

COMMERCIAL POND FISH CULTURE

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ABSTRACT

Commercial Pond Fish Culture Practice is comparatively new in Nigeria. It is therefore very important that simple Guide Lines be provided for the establishment, development, and management of such projects. The objective of this Paper is to fulfil this urgent need. All aspects of Commercial pond fish culture have been dealt with. Fish pond operations comprise of pond preparation, stocking, rearing, and harvesting.

These have been highlighted in the text, bearing in mind that the most important principle of fish culture is the acquisition of maximum production of marketable-size pond fish from a given unit area.

INTRODUCTION

In 1984, Nigeria's fish demand was about one million metric tonnes, and production estimate was 374,000 tonnes. In 1985, total fish consumption was put at 1.95 million metric tonnes, as against domestic production of 610,000 tonnes (NIOMR, 1985). Hitherto, shortfall in fish production was augmented by importation of stock fish, salted fish, frozen fish, and canned fish.

With the present rate of population growth in Nigeria: 55,670,055 (Census 1963); and 116,189,300 (Federal Government Projections 1985), it is estimated that fish demand will exceed two million metric tonnes by 1990. Now that importation of fish has been restricted, the alternative is for Nigeria to improve upon the implementation of the accelerated fish production programmes including Aquaculture (Fish Farming/Pond Fish Culture).

Fish production in Nigeria is mainly from two Sectors; Artisanal accounts for 90 percent, and Industrial has 5 percent. Production from aquaculture Section is only 3 percent. It is evident that Aquaculture (Fish Culture in ponds, cages, pens etc.) is the least exploited for fish production in Nigeria. Continuous development of this sector is to be pursued vigourously.

In this respect, Pond Fish Culture, that is cultivation or rearing of fish in ponds for production of pond fish as distinct from Sea Fish should be given special attention. Pond Fish Culture has a lot of potentials for commercially feasible projects which can increase fish production by 656,815 metric tonnes from about 25 percent of available 1,741,509 hectares of freshwater and brackishwater swamps (NIOMR, 1984).

As a matter of fact, the following Pre-Feasibility and Feasibility Studies have confirmed that development of Commercial Pond Fish Culture is practicable and profitable in Nigeria for both brackish water and freshwater swamps:-

- (i) Nigerian Government: Studies in Northern Nigeria - Panyam Fish Farm, Jos, 1953
- (ii) Federal Government (FDF) UN-FAO: Studies in Niger Delta, - Buguma Fish Farm, Via Port-Harcourt, 1963
- (iii) Federal Government (FDF)/AFRECO (Association of African Economy and Development, Tokyo, Japan) in Niger Delta, 1973
- (iv) Federal Government (NIOMR)/UN-FAO: Studies in Niger Delta-ARAC. Buguma/Aluu, Port Harcourt, 1976
- (v) Federal Government (FDF)/ASIAPHIL (Asiaphil Fish Corp. of Philippines): Studies in Nigeria - Ondo, Bendel, Rivers, Cross River, Benue States, 1979
- (vi) Federal Government (NDBDA)/FISESCO (Fisheries Services and Equipment Supply Company, Limited, Lagos, with Partners ASIAPHIL (Asiaphil Fish Corp, Manila, Philippines)- Full Feasibility Studies in Niger Delta Rivers State, for (a) 3 Commercial Fish Farms of 500 hectares each, (b) 10 Community Fish Farms 20 - 100 hectares each 1981

In order to achieve the objectives of enhanced commercial pond fish culture in Nigeria, water-tight fish ponds must be constructed at suitable sites, selected species of fish must be stocked, proper pond management techniques must be practised, and efficient methods of cropping must be maintained, to obtain maximum pond fish production level per hectare per annum.

In a paper entitled "Construction of Brackishwater fish ponds In The Niger Delta" by this author, presented at the Workshop on "The Mangrove Ecosystem of Niger Delta" - published by the University of Port Harcourt (1980), a vivid description of the principles of pond construction

was made with particular reference to Brackish water fish ponds. Similarly, in another Paper "Pond Construction/Engineering" presented by this author at the Fourth Annual Conference of FISON (Fisheries Society of Nigeria), NIOMR/ARAC, Port Harcourt (1985) explanations were made of the technicalities involved; in the construction of both fresh-water and brackish water fish ponds - indicating essential difference in constructional details.

The purpose of this Paper, therefore, is to present in a nutshell, the description of all activities involved in the establishment, development, operation and management of Commercial Pond Fish Culture, or Commercial Fish Farming in Nigeria.

BACKGROUND INFORMATION ON POND FISH CULTURE IN NIGERIA

Animal protein is a very important food item in the diet of Nigerians and it contains 40 percent fish protein. For over two decades, domestic supply of fish in Nigeria has been inadequate to meet the Country's needs. It was the demand for increased fish production; that directed the Nigerian Government's attention upon the potentialities of our natural resources.

The objective was to increase fish production through Aquaculture, by the Construction of modern water-tight fish ponds with suitable soil, in fresh water and brackish water swamps, and by the culture of suitable fish species in the ponds.

In order to implement the freshwater fish culture programme in 1953, Nigerian Government engaged the services of an Expatriate (from Europe), Dr. K.K. Zwilling to carry out investigation on the possibility of constructing modern freshwater fish ponds in the Country. A Nigerian Government Counterpart Officer; Mr. S.A. Wokoma, was seconded to the project to assist the Expert, also two Nigerian Officers Messrs A.A. Ibrahim, and J.A.E. Ojomo were attached for training.

After travelling throughout Nigeria for identification of suitable sites, the Expert established Panyam Fish Farm, at Panyam, near Jos for demonstration, experiment, training and fish production. The Expert proved that freshwater fish farming (Pond Fish Culture) was viable, and that personnel for extension services could be trained locally and Overseas.

As a follow-up, construction of freshwater fish ponds started spreading all over the Country, especially by Government departments such as Panyam Community Dam/Fish Ponds near Pankshin, Maska Dam/Fish Farm, near Zaria in the North; Agodi Fish Farm, near Ibadan in the West; Umuna Fish Farm, near Okigwe in the East.

Within the last few years, appreciable interest has been shown in freshwater fish farming/pond fish culture with commercial bias, by both private and public sectors, e.g. Aviara Fish Farm, and Fish Farms Limited, in Bendel State; Ellah Lakes Fish Farm, and the proposed Niger Delta Basin & Rural Development Authority 500 - ha. and Community Fish Farms in Rivers State; Government's Modern Fish Farms in Lagos State.

In spite of the offset made in focussing attention on conversion of freshwater swamps into fish farms; the Federal Government being aware that many Countries increased their national fish production by means of brackish water fish farming (pond fish culture), requested the Food and Agriculture Organization of the United Nations in 1962, to carry out investigation into the possibility of reclaiming the vast area of mangrove swamps of the Niger Delta into Brackishwater fish farms for culture of fish to increase pond fish production in Nigeria. The FAO granted this request and sent an Expert to Nigeria in October, 1962.

In 1963, the FAO's Expert, Dr. T.V.R. Pillay, assisted by his Nigerian Government's Counterpart Mr. S.A. Wokoma completed the investigation under the auspices of the Federal Department of Fisheries. The Niger Delta Development Board (Federal Government) Cooperated fully with the FAO Expert, and attached Mr. B.S. Moses Fisheries Research Officer to the project. They also provided transport and accommodation etc.

The result of the investigation demonstrated the feasibility of brackish water fish culture projects and the urgent need for training extension personnel to assist in the development of brackish water pond fisheries.

Dr. T.V.R. Pillay left Nigeria in 1964, and his successor Dr. K.K. Nair, FAO Expert arrived in 1965 to continue the experiments. Construction of the Experimental Brackish water fish farm was completed in 1966 at Buguma for the purpose of; Critical studies of fish culture; experiments on fertilization and fish feeds, studies on pond construction and management techniques; and training of extension staff. In January, 1967 Messrs, S.A. Wokoma and B.S. Moses were awarded FAO/UN Fellowships. They left Nigeria for studies Overseas in Pond Engineering and Advanced Aquaculture Course. The FAO assignment was interrupted by the Nigerian Civil War in 1967, and Dr. K.K. Nair was recalled to Headquarters, Rome, Italy.

Since then, many brackish water fish farms have been established by the public and private sectors - some with commercial bias. A few of them are: NIOMR's (Federal Government) Ikoyi Fish Farm Lagos, Niger Delta Basin & Rural Development Authority's (Federal Government) Pilot Fish Farm at Buguma and Bodo, Rivers State, Rivers State Ministry of Agric's Demonstration Fish Ponds, Port Harcourt,

University of Science and Technology's Fish Ponds Port Harcourt, Tomte Multipurpose Cooperative Development Authority's proposed 500 - hectare Commercial Fish Farms at Buguma and Bodo Rivers State, (Full Feasibility Studies Completed by FISESCO/ASIAPHIL, 1981).

ESTABLISHMENT OF COMMERCIAL FISH PONDS/FARMS:

The importance of carrying out Pre-Feasibility and Feasibility Studies, before the establishment of commercial fish ponds or fish farms, cannot be over emphasized, because of the huge investments involved. Stated below are relevant guidelines for such exercises.

A pond may be regarded as an earthen vessel for collecting and holding water. Its dikes and bottom soils must be of a type that will reduce seepage to a minimum (Wokoma-Ezenwa 1982).

In broad terms, a collection of fish ponds constitute a fish farm. Therefore fish farming or fish culture is simply the art of constructing fish ponds which can hold water stocking them with fish and making the fish grow. The ponds should be such that adequate level of water could be maintained. Fish culture may be practised on Subsistence Scale, Small Scale or Large Scale (i.e. Commercial Scale). The subsistence/small scale projects with one or few ponds in small area of about 1 to 10 hectares, are sometimes known as homestead ponds. Such ponds are generally owned by individuals or families for the purpose of providing pond fish and/or extra income. The large scale commercial fish ponds may range in size from 10 to 500 or more hectares.

Feasibility studies are generally conducted under the following guidelines or Terms of Reference:-

- (i) Site Identification; and Investigation: made in accordance with regulations governing aquacultural technology;
- (ii) Land Survey of Site; and production: of topographic map, in order to facilitate preparation of design plans, and specifications;
- (iii) Computation of Bill of Quantities, and Costings for construction of the Commercial fish farm;
- (iv) Investigation on Availability of Labour; materials, and finances required for the fish farm construction;
- (v) Surveying of Availability of support facilities, that would enhance the establishment and management of pond fish culture project; portable water;

- (vi) Provision of Production Description: relating to pond fish culture, cropping and post harvest management of the fish farm;
- (viii) Preparation of Operational Plans: for the Commercial pond fish culture project, in respect of production distribution and marketing of pond fish in Nigeria.

COMMERCIAL POND FISH CULTURE IN NIGERIA:

Commercial Pond Fish Culutre is comparatively new in Nigeria. It was introduced during the late Sixties. Interest in this lucrative business increased with the gradual decline of the "Oil Boom" in the early years of the current decade. Apart from the huge investments being made by the Public Sector for development of Commercial Fish Culutre Projects, the Private Sector is contributing its comparatively little quota towards the same objective, by investing in small scale, and large scale (Commercial) pond fish culture projects.

In this context, the essential aquacultural techniques involved in the successful organisation and management of such business venture are outlined.

Operation Strategy: The most important principle in fish culture is the acquisition of maximum production of marketable-size pond fish from a given unit area e.g. 5 ton/ha./yr. With this aim in view, fish pond operations comprise four main activities: Pond preparation. Stocking, Rearing, and Harvesting. In the operation or management of commercial fish pond it is advisable to understand and put into practice these important principles of management:-

- (i) Fish grows rapidly when there is plenty of food and slowly when food is scarce;
- (ii) Within one year after stocking, a pond supports approximately the maximum weight of fish for food available;
- (iii) Ponds are fertilied to produce more fish food, so as to produce more fish;
- (iv) Supplementary feeds are essential for increased fish production;
- (v) Proper methods of fertilization, stocking, feeding, and cropping will result in a higher production from the fish pond.

Having noted the above points, fish pond management practices are detailed under the following headings:-

Management of Dikes, and Water Supply/Drainage Mechanism

Newly constructed dikes should be protected against erosion caused by rain, wild-wind action, wave action, flood and tide. Grass and Creeping vegetation grow on dikes naturally, but should be planted if necessary. Cracks in dikes should receive immediate attention, by carrying out proper and adequate repairs. Pond bottom should be levelled to avoid any "Pot-Holes" that may hinder complex drainage of the pond. Water supply/drainage mechanism such as monks sluic gates, culverts, spillways, pipes, should be given adequate maintenance.

Management of Pond Water: Water quality control is essential in pond management practices. It entails checking of salinity, temperature, pH. Dissolved Oxygen, Turbidity etc. Fertilization of pond increases fertility which increases growth of fish. Pond water can be fertilized if fertility is low. Control of water weeds, pests, predators, mosquitoes are necessary.

Management of Pond Fish: This comprises of proper handling of fish fry/fingerlings for stocking, inducing fish growth, by making available natural and supplementary feeds, providing conducive habitat for the fish under cultivation, and adopting efficient harvesting techniques.

Pond Preparation/Activation of Environment: The fish pond environment is activated to enhance natural fish food production through adequate pond preparation and fertilization. The use of fertilizers can increase the productivity of fish ponds. Pond fish feeds on microscopic plants and animals (phytoplankton and zooplankton). These microscopic plants are present in most waters, but in very limited quantities. When the pond is fertilized, the minute plants multiply and grow rapidly thus making the colour of the pond water appear greenish or brownish. The reason for fertilizing the pond therefore is to produce more plants to produce more fish. The Activators are as follows:-

Lime: Prior to impounding water in the pond, lime (Calcium Carbonate) is applied to the moist pond bottom to kill pest, and solve the problem of acidity by raising the pH to desirable level that will enhance the effect of fertilizers. Compounds Commonly used are:

- (i) Agriculture Limestone (Calcium Carbonate)
- (ii) Hydrated lime or slated lime (Calcium hydroxide)
- (iii) Calcium Oxide.

Liming Rate: 1000 kgs to 5000 kgs/hectares per annum depending on the acidity.

Method: By broad-casting or spreading on pond bottom or on water surface, if pond is filled.

Fertilization: Fertilization of fish ponds are classified as Chemical Fertilizers (Inorganic Compound) and Organic Fertilizers (Manures). Chemical fertilizers contain nutrients (NPK) which stimulate phytoplankton production in fish ponds; require about 8 - 12 periodic fertilizer application to maintain good plankton bloom - 1000 kg. to 1,500kg/ hectare per annum.

Organic Fertilizers (Manure) are usually agricultural waste e.g. chicken droppings, cattle and pig dung; these waste products decompose and release inorganic materials that stimulate the growth of phytoplankton. A few days after liming the pond, chicken droppings and/or pig and cattle manure are applied to the pond with 8 - 10 cms. depth of water) about 2,000 kg to 2,500 kg/hectare per annum. After 7-10 days, when the plankton has bloomed, the water in the pond is increased to the required level of about 100 cms depth. Then the pond is ready for stocking.

Fish Species for Commercial Pond Fish Culture In accordance with the recommendation in Pre-Feasibility and Feasibility Reports (Ref: "Introduction" of this Paper and the writer's practical experience in Nigeria the following species of fish are recommended for pond fish culture in Nigeria:-

- (i) Brackish water: Tilapia (Sarotherodon nilotica, Sarotherodon malanotheron, (or T. heudeloti). Tilapia guineensis (or T. Melonepleura); Grey mullet (Mugil Cephalus) Chrysichthys spp; Elops spp; and Lutjanus spp.).
- (ii) Freshwater: Common Carp (Cyprinus carpio) T. giuneensis Tilapia (Sarotherodon mosambicus); Tilapia nilotica; T. Zillii s. galilaea; Clarias lazera; Heterotis spp. and predators Lates niloticus; Hetrobranchus spp.

Fish Stocking Density: The Stocking density is the number of fish which a pond can hold and maintain without exceeding its carrying capacity. Hence the number of fish to be stocked in a pond depends on the factors stated below. It is to be noted that fish stocking is done at cooler times of the day - early morning or late afternoon and early evening. Fish Fry/ Fingerlings must be acclimatized.

Factors That Determine Stocking Rate are: Size of Fish Pond, Number of fish for stocking; Average size of fish, Availability of fish food. and weight of harvest expected. In Nigeria two types of pond fish culture are practised:

Monoculture: Culture of one species of fish in a pond.

Polyculture: Culture of two or more species of fish in a pond. Polyculture is recommended for effective use of all types of natural food present in the pond.

Examples of Specific Fish Species: Stocking Rates;

- (i) Polyculture: Tilapia spp. Mugil spp. Chrysichthys spp.; may be stocked in one pond in the Ratio of 10:4:1 and the stocking rate will be 10,000 No. Fry/Fingerlings per hectare.
- (ii) Monoculture: Tilapia spp - 10,000 to 15,000 fry/fingerlings per hectare. Mugil spp. 10,000 to 20,000 fry/fingerlings per hectare. Chrysichthys spp. 7,000 to 8,000 fry/fingerlings per hectare Clarias spp: 15,000 to 20,000 fry/fingerlings per hectare.

Hatchery: In the operation of subsistence and small scale fish farms, collection of fish fry/fingerlings from the wild or purchase may be sufficient, but for Commercial Small Scale or Large Scale Fish Farms, it is imperative to build a hatchery within the project complex for production of fish seeds.

Fish Feeds, Natural and Supplementary Feeds: As stated above, fish will grow rapidly if there is plenty of food, and will grow slowly if there is scarcity of food. Pond can produce natural fish food such as Microscopic water plants, water animals and water insects.

In addition to the natural food supply from the pond system, supplementary diet may also be given to the fish in order to improve the growth e.g. wheat bran, rice bran, brewery waste, groundnut cake, palm kernel cake etc. but preferably compounded fish pellets.

Feeding Sequence: The frequency at which fish is fed, may depend on two factors: (i) The size of fish and (ii) the rate of consumption of feeds. Fish fry are fed at two to three hourly intervals; and the number of feeding is gradually reduced as the growth rate increases. Fish culturists and fish farmers feed bigger fish and brood stock once a day, six to seven days per week, for convenience.

However, experiments show that feeding twice daily induces slightly faster growth than once thrice or more times daily. For this purpose, ration is divided equally and fed morning, and evening respectively.

It is to be noted that feeding should not be done early morning or before 10a.m. in Nigeria, because the dissolved oxygen used by the fish and aquatic plants during the night has not been replaced by photosynthesis.

Calculation of Quantity of Food to be Used:

The quantity of supplementary feed to be given per day in relation to weight of fish stocked is dependent on the following factors: (i) Number of fish stocked (X)

(ii) Average weight of fish stocked (Y)

Therefore Gross Weight of fish = $X \times Y$. It is to be noted that the percentage of quantity of feed is between 2 percent and 4 percent of the Gross Weight of total number of fish in the pond.

Hence quantity of supplementary feed will be equal to 2% of $(X \times Y) = 2/100 \times (X \times Y)$.

Conditions that necessitate application of supplementary feeds are:

- (i) Insufficient natural food
- (ii) Available food not suitable for fry consumption
- (iii) Inducement of rapid growth

Feed Mill: Well formulated fish feeds must be available in adequate quantities in a commercial fish farm at all times. To this end it is advisable to establish a fish feed mill within the fish farm complex for production of fish feeds (pellets) in commercial quantities from local ingredients.

An example of a Formula for well formulated fish feed by composition contains:

75 percent wheat bran, 10 percent Ox-blood, 5 percent groundnut cake, 5 percent beans, 5 percent cassava starch, small quantity of table salt; some palm oil and vitamin premix.

Harvesting Pond Fish

As stated earlier, proper methods of fertilization stocking feeding, will yield good fishing. Proper Cropping could be carried out in several ways of which the following methods are suitable for commercial pond fish culture:

- (i) Use of Gill Nets: This method allows for selection of marketable size of fish as dictated by mesh-size of the net, thereby controlling fish population in the pond;
- (ii) Use of Seine Net: Total harvesting could be effected by this method, and the pond is emptied for preparation.
- (iii) Use of Catching Pond: This is the cheapest method fish are made to gather in the catching pond, and are netted out.
- (iv) Use of Gravity: The method of draining the pond, is suitable for brackish water fish ponds - water is let out of the pond at low ebb-tide by gravity and fishes are easily harvested.

Marketing and Distribution of Pond Fish

Pond fish marketing comprises of all business activities carried out in conveying fish from the source of production to the area of consumption, i.e. from the producer to consumer.

A well established Commercial Pond Fish Culture Project should have adequate facilities for handling, processing, storing, and transportation of fish. Marketing and Distribution system of the project should be well organised to avoid all complications; such as engaging the services of distributors with in-adequate finances and equipment.

In recent years, to be precise, 1975 - 85 price of pond fish has exalated very high, caused by the correspondingly astronomical increase in the cost of capital investment in fish pond construction e.g. Price of 1 kg of pond fish from ₦1 to ₦5.00 at source of production and cost of construction, 1 cub meter of earth movement from ₦2.00 to ₦4.00 used in building fish pond for production of pond fish.

Economics of Pond Fish Culture (Input and Output):

The Economics of managing a modern Commercial Pond Fish Culture Project, can be illustrated with conservative Estimates of 10 - Hectare commercial Fish Farm, Constructed in the freshwater swamps of the Rivers State:-

Economics of Operation Estimates:

10 - HECTARE COMMERCIAL POND FISH CULTURE PROJECT

A. CAPITAL EXPENDITURE

Construction of Commercial Fish Farm for Pond Fish Culture:-

BILL OF QUANTITIES

10 - Hectare Fish Ponds

BILL NO. 1

EARTH - WORK: SITE CLEARING, DIKE CANAL AND POND CONSTRUCTION

<u>Item</u>	<u>Description</u>	<u>QTY</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
1-1	<u>Land Clearing</u> Clearing bushes, grasses other vegetation felling all trees, stumping, up-rooting total roots grubbing. Burning cleared materials or deposit where directed	11	Ha.	2000.00	22,000.00

Item	Description	QTY	Unit	Rate	Total
1-2	Perimeter Feeder Canal Dike	10,000	M3	₱3.50	
1-3	" Dike	7,500	M3	₱3.50	
1-4	" Drainage Canal Dike	1,500	M3	₱3.50	
1-5	Secondary Drainage Canal Dike	4,000	M3	₱3.50	
1-66	Secondary Dike Provide, spread, shape and compact soil, layers of 0.15m earthfill at sub- base (total of times 1-2 to 1-6	6,000	M3	₱3.50	
		29,000	M3	₱3.50	101,500.00
1-7	Trench and Canal (Excavation)	1,000	M3	₱1.00	1,000.00
1-8	Inlet/Outlet Water Channel (Exca. disposal)	2,000	M3	₱2.00	<u>4,000.00</u>
1-9	BILL NO 1 GRAND TOTAL				<u>128,500.00</u> =====
BILL NO 2					
CIVIL WORK: FOUNDATION STRUCTURE MONK, TOWER					
2-1	MONKS, TOWERS <u>Foundation</u>	160	M3	₱2.00	320.00
	A Excavation	160	M3	₱2.00	320.00
	B Backfill: Backfilling by layers of 150mm compacted at each layer up to required elevation	56	M3	₱2.00	112.00
	C Hardcore: 150mm thick under monk slabs and cut off walls	200	M2	10.00	2,000.00
	D Blending 100mm thick concrete 1:2:4 aggregate min diam. 19mm	200	M2	25.00	5,000.00
<u>Structure:</u>					
	A In-situ concrete 1.2 aggregate min diam 19mm	100	M3	150.00	15,000.00
	B Mild steel Re-inforcement rods	2,500	kg	1.50	3,750.00
	C Sawn Form Work	700	M2	12.00	8,400.00
	D Asbestos pipes jointed with cement mortar (1.4) Inlet pipes 30cm. diam	10	Set	200.00	2,000.00
	E Reinforced concrete culvert 450mm X 1000mm	10	Set	250.00	<u>2,500.00</u>
	BILL NO. 2 GRAND TOTAL				<u>39,082.00</u> =====

Item	Description	QTY	Unit	Rate	Total
	BILL NO 3				
	Construction of Infrastrure, provision of facilities and equipment				<u>32,418.00</u>
	Hence Capital Expenditure:				
	GRAND TOTAL BILL NO. 1 & BILL NO. 2 + BILL NO. 3				<u>200,000.00</u>

B. RECURRENT EXPENDITURE PER ANNUM

(i)	Fish Fry/Fingerlings collection and/or purchase and stocking 100,000 at 10 kobo				10,000.00
(ii)	Cost of Agric Lime and fertilizers: 25 metric tonnes at ₦200/ton average				5,000.00
(iii)	Salaries and Wages at ₦835.00/month				10,000.00
(iv)	Transport, maintenance & incidental expenses				5,000.00
(v)	Cost of supplementary feeds or feed ingredients 20 tonnes at ₦500.00				<u>10,000.00</u>
					<u>40,000.00</u>
					=====

C. ESTIMATED REVENUE PER ANNUM

	Pond fish production from 8 hectares production ponds at 3 ton/ha./annum				24 tonnes
	Sale of pond fish, 24 metric tonnes (24,000 kgs) at average rate of ₦4.00/kg				<u>96,000.00</u>

N.B: For Intensive cultivation, 4 - 5 ton/ha./An. could be achieved.

DISCUSSION

It was the demand for increased fish production that directed the Nigerian Government's attention to the potentialities of the natural resources. The objective was to increase fish production through Aquaculture (including pond fish culture). This necessitated the commissioning of several feasibility studies that aimed at increasing fish production through the development of fish culture and fish farming in the Country.

Results of the studies proved that fish culture was feasible in Nigeria, and that increased fish production could be achieved by the construction of water-tight fish ponds, and subsequent culture of fish in the ponds to produce pond fish. Consequently, modern fish ponds were constructed and pond fish culture at subsistence/small scale levels were established successfully;

Commercial Pond Fish Culture is comparatively new in Nigeria because the level of production is gradually, developing into commercial ventures. It is interesting to note that recently, both public and private sectors are increasing their investments in this lucrative business especially now that the era of the "Oil Boom" is over!

It would pay a lot of dividend if this trend of development continues, so as to counter the serious shortfall in domestic fish production. There is still much to be done. In order to achieve this goal, perhaps in the next two decades, it would be absolutely necessary to adopt the lines of action stated hereunder:

Federal and State Governments as well as Commercial Establishments and Cooperative Societies, should pursue vigorously the establishment of large-scale fish farms which could be commercialised.

Federal Department of Fisheries, State Governments and River Basin Authorities should set up demonstration Commercial Fish Farms, hatcheries, seed-multiplication centers, fish feed mill, for servicing community fish farms to be operated on commercial basis.

Following the practice in Asian Countries, River Basin Authorities should construct small-scale and large scale fish farms, and hire them out or sell them on subsidized rates to interested individuals. Communities or Companies for pond fish production.

Basin Authorities, Rural Development Authorities and State Governments should establish Community Commercial Fish Farms in each local Government Area. The local people should be trained in simple pond construction, operation and management.

Universities, Polytechnics, Fisheries Institutions, Fisheries Societies, should increase their training facilities for aquaculture research and extension personnel; so that commercial pond fish culture projects would be adequately staffed and research results readily available for the industry. Also Nigerians should take advantage of the Post-Graduate Aquaculture Courses offered at the NIOMR/ARAC of FAO/UN, ALUU, PORT HARCOURT.

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REFERENCES

PIILAY, T.V.R. (1965) Investigation of the Possibilities of Brackish-water fish culture in the Niger Delta.

De Los SANTOS C.J. Jr. (1978) Modern Aquaculture for the Philippines.

SIVALINGAM, S. (1974) A Guide to the Construction of Fish Ponds. Federal Fisheries Occasional Paper No. 20.

WOKOMA, S.A., AND EZENWA, B.I. (1982) Construction of Fish Ponds in the Mangrove Swamps of the Niger Delta NIOMR Technical Paper No. 9.

ASIAPHIL FISHERIES CORP. MANILA, PHILIPPINES (1979) A Pre-Feasibility Study of Brackish water and Fresh water Fish Farming in Nigeria - Report to Federal Government of Nigeria.

FISESCO/ASIAPHIL (1984) Full Feasibility Studies of Three Fish Farm Projects of 500 Hectares each. Final Report to Federal Government of Nigeria. (Fisheries Services & Equipment Supply Company Limited). Asiaphil/Fisheries Corporation Manila, Philippines).

UNIVERSITY OF PORT HARCOURT (1985) The Mangrove Ecosystem of the Niger Delta Proceedings/of a Workshop.