STRATEGIES FOR THE ESTABLISHMENT OF PROFITABLE FISH FARMS IN NIGERIA

by

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ABSTRACT

Cost projections for the establishment of fish a farm was conducted. It is shown that fish farming should be a lucrative venture. However, many private fish farms are not making the desired profits because of a variety of problems. Besides managerial incompetence, availability of fingerlings for stocking in the ponds is shown to be a serious handicap to the success of investments in a fish farm. It is suggested that where the funds are available, each farm should be equipped with facilities for raising its needs of fingerlings. Since useful capital would be involved and knowledgeable experts to run the hatcheries are few, it is recommended that fish farms within a state or adjacent states should combine to establish viable cooperative hatcheries.

INTRODUCTION

The need to increase fish production in Nigeria has become most desirable because of the exorbitant cost of beef. Thi need is further enhanced by the ban on importation of froze fish and stock fish. The source of new production will be mainly through fish farming. Fish is a rich source of some amino acids, vitamins, minerals and poly-unsaturated fatty acids not found in other sources of protein (Kent, 1984). In addition, farming fish offers some advantages over farming domesticated land animals. One of these advantages is the ability of many species of fish to convert organic wastes such as sewage, piggery wastes, poultry wastes, cow dung and other organic industrial by-products into useful protein effeciently thus contributing to the management of wastes in our environments. Another is that swampy area unsuitable for agriculture are easily utilised in pond construction. More importantly however is the fact that protein production per unit area is far higher in fish culture than in raising of beef. Fish farming is a common

practice in several parts of the world and contributes a substantial portion of the total fisheries of many countries. For example, fish production by farming makes up over 50% of the total Israeli fisheries (Sarig, 1980).

Currently, sources of capture fisheries are reaching their maximum production. Ajayi (1982) has indicated that the inshore fisheries in Nigeria still has some room for expansion but that the shrimp resources are fully exploited. Ita (1982) has produced biological indices of everfishing in the Kainji Lake. With the Sahelian drought, the volume of Lake C had decreased considerably with consequent decrease in the fisheries. Th an area of great potential for fish production is in fish farms.

CURRENT STATUS OF FISH FARMING IN NIGERIA

Tobor (1985) projected that fish demand would increase from 1.018 million tonnes in 1985 to about 2.035 million tonnes in the year 2,000 A.D. He also indicated that domestic fish production was only 54 - 60% of our demand but was of the opinion that fishery resources in Nigeria could support 80% or more of our fish demand. Since fish production in natural waters is finite while production by fish farming is elastic, efforts must be made to encourage fish farming. Les than 5% of the total available environments most suitable for fish farming was cultivated in 1983 producing 20,500 tonnes o fish which represents about 3.12% of the total fish productic for that year (Tobor, 1985). With the cultivation of 25% of 1,751,509 ha of perennial swamps and brackish water at a production rate of 1.5 tonnes/ha/year about 0.7 million (656,815 tonnes) of fish can be raised, under intensive fish farming system, production rates of 2 - 3 tonnes/ha/year have been reported in Nigeria (Sivalingam, 1974). With good management, intensive fish farming in Warm and fresh waters can yield over 3 tonnes/ha/year of fish (Savig, 1980). Also realising that land outside the swampy zones of the country is being put into aquaculture, potential fish production from aquaculture can be over 1 million tonnes a year.

REQUIREMENTS IN THE CONSTRUCTION OF A FISH FARM

The cost of the establishment of a fish farm falls under various categories as follows:-

a) Land acquisition

A primary consideration in the acquisition of land for the consturction of a fish farm is the presence of water or the cost of procurring water. The land area required for a fish farm can vary from a few hectares to several hundreds depending on the finance and project design. A fish farm that plans to sell fish everyday will require several hundreds of hectares of land while those to sell intermittently will require lesser land area. The cost of land acquisition will be influenced by the current use of the land and its relative usefulness in agriculture. Leasehold from government and government agencies costs less than ₦100 per hectare. The cost is astronominal when land is privately acquired.

b) Survey and Design

A land designated to be used for a fish farm must be surveyed to provide information on the topography of the area. This will enable accurate computation on earthmovings that need be done on each pond. A master design must be carried out for the fish farm. The design must include:

i) a reservoir. The reservoir must have a monk, a dam and a spill way.

ii) the layout of the ponds in the farm. The surface area and depth of each pond must be indicated.

iii) and office complex. This may be a simple design that will have a store, offices, laboratory (for water quality monitoring and feed formulation) and toilet facilities. The cost of survey and design will vary but should not exceed 5% of the cost of construction of the ponds.

c) Construction of Ponds

The construction of a pond involves considerable earthmoving by use of heavy equipment like Caterpillar. The volume of earth to be moved can be computed from the contour profile and the desired depth of each pond. Ideally each pond should be about 1.5 m deep. The cost of earthmoving can be computed using current rate of hiring a bulldozer at about ₦120.00 per hour.

In addition, each pond will require a dyke and a monk. The construction of each of these is determined by the size of the pond or reservoir. The cost of construction of the dyke and monk is usually about 6% of the cost of the entire pond. The walls of the pond need to be compacted and grass planted in areas expected to be above water level. The cost of this is estimated at less than 0.5% of the cost of pond construction.

In order tc ensure that water seepage is reduced to the barest minimum a clay core must be built into the walls and floor of each pond. When construction is completed, the pond floor must be limed to kill off potential pathogens, eggs of predaceous invertebrates and reduce acidic condition in the substratum to alkaline.

MANAGEMENT OF A FISH FARM

Varying facets are involved in the management of a fish farm. There is:

a) Pond Maintenance

It is essential to maintain each of the ponds in an optimal condition always. There is therefore the need to monitor the physico-chemical features of each pond on a regular basis to ensure that the parameters are well within tolerance levels of the fish species in the pond. This will eliminate stress and ensure good growth of the fishes.

In some remote areas, facilities for monitoring physico-chemical parameters may not be available. In this situation visual observations of the fish in each pond must be carried out to assess their movements and behaviour. Any fish in a stress situation will be easily noticed. Dead or dying fish must be removed immediately.

The walls of the pond must be inspected regularly especially during the rainy season. Signs of cracks, crab holes and poor grassing must be quickly corrected. Fish predators - king fishers, heron, monitor lizard, and frogs must be eliminated or prevented from the ponds. As much as possible rain run off should be prevented from flowing directly into the ponds.

Supplementary Feeding

Dissolved nutrients promoting primary and secondary productions in the natural environment are seasonal and may not occur in required proportions to meet the nutritional demand of cultured fishes. Supplementary feeding satisfies this need and ensures that the fish gets the appropriate spectrum of its basic food requirements for its maximum growth.

Supplementary diets often called artificial foods could be mainly or partially made from natural ingredients and synthetic materials. Such preparations are made to meet the nutritional requirements of a particular fish species with provisions for fishes of different size intervals. Adequate feeding with supplementary diets improves fish resistance to diseases, ensures increased fish production and may enable more than one cropping session per year

(Dulong et. al. 1958; Mazid et. al. 1978). High protein diets are essential for juvenile fishes since they require more protein for their growth than the larger fishes. Supplementary diets must also contain appropriate fatty acids, essential minerals and vitamins. In addition, the supplementary diet must contain carbohydrates which provide most of the energy needed by the fish. Carbohydrates improve growth, food utilization, digestibility and enzyme activity in fishes (Nagayama and Saito, 1978) and act as a binder in the artificial feed (Lovell, 1971).

Materials which are cheap and available in large quantities should be used for the production of fish feeds. Such materials include palm kernelcake, groundnut cake, millet, rice bran, chicken offals, blood meal, brewers wastes and flour mill sweepings. The use of cheap feeds without reduction in effectiveness is desirable in reducing overhead expenses. There is therefore urgent need to increase research efforts aimed at formulating suitable diets for the various stages of the cultivable species and to collate information currently available in this field.

Water Quality Maintenance

Maintenance of water quality in the ponds of a fish farm should be directed towards three principal goals:

i) Control of physico-chemical features of each pond. Temperature: From all indications the high water temperatures in the tropics encourage rapid growth.

The temperature of a body of water can be controlled by reducing insolation by erecting a bamboo shed over it. Oxygen: Different fishes have different oxygen requirements but a range of 4-8 mg/l is optimal and some cichlids could withstand temporarily up to 3 mg/l or much lower in consequence of temperature and increased organic matter. Dissolved oxygen profile influences the stocking density of ponds.

Hydrogen ion concentration (pH): Alkaline ponds are more productive than acidic ones. The pH values in the range 7.0 to 8.5 are regarded as good for fish production. pH values lower than 6.0 and higher than 8.5 create uncomfortable stress situation for fishes.

Heavy metals: Heavy metals like mercury, cadmium, copper and zinc are toxic to fish even at low concentrations. Being bio-accumulated, they are also very dangerous to the consumers of the fish.

ii) Liming: This ensures pH stability. Most aquatic organisms tend not to withstand sudden or strong variation in pH. Apart from this liming has anti - parasite action, destroys some algae and aquatic plants as well as insects and larvae which are enemies to fish.

iii) Fertilization: It involves fertilization of the pond with inorganic and/or organic materials. These increase the natural food of fishes thus increasing fish production. Fertilizers containing phosphorus, potassium and nitrogen are highly favoured. Organic manures have added advantage of bringing in all nutritive substances and a favourable action on soil structure. Application of such manures must be monitored to prevent causing a dissolved oxygen deficit in the ponds.

Staff Requirement

The strength of staff required will be determined by the size of the fish farm. The minimum staff required in a fish farm are as follows:

i) Farm Manager: He is the overall boss on the farm. He overseas the day to day running of the farm. He should be well trained and have either an HND in Fisheries or a degree in Fisheries or Zoology

ii) A Supervisor: He is responsible to the Manager. He could serve as accounts clerk/ purchasing officer. He must be willing to participate in all facets of the work programmes in the farm.

iii) Two unskilled workers: They will be responsible for applying fertilizers to the ponds, providing supplementary feeding and cropping of the ponds. They must be able to swim and paddle a small canoe.

iv) Driver/Mechanic: To drive and maintain the official vehicle.

v) Consultants: A big farm may require the services of a consultant veterinary doctor and a fisheries scientist to intermittently assess the state of well being of all fish ponds and their component fish species.

vi) Two Security Men: To effect security in the farm against theft and related incidents.

Materials Required

A fish farm will require the following materials at one time or the other.

i) Nets: These should include a drag net and a cast net. If the reservoir in the farm is extensive, gill nets will be required. Hand nets are also required to remove fishes in strees condition.

ii) Canoe: A wooden, aluminium or fibre glass canoe is required for movement in each pond and in the cropping programmes.

iii) Wheel barrow: A wheel barrow is required for movement of materials (feed, fertilizer etc.) between ponds.

iv) Rainboots: At least a pair should be provided for each worker.

v) Fertilizer: The type of fertilizer required will be dependent on the nature of the water and its substratum. An expert advise is required. Inorganic fertilizers (e.g. Ammonium sulphats, NPK etc.) are quick acting in providing plankton bloom but their effect diminishes rapidly. On the other hand organic fertilizers (cow dung, poultry droppings etc.) give sustained plankton bloom when needed.

vi) Other materials required are cutlasses, spades, plastic containers, first aid kit and scale.

vii) Transportation - a pick up van.

Cropping in a Fish Farm

A pond should be cropped when the fish therein reach the acceptable size of the market. Cropping can be quarterly, half yearly or annual. The rate of growth of the fish will determine the frequency of cropping. We recommend half yearly cropping of polyculture ponds and an annual cropping of a tilapia pond.

Provision for Exigencies

In planning a fish farm there is need to allocate a reasonable amount of money to meet unexpected developments. There is the constant problem of price instability. We recommend that about 10% of the projected cost of the farm should be set aside for exigencies.

Insurance Policy

We recommend that an insurance policy be taken to cover equipment and accident to personnel and the ponds. For example, prolonged heavy rainfall can cause unexpected damage and flood in the fish farm.

Stocking

The rate at which any fish species is stocked in a pond either alone or in combination with other species depends on the productivity of the pond which is also hinged on the physico-geographical characteristics of the environment like temperature and light intensity as well as the water quality which must be high in nutrient, completely devoid of toxics and must also be well oxygenated. The stocking rate of any species is given as the product of $\frac{\text{Total production (kg) - Loss (mortality in number)}}{\text{Individual growth (kg)}}$.

Growth target and total productivity must be predetermined. Individual growth target of each species in the farm is got from substracting the mean weight at stocking from the mean weight at harvest. The normal limit of growth of the species is needed to fix the target. Loss due to varying causes should be computed at 5 to 10%.

Stocking a combination of species or polyculture is preferred since single species cannot exploit all available food in a pond. Proper combination will make fuller use of available food and space, reduce hazards due to predation and diseases. Priority in selection of choice species for polyculture is that combination which will include:

- a phytophagous species usually tilapia;
- a bottom feeder which can feed on detritus and benthic invertebrates;
- a predator/carnivore to control tilapia population.

The species in the later category must have restricted breeding habits, so as not to wipe out the stocks of other trophic groups. In fresh water polyculture, the readily available species and combinations are as follows:

- Tilapia - *Clarias* - *Heterotis*
- Tilapia - *Channa* - *Heterotis*

- Tilapia - Heterobranchus - Heterotis

- Tilapia - Carp (grasscarp) - Clarias

- Tilapia - Clarias - Chrysichthys.

The species composition for brackish water will primarily be as follows:

Mullet - tilapia (S. melanotheron) - snapper

Mullet - Chrysichthys - tilapia

Mullet - tilapia - megalops.

Available tilapias of food quality include T. zillii S. galilaeus, O. niloticus and S. melanotheron. All male hybrid tilapias are also being produced for intensive fish culture.

In the polyculture systems the stocking rates of the various trophic groups are not the same. The predators are usually fewer per hectare than the others. Optimum stocking rate of most fish tends to increase from natural ponds to fertilized ponds and highest in artificially fed and fertilized ponds. We recommend a stocking density of 20,000 specimens per hectare. The ratios of stocking are as follows:

Tilapia - Clarias - Heterotis	12000 - 3000 - 5000
Tilapia - Channa - Heterotis	10000 - 3000 - 7000
Tilapia - Heterobranchus - Heterotis	12000 - 3000 - 5000
Tilapia - Clarias - Carp	10000 - 3000 - 7000
Tilapia - Clarias - Chrysichthys	12000 - 3000 - 5000
Mullet - tilapia - snapper	5000 -10000 - 5000
Mullet - tilapia - Chrysichthys	5000 -10000 - 5000
Mullet - tilapia - megalops	5000 -13000 - 2000

Stocking rates can be varied to suit particular needs. For example, brooding ponds will have lower stocking density, than rearing ponds.

Estimated cost for stocking, supplementary feeding and water quality management:

Fish seed procurement:

Purchase of fingerlings are recommended if there is no hatchery centres managed by specialists to produce highly resistant brood of frys for stocking (frys usually taken as seed of size 2.5 - 5 cm and fingerlings 5 - 7.5 cm).

Tilapia 5,000 fingerlings @ 20k each	₦1,000.00
Clarias 3,000 fingerlings @ 50k each	1,500.00
Heterotis 3,000 fingerlings @ 30k each	900.00
C. nigrodigitatus 3,000 fingerlings @ 40k each	1,200.00
Common Carp 3,000 fingerlings @ 30k each	900.00
Heterobranchus 3,000 fingerlings @ 40k each	1,200.00
Supplementary feed	1,000.00
Liming	200.00
Fertilizer	250.00

In a big farm an allowance of ₦2,000.00 should be made available for consultants.

EXPECTED INCOME

Estimated total harvest from a polyculture system in the combinations given are:

Tilapia 1500kg @ ₦3.50 per kg.	5,250.00
Clarias 3,000 kg @ ₦4.50 per kg.	13,000.00
C. nigrodigitatus 4,000 kg @ ₦5.00 per kg.	20,000.00
Heterotis 4,000 kg. @ ₦4.00 per kg.	16,000.00
Heterobranchus 3,000 kg. @ ₦4.00 per kg.	12,000.00
Carp 3,000kg. @ ₦4.00 per kg.	12,000.00

Each combination is expected to yield a conservative total revenue of ₦30,000 giving room for a 5% total mortality.

CONSTRAINTS TO THE SUCCESS OF A FISH FARM PROJECT

Two main factors that can militate against the success of a fish farm are:

Management:

Several lapses in the management of a fish farm result in reduced production of fish and hence the profitability of

the entire project. Some of these include:

a) Inadequate security which will encourage poaching.

b) Poor control of predators and parasites.

c) Inproper control of flood.

d) Lack of knowledge of the status of the water quality in the ponds.

e) Use of the wrong fertilizer and

f) Irregular supplementary feeding and poor knowledge of the quantity and quality of the feed.

Stocking:

Many fish farmers do not know how many fish should be stocked in each pond. The problem is further compounded when more than one species is to be stocked in a pond. The ratio of one species to the others in usually unknown.

Many fisn farmers cannot accurately identify the fish species they are stocking in their ponds. For example, many Clarias spp. are usually stocked out only a few of these grow rapidly and reach market size. Similarly, the slow growing Chrysichthys auratus is often stocked with the fast growing Chrysichthys nigrodigitatus.

The greatest problem facing a fish farmer however is that he cannot even get enough fingerlings to stock in his ponds and often he is unable to get them when he needs them. These serious problems must be solved before a successful fish farm can take off.

RECOMMENDATIONS

While recognising the limited success achieved by the Nigerian Institute of Oceanography and Marine Research in producing pelleted fish feed, we recommend that the composition of the feed be indicated on the package and efforts should be made to produce the feed in far greater quantity than at present.

We are also of the opinion that it is necessary to have a form of short training for fish farmers in the identification of the species to be cultured. This we think is essential for the success of a fish farm project.

We recommend further that fish seed production and availability must be ensured before the commencement of the construction of a fish farm. Fish seed produced in the wild have poor growth rate and those so collected may include weed fishes. Quantity obtained are usually grossly inadequate for the need of the farm. In some species

fingerlings are produced seasonally. Then there is the added problem of accurate identification of the species involved. Fish seed are therefore best produced in a fish hatchery.

In a hatchery, the type and quality seeds required can be produced within a short time. Hatchery construction however requires a considerable capital investment and must be run by an expert. Such capital and expert may not be readily available. It is therefore desirable to have within a state or adjacent states a fish hatchery. Since considerable capital is involved and the experienced expert are too few, we recommend that a co-operative venture between fish farmers be initiated to establish a fish hatchery.

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