AQUACULTURE IN NIGERIA

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1. INTRODUCTION

The concept of fish farming is recent in Nigeria. With the establishment of Government pilot schemes, and an extension service in many states of the country, the practice is receiving more attention. At present, about 12.5 million ha of water surface area are being utilised for different types of culture in Nigeria. There is approximately 1 million ha of mangrove swamps in the coastal areas, of which a large proportion could be developed into brackish water systems.

Olayide *et al* (1973) have reported the average protein intake in Nigeria as 63.24 g/Caput/day. This is below the FAO estimated minimum requirement of 70g/Caput/day, of which 35g/Caput/day should be of animal origin.

The amount of fresh and frozen fish in the diet of Nigerians is increasing, particularly with the reduction of the cattle populations in the Sahelian region - the traditional source of animal protein in Nigeria (Mabawonku 1980), due to the effects of drought. Similarly, Awachie (1974) reported that fish consumption accounts for over 40% of animal protein in Nigerian diets.

According to the National Fisheries Development Committee (NFDC) report (1982), the effective demand for fish in Nigeria as estimated for 1980 was 1.5 million metric tonnes with a projected increase above 2.3 million metric tonnes by 1985. However the current effective annual total fish supply in the country was 800,000 tonnes in the same year, out of which 510,000 tonnes was produced locally. The balance of 300,000 tonnes was supplied from fish imports, in forms of frozen, canned and stockfish. In view of the large deficit in fish supply, there appears therefore an urgent need to increase the intensification of fish production in Nigeria.

With the reduction in catch from inshore fisheries due to over-exploitation of most commercial marine species and the increased costs of offshore fishing, the development of aquaculture would be a logical and effective method of boosting domestic fish production in Nigeria.

According to Pillay (1968), the coastal areas of Nigeria comprise of brackish water mangrove swamps; and approximately 1 million ha of these swampland is available in the Delta regions for large scale brackish water fish culture. The potentials for aquacultural development in such areas become enormous, and may be used to increase natural fish production through fish farming as practised in the Asian countries where two-thirds of the world's fish production is recorded (Wokoma and Ezenwa 1982).

Unlike the crop production subsector of agriculture, the fishing industry has expanded rapidly over the last two decades, particularly the domestic fish production. (Waniboko 1982). It was observed that between 1964 and 1979 there was an approximate ten-fold rise in fish production from 58,000 tonnes in Nigeria, while the domestic supply has increased from 20% to 70% of total; with a future prospect of further expansion through aquaculture.

This review therefore attempts to highlight the enormous scope for large scale development of fresh and brackish water fish farming, particularly in land-locked States in the villages where land is more readily available in Nigeria.

2. PRESENT LEVEL OF AQUACULTURE DEVELOPMENT

Although FAO (1957) reported that fish culture has been in operation in tropical Africa since 1924, in Kenya where trials with *Tilapia spp* were carried out, the practices of modern aquaculture is still a new concept in Nigeria.

However, the construction of the Panyam fish farm for 'Tilapia' production in 1944 marked the inception of fish culture in Nigeria (NFDC 1979). Demonstration fish ponds and commercial fish farms have been established over two decades ago, during which a series of government pilot schemes were set up from 1950, to raise local fish species in Okigwe, Ibadan and Ikoyi, Lagos. (1971). After the nationwide campaign of 'grow your own fish' in 1964 there seem to have been a remarkable increase in the number of fish farms in the country, notably: government fish farms at Baguda (Kano State), Funtua (Kaduna State), Etinam (Cross River State) and Benin (Bendel State). Community-owned fish farms were also sited at Onitsha, Ijebu-Ode, Oyo and Sokoto for extensive culture of *Tilapia spp, Clarias spp, Chrysichthys spp* and Cyprinus carpio.

However, recent estimates by Dada (1975) show that there are more than 2,000 fish ponds occupying a total area of over 1,000 hectares, situated all over the country.

A few hatchery and breeding centres have also been developed by some States' Fisheries Division and private farmers for accelerated fingerling production.

Aquaculture is just gaining prominence in Nigeria. Presently, its level of development and rate of growth is rather slow. Out of about 0.8 million ha of swampland in the six coastal States – Ondo, Ogun, Bendel, Lagos, Rivers and Cross Rivers; only about 27 ha (0.003%) is being utilised for fish farming. (Ajana 1980). The slow growth of aquacultural practices in Nigeria could be attributed to the basic problems of poor knowledge of the biology of local fish species and their culture. In addition there has been a lack of capital to set up fish farm projects.

Grover *et al* (1980) reported that aquaculture could succeed in Nigeria in view of the existing biological potentials; while Afinowi (1975) revealed that a total of 1,521,000 ha of water surface area was available for aquacultural development. Also PRC (1982) estimated a yield of between 3.5 t/ha/yr from fish farms, in Nigeria. From this estimate it would therefore be possible to obtain a potential fish production of up to 4.5 million metric tonnes from the total water surface area if effectively utilised for aquaculture.

3. AQUACULTURE FACILITIES

Ajayi and Talabi (1984) found that of the estimated total area of perennial water swamps and brackish water available in Nigeria, a considerable proportion of these possess desirable characteristics for aquaculture in terms of water supply, soil type, topography, access, tides etc.

A survey of inland waters in Nigeria revealed that aquaculture is practiced in various holding facilities such as ponds, lakes, reservoirs, river barrages and flood plains, with a total water surface area of about 12.5 million ha and a potential yield of 2.3 million metric tonnes per year (Table 1 and Table 2).

4. FISH PONDS

Modern aquaculture development in Nigeria is geared towards the use of earthen ponds for fish culture. The ponds are constructed with one to four-diked impoundments holding water at average depths of 1.5m to 2m; and are of two major types.

The first type of ponds are water-shed or single-dike barrage ponds constructed on the lower part of a valley where only one wall is built across the stream.

The second type are contour ponds with quadruple-dikes constructed on even surface land. The excavated soil is used to build the embankments for holding water. Sources of water supply to these ponds are basically from surface run-offs, pumping of water and tidal flow, controlled by means of monks and sluices.

A total of about 2000 fish ponds have been recorded in Nigeria, with an estimated surface area of 5,416 ha capable of producing up to 11,000 t/yr. (Afinowi 1975; Ita and Sado 1983).

Similarly, the Federal Department of Fisheries is developing 50 ha of fish farm at Tiga (Kano State), while there are some modern fish farms located at Oluponna (Oyo State); Ikene (Ogun State); Makurdi (Borno State); Wuya (Niger State) and Umuna Okigwe (Imo State) to enhance fish production through aquaculture. Each of the farms is estimated to have a capacity to produce about 2.5t/ha/yr. (NFDC 1982).

5. FISH CULTURE SYSTEMS

Recent studies reveal that the major established government pilot schemes in Nigeria such as the Pamyam fish farm, Agodi fish farm, Ikoyi fish farms (NIOMR) and Okigwe fish farms are mostly contour ponds.

However, most community and private-owned fish farms are of the barrage pond type often integrated with other forms of agricultural production. A few private fish farms have been equipped with modern recirculation systems operated under intensive farming conditions.

Although aquaculture appears to be an outstanding way of increasing fish production, particularly where harvest from the wild is limited; the amount of fish yield would depend on the degree of control exerted over the culture environment. Three major types of fish culture systems are distinguished in Nigeria presently:

(a) Extensive fish culture
(b) Semi-intensive fish culture
(c) Intensive fish culture

The extensive method of fish farming involves little or no control over the culture environment and the fish obtain all their food from the natural habitat as typified by the Ilesha Government fish farm in Oyo State, the Government fish farm at Okuo in Bendel State and private fish farms under integrated agricultural schemes. While the extensive fish farms may occupy more land, fish production in relation to the pond size is always low.

The semi-intensive method of fish culture as practised in Nigeria entails low level of supplemental feeding often with fertilisation of the ponds in addition to food from natural sources.

Fish culture systems utilising little space and water with high stocking density are managed intensively with regular adequate supply of supplementary feeds. A typical intensively managed fish farm in Bendel State has a production capacity for 5,600 tonnes/ha/year, where the stocked fish depend solely on artificial feeding. However the desirability of more economic use of water, together with a requirement for more environmental control has increasingly tended towards a more careful use of water. The intensive fish culture using a re-circulated water system tends to solve the problem of fish culture where water becomes a limiting factor.

In enhancing the development of aquacultural practice in Nigeria, a model fish farm comprising of five ponds with sizes ranging from 0.04 ha to 0.08 ha was constructed by the Department of Wildlife and Fisheries Management, University of Ibadan for training and research within the framework of a commercial enterprise.

Similarly Dada (1975), reported that there are few hatcheries and breeding centres in Nigeria for rearing fish seeds which are distributed to Government and private fish ponds at subsidised rates. Although indoor tanks are available, they are mostly used for research purposes.

6. FISH SPECIES USED FOR AQUACULTURE

Fish species for aquaculture are selected on the basis of their good performance under controlled conditions. Both indigenous and proven exotic species have been used for culture in Nigeria. (Table 3).

7. FISH FEED DEVELOPMENT

Although aquaculture is fast developing in Nigeria, the yields obtained from fish farms are still low. The low yield has been attributed to inadequate supply of balanced fish diets. At the moment, only a few institutions are engaged in fish feed manufacturing in the country, and it is still not possible to meet large scale demand for feeds.

However there is a large potential of feed ingredients from local plant and animal sources which are capable of supplying the nutritive requirements of fish.

Nutrition experiments on the production of balanced rations to meet the quantitative requirements of indigenous fish species are in progress in some research institutes and universities.

8. CONCLUSION

As demonstrated by the government's emphasis on forestry and crop production programmes in educational institutions, aquacultural practices should be intensified throughout all stages of educational curricula in the country. Fisheries research institutions should intensify their efforts in solving problems associated with local aquaculture production. Such problems to be looked into include those of fry production, fish feed requirements, feed formulation from local ingredients and the management practices required for economic rearing of desired fish species.

At community level, prospective fish farmers will benefit from research findings from the aquaculture industry if adequate information is made available through government extension agents. Similarly, the bank guidelines for obtaining loans to meet the initial capital requirement for establishing and developing a viable fish farm should be widely circulated. The role of extension services in creating a 'national' fish farming industry in Nigeria therefore becomes invaluable.

TABLE 1

ESTIMATES OF POTENTIAL FISH YIELD FROM ALL AVAILABLE INLAND WATER RESOURCES

Types of Water Body	*Estimated Surface Area (ha)*	*Expected Yield per ha (per year)*	*Potential annual Yield per ha (*Mt/year)*
Reservoirs			
(a) Large reservoirs	250,387.0	60 kg	15,023.22
(b) Small reservoirs	25,146.91	100 kg	2,514.79
			17,538.79
Rivers			
(a) Flood ponds	1,650.0	100 kg	165.0
(b) Main course	10,812,410.18	20 kg	2,164,316.20
(c) Flood plain	515,000.0	50 kg	25,750.0
(d) Stagnant pools of seasonal rivers	200,000.0	20 kg	4,000.0
			2,194,231.20
Major lakes	677,000.0	100 kg	67,700.0
Fish ponds	5,476.06	2000 kg	10,952.12
Miscellaneous Waterbodies			
(a) Cattle ponds	638.50	100 kg	63.85
(b) Burrow pits	2.0	100 kg	0.20
(c) Mining paddocks	106.0	100 kg	10.60
			74.65
TOTAL YIELD	12,487,817.65		2,290,495.98

N.B. *Mt/year = Metric tonnes per year
source: Ita & Sado (1983)

TABLE 2

WATER SURFACE AREA OF FISH PONDS AND FLOOD/CATTLE PONDS IN THE NINETEEN STATES OF NIGERIA IN DISCENDING ORDER OF MAGNITUDE (WITH EMPHASIS ON EXISTING FISH PONDS)

States	*FISHPONDS*			*Flood/Cattle ponds (ha)*	*Total Water Surface (ha)*
	Existing (ha)	*Proposed (ha)*	*Under constuction*		
Plateau	471.0	Nil	Nil		471.0
Oyo	448.58	33.0	Nil		295.40
Sokoto	195.40	100.0	Nil		295.40
Bendel	130.0	247.0	15.0		392.40
Imo	123.27	1.50	10.22		131.99
Kano	94.21	Nil	Nil	63.0	157.21
Benue	87.50	600.0	200.0		887.50
Ondo	84.19	549.96	2.06		636.21
Rivers	61.91	1029.25	499.58		1587.74
Anambra	55.66	Nil	Nil	1650.0	1705.66
Cross River	51.40	9.30	20.0		80.70
Ogun	48.15	39.0	46.0		133.15
Borno	24.70	Nil	Nil		24.70
Kwara	22.09	8.50	3.50		34.09
Bauchi	15.0	Nil	Nil	15.50	30.50
Kaduna	14.0	Nil	Nil	560.0	574.0
Lagos	13.43	10.0	Nil		23.43
Niger	4.70	70.0	40.0		114.70
Gongola	Nil	Nil	Nil		Nil
TOTAL	1,945.19	2,697.51	836.36	2,288.50	7,761.56

Source: Ita & Sado (1983)

TABLE 3

SOME CHARACTERISTICS OF ACCEPTABLE SPECIES IN NIGERIA

Species	*Acceptability by consumers*	*Seed availability*	*Feeding Habits*	*Salinity tolerance*	*Remarks*
Tilapia spp. *T. nilotica* *T. galilea*	Fair	Throughout all seasons.	Phytoplankton algae, detritus. Accepts supplementary feeds.	0-26%	Tolerant to wide ranges of temperature and salinity. Problem of prolific breeding.
**Chrysichthys spp.*	Very good	All seasons but obtained from wild sources and inadequate.	Mostly bivalves. Accepts supplementary feeds.	0-26%	Hardy and thrives well under polyculture with *Tilapia spp.* and *Mugil spp.*
**Clarias spp.*	Very good	All year round from the wild and artificial breeding but inadequate.	Worms and detritus. Accepts supplementary feeds.	0-10%	Very hardy. Tolerates muddy water. Recommended for polyculture with *Tilapia spp.*
**Mugil spp.*	Good	Throughout the year, obtained from wild sources.	Phytoplankton, algae, detritus.	0-35%	Performs well in brackish water. Trials in fresh water under way.
**Heteritis niloticus*	Fair	Seasonal (rainy season). Inadequate.	Phytoplankton and Zooplankton.	Fresh water only.	Fast growing; small sizes preferred.
**Macrobrachium spp.*	Very good	Seasonal wild sources and breeding programmes.	Detritus	0-10%	Abundantly distributed in certain areas.
**Cyprinus carpio* (Exotic)	Very good	Through artificial breeding. Inadequate.	Omnivore, and readily accepts supplementary rations.	Fresh water	Performs well in fertilized ponds, highly supplemented with feeds.

* Studies underway on their Biology and performance under culture conditions

Source: Ezenwa 1979

TABLE 4

ANNUAL COST AND RETURNS FOR A ONE HECTARE FISH FARM UNDER POLYCULTURE

Ground Area : 1.5 ha
Product Area : 1.0 ha

Capital Cost

	₦	K	S	2
Land at ₦900/ha	1350	00	1755	00
Survey at ₦500/ha	500	00	650	00
Clearing at ₦600/ha	600	00	780	00
Construction equipment	400	00	520	00
Labour for Excavation and Embankment	4000	00	5200	00
Shed	1600	00	2080	00
Nets	950	00	1235	00
Contingencies	300	00	390	00
Total Capital Cost	9700	00	12610	00
1. *Expenditure* Interest at 9% per annum and depreciation at 10% per annum for ₦9700.00 ($12,610.00)	1843	00	2395	90
2. *Operating Cost*				
Fingerlings (including transportation)				
– Tilapia 1000 fingerlings at 25k each	250	00	325	00
- Carp (*Cyprinus* sp) 5000 fingerlings at 50k each	2500	00	3250	00
– Catfish/Mullet 5000 fingerlings at 50k each	2500	00	3250	00
Fertilizer (N:P:K) applied at 30kg/ha/month for 10 months	60	00	78	00
Lime	32	00	41	60
Feed for 320 days – 2 tons at ₦1200/ton	2400	00	3120	00
Labour at ₦216/month for 12 months	2592	00	3369	60
Contingencies	346	00	449	80
Total	12523	00	16279	90

Returns	₦	K	$	
Tilapia 520kg/ha/year at N3.00/kg	1,560	00	2,028	00
Carp 2500 kg/ha/year at N4.00/kg	10,000	00	13,000	00
Catfish/Mullet 1800kg/ha/year at N4.00/kg	7,200	00	9,360	00
Total Revenue	18,760	00	24,388	00

Profit

₦18,760 – 12,523.00 = ₦6,237.00

$24,388 – 16,279.90 = $8,108.10

Rate of Return on Operating Cost = 49.8%

Currency Conversion: ₦1 = $1.3

Source: from Survey 1983

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