UNAABLE
INAUGURAL LECTURE SERIES

WATER, WATER, WATER, EVERYWHERE ---------An Enigma!

By

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UNAAB INAUGURAL LECTURE Series No. 32

Wednesday, 20th April, 2011

UNAAB
INAUGURAL LECTURE SERIES

This 32nd Inaugural Lecture was delivered under
the Chairmanship

of

The Vice-Chancellor
Professor Oluwafemi O. Balogun
B.Sc., Ph.D (Ibadan)

Published 20th April, 2011

ISBN:978-978-49426-2-1

Series No 32: Professor S.O. Otubusin

Printed by Intec Printers Limited, Ibadan.

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WATER, WATER, WATER, EVERYWHERE ---------An Enigma!

Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, Ogun State, Nigeria

VISION STATEMENT
Acceleration of the impetus toward national fish self-sufficiency through teaching/training, adaptive research and outreach programmes

MISSION STATEMENT
To achieve and maintain the lead in excellence in training equipped manpower for sustained exploitation of the nation's aquatic resources.

PROLOGUE

Scientists once thought that the vertebrate with the shortest lifespan was turquoise killifish. This small fish lives in seasonal rain pools in equatorial Africa and must complete its life cycle in 12 weeks (3 months) before the pools disappear. But researchers from James Cook University in Australia have now found that the pygmy goby (*Pandaka pygmaea* ---only 1 centimetre long = 0.4 inch) has an even shorter life span. It lives fast and dies young. This tiny fish lives in coral reels for an average of 56 days (less than 2 months). Its rapid reproductive cycle is designed to help it avoid extinction. Considering different sizes of fish, the huge whale-shark (*Rhiniodon typus)* can be 12 metres (40 feet) long! Scientifically, we may link this scenario with the evolution of living organisms known as organic evolution. It is broadly the sum of total adaptive changes that have taken place over a very long period of time. It leads to the development of "new" species from earlier ones – "new" species that lead their lives in different ways from the species from which they evolved. Many species also become extinct in this never-ending process. Scientists have made endless attempts to obtain a great deal of indirect "evidence" to support the **theory** of evolution viz Fossil Records, Radioisotope Dating. Biochemical Similarities, Molecular Records, Comparative Anatomy, Embryology etc. For example, all land vertebrates are reported to have had aquatic ancestors on the basis of embryology (Fig. 1)

Still on Origin of Life on Earth

To many biologists, the similarity of all living things on earth is more striking than the differences between them. Not only are all organisms composed of cells, but these cells work in essentially the same way, using the same complex molecules and the same type of genetic material read according to virtually the same genetic code. The flow of information in most living organisms from DNA via RNA to protein follows a well-defined path way. DNA contains a **digital code** with four-letter alphabets encoding the instructions for the construction and development of organisms (climaxing in human being composed of 100 trillion cells till today). The fact that all living organisms (single cells to sponges to worms, **to fish** to reptiles to mammals, and to primates and

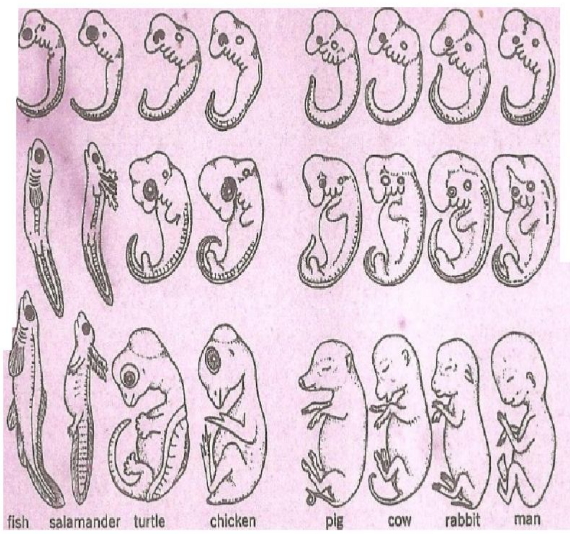

Fig. 1 Series of vertebrate embryos in three successive and comparable stages of development. *Top.* All are much alike in the earliest stage. *Middle.* Differentiation is evident, but the four mammals (at right) are quite similar. *Bottom.* Later the distinctive characteristics of each become evident. (*After Haeckel,* 1891.)

Figure 1

humans) share the four letters of the **RNA alphabet (A, U, G and C** which divinely interpreted as **All Under God's Control**!) is testimony to the idea that successful, self-replicating RNA string probably had a single origin and in turn, could have provided the common evolutionary origin of the information in all living organisms**.(DIVINE EVOLUTION !)**

Puzzle !!!

Scientists agreed that planet earth coalesced some 4.5 billion years ago.
By 4.2 billion years ago, enormous **oceans** covered the planet, and the first informational RNA molecules **may** have emerged around the high temperature volcanic vents.

Questions?

(1) From where did RNA originate?

(2) Who formed the RNA?

(3) Who was or were there when the planet earth coalesced some 4.5 billion years ago?

(4)How many of us here listening to this lecture will still be alive on planet earth even just 100 years from now(Year 2111 AD?) **Anno Domino!**

Mr. Vice-Chancellor and Chairman of this Inaugural Lecture
Members of past and present UNAAB Governing Council
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Directors of Centres
Heads of Departments and Units
Distinguished Professors
All members of the UNAAB Family
All Stakeholders in the PROJECT UNAAB
Ladies and Gentlemen of the Media
Distinguished Ladies and Gentlemen
Marvellous UNAABITES!

1.0 INTRODUCTION

"O Lord, how manifold are thy works! In wisdom hast thou made them all: the earth is full of thy riches. So is this great and wide sea, wherein are things creeping innumerable, both small and great beasts" (Psalm 104: 23, 24).

Then God created human beings (male and female created he them). He blessed them and said unto them: be fruitful and multiply and replenish the earth, and subdue it and have dominion over the **fish** of the sea, and over the fowl of the air, and over every living thing that move upon the earth(Genesis 1: 27, 28). Little wonder then that it was reported that it took about 250,000 years for human population to reach 1 billion in about the year 1800AD. (definitely from one couple at creation). It drastically reduced to over 100 years before human population hit another billion in 1927. From 1999, there has been an unprecedented growth in the global population indeed showing that by this year (2011), it would have taken the world another 12 years to reach 7 billion. On the other hand, the population of Nigeria is expected to hit 155.2 million this year with a Gross Domestic Growth of 5.8 per cent, GDP of $248 billion dollars and an inflation of 11.2 per cent.

It has been reported that fears that the world is overpopulated have gathered momentum occasioned by the unchecked growth of human population and the implications of climate change. The disastrous flood disasters reported globally including Nigeria (and right here in Ogun State around October last year) are but a few examples of the implications of climate change. However this inaugural lecture is not on climate change but on aquatic organisms with particular emphasis **on FISH!.** But then: **"NO WATER ------- no fish!".**

The largest number of living organisms is found in the hydrosphere, i.e. the oceans, seas, lakes, reservoirs, ponds, rivers and streams. Genesis 7:22 states that "All in whose nostrils was the breath of life, of all that was in the dry land, died (during the great flood recorded in the Holy Bible). **Hence I guess that there was no fish in Noah's ark!** It is therefore not surprising that Lagler, et. al. (1977) reported that **fishes are the most numerous** of the vertebrates constituting 48.1% of some 41,600 species of recent vertebrates (Fig. 2).

And the (Noah's) ark rested in the seventh month, on the seventeenth day of the month upon the mountains of Ararat in Eastern Turkey_ about 17,000 feet high between Black and Capsian Seas.

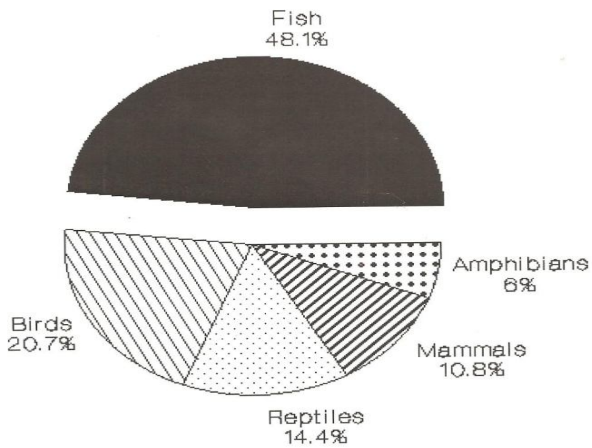


Figure 2: Percentage composition of animals constituting some 41,600 species of recent vertebrates

The Oceans are being looked to as a major source of food for the future. High productivity characterizes certain regions in the oceans, but larger regions of low productivity also exist. Presently, yearly harvests amount to about 82 million metric tons of fish and about 500,000 metric tons of seaweed. Thus, predictions are that the sea can yield only about 25 percent more than the present amount of organic food resources. At present, more than 70 percent of the earth's surface is covered with water which is the abode of fish. Fish are known to inhabit all types of water-bodies ranging from Antartic waters below freezing to hot springs of more than 40^{o}C and from soft, freshwater to water saltier than the seas. Fish have been reported in waters that are so quiet and dark that they have never been inhabited by other vertebrates or thoroughly explored by man. The vertical distribution of fish exceeds that of any of the other vertebrates (kept in Noah's ark, Genesis 7: 2). Fishes range from approximately 5km above sea level to some 11km beneath it (sea level).

Globally, lakes, reservoirs and wetlands important for inland fisheries cover a total area of about 7.8 million km^2 (Table 1) while oceans and seas make up 97.5% of the total volume. Considering these vast water bodies as abode of fish (the MOST numerous of vertebrates) it is puzzling or **enigmatic** that there is no enough fish for all (apologies to NEPAD Fish for All summit, 25th August, 2005). As once exclaimed by my name sake, Samuel Coleridge in his book titled "Ancient Mariner Water, water everywhere and yet not a drop to drink'. I chorus "**Water, water, water everywhere………….. an Enigma!?"** An attempt will therefore be made to **in-exhaustively** present this lecture on my 35- year "voyage" so far in the " waters" of Fisheries Management ("**hunting"** fisheries) and Aquaculture (culture fisheries) as briefly as possible: **practically, pragmatically, politically and prophetically.** The *modus operandi* will be in **words, in thought and in deed!.**

Box 1

Fisheries Management is based on fisheries science such that strategies to protect fishery resources on sustainable exploitation is possible (feasible). Modern fisheries management is often referred to as a government system of management rules (laws, decrees, edicts, etc) based on defined objectives and a mix of management means to implement the rules, which are put in place by a system of monitoring, control and surveillance (M,C & S). Fisheries science is the academic discipline of managing and understanding fisheries.It is a MULTIDISCIPLINARY science which draws on the disciplines of oceanography, marine biology, marine conservation, ecology, population dynamics, economics and management in an attempt to provide an integrated picture of fisheries. In some cases, new disciplines have emerged such as bioeconomics.

SUSTAINABILITY: Sustainable fishing
Issues involved in the long term sustainability of fishing include over fishing, by-catch, marine pollution, environmental effects of fishing, climate change and fish farming (often called **Aquaculture).**

2.0 FISH IN WORD--------
or is it fishing in words?

In ancient Egypt, the fish of the Nile River was an important part of people's diet , fish was used as a means of payment, a reward and considered as part of national revenue. In some parts of Nigeria, fish is one of the most important items used in payment of dowry during marriage ceremonies. In Egypt the Nile catfish, *Clarias sp,* which favours muddy waters, was believed to guide the solar boat through the dark river of the underworld at night (Feidi, 2001). A Nigerian musician once sang that fish come from heaven, referring to mud catfish occasionally found on bush paths during first rains*. **(Orun l'eja ti wa si aiye)*** Bas-reliefs showing fish and other aquatic animals and

Table 1: Distribution by continent of major surface freshwater resources

	Surface area								Share of total
	Lake	Reser-voirs	Rivers	Food-plain	Flooded forest	Peatland	Inter-mittent wetland	Total	%
				km					
Asia	898,000	80,000	141,000	1,292,000	57,000	491,000	357,000	3,316,000	42
South America	90,000	47,000	108,000	422,000	860,000	-	2,800	1,529,800	20
North America	861,000	69,000	58,000	18,000	57,000	205,000	26,000	1,294,000	17
Africa	223,000	34,000	45,000	694,000	179,000	-	187,000	1,362,000	17
Europe	101,000	14,000	5,000	53,000	-	13,000	500	186,500	2
Australia	8,000	4,000	500	-	-	-	112,000	124,500	2
Oceania	5,000	1,000	1,000	6,000	-	-	100	13,100	0
Total	2,186,000	249,000	358,500	2,485,000	1,153,000	709,000	685,400	7,825,900	100

fisheries – related activities are found on centuries- old temples in Cambodia. The local currency, **the riel**, is probably named after the most abundant fish species, trey riel, and an indication of its traditional importance to the economy. In the Lao People's Republic, giant catfish have traditionally been associated with spirits, royalty and sacrifice. Near Vientiane, every February, people used to gather to catch giant catfish. The first one caught belonged to the spirits and to the old man who was in contact with them (Mekong River Commission, 2003), whereas in Nigeria, every March there is the fishing festival at Argungu, Kebbi State where fishermen use clap nets (homa) to catch Nile perch *(Lates niloticus).* The fisherman with the biggest single catch wins a prize (Fig. 3). Fagade (1992) opined *inter-alia* that fish flesh is about the best source of animal protein; better digested than beef and poultry; contains mineral salts and its oil is mainly poly-unsaturated fatty acids with an anti-cholesterol factor. He concluded that regular consumption of fish is beneficial to human body. Some other authors noted that increased consumption of fish reduces the risks of sudden death from heart attacks, abates rheumatoid arthritis, decreases the risk of bowel cancer and reduces insulin-resistance in skeletal muscles (Anon, 2001; Conquer and Holub, 2002).

Ita (1993) gave a summary of 239 fish species belonging to 46 families recorded in the major rivers of Nigeria (Fig. 4). Earlier on, Ita et. al. (1985) reported an estimated surface area of 12.5 million hectares of lakes, reservoirs, ponds and major rivers in Nigeria (Fig. 5). This estimate does not include the vast brackish water (820 kilometer shore line), lagoon system extending from Lagos State in the West to Cross River State in the East with their trawl fish resources (Figs. 6(a) – 6(i).

Figs 4a-4g:Some Commercially important freshwater fish species of Nigeria. Total oil production in Nigeria was slightly over 2.2 million bbl per day, making it the largest oil producer in Africa. Crude oil production average 1.8 million bbl per day for the year. Recent offshore oil developments combined with the restart of some shut-in onshore production have boosted crude production to an average of 2.03 million bbl per day for the first quarter of 2010.

Ando (2011) reported that Nigeria currently has over 200 dams with a combined storage capacity of 34 billion cubic metres capable of irrigating about 500,000 ha. of land. Out of these, 19 dams have hydropower potential to generate 3,560.105 MW of electricity. He opined that Nigeria has potential to irrigate about 3.1 million ha. of farmland but only 150,000 ha. have been fully developed. Aside from the fact that irrigation has potential of increasing agricultural productivity by as much as ten-folds, fisheries production can be greatly enhanced by effective utilization of dams and irrigation facilities. (But this is not so – Tables 2(a) and 2(b).

Nigeria is the largest country in Africa with a land mass of 923,800 km^2 and a population of over 150 million - one-sixth of the black population in the world. It is the 8th largest oil producer and has one of the largest deposit of natural gas in the world (Table 2). Figure 7 shows Nigeria's oil export by country in 2009.

These vast abundant resources including human resources *inter-alia*, Nigeria is endowed with agitate ones mind to shout "**water, water, water, everywhere……….an Enigma!".** This expression was recently corroborated by Mr. Andrew Bird, the Regional Director for the University of Southampton, United Kingdom, when he said "Nigeria is a vast rich country in terms of human resources, in terms of its physical resources, there are huge potentials and already, you can say that Nigerians want to do well, there are a lot of entrepreneurs. I look forward to coming here several times more" (Sunday Tribune ,6 March, 2011, page 32).

Ironically, the United Nations Development Programme ranks Nigeria among the 25 poorest countries of the world (Poverty in the midst of plenty!). But going down the memory lane (or is it from hindsight?) in the 1960s agriculture was the mainstay of our economy constituting 70% of Gross Domestic Product (GDP), a similar percentage of government revenues and 89 percent of exports employing over 75 percent of the labour force. The country that time relied on revenues from primary products as a significant exporter of bauxite, coal, cocoa, groundnuts, livestock products, palm produce and tin. These were evident from the various successful farm settlements (including government-owned demonstration fish farms, viz at Panyam, Plateau State; Agodi, Oyo State; Umunna-Okigwe, Imo State; Odeda,Ogun State; Wuya, Niger State etc.); marketing boards; state-owned conglomerates such as Eastern Nigeria Development Corporation, Odua Group, Northern Nigeria Development Corporation, etc.

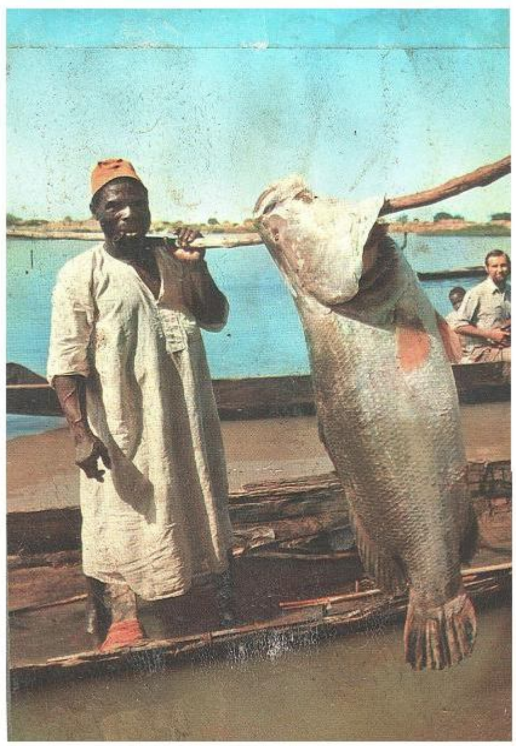


Figure 3:A fisherman with Nile perch (about 100 kg)

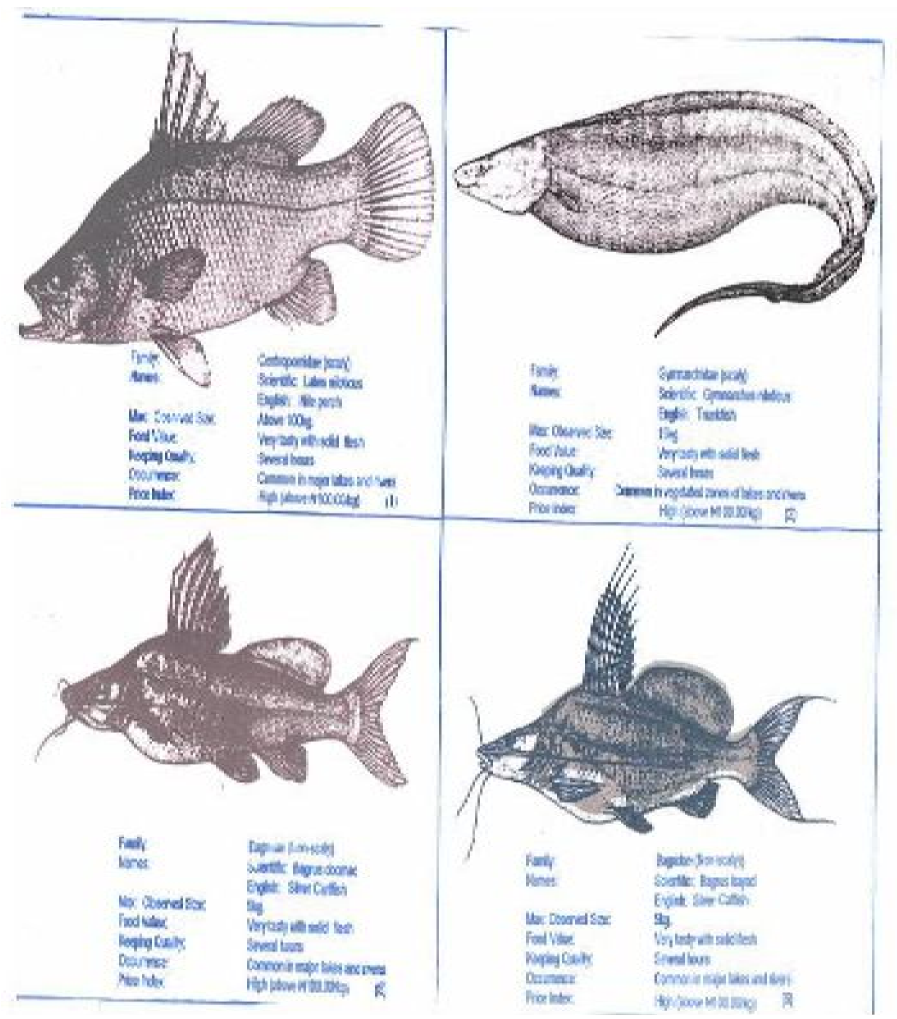

Family:
Names:
Max. Observed Size:
Food Value:
Keeping Quality:
Occurrence:
Price Index:
English: Nile perch
Above 100kg
Several hours
Very tasty with solid flesh
Common in vegetated zones of lakes and rivers
Family:
Names:
Max. Observed Size:
Food Value:
Keeping Quality:
Occurrence:
Price Index:
English: Silver Catfish
Several hours
Family:
Names:
Max. Observed Size:
Food Value:
Keeping Quality:
Occurrence:
Price Index:
Very tasty with solid flesh
Several hours
Common in major lakes and rivers

Figure 4a

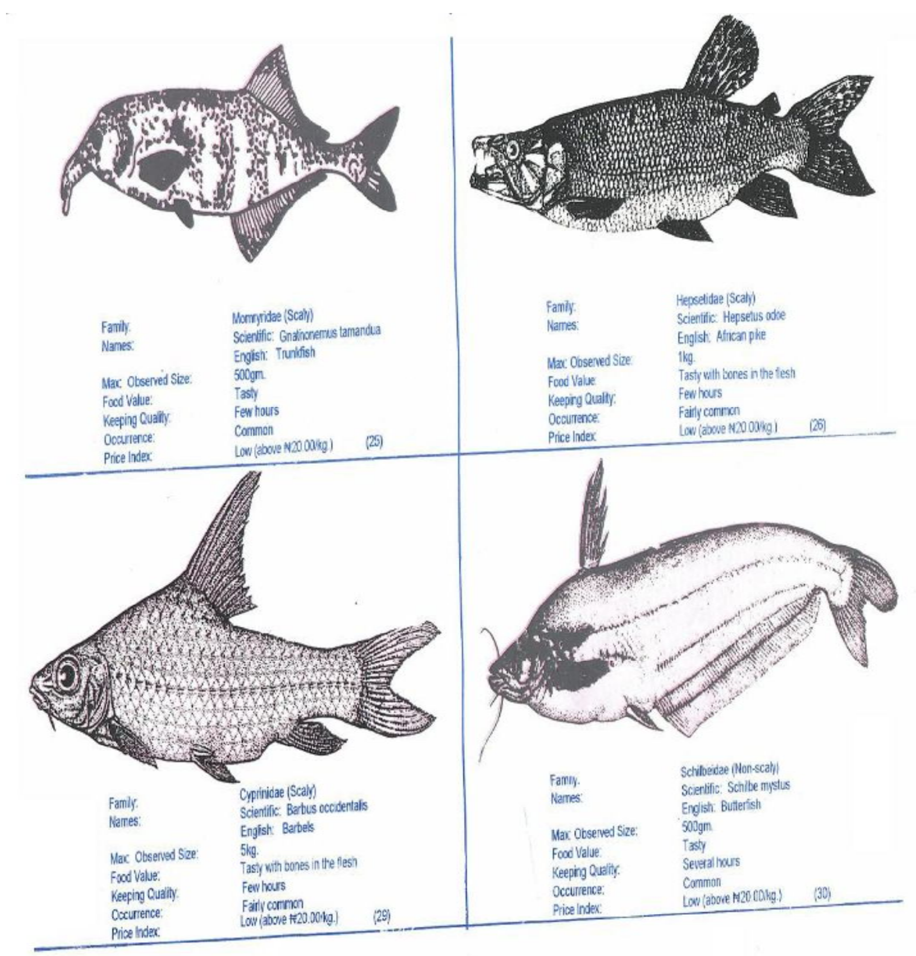

Family: Mormyridae (Scaly)
Names: Scientific: Gnathonemus tamandua
English: Trunkfish
Max. Observed Size: 500gm.
Food Value: Tasty
Keeping Quality: Few hours
Occurrence: Common
Price Index: Low (above ₦20.00/kg.) (25)
Family: Hepsetidae (Scaly)
Names: Scientific: Hepsetus odoe
English: African pike
Max. Observed Size: 1kg.
Food Value: Tasty with bones in the flesh
Keeping Quality: Few hours
Occurrence: Fairly common
Price Index: Low (above ₦20.00/kg.) (26)
Family: Cyprinidae (Scaly)
Names: Scientific: Barbus occidentalis
English: Barbels
Max. Observed Size: 5kg.
Food Value: Tasty with bones in the flesh
Keeping Quality: Few hours
Occurrence: Fairly common
Price Index: Low (above ₦20.00/kg.) (29)
Famny. Schilbeidae (Non-scaly)
Names: Scientific: Schilbe mystus
English: Butterfish
Max. Observed Size: 500gm.
Food Value: Tasty
Keeping Quality: Several hours
Occurrence: Common
Price Index: Low (above ₦20.00/kg.) (30)

Figure 4b

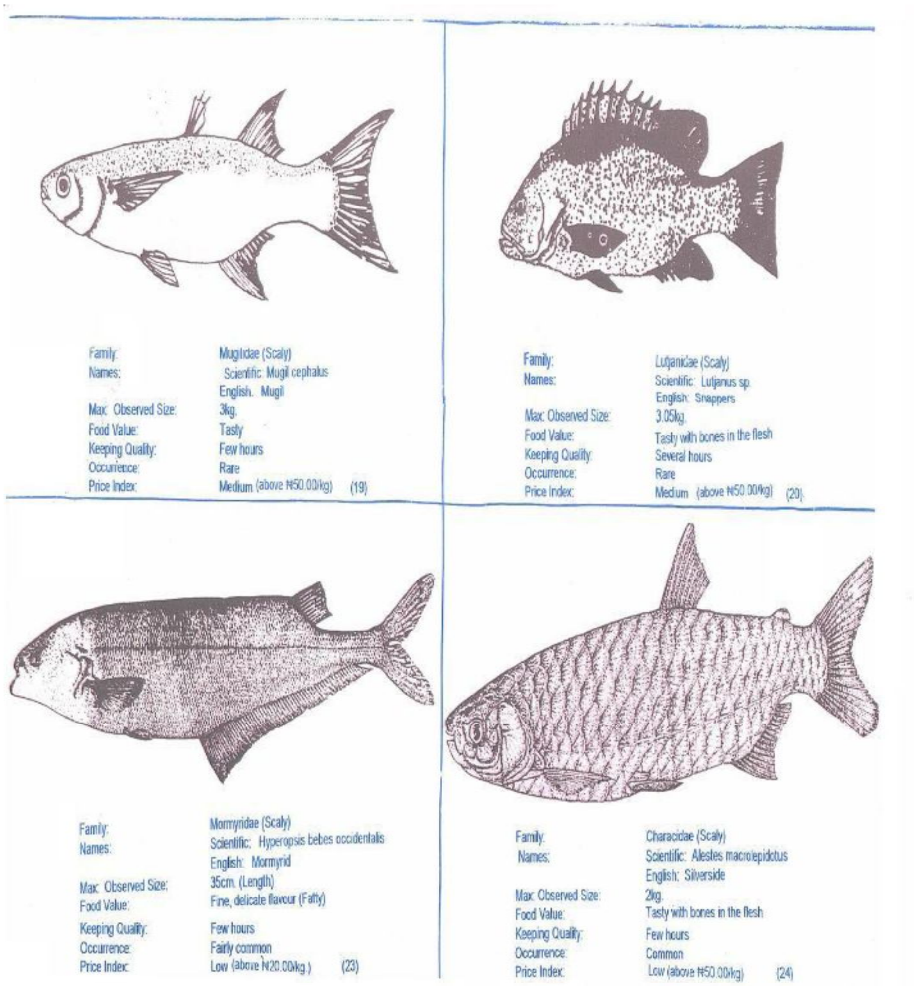

Family: Mugilidae (Scaly)
Names: Scientific: Mugil cephalus
English. Mugil
Max Observed Size: 3kg.
Food Value: Tasty
Keeping Quality: Few hours
Occurience: Rare
Price Index: Medium (above ₦50.00/kg) (19)
Family: Lutjanidae (Scaly)
Names: Scientific: Lutjanus sp.
English: Snappers
Max Observed Size: 3.05kg.
Food Value: Tasty with bones in the flesh
Keeping Quality: Several hours
Occurrence: Rare
Price Index: Medium (above ₦50.00/kg) (20)
Family: Mormyridae (Scaly)
Names: Scientific: Hyperopsis bebes occidentalis
English: Mormyrid
Max Observed Size: 35cm. (Length)
Food Value: Fine, delicate flavour (Fatty)
Keeping Quality: Few hours
Occurrence: Fairly common
Price Index: Low (above ₦20.00/kg.) (23)
Family: Characidae (Scaly)
Names: Scientific: Alestes macrolepidotus
English: Silverside
Max Observed Size: 2kg.
Food Value: Tasty with bones in the flesh
Keeping Quality: Few hours
Occurrence: Common
Price Index: Low (above ₦50.00/kg) (24)

Figure 4c

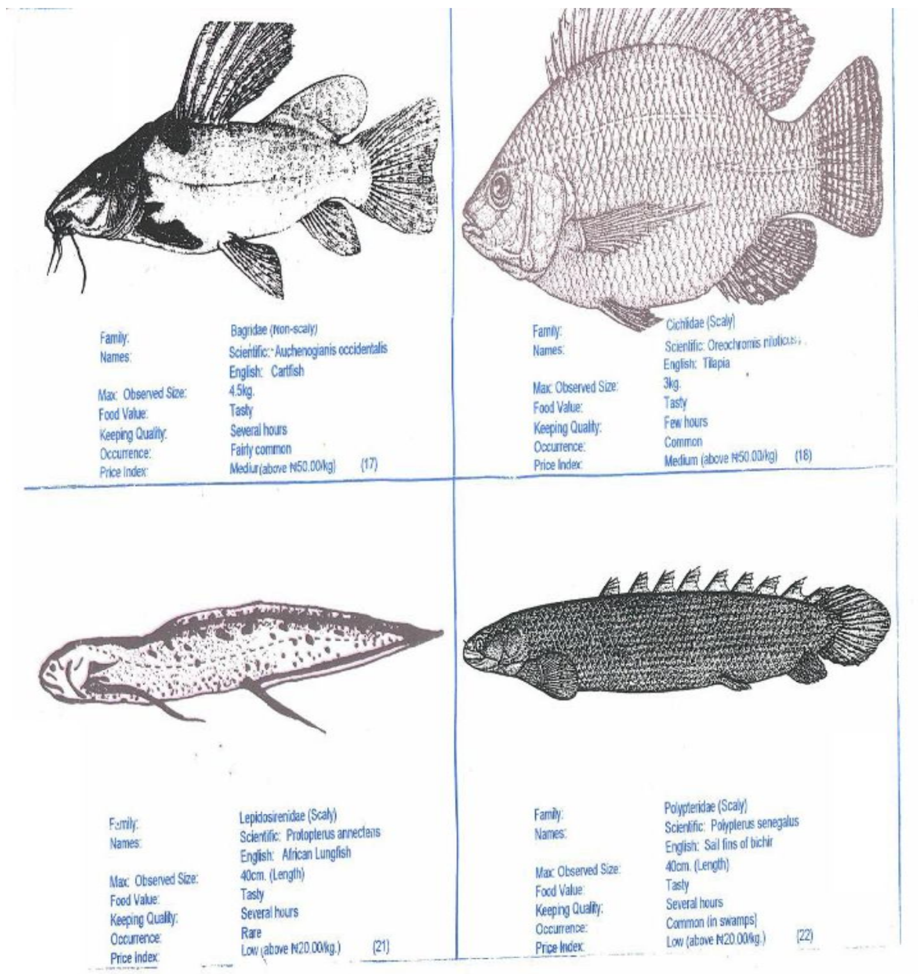

Family: Bagridae (Non-scaly)
Names: Scientific: Auchenogianis occidentalis
English: Cartfish
Max Observed Size: 4.5kg.
Food Value: Tasty
Keeping Quality: Several hours
Occurrence: Fairly common
Price Index: Mediur(above ₦50.00/kg) (17)
Family: Cichlidae (Scaly)
Names: Scientific: Oreochromis niloticus
English: Tilapia
Max Observed Size: 3kg.
Food Value: Tasty
Keeping Quality: Few hours
Occurrence: Common
Price Index: Medium (above ₦50.00/kg) (18)
Family: Lepidosirenidae (Scaly)
Names: Scientific: Protopterus annectens
English: African Lungfish
Max Observed Size: 40cm. (Length)
Food Value: Tasty
Keeping Quality: Several hours
Occurence: Rare
Price Index: Low (above ₦20.00/kg.) (21)
Family: Polypteridae (Scaly)
Names: Scientific: Polypterus senegalus
English: Sail fins of bichir
Max Observed Size: 40cm. (Length)
Food Value: Tasty
Keeping Quality: Several hours
Occurrence: Common (in swamps)
Price Index: Low (above ₦20.00/kg.) (22)

Figure 4d

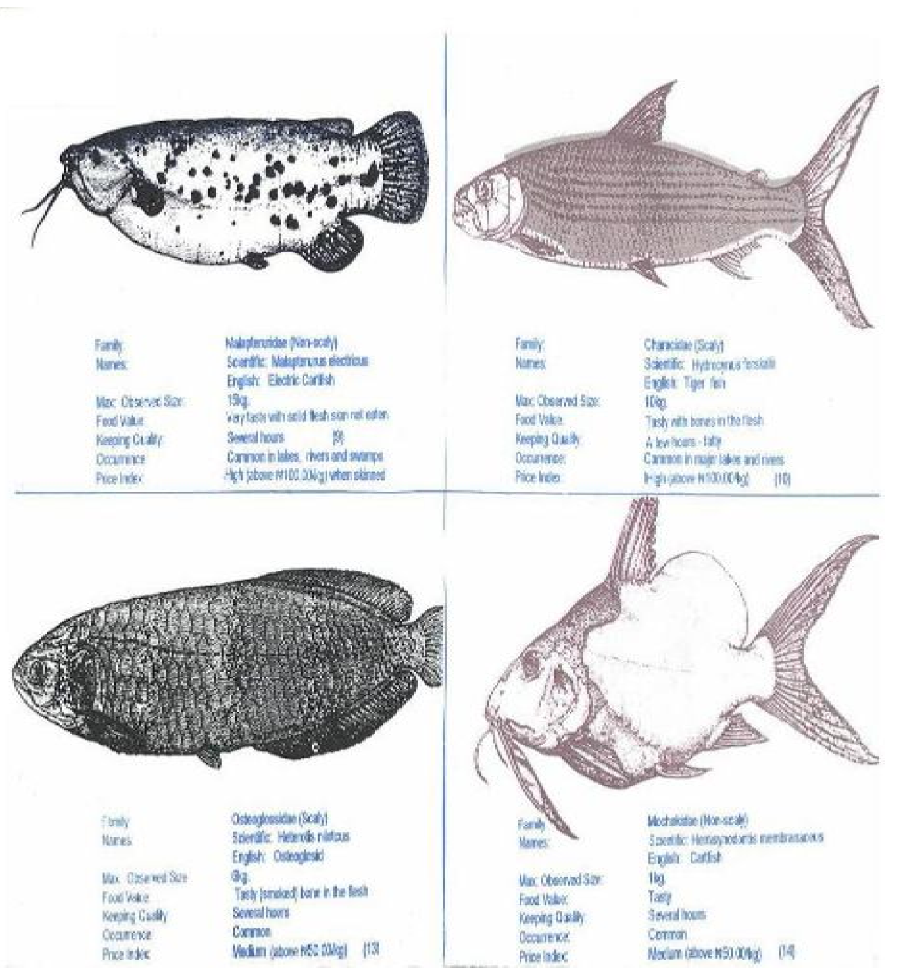

Family:
Names:
English: Electric Catfish
Max. Observed Size:
Food Value:
Keeping Quality:
Several hours
Occurrence:
Common in lakes, rivers and swamps
Price Index:
Family:
Characidae (Scaly)
Names:
Scientific: Hydrocynus
English: Tiger fish
Max. Observed Size:
Food Value:
Keeping Quality:
A few hours - fatty
Occurrence:
Common in major lakes and rivers
Price Index:
High (above N100.00/kg) (10)
Family
Names
English: Osteoglossid
Max. Observed Size
Food Value
Tasty (smoked) bone in the flesh
Keeping Quality
Several hours
Occurrence
Common
Price Index
Medium (above N50.00/kg) (13)
Family
Names:
English: Catfish
Max. Observed Size:
1kg
Food Value:
Tasty
Keeping Quality
Several hours
Occurrence
Common
Price Index
Medium (above N50.00/kg) (14)

Figure 4e

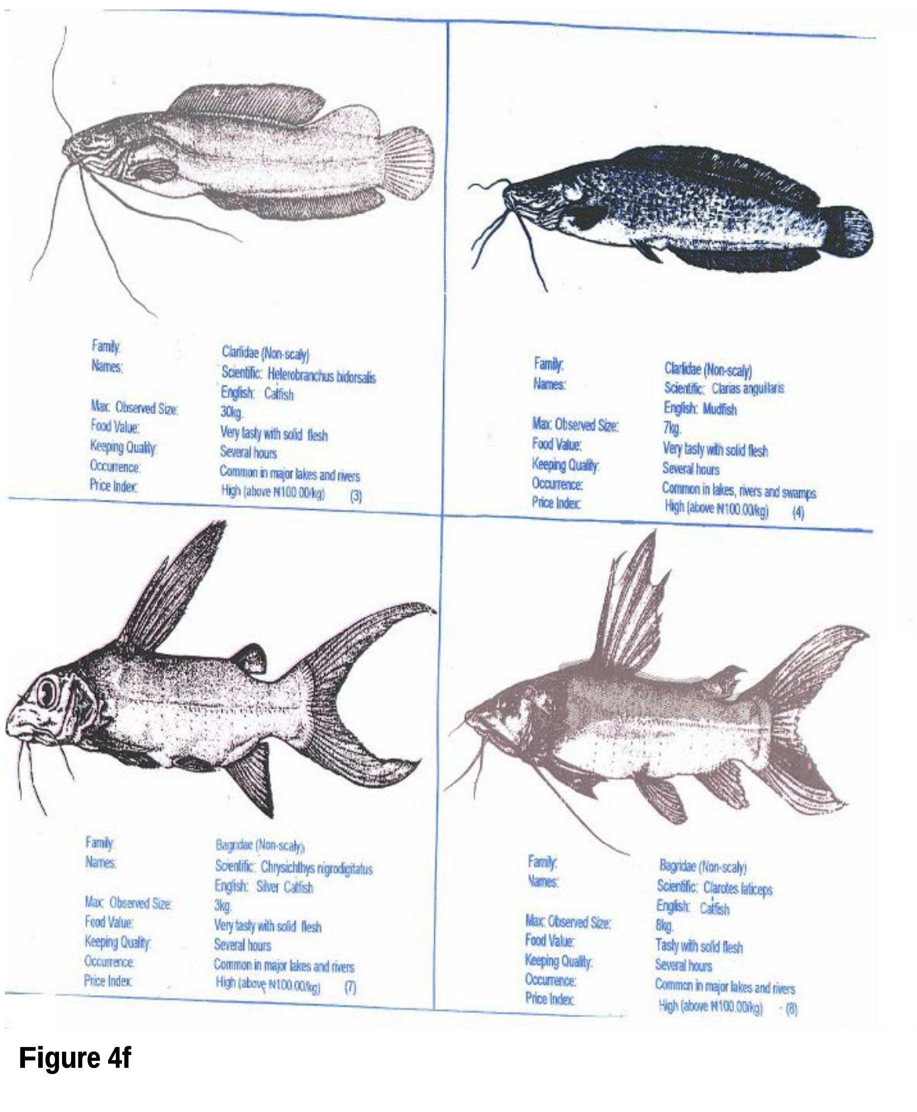

Family: Claridae (Non-scaly)
Names: Scientific: Heterobranchus bidorsalis
English: Catfish
Max: Observed Size: 30kg.
Food Value: Very tasty with solid flesh
Keeping Quality: Several hours
Occurrence: Common in major lakes and rivers
Price Index: High (above ₦100.00/kg) (3)
Family: Claridae (Non-scaly)
Names: Scientific: Clarias anguilaris
English: Mudfish
Max: Observed Size: 7kg.
Food Value: Very tasty with solid flesh
Keeping Quality: Several hours
Occurrence: Common in lakes, rivers and swamps
Price Index: High (above ₦100.00/kg) (4)
Family: Bagridae (Non-scaly)
Names: Scientific: Chrysichthys nigrodigitatus
English: Silver Catfish
Max: Observed Size: 3kg.
Food Value: Very tasty with solid flesh
Keeping Quality: Several hours
Occurrence: Common in major lakes and rivers
Price Index: High (above ₦100.00/kg) (7)
Family: Bagridae (Non-scaly)
Names: Scientific: Clarotes laticeps
English: Catfish
Max: Observed Size: 8kg.
Food Value: Tasty with solid flesh
Keeping Quality: Several hours
Occurrence: Common in major lakes and rivers
Price Index: High (above ₦100.00/kg) (8)

Figure 4f

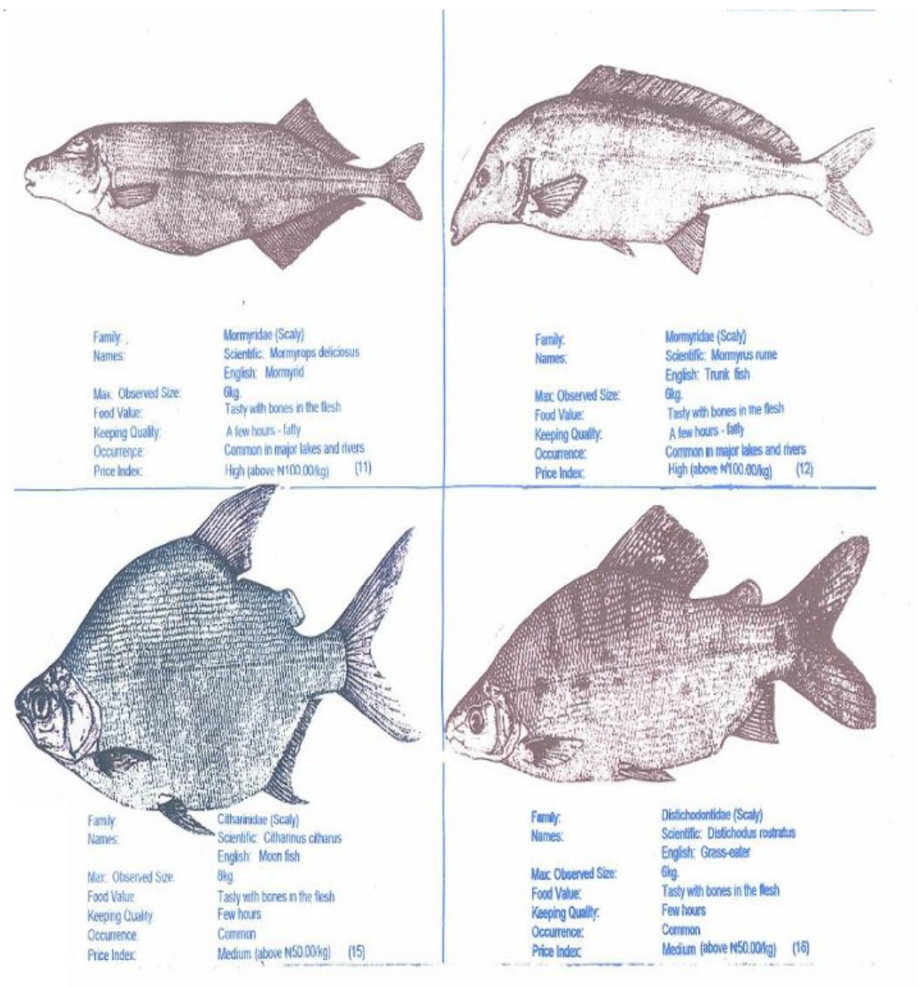

Family:
Mormyridae (Scaly)
Names:
Scientific: Mormyrops deliciosus
English: Mormyrid
Max. Observed Size:
6kg.
Food Value:
Tasty with bones in the flesh
Keeping Quality:
A few hours - fatty
Occurrence:
Common in major lakes and rivers
Price Index:
High (above N100.00/kg) (11)
Family:
Mormyridae (Scaly)
Names:
Scientific: Mormyrus rume
English: Trunk fish
Max Observed Size:
6kg.
Food Value:
Tasty with bones in the flesh
Keeping Quality:
A few hours - fatty
Occurrence:
Common in major lakes and rivers
Price Index:
High (above N100.00/kg) (12)
Family:
Citharinidae (Scaly)
Names:
Scientific: Citharinus citharus
English: Moon fish
Max. Observed Size:
8kg.
Food Value:
Tasty with bones in the flesh
Keeping Quality:
Few hours
Occurrence:
Common
Price Index:
Medium (above N50.00/kg) (15)
Family:
Distichodontidae (Scaly)
Names:
Scientific: Distichodus rostratus
English: Grass-eater
Max Observed Size:
6kg.
Food Value:
Tasty with bones in the flesh
Keeping Quality:
Few hours
Occurrence:
Common
Price Index:
Medium (above N50.00/kg) (16)

Figure 4g

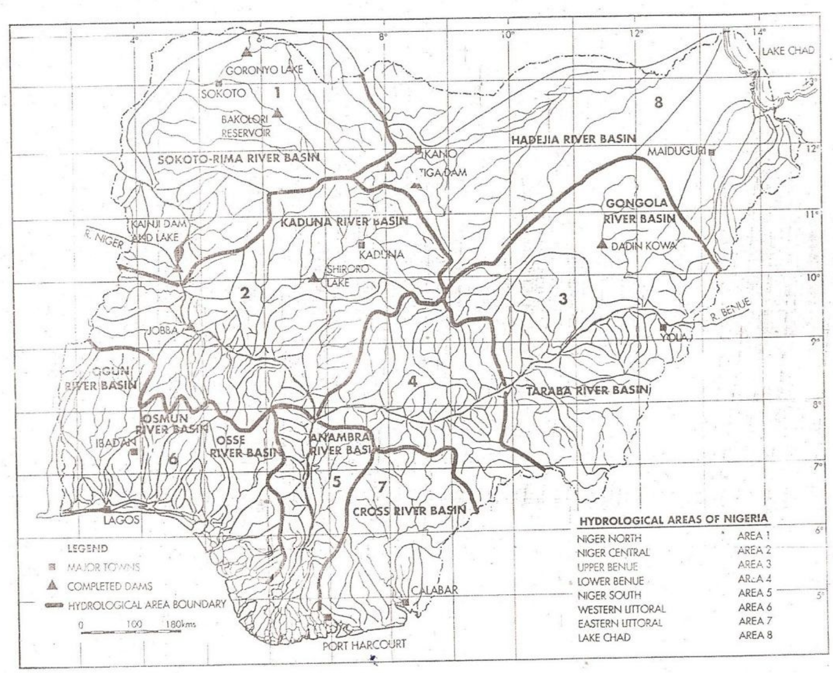


Fig. 1. Hydrological map of Nigeria showing the major inland waters.

Figure 5: Hydrological map of Nigeria showing the major inland waters

Figure 6a-6i: Some trawl fish resources of Nigeria

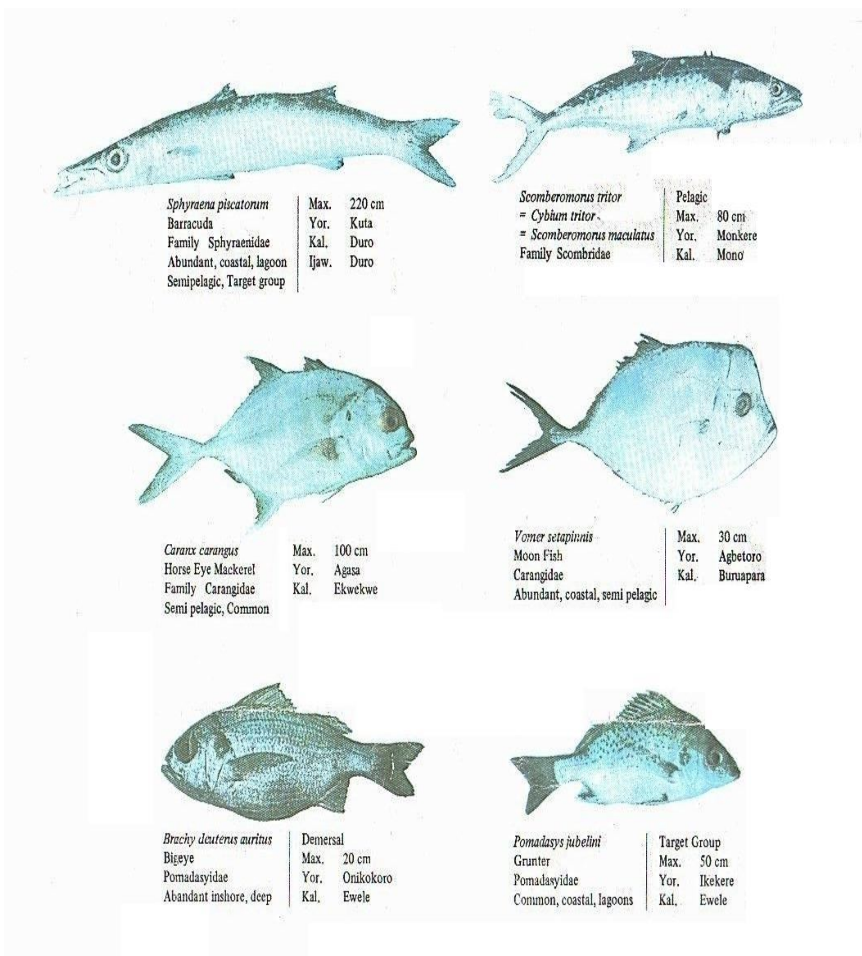


Figure 6a

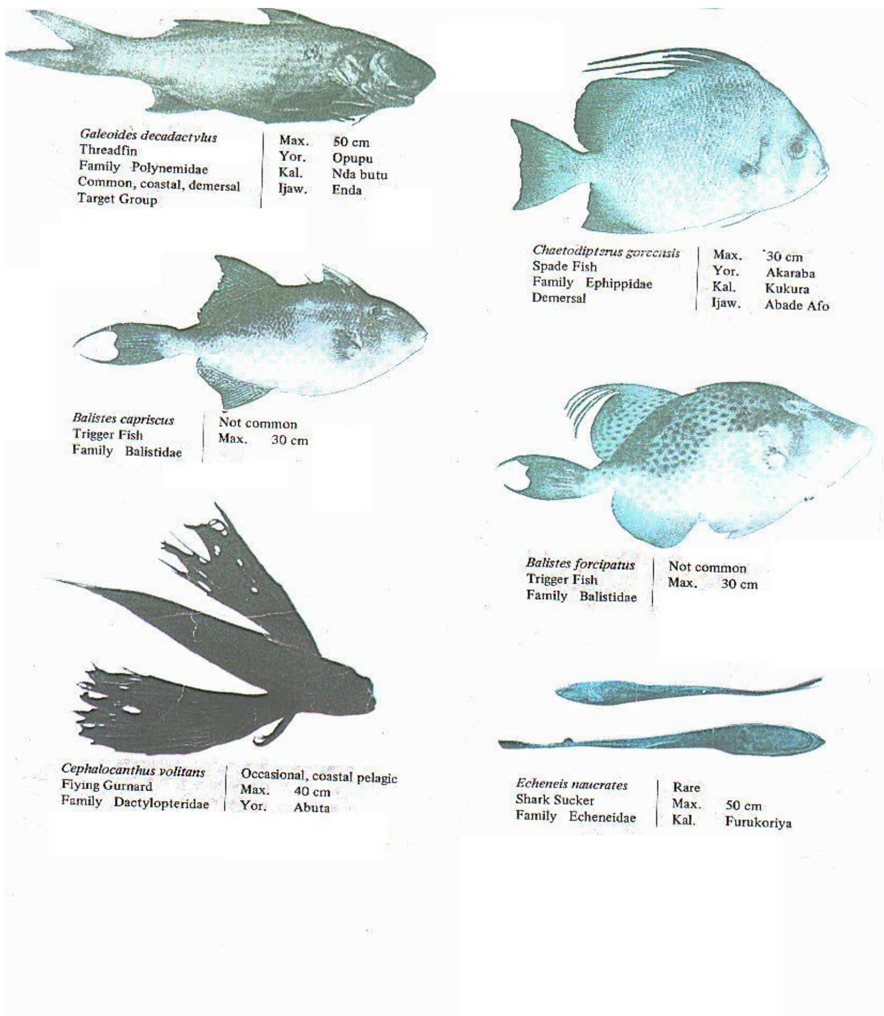

Galeoides decadactylus
Threadfin
Family Polynemidae
Common, coastal, demersal
Target Group
Max. 50 cm
Yor. Opupu
Kal. Nda butu
Ijaw. Enda
Chaetodipterus goreensis
Spade Fish
Family Ephippidae
Demersal
Max. 30 cm
Yor. Akaraba
Kal. Kukura
Ijaw. Abade Afo
Balistes capriscus
Trigger Fish
Family Balistidae
Not common
Max. 30 cm
Balistes forcipatus
Trigger Fish
Family Balistidae
Not common
Max. 30 cm
Cephalocanthus volitans
Flying Gurnard
Family Dactylopteridae
Occasional, coastal pelagic
Max. 40 cm
Yor. Abuta
Echeneis naucrates
Shark Sucker
Family Echeneidae
Rare
Max. 50 cm
Kal. Furukoriya

Figure 6b

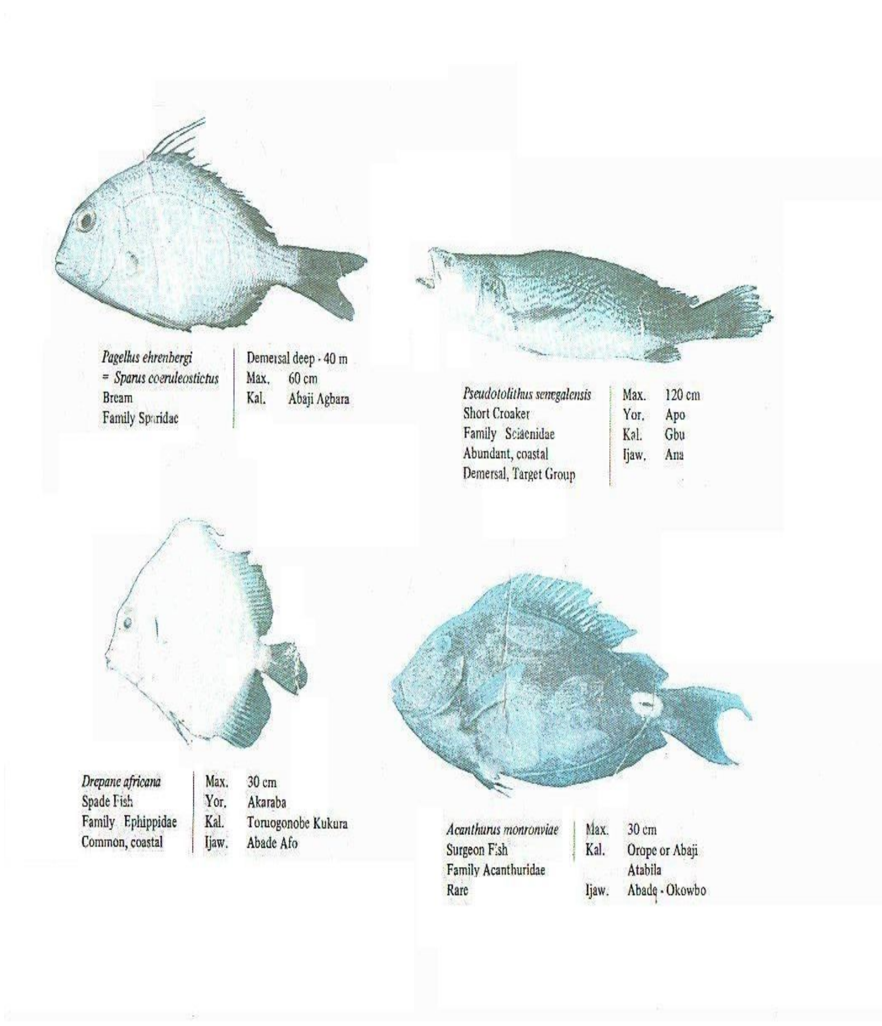

Pagellus ehrenbergi
= Sparus coeruleostictus
Bream
Family Sparidae
Demersal deep - 40 m
Max. 60 cm
Kal. Abaji Agbara
Pseudotolithus senegalensis
Short Croaker
Family Sciaenidae
Abundant, coastal
Demersal, Target Group
Max. 120 cm
Yor. Apo
Kal. Gbu
Ijaw. Ana
Drepane africana
Spade Fish
Family Ephippidae
Common, coastal
Max. 30 cm
Yor. Akaraba
Kal. Toruogonobe Kukura
Ijaw. Abade Afo
Acanthurus monronviae
Surgeon Fish
Family Acanthuridae
Rare
Max. 30 cm
Kal. Orope or Abaji Atabila
Ijaw. Abade - Okowbo

Figure 6c

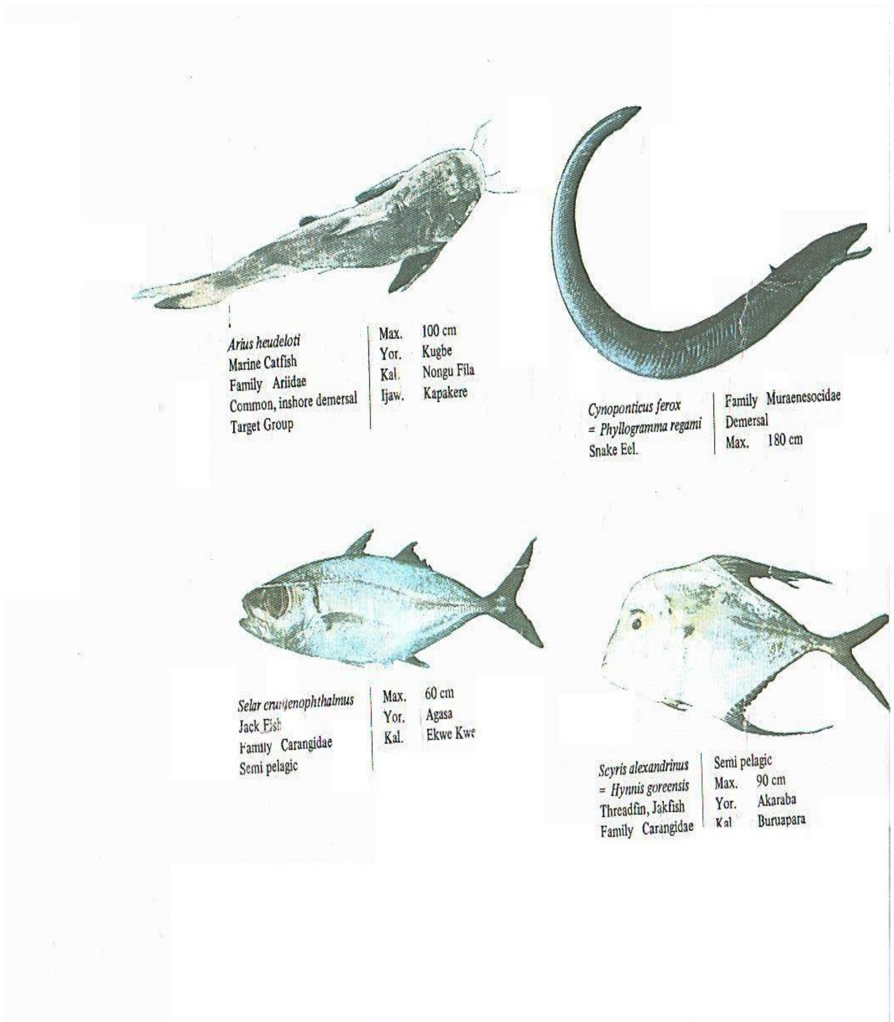

Arius heudeloti
Marine Catfish
Family Ariidae
Common, inshore demersal
Target Group
Max. 100 cm
Yor. Kugbe
Kal. Nongu Fila
Ijaw. Kapakere
Cynoponticus ferox
= Phyllogramma regami
Snake Eel.
Family Muraenesocidae
Demersal
Max. 180 cm
Selar crumenophthalmus
Jack Fish
Family Carangidae
Semi pelagic
Max. 60 cm
Yor. Agasa
Kal. Ekwe Kwe
Scyris alexandrinus
= Hynnis goreensis
Threadfin, Jakfish
Family Carangidae
Semi pelagic
Max. 90 cm
Yor. Akaraba
Kal Buruapara

Figure 6d

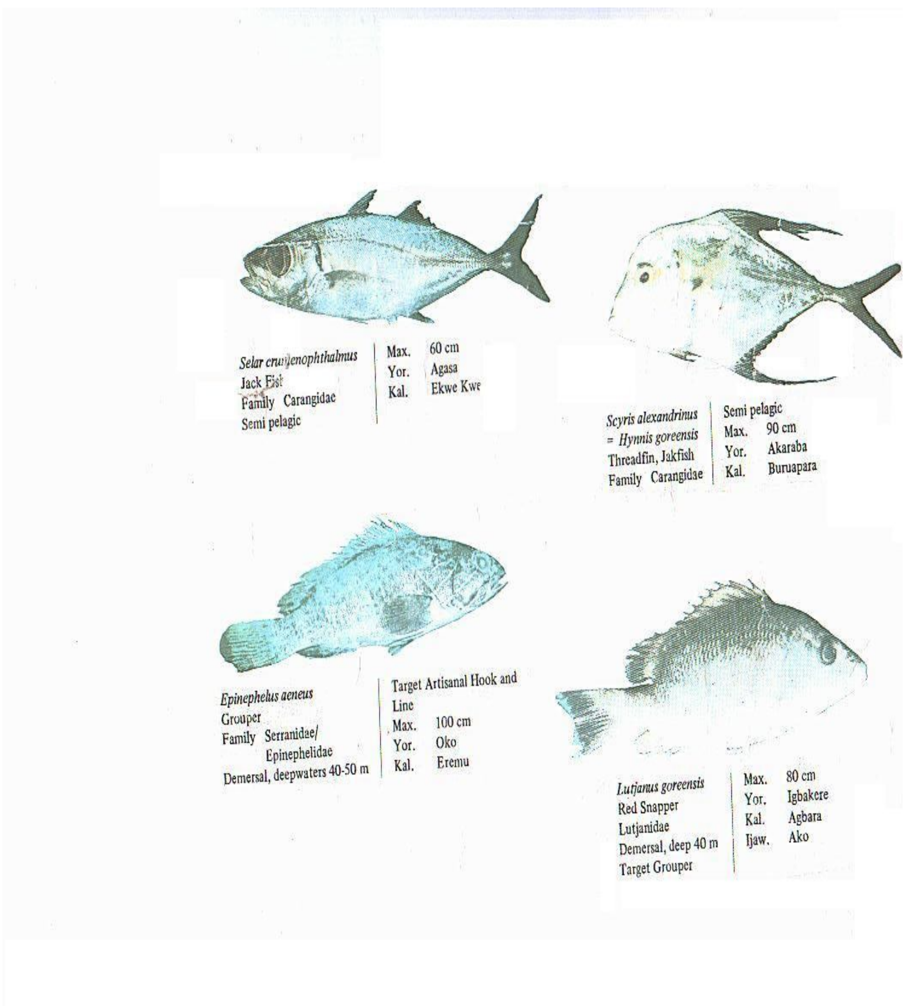

Selar crumenophthalmus
Jack Fish
Family Carangidae
Semi pelagic
Max. 60 cm
Yor. Agasa
Kal. Ekwe Kwe
Scyris alexandrinus
= Hynnis goreensis
Threadfin, Jakfish
Family Carangidae
Semi pelagic
Max. 90 cm
Yor. Akaraba
Kal. Buruapara
Epinephelus aeneus
Grouper
Family Serranidae/
Epinephelidae
Demersal, deepwaters 40-50 m
Target Artisanal Hook and Line
Max. 100 cm
Yor. Oko
Kal. Eremu
Lutjanus goreensis
Red Snapper
Lutjanidae
Demersal, deep 40 m
Target Grouper
Max. 80 cm
Yor. Igbakere
Kal. Agbara
Ijaw. Ako

Figure 6e

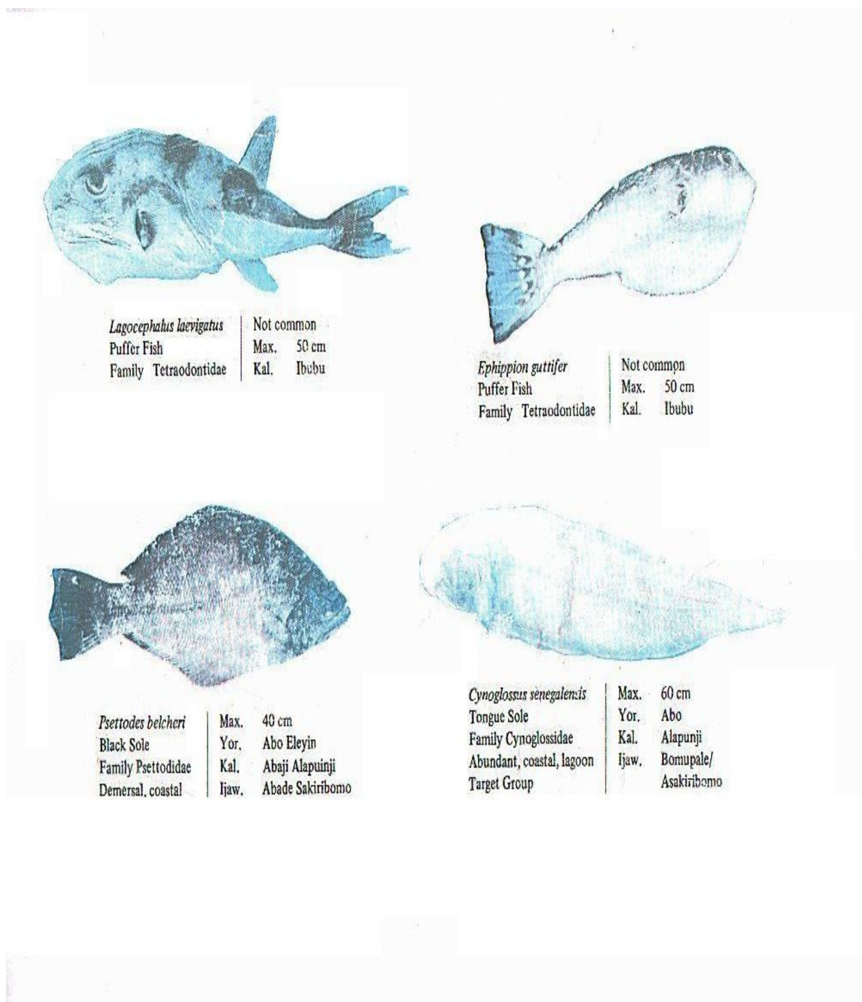

Lagocephalus laevigatus
Puffer Fish
Family Tetraodontidae
Not common
Max. 50 cm
Kal. Ibubu
Ephippion guttifer
Puffer Fish
Family Tetraodontidae
Not common
Max. 50 cm
Kal. Ibubu
Psettodes belcheri
Black Sole
Family Psettodidae
Demersal, coastal
Max. 40 cm
Yor. Abo Eleyin
Kal. Abaji Alapuinji
Ijaw. Abade Sakiribomo
Cynoglossus senegalensis
Tongue Sole
Family Cynoglossidae
Abundant, coastal, lagoon
Target Group
Max. 60 cm
Yor. Abo
Kal. Alapunji
Ijaw. Bomupale/
Asakiribomo

Figure 6f

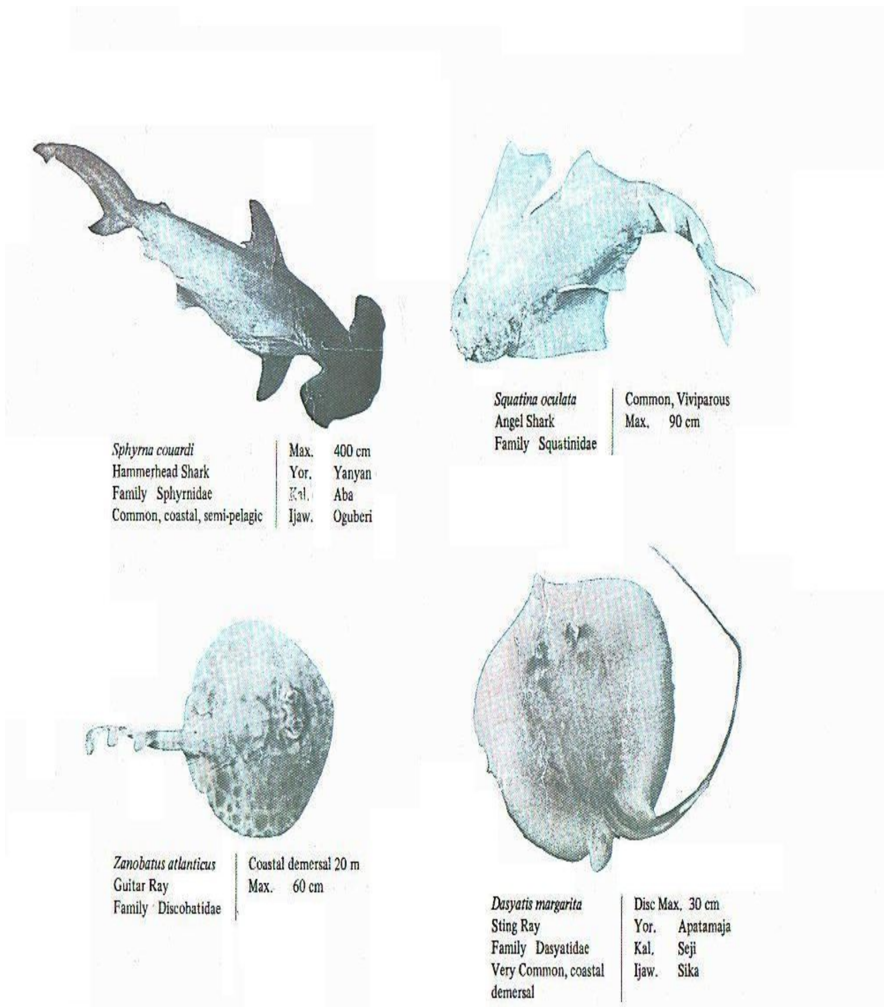

Sphyrna couardi
Hammerhead Shark
Family Sphyrnidae
Common, coastal, semi-pelagic
Max. 400 cm
Yor. Yanyan
Kal. Aba
Ijaw. Oguberi
Squatina oculata
Angel Shark
Family Squatinidae
Common, Viviparous
Max. 90 cm
Zanobatus atlanticus
Guitar Ray
Family Discobatidae
Coastal demersal 20 m
Max. 60 cm
Dasyatis margarita
Sting Ray
Family Dasyatidae
Very Common, coastal demersal
Disc Max. 30 cm
Yor. Apatamaja
Kal. Seji
Ijaw. Sika

Figure 6g

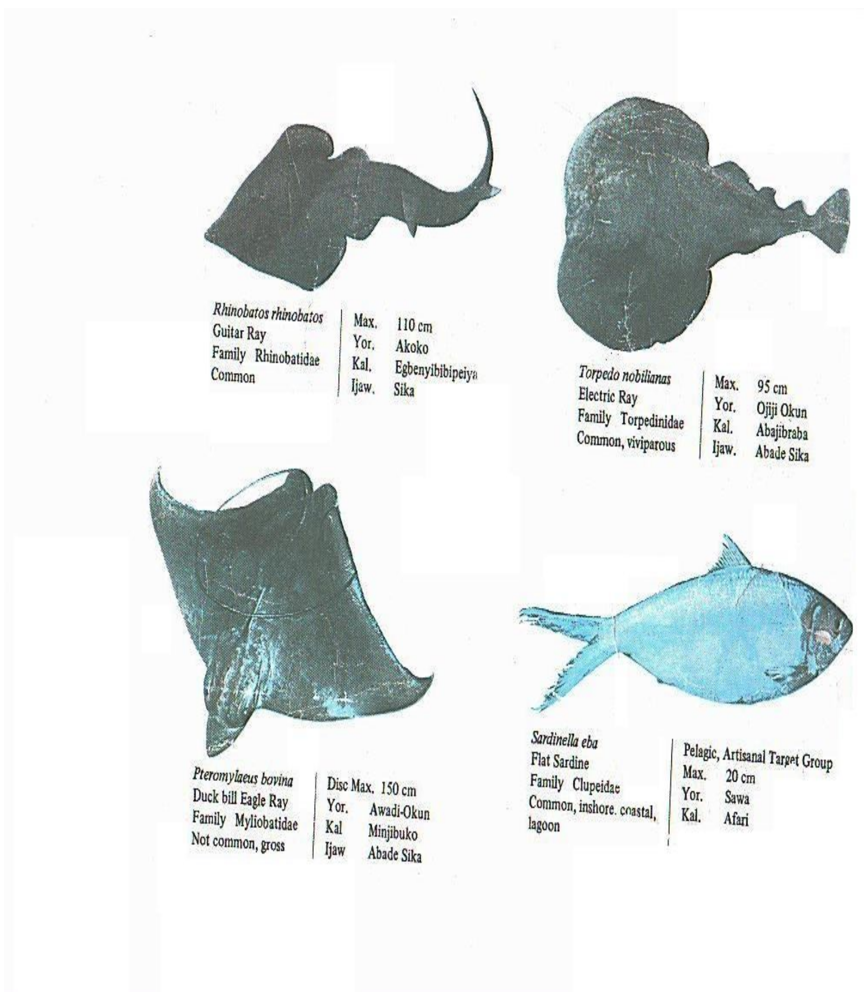

Rhinobatos rhinobatos
Guitar Ray
Family Rhinobatidae
Common
Max. 110 cm
Yor. Akoko
Kal. Egbenyibibipeiya
Ijaw. Sika
Torpedo nobilianas
Electric Ray
Family Torpedinidae
Common, viviparous
Max. 95 cm
Yor. Ojiji Okun
Kal. Abajibraba
Ijaw. Abade Sika
Pteromylaeus bovina
Duck bill Eagle Ray
Family Myliobatidae
Not common, gross
Disc Max. 150 cm
Yor. Awadi-Okun
Kal Minjibuko
Ijaw Abade Sika
Sardinella eba
Flat Sardine
Family Clupeidae
Common, inshore, coastal, lagoon
Pelagic, Artisanal Target Group
Max. 20 cm
Yor. Sawa
Kal. Afari

Figure 6h

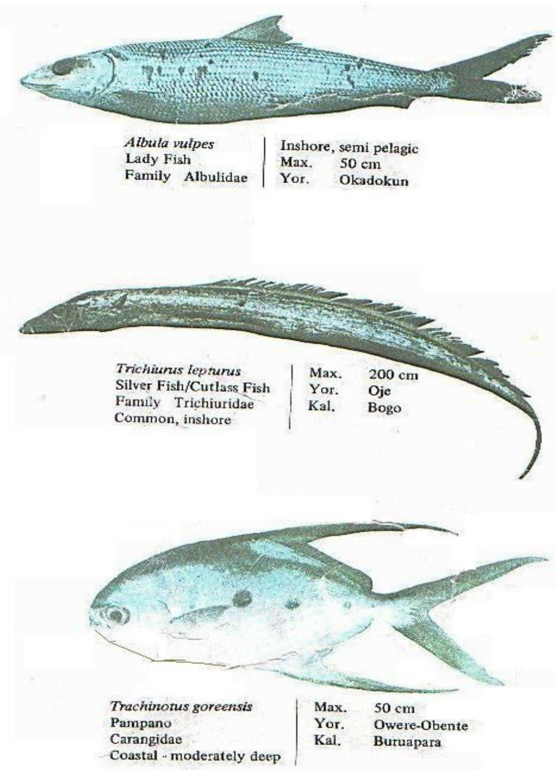

Albula vulpes
Lady Fish
Family Albulidae
Inshore, semi pelagic
Max. 50 cm
Yor. Okadokun
Trichiurus lepturus
Silver Fish/Cutlass Fish
Family Trichiuridae
Common, inshore
Max. 200 cm
Yor. Oje
Kal. Bogo
Trachinotus goreensis
Pampano
Carangidae
Coastal - moderately deep
Max. 50 cm
Yor. Owere-Obente
Kal. Buruapara

Figure 6i

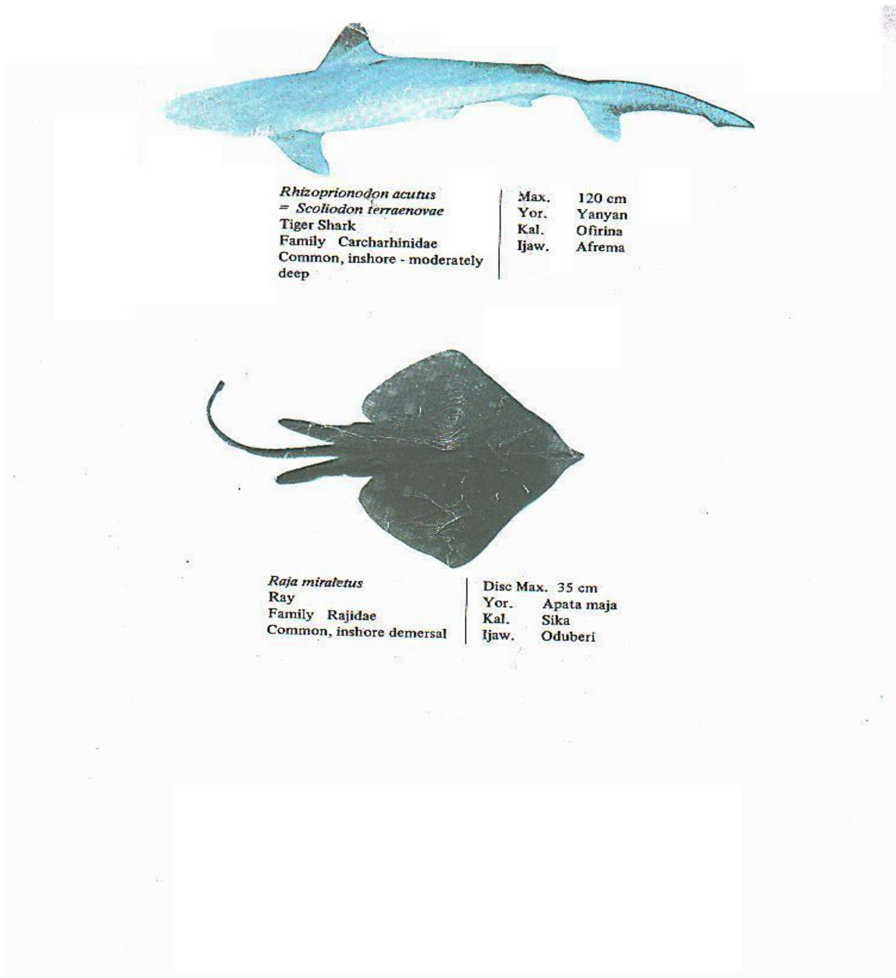

Rhizoprionodon acutus
= Scoliodon terraenovae
Tiger Shark
Family Carcharhinidae
Common, inshore - moderately deep
Max. 120 cm
Yor. Yanyan
Kal. Ofirina
Ijaw. Afrema
Raja miraletus
Ray
Family Rajidae
Common, inshore demersal
Disc Max. 35 cm
Yor. Apata maja
Kal. Sika
Ijaw. Oduberi

Figure 6j

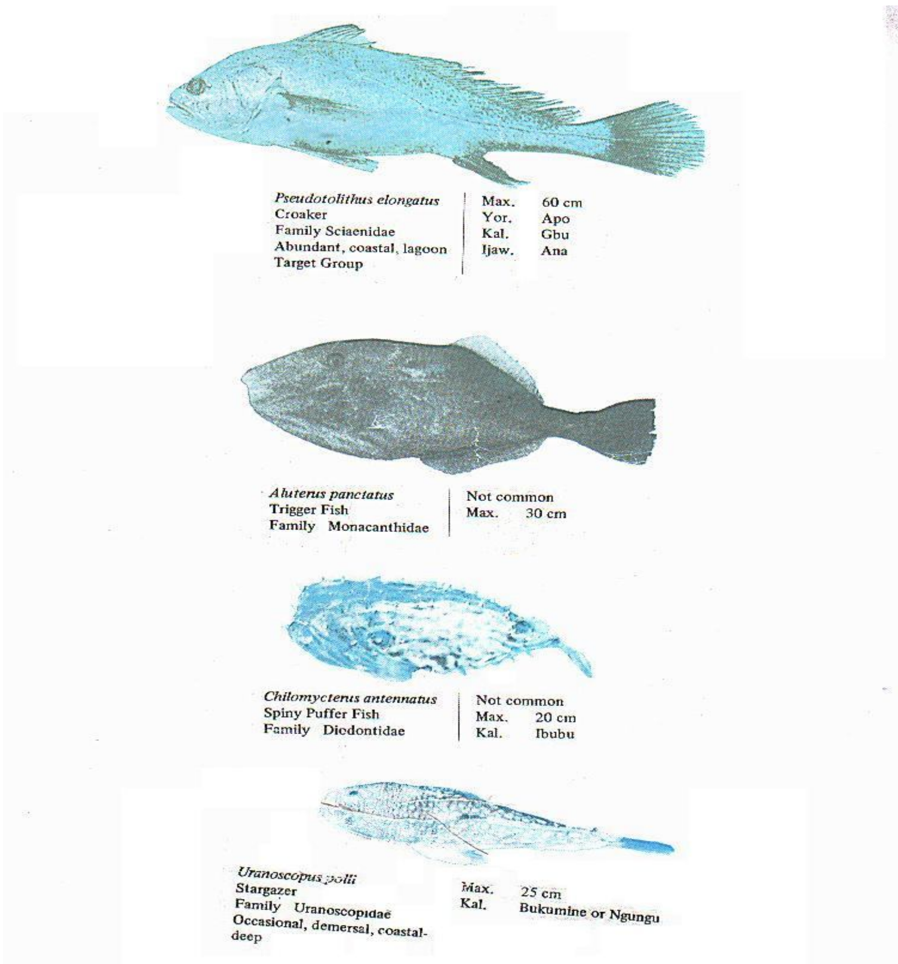

Pseudotolithus elongatus
Croaker
Family Sciaenidae
Abundant, coastal, lagoon
Target Group
Max. 60 cm
Yor. Apo
Kal. Gbu
Ijaw. Ana
Aluterus panctatus
Trigger Fish
Family Monacanthidae
Not common
Max. 30 cm
Chilomycterus antennatus
Spiny Puffer Fish
Family Diodontidae
Not common
Max. 20 cm
Kal. Ibubu
Stargazer
Family Uranoscopidae
Occasional, demersal, coastal-deep
Max. 25 cm
Kal. Bukumine or Ngungu

Figure 6k

Table 2(a): Percentage contribution of each sub-sector to domestic fish production (1995 – 2007)

Sub-sectors/ year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Ar-tisanal %	320,955	309,200	360,219	433,070	426,786	418,069	433,537	450,965	446,203	434,830	490,594	518,537	504,227
	86.5	86.9	87.2	89.6	89	89.5	89.1	88.1	87.4	85.4	84.7	81.4	81.9
Aqua-culture %	16,619	19,490	25,264.6	20,458	21,737.6	25,720.1	24,398	30,664.0	30,677	43,950	56,355	84,533	85,087
	4.5	5.5	6.1	4.2	4.5	5.5	5.0	6.0	6.0	8.8	9.7	13.3	13.8
Indus-trial %	33,479	27,244	27,703	29,954.56	31,139.40	23,308.3	28,378	30,091	33,882	30,421	32,595	33,778	26,193
	9	7.7	6.7	6.2	6.5	5.0	5.8	5.9	6.6	6.0	5;.6	5.3	4.3
GRAND TO-TAL	371,053	355,934	413,187.6	483,482.3	479,663	467,098	486,313	511,720	510,762	509,201	579,544	636,848	615,507

<u>Source:</u> Federal Ministry of Agriculture and Water Resources, Fisheries Department

Table 2(b): Nigerian fish production by Sector 2009 (tonnes)

Artisanal	508,210
Coastal fisheries	288,229
Inland	309,981
Aquaculture	152,796
Industrial	29,698
Fish (Inshore)	18,820
Shrimp (Inshore)	10,878
Distant water (Importation)	946,851

Source: Federal Department of Fisheries, Abuja

At present, barely 40 percent of its arable land and less than 5 percent of its suitable water bodies are being utilized for food and fish production respectively. Nigeria which was somehow self-sufficient in food production within the first decade of independence has become heavily dependent on food imports. In 2009, Oxfam, a British Charity Organization estimated that Nigeria was spending three billion dollars ($3 billion) on food imports (including about US #1 billion on fish). Whereas, agriculture still engages about 65 percent of the working population. A Punch Newspaper Editorial on October 3, 2010 described Nigeria as being seen as a classic case of "**resource curse" –** the despoliation and impoverishment of a people through unenlightened exploitation and utilization of riches accruing from a highly valued resource. This scenario undoubtedly should give fisheries and other fish- related activities operators (researchers and administrators involved in policy and governance especially in relation to employment generation, poverty alleviation and food security) – **FISH FOR THOUGHT** – considering just one unique example of the "miraculous agricultural development" in Israel – a country which is more than half-desert where water is in constant short supply. Israel Information Centre (1995) reported that the annual renewable water resources in Israel amounted to some 1.6 billion m^3, about 75 percent of which was used for agriculture. (**NB: Ando's estimate for Nigeria is 34 billion m^3).** The Israeli success was said to be in the determination and ingenuity of farmers and scientists who dedicated themselves to developing a flourishing agriculture in a near-desert country, thus demonstrating that the real value of land (also water) is a **function of HOW it is utilized.** The word HOW brings to mind basic questions commonly referred to as the "five W's and the How" questions. Effective planning involves the answering of these questions, and in turn these answers provide the basic ingredients of planning (Fig 8). These questions, one way or the other will be addressed appropriately but very briefly during the course of this lecture.

3.0 FISH FOR THOUGHT

3.1 Preamble

In order to think deeply about fish (or is it fish for thought) a comprehensive report will be given on global fish production and the place of Nigeria in the contribution of African continent.

3.2 World Fisheries Production and Utilization

FAO (2010) reported that capture fisheries and aquaculture supplied the world with about 142 million tonnes of fish in 2008 (Table 3). Eighty-one percent (115 million tonnes of this was used as human food providing an estimated apparent per capita supply of about 17kg (live weight equivalent), which is an all-time high (Table 3). Forty- six percent of the total food fish supply came from aquaculture, which is a slightly lower proportion than reported in the State of World Fisheries and Aquaculture 2008 owing to a major downward revision of aquaculture and capture fishery production statistics by China, but representing a continuing increase from 43 percent in 2006. Outside China, per capita supply has remained fairly static in recent years as growth in supply from aquaculture has offset a small decline in capture fishery production and a rising population (Table 4). In 2008, per capita food fish supply was estimated at 13.7kg if data for China are excluded. In 2007 fish accounted for 15.7 per cent of the global population's intake of animal protein and 6.1 percent of all protein consumed. Fish per caput (annual) consumption in **Nigeria** was 9.68kg in 2007 (Federal Department of Fisheries, 2009) Globally, fish provides more than 1.5 billion people with almost 20 percent of their average per capita intake of animal protein, and 3.0 billion people with at least 15 percent of such protein. In 2007, the average annual per capita apparent fish supply in developing countries was 15.1kg and 14.4kg in low-income food – deficit countries (LIFDCs) which have a relatively low consumption of animal protein.

However in **Nigeria,** intake of animal protein presently is about 4.82g per capita per day (i.e. about 1.76kg per capita per year!) as against 35g (12.78kg per capita per year) recommended by FAO. This is "**fish for thought"!** Federal Department of Fisheries (2009) however as earlier stated reported a **fish** per capita consumption (annual) of 9.68kg which translates to 26.502g per capita per day. But does this represent the fish consumption by the Nigerian upper-class mainly or the masses since there seems to be no "middle class" again!. However, FAO (2010) reported that in LIFDCs, which have a relatively low consumption of animal protein, the contribution of fish to total animal protein intake was significant at 20.1 percent – and is probably higher than that indicated by official statistics in view of the under-recorded contribution of small-scale and subsistence fisheries.

China remains till date the largest fish-producing country, with provision of 47.5 million tonnes in 2008 (32.7 and 14.8 million tonnes from aquaculture and capture fisheries respectively). These figures were derived from a revised statistical methodology adopted by China in 2008 for all capture fishery and aquaculture production statistics and applied to statistics for year 2006 onward.

Table 3: Nigeria's petroleum, natural gas, coal & other issues

Proven Oil Reserves (January 1, 2010)	37.2 billion barrels (Oil and Gas Journal)
Oil Production (2009)	2.21 million barrels per day, of which 1.8 million bbl was crude oil.
Oil Consumption (2009)	280 thousand barrels per day
Crude Oil Refining Capacity (2010)	505 thousand barrels per day
Major Refineries	Port Harcourt-Rivers State (150,000), Kaduna (110,000), Warri (125,000), Port Harcourt-Alesa Eleme (120,000),
Proven Natural Gas Reserves (January 1, 2010)	188 trillion cubic feet (Oil and Gas Journal)
Natural Gas Production (2008)	1,159 billion cubic feet
Natural Gas Consumption (2008)	432 billion cubic feet
Recoverable Coal Reserves (2006)	210 million short tons (World Energy Council)
Coal Production (2008)	0.009 million short tons
Coal Consumption (2008)	0.012 million short tons
Electricity Installed Capacity (2007E)	5.898 gigawatts
Total Energy Consumption (2007E)	4 quadrillion Btus*, of which Combustible Renewables and Waste (80.2%), Natural Gas (9.9%), Oil (9.4%), Hydroelectricity (0.5%), Coal (0%), Nuclear (0%) (IEA data)
Total Per Capita Energy Consumption (2006)	7.8 million Btus
Energy Intensity (2007)	5,000 Btu per $2005-PPP**

Environmental Overview

Energy-Related Carbon Dioxide Emissions (2008)	101 million metric tons
Per-Capita, Energy-Related Carbon Dioxide Emissions (2006)	0.8 metric tons
Carbon Dioxide Intensity (2008)	0.86 Metric tons per thousand $2005-PPP**

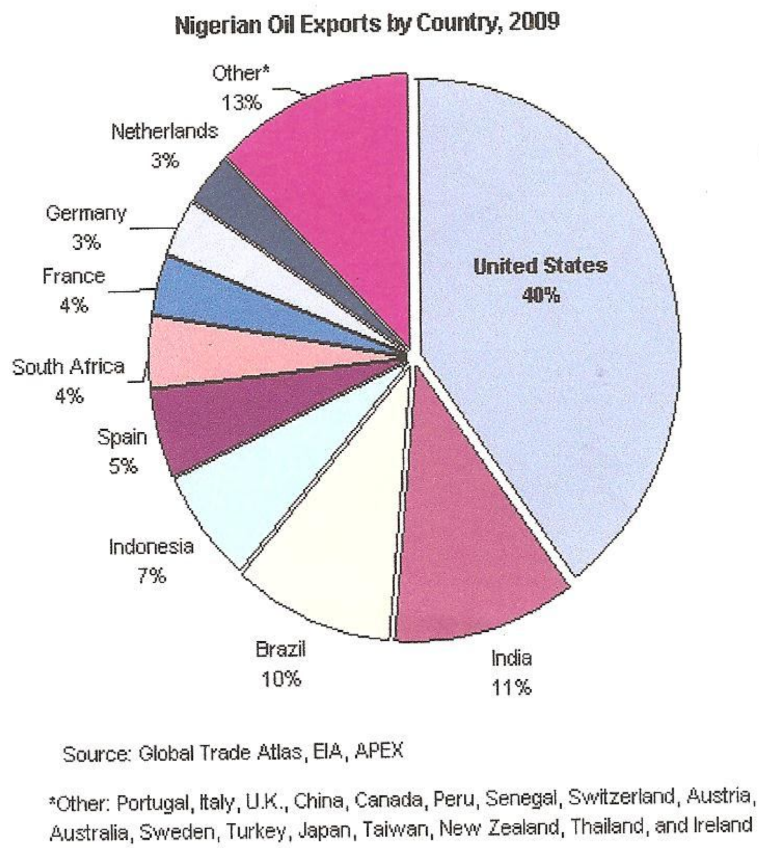

Nigerian Oil Exports by Country, 2009
Other*
13%
Netherlands
3%
Germany
3%
France
4%
South Africa
4%
Spain
5%
Indonesia
7%
Brazil
10%
India
11%
United States
40%
Source: Global Trade Atlas, EIA, APEX
*Other: Portugal, Italy, U.K., China, Canada, Peru, Senegal, Switzerland, Austria, Australia, Sweden, Turkey, Japan, Taiwan, New Zealand, Thailand, and Ireland

Figure 7

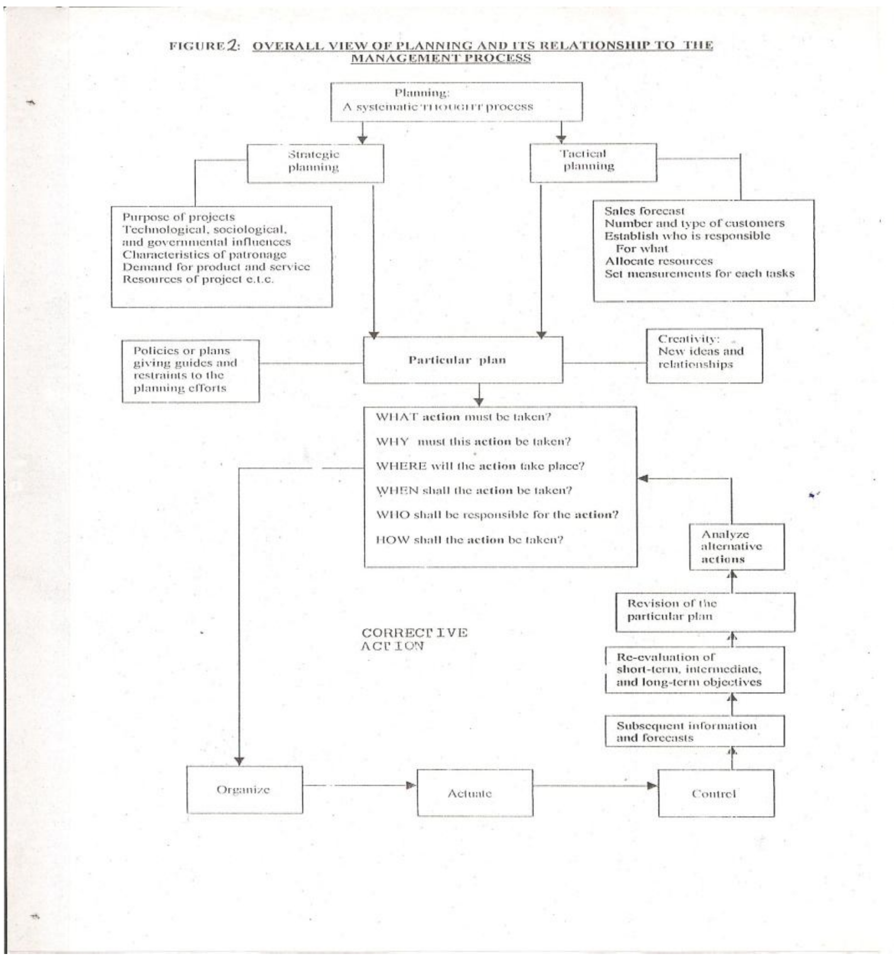


Figure 8: Overall view of planning and its relationship to the management process

Table 4: World fisheries and aquaculture production and utilization

PRODUCTION	2004	2005	2006	2007	2008	2009
INLAND	(Million tonnes)					
Capture	8.6	9.4	9.8	10.0	10.2	10.1
Aquaculture	25.2	26.8	38.7	30.7	32.9	35.0
Total Inland	33.8	36.2	38.5	40.6	43.1	45.1
MARINE						
Capture	83.8	82.7	80.0	79.9	79.5	79.9
Aquaculture	16.7	17.5	18.6	19.2	19.7	20.1
Total marine	100.5	100.1	98.6	99.2	99.2	100.0
TOTAL CAPTURE	92.4	92.1	89.7	89.9	89.7	90.0
TOTAL AQUACULTURE	41.9	44.3	47.4	49.9	52.5	55.1
TOTAL WORLD FISHERIES	134.3	136.4	137.1	139.8	142.3	145.1
UTILIZATION						
Human consumption	104.4	107.3	110.7	112.7	115.1	117.8
Non-food uses	29.8	29.1	26.3	27.1	27.2	27.3
Population (billion)	6.4	6.5	6.6	6.7	6.8	6.8
Per capita food fish supply (kg)	16.2	16.5	16.8	16.9	17.1	17.2

Note: Excluding aquatic plants. Data for 2009 are provisional estimates

Table 5: World fisheries and aquaculture production and utilization, excluding China

PRODUCTION INLAND	2004	2005	2006	2007	2008	2009
	(Million tones)					
Capture	6.5	7.2	7.6	7.7	8.0	7.9
Aquaculture	8.9	9.5	10.2	11.0	12.2	12.9
Total Inland	15.4	16.7	17.7	16.7	20.1	20.8
MARINE						
Capture	71.4	70.3	67.5	67.5	67.0	67.2
Aquaculture	6.5	6.7	7.3	7.5	7.6	8.1
Total marine	77.9	77.0	74.8	75.0	74.6	75.3
TOTAL CAPTURE	77.9	77.5	75.1	75.2	74.9	75.1
TOTAL AQUACULTURE	15.3	16.2	17.5	18.5	19.8	21.0
TOTAL WORLD FISHERIES	93.2	93.7	92.6	93.7	94.8	96.1
UTILIZATION						
Human consumption	68.8	70.4	72.4	73.5	74.3	75.5
Non-food uses	24.5	23.2	20.2	20.2	20.5	20.5
Population (billions)	5.2	5.2	5.3	5.4	5.4	5.5
Per capita food fish supply (kg)	13.4	13.5	13.7	13.7	13.7	13.7

Note: Excluding aquatic plants. Data for 2009 are provisional estimates

3.3 World Capture Fisheries

Global capture fisheries production in 2008 was about 90 million tonnes, with an estimated first-sale value of US $93.9 billion, comprising about 80 million tonnes from marine waters and a record 10 million from inland waters (Table 3 and Figure 9). The inland fisheries sector is extremely diverse. It involves a wide variety of fishing techniques, ranging from simple hand-held gear (e.g. twin clap nets – homa, koma, or foma used in catching *Lates niloticus* during Argungu Fishing Festival in Kebbi State, Nigeria) to small trawls or purse seines operated by commercial fishing vessels. Inland fisheries include commercial and industrial fisheries, small-scale fisheries and recreational fisheries, each with a different economic and social structure. China remained by far, the global leader (in capture fisheries) with production of about 15 million tonnes (Figure 10). Global inland capture fisheries production was fairly stable between 2000 and 2004 at about 8.6 million tonnes, but in the following four years it showed an overall increase of 1.6 million tonnes, reaching 10.2 million tonnes in 2008 (Table 3). Asia and **Africa** accounted for 66.4% and 24.5% of the world production respectively (Figure 11). The variations between 2004 and 2008 for the 14 countries (**including Nigeria as 8th**) with catches of more than 200,000 tonnes each in 2008 and which together represented about 78 percent of the 2008 world catches are shown in Table 5. Inland fisheries are a vital component in the livelihood of people in many parts of the world, in both developing and developed countries. However, irresponsible fishing practices habitat loss and degradation, dam construction, drainage of wetlands and pollution (including eutrophication) often act together, thus compounding one another's effects. These factors have resulted in substantial declines and other changes in inland fishery resources.

The top 15 producers are shown in Table 6 harvesting 92-4 percent of total world production of food fish from aquaculture. Indonesia replaced Thailand as the fourth largest producer. Philippines and Japan were in the 9th and 10th positions respectively followed by Egypt(11th).

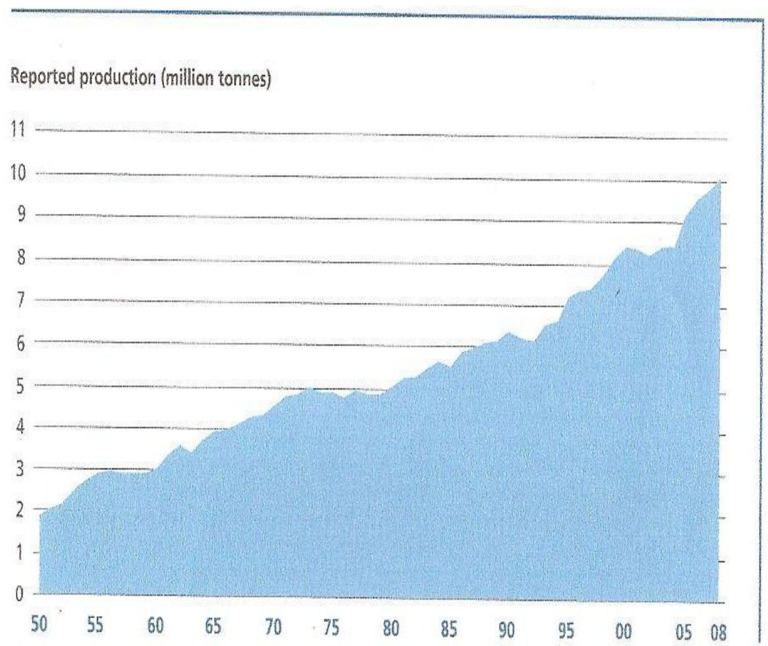
In 2008, fresh water fishes continued to dominate with a production of 28.8 million tonnes (54.7 per cent) valued at US $40.5 billion (41.2 percent) followed by molluscs (13.1 million tonnes), crustaceans (5 million tones), diadromous fishes (3.3 million tones), marine fishes (1.8 million tonnes) and other aquatic animals (0.6 million tonnes). The production of freshwater fishes in 2008 was dominated by carps (Cyprinidae, 20.4 million tonnes or 71.1 percent). A small portion (2.4 percent) of fresh water fishes was cultured in brackish water, including **tilapia** farmed in Egypt. In 2008, the largest producer of all carps was China (70.7 per cent) followed by India (15.7 percent). Other aquatic species produced were:

- **molluscs** (oysters, 31.8 percent; carpet shells and clams, 24.6 percent; mussels, 12.4 percent; and scallops, 10.7 percent).
- **Crustaceans** in brackish water (2.4 million tonnes or 47.7 percent), freshwater (1.9 million tonnes or 38.2% percent) and marine water (0.7 million tonnes or 14.1 percent).

Generally aquaculture has benefited to a great degree from cost reductions through productivity gains, whereas capture fisheries have at times suffered from rising energy costs.

3.4 World Aquaculture

Aquaculture continues to be the fastest growing animal food-producing sector and to outpace population growth, with per capita supply from aquaculture increasing from 0.7kg in 1970 to 7.8kg in 2008 – an average annual growth rate of 6.6 per cent. **It is set to overtake capture fisheries as a source of food fish.** While aquaculture production (excluding aquatic plants) was less than 1 million tonnes per year in the early 1950s, production in 2008 was 52.5 million tonnes with a value of US $98.4 billion (Table 3). World aquaculture is heavily dominated by the Asia- Pacific region, which accounts for 89 per cent of production in terms of quantity and 79 percent in terms of value. This dominance is mainly because of China's enormous production, which accounts for 62 percent of global production in terms of quantity and 51 percent of global value.



Source: FAO. 2010. FishStat Plus – Universal software for fishery statistical time series (online or CD-ROM) (available at: www.fao.org/fishery/statistics/software/fishstat/en).

Figure 9: Production in inland fisheries reported by FAO since 1950

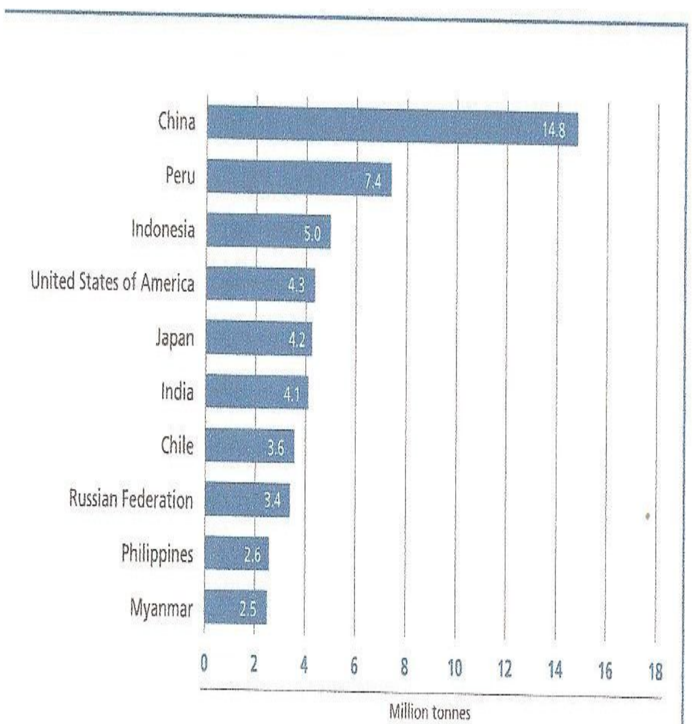


Figure 10: Marine and inland capture fisheries: Top ten countries in 2008

Table 6: Inland capture fisheries: major producer countries

Country	2004 (Tonnes)	2008 (Tonnes)	Variation 2004 – 2008	
			Tonnes	Percentage
China	2,087.167	2,248,177	151,010	7.2
Bangladesh	732,067	1,060,181	328,114	44.8
India	527,290	953,106	425,816	80.8
Myanmar	454,260	814,740	360,480	79.4
Uganda	371,789	450,0001	78,211	21.0
Cambodia	250,000	365,000	115,000	46.0
Indonesia	330,879	323,150	-7,729	-2.3
Nigeria	182,264	304,413	122,149	67.0
United Republic of Tanzania	312,040	281,690	-30,350	-9.7
Brazil	246,101	243,0001	-3,101	-1.3
Egypt	282,099	237,572	-44,527	-15.8
Thailand	203,200	231,100	27,900	13.7
Democratic Republic of the Congo	231,7721	230,0001	-1,772	-0.8
Russian Federation	178,403	216,841	38,438	21.5

[1] FAO estimate

Table 7: Top 15 aquaculture producers by quantity in 2008 and growth

	Production			Average annual rate of growth		
	1990	2000	2008	1990-2000	2000-2008	1990-2008
	(Thousand tonnes)			(Percentage)		
China	6,482	21,522	32,736	12.7	5.4	9.4
India	1,017	1,943	3,479	6.7	7.6	7.1
Viet Nam	160	499	2,462	12.0	22.1	16.4
Indonesia	500	789	1,690	4.7	10.0	7.0
Thailand	292	738	1,374	9.7	8.1	9.0
Bangladesh	193	657	1,006	13.1	5.5	9.6
Norway	151	491	844	12.6	7.0	10.0
Chile	32	392	843	28.3	10.1	19.8
Philippines	380	394	741	0.4	8.2	3.8
Japan	804	763	732	-0.5	-0.5	-0.3
Egypt	62	340	694	18.6	9.3	14.4
Myanmar	7	99	675	30.2	27.1	28.8
United States of America	315	456	500	3.8	1.2	2.6
Republic of Korea	377	293	474	-2.5	6.2	1.3
Taiwan Province of China	333	244	324	-3.1	3.6	-0.2

Note Data exclude aquatic plants

3.5 Income and Livelihood
The fish sector is a source of income and livelihood for millions of people around the world: Employment in aquaculture and fisheries has grown substantially in the last three decades, with an average rate of increase of 3.6 percent per year since 1980. It is estimated that, in 2008, **44.9 million people** were directly engaged, full time or more frequently, part time, in capture fisheries or in aquaculture, and **at least 12 percent of these were women.** It is also estimated that for each person employed in capture fisheries and aquaculture production, about three jobs are produced in secondary activities, including post-harvest, for a total of more than 180 million jobs in the whole of the fish industry. Thus, the primary and secondary sectors support the livelihood of a total of about 540 million people or 8**.0 percent of the world population.**

Employment in the fisheries sector has grown **faster** than the world's population and **than** employment in traditional agriculture. The 44.9 million people engaged in the sector in 2008 represented 3.5 percent of the 1.3 billion people economically active in the broad agriculture sector worldwide, compared with 1.8 percent in 1980. The majority of fishers and aquaculturists are in developing countries, mainly in Asia, which has experienced the largest increases in recent decades. FAO (2010) reported that in 2008, 85.5 percent of fishers and fish farmers were in Asia, followed by **Africa (9.3%),** Latin America and the Caribbean (2.9%), Europe (1.4%), North America (0.7%) and Oceania (0.1%). China, as expected, is the country with the highest number of fishers and fish farmers, representing nearly one-third of the world total. It is worthy of note that employment in fishing is decreasing in capital- intensive economies, in particular in most European countries, North America and Japan. This is the result of several factors, including decreased catches, programmes to reduce fishing capacity and increased productivity through technical progress. It is estimated that about 1.3 million people were employed in aquaculture and fisheries in developed countries in 2008, a decrease of 11 percent compared with 1990.

3.6 Global Fishing Fleet

Analyses indicated that the global fishing fleet was made up of about 4.3 million vessels and that this figure had not increased substantially from an FAO estimate of a decade ago. About 59% of these vessels were powered by engines. The remaining 41% were traditional craft of various types, operated by sails and oars, concentrated primarily in Asia (77 percent) and Africa (20 percent). These un-motorized boats are engaged in fishing operations, usually inshore or on inland waters.

3.7 Trade in fish

Trade in fish represents a significant source of foreign exchange earnings, aside from the sector's important role in food security, income generation and employment. In the year 2008, trade in fish and fishery products represented about 10 percent of total agricultural exports and 1 percent of world merchandise trade in value terms. The share of aquaculture and fishery production (live weight equivalent) entering international trade as various food and feed products increased from 25% in 1976 to 39% in 2008. Exports of fish and fishery products reached a record value of US $102.0 billion, 9% higher than in 2007, almost double the US $51.5 billion correspond value in 1998. Prices for fish species from capture fisheries increased more than those for farmed species because of the larger impact from higher energy prices in fishing vessel operations than on farmed species. The FAO Fish Price Index showed a drastic drop from September 2008 to March 2009 with the global financial crisis and recession, after which it recovered somewhat.

NB. Recently, Food Price Watch , a quarterly report by the World Bank reported that the global food price index has risen by around 15 percent between October, 2010 and January, 2-11. The index is now 29 percent above its level a year earlier and only 3 percent less than its peak level in 2008 (during the global economic crisis).

Preliminary estimates indicate that trade in fish and fishery products declined by 7% in 2009 compared with 2008. Available data for the first few months of

2010 indicate that there have been increasing signs that fish is recovering in many countries and the long term forecast for fish trade remains positive, with a growing share of fish production entering international markets.

China, Thailand and Norway are the **top three fish** exporters. Since 2002, China has been by far the leading fish exporter, contributing almost 10% of 2008 world exports of fish and fishery products, or about US $10.1 billion and increasing further to US $10.3 billion in 2009. World imports of fish and fish products reached the new record of US $107.1 billion in 2008, growing by 9 percent compared with previous year. Preliminary data for 2009 point to a 9% decrease, as a consequence of the economic downturn and the contraction in demand in key importing countries. European Union, Japan and the United States of America are the **major markets**, with a total share of about 69% in 2008. Japan is the world's largest single national importer of fish and fishery products, with imports valued at US $14.9 billion in 2008, a growth of 13% compared with 2007, although its imports decreased by 8% in 2009. **Nigeria's** fish imports for 2008, to reiterate was US $1.0 billion only. It is note worthy, however, that Japan has two Universities of Fisheries:

- National Fisheries University, Shimonosaki; and
- Tokyo University of Fisheries, Tokyo.

By value, Africa has been a net exporter since 1985, but it is a net importer in quantity terms, reflecting the lower unit value of the imports (mainly small pelagic). High-value species such as shrimp, prawns, salmon, tuna, sea-bass etc are highly traded, in particular as exports to more affluent economies, and low-value species such as small pelagics are also traded in large quantities. Products derived from aquaculture production are contributing an increasing share of total international trade in fishery commodities, with species such as **shrimp, prawns,** salmon, molluscs, **tilapia, catfish,** sea-bass and sun-bream. Central Bank of Nigeria (2010 reported **fish/shrimp** products earning N6.8718 billion in 2009 being the 3rd largest agricultural product after cocoa, beans and rubber. (Figures 11,12 & 13)

Globally, shrimps continue to be the largest single commodity in value terms accounting for 15 percent of the total value of internationally traded fishery products.

3.8 Others: Mental illness and Cancer

Mental illness ,depression and cancer are increasing globally. Some experts predict that they will become a major burden or challenge in terms of global health, especially in the developed world. In 2004, mental health overtook heart disease as the leading health problem in Europe and was estimated to cost Euro 386 billion a year. More recent studies suggest that consumption of seafood and in particular long-chain n-3 poly unsaturated fatty acids (LC n-3 PU-

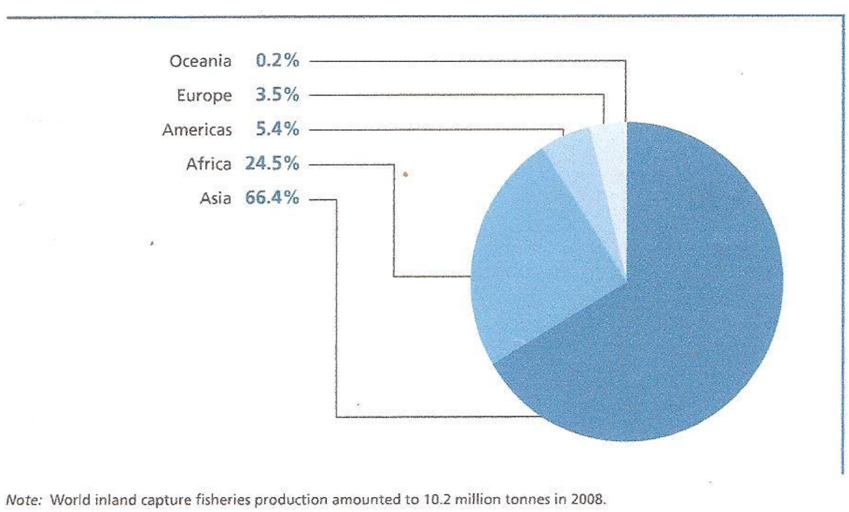


Figure 11: Inland capture fisheries by continent in 2008

Figure 12: Shrimps from 0yan Lake, Nigeria

Figure 13: Fresh catfish on sale at Olomore Freshfish Market, Abeokuta

New research also suggests that cancer patients undergoing chemotherapy may be able to avoid the attendant muscle loss and malnutrition by taking fish oil supplements that contain omega-3-fatty acids.

4.0 FISH IN DEED

4.1 Preamble

This author (or Inaugural Lecturer) in the brief account of his stewardship as Acting Head of UNAAB Department of Aquaculture and Fisheries Management (16th May to 18th November, 2001) titled:" **FISH FOR THOUGHT: The Giant Strides "(**Otubusin, 2002) listed the goals of the Department (AQFM) to include *inter-alia*.

- Strategies for rational exploitation of capture fisheries resources of Nigeria;
- Sustained research and development of high quality fast-growing fish seeds for stocking of small-to-large scale fish production systems like ponds, cages, pens, raceways, re-circulating system and other enclosures (including small reservoirs).
- Development of cost-effective and efficient fish feeds using locally available ingredients;
- Development of functional and durable but affordable fish culture systems for a large number of interested fish farmers in Nigeria;
- Development of environmentally- friendly, efficient integrated agric-cum-fish culture systems under a water-centred food/fish production strategy;
- Intensive training of middle to high level manpower using audio-visual aids and other relevant facilities.

Since the tri-podal mandate of the University hovers around Teaching, Research and Community Service or Extension (TRC or E) , attempts will be made under this section to give account, even though in-exhaustively, of my value – added contributions as a Professor under the TRC or E areas.

4.2 Teaching

It is unequivocal that Teaching takes the first stage because the **students are at the centre of** everything at any University level. It is incontestible that the students are at the centre of all Universities. Soon after 2002, there was the realization from our interactions with employers of labour (Table 7) that we needed to update our AQFM course contents in order to be relevant to the labour market. Entreprenuership doses were therefore injected appropriately into the Departmental courses especially FIS 506 – Fisheries Economics , FIS 509 – Fish Farming Engineering and FIS 510 – Fish Farming and Fishery Business Management. This was backed up with the award of the annual prize tagged "**Pa Isaac Thomas Otubusin Memorial Prize"** for the Best Final Year Student in Fish Farming Engineering with effect from 2000/2001 session.

Comments

Till date, our AQFM graduates constitute that greatest percentage of employees in large scale commercial private fish farms in Nigeria. The facts and figures on this are being compiled for future appropriate presentation .

In addition our AQFM graduates are in the fore front of **job creators** in viable fish farming (**especially fish hatcheries** in the southwest of Nigeria). It is on record that National Youth Service Corps (NYSC) members are regularly posted to these AQFM- graduates fish farms for their primary assignment. Students Industrial Work Experience Scheme (SIWES) likewise send their students from tertiary institutions to these AQFM- graduates farms for their industrial training (IT).

Most of the AQFM Aquaculture and Fisheries Management courses are delivered under the philosophy of **entrepreneurship.** Figures 14 to 17 are samples of entrepreneurial exposure of the AQFM students. Tables 8 and 9 show the AQFM undergraduate summary of enrolment and graduation respectively to date.

Table 8: List of some institutions/establishments AQFM students' visited or had their industrial attachment since inception

No	Name of Institution/Establishment
1	National Institute for Freshwater Fisheries Research, New Bussa, Niger State
2	Nigerian Institute for Oceanography and Marine Research, Victoria Island, Lagos
3	Oyan Lake (Frame/Catch Assessment Survey), Ogun-Oshun River Basin Development Authority, Abeokuta
4	Odeda Fish Farm (Eweje), Ogun State Ministry of Agriculture and Natural Resources, Fisheries Department, Abeokuta
5	Central Bank of Nigeria
6	NACB, Abeokuta
7	NAIC, Abeokuta
8	NEFRADAY Fish Farm, Ogbomosho-Ilorin High Way, Ilorin
9	Zartech Fish Farm, Oluyole Estate, Ibadan
10	Ajanla Farms (CHI Ltd) Off Km 20, Ibadan-Lagos Express Way, Ibadan
11	Oluponna Fish Farm, Iwo, Oyo State
12	Olomore Fresh Fish Market, Abeokuta
13	UNAAB Fish Reservoir, Alabata Road, Abeokuta
14	Akomoje Waterworks (Artisanal Fisheries) Abeokuta
15	M & M Fish Depot, Imo, Abeokuta
16	Chief Joda Fibre-Glass Boat Co., Ake, Abeokuta
17	UNAAB Feed Mill and Feed Depot, Kotopo, Abeokuta
18	Oluana Fish Breeding Centre, Ibadan
19	Talon R & D Farms, Igbogila, Ogun State
20	Allison Fisheries and Shipping Ltd., Apapa
21	Intercontinental Fishing (Nig) Ltd, Apapa
22	Obelawo Farcha Fishing Ind. Ltd., Apapa
No	Name of Institution/Establishment
23	Ocean Fisheries Ltd., Apapa
24	Savannah Shipping Co. Ltd., Apapa
25	Yinka Folawiyo Fisheries Nigeria Ltd., Apapa
26	Tarabaroz Fisheries Ltd., Apapa
27	Olujosun Ornamental Fish Export Co., Ota
28	Fish Cage and Pen Culture Project, Are Lake, O-ORBRDA, Alabata Road, Abeokuta
29	CHI Ltd (Recirculating Catfish System), Ajao Estate, Oshodi, Lagos
30	Honeywell Fisheries Ltd., Apapa
31	Benguela Fisheries Ltd., Apapa
32	ORC Fisheries Ltd., Apapa
33	Dolphin Fisheries Nig Ltd., Apapa
34	Arroways Aquarium Nig. Ltd., Ikeja, lagos
35	Integrated Poultry-Cum-Fish Farm, Alakotomeji, Badagry

Kola Adeoye
05/0243
FIS510

K. FISCHER MECHANIZED FARMS

Fish Production & Pond/Aquarium Services, General Contractors & Suppliers
Contact Address: 21 Environmental Crescent Unilag Estate Magodo, Lagos State.
E-mail:kfischer1111@yahoo.com
0806-217-8652

WAY BILL

CREDIT/CASH INVOICE	
Customer's Name Selling Point Location	MT/No ______ DATE
L.P.O. No	Branch
Supplying Centre	Removal Note No. Date
Truck No. Driver's Name ______ Signature ______	Arrival Time: Departure Time:

Product	Unit	Code	Quantity	Unit Price		Amount	
Fish							
Lobster							
Flash Point		Total Quantity		Total Amount ₦			
Density							

COMPARTMENTATION

QUANTITY							
SEAL NO.							
ULLAGE (CENTRE)							
ULLAGE (DESTINATION)							

Depot Rep's Name ______ *Signature* ______
Receiver's Name ______ *Signature* ______

AKINOSHUN M. KOLA 0310617

KAY FARMS

PLOT 3, OYEBAMIJI STREET, ASHI-BODIJA,
IBADAN, OYO STATE,
NIGERIA.

TEL: +2347030808528, +2348055476064

Experts in both inland and off-shore fisheries and seafood importation

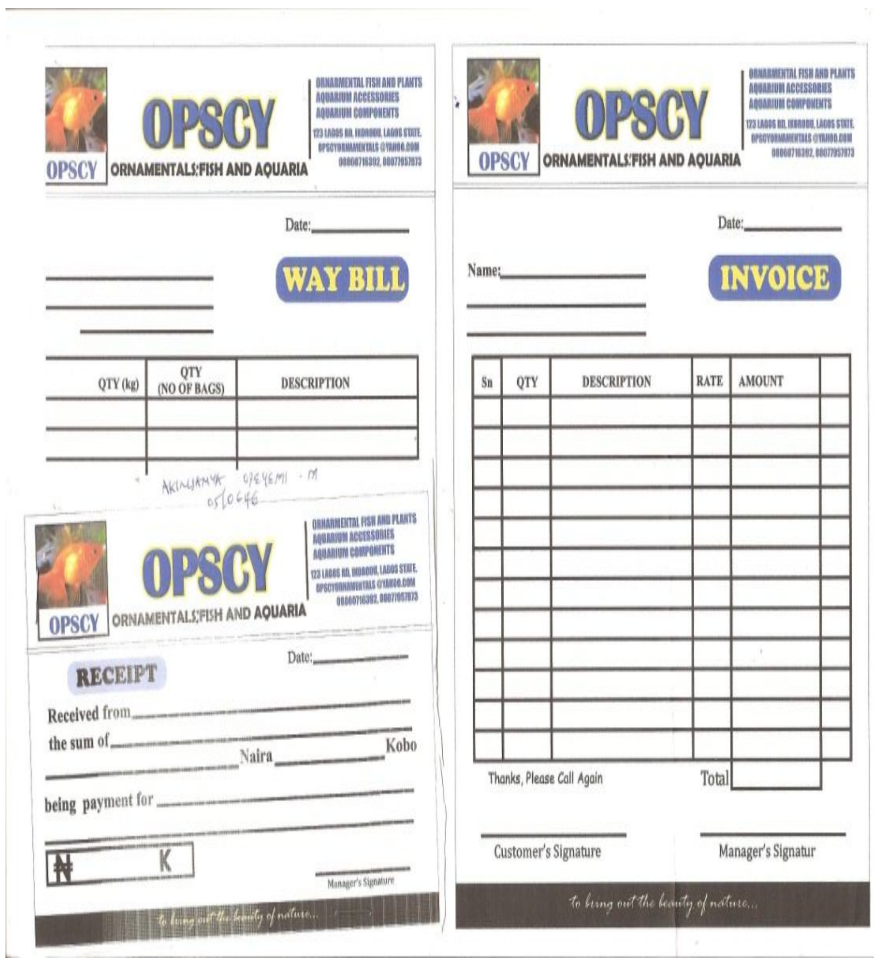
Figure 14


BB2
Farms And Agro Allied Industries Limited
16 Adeola Adeniji Street
Lekki- Ajah Road Lagos State
08035475222, 08055765188
bimbo_bb2@yahoo.com
HONEYMUH LIMITED.
GENERAL AGRICULTURAL CONSULTANT
Office: NO 1 Waffi Road, Jeffia Avenue,.
P.O. Box 126,Delta-state , Nigeria.
Phone No: 08032204991.
e-mail:honeymuh@yahoo.com
Our Ref............ Your Ref................ Date.................
Ogunwale Concept Nig.
A subsidiary of Z.A.B Nig Limited
OFFICE ADDRESS
BRANCH ADDRESS
E-mail:Gwalecepnig@yahoo.com.
LIZOL AQUA WORLD
Dealers in Ornamental Fisheries
FM
Farms & Feed Mills
No 2, Adeola Ajayi Str., Sango Ota, Ogun State.
08034955723, 08032596316

Figure 15


RASAKI R. A
030650
FOOD FIRST NIGERIA LIMITED
GENERAL AGRICULTURAL CONSULTANCY, SUPPLY OF AGRICULTURAL PRODUCTS
Office: 10, Latico street, Off Ejigbo Road, Iwo Osun State
P. O. Box 86, Akinbola Street Gbonagun Odo-Eran, Obantoko, Ogun State
Email:greatrasaky@yahoo.com
Phone No: 08062929393
OLAYEMI D.K
03/0643
BEECROWN NIGERIA LIMITED
DEALERS IN FISH FEEDS, LIVESTOCK FEEDS, SALES OF FINGERLINGS AND JUVENILE CAT FISH
BALOGUN BOSEDE AJOKE
03/0624
BOSBALOO CONSULTS
EXPERT IN FISH PRODUCTION AND CONSULTANCY SERVICES
Office Address: No 10 Balogun Street Sango-Otta,
OLUWASEYITANFUNMI UNLIMITED
Our Ref
Your Ref
Date
Consultancy importing, exporting and sales of sea foods (frozen and fresh) and sales of agricultural equipment

Figure 16


OPSCY
ORNAMENTALS:FISH AND AQUARIA
Date:
WAY BILL

QTY (kg)	QTY (NO OF BAGS)	DESCRIPTION

OPSCY
ORNAMENTALS:FISH AND AQUARIA
Date:
RECEIPT
Received from
the sum of
Naira Kobo
being payment for
₦ K
Manager's Signature
to bring out the beauty of nature...

OPSCY
ORNAMENTALS:FISH AND AQUARIA
Date:
Name:
INVOICE

Sn	QTY	DESCRIPTION	RATE	AMOUNT	

Thanks, Please Call Again
Total
Customer's Signature
Manager's Signatur
to bring out the beauty of nature...

Figure 17

Table 9: Undergraduate enrolment statistics for Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta

Level	92/93	93/94	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	Total
100	25	07	15	21	17	22	18	20	38	48	54	27	28	67	53	50	91	
200	-	35	10	18	23	20	22	29	30	44	52	-	68	59	63	63	55	
300	-	-	33	09	17	23	21	24	31	35	42	-	49	66	55	63	63	
400	-	-	-	33	09	16	22	21	22	27	34	-	41	45	63	55	62	
500	-	-	-	-	33	09	15	22	21	22	26	-	34	41	43	63	55	
FNG	-	-	-	-	-	0	02	-	4	4	4	-	6	2	6	-	10	
Total	25	42	58	81	99	90	98	116	146	190	212	-	226	290	283	294	336	
% Growth Rate (Annual)	-	68.0	38.1	39.7	22.2	-9.0	8.9	18.4	25.9	30.1	11.6	-	6.6	28.3	-2.4	3.9	14.3	

Foot Note: % GROWTH RATE BETWEEN 1998/99 AND 2009/2010 SESSION = 273.3%S

Table 10: Summary of graduation from the Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta (1997/98 to

Degree Class	97/98	98/99	99/2000	2000/ 2001	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/0 9	09/10	Total
First	Nil	Nil	Nil	Nil	Nil	Nil	Nil	VOID	Nil	Nil	02	01	Nil	
2nd (Upper)	8	2	1	4	7	4	8		11	13	10	20	17	
2nd (Lower)	14	9	8	10	10	12	11		11	22	26	32	28	
Third	1	6	3	4	3	6	2		3	5	2	7	11	
Pass	Nil	Nil	Nil	Nil	Nil	Nil	Nil		1	1	1	Nil	1	
Total	23	17	12	18	20	22	21		26	41	41	60	57	
%	76 (30.3)	80 (21.3)	79 (15.12)	114 (15.8)	131 (15.3)	133 (16.5)	184 (11.4)		149 (17.4)	156 (26.3)	169 (24.3)	209 (28.7)	207 (27.5)	

N.B 1994/1995 and 2004/2005 sessions were declared void

The first four sets graduated during the Headship of the Inaugural Lecturer.

4.3 Research
4.3.1 Fisheries Management

During this author's tutelage (1976 – 1979) at the then Kainji Lake Research Institute (KLRI), New Bussa, Kwara State (now National Institute for Freshwater Fisheries Research (NIFFR), New-Bussa, Niger State) he was fully involved in Fisheries Management research under the mentorship of a renowned Fisheries Expert (Mr. Edet Otu Ita FFS). Mr. Ita had since retired from civil service. Some highlights of my **"Fish in Deed"** under **Fisheries Management** are as follows:

4.3.1.1 Effects of Lunar Periods and some other parameters on fish catch in Lake Kainji, Nigeria (Otubusin, 1990a)

Lake Kainji (surface Area, 1270 km^2) is the largest hydroelectric power man-made lake in Nigeria. In this study,two fleets (eight nets per fleet) of passive-gradedexperimental gill net (mesh size 3.81 – 17.78cm) of equal surface area were used in catching fish simultaneously from the surface open water (one fleet) and the shore (one fleet) of Lake Kainji for a period of 12 months. The relationship between total fish catch and the parameters (lunar periods, net orientation, water transparency, net mesh size and habitat) was tested using multiple regression. The multiple regression analysis showed that all the parameters had a significant effect on total fish catch (R^2=0.21). Total fish catch in both surface and shore sets was higher at water transparency of less than 1.0m.

The parallel-oriented set of the surface fleet caught more fish than the perpendicular set. Total average fish catch (catch per unit effort (CPUE), number and weight) from the shore set was greater than the surface set, but bigger fish were caught in the surface fleet than in the shore. Bigger fish were caught 4-2 days to full moon and at full moon in the surface fleet, but only 2-4 days after full moon in the shore fleet.

Comment: The contribution of these findings to commercial fishing and rational exploitation of the lake fishery is hinged on the mesh size regulation (edict) of commercial gill nets on the lake.

The correlation matrix for the regression is as follows:
Number of observations = 757
FLEET vs FLEET = 1.00000
n SIZE vs. FLEET = 0.01993 n SIZE = 1.00000
CATCH vs FLEET = 0.09963 n SIZE = -0.41201
CATCH = 0.100000
WEIGHT vs FLEET = 0.04775 n SIZE = 0.11843
CATCH = 0.51096 WEIGHT = 1.00000
LUNAR vs FLEET = 0.00148 n SIZE = -0.01263
CATCH = 0.06075 WEIGHT = 0.05732
LUNAR = 1.00000
TRANS vs FLEET = 0.05330 n SIZE = -0.07129
CATCH=0.11146 = 0.11146
WEIGHT = -0.18324 LUNAR = 0.1771 TRANS = 1.00000
ORIENTATION vs FLEET = 0.55090 n SIZE = 0.01483
CATCH = 0.06891 WEIGHT = 0.02104 LUNAR = -0.03625
TRANS = 0.12656 ORIENTATION = 1.00000
WEIGHT/FISH vs FLEET = -0.10446 n SIZE = 0.48100
CATCH = -0.18204 WEIGHT = 0.49926 LUNAR = -0.06055
TRANS = -0.08883 ORIENTATION = -0.01434 WEIGHT/FISH = 1.00000

4.3.1.2 A comparison of the Composition and Abundance of Fish Species Caught with Experimental Gillnet with that of Artisanal Fishermen at Oyan Lake, South West Nigeria (Ikenweiwe, et. al. 2007a)

A study of the composition and abundance of fish species at the shore, surface and bottom of Oyan lake was carried out at the three stations along the entire stretch of the lake. This was compared with the catch (monitored simultaneously) from the artisanal commercial fishermen at the three fish landing sites selected along the lake. A fleet of nine passive graded experimental gill nets (mesh sizes 25.4mm to 177.8mm) of equal surface areas was used in catching fish from the shore; surface and bottom of the lake. The number and biomass

of fish catch from experimental gill netting for the entire lake were 16,698 and 191,721.2g respectively (11.5g/fish). The highest catch (no and weight) were obtained from station 3 (dam site) 6,654 and 70,826g and the least was from station 1 (lake inlet) 4,358 and 58,320g). In terms of number and weight the family Bagridae dominated both at the shore (no. 30.4%; wt 38.9%) and at bottom (no. 23.1%; wt 23.5%) zones of the lake while the family Cichlidae dominated the surface zone by weight only (19.9%). The Bagridae however still dominated the surface water by number (19.1%). Commercial artisanal fish landing estimates showed that the total landing (number) for the entire period of sampling was 4,628 weighing 1,856.6kg (40l.1g/fish). Mean catch per boat per sampling day was estimated to be 113 (number) and 4.280kg (weight).
Therefore the estimated fish landing (number and weight) **per boat** annually for 317 fishing days were 35,821 and 1356.76kg (about 1.4 tonnes) respectively.

Comment: The commercial fish catch (weight and number) compared with that of the experimental gill net (weight and no) gave a positive correlation (r=0.2) showing that one can be extrapolated to get the other one.

4.3.1.3 Socio-Economic Profile, Occupational Activities and Social Conditions of Rural Fisher Folks in Oyan Lake Area (Ikenweiwe, et. al. 2007b).

A study of socio-economic profile, occupational activities and social conditions of the inhabitants living around Oyan lake (40km^2 surface area) was carried out between January 2001 and August 2002. Five hundred (500) questionnaires were distributed among the people living around the entire stretch of the lake and 280 people responded. The commercial fish landing estimates showed that the total landing for the entire period of study was 4,628 (number) weighing 1,856.6kg. Mean catch per boat per sampling day (number and weight) were was estimated to be 113 and 4.28kg respectively. Therefore the estimated annual fish landing (number and weight) per boat for 317 fishing days were 35,821 and 1,356.7kg respectively. The number of fishermen that operated on the lake for the period of study was 283.

Comment: The potential annual fish yield from commercial fishery for the lake was 147.5 tonnes while the total number of active boats recorded for the entire lake was 43,241. This data will help in formulating regulations of the lake fishery.

4.3.1.4 Evaluation of the pelagic primary productivity and potential fish yield of Oyan Lake, South Western Nigeria (Ikenweiwe and Otubusin, 2005).

An evaluation of the pelagic primary productivity and potential fish yield of Oyan Lake was carried out between January 2001 and August 2002 at three stations along the entire stretch of the Lake. Standard methods were used to monitor the related physico-chemical parameters such as the water conductivity, total dissolved solids, and water temperature. The lake water depth measurement was also monitored at each of the sampling stations. All the above were used in computing the primary productivity and the potential fish yield of this lake. Ranges and means of each physico-chemical factors measured were water temperature 26.8 – 31.7^oC (mean 28.6 $\pm$1.3^oC). Dissolved oxygen 6.24 – 6.72 mg/l (mean 6.40 $\pm$ 0.3 mg/l); conductivity 64.9 $\pm$ 100.0 uohms/cm (mean 82.5 $\pm$ 0.6 u ohms/cm) and total dissolved solids 38.5 – 72mg/l (mean = 60.5 $\pm$ 2.1 mg/l). The mean daily gross pelagic production was highest at station 2 (4.03g $0_2m\ ^2d^{-1}$) and least at station 3 (dam site with 3.65g $0_2m\ ^{-2}d^{-1}$). The mean daily gross pelagic productivity for the entire lake was 3.85g$0_2m^{-2}d^{-1}$. Generally, the higher productivity values were recorded during the months of June to September.

Comments: The potential fish yield for the period of study was 1,599,868 tonnes/ha/yr using total dissolved solids as morpho-edaphic index. Considering Karlman's classification of lakes, Oyan lake is higher in productivity than most lakes in Nigeria and Africa.

4.3.1.5. Fisheries of Oyan Lake, South West Nigeria and Potential for Ecot-

ourism Development (Ikenweiwe, *et. al.* 2007).
The suitability of Oyan lake (South West Nigeria) as a tourist centre was investigated between January 2001 and August 2002. The natural resources around the lake area were highlighted and their enhancement of ecotourism were studied. The trend of tourists to the lake for the past years was highlighted. The highest number of tourists was observed during the year 1995 while the lowest number was recorded in 2003. A total of 293 Industrial Attachment students from the University of Agriculture, Abeokuta within a ten-year period have visited the lake while an additional 811 students visited the lake on field trip only between 1994 to 2006. A total of four hundred (400) different nationalities were recorded as visitors. 87.5 percent of these were citizens of Nigeria while 12.5 percent were international tourists. Infrastructural development needed to be put in place to enhance the visit of tourists to this lake were recommended.

Comments: Conservation of flora, fauna and cultural resources were suggested so as to enhance foreign exchange earnings. The relationship between climatic, faunal, floral, biodiversity, human and political environment for effective and productive tourism and national development were highlighted.

4.3.2 Aquaculture

4.3.2.1. Cage Culturability of some commercially important fish species in Lake Kainji, Nigeria (Otubusin, 1997).

In the cage culturability of some commercially important fish species in Lake Kainji for 150 days, the *microphagous/planktivorous Citharinus citharus, Oreochromis niloticus* and *Sarotherodon* galilaeus recorded high growth rates expressed in grammes per day (g/d) of 3.31, 2.82 and 2.03 respectively. *Clarias gariepinus* on the other hand, had a daily growth rate of 3.28g/d. It was demonstrated that in addition to the popular tilapias, *C. citharus* with no previous record of use in cage culture, was shown to be suitable for cage culture. This conclusion derives from its growth performance, fecundity, adaptability, feeding at the base of the food chain and particularly late maturity: an advantageous feature over the tila-

pias.
Comment: *C. citharus* is highly fecund (range 161,840 – 684,500 eggs).

4.3.2.2. Fish culture studies in floating cages in a waste water reservoir (Otubusin, 2003)

Tilapia (*Sarotherodon galilaeus)* fingerlings, average weight 10.8g were stocked at densities varying from 20 to 160 fish/m^3 in net-cages anchored in a waste water lagoon (0.40ha surface area). The fish were not given any supplementary feeding during the 150-day experiment. The highest mean fish production of 3.652kg/m^3 was recorded at stocking density of 160 fish/m^3 and least 0.748kg/m^3) at 20 fish/m^3.

Comment: Cage culture of *S. galilaeus* was observed to have potentials in waste water aquaculture and the harvested fish could contribute to fish meal produc-

Table 11: Growth performance of mixed fish species stocked in floating cage at Shagunu Bay, Lake Kainji for 150 days

Species	No. stocked	IFB (g)	Mean Weight (g)		Average growth (g/fish/d)
			Initial	Final	
C. citharus	10	540	54.0	550.0	3.31
O. niloticus	20	1000	50.0	475.0	2.83
C. gariepinus	5	675	135.0	627.0	3.28
S. galilaeus	20	600	30.0	335.0	2.03
H. bidorsalis	20	836	41.8	110.0	0.46
T. zillii	20	286	14.3	77.3	0.42
A.dentex	20	1200	60.0	97.5	0.25
D. rostratus	20	400	20.0	173.0	1.02

IFB: Biomass at stocking per fish species

4.3.2.3. Cage culture of freshwater moonfish (*Citharinus citharus)* in floating net-cage and external sex identification of the species (Otubusin, 2003)

Fresh water moonfish, *Citharinus citharus* (mean wt. range 58.0 to 75.0g) were stocked at 50 fish per cage at two sites: in a drinking water reservoir and a hydro-electric dam (reservoir) in a 150- day culture trial to study their growth performance. External sex identification of the fish using 450 specimens (weight range 400g to 650g each) was also carried out to obtain information useful for future induced breeding of the fish.
The fish in the hydro-electric reservoir grew better (1.92g/day) than those in the drinking water reservoir (0.90g/day). The use of curvature of the stretched anal fish was observed 100% accurate for external sex identification of the species. *C. citharus* was observed to have great promise in aquaculture and it was recommended that research should be carried out on artificial (induced) breeding of the fish for eventual mass production of its fingerlings.

Comment: The vast potential of this fast growing highly fecund cage-friendly fish is yet to be exploited-----water, water, water, everywhere……. An enigma!

4.3.2.4 The effect of duration of feeding on survival, growth and production of milkfish, *Chanos chanos* (Forskal), in brackishwater ponds in the Philippines (Otubusin and Lim, 1985).

Milkfish *(Chanos chanos)* fingerlings with an average weight of 16.3g were stocked at 4,000 per ha. in twelve 500m^3 experimental brackishwater ponds. The duration of supplementary feeding using pelletized chick starter (21.15% protein) at a ration of 5% of the biomass, was varied between 0 and 3 months. The duration of supplementary feeding had no significant effect on the survival, growth and production of milkfish. The results indicated that supplementary feeding of milkfish was not necessary at a stocking level of 4000 fish/ha. when adequate pond fertilization was carried out.

Comment.
This has immensely contributed to pond- raising of milk fish in the Philippines.

Table 12: Summary of sex identification of *C. citharus* using external features

Method	% Accuracy		No. of specimens observed
	Male	Female	
A Body shape	83.3 (50/60)	33.3 (30/90)	150
B. Colour of anal fin	100.0 (80/80)	60.0(42/70)	150
C. Curvature of stretched anal fin	100.0 (100/100)	100.0 (50/50)	150
Total No. of specimens			450

Table 13: Summary of results for milkfish receiving feeding treatments of different durations during the 82 days culture period

	Treatments			
	I	II	III	IV
Average initial wt (g)	14.4	17.6	19.0	14.1
Average final wt. (g)	249.9	213.8	220.2	212.6
Relative wt. gain (%)a	1616.1ns	1158.7	1147.4	1417.1
Survival (%)	96.4ns	95.5	92.8	95.6
Gross milk fish production (kg/ha)	967.5ns	816.3	816.8	811.9
Gross tilapia production (kg/ha)	14.9	-	1.0	215.7
Total production (kg/ha)	982.4	818.3	817.8	1027.6^{ns}

$$^{a}\text{ Relative wt. gain (\%)} = \frac{\text{(Final wt.} - \text{Initial wt.)}}{\text{initial wt.}} \times 100$$

[ns] Not significantly different (P=0.05) compared with the value of the other treatments.

Note: Figures are means of three replicates.

4.3.2.5. Effects of different levels of blood meal in pelleted feeds on Tilapia, *Oreochromis niloticus,* production in floating bamboo net-cages (Otubusin, 1987)

Oreochromis (=Tilapia) niloticus fingerlings (3.5 g average initial weight) were raised at a rate of 100/m^3 in floating bamboo net-cages for 120 days to evaluate the effect of varying levels (50%, 25% and 10%) of blood meal in feeds. The pelleted feeds were fed at rates of 10%, 5% and 3% of the fish biomass during the 1st, 2nd and 3rd plus 4th months of the experiment respectively.

The feed containing 10% blood meal was the most efficient in terms of total fish production, average weight gain and average final fish weight.

Comment
More recent studies are on-going (using UNAAB reservoir) on cage culture of tilapia, shrimp and catfish (*Clarias gariepinus)* with inclusion of varying levels of blood meal in formulated feeds to produce efficient, readily available and affordable feeds.

4.3.2.6 The effect of different protein sources in supplementary feeds on Tilapia *(Oreochromis niloticus)* in floating net-cages.

The effect of locally available protein sources including fish meal (FM), soybean meal (SBM), groundnut cake (GNC), and blood meal (BM) at 25% inclusion level in pelleted feeds (layer's concentrate/corn bran in ratio 1:3, and

Table 15: Summary of results for *Oreochromis niloticus* receiving different levels of blood meal feeds in floating cages for 120 days

Items	Treatments		
	I	II	III
Average initial wt (g)	3.4	3.3	3.8
Average final wt (g)	20.0	35.0	39.1
Average wt. gain (g)	16.6	31.7	35.3
Survival (%)	99.5	99.0	100.0
Total fish production (kg/m3)	1.993	3.465	3.910
Feed conversion ratio	2.17	1.36	1.67

premix 1.0%) were tested on tilapia (*Oreochromis niloticus*) in floating net-cages. *O. niloticus* fingerlings with mean weight, of 20.0g$\pm$0.84, were stocked at 50 fish/m^3 and fed the different feeds at 5% body weight for a 120-day culture period.

GNC in feed (28.02% crude protein, CP) performed best in terms of daily weight gain, final average weight/fish, feed conversion ratio (FCR), specific growth rate (SGR) and total fish production; closely followed by BM in feed (40.28% CP) but worst performance was in fish fed FM in feed (33.27% CP). The mean total fish production (kg/m^3) in treatment receiving GNC in feed was significantly different from mean total fish production in all the remaining three treatments ($p<0.05$).

Comment: Otubusin and Onyeabo (1988) earlier concluded that feed containing 74% cornbran, 1% premix, 25% fish meal (FM) performed best in the production of tilapia fingerlings in floating net-hapas.

4.3.2.7. Hybridization Trials using *Oreochromis niloticus* and *Sarotherodon galilaeus* in floating bamboo net-hapas in Kainji Lake Basin, Nigeria (Otubusin, 1988).

Breeders of *Oreochromis niloticus* (ORN) and *Sarotherodon galilaeus* (SAG) were stocked at a male to female ratio of 1:3 and 12/m^3 in floating bamboo net-hapas as follows: I, all ORN; II, all SAG; III, males ORN x females SAG; and IV, males SAG x females ORN, for normal reproduction and hybridization from 13 June to 22 September 1986. The breeders were fed 10% pelleted blood meal in feed (about 30% crude protein) at 5% of the biomass. The highest average fry production and spawning frequency was observed in I (male ORN x female ORN), followed by IV (male SAG x female ORN), then II (male SAG x female SAG) and least in III (male ORN x female SAG). The highest growth rate of the F_1 offspring was seen in the cross in treatment III followed by treatment I, then II and finally treatment IV.

Comment.
This is the **first time** that SAG was successfully crossed with ORN. Even though Hepher (in Trewavas, 1982) was of the opinion that it is very difficult to cross SAG with ORN, the observations made in this study have proved otherwise. .

4.3.2.8. Effect of broodstock (Male:Female) stocking density on fry production in *Oreochromis niloticus* in Net-Hapas (Otubusin, 2002)

The effects of broodstock (male:female ratios of 1:1. 1:3 and 1:5) of tilapia *(Oreochromis niloticus)* stocked at 12 breeders/m^3 on fry production in net-hapas in a freshwater reservoir were studied. The highest number of fry produced (2001) and highest number of spawning (4 times); highest average number of fry/month (1000); and highest spawning frequency/month (1.8) were recorded in the treatment with breeders of male: female ration of 1:3

Comment: The commercial tilapia fingerling production in net-hapas on NEPA Intermediate Basin at Kainji during the Directorate of Foods, Roads and Rural Infrastructure (DFRRI) era was based on the results (M:F) ratio of 1:3) from this study (DFRRI Extension Guide No. 5 (1988) Fish Farming in Cages, 19p.

4.3.2.9 Economics of Small-Scale Tilapia Fingerling Production in Floating Net-Hapas (Otubusin, 2001b)

The study attempts to provide information on the viability and profitability of small-scale tilapia *(Oreochromis niloticus)* fingerling production in floating net-hapas. 8 modules of 16 net-hapas (L x B x H : 1m x 1m x 1m) per module, fixed to a 6m x 6m bamboo raft with 16, 1.5m x 1.5m apartments were used. The breeders (M:F, 1:3) at stocking density of 12/hapa (hatchery) and fry density of 1000/hapa (nursery) were fed 20% CP pelleted feed and 30% CP powdered feed respectively. Annual production period was for 10 months. Cost analysis showed that total fixed costs accounted for 64.90% of the total cost of production while the total variable costs constituted 35.10%. The profitability analysis in the first year of operation showed that tilapia fingerling production in floating hapas could generate a rate of return to investment of 45.96%, a rate of return on fixed cost 170.81% and a rate of return on variable cost of 230.95%.

Table 14: Summary of tilapia fry production for a duration of 97 days

Treatment	Sex ratio	No. of fry produced	No. of fry/ female	Average no. of fry/spawning	Spawning frequency per month
I (all ORN)	1:3	1352(6)*	150	225	1.9
II (all SAG)	1:3	325(3)	36	108	0.9
III (male ORN, female SAG)	1:3	51 (2)	6	26	0.6
IV (male SAG, female ORN)	1:3	777 (5)	86	155	1.5

*Total no. of spawning in parentheses.

Comment.
Apart from being a boost to Aquaculture production, the system was in addition recommended for groups of small-scale operators to serve as a steady and reliable source of large quantity of good quality fingerlings for stocking and restocking Nigerian water bodies under the National Fish Stocking Campaign.

4.3.2.10 Economics of small scale tilapia production in floating net-cages (Otubusin , 2001a)

The study was aimed at providing information on the profitability of small-scale table-size tilapia production in floating net-cages. One module of 4 net-cages (L x B x H; 3m x 3m x 2.75m; 210/9, 12.7mm mesh size) fitted to a 7m x 7m bamboo raft with plastic floats was used in the production system. The stocking density was 2,500 fingerlings (average size 20g) per net-cage and a 5-month culture period with 2 runs per year. Cost analysis showed that cost of feed and fingerlings accounted for 54.32% of total production cost while fixed inputs constituted 25.66%. Other variable inputs (including cost of surveillance, 14.9%) accounted for 20.02% of total cost. The profitability analysis in the first year of operation showed that table-size tilapia production in floating cages could generate a rate of return to investment of 34.10%, a rate of return on fixed cost of 159.1% and a rate of return on variable cost of 116.26%.

Comment.
A Community-Based Implementation Strategy (CBIS) for effective grass root participation by Co-operative Societies; Farmers' Association, Community Development Associations was recommended for a successful use of this innovative fish production system with agricultural loan from financial/banking institutions.

Table 16: Profitability analysis of small-scale Tilapia fingerling production in floating net-Hapas

Profitability Indicators	Values	
	Year I	Year II
Net Farm Income (NFI)	N403,020	830.029
Rate of Return to Investment (%)	45.9	184.4
Return on Fixed Cost (RFC)	972,220	972,220
Rate of Return on Fixed Cost (%)	170.8	683.7
Rate of Return on Variable Cost (%)	230.9	369.6

NB: Undoubtedly, RRVC (%) is higher for tilapia fingerling production than in tilapia table-size production

Table 17: Profitability Analysis of Small-Scale Tilapia Farming in Floating Net-Cages

Profitability Indicators	Values	
	Year I	Year II
Net Farm Income (NFI)	109,850	171,850
Rate of Return to Investment (%)	34.10	53.34
Return on Fixed Cost (RFC)	192,500	192,500
Rate of Return on Fixed Cost (%)	159.10	932.20
Rate of Return on Variable Cost (%)	116.26	171.75

4.3.2.11 The production of catfish (*Clarias gariepinus)* in floating bamboo net-cage system in Nigeria (Otubusin and Olaitan, 2001)

Catfish *(Clarias gariepinus)* juveniles average weight, 80g, were stocked at 308 fish/m^3 in a lockable bamboo lattices/net-cage (6m^3 effective water volume) moored in a 2-hectare irrigation reservoir at Ajanla Farms, South-West Nigeria. The fish were fed *ad-libitum* twice daily with a 45% crude protein pelleted feed and were harvested after 153 days (about 5 months) culture period. At harvest the following data were obtained: Final weight per fish, 722g, daily weight gain, 4.2g/d; actual total fish production, 621kg (46.9% of number stocked); feed conversion ratio, 2.12. A mortality of 1.84% was recorded during the culture period while 51.67% of the stock escaped through leakage caused by a damage to the bottom of the cage (careless towing) during harvesting activities. Recommendations were made towards the better commercialization of the system through organized private sector participation.

Comment: This kick-started the commercialization of catfish cage culture in Nigeria under private sector participation.

4.3.2.12. High yields and growth of catfish *(Clarias gariepinus* Burchell 1822) in floating bamboo net-cages system trials in south-western Nigeria (Otubusin et al, 2007).

Juveniles of catfish *(Clarias gariepinus)* with average weights ranging between 114g and 309g per fish were stocked at between 900 and 1394 per floating cage ($6m^3$ water volume) in the 2-hectare irrigation freshwater reservoir of Ajanla Farms, South – West Nigeria under commercial catfish farming trials. The fish were fed manually *ad-libitum* with 45% pelleted sinking feed during the three culture cycles of between 106 and 178 days.

At harvest the third culture cycle (106 days) under which fish (average stocking size, 179g at 900 fish per cage) gave the highest total weight of fish at harvest, 1100kg; best growth rate per fish per day, 8.50g; total weight of fish harvested per m^3, 183kg; highest survival rate, 75.2%, highest total net fish yield per cage, 920.8kg; least total pelleted feed applied, 802.0kg and best feed conversion ratio, 0.87.

Table 18: Summary of data from the commercial catfish culture in bamboo-net cage system for 153 days, at Ajanla Farms, Nigeria

Parameters	Value
No. of fish stocked	1850/6m3 (308/m3)
Initial average weight (g)	80g
Final average weight (g)	722g
Growth rate per fish per day	4.2g
% mortality (No)	1.84% (34)
% Escaped (No)	51.67% (956)
% Harvested (No)	46.49% (860)
Actual harvest (wt)	621kg
Harvest per m3 cage	103.5kg
Total amount of pelleted feed used (wt)	1004.5kg
Feed Conversion Ratio	2.12
Expected harvested (if no leakage)	1,239kg
Cost of one cage	N35,000.00 (US $320.00)
Catfish selling price (ex-Lagos per kg)	N250.00 (US $2.30)

Comment: In view of the consistent high yields from the three culture-cycles, it was concluded that the floating bamboo net-cage system has a promising future for commercial catfish production in Nigeria. These results confirmed the commercial potentials of catfish cage farming hence its inclusion in the 2009/2010 development projects of Federal Ministry of Agriculture and Water Resources for which this author serves as a Consultant. Fish yield/m^3 in this study ranged between 152 and 183kg compared with recirculatory system (intensive) – 100 and 200kg (Table 20)

Note: The cages were launched in a reservoir with no need for water pumping etc.

Table 19: Summary of the Catfish Yields from three culture cycles in bamboo – net cages system at Ajanla Farms, Nigeria

	Culture Cycles			
	1st	2nd	3rd	Average
No.of fish stocked per 6m3 (and per m3	1142 (190)	1394(232)	900(150)	1145(191)
Culture period (days)	121	178	106	135
Initial average weight (g) (WI)	309	114	179	230
Final average weight (g) (WF)	1237	1120	1100	1152
Projected final average weight (g) in 135 days	1344	890	1327	1187
Total weight of fish harvested (kg) (TW)	913	955	1100	989
Projected TW in 135 days	1019	724	1401	1048
Average individual weight gain (g)	928	1006	921	945
Growth rate per fish per day (g)	7.67	5.75	8.50	7.30
Total weight of fish harvested (kg) per m3	152	159	183	165
% Survival (No)	64.6(738)	61.2(852)	75.2(677)	67.0 (756)

1st, 2nd and 3rd correspond to Cages A, B and C

Table 20: Total net fish yield and other growth parameters of catfish in bamboo net-cages, Ajanla Farms, Nigeria

	Culture Cycles			
	1st	2nd	3rd	Average
Initial total fish biomass (stocked) kg per 6m3 (per m3)	352.6(58.8)	158.9(26.5)	179.29(29.9)	230.2(38.4)
Total net fish yield, kg/6m3 (per m3)	560.4(93.4)	796.1(132.7)	920.8(153.4)	759.1(126.5)
Total pelleted feed applied, kg per cage (per m3)	2333.3(388.9)	1074.2(179.0)	802.0(133.7)	1403.2(233.9)
Feed Conversion Ratio (FCR)	2.64	1.12	0.87	1.54
Specific Growth Rate (SGR)	0.4979	0.5575	0.7439	0.5998

1st, 2nd and 3rd correspond to Cages A, B and C

Table 21: Pearson Correlation between all the parameters

Description	Yield	WI	NOSTK	BIOMASS	PELLETED	CLT PERIOD
Yield	-	.743	.480	.590	.424	.480
WI	.743	-	.778	.152	.320	.778
NOSTK	.480	.778	-	.930	.903	.000
BIOMASS	.590	.152	.930	-	.167	.930
PELLETED	.423	.320	.903	.167	-	.903
CLT PERIOD	.480	.778	.000	.930	.903	-

WI – Initial Weight, NOSTK – Number stocked, BIOMASS – Initial Biomass; PELLETED – Feed used, CLT PERIOD - Culture period

4.4 EXTENSION/COMMUNITY SERVICES

AT NIFFR, this inaugural lecturer was Consultant Aquaculturist to DFRRI on cage and pen fish culture systems. He was actively involved in the 1988 Nation-wide First-Ever Fish Farmers Workshops (Training the Trainers/Fish Farmers) sponsored by DFRRI then domiciled at Dodan Barracks, Lagos. This training popularized the now common homestead fishponds amongst other fish culture systems. In addition, he initiated and co-organized the first-ever Practical Fish Cage Culture Training at NIFFR and the second/third National Intensive (Practical) Cage Culture Training, using DO-IT-YOURSELF approach. All the training programmes were well attended by participants from private and public sectors. A book, titled: FISH CAGE CULTURE TECHNOLOGY, NIFFR Training Services No. 1 was published thereafter. Before the Inaugural, Lecturer transferred his services to UNAAB, NIFFR was already recognized as a reference centre for cage fish farming research/development. This recognition perhaps lead to the award of a "Contract" to NIFFR on fish cage culture in the Niger Delta area by Shell Petroleum Development Corporation (SPDC) after the transfer of this author. The outcome of the "Contract" is best reported by NIFFR!.

The author was involved as a team leader and member of various nationwide fisheries surveys including pre-impoundment or ecological impact assessment (EIA) survey, e.g. pre-impoundment fishery survey of proposed Jebba Lake (Otubusin, 1979; Ita, *et. al.* 1979).

During the author's sabbatical leave at Ahmadu Bello University (ABU) Zaria, he benefitted from an ABU Grant which was used to establish experimental floating bamboo-net cage system on Kubanni Reservoir. Two postgraduate students were supervised using the system for their research project while table-size catfish (*Clarias gariepinus)*were harvested and sold for the first time at ABU from floating cage system (Otubusin, 2009 (a) and (b) (Figs 18 &19).

A large scale integrated agriculture-cum-fish farm (about the best in North West Nigeria) was extended technical services at Funtua where till date ex-**UNAABITES** have been performing **marvelously** especially on the fish farming aspects. This is a dividend of UNAAB excellence to the Chairman of the farm, who was one-time Pro-Chancellor and Chairman of UNAAB Governing Council.

UNAAB undergraduate and postgraduate (Masters and Doctorate) project students also had the privilege of carrying out their research projects at AQUA-CONSULT INCORPORATION, Abeokuta – the research arm of the inaugural lecturer's aquaculture outfit without prejudice! – practicing what he preaches!

In addition, the modest contributions of this inaugural lecturer (IL) include:

(i) the donation of a high-yielding bored-well with submersible pump to AQFM
(ii) repair of outdoor AQFM concrete tanks;
(iii) installation of rain-harvester to supply water to the repaired (by IL) AQFM outdoor hatchery fibre glass tanks and the linking of the fibre glass tanks with plumbing network (Figs 20 & 21).

All these donated facilities are presently in use for aquaculture research by staff and students.

Figure 18: Floating bamboo cages on ABU Reservoir, Zaria

Figure 19: Twin bamboo cages on ABU Reservoir, Zaria

Finally, it is noteworthy that the private sector approach sponsored by CHI, Ajanla Farms for which this author rendered technical services brought commercial catfish cage farming to limelight in 2001 (Otubusin and Olaitan, 2001) (Fig 22). The final average weight per fish, total weight of fish harvested and culture period were 1.152kg, 1.187 metric tonnes and 135 days (4.5 months) respectively – in the three subsequent trials. The fish cage used was L x B x H: 3m x 2m x 1.5m, water volume, 6m^3 with 0.5m free board (Otubusin, et. al. 2007). However, the most recent cage design is a modular form of PVC with four (4 nos) flexible L x B x H 3m x 2m x 1.5m net-cages (Fig. 23).

Figure 20: Deep-well with taps donated to AQFM

Figure 21:Rain harvester and repaired fibre glass tanks at AQFM

Figure 22:Floating bamboo net-cages for commercial catfish culture

Figure 23: Modules of flexible net-cages for commercial catfish farming

BOX 2: FISH FOR THOUGHT

Remember some of our most wonderful inventions got off to SLOW STARTS as well:

- ⇒ The first electric light was so dim that a candle was needed to see its socket.
- ⇒ One of the first steamboats took 32 hours to chug its way from New York to Albany, a distance of 150 miles;
- ⇒ Wilbur and Orville Wright's first airplane flight lasted only 12 seconds and;
- ⇒ The first automobiles travelled 2 to 4 miles per hour and broke down often.
- ⇒ Carriages would pass them with their (carriages) passengers shouting, "Get a horse!".

BUT LOOK WHAT THESE INVENTIONS ARE CAPABLE OF TODAY! (Egner, D.C. 1990, Slow Starts; *In:* Our Daily Bread, 29 May, 1990, Vol. 35, Nos. 1, 2. Radio Bible Class, Grand Rapids, Michigan, USA).

SO LET IT BE WITH FISH CAGE CULTURE TECHNOLOGY IN NIGERIA!

5.0 REFLECTIONS ON NIGERIAN FISHERIES AND OTHER RESOURCES

IFAD-Assisted Fisheries Development Project-Trials in cage fish culture was reported undertaken in Cross River (1992), Rivers (1996), Ogun and Oyo States (2000) under the IFAD – Assisted Artisanal Fisheries Development Project (IFAD) Loan 236-NR, UNDP Grant NIR/88/011). The reports on the success of these trials perhaps are yet to be published.

Considering a fish supply gap of 500,000 metric tonnes, in Nigeria, a total of 125,000 modules of the latest 4 units per module floating cages will be needed to produce the fish deficit at a production rate of 4 metric tonnes per module in one harvest (culture period of 4.5 months).

N.B. Two culture periods are the usual scenario per year, hence 1,000,000 tonnes of fish per year and about 162 modules per local government area (774 LGAs). Since a module occupies a maximum of 50sq. metres, the surface area for 162 modules = 8,100m^2 which can be approximately one hectare. Hence only about 800ha of water surface will be needed to produce one million metric tonnes of fish annually.

Please remember that Ita, et. al. (1985) reported an estimated surface area of 12.5 million hectares of lakes, reservoirs, ponds and major rivers in Nigeria (Fig. 5). Ando (2011) also reported that Nigeria currently has over 200 dams with a combined storage capacity of 34 billion cubic metres. Yet all that is needed to annually produce the million metric tones of fish is 800 hectares (i.e. 0.0064% of Ita, et. al's estimate). Now it is evident that Nigeria has **water, water, water, everywhere…………… yet not enough fish…………….. it is ENIGMATIC!.**

Indeed, water, water, water………." is used as an **aphorism** in this lecture to give a clarion call to all stakeholders of the vast resources Nigeria is endowed with yet we suffer in the midst of plenty. Very briefly, the following are replete with the aphorism:

(a) Total crude oil production and reserves
(b) National gas reserves (almost untapped!)Table2
(c) Solid minerals reserves, e.g. coal (Table 2)
(d) High level well-trained manpower (most are the experts in the diaspora)
(e) The vast water bodies for large scale commercial food production – integrated livestock –agriculture – cum – fish culture.

Stop Press: It was reported that Mr. President charged some experts from "within and outside the administration with the task of producing a **strategic plan** for the speedy implementation of vital projects in the high priority sectors of public infrastructure, power supply, education, health, the Niger Delta, agriculture and water resources for which about N400 billion has been set aside in the 2011 budget". "The team is also expected to urgently evolve an **action plan** for the efficient and effective implementation of the President's N50 billion national job creation scheme to create thousands of new jobs for the country's unemployed youths………"

"Strategic plan" and "action plan" are very ideal but the sincere implementation devoid of corruption etc is what will make Nigeria great like Malaysia, South-Korea, Indonesia, etc.

Foot Note: FG targets $10 billion FDI (Foreign Direct Investment) in gas sector in two years. The Punch March 21,2011 front page)

But what is the problem with Nigeria and Nigerians? A very enigmatic question! I quote:

"There are six words that can describe the unpleasantness that I observe in politics and political party government. They are **corruption**, disloyalty, mischief, intrigue, rumours and lies. When people brazenly exhibit any of these characteristics, they claim it is politics. When I find these traits in any individual, I am repelled. I can neither trust nor rely on such a person. I think life must be based on an assumption of certain virtues, values and decency" Unquote (Obasanjo, 2010).

Box: 3 " EFCC recovers N 2 trillion assets from corrupt politicians " Sunday Punch Nov. 14, 2010 Cover Page.

The major problem of Nigeria and Nigerians (all of us) is corruption (*quod errat non demonstradum*). **Righteousness exalts a nation, sin is a reproach!**

6.0 RECOMMENDATIONS AND CONCLUSION

6.1 Recommendations

(a) For the umpteenth time, I re-iterate that University of Agriculture, Abeokuta (UNAAB) should be funded (by both public/private sectors and internationally) as a Centre of Excellence for Community-Based Implementation Strategy (CBIS) of an integrated agriculture-livestock-cum fish culture water-based project (Otubusin, 1996). The *modus operandi* will be strategically worked out by networking under the prudent, proactive, practical and pragmatic result-oriented leadership of our Vice-Chancellor, Professor Oluwafemi Olaiya Balogun.

(b) Even though some work have been reported on the biology and ecology (or is it bio-ecology?) of Nigeria fish species, more studies need to be carried out on how such fish species can be exploited for aquaculture production. These studies should include: distribution, seasonality, growth rate, fecundity, hardiness and all other parameters that are pointers to acceptance of the fish species for aquacultural purposes.

(c) Nigerians who are fish nutrition experts must put in concerted efforts with other experts (in Engineering, etc) to perfect the large scale commercial production of efficient, affordable and available floating pellet feeds urgently needed for profitable commercial fish farming. **No foreigner will do it for us!**

(d) From hindsight, there was that government economic policy focus – VISION 2010!. What of the outdated FOOD or HEALTH or SHELTER – FOR ALL BY YEAR 2000!. It is now VISION 20-20-20!!. Our Government to walk the talk. The Malaysian example, VISION 2020, should be enough FISH FOR THOUGHT!.

6.2 Conclusion

It should be noted that the founding fathers of Nigeria meant well when they fought with all their might, strength and blood for Nigeria's independence. They had a dream!. This dream must have been dreamt by these noble and honourable Nigerians who are great possibility thinkers. Therefore for this dream to come true (after 50 years), we must make it happen!. We should note that almost every great idea looks impossible when it is first born. But possibility thinkers take great ideas and turn the impossibilities into possibilities – that's progress. Considering the quality of existing human and material resources in Nigeria, Nigerians can be mobilized and motivated to be highly productive (in all facets) within a relatively short time. If we already have that leadership (UNAAB as a living recent example) that is credible one that leads more by example than precept, endowed with vision, industry, perseverance, service, sincerity and discipline, then we must muster concerted efforts to make it WATER, WATER, WATER EVERYWHERE……… Blessings!!!!!!!.

7.0 ACKNOWLEDGEMENTS

All GLORY and HONOUR to GOD, the FATHER, the Immortal, Invisble and only wise for HIS mercy and care. I acknowledge the following for their various roles:

The Vice-Chancellor of University of Agriculture, Abeokuta, Prof. Oluwafemi Olaiya Balogun, for his indefatigable efforts and his able leadership in the Project of UNAAB in all ramifications;

All Principal Officers, Vice-Chancellors and Deputy Vice-Chancellors of UNAAB (both past and present) especially from 1994 when I transferred my services from NIFFR, New-Bussa to the nascent Department of Aquaculture and Fisheries Management of UNAAB.

My Dean, Prof. Toyin Arowolo; all Professors; all teaching and non-teaching staff(too numerous to mention) in the College of Environmental Resources Management and all the Colleges in the University for the *esprit-de-corps.*

My Master of Fisheries (Aquaculture) Project Adviser, Dr. Chhorn Lim, an erudite scholar and fish Nutrition expert who taught me the rudiments of fish Nutrition research at University of Philippines/South East Asia Fisheries Development Centre (SEAFDEC), Iloilo City, Philippines;

My Doctorate Research Project Supervisor, Prof. Akinola A. Olatunde (then at Ahmadu Bello University, Zaria) for his kindness, brotherly love, guide and prayer after I successfully defended my Ph.D. Thesis

My undergraduate project supervisor, Prof. Eyo Okon (then of University of Ife) for his simple and but scientific design of my research project on Guinea Pig *(Cavea porcelus)* nutrition;

My Fisheries and Hydrobiology lecturer at UNIFE, Prof. A.M.A. Imevbore, for his stimulating and down-to-earth lectures that made me to take to the fisheries profession.

My mentor and “in-law”, Chief Edet Otu Ita, who taught me practically on-the-field to give me a solid foundation in Fisheries Management/Fish Population Dynamics/Fish Stock Assessment as a young Research Officer at the then Kainji Lake Research Institute, New Bussa;

All past and present Directors and staff of Kainji Lake Research Institute and National Institute for Freshwater Fisheries Research, New – Bussa for their brotherliness and love;

My colleagues at the Department of Biological Sciences, Ahmadu Bello University, Zaria for their cooperation and cordially during my sabbatical. They made the floating cage culture on Kubanni Reservoir, ABU, Zaria succeed to God's Glory. Prof. Sonnie Oniye, my former student at CAS, Kano was very supportive and loving.

Alhaji Sanni Bagiwa Idris, my very good friend, former Pro-Chancellor and Chairman, UNAAB Governing Council took good care of me throughout the sabbatical at ABU, Zaria. His integrated agriculture-cum-livestock-cum fish farms were placed at my disposal for undergraduate and postgraduate students field trips and research. His amiable wife, Hadjia Murja Bagiwa Idris was very caring to my family.

Retired Air Vice-Marshall Larry Konyian, then Chairman, Directorate of Foods, Roads and Rural Infrastructure (DFRRI), Dodan Barracks for his encouragement and DFRRI-grant partly used for my extensive Ph.D. research on fish floating cages;

All my Nigerian colleagues, especially at UP-SEAFDEC, Iloilo City for their brotherly love;

Mr. I.O.A. Adetona of the Teaching and Research Farm Directorate (TREFAD) for taking pains to type this Inaugural paper;

All my students, colleagues (especially Dr. Moses O.O. Oyatogun and Prof. N.J. Bello) and friends(Dr. Mrs. O. Y. Olukoya of CBN, Abeokuta) who assisted in numerous ways in the preparation of this inaugural lecture, I say God reward you all abundantly to overflowing;

My faithful, loving and caring wife, Ajibola Olutayo Otubusin (Nee Smith) and our wonderful divinely favoured children: Mmandu (Sharon); Oluwatomilola (Shalom), Mob'Oluwaduro (Shalva); Openifun-Oluwa (Ovation); and Jesutofunmi (Faith).

My pleasant and loving in-laws from Akwa-Ibom/Ogun States;

All members of the Otu family (both in Nigeria and the diaspora) ably represented by my paternal uncle, Prince C.O. Otubusin, GMOA – the printing giant of Pacific Printers Nigeria Limited (A subsidiary of Nigerian Security Printing and Minting Co) and Engr. Kenneth Olu. Otubusin;

All members of Ogunyoye family (both in Nigeria and in the diaspora) ably represented by my maternal uncle, Chief (Engr) T.K. Ogunyoye, the Baba Ijo of St. James' Cathedral, Mobalufon, Ijebu-Ode;

My siblings: Mrs. Florence Olu. Oyefeso, Mr. Joseph Olu. Otubusin, Ms Labake Otubusin and Mrs. Dorcas T. Akinyele of African Union, Marina, Lagos;

Last but not the least, my loving parents of very blessed memory, Pa Isaac Thomas Otubusin and Madam Lydia Oladunni Otubusin (Nee Ogunyoye). Both of them were friends of UNAAB.

To all too numerous to mention, I say "THANK YOU!" "NAGODE!", "ESE PUPO!" "DAA LU NSO!" "SALAMAT PO!" "MERCI!"

EPILOGUE

Please join me in singing!
THERE SHALL BE SHOWERS OF BLESSING
"There shall be showers of blessing"
This is the promise of love;
There shall be seasons refreshing,
Sent from the Saviour above.

Showers of blessing,
Showers of blessing we need;
Mercy drops round us are falling,
But for the showers we plead

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Appendix 1: Assignment on Brief Assessment of Governance in Nigeria: Time Series Data

S/N	Period	Days	Exchange Rate US $ - N	GDP	Foreign Reserve US $	Excess Crude unshared Account US $	Total Foreign Debt US $	Price of Crude per barrel
1	Oct. 1960 – Jan 1966							
2	Oct. 1963 – Jan. 1966							
3	Jan. 1966 – July, 1966							
4	Aug. 1966 – July, 1975							
5	July 1975 – Feb. 1976							
6	Feb 1976 – Oct. 1979							
7	Oct. 1979 – Dec. 1983							
8	Dec. 1983 – Aug. 1985							
9	Aug. 1985 – Aug. 1993							
10	Aug. 1993 – Nov. 1993							
11	June 1998 – May 1999							
12	May 1999 – May 2007							
13	May 2007 – May 2010							
14	May 2010							