



Fisheries and Aquaculture Development in Nigeria: The Challenges and Possibilities.



23rd **Public Lecture**

of the Federal University of Technology,
Owerri (FUTO), Imo State.

Delivered on **Friday, 27th May, 2011**

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**"FISHERIES AND AQUACULTURE DEVELOPMENT
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1.0 INTRODUCTION

I want to thank the Vice Chancellor Prof. COE Onwuliri for the invitation extended to me to come and talk about Fisheries and Aquaculture (F & A) Development in Nigeria Challenges and Possibilities. The field of Fisheries and Aquaculture is very dear to my heart as you will notice in the course of our interaction today. I salute many of our senior and emerging Nigerian scientists who have contributed to the growth of this area. Some of their names will be popping up in the course of this lecture.

Aquaculture is the art and science of managed rearing and grow-out of aquatic organisms under controlled conditions. The fisheries and aquaculture sector is crucial to food security, poverty alleviation, employment and general well being of rural and urban communities. It has been reported that by 2008 over 45 million people were directly engaged in the sector and support the livelihoods of about 540 million people or 8% of the world population.

Aquaculture employs many different strategies to achieve the final goal of producing marketable farm-raised seafood products. Extensive, semi-intensive, intensive and super-intensive farming methods are all being utilized today. Aquaculture techniques for many different species have been continually refined over the last fifteen to twenty years.

1.1 Global Perspectives

The world fisheries and aquaculture sector is under the vagaries of the current economic crises, food price volatility, global warming caused by Carbon dioxide and green house effects. In 2000, reported total aquaculture production (including aquatic plants) was 45.7 million tons by weight and US\$56.5 billion by value. China was reported to have produced 71 percent of the total volume and 49.8 percent of the total value of aquaculture production. More than half of the total world aquaculture production in 2000 was finfish, and the growth of the major species groups continues to be rapid with no apparent

slowdown in production to date. (FAO Fisheries and Aquaculture Department 2010)

1.2 Statistics

Below are the statistics of the status of the world fisheries and aquaculture production as of 2008 (based on FAO 2010).

Top 10 Aquaculture Producers By Volume in 1994

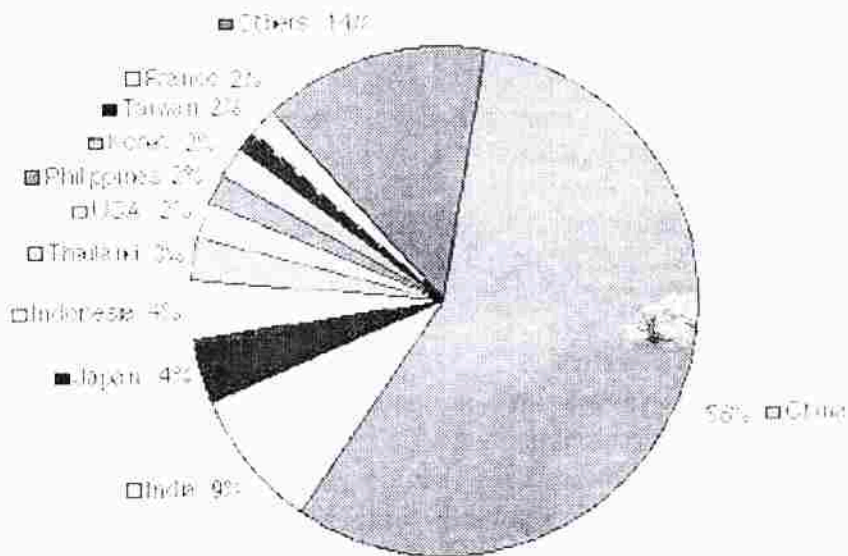


Fig. 1: Top 10 Aquaculture Producers by Volume in 1994 (FAO 2011)

Table 1. Shows 16 countries production by volume including Nigeria

Country	Capture Fisheries	Aquaculture	Total
1. Bangladesh (4%)	1557754	1005542	2563296
2. Cameroon	138000	340	138340
3. Chad	40000	0	40000
4. China (71%)	14791163	32735944	47527107
5. Congo Dem Rep.	236000	2970	238970
6. Egypt (2%)	373815	693815	1067630
7. Ghana	349831	5594	355425
8. India (11%)	4104877	3178690	7283567
9. Kenya	133286	4452	137738
10. Niger	29960	40	30000
11. NIGERIA (1%)	511368	113207	681575
12. South Africa (1%)	643686	3215	646901
13. Togo	2141	1	2142
14. Uganda	450000	52250	502250
15. UK (1%)	596004	179187	775191
16. USA (7%)	1319853	500111	1819967

Global Fisheries & Aquaculture Production

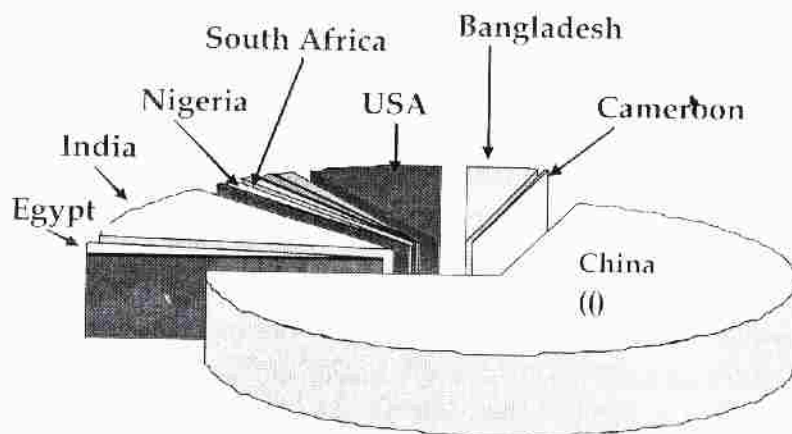


Fig. 2 Global Fisheries & Aquaculture Production (selected countries)

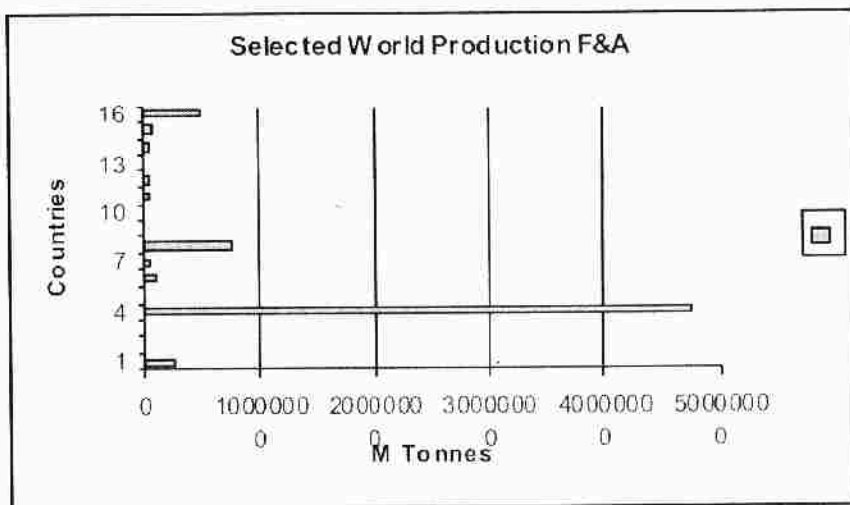


Fig. 3 Global Fisheries & Aquaculture Production

2. HISTORY OF MODERN SCIENTIFIC AQUACULTURE IN NIGERIA

The history of modern scientific aquaculture in Nigeria dates back to the colonial times in the early 1950s. In 1953, the British colonial Government of Nigeria initiated a feasibility/viability study on the construction of modern freshwater ponds for fish culture. The study team was led by a fisheries expert Dr. K.K. Zwilling and assisted by a Nigerian forerunner in fish culture' Mr. S.A. Wokoma.

Following the above study, the first modern scientific fish culture complex was constructed in 1954 at Panyam some 80km southeast of Jos in the then Middle Belt region of the country and the present state capital of Plateau State. The fish farms were used as demonstration farms, for experiments, as pilot fish

farms, for training and fish production. Other freshwater fish ponds were constructed by the government at other locations: Maska dam/fish farms near Zaria now in Kaduna state, Agodi farms in Ibadan in Oyo state and Umuna fish farms in Okigwe in Imo state (Wokoma 1987).

The post independence government of Nigeria, with the aid of the Food and Agriculture Organization of the United Nations, introduced brackish water aquaculture. By 1966, some pilot experimental brackish water fish farms had been constructed by the government in the coastal zones especially in the Port Harcourt areas. The Nigerian civil war (1967-1970) disrupted most government projects in freshwater and brackish water aquaculture. However, since the end of the war many more such farms have been established including privately owned fish farms.

2.1 Nigeria's Water Resources

Nigeria has abundant water resources suitable for the development of aquaculture. On the Atlantic coast of West Africa, Nigeria has an extensive coastline about 960 km (800mi.) extending from Ogun state to the Cross River state, over 12.5 million hectares of inland water mass (Ita, 1993, Table 1) and over 1.5 million hectares (West, 1982) of brackish water available for fisheries resource development.

Table 2: Summary of water surface area of lakes, reservoirs, ponds, and major rivers in Nigeria (After Ita et al; 1985).

<u>Water Body</u>	<u>Hectares</u>
Lake Chad (Nigerian sector)	550,000.0
Kainji Lake	127,000.0
Anambra River	1,401,000.0
Benue River	129,000.0
Cross River	3,900,000.0
Imo River	910,000.0
Kwa Iboe River	500,000.0
Niger River (Less Kainji and Jebba Lakes)	169,810.18
Ogun River	2,237,000.0
Oshun River	1,565,400.0
Fish ponds	5,476.06
Flood ponds	1,650.0
Cattle ponds	638.50
Stagnant pools of non-perennial Rivers	200,000.0
Reservoirs	275,534.91
Floodplains	515,000.0
Burrow pits	2.0
Mining paddocks	106.0
TOTAL	12,487,817.65

A number of man-made lakes are lumped as reservoirs, but the details are available (FAO 2001) Appendix 1

In spite of the abundant water resources with which Nigeria is blessed, the protein production from traditional husbandry is far below the demand. The projected population of Nigeria from available data stands at over 140 million in the year 2000 and nearly 154.7 million in 2011 FAO (2011) (see Table 2 and Fig 1 showing some topographical features of the country.



Fig 4. Map of Nigeria showing the main topography of the country

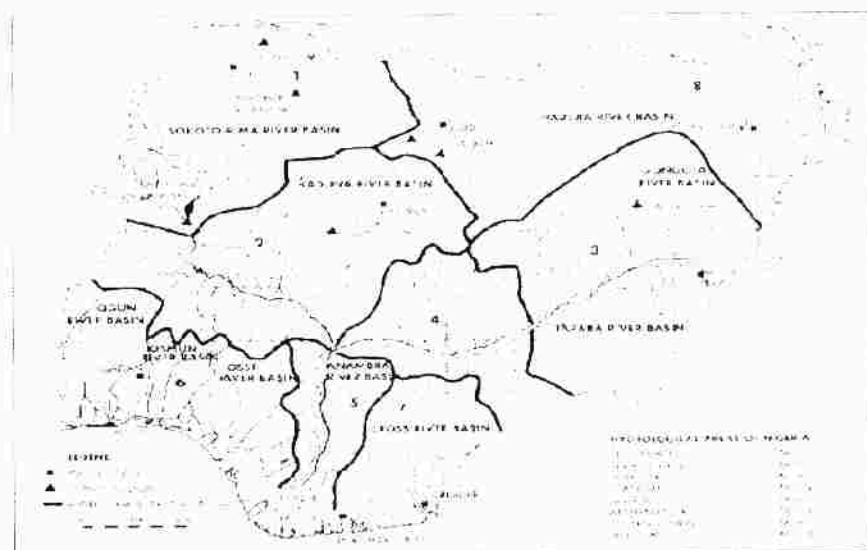


Fig 4b. Map of Nigeria showing the main hydrological areas of the Nigeria (FAO 2011)

Table 3. Projected fish demand and human population for Nigeria, 1980-2000

Year	Projected human population (Million)	Projected per capita consumption	Projected fish demand (Million tonnes)
1980	84.732	9.29	0.787
1981	86.897	9.55	0.830
1982	89.118	9.81	0.874
1983	91.39	10.07	0.920
1984	93.732	10.33	0.968
1985	96.128	10.59	1.018
1986	98.586	10.85	1.070
1987	101.107	11.11	1.123
1988	103.693	11.37	1.179
1989	106.345	11.63	1.237
1990	109.067	11.89	1.297
1991	111.858	12.15	1.359
1992	114.720	12.41	1.424
1993	117.657	12.67	1.491
1994	120.669	12.93	1.560
1995	123.759	13.19	1.632
1996	126.929	13.45	1.707
1997	130.180	13.71	1.785
1998	133.516	13.97	1.865
1999	136.933	14.23	1.949
2000	140.446	14.49	2.035
2011	154.700	—	2.230

Source: Mid-year population projections, 1963-2000, National Population Bureau, Demographic Division, Lagos.

2.2 The Nigerian Fisheries

The aquaculture sector has been proposed to be an important component of the Nigerian Fisheries since the operational cost

of capture fisheries is prohibitive with the present depressed economy in Nigeria. An increase in the demand of fish for protein became more obvious after the Sahelian drought of 1971 to 1974. The drought caused a major depletion of the Lake Chad fisheries that heavily supported the people of that region and beyond. The Lake Chad fisheries experienced a classical “boom and bust” scenario. The Lake Chad fishery, production increased from 15,000t (1960) up to 220,000 t (1974), and has now dropped to 52,000 t (1997). The initial increase in production can be attributed to an increase in fishing intensity. The Sahel drought of the 1970s and 1980s reduced the size of the lake and concentrated stocks, making them easier to catch. The drought also eventually reduced the fish carrying capacity of the region and in combination with continued intensive fishing has led to a fall in fisheries production. Neiland et al 2002.

Nigerians have a huge appetite for fish, with current consumption standing at 1.2 million metric tons. Of the current annual demand of 1.5 million metric tons, the country only produces 511,000 metric tons, leaving an annual deficit of about a million metric tons, which the country imports annually to meet domestic consumption needs.

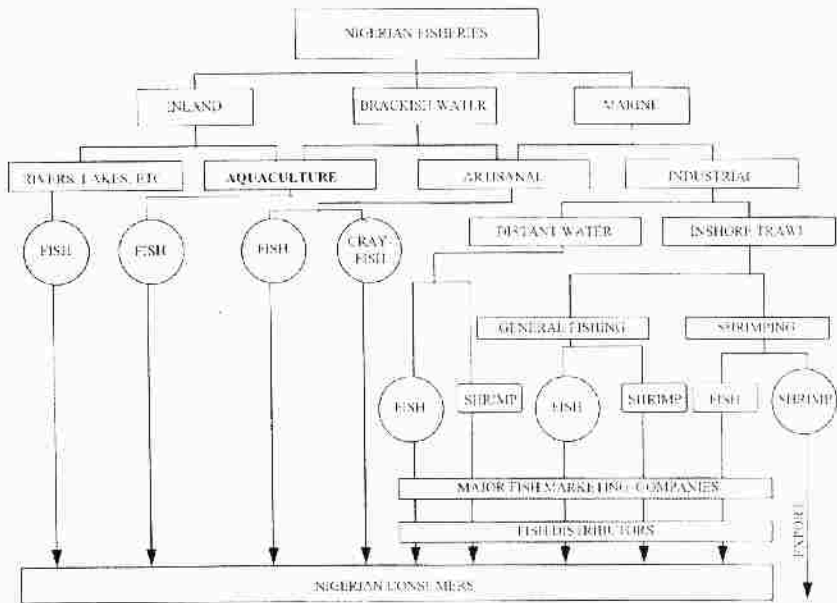


Fig. 5: Structure of the Nigerian Fisheries (After B.S. Moses 1983)

The sole dependence on capture fisheries to provide the bulk of fish consumed was no longer viable because of over fishing and the use of obnoxious fishing methods.

Most of the fish supplies in Nigeria are those caught by artisanal fishermen within the exclusive economic zone (EEZ). The aquaculture sector accounts for less than 10% of the total fish production (see the structure of Nigerian Fisheries Fig. 4, Moses, 1983). The development of aquaculture in Nigeria, particularly since the civil war (1970) is surveyed. The trend followed is more on the contribution of the various governments, their establishments as tools of aquaculture development, the policies, problems, and recommendations.

3. ESTABLISHMENTS AS TOOLS OF AQUACULTURE DEVELOPMENT:

Various governments since Nigerian independence (1960) had consistently and consciously worked towards fisheries development as is evidenced by the numerous establishments and polices which are described below.

3.1 The Nigerian Institute of Oceanography and Marine Research (NIOMR) Victoria Island, Lagos.

NIOMR was established in November 1975 from the Research division of the present Federal Department of Fisheries and given the mandate to conduct research into the resources and physical characteristics of the Nigerian territorial waters and the high seas and beyond.

The breakdown of their function includes research into the following:

1. The abundance, distribution and other biological characteristics of fishes and other marine forms of life and practical methods of their rational exploitation and utilization.
2. The socio-economic problems of exploiting the resources of the sea and brackish waters.
3. The effects of pollution on Nigerian coastal waters and its prevention.
4. The improvement of brackish water fishing and aquaculture (Federal Ministry of Education, Science and Technology 1985).

3.2 Federal Fisheries Departments

The Federal Department of Fisheries was established in 1976 to carry out the following functions: fisheries planning, statistics and data collection, implementation of fisheries

development programs, enforcement of fishing regulations, licensing of fishing vessels and national coordination of fisheries development. The Federal Department of Fisheries has offices in all then thirty-one States.

3.3 Federal Fisheries Schools

Federal Fisheries Schools were established in NIOMR and New Bussa in 1969. These schools are involved in manpower training in marine and freshwater fisheries.

3.4 Kainji Lake Research Institute (KLRI) National Institute for Freshwater Fisheries Research (NIFFR)

The Kainji Lake Research Institute was established in 1975 under the Agricultural Research Council of Nigeria. It is the largest and premier man-made lake in Nigeria. The Institute is charged with the responsibility for research into other man-made lakes in the country. The different facets of the research will cover the following:

1. The limnological behavior and characteristics of the Kainji and other man-made lakes and their effects on the fish and other aquatic life.
2. The abundance, distribution and other biological characteristics of species of fish and practical methods of their rational exploitation in the said lakes and major rivers of Nigeria.
3. The public health problem arising from the construction of dams and the resettlement of people around them.

3.5. Lake Chad Research Institute (LCRI)

Established at the same time as the Kainji Lake Research

Institute with similar mandate - to carry out research in inland fisheries and freshwater fish culture.

3.6 River Basin Authorities

In 1976, eleven River Basin Development Authorities were established. Part of their responsibility was fisheries development.

3.7 Universities

Various Federal and State Universities have strong fishery based programs/Departments. For example the Federal Universities of Agriculture at Makurdi in Benue State and Abeokute in Ogun State have strong Fisheries based programs.

3.8 African Regional Aquaculture Center (ARAC)

The Food and Agriculture Organization of the United Nations in 1980 established this center in Port Harcourt, Rivers State. The objectives of the Center are to promote fisheries production for food and for export and to develop through research and training a sound technical base for the scientific growth of aquaculture. ARAC organized short courses and training from time to time for aquaculture personnel from various African countries. The University of Port Harcourt benefits from the use of ARAC facilities for their fisheries programs in the Zoology Department.

3.9 Operation Feed the Nation (OFN)

On May 21, 1976, the then Head of State, General Olusegun Obasanjo, launched Operation Feed the Nation (OFN). In his

speech, he observed a steady decline in agricultural production, government's importation of a variety of food items from abroad, the drifting of young men and women from rural areas to the cities. He also said that fishing nets and large quantities of pesticides would be provided for the purpose.

3.10. Green Revolution

The Green Revolution was inaugurated in April 1980 by the Shagari administration to boost agricultural production as well as ensure rural development. Fisheries were not singled out like any of the other facets of agriculture. The development of fisheries in the Green Revolution was an integral part of the total agricultural development.

3.11. Directorate of Foods, Roads and Rural Infrastructure (DFRRI)

DFRRI was established in 1986 under the administration of General Ibrahim Babangida. The DFRRI has concrete interest in Fisheries Development. In the aquaculture development program of DFRRI, the Directorate has sponsored a number of courses for Fisheries extension officers.

DFRRI has also inaugurated a committee with nation-wide experience in fish farming to write Aquaculture Extension Guides in

- i) Fish pond management.
- ii) Fish farming in cages.
- iii) Pond site selection and construction.
- iv) Water quality management and
- v) Fish feeds and their application in ponds.

Other groups that have Government funding for agriculture (part of which includes aquaculture) are the Agricultural Development Projects (ADP) The ADPs, represented in all the states, are currently in collaboration with the World Bank carrying out projects with the aim of bringing modern agricultural practices to the grassroots by the transfer of research findings through "on farm adaptive research". Aquaculture programs feature prominently in the ADP projects. Other programs include Mass Mobilization for Social and Economic and Reconstruction (MAMSER) Directorates for Employment and even Better Life for Rural Women. Some of these groups are involved in direct fish production.

4.0 NIGERIA'S FISHERIES POLICIES

Information so far available show that fisheries development has been an integral part of the various development plans of Nigeria. Most agricultural development programs have included fisheries development notably those of the Operation Feed the Nation, (1976), Green Revolution (1980) and DFRR 1988. The fishery policies as found in various development plans are basically the same. The objectives of the national fisheries policy, according to the Federal Ministry of Agriculture, Water Resources and Rural development (1988) are as follows:

1. The achievement of self-sufficiency in fish production within five years.
2. The development and modernization of the means of fish production, processing, storage and marketing by the adoption of improved technology and management practices.
3. The promotion of export trade in shrimps, crabs, oysters,

periwinkle and shark fins.

4. Improvement of the quality of life in fishing villages through the provision of fisheries infrastructure and basic utilities such as potable water, schools, electricity, health centers, roads and so on.

5. Provision and improvement of employment opportunities in the rural areas by engaging the rural population and school leavers gainfully in fisheries and ancillary functions.

6. The acceleration of research in all aspects of fisheries with a view to determining the potentials and parameters for development and management.

7. Consolidation and improvement in existing training programs designed for the development of the manpower required to help meet the fish production targets.

8. Promotion of fisheries curricula in the nation's institution of higher learning.

9. Ensuring the proper utilization of all agro-industrial by-products of crops and animal residues that are found to be suitable for culturable fish species.

10. Encouragement of private enterprises through training and provision of credit for the development and multiplication of various indigenous culturable fast-growing fish species for seed production.

11. Rapid development of aquaculture.

The above policy objective for fisheries, if implemented, will go

a long way into solving the problem of animal protein deficiency.

5. PROBLEMS OF FISHERIES DEVELOPMENT IN NIGERIA

The various problems inherent in the fisheries sub-sector over the years are as itemized below:

5.1 Non-implementation of government policies.

There is a gap between the planned and actual capital expenditure in the fisheries sub-sector and probably as in other sub sectors. There has been misplacement of investment with reference to fish farming which is expected to augment fish production alongside artisanal fisheries. Thus, in spite of the noble fishery policy for Nigeria, their implementation to the grassroots appears to be far from reality.

5.2 Financial bottlenecks.

Finance is required for the construction of ponds, purchase of fish seeds or fingerlings, and the proper management of facilities. Most fish farmers do not have initial capital to offset the cost of these inputs. The controlling and organizing of open access fishing in the high seas is very expensive business. Tables 3 and 4 show that the proportion of funds allocated to the fisheries sub-sector of agriculture was the lowest in the second, third and fourth development plans after the Nigerian civil war. Fisheries showed a decrease of 1% in the second plan period as compared to the first with an increase of 0.2 % in the third plan period. Overall 0.9 % decrease in total expenditure in agriculture in the fourth plan resulted in an unparalleled decrease of 2.0 % in fisheries allocation for the same period (Table 3).

A summary of planned capital expenditure of the agricultural sector in the 4th plan (1981- 85) by Federal, State and Local governments (Table 5) indicates that the livestock, forestry and fishery sub-sector appear as residual claimants in Federal capital allocations. Federal capital allocations hardly exceeded 6%, 1% and 2% of the total agricultural budget for livestock, forestry and fisheries sub-sectors respectively in recent years (Mijindadi, 1986). All available evidence shows that there is a gross neglect of the fishery sub-sector in terms of planned allocation by the various governments.

Table 4. Sectoral Allocation of Funds to Aquaculture (%) in the past four Development Plan periods, 1962-1985 Activity sub-sector.

	1962-68	1970-74	1975-80	1981-85
Crop production and farm mechanization	89.5	81.1	74.8	88.7
Forestry	3.1	5.3	5.0	2.90
Fisheries	5.4	4.4	4.6	2.6
Livestock & Veterinary	2.0	9.2	15.6	5.8
Total	100.0	100.0	100.0	100.0

Source: Federal Republic of Nigeria Development Plans, 1962-1985.

5.5 Labor problem.

Fish farmers can hardly employ extra hands for the purposes of expansion and intensification. Thus, they inevitably continue production at subsistence level instead of large-scale commercial production.

5.6 Inadequate Fisheries extension officers.

The fisheries extension officer/farmer ratio in Nigeria is well

below standard. Training institution for fisheries extension officers are certainly inadequate or not doing enough.

5.7 Management problem.

Most farmers engaged in fish production enterprise lack the skill required for modern fish production practices. They cannot understand the extension guides for fish production except through the fishery extension officers. They lack the ability to demonstrate profitability in fish production venture since the trend in modern aquaculture is scientific and not cultural.

Scientists need to demonstrate that fish production can yield profitable results. The results of what little research has been conducted have not been recognized. There are sufficient arrays of fish species, which have been found suitable as candidates for fish culture in Nigeria. (See table 5)

Table 5. Summary of Planned Capital Expenditure of the Aquaculture sector in the 4th plan by Federal, State and Local governments.

Subsector	Federal Gov.		State Government		Local Government	
	NMillion	%Total	NMillion	%Total	NMillion	%Total
*Field Crops	2,901.9	50.6	2,196.8	73.52	278.6	63.46
Irrigation	2,000.0	34.9	245.7	8.22	9.1	2.07
Livestock	252.8	4.4	310.5	10.39	108.5	24.73
Forestry	97.2	1.7	173.5	5.80	21.2	4.82
Fisheries	87.3	1.6	62.0	2.07	21.6	4.92
Agric. Research	390.0	6.8	-	-	-	-
TOTAL	5,729.2	100	2,988.5	100	439.0	100

* Includes allocations for ADPs and related programs.

Sources: 1. Based on 4th National Plan, 2. Mijindadi, 1986.

5.9 Poor communication network in the production centers.

This accounts for poor harvest preservation, fish distribution and marketing. Rural feeder roads in Nigeria are either absent or inadequate.

5.10 Lack of effective fisherman co-operatives

This renders the fisherman/fish farmers economically and politically powerless. Co-operatives are important to benefit from government financial assistance schemes.

5.11 Lack of accurate statistics

Fisheries development has been hampered in the past by paucity of data on fish catch, effort, marketing and related parameters. For a meaningful fisheries development plan, accurate statistics is a *sine qua non*.

Ita (1993) has added other dimensions to the problems of aquaculture development in Nigeria. Aquaculture is a comparatively new science to Nigeria and therefore manpower for the industry is developing slowly. Even when trained manpower has been developed, technical personnel in aquaculture find it difficult to apply their knowledge in the field because of lack of facilities for practicing their profession. The knowledge acquired is gradually lost through lack of practice/use.

Private investors are faced with the problem of hiring non-practicing professionals only to be frustrated in the long run after a lot of damage has been done. Sometimes the investors are unwilling to pay for the services of a practicing professional and end up with a trial and error approach that never works. Some of the sources of error itemized by Ita include: wrong

choice of site which consequently requires heavy capital for development; wrong farm design, again leading to heavy capital investment in farm development; choice of wrong farm managers to avoid paying adequate salary to the appropriate qualified and practicing personnel; and lack of or poor feasibility study prior to the initiation of the project.

A more comprehensive account of major fisheries management problems pertaining to policy processes are discussed by Ovie and Raji (2006)

6. COMMONLY AND SUCCESSFULLY CULTURED FISH SPECIES IN NIGERIA

6.1 Tilapias

These are African cichlids and have been known by various biological names such as *Tilapia niloticus*, *Sarotherodon niloticus*, and *Oreochromis niloticus*. Other species such as *T. mossambicus*, *T. hornorum*, *T. zillii* and *T. mariae* that has been proposed as a possible candidate for culture (Ajuzie 1996). The Igbo name for the tilapias is (Ikpokpo). (Figures 3.1-3.3). Tilapia is the most widely cultured finfish in the world except for the common carp *Cyprinus carpio*.

The culture attributes of Tilapia are as follows:

- ✍ Hardiness they withstand conditions that would otherwise be adverse to others.
- ✍ Easy to breed can easily breed in captivity without inducement.
- ✍ Rapid growth they are known to grow faster than most other cultured species.
- ✍ High quality of flesh the demand for the fish as food is

high.

Tasty, hardy, and easy to handle.

Members of the genus tilapia belong to the family Cichlidae. They are perch-like fish, which have had a history of culture that dates to over 4000 years ago. Bardach et al (1972) theorizes this is the fish that St. Peter caught in the Sea of Galilee and the fish which Christ fed to the multitude (hence St. Peter's fish). The tilapias are indigenous to Africa and the Near East. They have spread from the lakes and rivers of their native lands to most tropical and subtropical regions of the world.

Tilapias are inexpensive and easily reared food all over the world. They can now be cultured both in warm water and in recirculating systems in the temperate regions of the world. Tilapia is quickly gaining recognition and popularity in the United States. The United States Department of Agriculture (USDA) reports that the United States now uses approximately 90 to 100 million pounds of tilapia per year. According to the American Association of Tilapia, production of tilapia has increased 300 percent over the past 5 years. The Asian communities in the United States are the main consumers of tilapia in that country.

Tilapias are omnivorous- feeding on a wide range of foodstuffs and breed easily in ponds without inducement. They are very prolific resulting in stunted growth, which does not allow the fish to grow to table size. Several techniques used to remedy this problem include the culture of monosex tilapias, the use of sex reversal techniques by hormone inducement, and the practice of polyculture with catfishes and others.

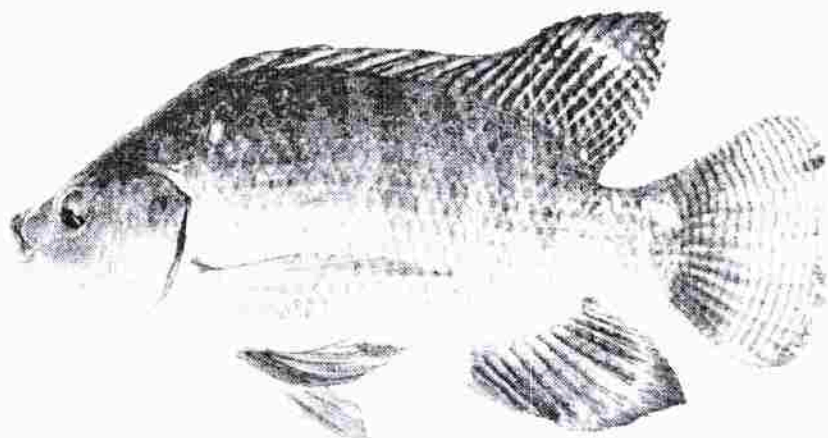


FIG. 6.2 *TILAPIA NILOTICUS* (After Holden and Reed 1972)

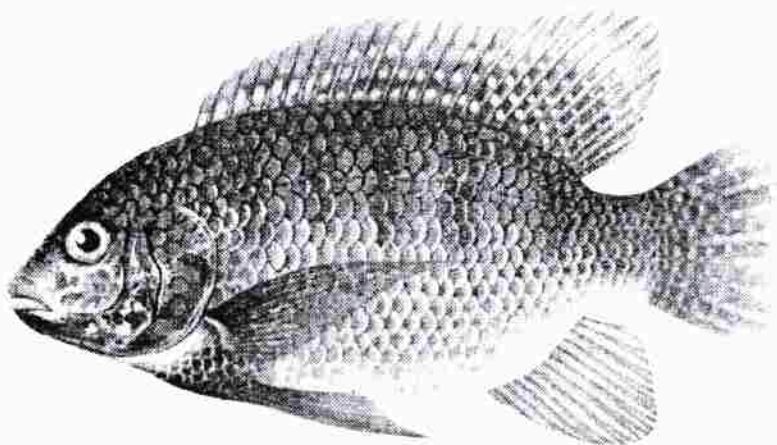


FIG. 6.3 *TILAPIA AUREA* (After Holden and Reed 1972)

high.

Tasty, hardy, and easy to handle.

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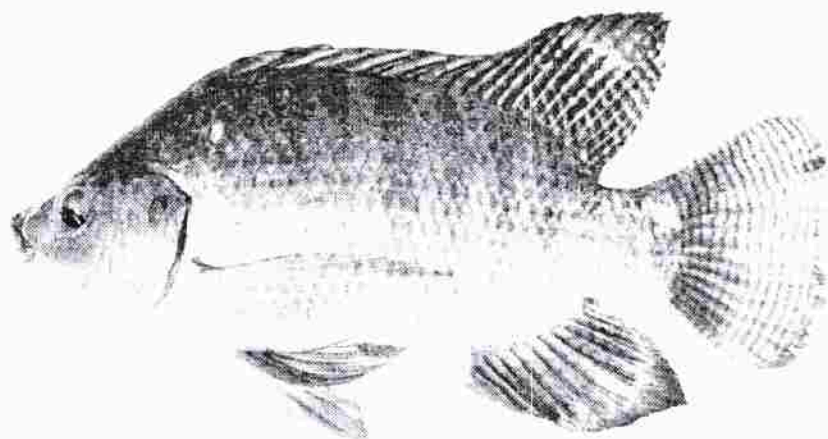


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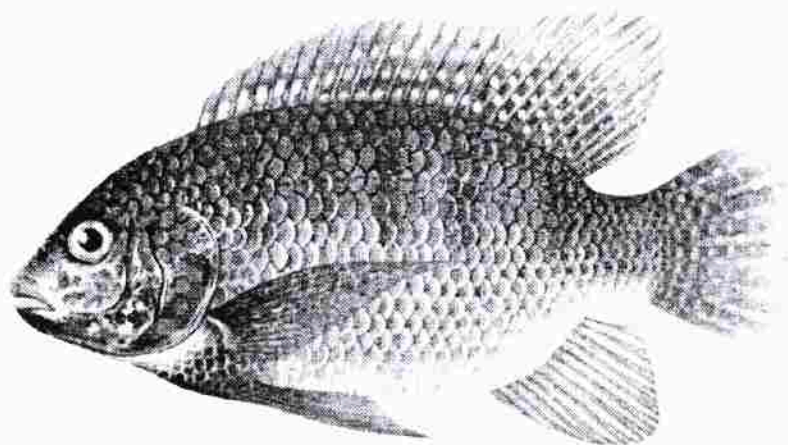


FIG. 6.3 *TILAPIA AUREA* (After Holden and Reed 1972)

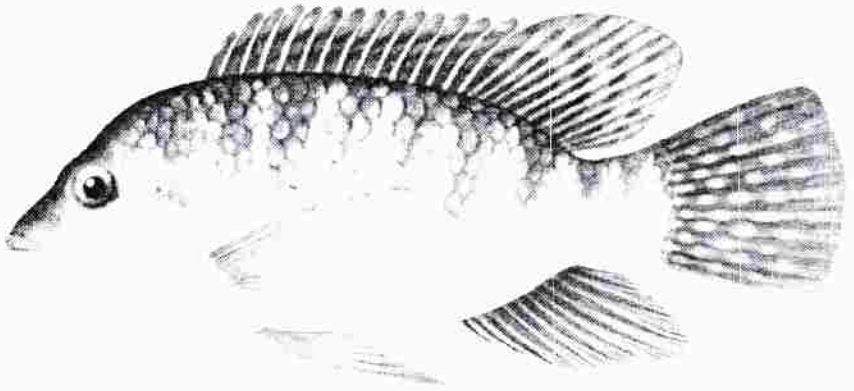


FIG. 6.4 *TILAPIA ZILLII* (After Holden and Reed 1972)

6.4. Clarias

Clarias (African catfish), *Clarias lazera*, *C. senegalensi*, *C. mossambicus*, *C. gariepinus* are different biological names given to the same catfish. The variation in nomenclature depends on what part of Africa one is dealing with. Viveen et al (1987) have rightly lumped all of them into *Clarias gariepinus*. Clarias are widely distributed in Africa. They are scaleless, eel-like in appearance. They tolerate high temperatures and low dissolved oxygen since they can survive in mud. They grow fast 10g fry can reach 500g in 6 months.

It is difficult to breed them in captivity, but recent overall technological development in aquaculture has now made their induced spawning in hatcheries all over the country possible. The adult male can be distinguished from the female by the elongated backward projecting form of this papilla. In female, the papilla has the form of an oval eminence

In nature, the reproductive cycle starts at the beginning of the rainy season. The final stimulus to spawn appears to be associated with a rise in water level and inundation of marginal areas. Spawning takes place in large shoals of adult males and females in water, which is often less than 10 cm deep and situated at the edges of lakes and pools.

The African catfish spawns in captivity on a variety of substrates including sisal fibers, aquatic macrophytes, palm leaves and stones. During courtship, which can last several hours, the female catfish lays her eggs in several batches. The male fertilizes at the same time each batch of eggs by releasing a cloud of sperm on top of the eggs. Within seconds the female distributes the fertilized eggs over a wide area by wiping them with her tail. The eggs will finally adhere to the flooded vegetation. After spawning the shoal of catfish migrates back to deeper water.

There is no parental tending of the eggs. After a few weeks, the African catfish will often have developed a new batch of eggs, and is prepared to spawn again. A second spawning can be induced by rainfall or by inflow of water from an upstream source. In this way several spawnings per year can take place. Probably due to a high mortality rate among the eggs and larvae in nature, fry and fingerlings from the African catfish are difficult to find. The fish culturist prefers, therefore, to rear eggs and fry in a hatchery (Viveen et al 1987).

The demand for catfish meat is high in most parts of the country especially in its smoked form. They form a major part of the popular mix of wood smoked fish known as mangala. The Igbo name for the catfish is *Alila* (Figure 3.4)

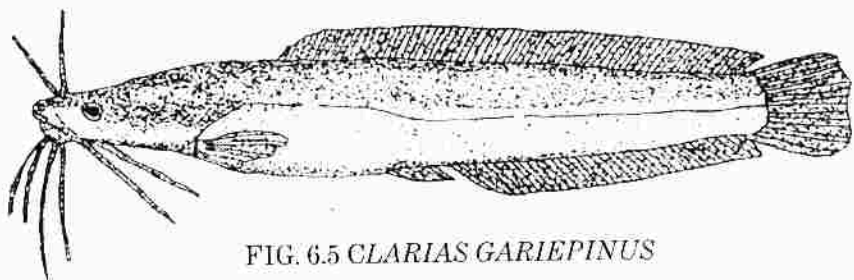


FIG. 6.5 *CLARIAS GARIEPINUS*

6.5 Heterobranchus

Only two genera of this catfish are known in Nigeria: *H. bidorsallis* and *H. longifilis*. Like clarias, they inhabit swamps and are distributed in Africa. The external features are like those of the clarias except that they possess an adipose fin on the dorsal-posterior region. They are omnivorous and predacious on small fish.

Like their clarias relative, they are difficult to breed in captivity without inducement. Induced spawning has been quite successful. They have produced viable hybrid with clarias. The catfish is abundant, popular and highly prized when compared to the *Clarias gariepinus*. They also grow fast and attain up to 30kg. The Igbo name is *Echim* (Figure 6.5)

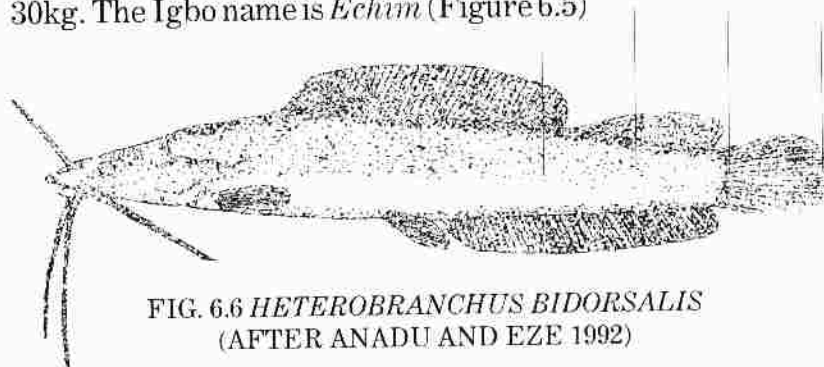


FIG. 6.6 *HETEROBRANCHUS BIDORSALIS*
(AFTER ANADU AND EZE 1992)

6.6 Channa

Channa obscura (snakeheads) have elongated cylindrical bodies covered with cycloid scales including the head. The upper part of the head is flattened like the snakehead. They are common in commercial catches in the swampy areas. The young ones feed on earthworms, tadpoles, and fish. Adults eat exclusively fish and are voracious predators. They possess accessory breathing organs like the Clarias. This makes them extremely hardy, as they are able to survive in very low dissolved oxygen and muddy waters. There are no record of breeding in captivity, but can be fattened in grow out ponds. They are distributed widely in floodplain of Africa south of Sahara. Channa have been successfully cultured otherwise. They are recommended in polyculture with tilapia (See figure 6.7)

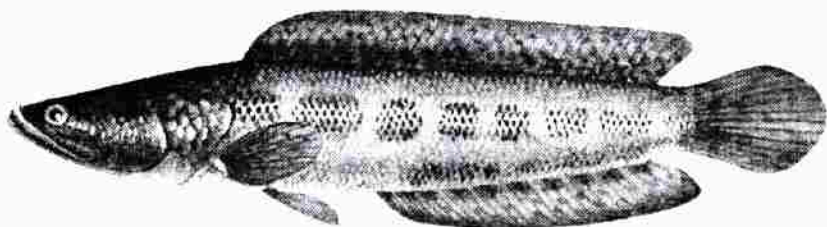


FIG. 6.7 CHANA OBSCURA (After Holden and Reed 1972)

6.7 The Common Carp

Cyprinus carpio (Linnaeus), the common carp, is the most widely cultured freshwater fish in the world. It is an omnivorous species that has been bred for rapid growth, great efficiency in utilization of food, good body conformation and other desirable

attributes (Bond 1996). They are mostly bottom feeders on various foodstuffs.

The common carp belongs to the family of the Cyprinids, with compressed bodies covered by fairly large cycloid scales; naked heads, with more or less protrusible mouth with jaws devoid of teeth; abdominally situated pelvic fins; long dorsal fin , 17-21 rays; two barbels, rear one much larger on each side of the upper jaw, no spinous or adipose fins (Reed 1967). The goldfish *Carassius auratus* belongs to the same family of the minnows.

The common carp is naturally distributed in Europe and Asia. They are exotic to Nigeria, but the European carp have very successfully cultured in all parts of Nigeria. They spawn on submerged vegetation. Kakabans have been used to mimic natural vegetation suitable for spawning. Natural and artificial propagation is possible. In Japan, ornamental carp have also been bred for color, shape, and size variations, for use in garden ponds. (See figure 6.8)

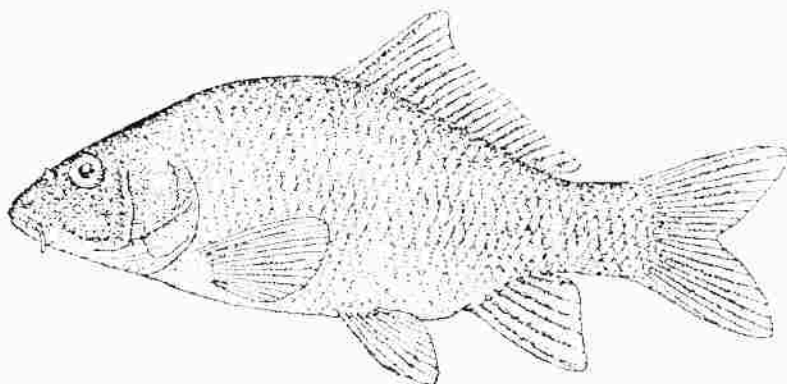


FIG. 6.8. *CYPRINUS CARPIO* (Common carp)

6.8 Heterotis

Heterotis niloticus belongs to the family Osteoglossidae the only species. *Heterotis* is easily recognized by its very large bony scales, the long dorsal and anal fins. The head has no scales.

Heterotis is a nest builder, the young has external gill filaments. They feed on minute organisms called planktons (planktivorous). They will accept artificial feeds in captivity. They have a habit of leaping out of the water with a loud noise. They spawn in swamps during the wet season. They grow fast and can reach 1 m long and 6 kg by weight. There are no records of their breeding in captivity but have been reared in many ponds. They may not be as tasty as the Lates or *Gymnarchus*. The Igbo name is *okpo* (Figure 6.9)

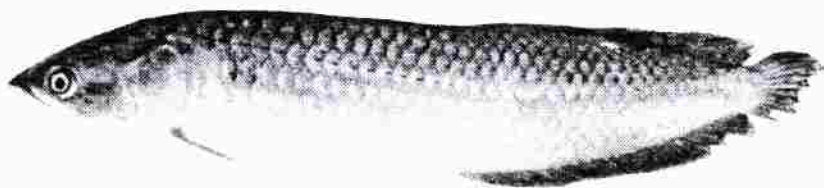


FIG. 6.9 *HETEROTIS NILOTICUS* (After Holden and Reed 1972)

6.9 *Gymnarchus*

Gymnarchus niloticus are eel-like in shape with a long head. The dorsal fin extends the entire length of the back. They have small eyes and tiny scales. The young ones feed on insects, otherwise they are predatory. They are mainly nocturnal. The flesh is relished when smoked. It is highly regarded in the north

where the Hausa name is appropriately called *Dan sarki* 'prince'. In Igboland it is referred as beautiful (*asa*). It is used in the Igboland for important occasions such as marriage, weddings, and other ceremonies. It can grow to a length of 1.5 m and 15 kg by weight

There is no record of spawning in captivity, but they have been raised in ponds. They are possible candidates for polyculture with some stunted catfish and tilapia because of their predacious nature. (Figure 3.9)

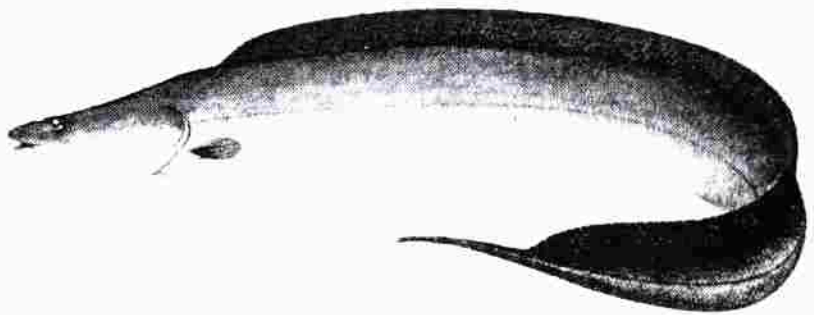


FIG. 6.10 *GYMNARCHUS NILOTICUS* (After Holden and Reed 1972)

6.10 Lates

Lates niloticus (The Nile/Niger Perch) belongs to the Family of the Cetropomidae. It is the only freshwater species of this family commonly found in West Africa. The Hausa name is *giwan ruwa*, which means the elephant of the water. It is a voracious predator feeding mainly on other fishes. The Igbo name is *Aja* one of the two most revered fish in Igboland; the other being the *Gymnarchus niloticus* - *Asa*. Lates grows to 6ft

in length and up to 80kg (160 lb.) by weight. It is referred to as the Nile/Niger Perch (Reed et al 1967).

The presence of the Nile/Niger Perch in the river Niger, Nile and Lake Chad is a strong evidence in support of the past geologic historic linkage of the Niger, the Nile and the lake Chad. *Lates niloticus* is a very important commercial catch in the above bodies of water. They have been extensively stocked in newly constructed dams in Nigeria where they have successfully established themselves in such dams as the Kainji dam, Tiga Dam in Kano State, Miango in Plateau State, Okene reservoir in Niger State and others.

The flesh of *Lates niloticus* is the most prized of all African freshwater fish (Reed et al 1967). It is held in high esteem and a very attractive game fish. It is a veritable giant among freshwater fish and because of the magnificence the size and voracious nature; the Egyptians once worshiped it. It has been successfully cultured in many fish farms that I had visited in Nigeria such as The Okigwe fish farm in Imo State, Rock water fish farm in Jos Plateau State, and the Bagauda pilot fish farm in Kano State.

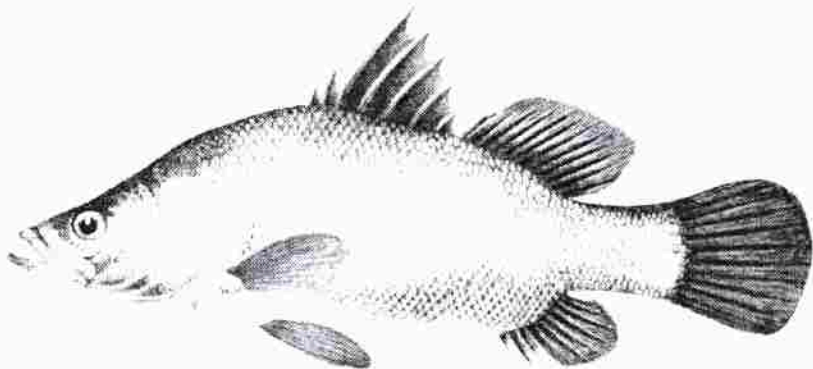


FIG 6.11 *LATES NILOTICUS* (After Holden and Reed 1972)

Reed et al 1967 reports that lates breed satisfactorily in man made lakes and reservoirs. They must qualify as candidates for polyculture with some other culture fish such as the Tilapias. They will help to improve Tilapia production by culling the stunted populations (See figure 6.11)

7. Nigeria's Fisheries Legislation

Fishery resources in the sea, lakes, lagoons and rivers are in most countries considered a common "free for all" property - at least as far as the nationals of that country are concerned. Nigeria has legislation at the moment only on marine Fisheries as reviewed by Adebolu (1982).

These legislations are

- i) The Sea Fisheries Act of 1971,
- ii) The Sea Fisheries (Fishing) Regulations of 1972, and
- iii) The Exclusive Economic Zone (EEZ) Act of 1978.
- iv) In 1992, the (Federal Government of Nigeria)FGN promulgated the inland water Fisheries Decree No.108. The decree set out to harmonize the administration, management, protection and improvement of inland water fisheries.

The EEZ is described as the area extending from the external limits of the territorial waters of Nigeria up to a distance of 200 nautical miles into the sea.

These regulations variously concern the development, management, exploitation and conservation of Nigerian marine resources. The EEZ Act vests the exploitations and exploration of the natural resources of the seabed, sub-soil and super-adjacent waters of the EEZ in the Federal Republic of Nigeria. No effective laws exist which govern the management and

conservation of the inland waters. Adebolu (1982) suggests that States draw their own inland Waters Fisheries regulations first from which a central regulation could be drawn. Regulations on pollution of inland waters are an important complimentary facet of aquaculture development. From my experience in the United States, law enforcement in the use and exploitation of water resources which include requirements such as boat licensing, titling, fishing licenses etc are enormous avenues for generating funds to the states. Like many other laws/rules in Nigeria, enforcement of fisheries regulations is very tardy or completely absent, resulting in loss of huge revenues to the government and in the abuse and degradation of the aquatic environment. Salzwedel et al (2000) report the Fisheries rules and regulation in 23 states of Nigeria. Ovie and Raja (2006) traced the evolution of relevant fisheries policy development from previous accounts of Ladu and Neiland (1997), Ladu and Ovie (2001) and Neiland *et.al.*, (2002). The various fisheries legislations are embedded in the policies beginning from 1941 when the colonial authorities established the Department of fisheries in Lagos.

Finally, the question of social and political instability which Nigeria has been experiencing for over 38 years affects the development of aquaculture like other serious enterprises adversely. Serious local and foreign investors are discouraged to invest in an unstable economy.

GENERAL RECOMMENDATIONS

Nigeria has as a result of the above itemized water resources, incumbent facilities, infrastructures, and policies that have been moving in some positive directions of aquaculture development in the past twenty years. There has been increased awareness and production in Fisheries resources in both marine and freshwater. Fish farming has been growing steadily. The number of Fisheries scientists/experts has increased. Fishing gears and other fishing facilities are receiving innovations. Fishermen are responding to the innovative fishing co-operatives. Fishermen communities have been successfully set up in some States. The private sectors are getting involved in fish culture.

However, as a result of the equally increasing population of Nigeria, Fisheries production is yet far from meeting the demand for fisheries products and animal protein.

Some of the following are recommendations that come to mind as one is thinking of successes in aquaculture practices in Nigeria: a more aggressive and intensive fish farming and management practices, including the farming of species apart from fishes such as shrimps and freshwater crayfish, crabs and maybe oysters. There is enormous demand of fresh and brackish water crayfish (crawfish) in the Nigerian market for food condiments, yet there is no record of any attempts at farming any of these. There is need for more comprehensive use of the inland waters for stocking of adequate fish species. The implementation of government aquaculture policies to the grassroots, enforcement and the improvement of marine and inland fisheries legislation for the purposes of conservation, increased budgetary allocation to the fisheries sub-sector and

proper monitoring, provision of credits to fish farmers, the utilization of local materials in aquaculture practice, the use of trained practicing professionals in the project design and supervision, and finally the mobilization of the community for fisheries development.

However, on a global scale, if aquaculture is to continue to grow its operations must be environmentally stable as well as profitable. Wetlands/Marshlands are a very valuable part of the aquatic environment with regards to availability of nutrients. They are breeding ground to fishes and other aquatic organisms. In 1990, the Nigerian Man and Biosphere Committee organized a State of Knowledge Workshop on Nigerian wetlands, which in a broad sense include floodplains, lakes, reservoirs and swamps. Among the contributions to the Workshop included but not limited to The distribution, ecology and fisheries potentials of Nigerian wetlands, the ecological effects of human activities on the value and resources of Nigerian wetlands, the structure and function of some Nigerian wetland ecosystems, wetlands in the Sahelian north-eastern Nigeria

Anadu and Okafor (2004) proposed the use of rainwater harvestation as a probable means of aquaculture and soil erosion abatement serving the dual role of fish production and environmental protection.

Aquaponics is a new high technology in fish culture comprising the rearing of fish and vegetable with minimal soil invasion.

Finally, the availability of energy for aquaculture or any agriculture production is intimately tied to the use of electricity. It is not an exaggeration to say that our country has scored a

grade of “F” for energy generation. Without adequate power supply to all, there will be no meaningful aquaculture practice to match the global pace. Aquaculture requires power to operate machineries, buildings, aeration and others.

Research into alternative energy supplies such as the use of wind and solar energy to harness and distribute energy for all aspects of agriculture including aquaculture is a challenge to our Universities of technology such as FUTO.

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Appendix 1

B: Major Lakes and Reservoirs

Ita and Sado *et. al.* 1985

i) Lake Chad (natural)	550,000
ii) Kainji Lake (man-made)	127,000
iii) Jebba Lake (man-made)	35,000
iv) Shiroro Lake (man-made)	31,200
v) Goronyo Lake (man-made)	20,000
vi) Tiga Lake (man-made)	17,800
vii) Chalawa Gorge (man made)	10,100
viii) Dadin Kowa (man-made)	29,000
ix) Kiri (man-made)	11,500
x) Bakolori (man-made)	8,000
xi) Lower Anambra (man-made)	5,000
xii) Zobe (man-made)	5,000
xiii) Oyan (man-made)	

Source: FAO (2011)

FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
LIST OF PREVIOUS PUBLIC LECTURES AND LECTURERS

S/NO	LECTURER	DATE	TITLE
1	Prof. Umaru D. Gomwalk	Jan. 19, 1985	"University of Technology in Modern Nigeria Society: An outlook for the future".
2	Alhaji Shehu Musa Mckaman Nupe	Dec. 2, 1988	"Nigeria my vision for 21 st century".
3	Dr. C. N. Ogbu	March 1, 1989	"Sexually Transmitted Disease and the Aids Scourge".
4	Prof. S. A. Okecha	May 31, 1995	"Environmental Pollution: The Scourge of Life kind".
5	Prof. J.I. Ejimanya	Oct. 3, 2005	"Expanding human sensing capabilities: a multi-disciplinary challenge".
6	Prof. S. O. Ogwude	Nov. 26, 2003	"On the Woman question".
7	Prof. A. I. Onuchukwu	Aug. 12, 2004	"Preventing kerosene explosion in our homes".
8	Prof. G. Oyibo	Dec. 2, 2004	"Mathematics and Physics interfacing with human development".
9	Prof. E. Okeroafor	June 16, 2005	"Essence and Relevance of Strategic Planning in the University System".
10	E.I. Oyia	Dec. 8, 2005	"Liquefied Natural Gas (LNG) and the Nigerian Economy".
11	Prof. (Mrs) E. Onyejekwe	April 3, 2008	"The Digital Promise and Health Informatics".
12.	Dr. Goddy Chuma Okoye	Aug. 30, 2008	"Biomedical Technology and Human Life".
13.	Engr. Prof. P.B.U. Achi	Sept. 18, 2008	"Problem-based Learning: The really effective education Pedagogy for Africa".
14.	Prof. Christopher Okoro	Feb. 12, 2009	"Universities as Effective Centres for Science and Technology Development".
15.	Dr. Ndubuisi Ekekwe	May 22, 2009	"Neuromorphs and versatile bio-acquisition system".

16.	Dr. (Mrs) Doris Iro	Jan. 14, 2010	"The role of Physiotherapy in the concept of Public Health".
17.	Prof. (Mrs) B. Ngozi Anyanwu	June 23,2010	"Instilling Moral Ethics in the University Community: A <i>sine qua non</i> for National Growth ad Development".
18.	Prof. Kas M. Ibe	July 7,2010	"Hydrogeoenvironmental risk Assessment: The Challenges and Promises".
19.	Dr. I.I. Onyeche	Aug. 5,2010	"Focus on GIS training and its applications".
20.	Mr. Charles O. Omeire	Dec. 15,2010	"Town and Gown Dialectics: A Healthy Partnership or a Marriage of Convenience?"
21.	Dr. Nnamdi J. I. Oziri	Jan. 12,2011	"Ageing Challenges And Options In The 21st Century Developing Countries"



