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Aquaculture for sustainable development in Nigeria

Nicholas E. Okwodu

Department of Integrated Science, School of Science Education,
Federal College of Education (TECH), Omoku, Rivers State, Nigeria

E-mail address: jaopara@yahoo.com

ABSTRACT

Aquaculture is the rational rearing of fish and other aquatic organism in man-made ponds, reservoir and cages. It is also referred to as fish farming. Aquaculture is still being practiced at subsistence level in Nigeria. It is essentially a rural, secondary and part-time activity taking place in small farms in small freshwater ponds. Aquatic organisms produced through aquaculture include fish, aquatic invertebrates, planktons and aquatic plants (seaweeds). 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. The application of aquaculture has unveiled to an extent the degree to which fish farming can sustain the economy and provide the necessary protein need of the country. The management of aquaculture for fish production starts from the setting up of the farm until the ponds begin to yield. The major management problem of fishery conservation is how to control both man and the aquatic crops for the present and the future when the demand will probably be greater than now. Aquaculture is very important and is the fastest growing animal based food producing sector particularly in developing countries.

***Keywords*:** Aquaculture; fish farming; farm; developing countries

1. INTRODUCTION

Aquaculture is the rational rearing of fish and other aquatic organisms in man-made ponds, reservoirs, cages or other enclosures in lakes and coastal water. It is also referred to as

fish farming. Aquatic organisms produced through aquaculture include fish (tilapia, Clarias, and Catfish) aquatic invertebrate (mollusk, bivalves, gastropods, crabs, lobsters, shrimp etc.) planktons and aquatic plants such as edible seaweeds. Algae are grown for chemical extraction while the aquatic invertebrates and planktons for the fish to eat.

Most fish and crustacean aquaculture occurs in earthen ponds usually equipped with water inlets and outlets that permit independent control of water addition and discharge.

Aquaculture is considered to be an agricultural activity which mainly produces protein crops while starchy staple crops predominate in terrestrial agriculture. In addition the bulk of production in terrestrial agriculture is based on a limited number of species, while aquaculture produces more than 220 species

It was only recently that scientists turned their attention and laid down the basic principles of modern pond fish production. Scientist applied the knowledge of biology, ecology, chemistry, hydrology, and other sciences which had helped the advancement of agriculture. Aquaculture is still being practiced at the subsistence level in most countries of the world especially South East Asia, Africa Carribean and South America.

FAO [1988] workshop noted that aquaculture production in Sub-Saharan Africa is still very low with Nigeria being the more important producers. Aquaculture is very important and is the fastest growing animal-based food producing sector particularly in developing countries. This sector contributes nearly a third of the world's supply of fish product.

2. FISHERY PROBLEMS IN LARGE RIVERS (e.g. RIVER NIGER)

Fishery is an organized efforts by humans to catch fish or other aquatic species in rivers, seas and oceans. Most fisheries are marine rather than freshwater. Ocean and seas provides 90% of the world catches. Large rivers are valuable natural resources and are sites for many human activities. The potential uses of large rivers have always attracted human settlements on their shores resulting in growing population pressure and conflicts arising out of multiple demands and uses. Fishery problems arising out of the different uses of rivers would obviously vary with the type of use and the nature of change it brings about in the riverine habitat, fish food supply, spawning site, nursery grounds and lebensraum in general.

The major clusters of activities that have significantly affected fishery productivity in large rivers in Nigeria include:

(1) Dam construction
(2) Agricultural development
(3) Industrial development
(4) Flood control
(5) Navigation improvement
(6) Increasing urban water supplies
(7) Construction of impoundment
(8) Natural hazards
(9) Gear problem

Dam Construction and Impalement

Dam construction and operation for water storage; power; navigation; industry etc has created a lot of fishery problems ranging from;

[i] large scale earth movement; temporary diversion and disruption of river flow to permit construction
[ii] change in the hydrology of the river down stream
[iii] seasonal flows will be reduced
[iv] water quality characteristics of flood water flows may be altered
[v] velocities of water flow downstream will be reduced and average temperature will rise; flow regulation also could reduce the growing period for hatching in nursery water
[vi] inundation zone that provide fish spawning and feeding habitat will be grossly reduced if not eliminated entirely

Agricultural Development

Agricultural development [including irrigation; pond construction; fertilizer application; multiple cropping] to increase field crop production by the implementation of intensive agricultural technique has resulted in deforestation; diversion and draining areas of natural fish producing lakes and ponds. Destructive agriculture; erosion and excessive warming of waters has resulted in changing the fish producing characters of many streams usually for the worst;

Industrial Development

Industries that emerge from large dams are electro-processing; agric-related industries [which produces pesticides; fertilizer; livestock; fish feeds and other chemicals]; river transport oriented industries; sewage and industrial waste reduces the quality of water suited for desired aquatic life

Natural Hazards

Natural hazards such as cyclones; flood; tidal waves; natural pollutions such as red tide of protozoan in marine water; parasite and predators and the gradual evolution of lakes towards sluggish base level ways have devastating effect on fishing communities

Navigation Improvement

Dredging and channeling a river for navigation purposes not only remove considerable amount of sediments back into suspension; soil dumped on shallow spawning or nursery ground;

Urban Water Supply

Population grows leading a drift of people towards urban areas; water resource development scheme; water treatment to enable re-use increase and hence affect fisheries Reclamation of water for urban dwelling and industrial activities disrupt the habitat and spawning ground of fishes.

These multiple problems or resultant catastrophes on fishery calls for an organized fish farming approach that would sustain the productivity of a nation; therefore it becomes necessary for aquaculture to be taken serious in this country. Management for sustainable yield is therefore very difficult in an fishes [wild fishing].

Fish Exploitation

Over fishing and under fishing have both contributed to the problems of fisheries conservation. The greatest problem in this respect is how to manage each fishery in order to get maximum yield of desired species.

2. SETTING UP AND MANAGEMENT OF AQUACULTURE

In setting up aquaculture [Fish farm]; consideration should be made on the following

1) Water Supply and Filling the Pond

There must be constant supply of water of good quality and quantity. Water is required to fill the initial phase of the pond to replace losses by evaporation, seepage and drainage during harvesting and management operations. In filling the pond, the farmer must prevent or minimize the establishment of aquatic vegetation and bar the entrance of wild fish by filtration. 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 water not from adjacent pond.

Well water is the best source because it is free of disease, parasite, predators and pesticides. The freshwater from well has to be sprayed into the air, run over baffles or otherwise aerated. Surface water has to be filtered before use. Saran screen has proved to be an effective filter for surface water. It is inexpensive, easy to fabricate and allows the passage of large volumes of water. Recirculation systems which utilizes a sand or gravel filter has been used and this acts both to remove debris as well as oxidize ammonia nitrate.

2) Site Suitability

For conventional drainage fish ponds, the site chosen must have the following.

[A] Suitable Topography

- Sites with many trees are not suitable because of the cost of uprooting trees and if the trees are not properly uprooted, the stumps that are left will cause leakage of pond.
- hilly areas are not too suitable for pond construction because of the cost of filling the places with water getting water to site.

[B] Suitable Soil

The soil must be impermeable to water, must be water logged. If the soil is porous and contain air, it will not hold water. Soil with good proportion of clay is ideal for pond construction because clay is capable of retaining [holding] water and prevent seepage from bottom and dykes.

[C] Less Vegetation

Wooded sites are not suitable as clearing, stumping greatly increases cost of projects. Grassland [in the case of freshwater ponds] or bare-tidal flats [in the case of brackish water ponds] are preferable.

[D] Pond site must be near as much as possible to the owner's house.

This removes strenuous journey, possibility of fish being stolen and or eaten up by enemies such as crocodile and predators

3) Size, Shape and Depth of Fish Pond

Two or more areas of land are required for community farm or for wealthy farmer's commercial pond. Quarter acre of land is enough for individuals for hobby and or for subsistence farming. Farms could also be established by individual at a very small level at the farmer's backyard of not more than half a plot of land. Size of pond is determined by environmental condition of the area. The pond is dug and the recommended shape is either rectangular or square. Irregular shaped ponds are difficult to harvest'. The depth of a pond should be about 5- 6feet where water is not reliable. Deep pond is not good because there will be stratification. Shallow pond is not too good because the water will be heated.

4) Suitable organisms to culture.

Aquatic organisms to be stocked should have the following characteristics.

i. It should grow fast, nourishing itself from natural foods in the pond or from feeds that can be cheaply supplied.
ii. It should reproduce in captivity or semi confinement (e.g. tilapia) or yield easily to manipulation designed to make it breed in confinement e.g. common carp(cyprinus carpio), failing to breed, the young should be readily available for gathering in the natural habitat (e.g. the fry of milk fish, chanos, mullets etc)
iii. Its egg or larvae or both should be hardy and capable of being reared under artificial but controlled conditions.

It is doubtfully whether any single aquatic organism can have all these characteristics. Success in the culture of any depends to some extent on the *skill* with which, the aqua-culturist can make the missing characteristics less crucial. For proper management and utilization of organism in water.

i. Fish should be stocked in the right number of the right type of fish at the right time.

The more the fish is stocked, the higher the yield, provided there is no competition for food.

ii. Fish to be stocked in a fish pond should be of various feeding habit (poly culture).

Thus one should look for herbivorous fish, surface feeders, and bottom feeders. This will allow the various water layer and all potential food sources to be utilized. This will also eliminate competition between various fish in the pond and subsequent under feeding. In mono culture, only one species of fish is stocked in the same pond. The stocking density can

be increased through multiple stocking of different age and size group provided the fish has different food and feeding habit at different stages of its life history. Care must be taken to ensure against stocking unwanted fish.

iii. The biology of fish to be introduced should be known

iv. The water chemistry of pond, type of food present in the pond and also the food.

Preference of the fish should be known.

5) Stock Manipulation

Stock manipulation include genetic selection for required qualities such as fast growth, good quality flesh, less fat, but high protein content etc. The production of *Monosex tilapia* either through hybridization (eg cross between *S. Mossantblcus* and female *S. niloticus* produces hybrid which are 100% male) or through sex reversal when the young are treated with certain hormones. Success in tilapia culture now depends on the ability to produce hybrids which are 100% mono -sex (male) for the stocking production pond. This is because tilapia breed easily in pond but produce stunted fish that cannot grow fast.

6) Supplemental Feeding

Intensive culture of fishes requires supplemental feeding. Artificial feeds of various types are to be done economically. Excessive feeding of fish results in an increase demand for oxygen by decomposition process as well as increased in ammonia level Monotonous feeding should be avoided as this will lead to nutritional deficiencies. Supplemental feeds brings about fish yield in pond than if the fish were left to feed only on the natural food (plankton, insects, insect larvae, mollusc, detritus etc.). In the pond, supplemental feeds include rice bran, groundnut, cake, maize, palm nut, cassava, cocoyam and papaya leaves, pelleted feed from feed meals. Pond fish like other animals require balanced diet in order to be healthy and grow fast.

7) Control of Parasites and Diseases

Proper management of pond, lake or fish farm for fish production starts before the pond is filled. Whenever possible the pond bottom should be completely dry and free of depression, obstacles and vegetation. Disking the bottom is usually sufficient preparation for a dry pond, unless leveling is necessary to fill large depression. Pathogenic organism that attack pond fish include protozoan, monogenetic trematode, parasites/ crustacean, bacteria and toxic substances produced by filamentous algal bloom. A farmer who faces a disease problem for the first time should request the assistance at the nearest source.

Technique for diagnosis and treatment of fish diseases are similar to those used in human and veterinary medicine. Before any treatment, a fish farmer should

(i) Know the water (ii) Know the fish (iii) Know the chemical.

Fish disease may be treated by

(i) Adding chemicals to the water

(ii) Medication to diet

(iii) Ectoparasitic infections are generally treated by spraying with such chemicals as

(a) Malachite green (b) dipterex and bromex. (c) cupper sulphate (d) $KMnO_4$. It is better to prevent the outbreak of disease by keeping the pond well aerated, and the fish in good health condition than to attempt treatment. Take care of those factors which aggregate the development of disease outbreak - overcrowding, low oxygen, underfeeding, entry of wild fish. If infection is heavy it is necessary to drain the pond, remove the fish and lime the bottom.

Five Common Symptoms of Fish Diseases

a) Change in behavior: fish in good health cannot be seen in pond except during feeding periods. Should the fish gather in the vegetation, near the incoming water supply, or in any particular areas of the pond where they can be readily seen, disease should be suspected. Also swimming behavior may make fish conspicuous due to parasite attack.

b) Sign of reduce vitality: Healthy fish swim quickly away from disturbance along the bank. If fish do not rush away when the fish farmer approaches, he should suspect some type of disorder.

c) Dropping fins, loss of balance or general sluggishness

d) Failure to feed: under good water conditions healthy fish feed vigorous. Often take food immediately after it is provided. Low oxygen concentration and high water temperature as well as diseases may cause fish to stop feeding but failure to accept feed is a positive sign that pond condition is not good.

e) Lesions or sore- e.g. open ulcers or large discoloured areas on the body, hemorrhagic areas on the head ,body, fins, cysts in the skin, muscle or internal organs, an inflamed areas surrounding a parasite.

Fish farmer can keep the fish in good physical condition by proper water management, adequate nutrition and prophylactic treatment

8) Control of Weeds and Predators

These problems should be given attention in order to increase fish yield in tropical pond. Weeds can be quite a nuisance in tropical ponds. They are usually removed by hands, by allowing cattle to graze on it if they are near the banks and by the application usually in low concentration of herbicides such as sodium arsenite, sodium chlorate, Diuron and delapon. Predators on pond fish include birds, frogs, snakes, insects, and carnivorous fish.

Removal of the predators by draining and liming may be sufficient and if necessary such chemicals as andrex in low concentration (about
018ppm) may be applied to the pond.

9) Control of Water Quality

The pond water has to be maintained at its optimum quality.

a) pH 6.5 - 9. Low pH is improved by the addition of lime (in the form of CaO, $CaCO_3$, $Ca(OH_2)$

b) **Dissolve Oxygen:** Excessive application of organic manure increases the biochemical oxygen demand (BOD). If there is danger of deoxygenation, some method of aeration such as stirring the water, adding more water to cause wave and other motions can help. It is most important therefore, that the fish farmer understand the factors affecting production and depletion of oxygen in ponds. If fish are still in danger of suffocation after the above measures, application of up to 6ppm potassium permanganate ($kmno_4$) also provides temporary relief.

Fresh water and reduction of fertility provides the most lasting solution.

c) **Water Temperature** affects the fish welfare during its life. Water temperature influences activity, feeding, growth, dissolve oxygen, resistance to pathogen and reproduction of all fish

10) Fish Pond Fertilization

The application of fertilizers in the form of either organic manure (such as poultry and pig droppings, cow dung, compost manure) or in the form of inorganic fertilizers (such as super phosphate, ammonium sulphate, potassium nitrate) either singly or in combination to give suitable N-P-K ratio, generally increases the fish yields of ponds. The action of fertilizer is mostly indirect, its application makes nutrients available resulting in the production of adequate phyto-planktons, then zoo planktons either or both of which may be eaten by fish or by other invertebrate which are in turn eaten by fish. Some organic manure however may be eaten directly by fish. Lime is not strictly speaking a fertilizer.

It is used to keep the bottom of the mud from getting too acidic, help to release valuable materials in the pond. Lime supplies calcium which is one of the essential plant nutrients. Application of lime brings about the decomposition of the debris leading to increase fertility in the pond. For an acre of fish pond, the recommended fish manure is about

(i) 500-1500 Lb/week for pig manure

(ii) 100-200 Lb/week for poultry manure.

In applying organic manure proper care must be taken to ensure that oxygen does not fall below the lethal level. For most species, anything below 3ppm of oxygen is lethal.

3. AQUACULTURAL SYSTEMS

Three main systems have been identified.

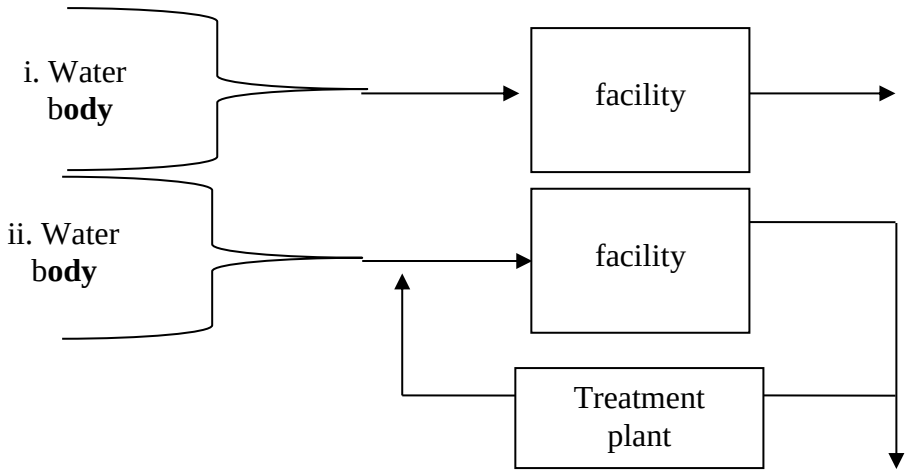
1) Extensive Aquaculture', carried out in reservoirs and in undrainable ponds.

The fish once stocked is left to their natural carrying capacity of the pond water. It is characterized by low input, low density stocking no artificial feeding, no fertilization and the yield per unit area is low and improve pond management. All resulting in high yield per unit area.

There are two types

(a) Open flow system

(b) Recycling system.



2) Intensive:- This involves heavy inputs, high density stocking

3) Semi - intensive aquaculture - pond is fertilized with organic and inorganic fertilizer, small quantity of supplemental feeding and occasionally, the yield is intermediate between those obtained from intensive and extensive culture. Most aquaculture undertaking in the tropics are of this nature.

4. FISH PRODUCTION AND STATUS OF AQUACULTURE IN NIGERIA

Aquaculture is still being practiced at the subsistence level in most countries of the world. Because of this, statistics of production are difficult to collect and this makes proper assessment difficult. Nigeria has been cited as an area with high aquaculture potential.

FAO (1988) reported that small or large scale fish farming using indigenous species and feed material can be highly productive and profitable. The culture of *Tilapia nolitica* in ponds fed on pelleted feeds made from locally available agricultural and industrial waste product yield a production of 5000 kg/ha/yr and found to be perfectly feasible and economical in Nigeria.

Production in Nigeria is characterized by small scale rural activities, secondary and part time taken place in small farms in small freshwater than intensive commercial operations. Fish are very prolific. 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 losses. Aquaculture is the fastest growing animal base food producing sector, particularly in developing countries. The sector alone contributes nearly a third of the world's supply of fish products.

Aquaculture produces more than 220 species unlike terrestrial farming which the bulk of production is based on a limited number of species. Aquaculture in Nigeria is based principally on cichlids, silurids, catfish and cyprinids which contributes 43%, 23% 15% to the total production respectively. 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.

Pilley (1976) of FAO at FAO technical conference on aquaculture in Japan reported that the total output of cultural aquatic organisms (fin fish, shrimp prawn, oysters mussels, clams, scallop, cockles and seaweed) in 1976 amount to 6.09 million tones. The total world fish output in 1976 was 69.9m tones. Production from aquaculture thus contributed 8.8% to the world fish catch. Projections and estimates indicate that this production would have risen to 80 m tones (about 15% of the total world fish supply.)

Pilley statistics of production in tropical developing countries is roughly 1,2m tones forming about 20% of the total world output.

Huisman (1986) notes that aquaculture has obviously not found its niche in African society and Africa's contribution (of 11,800 metric tones in 1985) to global production remain insignificant at approximately 0.1% The emphasis on the culture of cichlids is regarded by Huisman (1986) to be one of the factors which constrains aquaculture in Africa because of the problems inherent in tilapia farming, that is the tendency towards prococial development and over population of ponds with small sized fish. FNI (1980) reported that production of fish in Nigeria stands at 11.3 tones which represent 2.3% of world catch. In 2002, the global production from fishing an aquaculture combined reached about 133 million tones. The quantities fished remained stable at about 93 million tones per year between 1999-2002. China and Peru are leading the top ten countries with the largest catches for over a decade. Recently a geographical information system (GIS) was used to evaluate the potential of fish farming in Africa with the outcome that nearly half of the continents surface are judged as having a positive aquaculture potential CIFA (1993).

5. THE ROLE OF AQUACULTURE TO NATIONAL DEVELOPMENT

1) Foreign exchange earner

(A) Sports and recreational fish are trained in aquaculture and is major earner of foreign currency. Fishes are sold locally for income earning too.

(B) Fisheries are a huge global business, providing revenue to estimated **38** million people (FAO **1978)-**Thailand become the world's main exporter of fish and fish product with export valued at an estimated US 4.5 billion dollars ($4.5B)

(C) Contributes nearly a third of the world's supply of fish products. Total world aquaculture production reached U.S $45.4 billion (28.8m tones of products) in 19f 97.

2) As a Source of Food

Fishery exists for the purpose of providing food for human. It is estimated to provide 16% of the world population protein. Fish is mainly consumed fresh, processed in frozen, canned or cured form. More than three quarter of the world fish production is consumed by human and most of the remaining portion is fed to animal particularly in the form of fish meal. Fish is also produced as bait for industrial fishing.

Seaweed is used (a) as livestock feed (b) fertilizer for agriculture (c) industrial paste for textile and plastering (d) contain allogenic acid used to form salts (e) for medical use as expellant for round worm. (f) As food for man.

3) Employment

Aquaculture provides direct employment to the populace. There is dignity of labour. Fishermen are highly peasants in the society but aquaculturist are regarded as industrialist.

4) As a source of unity in a community and cultural identity.

These has been achieved through

a) Communion ownership of the ponds. (b) fishing together in a community pond (
c) Sharing of proceeds by the people
c) Formation of co-operative society to have fish farms
d) As an occupation that depicts the peoples cultural identity.

5) Aesthetic Value

a. Fishes are trained for sports and recreation in the fish farm e.g. Dolphin,
b. Ornamental fish and fish products are obtained for decoration, pleasure and aesthetic interest.
c. For exhibition. Goldfish have been bred for many centuries in China, Japan culturist and they have been holding annual goldfish exhibition throughout the country fish festival.
d. Provide tourism and recreation,
e. Fishing festivals and exhibition are held in Kebbi State, Nigeria every year called Arigungu fish festival

6) Scientific Study of Aquatic Life

a) Contribute to the understanding of aquatic ecosystems (b) interest to students of evolution for the explosive speciation that have occurred. (c) Use for behaviour studies and this background information is much needed to know how fish behave under natural condition.

7) Eliminate use of complicated gear and craft.

Aquaculturist does not require complicated gear and crafts to harvest as in the wild state. Safety is guaranteed during harvest as cap siding of boat and fearful waves inherent in the wild are eliminated

8) Prolific and faster to grow

a) Fishes grow faster under aquacultural condition than in the wild state because of supplemental feed.
b) The yield is high and fishes are not prone to pest, parasite or disease and incessant pollution of water by oil spills inherent in the wild state.

9) Alternative to wild stock

Because, many wild stocks are being depleted and the world catch is not increasing at a rate that can keep pace with the demand. Exploitation of wild stock is becoming less and less profitable because of increasing cost of fuel, other inputs, gear problems and fishing unwanted species.

10) Waste Recycling

Means of recycling waste or effluents from factories and sewage disposal system which are being used as feed in the pond.

6. CONCLUSION

Aquaculture is still been practiced at the subsistence level in most countries of the world. Captured fisheries production is stagnating and aquaculture output is expanding faster than any other animal base food sector. Nigeria has long been cited as an area with high aquacultural potential. Some important species used in aquaculture in Nigeria include catfish, (*Chrysichthys* spp.), mudfish *(Clarias spp.),* common carp *(Cyprinus carpio).* mullet *(mugil spp.*), Tilapia (*S. niloticus, S. Mossambicus, Tilapia zillii).* The state of the world fishries and aquaculture concludes that development in the world fishery and aquaculture during recent years have continued to follow the trends that were already becoming apparent at the end of the 1990s. There are growing concerns with regard 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.

7. RECOMMENDATIONS FOR ENHANCEMENT OF AQUACULTURE FOR SUSTAINABLE DEVELOPMENT

On the basis of the present state of our knowledge, development and management of fish farms aimed at maximizing sustainable yield especially in developing countries likes Nigeria, with large deficit in the animal protein requirement of the hinter land people should take cognizance of the following

A. We must give the same level of assistance to these fisheries as to other economic activities to increase income and raise the standard of living.
B. In planning for development government must concentrate efforts on the development of small scale fish farming. Any diversification in agriculture that does not include aquaculture development is incomplete. Fisheries must be integrated into the development of the society in general. It has also reduce urban migration and its attendant problems.
C. Provision of credit facilities: Fish farming requires energy subsidy in the form of supplemental food, labour, introduction of exotic species, construction of fingerling multiplication centres and these should be available and cheap to farmers.
D. Education: Aquaculture should be included in the school curriculum along side with agriculture in our primary and secondary schools. By educating our young people we are indirectly educating our parents, the illiterate and the community at large.
E. Enlightenment programmes: The populace should be given adequate enlightenment about the importance of fish farming. Lack of information may have been responsible for low engagement in fish farming, inadequate harvest of many under exploited and unexploited segment of the resources.
F. Marketing and preservation of fishes and products. We must devise means for

developing new co-operative associations to protect the interest of small producers. Preservation facilities should be provided to store excesses.

G. In addition to the effort to increase the standard of living, social infrastructures, social services and environment for fishermen must be set up in sufficient quantity.
H. Gear control measures to enhance selective and effectiveness in exploitation of various stocks and habitat.

Aquaculture on flood plains of large river is considered as a management measure aimed at maximum exploitation of their fisheries resources. Aquacultural practice is regarded as a natural extension of the procedures for keeping the largest possible area of the flood plain under as high a level of water as possible during the dry season in order to increase fish protection (Awachie 1968, 1973 Reed et al 1967).

The recommendation so far made do not in exhaustively depict all the measures that could be taken. It is worthwhile mentioning that the application of aquaculture has unveiled to an extent, the degree to which fish farming can sustain the economy and provide the necessary protein need of this country.

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