du terroir" and in Egypt, it is called Wadaa al-yad.

Allodial title, a system in which real property is owned absolutely free and clear of any superior landlord or sovereign. True allodial title is rare, with most property ownership in the common law world (Australia, Canada, Ireland, New Zealand, United Kingdom, United States) being in fee simple. Allodial title is inalienable, in that it may be conveyed, devised, gifted, or mortgaged by the owner, but it may not be distressed and restrained for collection of taxes or private debts, or condemned (eminent domain) by the government.

Feudal land tenure, a system of mutual obligations under which a royal or noble personage granted a fiefdom-some degree of interest in the use or revenues of a given parcel of land-in exchange for a claim on services such as military service or simply maintenance of the land in which the lord continued to have an interest. This pattern obtained from the level of high nobility as vassals of a monarch down to lesser nobility whose only vassals were their serfs.

Fee simple: Under common law, this is the most complete ownership interest one can have in real property, other than the rare Allodial title. The holder can typically freely sell or otherwise transfer that interest or use it to secure a mortgage loan. This picture of "complete ownership" is, of course, complicated by the obligation in most places to pay a property tax and by the fact that if the land is mortgaged, there will be a claim on it in the form of a lien. In modern societies, this is the most common form of land ownership. Land can also be owned by more than one party and there are various concurrent estate rules.

Native title: In Australia, native title is a common law concept that recognizes that some indigenous people have certain land rights that derive from their traditional laws and customs. Native title can co-exist with non-indigenous proprietary rights and in some cases different indigenous groups can exercise their native title over the same land.

Life estate: Under common law, this is an interest in real property that ends at death. The holder has the use of the land for life, but typically no ability to transfer that interest or to use it to secure a mortgage loan.

Fee tail: Under common law, this is hereditary, non-transferable ownership of real property. A similar concept, the legitime, exists in civil and Roman law; the legitime limits the extent to which one may disinherit an heir.

Leasehold or rental: Under both common law and civil law, land may be leased or rented by its owner to another party; a wide range of arrangements are possible, ranging from very short terms to the 99-year leases common in the United Kingdom and allowing various degrees of freedom in the use of the property:

- Rights to use a common, which may include such rights as the use of a road or the right to graze one's animals on commonly owned land.
- Sharecropping, under which one has use of agricultural land owned by another person in exchange for a share of the resulting crop or livestock.
- Easements, which allow one to make certain specific uses of land that is owned by someone else. The most classic easement is right-of-way, but it could also include (for example) the right to run an electrical power line across someone else's land.

In addition, there are various forms of collective ownership, which typically take either the form of membership in a cooperative, or shares in a corporation, which owns the land (typically by fee simple, but possibly under other arrangements). There are also various hybrids: in many communist states, government ownership of most agricultural land has combined in various ways with tenure for farming collectives.

Four major land tenure systems are: communal land tenure, individual ownership; lineage or inheritance land and leased ownership. Communal land tenure refers to the system of land ownership whereby; a particular community owns the land within their boundaries. The land is further shared among various units making up the community. In individual ownership, an individual acquires an area for selfish reasons. When the land is acquired through ancestors, it is referred to as lineage land or inheritance ownership. One may acquire land on temporary basis for a specified period. This is leased ownership. Rent is being paid for the period under question. At the expiration of this period, the ownership is reversed to the landlord. Historically in the system of feudalism, the lords who received land directly from the Crown were called tenants-in-chief. They doled out portions of their land to lesser tenants in exchange for services, who in turn divided it among even lesser tenants. This process that of granting subordinate tenancies is known as subinfeudation. In this way, all individuals except the monarch were said to hold the land "of" someone else. Historically, it was usual for there to be reciprocal duties between lord and tenant. There were different kinds of tenure to fit various kinds of duties that a tenant might owe to a lord. For instance, a military tenure might be by knight-service, requiring the tenant to supply the lord with a number of armed horsemen. The concept of tenure has since evolved into other forms, such as leases and estates.

Although the doctrine of tenure has little importance today, its influence still lingers in some areas. The concepts of landlord and tenant have been recycled to refer to the modern relationship of the parties to land which is held under a lease. It has been pointed out by Professor F.H. Lawson in Introduction to the Laws of Property (1958), however, that the landlord-tenant relationship never really fitted in the feudal system and was rather an "alien commercial element". The doctrine of tenure did not apply to personal property. However, the relationship of bailment in the case of chattels closely resembles the landlord-tenant relationship that can be created in land.

Fish farming infrastructures: Fish farm tools used in most fish culture practices are very crude and primitive. Most fish culturists are illiterate. A wide spread poverty among interested fish culturist hinders the purchase of machineries. Lack of good roads and transport facilities for the transportation of fish from rural to urban areas: This can lead to poor marketing of aquaculture product. Lack of government assistance to fish farmers to established fish farms is also not out of place. Despite these, pest, predators, competition and disease hinder fish culture practices. This chapter reviews pests, predator’s competition and diseases, which can hinder fish culture practices.

The maintenance of fish health is important in fish culture. Pest, predators, competition and disease all interfere with culture fish health. Fish pest, constitute a nuisance in fish culture and if not checked can pose

serious management problems. Fish predators do not only reduce total fish production, but also serves as intermediate host to fish disease. In the fish culture media, organisms compete with one another for food, space, light, nutrients, oxygen and nesting site. Intra specific competition within individuals of the same species and inter specific competition refers to competition between different species. Both types of competition can affect the stocked fish adversely. Fish yield can also be reduced. This situation is compounded by the closed nature of a fishpond system.

Associated industries are involved in manufacturing equipment used in Culture fisheries. These include nets, fertilizer plants, biofilter media, drugs, fiber glass tanks, etc. Fin fish, shell fish and other farmed aquatic organisms are produced in freshwater, brackish water and marine environment.

The culture system: The receptacles for cultivation of these organisms include earthen ponds, pens, cages, rice fields, raceways, open water bodies, etc. Based on the level of operation, the system is classified as:

Extensive: In extensive fish culture practice, no exogenous input is used and stocking density is low.

Semi-intensive: Fertilizer is applied in semi intensive fish culture practice to augment or stimulate natural production of food organisms for the cultured organisms; stocking rate is moderate; supplementary feed is provided.

Intensive: The density stocking rate is high and provision of a nutritionally complete feed. About 70-80% of the total global production of farmed fin fish and crustaceans takes place within extensive and semi-intensive farming systems. In Asia, integrated farming system, in which livestock wastes are inputs in fish production and waste water fed systems, in which domestic sewage and municipal waste water are used, are common practices. In Africa, culture fisheries are practiced in earthen ponds where livestock wastes (used in fresh or dried state) are used extensively for fertilization (Arthur *et al*., 2004)

In Asia, cages and pens are usually installed in highly eutrophic aquatic systems. In the earthen pond systems, poly culture of fish species is common in order to fully exploit all the feeding riches. Feeding is supplementary and usually agro by products are utilized for that purpose. However, in the developed countries, aquaculture production is based essentially on the intensive monoculture of high value fish in ponds, tanks or cages at high stocking densities and fed manufactured complete diet. Fish culture in re-circulating system is becoming popular in developing countries. Here water is reused after undergoing a purification process. These farming systems have effluents which are discharged into natural water bodies or adjoining land.

Hazards and risks: Hazards and risks related to aquaculture can be categorized into occupational, environmental and food safety and public health (Ahmed, 1991). Each of the different types of hazards has other components such as biological and chemical. The culture fisheries industry has diverse workplaces with individual peculiarities. The hazards in aquaculture can be classified into physical, chemical and biological (MacDiarmid, 1997).

Physical: There are several physical risk factors in the culture fisheries industry. Farm hands and other workers in aqua farms are susceptible to many injuries in the course of their work. The fish farmers in the informal sector are more vulnerable because governments in developing countries have apathy to occupational health and safety issues. All the stakeholders, farm management, workers and governments do not appreciate the problems that can be solved or mitigated through occupational safety and health. The list of physical hazards is as follows:

- **Noise:** Feed mill workers (especially those that operate with locally fabricated machines in the developing countries) are exposed to excessive noise. The following harmful defects are attributed to noise: hearing defects, hearing loss and mental fatigue.
- **Injuries:** Farmers are exposed to diverse injuries such as:
  - **Sting from fish spines:** This arises during fish handling without appropriate safety devices. It may cause severe pains and can result to tetanus infection or wit low.
  - **Cuts, sprain, fracture, etc.:** sharp implements/object such as knives, oyster shells, falls and other predisposing factors can cause these injuries. Hatchery workers are also exposed to the risk of needle stick injury which can open a gateway to many viruses and other diseases.
  - **Occupational asthma and rhinitis:** Feed mill workers are at risk of contracting these diseases. The greatest risks occur in the foodstuffs and agricultural sectors. He attribute dust released from flour and animal feed mill as the second most common cause of asthma Snake bites, crab clawing and bites from fish (such as tiger fish, snapper, etc.) are hazards workers in earthen pond fish

farms are exposed to, especially when they are not using appropriate protective gear. This is prevalent in rural fish farming.

- **Mechanical injuries:** These are associated with laboratories and processing plants.

Chemical: Culture fisheries practitioners are exposed to chemical hazards through the following routes:

- **Constant use of chemicals:** This includes inorganic fertilizers which are used extensively in enriching fish ponds. Others are lime, pesticides, formaldehyde, etc. Some of these are caustic and can cause severe burns or skin irritation resulting in severe cases of occupational dermatitis. Some laboratory chemicals are hazardous and Inhalation may lead to development of respiratory ailments such as bronchitis, rhinitis and asthma. Direct contact with these chemicals could result in burns, skin irritation and allergies. It has been observed that laboratory workers that have prolonged exposure to organic solvents such as chlorinated hydrocarbons, alcohols, ester, ketone, etc., are at risk of brain and nervous system damage. The symptoms include premature ageing, memory impairment, mild depression and anxiety. The following symptoms to formaldehyde poisoning: allergic dermatitis asthma and rhinitis.
- **Acute and chronic pollution of water ways:** Pesticides, oil spills and other xeno biotics can pollute ponds and water sources which can also pose risks for workers that work in such farms.
- **Flocculants:** These are applied to ponds to precipitate suspended clay particles. Examples are aluminum sulfate (alum), calcium suilhate (gypsum).
- **Disinfectants:** These are used to disinfect equipment and holding units e.g., formalin hypochlorite, etc.
- **Fumes, smoke and soot:** Fumes from water pumping machines feed mill and other machines; and smoke inhaled by workers smoking fish or drying feed are considered serious health risks. These are associated with asthma, cancer and other serious ailments.

Biological: These include parasitic infestation and pathogenic infections:

- **Parasites:** Examples include leeches in ponds which attack individuals that the wade unprotected. In developing countries where human and animal wastes are used as inputs, nematode, cestode and other parasites are hazards, farm workers are exposed to.
- **Pathogens:** Risk of fungal and other pathogenic infections such as *Vibrio* has a high likelihood in intensively manure ponds. Individuals pricked by spines of *Tilapia* sp infected by *Vibrio vulnificus* caused amputation of fingers. Fatal cases have also been reported in NSSP operations Manual, 1992 Revision.

Environmental pollution: There are a variety of risks mediated by environmental effects of Culture fisheries:

- **Biological pollution:** The introduction of non-endemic species into natural water arising from their inadvertent release from aquaculture facilities is considered a serious environmental threat. The introduced species may carry diseases and parasites alien to the native with disastrous consequences. Instances abound where exotic fish species wiped out native stocks.

  The Introduced species may have the tendency of out-competing the native stock partly because they do not have natural predators, parasites and pathogens in their new environment. This trend creates biodiversity loss in natural waters. The introduction of genetically modified organisms such as transgenic fish is considered hazardous to the environment. Such fish would pose ecological or genetic risks when they escape from production facilities.

  The authors further stated that the ecological hazards would include the possibility of the transgenic fish being a voracious predator or competitor thereby impacting negatively on key ecological processes. Inter breeding of introduced or transgenic fish with the native stock could cause dilution of the gene pool. There is a considerable risk of transferring transgenic fish. Transmission of diseases and parasites to native stocks from cage and pen facilities is a major problem. In many countries disease testing and certification programs for animals are not implemented with the result that native stocks are exposed to non endemic parasites and diseases from aquaculture facilities.
- **Organic pollution:** The effluents from aquaculture facilities constitute significant sources of organic pollution. The effluents, which consist largely of fish and feed wastes, contain large quantities of nutrients that damage the water quality and also generate unwanted algae.

- **Chemical pollution:** Use of chemicals in ponds and laboratories constitutes considerable risk to the environment. These chemicals can become disruptive and when they find their way into natural aquatic systems they can cause irreparable damage to the ecosystem. Chemicals such as fertilizers, pesticides, antifoulants (for cages), chemotherapeutants are all considered risk factors in the environment.

Habitat modification: Aquaculture sites negatively impact the environment. Aquaculture development can sometimes change landscapes of aquatic systems resulting in habitat destruction and loss of biodiversity. The newly created habitat may not be able to sustain the natural ecological balance (Karkkainen, 2002).

Food safety and public health hazards: Culture fisheries products like other foods have hazards that may adversely affect the consumers' health. The production system also presents risks to public health (Angulo, 2000). The major health risks of aquaculture products are biological especially for the organisms produced in waste water or water receiving animal and human wastes. The pathogenic, entero-bacteria (from the human digestive tract), have been found in fish guts (Buras, 1993).

This, therefore, raises the question of the safety of consuming fish products from such environments. Food borne trematodes such as *Clonorchis sinensis* and *Opisthorchis viverrini* are known to cause diseases particularly among Asians that eat their fish raw or poorly cooked. Enteric diseases caused by trematode parasites have been reported in Egypt and Republic of Korea. Fish borne nematodiases have also been reported as incidental infections (Reilly and Kaferstein, 1997).

There are hazards associated with human pathogenic bacteria in finfish and crustaceans. These bacteria are partly the indigenous flora and partly a consequence of contamination through human or animal waste. Other sources of contamination include postharvest handling and processing. Aquatic microorganisms such as algae and detritus produce toxic compounds, which can present significant human health risks. A good example is the dinoflgellate, *Alexandrium tamarensis*, which causes toxic red tide. Humans that consume shellfish (lobster and crabs) that have ingested this organism stand the risk of being afflicted with paralytic shellfish poisoning. Shellfish have also been implicated as vectors of human pathogens such as *Vibrio* bacterium which is a causative organism of human gastroenteritis.

Filter feeders such as clams, mussels and oysters, which accumulate contaminants in their internal organs, also present potential threat to the health of consumers. The greatest number of seafood-associated illnesses is from consumption of raw mollusks harvested in waters contaminated with raw or poorly treated human sewage. Some chemical products used in aquaculture are considered hazardous in terms of food safety. These include chemical fertilizers, lime, flocculants, algaecides, disinfectants and chemotherapeutants.

Some of these compounds may be biomagnified in the animal tissue and so consumers are at risk of intoxication with the chemicals. Other chemicals may be released from other sources e.g., industrial hydrocarbons and thus pollute aquaculture water source. This is more pronounced in urban aquaculture where waste water is reused. Fish raised in contaminated water should be considered as risk. Other hazards of public health interest include proliferation of mosquito larvae and cercaria which increase the incidence and prevalence of malaria and filariasis, respectively. This is more common in developing countries where numerous small fish impoundments are constructed thus promoting higher densities of these organisms. Food contamination by residues of antibiotics and veterinary drugs is also considered a hazard.

Furthermore, antibiotic resistance has been reported in areas where farmed aquatic animals are receiving treatment. The use of antibiotics by the Ecuadorian shrimp farming industry caused the development of multidrug resistant *Vibro cholera*. Humans infected by such antibiotic-resistant organisms would find treatment complicated. The contentious issue of the safety of genetically modified fish is worth looking at. Transgenic fish have been classified as hazardous in terms of food safety because of their potential allergen city and toxicity. These claims, however, need to be validated. In addition introduction of pathogenic organisms during processing of products under unhygienic conditions is also of public health importance.

Fish diseases: A fish disease is an illness of fish body caused by infection or internal disorder. It is an expression of a complex interaction between a susceptible host, a pathogen and the environment. In the presence of an infective agent in an effective number, a susceptible host suffers an infection in adverse conditions. Diseases manifest in various ways for the impairment of the normal physiology in the host. What is referred to, as disease in fish culture is often a reflection of one or more marginal environmental factors, water quality, high pathogen population and

nutritional deficiency. Therefore, the cause of fish diseases is diverse while the occurrence of disease is multi factorials. In fish culture, it is more difficult to control and prevent disease than the control of infective agents.

Causes of diseases in culture fish: The major contributive factors of fish diseases are as follows:

- The large quantity of organic material found in ponds due to Fertilization, supplementary feeding and faeces, which form an ideal habitat for microorganisms.
- In stagnant waters, microorganisms are scarcely absent. The water temperature of such water bodies is relatively high. Higher temperatures favor the development of pathogenic microorganisms.
- Overcrowded density of stocking and poor fish culture condition exposes the fish in the pond to greater pollution risk. Pollution favors the development of host specific disease and pathogens, while overcrowding stresses the fish. Stressed fish are more susceptible to diseases and pathogens.

Symptoms: These are changes in fish body that indicates an illness. In catfish, these changes can often be recognized by abnormal behavior such as loss or appetite for food, nervous or "waddling" swimming, straying in vertical position at the surface, or by clinical signs such as mutilated barbell or fins, white or red brown spots on the skin and pop eyes. The pond can be monitored daily for diseases, especially during feeding time when catfishes usually frequent the surface of the water.

Diagnosis: Smears of the tissues, skin, gill filaments and intestine can be prepared and viewed microscopically for bacterial, fungal and parasitic infections using ×40 and ×100 magnifications for the identification of disease and administration of specific therapy.

There are 4 types of organism responsible for disease in fish. These include bacteria, fungi, parasites and virus. Some diseases are environmental, nutritional or caused by worms and unknown cases.

Pathogens can easily be transmitted from fish to fish through the gills ad skins. Fish can die of disease or contamination of the culture media. Fish of all sizes and species die rapidly when the culture medium is contaminated. A large number of fish species of the same year class can die within a short period of time where there is a disease outbreak in the culture medium. Poor water quality, bad feeding regime, rough handling of fish, noisy environment and disturbance of the stress sensitive species can retard the immune system of the culture fish. Fry and fingerlings are more susceptible because they are yet to build up immunity. A proper understanding and management of these problems can facilitate fish culture practices. The production of good quality fingerling in fish farming business is highly essential. This can only be achieved under a controlled environmental requirement of fish. Optimum production of fish is only obtainable under environmental condition devoid of stress causing factors, which may lead to disease outbreak. Successful fish husbandry is an indication that good environmental conditions have been provided by the rearing facility.

Disease surveillance in the hatchery is as important as adequate rearing facilities, quality fish feed, trained personnel and good fish transport equipment. The avoidance of disease problems by careful planning is far less costly than problems that must be corrected after they occur. An adequate supply of clean, freshwater, which is free of resident fish and fish eggs, is one of the important assets, a facility can have. Disease cannot occur unless the pathogen is introduced into fish culture system. Eggs from uninfected sources have the best chance to remain free of infectious diseases if they are reared in clean water and clean facilities.

Techniques that minimize environmental stress such as aeration devices can be applied at all installations, old or new. Aeration devices used; to remove excess gases from inflowing water are good. Aerators, effectively reduce supersaturated nitrogen gas levels associated with disease problems, impaired growth and other conditions, which are often difficult to diagnose.

Serious deficiencies that may have been built into a facility may cause recurring disease problems. Inappropriate management decisions on the number of eggs that may be incubated at a facility can also contribute to the difficulties encountered. Basic corrective measure is required as fish culture practices must be coordinated with construction and layout of the facility, the kinds of fish being reared, the quality and quantity of the available water supply.

In some situations, good progress is possible. In others, the program is pressed forward in spite of the facilities. The purpose of fish disease control polices and improved husbandry practices is to help hatchery personnel stop doing things that created problems in the past and apply the knowledge gained from these experiences to facilitate the production of quality fish at minimal cost in future. This may be difficult medicine

to swallow because the required changes may necessitate the alteration of traditional programs or reduction in the number of fish produced.

Disinfections should be done whenever it becomes desirable to rid a facility of an infectious agent because of the production problems that agent has caused. The time to disinfect is whenever the facility can be taken out of production. Prior to disinfection; all loose equipment should be thoroughly scrubbed with warm soapy water. Such equipment includes buckets, pans and small troughs tubs. Hatching and rearing troughs should be scrubbed clean. Sidewalls and bottoms of all concrete tanks should be scrubbed; particular attention should be given to removing any leftover eggs.

During the cleaning process, all fish rearing facilities should be scrubbed clean of algae, dirt and organic waste. The person in charge should tour the entire hatchery facility to plan and schedule disinfection work to make sure that all facilities are in the proper state of preparation for effective disinfection.

After a hatchery has been completely disinfected and placed on a disease free water supply, the prevention of contamination is of utmost importance. Production should start only with disinfected eggs from certified disease free stocks. All equipment coming into the hatchery should be thoroughly disinfected before coming into contact with clean hatchery equipment or water. All equipment at the hatchery and all employee hand should be cleaned and disinfected at frequent intervals. The liberal use of warm water and soap is recommended.

The spread of disease can be prevented only by complete adherence to rigid standards of cleanliness similar to those used in operating rooms at hospitals. A keep it clean attitude must be instilled in all employees with the realization that even a minor slip in procedure may undo all previous efforts to eliminate disease /infection.

As aquaculture expands throughout the world, there is greater traffic in the transfer of live fish and fish eggs from country to country. With such transfer, the opportunities for introduction of fish disease and parasites have become an urgent problem for fish culturist (Edwards, 2001).

The eggs will develop normally if kept in optimum conditions. However, frequently, there are mortalities that are difficult to explain. This may be from a number of causes. Dissolved oxygen depletion can be a cause; a sharp variation in the temperature, incomplete fertilization and shocks can also cause mortality.

Saprolegniasis is a fungal disease of fish eggs caused by a member of the family, saprolegniaceae. This name has been broadly accepted when the etiology is a species of the genus Saprolegnia, Achlya or Dicthyucliu. Only microscopic examination will distinguish the actual etiology of the disease. Therapy for the disease, Irrespective of the etiology is similar. All freshwater and brackish water fish eggs are potentially susceptible to saprolegniasis. Living fish eggs are not usually susceptible to invasion by any of the saprolegnia. Dead fish eggs are growth medium for the fungi and fungal growth on dead eggs may be responsible for killing normal eggs by suffocation and invasion.

Dead fish eggs are a fertile medium for growth of a single saprolegnia zoospore. This can initiate growth on a dead fish egg. The mycelia mass extends from the egg into the water surrounding the egg. A single dead egg with fungal growth can be the medium, which produces a suffocation mycelia growth over living eggs. The partially suffocated eggs around the dead egg are, directly invaded by the fungi. The suffocating effect is spread until the eggs in the entire trough or incubator tray are killed. The tremendous increase in zoospore production from fungal growth on dead eggs yield plenty of infective units for each additional dead and dying egg. The invasion of eggs appears to increase in tempo until all eggs in the group are killed and invaded by the fungi. The rapidity of fungal growth on susceptible fishes or fish eggs is related to environmental temperature. A proper understanding and management of these problems can facilitate fish culture practices.

Competition: Organisms in fishponds constantly compete with each other for available food, space, nutrients and other factors:

- **Food and space:** Competition for food and space is one of the most frenzied in the pond. Predators and pests at the bottom of brackish water ponds consume a substantial part of the pond food, especially supplementary feeds. Predatory crabs can consume a large portion if thrash fish is used to feed pond or caged fish, nesting fishes (especially substrate spanners) compete with each other for nesting sites in the pond. In stocking, it is not always wise to stock two substrate spanners in the same pond. If this happens, competition for space can be very fierce. In such situation fish growth and productivity can be adversely affected.
- **Nutrients:** Pond fish need a lot of nutrients from the water for growth. Some of the nutrients are absorbed directly from the water through the body surface while others are absorbed through the food. Aquatic plants, which grow in ponds, absorb a lot of these nutrients (carbon, sulphur, nitrogen,

potassium and sodium) for growth. Crabs absorb calcium for the growth of their shells. Pond fish equally need calcium for the formation of bones. There is continuous competition for nutrients by all these pond organisms. To ensure maximum growth of the target fish, it is essential that all competing organisms be minimized.

- **Light:** In integrated fish culture, the plants: oranges, sugar cane, rye grass and potatoes are planted on dykes. The tall trees provide shade, which covers the pond surface and this result in reduction of the amount of light entering into the pond. This can lead to low photosynthetic activity, hence reduced primary productivity in the pond. Aquatic weeds, plants and algae in large quantities compete for light. A part from shading the pond surface, they reduce the pond water temperature and retard fish growth in the water body.
- **Oxygen:** Adequate oxygen supply is necessary for fish growth. Reduction of oxygen levels in ponds can be caused by respiration in algae, oxidation of heavy metals and decomposition of decaying organism. Only a small portion remains for fish respiration. There is therefore serious competition of oxygen in the pond. Pond water can be monitored to ensure steady dissolved oxygen levels in the ponds. The measures: Pumping in fresh water, splashing and turning on aerators can be adopted.

Health implications: Fish farming has become an important activity in many countries including Nigerian. Fish farming is practiced largely by, individuals and large companies as a means to increase sources of animal protein in the diet of the population. Fishponds can also pose health hazards. Schistosomiasis may be contracted through working in fishponds if the weeds in the ponds are allowed to overgrow and weeds on the banks hang into the water. This provides breeding places for the intermediate host snails of schistosomiasis. The act of urinating or defecating in or near fishponds contaminates them with the parasite eggs. Good fish farming practice, therefore, requires that latrines and urinals are located at least 10 m away from the ponds and that pollution of the soil with excreta near the ponds should be avoided (Price, 1997). The need for educating the fish farmer on healthy fish farming cannot be over emphasized. The agricultural extension officers who promote fish farming should also educate farmers and their families on the possible consequence of polluting fishponds and how to avoid such (Ojok, 1995).

Water resources development schemes are vital for the economic progress of many countries. The number and size of these water impoundments continue to increase the quest for meeting food, power and recreational demands of the ever-increasing population. Water in these reservoirs is used for various purposes, which include hydroelectric power for industrialization, irrigation for increased crop production, commercial fishing, recreation and transportation.

Although the increased agricultural and power potential created by dams ought to lead to improved health and well being in the human population living around them, millions of people are suffering today from diseases associated with the development of manmade lakes. Many of these diseases, particularly, schstosomaisis, malaria and arbovirus infections are yet to be controlled. This can largely be attributed to the lack of planning for the health of the human communities in dam and pond construction.

In developing countries, these communities are not only yet to develop basic standards of hygiene and are therefore not provided with safe water supply and proper sanitation, but are also subject to infectious diseases.

Water controls the life cycle of many species carrying human disease. When a dam is build and pond is constructed, the ecological balance of the surrounding region is disturbed and major changes in the aquatic flora and fauna of the water body occur, providing favorable environment for disease intermediate host of medical importance,

A number of large scale water resources development in Africa have been extensively studies with regard to changes in environmental health caused by the presence of a man-made lake and associated irrigation schemes. In areas endemic for schistosomiasis, dramatic increases have been reported in the prevalence and intensity of the disease following the construction of dams. In the Volta Lake, the prevalence of urinary schistosomaisis among children in a village resettled beside the water rose, increase from 8% in 1967 to 99% in 1986. In the Kariba dam (Zimbabwe), urinary and intestinal schistosomiasis increased to 69 and 16% respectively during the 10 years following dam construction.

Although, no study was carried out on schistosomiasis in the Kainji lake area prior to construction of the lake in 1968, studies carried out after its construction showed an increase in the prevalence of the disease in the lakeside settlements from 32% in 1970 to 74% in 1972. Infection rates ranging from 0 to 100% were obtained for the four study villages of Yelwa, Shagunu, Karabonde and Dogonogari. Urinary schistosomiasis was shown to be more widespread than intestinal schistosomiasis while the highest prevalence rates and intensity of infection

were reported for the 9-13 years age group. Mild infection prevailed generally in the population, except in children (Johnson, 2000).

Population migration: Water resources development and agricultural projects have been associated with population migration and resettlement of communities. Human activities in such resettlement programmes, which often lack adequate health and sanitary conditions and safe water supplies, have been susceptible to the rapid spread of water borne disease such as schistosomiasis. The factors responsible for this spread include overcrowding; water contact occupation (e.g., fishing, household activities such as washing and fetching water), poor hygiene, poor sanitation, poor water supply and leisure activities such as swimming (FAO, 2006)

Migration can increase the transmission of schistosomiaisis. Infected immigrants can introduce the infection into an area while non-infected immigrants can contact it in their new environment. Immigrants in new settlement usually have only limited supply of water, which is often of poor quality. The inevitable overcrowding and inadequate sanitary facilities lead to uncontrolled pollution of water bodies.

Agricultural development projects: These involve the cultivation of such crops as sugar-cane, rice and cotton that are dependent on irrigation schemes. The irrigation canals have invariably provided suitable breeding sites for the intermediate host snails and other disease vectors. This in turn exposes the working population to the infective stages of these parasites in the course of their work. These diseases clearly pose very serious problem to countries whose future lie in accelerated agricultural development.

Dams and irrigation projects: These projects are widespread in Nigeria. Presently there are a total of 200 dams of all categories constructed in the country for various purposes. A number of downstream irrigation projects are also on, to meet the overall national objectives of the Federal Ministry of Water Resource and Rural Development, in Nigeria, which is, to increase crop production through all year-around irrigated agriculture for national self sufficiency.

Fish projects include Kainji, Tiga, Bokolori, Shiror, Jobber, Lokoja, Makurdi and Ikom Lakes in Niger, Kano, Sokoto, Kaduna, Kwara, Kogi, Benue and cross Rivers, respectively. The earliest of the Kainji Lake created in 1968, for navigation and irrigation (flood control and water supply). Analysis of the survey carried out by the number, uses, etc., of man- made lakes in all states of Nigeria showed that the reservoirs were created for various purposes such as fishing, irrigation and water for animal and human uses; and sport and tourism (swimming ponds).

The creation of these reservoirs usually lack preliminary studies into health problems of the area prior to their creation which makes it difficult to assess impact of their creation on the human population. For instances, neither in Kanji nor Toga were pre-impoundment human parasite surveys conducted.

Human diseases: In the case of Kanji, the prevalence of 45-65% of onchocerciasis in many villages close to new Bussa was reported. Subsequent studies in this area, it showed increased trends in prevalence of helmint infection, particularly (schistosomiasis mansoni) because of lack of infrastructures and good hygiene promoting habits in the area. The health of the persons used for the construction of a dam should be given adequate consideration (Karanja *et al*., 2003)

The substitution of a large static seasonally fluctuating stretch of water for a flowing river radically alters the suitably of the area to maintain the intermediate hosts of certain very important disease. The important effects of altering the balance of nature are those affecting the intermediate host of human disease (Rea *et al*., 2010) The creation of a lake, rendering the water above it static, prevents the breeding of black flies; though they may breed in spillways and main river downstream and in the tributaries. However, the state or sluggishly flowing water provides ideal conditions for the breeding of snails intermediate hosts of schistosomiasis, favoring the disease transmission (Charmish, 1996).

Schistosomiasis: Studies have shown that these dams and irrigated land, not only provide ideal habitat for snail intermediate hosts of schistosomaisis but also provide opportunities for exposure of the nearby population, If coming in constant contact with these water bodies for various needs, to infection.

There have been reports of the presence of floating and submerged macrophytes in dams. These provide both habitat and food for a variety of disease intermediate hosts. For instance, *Eichornia crassipes* and *Ceratophyllum demersum* provide good habitat and grazing material for snail intermediate hosts of schistosomiasis. When the Volta dam was first filled in 1960, aquatic weeds harboring snails were widespread among the submerged trees and floating vegetation mats were formed leading to epidemic of *Schistosomia hasematobium* transmission (probably introduced to the dam by fishers, migrants and local people from lower Volta. In Lake Kariba, weed mats (Salvina) provided floating habitat for snail host of schistosomiasis further

introduced to tourist bathing area. Sharp increase in number of infected persons have also been reported following water impoundments in Egypt, Tanzania, Ghana, Congo, Eastern Transvaal and Nigeria (Clarke, 2002).

Reported areas, where water has been impounded (Kainji Lake and Malumfashi-funtus) indicate an upward trend in the transmission of schistosomasis. The construction of Aswan dam in Egypt resulted in a marked increase in the prevalence of schistosomiasis infection from 0 to 80%.

In schistosomiasis, the adult female worm produces eggs continuously and can live up to 35 years, though they usually last for not more than 5 years. Each female worm produces between 40 and 3500 eggs a day. These are expelled through urine or faces. Others are trapped around the bladder (FAO, 1966)

Schistosomiasis affects 200 million people in 74 countries in the world. These people suffer clinical morbidity or disability. The disease kills few people but its sapping chronic effects also make it major socio economic importance in some countries. It is second to malaria in terms of the consequent disability and lives lost. Fifty percent of hepatic dysfunction among children in Nigeria is attributed to Schistosomaisis. Report from populations dependent on impounded waters in Nigeria; particularly children, are Prone to high infection rates of schistosomiasis. For example, There are reported prevalence rates of schistosomaisis of 60% for children of Enrile dam area; 46.7% for Tiga Lake basin school children, 67.9% for Owena Army Barracks school children and 80% and an outbreak of the disease in two resettlement villages near Abeokuta (Ibero and Abule titun) close to a newly constructed reservoir located 20 kms from Abeokuta (Mott, 1996)

Malaria: The presence of *Pistia stratiotes* encourages breeding of mosquito vectors of yellow fever and malaria (Christopher *et al*., 2012). Irrigated agriculture is a prolific source of mosquitoes breeding (Kilama and Ntoumi, 2009). The high relative humidity it creates may increase the longevity of the mosquito, which increases the probability of transmission (Collins and Barnwell, 2009). Malaria is a serious infection of the blood by plasmodia protozoa transmitted by the bites of Anopheles mosquitoes (Dondorp and Day, 2007). Infection with *Plasmodium falciparum* mosquito vector transmitted by *Anopheles gambiae* complex of mosquito vectors is responsible for the deaths of about a million children in Africa each year (Wellems, 2002).

Filariasis: Infection with filarial parasites leads to elephantiasis a disfiguring disease, affecting one or both legs or hydroceol, an equally grotesque enlargement of the scrotum (Hoerauf, 2008). Infection can also cause acute fever, inflammations of the lymphatic system and the bronchial asthmatic condition called tropical pulmonary eosinophila. The most common of these filarial parasites is *Wuchereria bancrofti* affecting about 106 million people in the tropical areas of Africa, India, S.E Asia, the Pacific Islands and South and Central America. It is transmitted by Anopheles mosquitoes in rural areas and in cites, largely by culex mosquito species which breeds in latrines sewage and ditched. Adult worms settle into the lymphatic system and take 3-15 months to mature and survive in the body for many years. These adults, which are several centimeters long also cause blockage of lymphatic ducts. The young ones (microfilaria) also remain in the body as immature forms and die after some 6 months to 2 years. They move, secrets and excrete; and die as foreign bodies thereby causing immense damage and placing enormous burden on the infected host (Taylor *et al*., 2005).

Onchorcerca volvulus affects some 17 million people in Africa. It is transmitted by simulium black flies which breed in highly oxygenated fast flowing rivers (Osei-Atweneboana *et al*., 2007) The adults of these worms settle in nodules (lumps) under the skin (Thylefors *et al*., 2008). The female worms produces millions of microfilaria and for some 10-14 years invade the skin and the eye. In the skin, they cause unbearable itching and destroy skin elasticity, texture and appearance. In the eye, they can destroy the retina and make the cornea opaque. Leptospirosis is also associated with irrigation where a dense population of infected rodents occurs with neutral or alkaline surface waste (Trattler and Mark, 2007).

The first and most important step in fish culture is preventing or reducing health hazards. Health planning must be built into the project from inception. Indeed, human health must be given explicit consideration at all stages in the planning and construction. The feasibility analysis of all wet land schemes should include consideration of the project impact on transmission and severity of water-borne disease, particularly schistosomiasis. As such, there is the constant need to monitor ecological changes after construction of fishponds. At present, it is not feasible to expect the enactment of laws in Nigeria, which will have to be enforced to:

- Control access to the lake shore
- Prevent squatting
- Ensure proper sanitation
- Compel diagnosis and treatment of infected persons

However, a simple diagnosis tests are available and safe, effective single dose drugs such as praziquantel are available for treatment of these disease. The administration is usually once a year. The screening and treatment of staff of wetland schemes at intervals should be considered mandatory. Such a step would only enhance their productivity and promote good health. Fish culture is meant to change things for the better. The excise should therefore be accompanied by a real attempt to change and improve living health condition of the people.

CONCLUSION

Land tenure system, fish farming infrastructures, the culture system, hazards and risks, environmental pollution, habitat modification, food safety and public health hazards, fish diseases, competition, health implications, population migration, agricultural development projects and human diseases are key issues in culture fisheries management and practices.

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