FEDERAL UNIVERSITY OF AGRICULTURE
ABEOKUTA NIGERIA

75th INAUGURAL LECTURE

REPOSITIONING OUR COASTAL ENVIRONMENT: A RESCUE MISSION FOR AQUACULTURE AND FISHERIES PRODUCTION AND MANAGEMENT IN NIGERIA

by

Professor Yemi Akegbejo-Samsons

(Professor of Aquaculture and Coastal Resources Management)

Department of Aquaculture and Fisheries Management (AQFM)
College of Environmental Resources Management (COLERM)
Federal University of Agriculture, Abeokuta, Nigeria

REPOSITIONING OUR COASTAL ENVIRONMENT: A RESCUE MISSION FOR AQUACULTURE AND FISHERIES PRODUCTION AND MANAGEMENT IN NIGERIA

by

Professor Yemi Akegbejo-Samsons
(Professor of Aquaculture and Coastal Resources Management)

Department of Aquaculture and Fisheries Management (AQFM)
College of Environmental Resources Management (COLERM)
Federal University of Agriculture, Abeokuta, Nigeria

FUNAAB INAUGURAL LECTURE
Series No. 75

Wednesday May 10, 2023

FUNAAB INAUGURAL LECTURE

Series No. 75

by

Professor Yemi Akegbejo-Samsons
Professor of Aquaculture and Coastal Resources Management

The 75th Inaugural Lecture was delivered under the Chairmanship

of

The Vice-Chancellor

Professor Babatunde Kehinde
B.Sc (Agric Biology); M.Sc (Crop Improvement),
Ph.D (Ibadan), FGSN, FAIMP, FIHSC

Published Wednesday May 10, 2023

ISBN: 979-978-799-676-1

FUNAAB INAUGURAL LECTURE SERIES

Professor Yemi Akegbejo-Samsons
OND (Ife), BSc, MSc (Ibadan), DMA (Dal, Canada), PGDE (Ibadan), PhD (Akure)
(Professor of Aquaculture and Coastal Resources Management)
Department of Aquaculture and Fisheries Management (AQFM)
College of Environmental Resources Management (COLERM)
Federal University of Agriculture, Abeokuta, Nigeria

PROTOCOLS

The Vice-Chancellor,

Deputy Vice-Chancellors (Academic and Development),

The Registrar,

The Bursar

The University Librarian

Members of the University Senate

Dean, College of Environmental Resources Management

Other Deans and Directors,

Ag. Head, Department of Aquaculture and Fisheries Management,

Eminent Scholars and Special Guests

My Academic Mentors

My Lords: Spiritual and Temporal

Members of my Immediate and Extended Families

Distinguished Fellows/Members of Fisheries Society of Nigeria

Distinguished Ladies and Gentlemen,

Gentlemen of the Press,

Great FUNAABITES!

1.0 PROLOGUE

An Inaugural lecture represents a significant milestone in an academic's career. It celebrates their promotion to the rank of Professor at the University. Even though by the special grace of God I was appointed as a Professor in the year 2009 by this unique citadel of knowledge, I stand before you all today to present my Inaugural lecture, titled " Repositioning our Coastal Environment: A Rescue Mission For Aquaculture And Fisheries Production And Management In Nigeria". This opportunity also creates wider awareness of the benefits of the University's teaching and research, most especially an opportunity for Professors to inform colleagues in the University and the general public about their research career and update colleagues about their former, current or future research directions.

Indeed, the origin of the title 'professor' comes from the need to profess, or declare publicly, ones' knowledge. The rite of passage to become a professor in a University has for hundreds of years included the test of having to profess your knowledge to, a lay audience and fellow academics.

Quoting from the declaration of Wits University, Johannesburg, South Africa, "in a world of rapidly increasing quantities of knowledge, more and more specialization takes place. One danger of this trend is that knowledge becomes isolated, and therefore fails to benefit from collective thinking and cross-pollination of ideas". It is in this context that we must see the challenge of professing knowledge with the general public and the larger academic community.

The Professorship Chair was founded in 1862 in the University of Oxford with Professor Montagu Burrows chosen as its first occupant (Charles, 1960). However, in 1973, in Nigeria, Professor Tekena N. Tamuno in the Department of History, University of Ibadan, presented the first Inaugural lecture entitled, "History and History-makers in Modern Nigeria" (Afigbo, 1975, pp 715 -720).

Since then, this unique, special and academic exercise has become a thing of glory in Nigeria.

Today, this exercise gives me the privilege to share my more than 31 years of experience in the world of academics.I joined this University on the 21st of July 1997 as a Lecturer ll in the Department of Aquaculture and Fisheries Management. And since then, I have been privileged to occupy academic and non-academic, College, Departmental and University academic and Management positions. And by the special grace of God and hard work, I was promoted to the Rank of a Professor in October, 2009 after 12 years of meritorious service.

2.0 INTRODUCTION

It is indeed a great pleasure for me to stand before you today to present the 75th Inaugural Lecture of the Federal University of Agriculture, Abeokuta. This is the third Inaugural Lecture from the Department of Aquaculture and Fisheries management. The first one was presented by Professor Sam Olu Otubusin, while the second one was presented by Professor Geoffrey N. Ezeri. This is also the eleventh Inaugural lecture from the College of Environmental Resources Management coming after presentations by Professors Julius A Okojie, B A. Ola-Adams, Olasumbo Martins, Samuel A. Onadeko, Niyi J. Bello, Samuel O. Otubusin, Adegboyega M. Aduradola, Godfrey N. Ezeri, Toyin A. Arowolo and Sam O. Oluwalana.

Mr. Vice Chancellor Sir, the title of my lecture as advertised, is "Repositioning our Coastal Environment: A rescue mission for Aquaculture and Fisheries production and Management in Nigeria".

2.1 Aquaculture and Fisheries

2.1.1 Aquaculture

An understanding of the principles of operation of capture and culture fisheries helps to throw light on the definition of aquaculture. The expressions - capture and culture fisheries are self-explanatory. In the former, one reaps the aquatic harvest without having to sow, whereas, in the latter, one has to sow the seed, nurse it, tend it, rear it and harvest it when it grows to marketable size (Kutty, 1987). There are many and various definitions that different authors, and fish practitioners has given to aquaculture. In this lecture, I will cite a few in order to emphasis the influence of the environment on this very important production sector.

Jhingran (1987) observed that "aquaculture has been defined by the Japanese Resource Council, Science and Technology Agency as an industrial process of raising aquatic organisms up to final commercial production within properly partitioned aquatic areas, controlling the environmental factors and administering the life history of the organism positively and it has to be considered as an independent industry from the fisheries hitherto." He further opined that aquaculture is also the organized production of a crop in the aquatic medium. The crop may be that of an animal or a plant. Naturally, the organism cultured has to be ordained by nature as aquatic, such as finfish (tilapia, carp, trout, milkfish, bait minnow, yellow tail, mullet, catfish); or shellfish (shrimps, prawns, oysters, mussels, pearl oyster for cultured pearls).

Another school of thought says that Aquaculture is the farming of aquatic organisms and plants in fresh, brackish or salt water. Galawat and Yabe, (2012) referred to aquaculture as the breeding, raising, and harvesting fish, shellfish, and aquatic plants in controlled aquatic environments like the oceans, lakes, rivers, ponds and streams. Aquaculture is highly flexible and adaptable to a wide range of environments, markets and investment levels from small ponds that produce a few kg of fish for home consumption up to high density raceways or cages that can carry hundreds of kg per m3 (Brummett et al, 2008). Ponds are the cheapest and simplest systems to build and manage fish, the main problem being that they must be sited in areas where the soil is heavy enough to hold water and the topography has enough slope to permit complete draining without the use of expensive pumping.

Ponds also take up a lot of space as their carrying capacity seldom reaches 1 kg per m2 , being limited by the ability of the natural ecosystem to produce oxygen and absorb metabolic wastes. On the other hand, fish growing in the more or less natural environment of ponds are at relatively reduced risk of stress and disease and if properly fed can grow efficiently on a combination of low-value inputs and natural foods (Brumett et al, 2008)

In their work, Beveridge and Phillips (1993) declared that Aquaculture is practiced in marine, brackish and fresh waters, the great bulk of current production being in the latter. In fresh- and brackish-waters, aquaculture is practiced in cages in natural (lakes, rivers, estuaries, streams etc.) and quasi natural water bodies (reservoirs, irrigation channels etc.), and in purpose built ponds on land, consuming land. It has been suggested that often aquaculture utilized 'marginal' land, not suitable for agriculture.

De Silva (2012) in his own opinion declared that Aquaculture is the farming of waters, though a millennia old tradition, only over the last three decades has become literally 'the new kid on the blocks' from viewpoints of food production, food security, a provider of significant employment/livelihood opportunities, and a source of income generation.

Some authors have equally observed that aquaculture has been an age old practice that commenced in China (De Silva & Davy, 2010). However, its significance to the contribution to “human food basket” is of only three to four decades old. There is a universal acceptance that aquaculture has matured to be an important contributor to meet human food fish demands, and is often mooted as the fastest growing primary production sector.

Aquaculture is a relatively new primary production sector from the viewpoint of its significant and important contribution to the human food basket.

However, this increasing importance happened to occur when the world as a whole became conscious and realized that all developments, be it in the primary production sector or elsewhere, have to be sustainable and environmentally minimally perturbing, and have to comply with increasing food quality and nutritional needs (De Silva & Davy, 2010).

Based on the submission of Jhingra (1987), some of the major objectives of aquaculture include the followings:

(a) Production of protein rich, nutritive, palatable and easily digestible human food benefiting the whole society through plentiful food supplies at low or reasonable cost.

(b) Providing new species and strengthening stocks of existing fish in natural and man-made water-bodies through artificial recruitment and transplantation.

(c) Production of sport-fish and support to recreational fishing.

(d) Production of bait-fish for commercial and sport fishery.

(e) Production of ornamental fish for aesthetic appeal and,

(f) Recycling of organic waste of human and livestock origin.

It has been observed generally that aquaculture is inherently a resource-efficient means of producing food. For example, marine aquaculture requires no land, and minimal fresh water. Since fish are grown in the water, where the effects of gravity are lessened, they can devote more energy towards growth and need less food per unit of production than animals on land. And farming in the ocean allows for three-dimensional endeavours, allowing much more animal protein to be produced in the same area per unit time.

Tacon (2001) noted that of the different global food production supply systems, aquaculture is generally viewed as an important domestic provider of much needed high-quality animal protein and other essential nutrients generally at affordable prices to the poor segments of the community. Increased production from aquaculture will help combat hunger and malnutrition, which remains one of the most devastating problems facing the majority of the poor in the world.

Aquaculture makes use of land, water, wild fish and other natural resources in order to provide the right conditions for the cultured organisms to grow. Aquaculture covered about 18.8 million ha of land worldwide as at 2012 (Waite et al. 2014) while over 1.4 million ha of rice fields were used for aquaculture in China as at 2008 (FAO, 2011). Aquaculture tends to have a land utilization advantage over agriculture with the former utilizing only 0.5% of land (22.5 million ha) compared to Agriculture (4.9 billion ha) in 2010 and yet producing more tonnage of fish per hectare (Boyd and McNevin, 2014). Aquaculture modifies the environment, habitats, flora and fauna, scenery, proximal or in vivo water bodies as well as soil (Dosdat, 2009). Continual consumption of these resources by aquaculture without a thought about sustainability will lead to depletion notwithstanding the competing claims on these resources by other sectors of productive economy.

2.1.2 Fisheries

Fisheries from the Wikipedia, free encyclopedia, can mean either the enterprise of raising or harvesting fish and other aquatic life or more commonly, the site where such enterprise takes place is termed a fishing ground. Commercial fisheries include wild fisheries and fish farms, both in freshwater bodies (about 10% of all catch) and the oceans (about 90%). About 500 million people worldwide are economically dependent on fisheries.

A fishery is defined in terms of the "people involved, species or type of fish, area of water or seabed, method of fishing, class of boats, and purpose of the activities or a combination of the foregoing features". Fisheries comprise marine fisheries operating along the coast, lagoons and off-shore as well as inland (freshwater) activities, on lakes, rivers, reservoirs, floodplains, permanent or seasonal water bodies. One can distinguish commercial, subsistence or recreational fisheries. As an economic activity, a fishery is characterized by its operational scale, ranging from small-scale to large-scale activities. What differentiates a small-scale fishery from a larger one is not necessarily clear, and "scale" is often considered partly contextual; a small-scale fishery in one country may be considered a medium-scale fishery in another (HLEP, 2014)

Aquaculture and Fisheries provide food, livelihoods and economic benefits to millions of people in the world. Global fish production was estimated at 171 million tons in 2016, supplying around 20.3 kg/capita per year and 17 per cent of global animal proteins and essential micro-nutrients.

Upstream and downstream activities along the fish and seafood value chain provided significant employment and economic benefits to countries and local coastal communities. As a result, around 59.6 million people were employed in fisheries and aquaculture in 2016 and some 200 million direct and indirect employment opportunities occur along the fish and seafood value chain.

Furthermore, fish and seafood is one of the most traded food commodities. Some 35 to 38 per cent of the world production enters international trade generating US$ 152 billion in 2017. Over 50 per cent of this trade originates in developing countries whose net trade income (export – import), valued at US$ 37 billion in 2013, and is greater than the net income of most other agricultural commodities combined (FAO, 2020).

Generally, the fishery sector (captured and farm-raised) in Africa generates a variety of benefits including food and nutrition security, employment, livelihoods, exports and foreign currencies, conservation and biodiversity values. About 200 million people – or about 30% of the continent's population - eat fish as their main source of animal protein and micro-nutrition.

In addition, fisheries also provide livelihoods for over 12.3 million Africans, of whom 6.1 million are direct fishers, 5.2 million are processors and 0.9 million are fish farmers. Of the 12.3 million people employed in the fish sector, 27.3 % are women; of whom 91.5% are employed in processing, 7.2% are fishers and 1.3% is fish farmers. Fish produces a total first sale value of US$19.72 billion, the majority of which is earned by small-scale operators supplying food to local and sub-regional markets (NEPAD, 2014). Among the various fisheries, the highest value is produced by the marine artisanal fisheries (0.43%), followed by marine industrial fisheries (0.36%), inland fisheries (0.33%) and aquaculture (0.15%). The overall contributions of fishing and processing respectively are 0.76% and 0.33% and this illustrates the importance of post-harvest sub-sector in the continent. In order for fish to make a meaningful contribution to Africa's food and nutrition security, there is a need to control post- harvest losses which are estimated at 20-25% or a total of 2 million tons of fish annually (NEPAD, 2014).

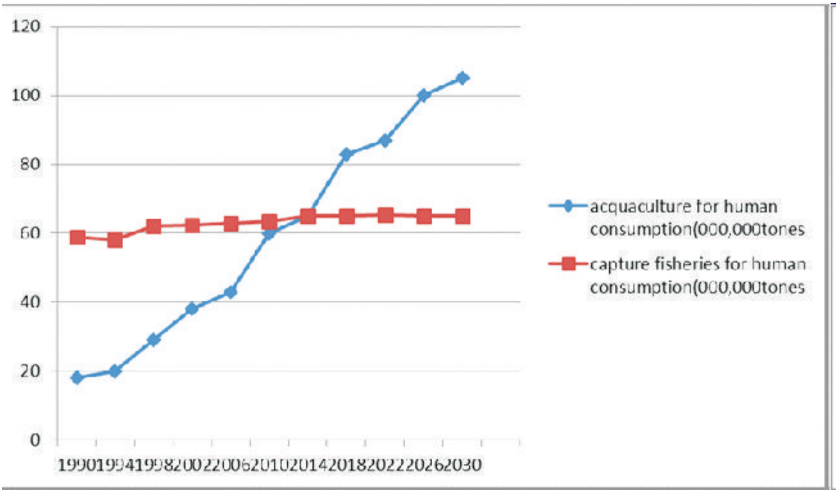

Fig 1: Global capture fisheries and aquaculture production 1990 – 2030 (SOURCE: Nwokedi *et al*, 2020)

While African capture fisheries have been (over) exploited to their maximum (FAO, 1999) and aquaculture has languished, African demand for fish has grown. Africans are second only to Asians in the importance of fish in the diet, with 17.4% of total animal protein intake in the form of fish (compared to 25.7% in Asia).

The principles of management of capture and culture fisheries are very different from each other. In the case of capture fisheries one has to attempt to harvest maximum sustainable yield by regulating fishing effort and mesh after taking into account parameters of population dynamics such as rates of recruitment, natural and fishing mortalities, fish growth and size at which recruitment occurs. Management of capture fisheries requires knowledge of the dynamics of the fish populations under exploitation. The extended exclusive economic zone of 200 miles brings into focus the national and international complexities of regulating the capture fisheries of the seas and the oceans and apportionment of the marine harvest because fish populations do not abide by man-made boundaries (Kutty, 1987).

2.2 Significance of Aquaculture and Fisheries Production

The fisheries and aquaculture sector is very heterogeneous. A diversity of resource, economic and social conditions and constraints drive the organization of the sector and in return diverse structures perform differently in their environmental, economic and social dimensions.

Fisheries and aquaculture is a source not just of health but also of wealth. Employment in the sector has grown faster than the world's population. The sector provides jobs to tens of millions and supports the livelihoods of hundreds of millions. Fish continues to be one of the most-traded food commodities worldwide. It is especially important for developing countries, sometimes worth half the total value of their traded commodities.

Way back to 1995, tailored into the principles set out in the benchmark of the *Code of Conduct for Responsible Fisheries*, the Blue Growth focused on capture fisheries, aquaculture, ecosystem services, trade and social protection. Blue Growth means the economic development based on the use of the economic potential of the oceans, seas and coasts for sustainable growth and jobs, to be developed in harmony with the marine environment. The World Bank defines the Blue economy as “the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health.”

The Food and Agriculture Organization of the United Nations (FAO) Blue Growth Initiative (BGI) aims at building resilience of coastal communities and restoring the productive potential of fisheries and aquaculture, in order to support food security, poverty alleviation and sustainable management of living aquatic resources.

Mr. Vice Chancellor, Sir, this in itself shows the significance of aquaculture and fisheries production vis-a-vis the coastal environment that harbours the existence of these resources.

In line with FAO's Reviewed Strategic Framework, the initiative focused on promoting the sustainable use and conservation of aquatic renewable resources in an economically, socially and environmentally responsible manner.

This Inaugural lecture will dig into some aspects of the usefulness of the coastal environment for a better utilization for food security. A deeper look at reconciling and balancing priorities between growth and conservation, and between industrial and artisanal fisheries and aquaculture, ensuring equitable benefits for communities living in the coastal areas of Nigeria will be adventured.

Fish production in Nigeria is currently achieved through two main sources, namely, the capture fishery (capture) and fish farming (aquaculture).

Fish capture refers to the aggregate quantity of fishery resources harvested from all wide sources by the state as the total output of the fishing effort (manpower, time, gears, trawlers etc.) put into harvesting the wide fishery (freshwater and marine fishery) over the same period of time, usually one year (FAO, 2010).

2.3 Role of Fish in Human Diets

Humans and fish have been inextricably linked for millennia, not only as an important animal protein source, providing many millions of livelihood means and food security at large, but also from an evolutionary viewpoint. Indeed, one school of thought has suggested that the development of the human brain, and hence, what humans are today, has also been linked to food sources rich in n-3 (DHA, EPA) and n-6 (AA) PUFAs – literally fish constituting a major part of the diet of our ancestors. In this regard, a large quantum of evidence has been brought forward to show that *Homo* *sapiens* evolved not in a savannah habitat, but in a habitat that was rich in fish and shellfish resources (Crawford *et al* . 1999). There are numerous publications and research materials that highlighted fish as a "wonderful dietary cargo".

Mr. Vice Chancellor, Sir, permit me to mention a few of these dietary qualifications of fish in this inaugural lecture.

(a) Fish is a rich source of vitamins, particularly vitamins A and D from fatty species, as well as thiamin, riboflavin and niacin (vitamins B_1, B_2 and B_3). Vitamin A from fish is more readily available to the body than from plant foods. Vitamin A is required for normal vision and for bone growth. Fatty fish contains more vitamin A than lean species. Studies have shown that mortality is reduced for children under five with a good vitamin A status. As sun drying destroys most of the available vitamin A better processing methods are required to preserve this vitamin (**Meena, 2011)**.

(b) The minerals present in fish include iron, calcium, zinc, iodine (from marine fish), phosphorus, selenium and fluorine. These minerals are highly 'bioavailable' meaning that they are easily absorbed by the body. It is evident that fish contribute more to people's diets than just the high quality protein they are so well known for. Fish should therefore be an integral component of the diet, preventing malnutrition by making these macro- and micro-nutrients readily available to the body (**Meena, 2011)**.

(c) The importance of fish in providing easily digested protein of high biological value is well documented. In the past, this has served as a justification for promoting fisheries and aquaculture activities in several countries. On a fresh weight basis, fish contains a good quantity of protein, about 18 - 20%, and contains all the eight essential amino acids including the Sulphur containing lysine, methionine, and cysteine. Fish is a particularly nutritious food, rich in numerous micro-nutrients that are often missing in diets, particularly those of the poor. The presence of essential nutrients (such as iodine, vitamin B12 and D), the long-chain fatty acids (LC-PUFA), *eicosapentaenoic* (EPA) and *docosahexaenoic* (DHA) omega-3 fatty acids, protein of high quality and fish's very rich content in calcium, iron, zinc and vitamin A, is well documented in many literatures (HLPE, 2014).

(d) Fish (either produced through fish farming/aquaculture activity or caught from wild stocks – marine, coastal, off-shore and freshwater) is used in many developing countries as a primary source of protein. Fish is also a major source of livelihoods and income, particularly in developing countries. It is estimated that more than 158 million people in the world depend directly on fish-related activities (fishing, fish farming, processing and trading). More than 90 percent of these are small-scale operators living in developing countries (HLPE, 2014).

Washington State Department of Health (USA) observed that eating fish is an important source of omega-3 fatty acids. These essential nutrients keep our heart and brain healthy. It concluded that these Omega-3 Fatty Acids help in the following ways: (i) help maintain a healthy heart by lowering blood pressure and reducing the risk of sudden death, heart attack, abnormal heart rhythms, and strokes. (ii) aids healthy brain function and infant development of vision and nerves during pregnancy. (iii) may decrease the risk of depression, ADHD, Alzheimer's disease, dementia, and diabetes and (iv) may prevent inflammation and reduce the risk of arthritis (Department of Health, Washington, 2022).

Fish, in a broad sense, including fisheries and aquaculture, plays a crucial role for food security as a purveyor of food (availability), livelihoods and income, particularly for some vulnerable and marginalized populations (accessibility) and provides essential micro-nutrients (utilization).

Fish plays an important role for food security and nutrition by providing food and income.

However, fish, fisheries and aquaculture are often kept on the side of debates relating to food security and nutrition. Three fundamental aspects stand out to ground the importance of fish for food security and nutrition: (i) the protein and nutrient content of fish as food; (ii) the role of fisheries and aquaculture activities as a source of income and livelihoods; and (iii) the relative efficiency of fish to produce/transform proteins (HLPE, 2014).

Mr. Vice Chancellor, Sir, I will like to recall what Prof G. N. Ezeri said in 2014 during his inaugural presentation, and I quote, "The fisheries sector makes a vital contribution to the food and nutritional security of 200 million Africans and provides income for over 10 million engaged in fish production, processing and trade. Moreover, fish has become a leading export commodity for Africa with an annual export value of US$ 2.7bn. Yet, these benefits are at risk, as the exploitation of natural fish stock is reaching its limit and aquacultural production is yet to fulfill its potentials". He concluded with the following affirmations as thus, "Fish is a heavily traded food commodity and fastest growing agricultural commodity in international markets.

Plate 1: Typical smoked fishes on display in the market.

Commercially valuable species have been over-fished and smaller fish species are being captured daily. The beneficial health bonus of fatty fish consumption, especially those involving the Omega–3 polyunsaturated fatty acid found in fish such as salmon, mackerel, eel and tuna, is without doubt a further incentive for the upward movement of the index of demand for fish as food."

2.4 Global fish production system

Mr. Vice Chancellor, Sir, let me start by quoting the World Bank. In their 2013 *Fish to 2030 Report*, it goes thus: - "Aquaculture has grown at an impressive rate over the past decades. It has helped to produce more food fish, kept the overall price of fish down, and made fish and seafood more accessible to consumers around the world. That's why greater investment is needed in the industry - for new and safer technologies, their adaptation to local conditions, and their adoption in appropriate settings." (World Bank, 2013)

Based on the World Bank estimate, global population is expected to reach 9 billion by 2050, and the world food-producing sector must secure food and nutrition for the growing population through increased production and reduced waste.

It was observed that production increase must occur in a context where resources necessary for food production, such as land and water, are even scarcer in a more crowded world, and thus the sector needs to be far more efficient in utilizing productive resources. Fisheries and aquaculture must address many of these difficult challenges (World Bank, 2013).

Ocean and inland waters, which include seas, lakes, rivers and reservoirs will continue to provide significant benefits to humanity. These encompass (i) food and nutrition security from fisheries and aquaculture, (ii) economic and social development from fisheries and aquaculture, marine and coastal tourism, shipping, mining, energy and (iii) ecosystem services such as carbon sequestration, water filtration, atmospheric and temperature regulation, protection from erosion and extreme weather events. In addition, Fisheries and aquaculture supply 17 percent of global animal proteins and support livelihoods of about 660– 820 million livelihoods (or 10–12 percent of the world's population). Currently 3 billion people depend on fish for twenty percent of their average per capita intake of animal protein (Ababouch, 2015).

The followings are the fish production systems in the world:- (i) freshwater pond culture; (ii) rice-fish culture or integrated fish farming; (iii) brackish water finfish culture; (iv) mariculture involving extensive culture and producing fish/shellfish (e.g., oysters, mussels, cockles) which are sold in rural and urban markets at relatively low prices.

Generally, aquaculture is practiced either as (a) water-based systems (cages and pens, inshore/offshore); or (b) land-based systems (rain fed ponds, irrigated or flow-through systems, tanks and raceways). However, aquaculture as a fish farming system is carried out in three main forms and variations. These are (i) Completely closed system that is called integrated recycling system; (ii) Flow-through/raceway that is called semi-closed system and (iii) Open system that is called floating cage system.

The world produces around 200 million tons of fish and seafood every year (FAO, 2020).

The country that catches the highest volume of fish is China, with a total volume of 58.8 million tons followed by Indonesia and India. With a total global fish production of 178.8 million tons, one third of the world's fish production comes from China. Scientific developments of the last 50 years have led to a much improved understanding of the functioning of aquatic ecosystems, and to global awareness of the need to manage them in a sustainable manner.

The latest and most current FAO Report, (SOFIA, 2020) has given us many convincing facts and figures that has showed that global fish production is estimated to have reached about 179 million tons in 2018, with a total first sale value estimated at USD 401 billion, of which 82 million tons, valued at USD 250 billion, came from aquaculture production. It also shows that of the overall total, 156 million tons were used for human consumption, equivalent to an estimated annual supply of 20.5 kg per capita. The remaining 22 million tons were for non-food uses, mainly to produce fishmeal and fish oil. It showed that Aquaculture accounted for 46 percent of the total production and 52 percent of fish for human consumption.

The report went on further to show that global food fish consumption increased at an average annual rate of 3.1 percent from 1961 to 2017, a rate almost twice that of annual world population growth (1.6 percent) for the same period, and higher than that of all other animal protein foods (meat, dairy, milk, etc.), which increased by 2.1 percent per year. Per capita food fish consumption grew from 9.0 kg (live weight equivalent) in 1961 to 20.5 kg in 2018, by about 1.5 percent per year.

2.5 Role of Fisheries Production in Africa

Africa's domestic fish supply is still dominated by capture fisheries owing to the continent's endowment of vast fish resources in marine and inland waters. Morocco, Nigeria, and South Africa are the top three fisheries producers in the continent (FAO, 2018).Being an important part of the African agri-food system, fish has significant potential to contribute to the goal of reducing food and nutrition insecurity in Africa.

Fish provides 19% of animal protein in-take to Africans and plays a unique role in providing a range of micronutrients and essential fatty acids (Chan *et al.*, 2019). In Africa's food systems, fish and other aquatic foods play a multifaceted role generating income, and providing a critical source of essential micronutrients, particularly for women and infants. Nevertheless, the current and future values of fish and aquatic foods in Africa are often overlooked in development research, policy and investment.

Fish supply comes into Africa through two major sources. These are Wild harvesting and Fish farming, popularly called Aquaculture. Africa has extensive marine fisheries that are exploited by foreign commercial fleets. However these catches are destined for export and play little role in meeting the continent's food needs. Rather, it is the small-scale coastal inshore, and inland freshwater, fisheries that provide most (> 90%) of the fish consumed across the continent. All African countries have fisheries and most have aquaculture potential and many could benefit from the investments (The World Fish Center, 2009).

Further reports have shown that in sub-Saharan Africa, fisheries and fish-related activities represent the main livelihood support for between 6 and 9 million households, providing food security to over 40 million persons through wages and self-generated revenues (World Fish Center, 2005). In Africa, fisheries support some 10 million livelihoods. Fish is the cheapest source of animal protein on the continent, and provides nutrition and food security, with 20% of animal protein intake in Africa. Africa is a net exporter of fish, with the trade providing the sum of $4.3 billion in revenues per year (FAO, 2007). Some of the world's most fertile fishing grounds can be found off the coast of Africa. Approximately 4.6 million tons of fish are harvested from the continent's marine waters each year, together with a total of 2.3 million tons from inland fisheries and 0.7 million tons from aquaculture–with an estimated total value of almost $4.9 billion at first sale. In most coastal countries in Africa, the fishing sector is a major contributor to rural income and employment, attracts considerable local and foreign investment, enhances food security, and in many cases is a substantial source of foreign exchange and funding for public budgets (World Bank Group, 2012)

2.6 Role of Fisheries Production in the Nigeria's National Economy

The Fisheries production is noted for its important economic contribution in terms of nutrition and food security, employment and enterprise development, local and foreign exchange earnings and also important in terms of the livelihoods of many rural people.

The fisheries sector of the nation, Nigeria is crucial to the national economy because it has been established that it contributes about 5.40% of the nation's Gross Domestic Product (GDP). Fish accounts for around 40 percent of the country's protein intake with fish consumption at 13.3 kg/person/. Total fish production per year is close to 1 million metric tons (313,231 metric tons from aquaculture and 759,828 metric tons from fisheries) (World Fish, 2021). According to the FAO, in Nigeria, around 94 million hectares are used for fishery production, and about 1,477,651 people work as fisheries (FAO, 2021).

Mr. Vice Chancellor, Sir, Nigeria, as a maritime nation with a vast population of over 160 million people and a coastline measuring approximately 853 kilometers, fish production as an enterprise possesses the capacity to contribute significantly to the agricultural sector (Osagie, 2012).

Akinrotimi *et al.,* (2011) in their work exposed the fact that fish supply in Nigeria comes from four major sources. These are artisanal fisheries, aquaculture, industrial trawlers and imported frozen fish. The Niger Delta Region contributes over 50% of the total domestic fish supply. This region is blessed with abundance of both fresh, brackish and marine water bodies that are inhabited by a wide array of both finfish and other non-fish fauna that supports artisanal fisheries (Akankali & Jamabo, 2011). Nigeria's coastal zone is endowed with numerous living and non-living resources. The most important living resources are fin and shellfish including shrimps. Nigeria's domestic fish production hovers around **400,000-500,000 metric tons annually** (Akinrotimi *et al.,*2011)

3.0 Coastal Zone/Environment

The coastal zone/environment itself is an area considered in some European countries to extend seawards to territorial limits, while others regard the edge of the continental shelf at around the 200 m depth contour as the limit. Agreement as to what constitute a coastal zone varies from one jurisdiction to another in the world.

Broadly speaking a coastal zone is understood to be a defined spatial extent encompassing land (including submerged land), sea, and the land-sea interface, where each entity within the defined spatial extent exerts strong influence upon the others in terms of ecology and uses. Over 50% of the earth's population live within 100 km of coasts, and this population is expected to increase by 35% by the year 2025 (Mmom & Ckukwu-Okeah, 2011).

3.1 The Nigeria Coastal Zone/Environment

The Nigerian coastal zone sprawls a total of nine states, out of the thirty-six states of the federation, namely: Akwa-Ibom, Bayelsa, Cross River, Delta, Edo, Lagos, Ogun, Ondo and Rivers. The coastal states are estimated to account for 25% of the national population. (Table 1). The coastal areas stretch inland for a distance of about 15 km in Lagos in the West to about 150 km in the Niger Delta and about 25 km east of the Niger Delta. The coastline stretches for about 853 km comprising inshore waters, coastal lagoons, estuaries and mangrove especially in the Niger Delta (Mmom & Ckukwu-Okeah, 2011).

State	**Length of Coastline**	**% of total Coastline**
Ondo	84	8.72
Ogun	69	7.17
Rivers	111	11.53
Cross River	129	13.40
Lagos	171	17.76
Delta	117	12.15
Bayelsa	186	19.31
Akwa Ibom	96	9.97
Total	**963**	**100**

Table 1: Coastline of Nigeria State by State.
Source: Folade (2011)

The ecological zones in Nigeria are based on the classification of Keay (1949), and are defined from South to North as follows: Mangrove Swamp and Coastal Vegetation, Freshwater Swamp Forest, Lowland Rain Forest, Derived Savanna, Guinea Savanna, Sudan Savanna, and Sahel Savanna (Figure 2) (Keay, 1949). The Freshwater swamp forest forms a wide belt inland after the mangrove and coastal vegetation. The zone has more open canopy, which may reach 45 m in height, densely tangled, and almost impenetrable undergrowth. It is usually flooded during the wet season and dries out during the dry season leaving portions of dry forest floor interspersed with permanent pools of water. (FORMECU,1998). Much of this vegetation type has been converted to agricultural and urban lands, and the original swamp forest remains mostly on alluvial sites along the major rivers. While a few areas of the rainforest remain untouched (undisturbed) with top canopy closely interlocked, most rainforest has been disturbed/degraded through conversion to agricultural farmlands, indiscriminate felling and wood removal, except for parts of the Cross River State.

In some areas, tropical rain forests have become limited to forest reserves, national parks and game reserves, which are also encroached (FDF, 2019). Nigeria is blessed with arable land for agricultural purposes, crude oil and natural gas deposits, and other mineral resources such as tin, iron ore, coal, lead, zinc, limestone, niobium etc. In addition, Nigeria has several water bodies which are distributed as freshwater (river, creek, creek lets, ponds, lakes and streams), estuarine (fresh and salt water interphase) and marine/salt water (Izah, 2018)

The aquatic ecosystem is also habitats to several biological species including fisheries (viz: both fin and shelled fish), some aquatic mammals, reptiles etc. Up to 2.6–3.0% of Nigerian land mass is wetlands especially in the Niger Delta region. According to Ramsar Convention, wetlands are characterized by marsh, fern, water/peatland which are either natural or artificial, permanent or temporary, with static or flowing water which can either be estuarine, fresh or marine with a depth of ≤ 6 meters at low tide (Izah, 2018)

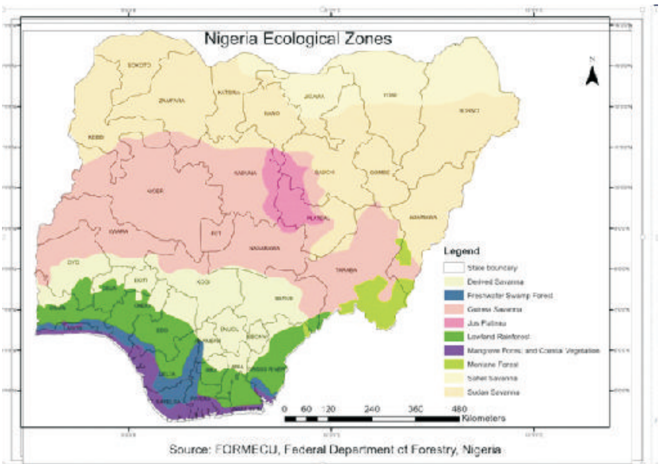

Figure 2: Nigeria Ecological Zone
Source: FORMECU, Federal Department of Forestry, Nigeria.

3.2 Nigeria Coastal Environment: Ecosystem, Structure and Functions

The concept of ecosystem was first put forth by Tansley (1935). Ecosystem is the major ecological unit. It has both structure and functions. The structure is related to species diversity. The more complex is the structure the greater is the diversity of the species in the ecosystem. The functions of ecosystem are related to the flow of energy and cycling of materials through structural components of the ecosystem. According to Woodbury (1954), ecosystem is a complex in which habitat, plants and animals are considered as one interesting unit, the materials and energy of one passing in and out of the others. The structure of an ecosystem is basically a description of the organisms and physical features of environment including the amount and distribution of nutrients in a particular habitat. It also provides information regarding the range of climatic conditions prevailing in the area. The coastal ecosystem is one of the major aquatic ecosystems and is quite distinct in terms of structure and diversity. Coastal ecosystem is formed in the union of land and water. Coastal ecosystems harbor a variety of plants and algae and serve as a home to snails, shrimps, crabs, lobsters and fishes.

The coastal zone of Nigeria could be described based on geomorphology, vegetation, natural resources and socio-economic activities (Ifeyinwa, 2000). Geomorphologically, the barrier-lagoon coast extends eastward about 250 km from the Nigerian-Benin border to Ajuno village, consisting of narrow beach ridges aligned parallel with the coast and backed up by the Badagry, Lagos, and Lekki lagoons with beach sediments of medium to coarse grained sand and moderately well sorted, (IBE, 1998). Some of the notable ecosystem includes brackish water, freshwater swamp forest, lowland rainforest, mangroves forest etc.

3.2.1Brackish-water Ecosystem

Merriam-Webster defines the term brackish as “somewhat salty”. Brackish water refers to a water source that is somewhat salty (more so than freshwater) but not as salty as seawater. The exact amount of salinity will vary depending on environmental factors and cannot be precisely defined. The salinity is usually measured in a range rather than an exact amount. Generally speaking, the variation of salinity usually measures from 10% to 32% while the average salinity of freshwater sources is around 0.5% (*Wikipedia)*.

Brackish water is water which contains more sea salts than freshwater but less than the open sea. Moreover, brackish water environments are also fluctuating environments. The salinity is variable depending on the tide, the amount of freshwater entering from rivers or as rain, and the rate of evaporation. As a result many brackish water fishes are tolerant of changes in salinity, and in fact many positively benefit from similar periodic changes in aquaria.

Brackish water is water that has more salinity than fresh water, but not as much as seawater. It may result from mixing of seawater with fresh water, as in estuaries, or it may occur in brackish fossil aquifers. The word comes from the Middle Dutch root "brak," meaning "salty".

Certain human activities can produce brackish water, in particular certain civil engineering projects such as dikes and the flooding of coastal marshland to produce brackish water pools for freshwater prawn farming.

Brackish water is also the primary waste product of the salinity gradient power process. Because brackish water is hostile to the growth of most terrestrial plant species, without appropriate management it is damaging to the environment Brackish water normally naturally occurs in estuaries, deltas of rivers, lagoons and backwaters, which everywhere in the world are under tidal regime.

In such habitats the salinity of the water fluctuates widely between negligible oppt to 35 ppt, depending on the phase of the tide and volume of fresh water discharged through the river into the sea.

Technically, brackish water contains between 0.5 and 30 grams of salt per litre-more often expressed as 0.5 to 30 parts per thousand (ppt or ‰). Thus, brackish covers a range of salinity regimes and is not considered a precisely defined condition. It is characteristic of many brackish surface waters that their salinity can vary considerably over space and/or time.

3.2.2. *Freshwater Ecosystem*

Freshwater ecosystems are a subset of Earth's aquatic ecosystems. They include lakes, ponds, rivers, streams, springs, bogs, and wetlands. They can be contrasted with marine ecosystems, which have a larger salt content. Along the freshwater systems of the coastal zone are wetlands. These wetlands include marshes, mangroves, bogs, swamps and fens. Freshwater ecosystems play a fundamental ecological role and provide economically important products and services. They provide critical habitats for a large number of aquatic plants, fishes, reptiles, birds and mammals. They host many migratory and threatened species of birds, reptiles and fish.

3.2.3 *The Niger Delta in the Nigerian Coastal zone*

There is no way that we will talk about the Nigerian coastal area, vis-à-vis fisheries production without mentioning the Niger Delta. Mr. Vice Chancellor, Sir, the Niger Delta region is one of the most prominent regions in Nigeria, endowed with several water bodies that are distributed as freshwater like rivers, stream, creeks, lakes and estuaries (which interphase fresh and salt water) and marine water (Izah, 2018). Different authors in their different works have reported that the Niger Delta area comprises of nine (9) states, i.e, Ondo, Edo, Delta, Bayelsa, Rivers, Imo, Rivers, Abia, Akwa-Ibom and Cross Rivers. This area consists of approximately 70,000km^2 and it is the largest wetland area in Africa and the third largest in the world (Ogbe, 2011).

Approximately 2,370 square kilometers of the Niger Delta area is comprised of rivers, creeks and estuaries and 8,600 square kilometers is made up of stagnant swamp (Ohimain, 2012). This region is the oil producing area of Nigeria, which consists of highly diverse ecosystems that are supportive of numerous species of terrestrial and aquatic fauna and flora. Crude oil spills endanger fish hatcheries in coastal water and also contaminate valuable fish.

The coastal communities of the Niger Delta region has remarkable potentials for the development of brackish water aquaculture, but these remain largely undeveloped not only because of the difficult nature of the terrain, but the government as well as the multinationals have not understood and tapped the potential role of brackish water aquaculture in managing the crisis in the Niger Delta (Anyanwu *et al.*, 2007). Figure 3 shows the entire 9 states that comprise the Niger Delta. The other Plates 2,3,4, 5 and 6a,b, below show the different fish species of this unique area; the various fishery activities and the richness of the Niger Delta area. If granted the much needed priority, Nigeria can still turn the region to an economic hub for diverse human activities that will enhance fish production even in the midst of Oil prospection.

Fig 3: The Niger Delta Region of Nigeria
Source: Author

Plate 2: Some of the Fishery Resources of the Niger Delta

Plate 3: Some of the Fishery resources of the Delta area of Nigeria

Plate 4: Fishing activities in the Delta area of Nigeria

Plate 5: Some major fish species in Nigeria

3.3 Coastal Environment for Food Security

Fisheries and aquaculture contribute significantly to food security and livelihood.According to the United Nations' Committee on World Food Security, food security is defined as meaning that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life (*Wikipedia*, 2022). At the 1974 World Food Conference, the term "food security" was defined with an emphasis on supply; food security is defined as the "availability at all times of adequate, nourishing, diverse, balanced and moderate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices". (*Wikipedia*, 2022).

Mr. Vice Chancellor Sir, the United Nation's Food and Agriculture Organization (FAO) opined that global production from capture fisheries and aquaculture is the highest fish supply currently on record and remains very significant for global food security, providing more than 15 % of the total animal protein supplies and at least 50 percent of animal protein and minerals to 400 million people in developing countries (Keith, 2010).

About 90 per cent of the fish we consume in Nigeria is imported. Efforts to secure long-term sustainable fisheries and a healthy and efficient ecosystems are regularly threatened by illegal, unreported and unregulated (IUU) fishing and other related activities which are encouraged by corrupt practices. In Nigeria and other African coasts, fish stocks are depleting rapidly, due to the activities of illegal industrial fishing boats that are ravaging large quantities of our fish for export. Nigeria loses about $60 million annually through illegal fishing in its territorial waters. In reverse, the nation is importing over $200 million worth of seafood products annually to supplement local production (The Nation- 5th December 2011).

According to available sources, the supply of fish that will meet the increasing fish demands by Nigerians is from two major groups, viz (a) domestic production of fish and (b) importation of fish. However, importation has served as a major supply of fish in Nigeria providing more than half (56.0%) of fish supply (Nakazawa and Komatsu, 2013)

Mr. Vice Chancellor, Sir, Nigeria is the largest fish consumer in Africa and among the largest fish consumers in the world with about 3.2 million metric tons of fish consumed annually. Its fisheries and aquaculture are among the fastest growing subsectors in the country.

With a coastline of 853km and over 14 million hectares of inland waters, total fish production per year is close to 1 million metric tons (313,231 metric tons from aquaculture and 759,828 metric tons from fisheries). Fishing is a vital livelihood for the poor as well as an important protein source at the household level in Nigeria (Payne, 2000)

Mr. Vice Chancellor Sir, I make it bold to say that this nation can produce our needed fish for home consumption and for export to the outside world. Other Plates (9) shows the various ways and activities that can be improved and enlarged for sustainable fish production. Encouraging rural small-scale and large-scale production is a viable option for mass production that will reduce importation of fish.

Plate 6a: Fishing activities in some coastal areas of Nigeria

Plate 6b: Fishing activities in some Coastal areas of Nigeria

3.3.1 Reconciling and balancing priorities between Growth, Production and Conservation

In 2013, the Food and Agriculture Organization (FAO) exclaimed that the booming world fish -trade was generating more wealth than ever before (Blueprint, 2014).

It signified that countries like Nigeria needed to do something to help small-scale fisheries and fish farmers. In that year, (2913),according to the Minister of Agriculture and Rural development, Dr. Akinwumi Adesina, “Nigeria spends an estimated N125.38 billion importing fish every year even though it has abundant water resources and marine ecosystems to produce high quality fish”. While addressing the 2nd stakeholders' interactive session on re-positioning the fisheries sector, held Abuja in that same year, the Minister said, hope is not lost, as Nigeria is working to improve the sector by promoting greater investments in aquaculture, improving artisanal, inland and marine fisheries. Quoting him, “Our four-year target is to increase the production of fish fingerlings by 1.25 billion per year, the production of fish feed by 400,000 metric tons per year; and increase table size fish production by an additional 250,000 metric tons per year." (Author, 2023)

Mr. Vice Chancellor, Sir, this is year 2023, we are yet to see the outcome of that pronouncement. The need to balance and reconcile growth, production and conservation is always there to confront every responsible government. Unfortunately, elected or enforced governments of the developing countries have deliberately refused to toe this line of development.

Nigeria's 853km coastal length, with a high human population is one of the most threatened land area by coastal and marine erosion and land subsidence. It has been confirmed that its devastating effects are found in the low lying belts of the mangrove and freshwater swamps along the coast and plains of large rivers in the coastal southern states of Nigeria (Nwaehukwu, 2000).

Other economic activities such as Crude oil exploration and exploitation also create serious problems especially in the Niger Delta, resulting to hazards such as soil degradation; deforestation, water resources degradation and destruction of biodiversity have caused huge losses in terms of human life, natural resources and infrastructural losses (NEST, 1991)

3.3.2 Industrial uses and Artisanal/Aquaculture options

Currently the Nigerian fishing industry is in a dynamic state. There is overcapitalization in theindustrial fleet; over fishing of the coastal resources; declining catch, both in quantity and especially in quality; environmental degradation that is seriously impeding the productivity of the artisanal sector; and declining efficiency due to lack of technical innovation (FAO FishCode, 2007). You will all agree with me that this is a sad and gory narration. However there is still hope.

Mr. Vice Chancellor, Sir, artisanal fishery has continued to dominate the fisheries, contributing over 85% of total fish production. The inland water and coastal seas are fully exploited and any increase in fishery production is not likely. Aquaculture potentials remain untapped as much as deep-sea fisheries. The combined potential of the fisheries resources -freshwater, marine and aquaculture can meet over 90% of the nation's demand for fish. Opportunities for investments, therefore, exist in the various subsectors, especially in the areas of storage, processing and preservation for the capture fishery and fish seed multiplication for aquaculture (Nwafili & Gao, 2007).

Coastal aquaculture plays an important role in livelihoods, employment and local economic development among coastal communities in many developing countries, including Nigeria. It is practiced in completely or partially artificial structures in areas adjacent to the sea, such as coastal ponds and gated lagoons. If well planned in Nigeria, it will contribute immensely to the volume of farmed fish in Nigeria. Although coastal ponds for aquaculture, modern or traditional, are found in almost all regions in the world, they are far more concentrated in South, South-East and East Asia and Latin America for raising crustaceans, finfish, and molluscs. However, most African countries are far behind despite ambitious projections at the regional and national levels. Proper policies and planning, supported by an enabling environment in support of infrastructure, technical expertise and investment are needed to promote marine aquaculture in Africa (FAO, 2020).

Plates, 7 and 8 show a typical floating cages that can be conveniently assembled for mass production of fish within a framed cycle of 6 months depending on the expected harvesting sizes and available time space.

Plate 7: Typical Floating cages (Author)

Plate 8: This is another typical Cage Culture with Concrete Walk way. (Author)

3.3.3 Ensuring uses and expanding benefits of the coastal environment

The Nigerian coastal marine domain is rich with a variety of resources that support livelihoods and economic development. These include established activities like fisheries, shipping, offshore Oil and Gas, maritime and coastal tourism, marine manufacturing and construction, dredging, etc., and emerging activities such as marine aquaculture, deep and ultra-deep water oil and gas, offshore wind energy, ocean renewable energy, marine and seabed mining, etc. (Ateme, 2021).

The coastline comprises inshore waters, coastal lagoons, estuaries and mangroves, especially in the Niger Delta area. The major economic activities in the coastal zone are Oil and Gas exploration, fishing, shipping, agriculture, sand-mining and tourism. The coastal area is dotted by ports and large metropolitan and urban centers including Lagos. However, coastal zones in Nigeria face a range of challenges, such as coastal erosion, flooding, overexploitation of natural resources, marine and coastal pollution, and mangrove depletion and Nypa palm invasion.

All these are negatively impacting the people's livelihood and Climate change and Sea level rise are exacerbating them (WACA, 2019).

Mr. Vice Chancellor, Sir, let me quickly mention that, the five major water bodies that make up the Coastal system globally include;

(a) Marine, (Coastal wetlands including Coastal Lagoons, rocky shores and coral reefs).

(b) Estuarine (including deltas, tidal marshes and mangrove swamps).

(c) Lacustrine (associated with lakes).

(d) Riverine (including wetlands along rivers and streams).

(e) Palustrine (including marshes, swamps and logs).

Incidentally, Nigeria is endowed with all these natural resources. In addition the following fish communities in the coastal areas are exploited by the artisanal fishing units in Nigeria: (i) the estuarine and creek sciaenid sub-community; (ii) the offshore supra-thermocline sciaenid sub-community (on soft deposits); (iii) the shallow supra-thermocline sparid sub-community (on sandy, corally and rocky substrates); and (iv) the deep sub-thermocline sparid sub-community (on both hard and soft deposits).

The inshore fish resources of the Nigerian waters (0-50 m) includes demersal, pelagic and shell fish resources. Tobor *et al* (1977) recorded about 157 species of fish belonging to 71 families in the Nigerian inshore waters. Demersal species are grouped according to their area of occurrence either above or below the thermocline at 30-40 m depth. The pelagic fish resources are mainly the Clupeid family and the most exploited are *Ethmalosa fimbriata, Sardinela madarensis, Sardinella aurita, Illisha Africana.* Others such as anchovy and the Scombrids are not the major targets of the small scale fishery. Shell fish harvested by the artisanals include White shrimps (*Nematoplaemon hastatus, Palaemon hastatus)* brackish prawn (*Macrobranchium macrobranchium),* River prawn (*Macrobranchium vollehovenii)* juvenile pink shrimp (*Penaues notialis* and *Penaues duorarum)* (Adebayo and Ajayi, 1982). Shrimp resources are abundant around river mouths and lagoons entrances. Important species occurring in Nigerian waters are the Pink shrimp (*Penaeus notialis)* found in 10-50 m of water. The Tiger shrimps *(Penaeus kerathurus)* and the near shore coastal shrimp (*Parapenaeopsis atlantica)* are also found.

Mr. Vice Chancellor, Sir, in Nigeria, immense tracts of mangrove forests have been destroyed as a result of petroleum exploitation in the mangroves (Diop, 1993; Wikipedia, 2006). These activities not only caused environmental degradation, but destroyed the traditional livelihood of the region in addition to causing environmental pollution which is affecting weather conditions, soil fertility, waterways aquatic habitats and wildlife.

Plate 9: Typical Floating Cages with wooden walkway in Badagry

4.0. MY RESEARCH FOCUS

Mr. Vice Chancellor, Sir, I have been in the fisheries profession since the completion of my first degree at the University of Ibadan in 1982. Beginning from1986 after obtaining my MSc degree in Fisheries Management, I have contributed to knowledge in this field on a broader and wider scope in Fish Nutrition, Fish breeding and Propagation, Fish Ecology and Management.

As a lecturer at the College of Education, Osiele, Abeokuta, before transferring my stewardship to this University, I have contributed to fisheries knowledge as an Instructor and Trainer in Fisheries Technology especially in the areas of Fish pond construction, Pond Water Management and Coastal resources biodiversity studies along Ondo, Ogun and Lagos States.

I have also shared my knowledge in many higher tertiary Institutions as an Instructor, invited guest speaker and seminar coordinator in Fisheries and Aquaculture events both in and outside Nigeria.

I am very happy to note that my appointment as a Lecturer in the University of Agriculture, Abeokuta since 1997 has given me a broader, bigger and brighter opportunity to focus my research work on specific areas of investigation and purposeful research assignments over the years.

Mr. Vice Chancellor Sir, let me categorize my contributions to knowledge into four distinct major areas.

(a) Published works and Research papers (articles), both in Local and High Impact International Journals and published works and papers (proceedings) in attended local and international meetings, seminars, workshops and Conferences.

(b)Published Books and Chapters in Local and International Books and Literatures.

(c)Administrative/ Academic / International Representations and Positions of relevance.

(d) Academic Mentor and Guidance.

Mr. Vice Chancellor, Sir, I will proceed to present these contributions one by one.

4.1 Published works and papers (articles), and Proceedings both in Local and High Impact International Journals

Mr. Vice Chancellor, Sir, as I have mentioned earlier, my research focus has been so diversified so as to cover the various aspects of aquaculture and fisheries management both on land and in the sea. Thus, my published works periscope the following areas: - Fisheries management, Fish nutrition, Fish biodiversity, Utilization of agro by-products for fish food, Coastal wetland study, and Climate change and Fisheries. With over 55 published journal articles, and 34 proceedings I will want to humbly present some of my contributions.

4.1.1 Research on Fisheries management

Aquaculture and Fisheries management as a Course was introduced to Nigeria in the early 1980s. However there was a dearth of instructional Textbooks. This situation limited the few Universities who were teaching the various aspects of the course via the Departments of Zoology to depend on Hand notes and photo copied pamphlets. However with the publication of my book, which I wrote in 1997, titled *Introduction to Aquaculture and Fisheries Management in Nigeria. Natural Resources Series #2,* published by *GOAD* Publishers, the teaching and training of students became easy and accessible. The book was highly demanded for by Universities and Mono-technic Institutions in Nigeria, where they were recommended as sole textbook for the teaching of practical aquaculture and management. The book was the first of its kind in Nigeria at that time and it contributed immensely to the propagation of the profession, especially where there was no indigenous text book as lecture manual then. I have presented unpublished works, papers and training manuals in Fisheries and Aquaculture Management at different professional and ordinary for a within and outside Nigeria. During these events, issues and prospects in Fisheries management were discussed.

Akegbejo-Samsons and Gbadebo (2000) investigated the nutrient fluxes between the land and sea in the coastal length of Ondo state. In addition we looked at the effects of human-induced activities on the fish resources of the study area. The chemical composition of the rivers, creeks and the floodplains were analyzed. The water samples were analyzed for general chemical factors, nutrient and trace elements. Their effects of all these variables on fish distribution in the entire coastline were reported. The study gave us vital information on fish distribution in the coastal area of Ondo state.

4.1.2 Research on Fish Nutrition

Globally, the supply of adequate and appropriate feeds to cultured fish in their different stages of growth, from juveniles to market sizes, has been of major concern to commercial fish farming ventures. Nigeria is not an exception. Feeds and feeding practices make for success and/or profit in aquaculture. Fish meal, fish oil and essential energy providing ingredients constitute the main expensive inputs in fish nutrition. Given that feed costs can account for almost 60% of the operational costs in a farm, there is no doubt that economical feeds that are low in fish meal and fish oil contents would be high on the agenda in order to attain the sustainable expansion of aquaculture in the country.

Over 60% of my research works have been focused on finding cheaper and locally available feedstuffs and plant-based alternatives that can be incorporated into practical fish diets. This is done with the sole aim of reducing the cost of producing a kilogram of fish from the feed fed to most of the farmed species. The issue of the supply of protein to adequately increase the value of diets fed to fish has also been on the front burner for decades. This formed the basic focus of some of my works investigating the possible replacement of fish meal with other cheaper protein sources from animals and plants.

I (Akegbejo-Samsons, 1999a) carried out to evaluate the growth response and nutrient digestibility by *Clarias gariepinus* fed varying levels of dietary Periwinkle flesh as a replacement for fish meal in low-cost diets. Results show that periwinkle flesh was most suitable as a protein supplement when incorporated at 50% replacement. The daily body weight gain, feed conversion rate, protein efficiency ratio and protein productive value were highest in diet with 50% replacement closely followed by diet with 25% replacement.

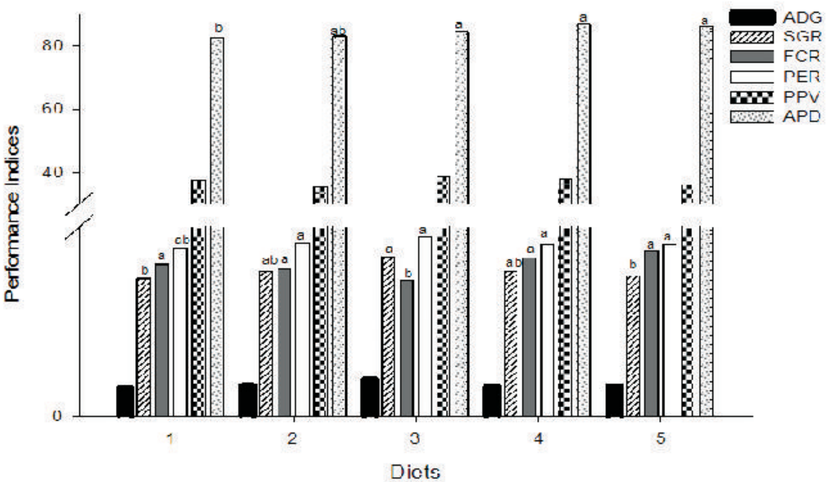

Figure 4: Growth performance, nutrient utilization of *C. gariepinus* fed diets of varying levels of dietary periwinkle as replacement for fish meal

Figure 4 shows the growth performance, nutrient utilization of *C. gariepinus* fed diets of varying levels of dietary periwinkle flesh as replacement for fish meal. In coastal areas where periwinkles are abundant, this work, shows that the farmer can reduce the cost on fish meal inclusion by halve for every ton of fish meal required.

In a similar work, I (Akegbejo-Samsons, 1999b) examined the use of cassava flour to replace yellow maize in the diets of catfish.

Maize is a major supplier of energy in fish diets. Maize has many uses, both in human and animal diets, hence its cost and availability has a serious implication to the average fish farmer. Cassava flour and yellow maize, which are both energy sources in the diets of fish were replaced with each other in varying proportions. Five diets were formulated to contain a constant level of protein and varying amount of cassava flour/or yellow maize as follows: Diet A (100% cassava flour), diet B (100% maize), diet C (50% cassava flour, 50% maize), diet D (67% maize, 33% cassava flour) and diet E (67% cassava flour, 33% maize). The result shows that diet B fed with 100% maize had the significantly (P <0.05) better growth and food utilization with the best FCR (0.85); PER (1.29) and SGR (2.36).

This was followed by diet E containing a higher proportion of cassava flour mixed with maize. Even though both ingredient are energy sources, a predetermined juxtaposition of the levels of inclusion was suggested in reducing feed cost

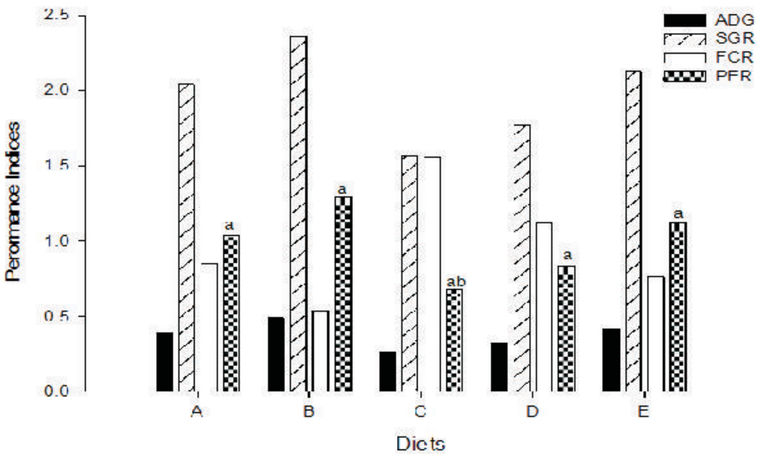

Figure 5: Growth performance, nutrient utilization of *C. gariepinus* fed diets of varying cassava flour/yellow maize substitution

Fagbenro and Akegbejo-Samsons (2000) worked on the optimum protein requirements of diets formulated for economic growth of *Heterotis niloticus*.This research was to lead us to the optimum requirement of protein that could be added to formulated diets of farmed *H. niloticus*.The Apparent digestibility coefficient (ADC) of crude protein and gross energy in diets containing white fish meal, bovine blood meal and groundnut cake were determined for *H. niloticus* fingerlings using chromium oxide as a digestibility indicator. Based on the digestible protein (DP) and digestible energy (DE) values of the protein feedstuffs, iso-caloric diets (3500 kcal/kg) containing 280, 320, 360, 400g DP/kg were formulated to supply DP:DE ration of 82.6, 94.2, 105.4 and 117.0 mg DP/kcal DE, respectively and fed to *H. niloticus* fingerlings (18g) to satiation for 120 days in triplicate 15m^3 concrete cisterns. The results indicated that figures received from weight gain, growth response and feed efficiency showed that the optimal dietary protein required for maximum growth performance by *H. niloticus* is 360g DP/kg diet.

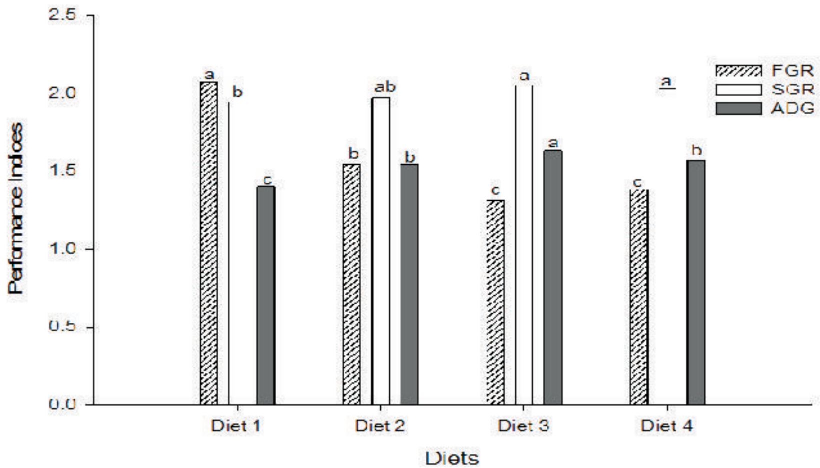

Figure 6: Growth response and feed utilization of *Heterotis niloticus* fed diets containing graded dietary protein:energy levels

In many African countries, aquaculture is generally carried out at a subsistence or semi-intensive level. It is therefore necessary to evaluate whether it is cost effective to maintain the cultured fish at a dietary protein level which gives maximum growth or whether a lower dietary protein level is desirable.

Fish species need energy for different metabolic functions. In our work (Akegbejo-Samsons and Olagunju, 2002), using the locust bean slurry as energy source, we principally designed itto reduce cost and also reduce the dependence on yellow maize in the supply of energy in fish diets. In the savannah area of Nigeria, locust bean is a delicacy and spice in stews and soups. The slurry is usually discarded after processing, so it can be used for other purposes. This locust bean slurry causes aquatic pollution and even environmental menace in the areas where the harvesting and processing is a viable trade. The need to prepare the slurry in the best acceptable and useable form led us to the study of the chemical composition and the binding power of the slurry. The slurry of the tropical bean of *Parkia biglobosa* was used to replace certain proportions of yellow maize in the diets of *C.gariepinus.* Diet with 100% slurry waste had significantly ($P<0.05$) better growth and food utilization with the highest ADG (0.43), SGR (2.41), FCR (1.78). The overall results showed that the slurry can be wholly or partially (at higher proportion) used as a replacement for maize (Figure 7).

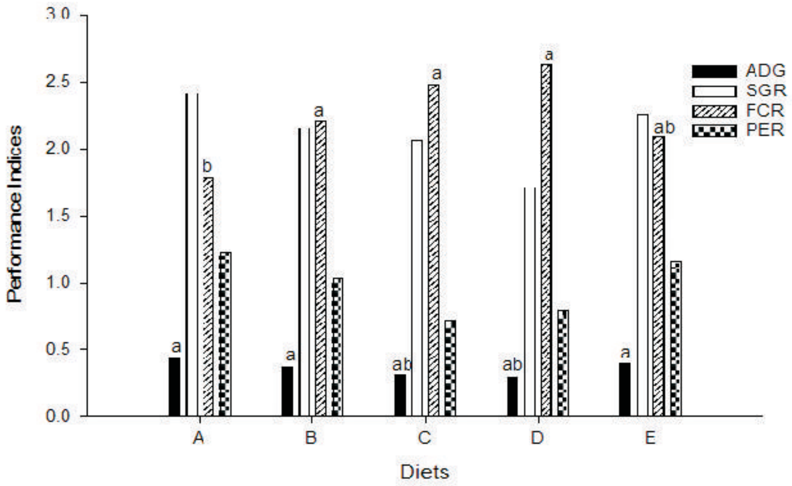

Figure 7: Growth performance, nutrient utilization of *C. gariepinus* fed with varying LBS/Yellow maize substitution

This slurry is available throughout the season and has no competitive uses for humans, and apart for the cost of processing and handling, we found out that it is a viable substitute for yellow maize.

A similar work was also done for Tilapia, *Oreochromis niloticus* (Akegbejo-Samsons & Ojini, 2004). The replacement proportion was similar to the experiment on Catfish, however the results show a departure from what was obtained for Tilapia. The results (Figure 8) showed that *P. biglobasa* slurry was better utilized by Tilapia in diets 3 (75% slurry and 25% yellow maize) and 5 (25% slurry and 75% yellow maize), where their replacements were neither wholly nor equal. Table 2 shows the proximate composition of the dietary ingredients (g/100g dry matter for the two experiments, while Table 3 shows the water parameters in the experimental tanks.

Table 2: Proximate composition of dietary Ingredients (g/100g dry matter)

Components	Crude protein	Lipid	Crude fibre	Ash	Moisture	NFE
Fishmeal	60.3	8.1	0.9	11.6	7.8	11.3
Yellow maize	9.5	4.1	3	2.8	6.9	73.7
LBS	7.9	2.3	18.9	12.3	9.3	49.3
Rice bran	10.6	8.8	12.3	9.1	5.5	53.7
Oyster shell	5.7	4.4	2.9	3.6	2.6	80.8

Table 3: Water parameter in experimental tank for the duration of the experiment

Parameter	Range	Mean Value
pH	8.2-9.6	8.7
Temperature (^0C)	25.8-32.9	30.2
Total ammonia mg/l NH3-N	0.19-4.22	2.65
Total alkalinity mg/l CaCo3	279-469	384
Dissolved Oxygen mg/l	8.84-12.9	10.8

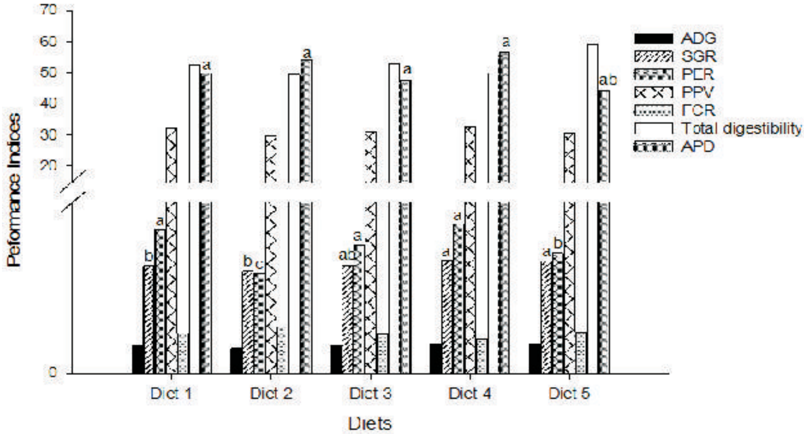

Figure 8: Growth response and feed utlilization of *O. niloticus* fed varying LBS/Yellow maize substitution

Also, in our work, Alegbeleye *et al* (2004) with a view towards finding a replacement for Ground nut cake (GNC) in fish feed, we worked on some options. We tried to replace GNC with rubber seed cake (RSC) in the diets of Nile Tilapia, *Oreochromis niloticus*. Groundnut cake (GNC) is a major supplier of protein in fish feeds. This situation has necessitated the search for a cheap suitable alternative protein source which may otherwise not be suitable for human consumption. The Rubber tree (*Hevea brasiliensis*) is planted essentially for its latex, however the seed is a veritable source of oil and seed protein (36% CP). In the savannah areas of Nigeria, the rubber plantations cover an estimated 200,000 hectares producing about 20,000 tonnes of seed per year (Nwokolo, 1996). Our study was carried out to determine the level of RSC (a byproduct of the oil extraction of the rubber tree seed) that can be used to replace GNC in practical diets of *O. niloticus*. GNC was interchangeably replaced in the formulation of five experimental diets (Figure 9). Fish fed with 30% RSC inclusion level gave the best result with the highest SGR (1.73), best food conversion ratio, FCR (1.69) and protein efficiency ratio, PER (1.97). Table 4 shows the proximate composition of the different dietary ingredients used for the experiment. Rubber seed has a CP content of 20.21 compared to soya bean, 44.08.

Table 4. Proximate composition (%DM) of dietary ingredients

Samples	Moisture	Ash	Fat	CP	Crude Fibre	NFE
Fish meal	12.00	18.20	8.00	72.70	1.10	4.00
Corn	12.20	1.40	5.50	10.00	1.40	79.60
Soyabean	6.77	4.29	19.10	44.08	5.71	20.05
Rubber Seed	5.82	4.03	47.58	20.21	4.46	17.90
Groundnut	7.08	19.08	8.80	36.52	4.31	30.21

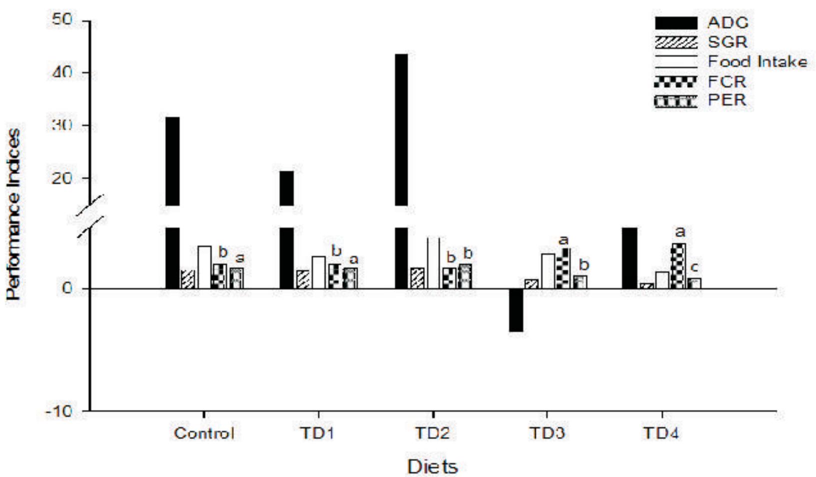

Figure 9: Growth, feed utilization and carcass composition of *O. niloticus* fed diets containing varying levels of rubber seed cake.

Observation from this study indicates that RSC can be recommended as a dietary protein source for *O. niloticus*. It could be used to replace 15-30% of the total GNC needed.

Akegbejo-Samsons *et al (2004)* sought an alternative to binders used in feed formulation in the aquaculture industry in Africa. The commonest binders used in fish feed formulation are starch, which is in form of dextrin, carboxyl-methyl-cellulose (CMC), sodium bentonite, Guam gum, agar and gelatin etc. They are all imported and often not locally available. We used the pulp waste of the African locust bean as a local feed binder. This study reports the assessment of the nutrient quality (Table 5) and the binding power of the dried pulp wastes produced from the African Locust Bean (*Parkia biglobosa)* in low cost fish diets. Fermented and unfermented pulp wastes were analyzed for the study (Table 6). Six diets were prepared using common fish feed ingredients.

Table 5: Dry matter and proximate composition of the African locust bean pulp (waste) pulp

Components (%)	Fermented waste	Unfermented waste
Moisture	6.5± 0.87	7.50± 0.87
Dry matter (DM)	93.50± 0.88	92.50± 0.67
Ash content	15.86± 0.15	14.14± 0.03
Crude Fibre content	21.55± 0.04	22.63± 0.28
Crude protein content	11.75± 0.12	10.13± 0.06
Fat content	1.38± 0.03	1.30± 0.07
Sugars	8.94± 0.19	13.32 0.58
Starch	32.14± 0.57	28.20± 0.09
NFE	28.70± 0.30	26.30± 0.02
Carbohydrate	44.06± 0.01	46.26± 0.70
pH	3.22± 0.05	2.97± 0.05

Table 6: Amino acid profile of the African locust bean pulp (waste)

Amino acid	Fermented waste (mg/100g)	Unfermented waste (mg/100g)
Histidine	1.39 0.02	1.94 0.03
Methionine	0.55 0.04	0.74 0.03
Lysine	3.15 0.04	3.89 0.02
Leucine	4.26 0.01	3.79 0.01
Isoleucine	2.59 0.01	2.22 0.02
Proline	6.67 0.04	6.57 0.01
Phenylalanine	3.70 0.02	3.52 0.02
Cysteine	1.11 0.02	1.29 0.01
Threonine	1.01 0.02	1.20 0.02
Glycine	2.32 0.01	2.04 0.02
Tyrosine	2.41 0.02	1.85 0.01

The binding /cohesive power of the pulp was assessed by subjecting the diets containing the various proportions to series of local shearing and shaking processes such as running the diets through hard plastic containers and polythene containers. The rate of crumbling were observed and assessed. After preparation and storage of diets for over 12 weeks, it was observed that diets with high concentrations of pulp crumbled less than those with less concentration of the pulp, when passed through the crumblier. Diet 6 with 100% pulp maintained the binding quality, having minimal crumbles. Diet 1, the control diet with 100% corn starch as a binder crumbled gradually into powder over time. Diets with higher quantities of the pulp waste had a higher sticking and binding properties for the fish diets when compared to the corn starch. Yellow maize from which corn starch is obtained is seasonally available at exorbitant prices in the northern part of Nigeria, while *P. biglobosa* pulp waste is readily available from the African locust bean. The animal production sector in Nigeria spends over 4 million (as at the time of this study) every year sourcing for yellow maize. A reduction in the quantity of yellow maize when the locust pulp is incorporated is envisaged and millions of Naira will be saved by the feed industries. Apparently the use of this pulp waste is a viable step towards the recycling of the pulp and an effective substitute for corn starch used in the formulation of fish feeds.

Table 7: Gross composition of experimental diets used to examine the crumbling effect

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6
Corn Starch	25.79	14.10	10.57	7.05	3.52	-
Pulp	-	3.52	7.05	10.57	14.10	24.68
Fish meal	16.34	18.38	18,38	18.38	18.38	16.61
Soybean meal	49.00	55.15	55.15	55.15	55.15	49.83
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Oyster meal	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin/Premix	0.60	0.60	0.60	0.60	0.60	0.60
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vegetable oil	5.00	5.00	5.00	5.00	5.00	5.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
[1]CPV (%)	40	40	40	40	40	40

CPV= Calculated Protein Value

4.1.3 Research on Fish Biodiversity and the Coastal Environment

The need to identify the quality and quantity of the fish species diversity in the wetlands and coastal areas of Nigeria is of paramount importance to fish resources management and conservation. I have been involved in the studies of population assessment of major and economic fish species in South-west coast of Nigeria. This has led to diversity studies of commercial fish species such as *Clarias gariepinus, Heterotis niloticus,* in both Ondo and Ogun States (as shown in Table 8). In conjunction with other scholars we did some studies on the inland fisheries of Cross River in the Cross River State of Nigeria.

Nigeria has a maritime area of 46,000 sq. km and an Exclusive Economic Zone (EEZ) area of 210,900 sq. km. The entire coastline, which lies in the Gulf of Guinea has a narrow Continental shelf of between 14 and 27 km wide. Over 80% of the domestic fish production in Nigeria is accounted for by the small scale fisheries operated by fisherfolks, which number over half a million. The Nigeria's coastal area is known to have both demersal and brackish-water fish stock. In order to encourage conservation of our coastal resources as it is done in Forestry, I looked at the possibility and benefits of establishing Marine Reserves in some communities of our coastal areas, with a view towards conserving some specific fish resources in those areas (Akegbejo-Samsons, (1997). The result shows that the following areas can be considered for marine Reserves: (a) Lagos State – Lekki, Akodo-waya, Yeroyan, and Epese; Ogun State- Ode-Omi, Igbekki, Iwopin and Akere; Ondo State- Orioke-Iwamimo, Ayetoro, Aiyelala and Mahin Lagoon; Edo/Delta – Ogidigban, Oghere/Orere and Benitoye; Rivers State- Oyorokoto, Elemekunkiri and Brass (Figures10 and 11)

Figure 10: Map of Nigeria showing where Marine Reserves can be created.

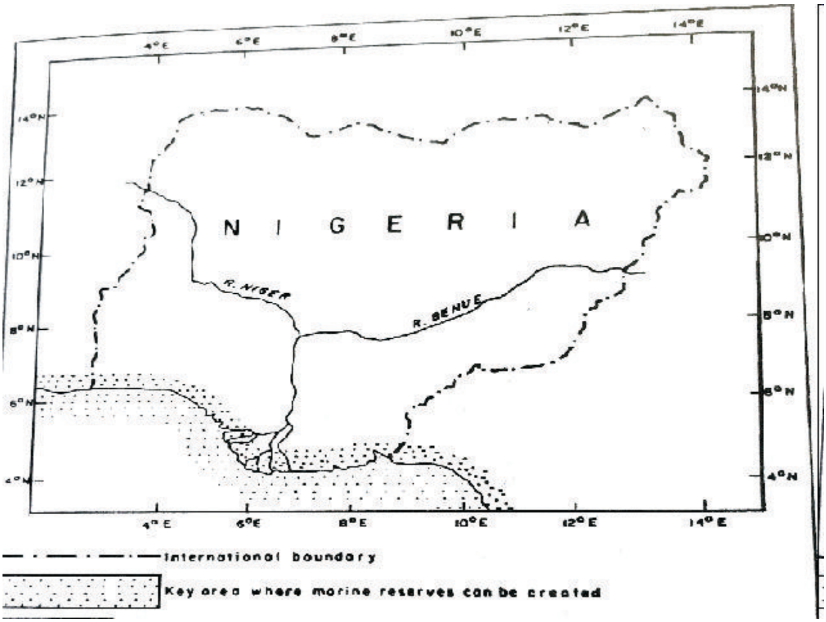

Figure11 : Nigerian coastline showing proposed Reservation Areas

The Nigeria's coastal zone is known to be a repository of diverse renewable and non-renewable natural resources. Unfortunately, coastal zone management activities are yet to be established in practical terms when compared to other nations like Tanzania, Italy, Canada and Norway. My work (Akegbejo-Samsons, (1998), identified the various major components of the coastal area of Nigeria and proposes the basis for an integrated management (CZM) approach for the various components as it is done in other nations of the world.

A study of the resources of Ilaje/Eseodo coastal area of Ondo state was investigated with a view towards effective management (Akegbejo-Samsons, 1999). Ondo State is one of the eight coastal states in Nigeria that share a common boundary with the Atlantic Ocean. There are over 76 fishing communities along/within this study area whose major occupation is artisanal fishing interjected with farming, hunting and trading. Over 32 fish species were encountered and assessed as shown in Table 8.

Table 8: Fish resources of the study area in order of commercial importance

SPECIES	% Abundance	Ecological Niche
Bonga (Ethmalosa fimbriata)	34.5	coastline fringe
CICHLIDS	(23.6)	
Tilapia Melanopleura	7.4	Swamps, floodplains
Tilapia zillii	4.6	Swamps, floodplains
Sarotherodon galibaeus	5.3	Swamps, floodplains
Oreochromis niloticus	6.3	Swamps, floodplains
CATFISH	(24.4)	
Clarias anguilaria	6.8	Lagoons
C. gariepinus	6.8	Swamps
Heterobranchus spp	5.3	Floodplains
C. longifilis	1.6	Floodplains
Chrysichthys nigrodigitatus	3.9	Creek, lagoons
OTHERS		
Hererotis niloticus	9.3	Swamps
Gymnarchus niloticus	1.8	Floodplains
Chana obscura	3.5	Floodplains
Momyrus rume	0.4	Carials
Mugil cephalus	0.3	Carials
Synodontis spp	0.8	Carials
Shrimps and Prawns	1.4	coastline fringe

Currently the need to have a holistic and integrated Coastal Zone Management in Nigeria is becoming very daring and obvious. Nigeria's coastline has a coastal resources base and a concentration of population shared between 8 states along the coast.

Uniquely, the coastline consists of wetland vegetation that can be divided into two main categories, namely the freshwater (raffia palm) swamps and saltwater (mangrove) wetlands. The entire mangrove swamp is approximately 3.5 million hectares spreading from Lagos to Calabar in Cross river state. A recent categorization of the entire are shows that about 28,000sq km is made of swamp forests, 10,000sq km of ponds and unspecified are of water catchment and inland lagoons. Nigeria's coastal ecosystem has the potential for (i) Swamp Rice cultivation, (ii) Aquaculture, i.e. finfish, shell fish and shrimp (iii) Sand extraction, (iv) Mineral mining and (v) Wood/timber exploitation. In an attempt to expose the different utilization potentials of the different coastal state, I carried out a community-based coastal resources inventory in four of the coastal states of the South west area of Nigeria, namely Lagos, Ogun, Ondo and Delta states. Employing the services of the communities and the resource users themselves, the tangible and the intangible renewable and the non-renewable resources were assessed. Results obtained showed huge fishery components in all the states. These include Family *Clariidae, Cichlidae, Osteoglosidae, Centropomidae, Bagridae and Mugilidae.* Principal fish species include *Clarias gariepinus, Heterotis niloticus, Oreochromis niloticus, and Gymnarchus niloticus.* Results also show activities such as dredging and sand mining. Marine transportation was common to all the four states, while Port activities were common to only Lagos and Koko ports in Delta.

In Nigeria, only four finfish species are vigorously cultured in both southern and northern zones. These include Tilapia spp (*O. niloticus, S. melanolpeura*), Clarias spp (*C. gariepinus,*) the

Catfish (*Chrysichthys. nigrodigitatus)* and the Oyster (*Crassostrea gasar*) with some *Heterotis niloticus)* in some southern coastal area. Akegbejo-Samsons *et al, 2005*) carried out a study to identify some of the culture problems associated with the culturing of *H. niloticus* in both large reservoirs and small earthen ponds in Southwestern Nigeria. The focus was essentially to shift the exploitation of the species from the wild to culture environment. *H. niloticus* is the sole Nigeria species known in the family *Osteoglossidae*. It is a large fish with a long body covered with large bony scales. It is a major component in the harvest of fisher folks in Mahin lagoon, Lekki peninsula, and Badagry creeks where it supports a N94 million trade. The study was to see why and how this species can be cultured in controlled environment with a view to reduce the exploitation pressure in the wild. Two reservoirs and four rearing ponds were used, each reservoir received 1000 juveniles, while each pond received 250. The experiment was designed to replicate the natural environmental conditions peculiar to the fish. Feed application was *ad infinitum* by introducing two head pans of spent grain to each of the ponds and reservoir on a 5-day basis. Results show that growth and Condition Factor were different but better and higher in the reservoirs than in the ponds Table 9.

Daily weight gain (DWG) was between 1.63 and 1.72g in the ponds, while it was higher (3.16 3.19 g) in the reservoirs. Fish raised in the reservoirs reached maturity level faster than those raised in the ponds. From this study it is recommended that *H. niloticus* can be favourably cultured in reservoirs in the country, thus reducing the pressure on the wild population of the spp.

Table 9: Growth performance and CF of *H. niloticus* raised in Ponds and Reservoirs

Parameters	Pond 1	Pond 2	Pond 3	Pond 4	Reservoir 1	Reservoir 2	SE
IMW (g)	135.2	134.8	132.5	134.9	134.3	134.4	13.1
FMW (g)	575.3[a]	591.1b	586.1a	599.3bc	987.5a	995.7a	38.6
DWG (g)	1.63a	1.69a	1.68a	1.72a	3.16a	3.19a	0.12
%WG (g)	325.52a	338.5a	342.34a	344.26ab	635.29ab	640.85a	106.8
FGR	1.45a	1.55a	1.59a	2.32a	2.35b	2.28b	0.15
SGR	0.54a	0.55a	0.55ab	0.55a	0.74b	0.74a	0.03
CF	0.65a	0.66a	0.66a	0.65a	2.04a	2.08a	0.01

The diversity and distribution of fish species in the coastal area of Ogun state was investigated (Odulate *et al,* 2006). As the world's population increases, there has been ever-increasing pressure on the environment and this has led to widespread loss of biotic communities. Extinction of species is now occurring at an unprecedented rate more than the natural rate. The importance of the need to assess fish species composition, their distribution and diversity in our territorial waters keeps steering at us in Nigeria. The study area was carried out at Ode-Omi waterside where artisanal fishing was being carried out without any monitoring or control. The area was divided into three zones for effective data collection.

Data collected showed that 38 fish species belonging to 35 families were identified. However 28 species were of commercially important marine fish species.

Table 9 : Relative fish species composition and distribution in the marine coastal area of Ogun State.

S/N	SPECIE	FAMILY	TOTAL FISH ABUNDANCE	RELATIVE ABUNDANCE (%)	% CUMULATIVE FREQUENCY
1	*Ethmalosa fimbrata*	Clupeidae	101524	28.86566282	
2	*Sard inella spp*	"	93097	26.46966837	55.33533118
3	*Ilisha Africana*	"	62941	17.89560777	73.23093895
4	*Pentamemus quinquarius*	Polynemidae	30920	8.791283778	82.02222273
5	*Chloroscmbrus chrysurus*	Carangidae	16241	4.617698572	86.6399213
6	*Psedotoilithus epipercus*	Sciaenidae	5992	1.703666636	88.34358794
7	*Caranx crysos*	Carangidae	5948	1.691156401	90.03474434
8	*Pseudotilithus typus*	Sciaenidae	4918	1.398303157	91.43304749
9	*Trichurus lepturus*	Trichuridae	3502	0.995701028	92.42874852
10	*Parapenaeopsis atlanticus*	Penaeidae	3303	0.939120644	93.36786917
11	*Hemicaranx bicolor*	Carangidae	3231	0.918649349	94.28651852
12	*Pterioscion peli*	Sciaenidae	2961	0.841881994	95.12840051
13	*Liza spp*	Migillidae	2661	0.756584933	95.88498544
14	*Brachydeuterus auritus*	Haemulidae	2401	0.682660813	96.56764626
15	*Penaeus notialis**	Penaeidae	2247	0.638874989	97.20652124
16	*Portunus validus**	Portunidae	2170	0.616982076	97.82350332
17	*Pseudotilithus elongatus*	Sciaenidae	1280	0.363934128	98.18743745
18	*Galeiodes decadactylus*	Polynemidae	998	0.28375489	98.47119234
19	*Pseudotolithus senegalensis*	Sciaenidae	812	0.230870712	98.70206305
20	*Elops lacerta*	Elopidae	629	0.178839505	98.88090256
21	*Sphyraena spp.*	Sphyraenidae	610	0.173437358	99.05433991
22	*Scyllaride spp.**	Scyllaridae	554	0.15751524	99.21185515
23	*Caranx hippos*	Carangidae	452	0.128514239	99.34036939
24	*Cynoglossus spp*	Cynoglossidae	441	0.12538668	99.46575607
25	*Scomberomorus tritor*	Scombridae	432	0.122827768	99.58858384
26	*Arius spp.*	Ariidae	327	0.092973797	99.68155764
27	*Alectis ciliaris*	Carangidae	289	0.082169502	99.76372714
28	*Tylosurus rafale*	Belonidae	196	0.055727413	99.81945455
29	*Lobotes surinamensis*	Lobotidae	150	0.042648531	99.86210308
30	*Dentex spp.*	Sparidae	140	0.039805295	99.90190838
31	*Hemramphys spp*	Hemiranphidae	125	0.035540442	99.93744882
32	*Polydactylus quandrifis*	Polynemidae	106	0.030138295	99.96758712
33	*Lophiodes kempi*	Lophiidae	54	0.015353471	99.98294059
34	*Lutjanus agennes*	Lutjanidae	41	0.011657265	99.99459785
35	*Lagocephalus laevigatus ***	Tetrao dontidae	8	0.002274588	99.99687244
36	*Echiophis creutzbergi*	Ophicthidae	5	0.001421618	99.99829406
37	*Coryphaena equisetis*	Coryphaemidae	4	0.001137294	99.99943135
38	*Cypselurus spp*	Exorcoetidae	2	0.000568647	100
	Total		351712	100	

Simpson's diversi ty index (1-D) =0.8 ; Species richness (S) = 38 ; 25 Families ; 38 Species
* Shellfish (4); Fin fish (34); ** Poisonous fish

They contributed 73.6% of the total catch sampled. The total fin fish identified were 34 (89%) and 4 shell fishes (11%) belonging to 3 families were recorded. Fish species of importance and abundance in the study area include *Ethmalosa fimbriata* (28.8%), *Sardinella spp* (26%), *Illisa africana* (17.8%), and *Pentanemus qiunquarius* (8.7%).

It is a wellknown fact that biological assessment studies can be useful in establishing the relative wellbeing of a fish population, differentiate taxonomic units and conduct fish stock size assessment.

Based on this, we (Offem *et al*, 2007) did a biological assessment of *O. nilotus* in the three zones of the Cross river floodplain between January 2004 and December 2006.

In this study the knowledge on fish biological indices including sex ratio, diet habit, length-weight parameters, condition factor and fecundity has contributed greatly to the understanding of the fish population structure of the Cross River inland wetlands (Figures 12 and 13).

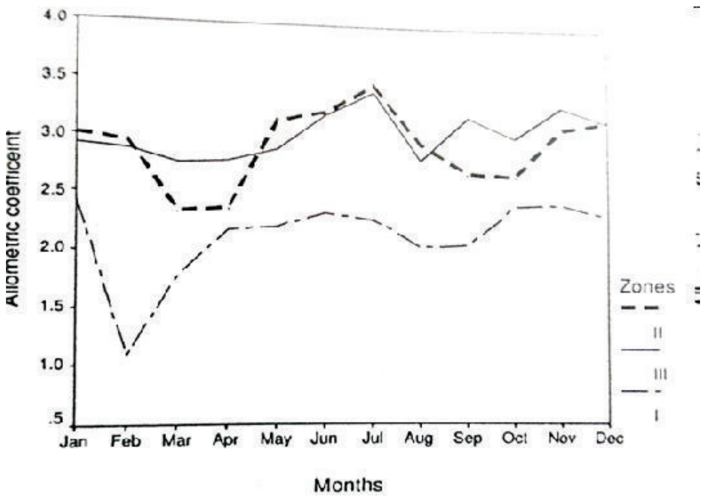

Figure 12. Monthly mean variation in the parameter of length-weight relationship of *O. niloticus* (both male and female pooled) in the 3 zones of Cross River State (2004-2006).

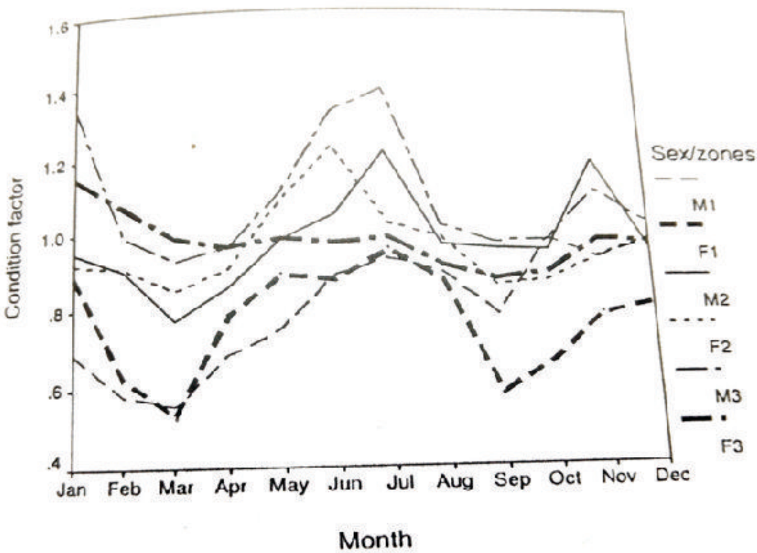

Figure 13. Monthly mean variations in the condition factor of male and female O. niloticus in the three zones of Cross River Inland Wetlands (2004-2006)

In an attempt to determine the physical and chemical attributes and its consequent influence on the fish fauna of the Qua Iboe River, we (Etuknwa *et al*, 2009) conducted a bio-assessment of water quality, physical habitats and fish resources of the Qua Iboe River in Akwa Ibom State, one of the coastal states of Nigeria. Using a modified Rapid Assessment Protocol (RBP), results show that anthropogenic disturbances affected habitat conditions and was varied in severity according to the types of disturbance. Fish assemblage thrived with varying biological condition scores for each site. Tables 10 and 11 show the fish species composition (% by number while Table 11Index of biotic integrity scores for sites in the study areas during the wet season.

Table 10 : Fish species composition (%) by Number in sites on Qua Iboe River, Etinan

	ND		IO		IA		EU	
	WET	DRY	WET	DRY	WET	DRY	WET	DRY
Species	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)
Xenomystus nigri	7(5.93)	-	4(4.17)	3(6.82)	-	-	1(1.19)	-
Papyrocramus afer	8(6.78)	1(4.35)	2(2.08)	2(4.55)	-	-	-	-
Gnathonemus petersii	4(3.39)	2(8.70)	11(11.46)	-	3(4.05)	-	6(7.14)	-
Petrocephalus ansorgii	10(8.47)	-	17(17.71)	-	16(21.62)	-	12(14.29)	-
Brycinus longipinnis	8(6.78)	6(26.09)	14(14.59)	6(13.64)	15(20.41)	23(38.33)	18(21.43)	18(25.17)
Bryconaethiops quinquesquanmae	-	1(4.35)	1(1.04)	4(9.09)	4(5.41)	6(10.00)	11(13.10)	9(12.86)
Miralestes elongates	1(0.85)	1(4.35)	-	-	-	-	-	-
Chrysichthys nigrodigitatus	-	-	-	-	3(4.05)	-	7(8.33)	2(2.86)
Chrysichthys alueensis	-	-	-	1(2.27)	2(2.70)	2(3.33)	4(4.76)	-
Parauchenoglanis fasciantus	-	-	-	5(11.36)	-	-	-	-
Synodontis obsesus	3(2.54)	-	1(1.04)	-	14(18.92)	9(15.00)	7(8.33)	10(14.29)
Parailia pellucida	-	-	2(2.08)	-	-	-	-	-
Parachana obscura	2(1.69)	-	-	-	-	2(3.33)	-	-
Chromidotilapia guntheri	15(12.71)	1(4.35)	14(14.59)	7(15.91)	3(4.05)	-	2(2.38)	3(4.29)
Thysochromis ansorgii	1(0.85)	3(13.04)	-	2(4.55)	-	-	-	-
Hemichromis fasciatus	14(11.86)	2(8.70)	8(8.33)	1(2.27)	3(4.05)	2(3.33)	4(4.76)	1(1.42)
Pelvicachromis pulcher	-	-	-	-	-	1(1.67)	-	2(2.86)
Tiliapia mariae	30(25.42)	5(21.74)	15(15.63)	9(20.45)	11(14.86)	13(21.67)	12(14.29)	24(34.29)
Polycentrospsis abbreviate	-	-	3(3.13)	-	-	-	-	-
Ctenopoma kingsleyae	15(12.71)	1(4.35)	4(4.17)	4(9.09)	-	2(3.33)	-	1(1.42)
Total	118(100)	23(100)	96(100)	44(100)	74(100)	60(100)	84(100)	70(100)

Table 11: Index of biotic integrity scores for sites in the study areas (wet season)

	Metric Value (Score)			
Metrics	ND	IO	IA	EU
Total No. of species	13(5)	13(5)	11(5)	11(5)
No. of benthic invertivore species	3(5)	3(5)	3(5)	3(5)
No. of cichlidae species	4(5)	3(5)	3(5)	3(5)
No. of intolerant species	2(5)	0(1)	0(1)	0(1)
% tolerant species	64.64(3)	83.15(1)	73.33(1)	75.58(1)
% invertivores	57.63(5)	70.15(5)	56.60(5)	58.14(5)
% camivores	13.56(1)	12.18(1)	6.66(3)	9.30(2)
% generalist feeders	2.54(5)	1.02(5)	22.67(1)	16.28(1)
CPUE	30(5)	24(3)	19(3)	21(3)
% with tumors, fin damage, skeletal anomalies	5.94(5)	4.21(5)	8.00(5)	19.05(3)
Original score	44	38	34	32
Normalized score	88	74	68	64

ND- Ndon Eyo; IO- Ikot Inyang Ossom; IA – Ikot Abasi; EU – Ekpene Ukpa

We (Offem e*t al*, 2008a), conducted a monthly fishery assessment investigation from January 2004 to December 2006. Studies were variously carried out in the floodplain of the Cross River with a view towards highlighting the endemic fish-stock and the management implications for the fishery components. This study shows the distribution of fishing localities, types of fishing crafts, and the catch components of the investigated fishers.

A total of 2768 artisanal fishermen were enumerated. 417 were full time fishermen, 892 part-time, 969 shoreline and 489 assistants. Most of the gear types used include, Gill nets, Set nets, Lift nets and traps. However, in quantity, the common gears used were hook and line (30%), cast net (20.1%), gill nets (13.3%). Based on the summation of catches, estimated catch per annum was 14,670 MT. The study shows that there was no sustainable management practice in the entire area. Community based management system that establishes participatory involvement of fishermen in the conservation and rational exploitation of fisheries resources was therefore recommended. The results are presented in Table 12

Table 12: Percentage and sizes of gear types used in Cross River inland wetlands

Gear type	Average No.	Percentage	Mean Mesh size (mm)	Mean head line (m)
Gill Net:				
Set gill net	47	3.8	62.8	150
Drifting gill net	18	1.2	50.5	2400
Fixed gill net	41	2.8	58	200
Emcycling gill net	24	1.6	35	350
Seine nets:				
Beach seine net	43	2.9	38	250
Boat seine net	38	2.6	48.4	250
Lift Net (Mosquito net)	202	13.6	0.5	6 x 6
Falling gears:-				
Cast Net	288	19.4	10	4
Dip Net	13	0.9	12	2
Traps:				
Pots	164	11	6	2.5
Fyke nets	38	2.6	9	1.5
Fences	27	1.8	10	100
Hook and line:				
Set longline (baite &)	159	12.7	7-14	50
Drifting long line	34	2.8	10-14	200
Hand & Pole	164	13.06	12-14	1.5
Bail (dewatering)	180	12.1	-	-
Poison	42	2.8	-	-
Spear	12	0.8	-	-
Cutlass	49	3.3	-	-
Total	1483			

We (Offem *et al*, 2008b) carried out another study on the diet, size and reproductive biology of the silver catfish, *Chrysichthys nigrodigitatus,* in the Cross River of Nigeria with a view towards its domestication in ponds and reservoirs.

The Silver Catfish, *C. nigrodigitatus,* occurs in most of the major rivers in Africa including Nigeria. They are highly valued food-fish in these native African waters and are among the dominant fishes of commercial values. This paper presents the results of the diet habit, sex composition, reproductive characteristics and Condition factor of the fish species (Figure 14). Other various findings of this work are also represented in Figures 15, 16 and 17.

There was a predominance of males over the females in the Cross river. There was a wide food spectrum exhibited by the spp which enables it to switch from one food category to another in response to fluctuations. Spatial and monthly variation in the biological characteristics in this study gives an evidence of heterogeneity in habitat type in the different zones of the study area

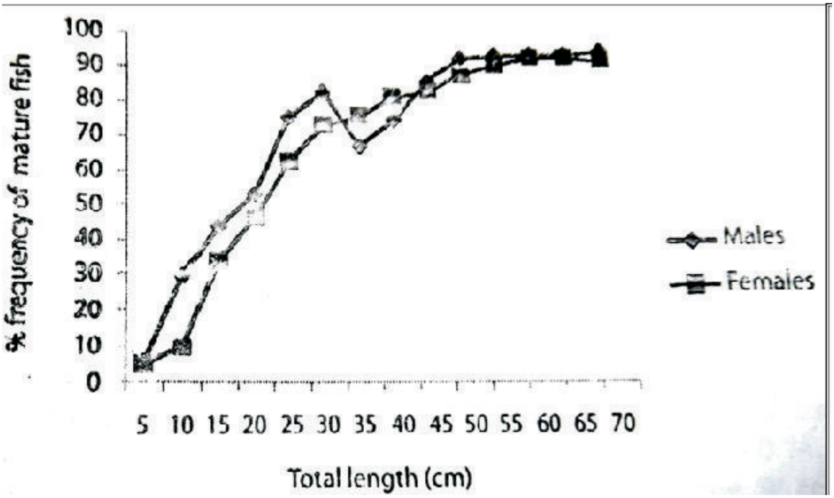

Figure 14. Percentage frequency of mature male and female *C. nigrodigitatus* at different lengths.

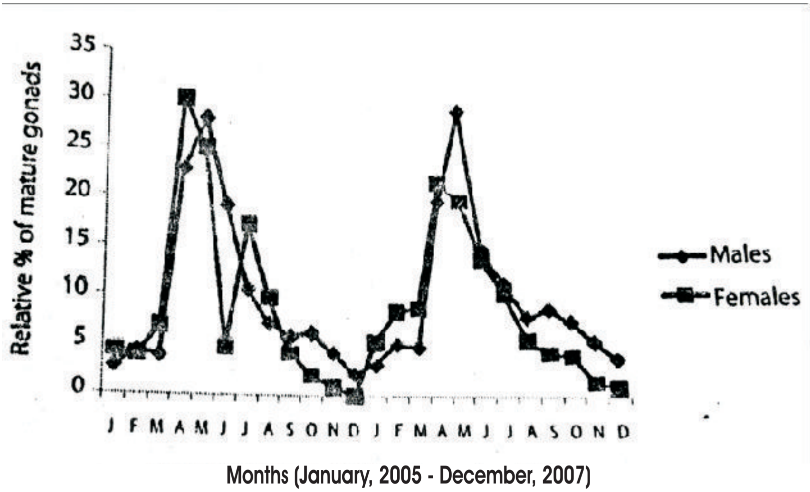

Figure15: Relative percentage of matured gonads in the male and female of *C. anguilaris* in Cross River

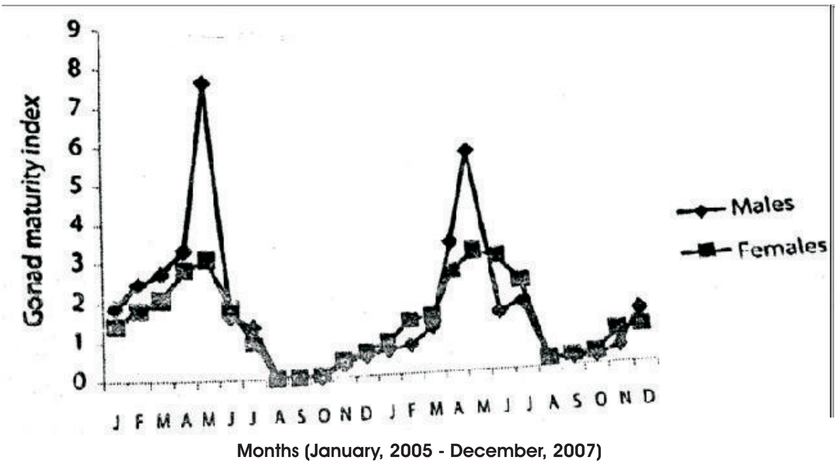

Figure 16: Dynamics in the gonado-somatic index (GSI) of *C. nigrodigitatus* male and female in Cross Rivers

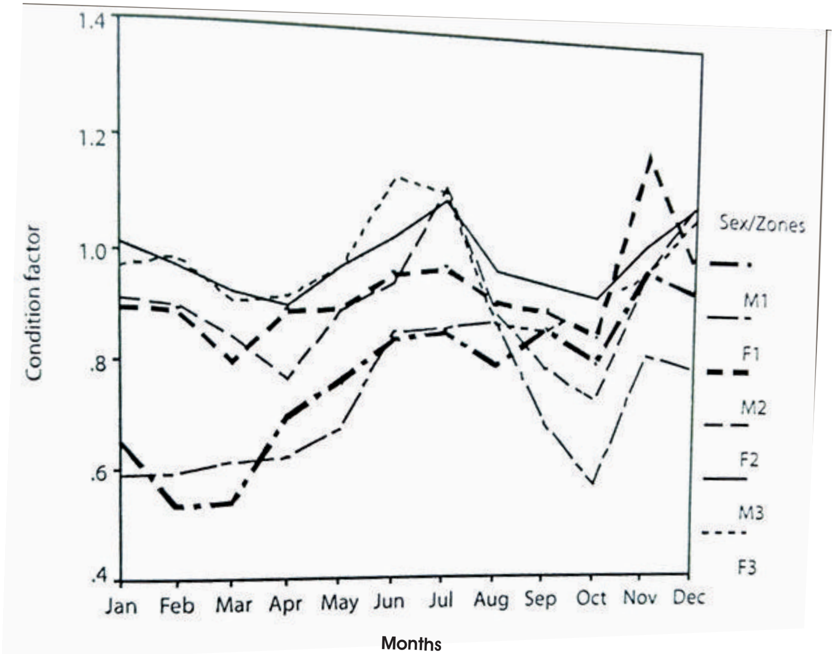

Figure 17: Monthly mean variation of condition factor of *C. nigrodigitatus* (male and female) in the Cross River

We carried out further studies on the reproductive aspects of the common freshwater fishes in the Cross River (Offem *et al* 2008c). Reproduction in fishes is one of the basic biological features enabling survival and continuation of species. It may have divisive effect on their population size because of the diversity of aquatic environment. The study was designed to provide a checklist of the reproductive potential and breeding seasons of some common economically important freshwater fishes in Cross River and also to study the influence of environment on the production cycle of the fish species along the Upper, Middle and Lower regimes of the Cross River. Majorly, we needed to investigate the important water quality parameters of the water bodies as shown in Table 13.

Table 13: Mean variation and F-values of the analysis of variance (ANOVA) of physico-chemical parameters of water measured at three sampling sites. I: Upriver, II: Mid-river, III: Downriver

				ANOVA	
Properties Physical	**I**	**II**	**II**	**F-value**	**Prob.**
Water temperature (OC)	27.4±1.5	25.9±1.4	24.1±1.4	3.36	P<0.05
Water depth (m)	6.4±4.6	7.5±4.8	9.7±6.6	4.32	P<0.05
Water width (m)	134.2±32	196.5±12.7	316.5±4.4	5.8	P<0.05
Flow velocity (m/s)	0.28±0.17	0.19±0.06	0.15±0.05	4.32	P<0.05
Transparency (cm)	42.1±22.9	37.2±19.5	33.8±14.3	1.56	P<0.05
Chemical Dissolved oxygen (mg/l)	6.6±0.8	6.8±0.9	7.7±0.7	0.98	P<0.05
pH	6.6±0.9	7.2±0.7	7.0±0.7	1.43	P<0.05

Table 14: Mean and standard deviation values of Fecundity, Egg Size and Gonado-somatic index (GSI) of some commercially important species in the Cross River.

Sampling Reaches	**Species**	**Mean frequency**	**Mean GSI**	**Mean egg size (mm)**
Upper reaches	*Chrysichthys nigrodigitatus*	56,012±11,234	15.3±3.2	1.1±0.07
	Oreochromis niloticus	176±78	8.4±1.5	3.4±0.67
	Clarias anguillaris	5,234±2,134	14.4±2.3	3.3±0.44
	Chrysichthys auratus	5,345±2,343	14.2±4.3	1.2±0.22
	Heterotis niloticus	1,033±597	6.4±1.4	1.5±0.41
	Labeo coubie	111,784±21,456	14.6±3.6	1.1±0.21
Middle reach	*Chrysichthys nigrodigitatus*	68234±17,459	18.4±2.4	2.0±0.12
	Oreochromis niloticus	189±67	10.5±3.2	3.7±0.87
	Clarias anguillaris	4256±2,101	12.7±4.1	1.9±0.88
	Chrysichthys auratus	8874±3,455	16.7±5.3	1.9±0.42
	Heterotis niloticus	3110±1,266	8.7±2.2	2.1±0.58
	Labeo coubie	116456±8,965	17.9±6.6	1.6±0.11
Lower reach	*Chrysichthys nigrodigitatus*	85239±46,344	22.1±4.2	2.8±0.76
	Oreochromis niloticus	223±45	13.2±3.8	3.2±0.56
	Clarias anguillaris	4835±1,999	12.8±5.3	2.1±0.77
	Chrysichthys auratus	11212±2,722	18.8±2.8	2.7±0.66
	Heterotis niloticus	5431±2,177	10.3±1.7	3.3±0.99
	Labeo coubie	112,234±13,453	21.7±3.9	1.4±0.15

Table 14 shows the various results of our work. The reproductive potential of the freshwater fishes in the Cross River inland wetlands vary with the species, size, environmental factors and season. Peak breeding season for the species was either between July/August, or September/October. The data generated in this study can provide knowledge on rational stock utilization, protection of new recruits and prediction of recruitment variability of the fishes.

We investigated the trophic ecology of the commercially important fishes in the Cross River. Diet composition and food indices of the endemic species were investigated. The diet composition, food richness, diet breadth and gut repletion index of 47 fish species belonging to 28 genera and 16 families of the inland wetland areas of Cross River. Food richness and distribution of each species in terms of location and site was analyzed (Offem *et al*, 2009a). There was variation in the composition of food objects in the different species despite the similarity in the rank-order. Major food items in the diet of the 46 species consists of detritus (79.9%), fish and fish fry (41.3%), insect and insect larva (41.3%), phytoplankton (26.1%), crustaceans (23.9%), mollusk (13%). Food Richness (N) varied between 5 and 20; Diet Breadth (D) from 0.22 to 0.88 and Gut Repletion Index (GRI) between 34 to 100%.

The decline in the abundance of fresh water fish resources is always an issue in the fishery and fish management generally. The declining trend in fish production, is often thought to prevail due to either over-exploitation using bad fishing methods or factors relating to availability of food for the fish. In this study, we investigated some aspects of the trophic biology of six commercially important freshwater species in the Cross River. The species-dependent regime in trophic spectra showed that there was variation in the consumption of food items by different species despite similarity in the food objects (Tables 14).

Tables 15, 16 and 17 show catch representation of the different fish species in the three reaches of the sites, the average percentage occurrence of the main preys by reaches and the seasonal variation in the mean percentage occurrence of main food items in the stomach of fish species in the experimental sites of the Cross River.

Table 15: Average catch rate (kg/h) of selected fishes by reaches. I: Upper reach, II: Middle reach, III: Lower reach

	I	II	III1
Oreochromis niloticus	0.8	2.8	2.5
Clarias gariepinus	3.8	1.8	2.5
Chrysichthys nigroditatus	0.7	3	4.2
Heterotis niloticus	0.5	1	2.4
Labeo coubie	0.8	1	0.5
Bryocynus nurse	0.4	0.8	1.2

Table 16: Average percentage occ urrence of the main preys by reaches

Reach Food item	I	II	III
Macrorachium sp	_	18.5±4.5	17.1±2.2
Nertina sp		0.6±0.2	34.2±4.3
Pellonula sp (prey)	20.8±2.5	3.4±1.2	8.2±4.3
Nymphaea	2.4±0.8	20.4	1.2±0.2
Spirogyra	10.4±2.1	9.8±0.4	3.5±0.8
Detritus	3.4±0.5	6.4±1.7	30.4±2.0

Table 17: Seasonal variation in the mean percentage occurrence of main food items in the stomach of fish species

Seasons Food item	Wet season	Dry season
Macrorachium sp	22.8±4.5	5.4±1.2
Nertina sp	19.8±6.7	-
Pellonula sp (prey)	28.6±4.4	-
Nymphaea	3.9±0.8	20.8±6.5
Spirogyra	1.8±0.5	25.5±5.8
Detritus	23.6±4.6	8.9±2.1

The dynamics of limnological features in freshwater ecosystem are very important to the survival of the endemic fish species. The stability of zooplankton in any aquatic body of water is of profound importance because they represent a unique food source for fish and many other aquatic vertebrates. They are an important link in food chains of virtually every inland water body converting phytoplankton/benthic plants, bacteria, fungi, and decaying organic matter into animal tissue that can be used by larger animals.

We investigated the physico-chemical factors and zooplankton diversity of the Cross River system for a period of two years in order to quantify the relative importance of the local environmental conditions and diversity of the principal zooplankton species of the system (Offem *et al*, 2009b).The stability of zooplankton in any aquatic body of water is of profound importance, because they represent important and sometimes unique food source for fish and many aquatic vertebrates.

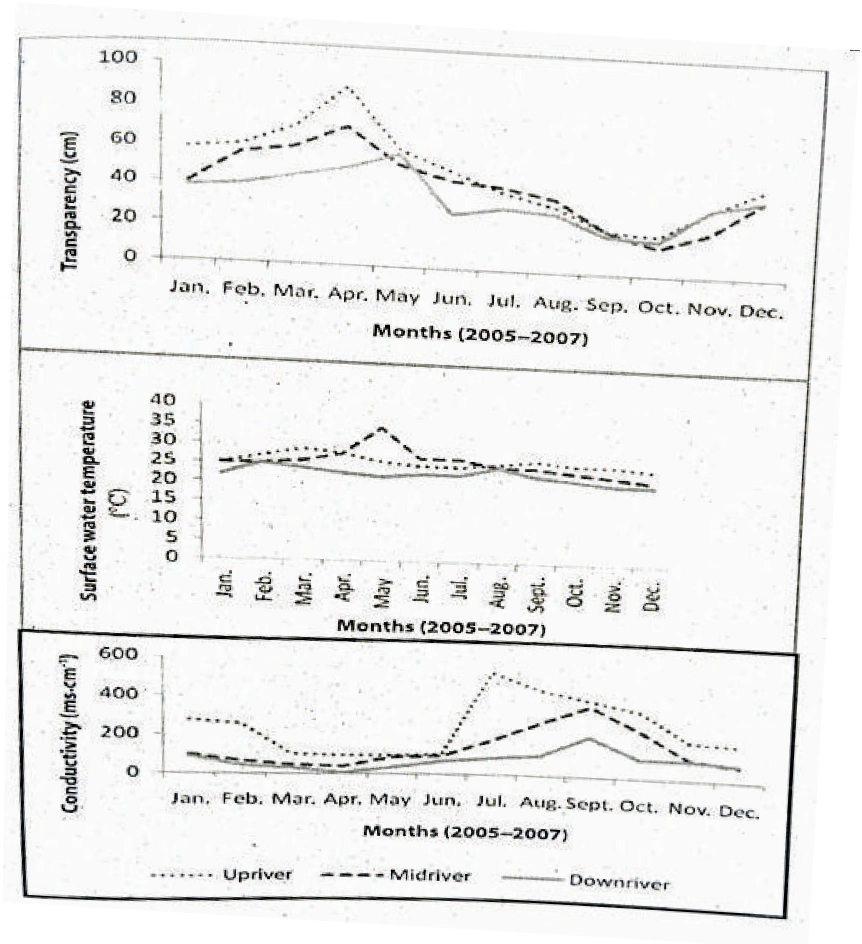

Figure 18. Monthly variations in the transparency (cm), water temperature and water conductivity (us cm^{-1}) © of Cross River wetlands.

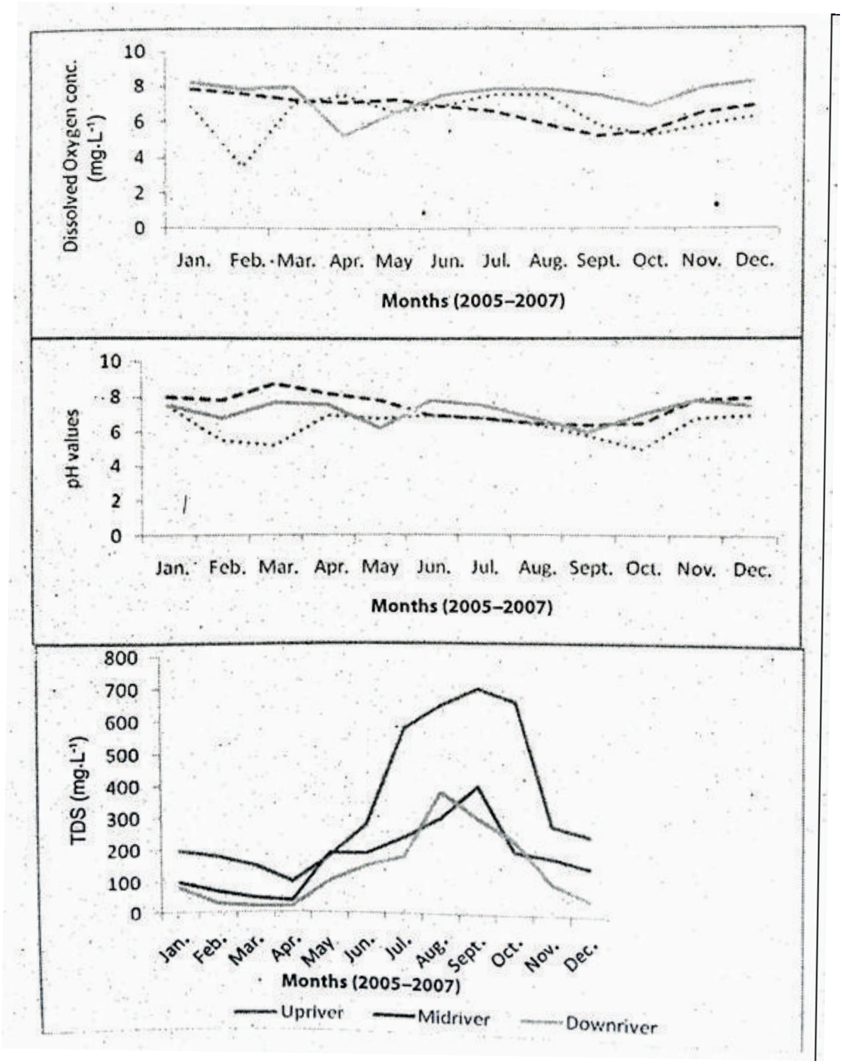

Figure 19. Monthly variation in the dissolved oxygen ($mg.L^{-1}$) pH and TDS of the wetland of Cross River

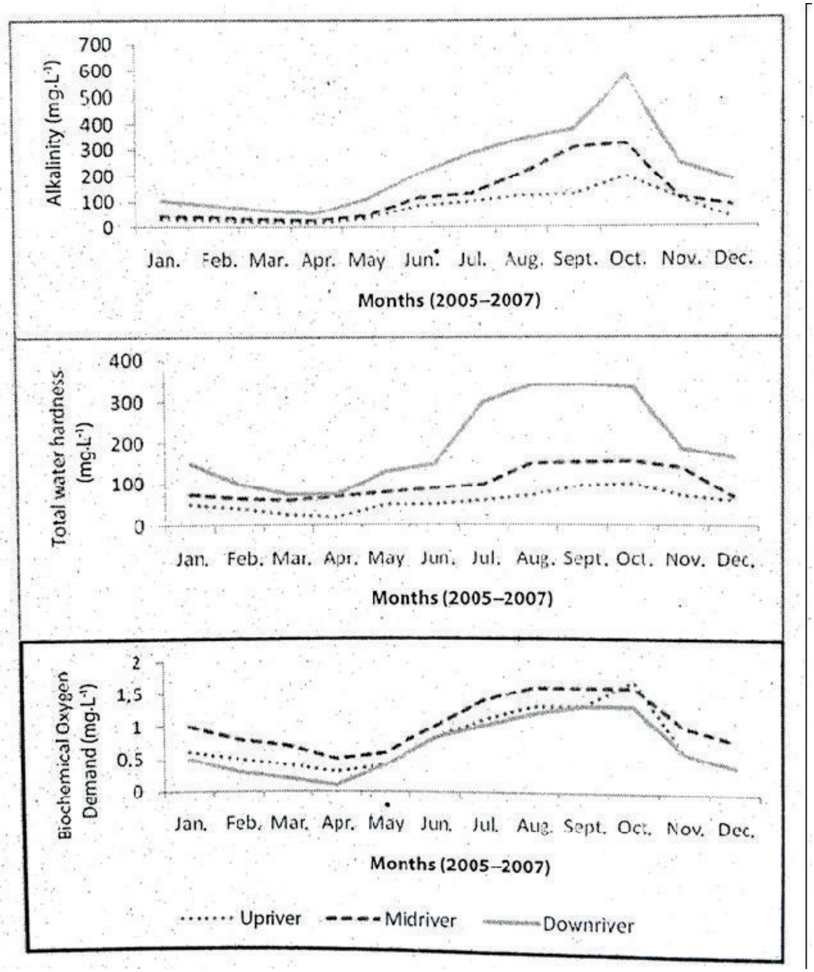

Figure 20. Monthly variation in the alkalinity, total hardness (mg.L^{-1}) and Biochemical Oxygen Demand of the Cross River wetlands.

As depicted by Figures 18, 19 and 20, the study showed that the hydrology of the Cross River wetlands is highly influenced by rainfall which in turn influence the water level and other parameters. Due to changes in the physical habitat characteristics, leading to highly unstable aquatic habitat, there was a noticeable instability of zooplankton population.

Offem *et al* (2009c), examined the specie composition and diversity of the major fish species along the three regimes (length) of the Cross River, (i.e. the upper (I), middle (II) and the lower (III). It was aimed at quantifying the relative importance of the lateral, local and longitudinal attributes along the river corridor in relation to distribution and the relative abundance of the principal fish species of the Cross River. The results showed that the middle regime of the River had a higher richness value (10.09) compared to the Upper regime (5.33). The lower river portion had the highest total number of individuals. The wet season was more favourable in all aspects of fish well-being and abundance compared to the dry season (Tables 18 and 19).

Table 18: Richness, diversity, equitability and relative abundance of the ichthyofauna in the sampling point

Indices	I	II	III
No of individuals	2412	5841	7233
No of species	19	39	33
Richness index (d)	5.33	10.09	8.29
Diversity function (D)	2.46	6.27	4.97
Equitability	0.13	0.16	0.16
Relative abundance (%)	16.67	40.37	50

I Upper-river, II mid-river, III I down-river

Table 19: Seasonal variation in the richness index, diversity function, equitability and the relative abundance of 46 fish species in Cross River

Indices	Dry season	Wet season
No of individuals	4235	10231
No of species	22	41
Richness index (d)	5.79	9.98
Diversity function (D)	1.87	4.31
Equitability (E)	0.09	0.11
Relative abundance (%)	29.27	70.72

Conversely, in the Gulf of Guinea of the Southwest, Nigeria weassessed the fish catch composition of the maritime artisanal fishery. The aim of this study was to propose management options for sustainable production and resource utilization. The results showed 69 fish species from forty-two families. This consisted of 59 finfish and 10 shellfish species. In all, the Clupeid family had the highest contribution both by weight (40.5%) and abundance (53.7%). *Sardinella maderensis* was the most abundant species by number (30.6%) and weight (27.9%). *Parapenaeopsis atlanticus* was the most abundant shellfish (51%) while *P. validus* was highest by weight (87%). Effective management of these fish resources is necessary to ensure fish food security (Odulate e*t al,* 2013*)*.

4.1.4 Research on Utilization of Agro by-products for Fish food

The low level of Nigeria's technological advancement has contributed to the low level of agro-products utilization, as a result wastages persist in the rural economies of the poor farmers. As already mentioned my research works have looked at the utilization of various agro-products that could have hitherto been regarded as waste. These include the use of pine apple waste, locust bean waste, maize gluten and rubber seed cake. Permit me to highlight three major findings of the works carried out with colleagues within and outside Nigeria.

In our work, (Fasakin *et al,* 2006), we investigated the efficacy of maize gluten supplemented with crystalline L-lysine as a potential source of amino acid for enhancing productivity index in a partially substituted fish meal diets for the African clariid catfish, *C. gariepinus.* Six iso-nitrogenous and iso-caloric diets containing 36% crude protein and 13% oil were formulated. Diet 1 containing 100% high grade fish meal protein source (Norwegian, LT-94) served as the control. Maize gluten meals in diets 2 to 6 were improved upon incrementally with crystalline L-lysine supplementation at 0.6, 0.9, 1.2, 1.5 and 1.8% respectively in which fish meal inclusion in the diets were reduced by 75% (Figure 21).

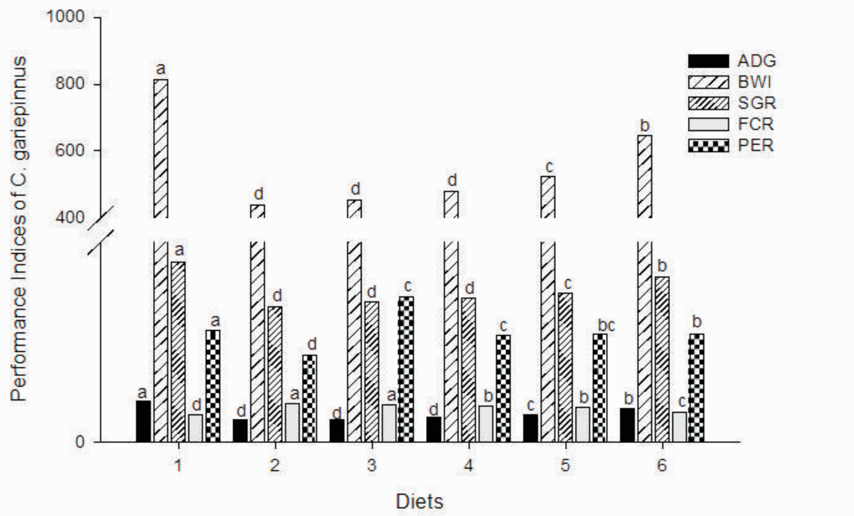

Figure 21: Performance evaluation of *C. gariepinus* fed experimental diets

All the fish fed on the experimental diets showed no dietary related mortality or morphological symptoms of nutrient deficiencies such as dorsal or caudal fin erosion and colour pigmentation which are symptoms of lysine deficiency. Though fish fed on fish meal based diets (control) had the best overall performance and significantly (P <0.05) different from other groups of fish fed maize gluten supplemented with L-lysine, there was an improvement in the performance indexes of the fish with increasing levels of L-lysine supplementation in maize gluten based diets. There is need for further work to establish the optimum dietary supplementation of lysine in maize gluten for *C. gariepinus*.

A wide range of by products from plants, animals and industrial processes have been tested and found to contain nutrients which can be exploited as dietary ingredients for warm water species such as Tilapias and Clarias. In our work (Akegbejo-Samsons, *et al, (2007)* we attempted to utilize the crush waste of Pine apple (*Anana comosus)* as alternative energy source to maize in diets of juveniles of African catfish, *C. gariepinus.* This study presented the results of trials in substituting Pine apple waste for maize on the growth and body composition of *C. gariepinus* juveniles. Five diets (42% crude protein) were formulated such that yellow maize was replaced at varying level (0.25, 50, 75, and 100%) with pine apple waste.

Table 20. Chemical composition of maize and the pineapple crush waste used for the experiment (g/100g dry matter)

Parameter	Pineapple	Maize
Dry matter	8.00 ± 0.4	8.00 ± 0.2
Crude protein	5.3 ± 0.5	9.6 ± 0.9
Ether extract	1.1 ± 0.2	5.4 ± 0.3
Crude Fibre	1.2 ± 0.4	3.0 ± 0.1
Ash	8.2 ± 1.7	2.8 ± 0.6
Moisture content	9.5 ± 1.9	6.9 ± 1.8
NFE	7.8 ± 1.5	6.1 ± 1.2

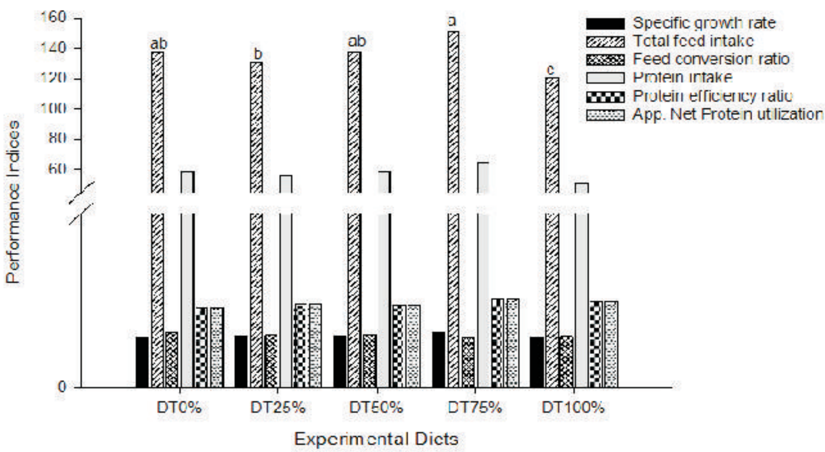

Figure 22: Growth performance and nutrient utilization of *Clarias gariepinus* fed experimental diets.

Growth performance of fish was highest in diet 4 (75% pine apple waste) for all investigated growth parameters such as average daily growth (1.87g), final body weight (150.35g) and protein efficiency ratio (2.02). This reveals that the use of pineapple waste at concentration up to 75% in the feeds of *C. gariepinus* can be well utilized. Pine apple wastes generated in the processing plants of Pine apple Juice are becoming environmental pollutants and thus can be conveniently converted to fish feed ingredients, thus lowering the cost of production of fish feeds in Nigeria.

4.1.5 Coastal Wetland studies

Coastal wetlands are areas of land that are permanently or seasonally inundated with fresh, brackish or saline water. They contain a range of plant species and animal species that are adapted to the conditions of these areas. They provide many ecosystem system services that benefit people and nature. They sustain commercial and recreational fisheries, protect our coastlines from ocean-related threats etc. Nigeria's coastal wetlands are known to be very rich in brackish water and migratory marine fish species. However not much work has been done in this area when compared to what has been carried out in inland waters. I have worked extensively on the extent (quantity) of coastal fish resources in Ondo state. My work here has contributed much literature to the fish resources of the coastal area of South west Nigeria.

In 1986, a National Conservation Strategy for Nigeria was published. The Publication, a product of two year's work was undertaken for the purpose of conservation of our multi-dimensional resources. Though mention was made of marine resources conservation, no reference was however, made of Marine Protected Areas (MPAs) and resources conservation. Marine protected areas are intended to be multipurpose used areas. Akegbejo-Samsons (1994) advocated for the establishment of National Coastal Protected Areas in the coastal wetlands of

Nigeria, especially in Ondo state. Among the benefits of the creation of MPAs include (a) mapping out areas for swamp rice production, (b) fishing and fish culture, (c) shrimp culture, (d) crab culture, (e) mangrove oyster culture, (f) wood and timber exploitation, (g) mat production and , (h) fossil oil production.

Attempts to develop wetland assessment procedures have been restricted largely to the United States and Canada, where the most comprehensive system so far developed is that of Adamus (Adamus and Stockwell, 1983). Wetlands are being lost worldwide because of human intervention. However, there are many types of human intervention which have little impact upon the natural properties of the system. Akegbejo-Samsons (1994) investigated and recommended mariculture options for fish production in Nigeria's coastal lagoons and marsh areas. Lying between Badagry in the west and the estuary of the Cross River in the east, Nigeria's coastal wetlands cover a distance of about 850 kilometre. This consumes an approximate size of 850,000 hectares. Mariculture (marine aquaculture), the husbandry of motile fish species in enclosures and structures erected within lagoons, creeks, estuaries or flood plains can be sustainably practiced with minimum negative effects on the ecosystem.

In Ondo state, Akegbejo-Samsons (1995), the wetland system was divided into three sub-zones in line with the ecological functions. The fish species were randomly sampled directly from the landings of the fishermen on sites. A total of about 32 fish species were identified during the study, out of which 13 were found to be commercially important.

The catfish family dominated most of the catches in number and in weight in all the three geo-strata. This was followed by the Cichlids. A partnership model for the sustainable utilization and conservation of biodiversity of our water resources and protected areas was advocated by Akegbejo-Samsons (1994). In the developed countries, water bodies are used for diverse and conflicting purposes beginning from the liquid (water) form to the ecosystem. The endemic resources are equally harnessed by diverse groups, fulfilling diverse needs.

A partnership that emanates from protected management programmes is a viable option in the conservation of the biodiversity of such water bodies in Nigeria. Of primary importance is the issue of owns and manages such protected areas such as those owned and managed by the Federal government (Kainji Lake), owned and managed by parastatals (IITA lake), and those owned and managed by tribal or indigenous people.

4.1.6 Research on Climate Change and Fisheries Management

Climate change issues crept into focus some years ago. Africa has been adjudged to be the most affected /vulnerable continent in years to come. I have been invited and sponsored by many international organizations such as CTA, UNEP, IHBP, UNESCO and ICRAF to attend and present papers on Climate change, as it affects Nigeria and Africa as a whole. My major discussions in these in all these fora had been the implications of climate change on the fisheries and coastal livelihoods of the African continent in general and Nigeria in particular.

At the 11th International River*symposium* held in Brisbane, Australia, Akegbejo-Samsons (2008) highlighted the various impacts of Climate change on fisheries production in land-water interface of Ondo State.

4.2. Published Books and Chapters in Books

I have the privilege of writing and publishing the following books and Chapters in Books. They are as follow:

(a) Introduction to Wildlife Management in Nigeria. 55 pp. Published by GOAD EDUCATIONAL PUBLISHERS, Abeokuta, Ogun State, 1996. Natural Resources Series 1.The Book was dedicated to Professor S. S. Ajayi, the first Professor of Wildlife Management in Nigeria, and the first African Professor Emeritus of Wildlife Ecology, University of Ibadan. Ibadan; Professor T. A. Afolayan of the Federal University of Technology, Akure, Dr Kelvin Milligan, UK and my father, Pa Elder Samsons Matanmi Adejube Akegbejo.

(b) Introduction to Aquaculture and Fisheries Management in Nigeria. 76pp. Published by GOAD EDUCATIONAL PUBLISHERS, Abeokuta, Ogun State, 1997. Natural Resources Series 2. The Book was dedicated to Professor Adebisi M. Balogun, former Vice Chancellor, Federal University of Technology, Akure, who equally Co-supervised my PhD Work in 1995.

(c) Development challenges of multi-functional Coastal system in the Niger Delta, Nigeria. (2012). A chapter In: Walter Leal Filho (Eds). Climate Change and Disaster Risk Management. Pp 119-127 Published by Springer, Berlin, Heidelberg.

(d) Tuning Africa – Tuning and Harmonization of Higher Education: The African Experience.(2014). Chapter 4: Agricultural Science, *Oyewole O B et al 2014: 91-134*

(e) Fish Production, Preservation, Processing and Storage. Training Manual of the 2006 Joint Training of Fish Farmers in Epe, Lagos State. (2006). *Edited by A. M. Omotayo, Y. Akegbejo-Samsons and O. J. Olaoye 2006. Pp 46*

(f) Design and Implementation of Degree Programs in Agricultural Sciences (2018) Kamleshwar Boodhoo (Editor) Authors: Kamleshwar Boodhoo, Yemi Akegbejo-Samsons, Olubunmi Abayomi Omotesho, Ahmed Elamrani, Taky Hortense Atta Diallo, Mariama Sene, Christopher Mubeteneh Tankou, Rashid A.M. Hussein, Henri R. Mloza Banda,*et al.* Published by University of Deusto Bilbao. Pp 106

(g) Food Security for African Smallholder Farmers. Sustainable Agriculture and Food

Security (2022). Chapter 11: Aquaculture and Fisheries Production in Africa: Highlighting potentials and benefits for food security. Pp 171-190. *Edited by Hupenyu Allan Mupambwa et al 2022.* Published by Springer. Berlin.

4.3 Administrative/ Academic / International Representation

Mr. Vice Chancellor Sir, I have been privileged to occupy Administrative, Academic and Ad-Hoc local and international positions and engagements that had given me tremendous opportunities to impact ***the town and the grown.*** This has led me to so many countries in the world, even twice up to far away Continent of Australia. Let me briefly highlight some of these positions and engagements.

4.3.1. Administrative

Mr. Vice Chancellor, Sir, I have held various administrative and academic positions that have imparted academic excellence on both students and Staff of this University. This include among others, the following: - (a) SIWES Co-coordinator, (Students Industrial Placement Scheme), Department of Aquaculture & Fisheries Management, University of Agriculture, Abeokuta. (1997 to 2000); (b) Post-Graduate Programme Co-coordinator, Department of Aquaculture & Fisheries Management (2001-2004); (c) Deputy Dean, College of Environmental Resources Management, University of Agriculture, Abeokuta. (2004 - 2006); (d) Member, Senate Council, University of Agriculture, Abeokuta.

(2004 - 2007); (e) Member, Senate Committee on Examinations, (2004 -2007); (f) Member, Time Table and Examinations Committee, (2004-2007); (g) Member, Standing Committee of Postgraduate School Board, (2004-2007); Chairman, Time Table and Examinations Committee (TIMTEC), (2006-2007); (h) Deputy Dean, Post-Graduate School, University of Agriculture, Abeokuta, Nigeria. (2006-2007); (i) Visiting Professor, Joseph Ayo Babalola University, Ikeji-Arakeji, Nigeria, (September 2007-September 2008); (j) Acting Dean, College of Agricultural Sciences, Joseph Ayo Babalola University, Ikeji-Arakeji, Nigeria. (February- March, 2008); (k) Head, Department of Animal Science and Production, Joseph Ayo Babalola University, Ikeji-Arakeji, Nigeria. (September 2007-September 2008); (l) Sabbatical Staff,Department of Forest Resources Management, University of Calabar, Nigeria (August 2017- August 2018) and (m) Adjunct Professor, Department of Forest Resources Management, University of Calabar, Nigeria (February 2018-February 2019).

Mr. Vice Chancellor, Sir I was the Dean of Students, for this University between 2012 and 2016 academic sessions. This unique opportunity opened to me various gateways to educate the youths, improve their academic perception and improve their preparedness for their tomorrow. Having been a Student Union leader, (PRO, Student Union) at the University of Ibadan during my undergraduate days in the 1970/80s, my position as the Dean of Students here in the Federal University of Agriculture was very instructive, easy, entertaining and effective.

4.3.2. International Representation

Mr. Vice Chancellor, Sir, I have represented Nigeria and this University in many International academic activities and fora. I will mention just a few. This include (a) Agriculture and Fisheries Expert.in the AU/EU Tuning Africa–Tuning and Harmonization of Higher Education: The African Experience between 2011 and

2017, which was held in four African countries and Europe. This took me to over three European countries and four African countries during this programme. I was a member of the Agricultural Team/Section, and we produced two different publications in two different chapters respectively in the published *Tuning Book*. The *Tuning Africa*programme is a network of intercultural interconnected communities of academics who reflect, debate and elaborate instruments and share academic debates.

(b) Fisheries and Ocean Expert in the 3rd International Ocean Institute (IOI) training program in Ocean Governance for Africa held at IOI South Africa HQ SANBI, Kirstenbosch, Cape Town South Africa between September and October, 2016.

It was designed to improve Ocean uses in Africa, especially in governments' responsibilities towards efficient and effective Ocean uses and management.

4.3.3 Faculty, College and Academic Representation

I have been invited as an External Examiner for various degrees in aquaculture and fisheries management in many tertiary Institutions, among which are the following Universities in Nigeria.

(a) Undergraduate Courses, Department of Animal Science and Fisheries, Olabisi Onabanjo University, Aiyetoro Campus, Ogun State (2009-2011)

(b) Federal University of Technology, Department of Fisheries and Aquaculture, Akure, Nigeria (2011-2013)

(c) Department of Fisheries & Forestry, College of Agricultural Sciences, Osun State University, Ejigbo Campus, Ejigbo, Osun State (2014-2015)

I have been invited by the NUC to assist in various Accreditation

Exercises across Federal, State and Private Universities, among which are: University of Benin, Benin City; Rivers State University, Port Harcourt and Niger Delta University, Wilberforce Island etc.

I have at various times and seasons being appointed by many Universities to assist in the Assessment of the Publications and Promotion exercises of many academics to the positions of Senior Lecturers, Associate Professors and Full Professors in this country. These include, Bells University, Ota, University of Ibadan, Federal University of Technology, Akure, Ogun State University, Ago Iwoye, Delta State University and Federal University, Oye Ekiti.

4.4 Academic Mentor and Guidance

I have been major and minor supervisor in many undergraduate and postgraduate research pursuits. Most especially, Mr. Vice Chancellor is the supervision of MSc and PhD dissertations and Thesis respectively. I wish to inform Sir, that at least four of my postgraduate students are today Professors in this University and in other Universities.

Permit me to mention some of them, who I believe are seated in this auditorium with us now. They are Professor F I Adeosun, (current Dean of Students), Professor D. O. Odulate,(former HOD, Aquaculture and Fisheries Management), Prof W A B Abdul, (former Director, FUNABOT), Prof Ben O. Offem, (former Dean, Faculty of Agriculture and Forestry, Cross State University of Technology, Obubra Campus, Calabar).

I am a mentor and a worthy guidance to numerous students, Alumni and Staff of this University and other Institutions in and outside Nigeria. This is not only on Aquaculture and Fisheries Career, but on spiritual and general academics.

I was and am currently Editor, and member of many Editorial Boards of Local and International reputable Journals, including our own University Journal here in Abeokuta.

5.0 RECOMMENDATIONS

Nigeria is the world's largest producer of catfish, one of the most commercially important freshwater fish species in Africa. Catfish is the most popular fish on the local market. There is also a substantial trade in smoked fish to neighboring countries and Nigerians in the United States, Europe and the Middle East. The FAO statistics showed that the country's aquaculture production grew from 22,000 tons in 1999 to over 300,000 in 2017 (FAO, 2018).

The industry today is worth N261.8 billion, according to an estimate from the FAO-FISH4ACP project seeking to help farmers with improve access to key export markets and enhance productivity. The need to expand our fish production from the coastal and marine environment via expanded aquaculture of endemic fish species is very paramount.

At the FAO-FISH4ACP farmed African catfish value chain validation meeting in Abuja, in 22-24, March 2022, farmers, breeders and other actors took turns to point out major issues affecting the business and how the industry is threatened by diminishing catfish genetic resources, lack of industry proper regulatory mechanism, lack of a breeding programme, indiscriminate mixing of genetic resources and host of other issues.

The focus of this lecture has been on the aquaculture (fish farming) and the artisanal fishery sectors of the coastal and marine environments of Nigeria, hence most of my recommendations will focus on these all important two sectors of fish production and management in the coastal/marine environment of Nigeria.

My recommendations will also corroborate other ones already proffered by my colleagues and other researchers who had presented their inaugural lectures in time past.

5.1 Aquaculture/Fish farming

(1) Fish products are among the most widely traded foods, with more than 37 % (by volume) of world production traded internationally. Nigeria government must focus on and improve the International Trade Treaties of fish and fish products to benefit the country and the citizens that are involved in fish exportation and importation. Legislations and rules that make for corrupt-free transaction should be enforced.

(2) Tilapia is one of the most important groups of aquaculture species in the world. In 2018, out of the 82.1 million MT of aquaculture food-fish produced, 5.5 million MT came from tilapia. However one of the major problems of expanding tilapia aquaculture is the lack of a systematically managed and maintained breeding population in order to produce high quality seed. It is therefore suggested that both the Ministry of Agriculture and Rural Development, World Fish and the Research Institutions in the country speed up the systematic introduction of the improved variety of tilapia into Nigeria to support the necessary growth of the tilapia sector. World Fish's GIFT has been distributed to many developing countries. Several studies have identified the socio-economic benefits arising from farming GIFT (Genetically Improved Farmed Tilapia). Nigeria should benefit from these innovations.

(3) The African catfish, *Clarias gariepinus, Heterobrachus bisordalis* and a few catfish family deserves a national attention in terms of production beginning from breeding, feeding, and total culturing.

5.2 Captured-based Aquaculture (CBA)

(4) Aquaculture, either as broodstock whose eggs will hatch and develop under culture in ponds or cages, or as early life-history stages for on-growing under confined and controlled conditions is

one of these strategies. This system of aquaculture production has been termed by the Food and Agriculture Organization of the United Nations (FAO) as capture-based aquaculture (CBA) and is practiced worldwide on a variety of marine and freshwater species, with important environmental, social and economic implications. The use of wild fish and fishery resources for aquaculture production in the coastal areas of Nigeria should be encouraged. Specific/targeted fish species that are of high market and economic values can be selected and introduced for farming and cultured in enclosures such as cages, pens and tanks.
It is widely considered that the economic cost of seed taken directly from the wild is lower compared to seed reared in hatcheries for many species.

5.3. Fishery and the Coastal environment

(5) Climate change has a modifying influence on fish distribution and the productivity of marine and fresh water species. This has impact on the sustainability of fisheries and aquaculture and the coastal stakeholders and livelihoods of the communities that depend on fisheries. The management of coastal erosion and marine inundation in the context of global climate change is very difficult a challenge that involve cooperation at local to global levels. Funding for the study of Climate change and climate prediction should be adequately provided by government and other funding agents within and outside the country.

(6) The small-scale fishermen operate dug-out or improved canoes. From their set nets they land demersal species such as croakers, catfish and shiny nose, of good individual size. They also target shrimp (Penaeids) in the estuaries at a convenient stage of their maturation cycle, thus curtailing recruitment at sea for the industrial shrimpers. Shrimps command a high price in the market, hence the farming of shrimps as aquaculture species should be encouraged through research activities and improved methods of culture.

There are a lot of exportable and culturable shrimps in our fresh, brackish and marine water (Bolarinwa, 2007). The culture of shrimp in Nigeria was almost non-existent until recently a company, Atlantic Shrimpers Limited set up a state-of-the-art shrimp farm in Badagry. The culture of shrimp requires sophisticated technology and high capital intensity, therefore government assistance is very paramount. Nigeria should encourage the cultivation of these spp especially for export through coordinated and purposeful funding. Pink shrimps (*Penaeus duorarum* and *Parapenaeus atlanticus* are in great demand internationally. Culturable freshwater prawns such as *Macrobranchium spp* and *Palemon maculatus* are in Nigeria's estuaries. These call for investment and foreign exchange focus.

(7) The nation needs a science based policies for fisheries production and management just like other developed countries. Therefore sustainable management of both fisheries and aquaculture through science-based formulation of National policies is imperative for huge national development. In order to do so, capacity building of human resources is very paramount. Fisheries Research Stations, Universities teaching Aquaculture and Fisheries management, among others, should be adequately funded and well equipped to teach and train Nigerian youths.

(8) Nigeria has signed and ratified many International and Regional regulations and conventions. These regulations include the Sea Fisheries Act of 1971, the Sea Fisheries (Licensing) Regulations of 1971, the Sea Fisheries (Fishing) Regulations of 1972, the Exclusive Economic Zone Decree of 1978, the Sea Fisheries Decree of 1992, and the 1995 Sea Fisheries Regulations. They are meant to assist every coastal nation in the efficient management of its seas, ocean and coastal zone. Nigeria will only reap the full benefits of these regulations if we enforce and adhere to all the conditions of operations and enforcement.

The Nigerian Institute for Oceanography and Marine Research

(NIOMR) Lagos, was primarily established in 1975 to conduct research on the living and non-living resources of the ocean and coastal zone. There is an urgent and continuous need to adequately fund this Institute and other Research Institutions so that Nigeria can benefit from God's gifts to the benefits of her citizens.

(9) In order to culture, cultivate and nurture more of our 26 freshwater fish species in the entire coastal zone of Nigeria, we must amplify numerous pond culture techniques and the establishments of Raceways and Floating cages for our marine species. The four zones of the coastal environment (freshwaters, brackish water, coastal and off-shore) of Nigeria has its own indigenous fish spp and suitable land topography, hence maximum utilization of these zones for fish farming can be suitably carried out.

(10) The culture of Oyster or Crab in Nigeria is not very popular or even non-existent. Apart from the local riverine women, who pick them from the mangrove areas for subsistence and part time vocation, there is no form of mechanized capture of oysters and crabs in Nigeria, despite the abundance of the African giant oyster (*Grassostrea gasar*) and the Swimming crab (*Callinectes amnicola*). The popular periwinkle, (*Tympanotonus fuscatus*) is a special delicacy that can be cultured for export, thus can become a huge source of foreign exchange earnings.

(11) Additional protected areas must be created in the enclaves of our coastal zone and the management of all existing protected areas requires increased public awareness, financial support and political will. With stronger enforcement of national and international laws in these areas, production will be expanded and the rural communities especially the women folks have additional financial capacity to live a decent life.

(12) Government should design a specific and special programs/projects that will look at the following constraints that are the permanent features in the coastal areas of Nigeria:- (i) lack

of capital to increase production and technical inputs; (ii) lack of capital to provide credit for the various groups that are involved in the coastal fishery; (iii) establishing a credit system(s) for the target groups; (iv) access to capital for purchase of fish, for financing fish processing activities and improved techniques, and for financing fishing operations; (v) improved knowledge, skills and technology in fish processing to reduce wastage, to improve quality, to increase quantity, reduce health hazards, reduce labour time and fuel consumption.

6.0. CONCLUSION

Mr. Vice Chancellor, Sir, in conclusion, this lecture has covered various aspects of aquaculture and fisheries production and management in Nigeria, with emphasis on the marine/coastal areas of Nigeria. Let me say with mush emphasis that fish is critically important to Nigeria for food and nutritional security, foreign exchange, employment and livelihoods. A rapid and dedicated change in the supplies and distribution is necessary over the next 20 years in order for the country to realize its full potential. The potentials of the marine and coastal areas of Nigeria has been largely underutilized. Our marine waters and the endemic fish species need a specialized national focus by way of (a) improved and increased funding for research and training. Our research Institution (NIOMR) must be well funded while the Departments offering Aquaculture and Fisheries Management in our Universities must be well equipped to carry out visits, excursions and practical that guarantee excellent modern day training.

(a) Fish and Fisheries provide the main source of animal protein for about one billion people worldwide,

(b) Aquaculture and Fisheries provide food for consumption, employment and financial income, and a food source when other sources are at seasonal lows;

(c) Fish as food is especially important for the poor as they are often one of the cheapest and most accessible sources of protein available. Generally, competing demands for natural resources and access to their exploitation can lead to conflicts and overexploitation of fisheries, with negative impacts on food security.

It is thus evident that management of fisheries that ensures their sustainability is essential to maintain their contributions to food security

8.0 ACKNOWLEDGEMENT

Mr. Vice Chancellor Sir, ladies and gentlemen, I wish to use this opportunity to appreciate

and thank the Almighty God, the giver of life who has saved me and has kept me till today to stand before you all to deliver this inaugural lecture. To Him alone be all the glory.

They say that charity begins at home. I wish to thank God for His numerous favour over my life among the 10 children of my father, right away from our little village in the Akoko South East area of Ondo State. God took me out of that little village to cities and palaces in numerous countries all over the world. This is the Lord's doing, it is marvelous in our sight. In spite of the fact that my father was rich enough to pay my school fees throughout my academic years, God indeed favoured me to enjoy both local and International scholarships/funded trainings for my Diploma course, First and Second degrees and my Doctorate program. Throughout all my travelling years for conferences and trainings, He made me to receive special considerations for grants, funds and scholarships.

I wish to acknowledge the special love that I received from my late

father, Pa Samsons Matanmi Adejube AKEGBEJO, whose unique love for education made sure that all his children we adequately educated. He was a very rich farmer who loved education. He would gather us together to instill discipline, hard work, honesty, good morals and God-fearing attitudes and attributes on us. It was his usual concluding statement to tell us thus, "remember the son of whom you are".

I also want to thank my late mother, Madam Juliana Yekemi AKEGBEJO, a wonderful mother, too generous to a fault. She was a patient second wife in the house of a rich farmer, who spent all their time in the farm except on Sundays. Preparing meals for all of us was never a burden to her. Rest in perfect peace, Maami.

To all my siblings from the two sides, I say thank you all. My kind appreciation to my brothers and sisters that I spent my semester holidays with, anytime that I was not on vacation jobs most of academic days. You were very useful. I say God will bless you all.

I was spotted by Prof Julius A. Okojie at the Federal College of Education, (FCE) Osiele, Abeokuta on my arrival from Canada, during one of the convocation ceremonies. I had earlier promised the Provost of the College that the visitors and invited guests will not receive paper gifts but three large live fishes (*C. gariepinus, Heterobranchus spp* and *H. niloticus)* per pack. It was the pack we gave to Prof Okojie that made him to ask the Provost to surmount the brain behind the fish package, the "Fish producer" for a meeting with him. There and then he asked me to apply and move to the Department of Aquaculture and Fisheries of this University. My great thanks to him for paving the way for me to start my academic career in this University.

I want to, with due admiration, thank all those, high and low, academics and non-academics, peasants and artisans, who have contributed to my growth and development in the academic world. They are too numerous to mention one by one, but I will try and single out a few, without any disregard to and for any one.

Mr. Aworuwa, our Agriculture teacher in St Patrick's College, Oka-Akoko (a product of the School of Agriculture, Samaru-Zaria) introduced many of us into the field of Crop and Animal Production in our young age, in Form 2, and there and then my interest in Agriculture grew with age and experience. He laid this foundation that we are celebrating today. Thanks you very much Sir, my old teacher. Mr. Fasuyi, my Principal at the School of Agriculture Akure continued from there and discipled me into Practical Agriculture during my years as a student in the now, College of Agriculture, Akure. My special thanks to you Sir.

On admission into the University of Ibadan, Professor D. U. U. Okali, the doyen of Ecology and Forestry Management was one of the Professors that pioneered the creation of the Department of Fisheries Resources Management from the Department of Forestry in UI, I was favoured to be one of the first pioneering students of that notable session. Eleven of us made history to be the first 11 of the Department that has now grown to an academic rock having produced numerous well known Professors in Nigeria and internationally. Among these are my instructors such as Professor Faturoti (now Retired), who supervised my MSc degree; Professor Fagade (Uncle Fag) now retired) and Prof Adebisi of the Department of Zoology University of Ibadan (UI) (now retired), Professor A. M. Balogun (now retired), who supervised my PhD at the Federal University of Technology (FUTA) Akure. Late Professor Amubode of the Department of Forestry, Professor Julius Okojie (now retired), an academic icon of Forestry in University of Ibadan (UI), who incidentally paved the way for my recruitment into this University as a lecturer. Professor S. Adeola, who later left UI and joined this University in the Department of Forestry and Wildlife, Professor T. Afolayan, of blessed memory, who co-supervised my PhD, and facilitated my surjon in Canada. Professor I. F. Adu, of blessed memory was very useful and fatherly, as part of my recruitment into this University. I thank you all.

My stay in this University since 1997 till date has given me the opportunity to interact with many colleagues and Professors. I appreciate the Deans and Directors I have worked with especially Prof O. Martins (retired) (as his Deputy Dean, COLERM); Prof T. A. Arowolo, (retired) (as his Deputy, COLERM); Prof O J Ariyo (as his Deputy, PG School); Prof Steve Afolami (retired) (as his Deputy, PG School). I extend my appreciation to my friends and colleagues in the College of Environmental Resources Management (COLERM) and Department of Aquaculture and Fisheries management (AQFM). It has been wonderful working with all of you.

I thank God for giving me the opportunity to work with Prof O. B. Oyewole as the Dean, Students Affairs, during his tenure as the Vice Chancellor. I thank the Almighty for seeing me through all the vicissitudes and acrimonies characterized by the position and circumstances of that period.

To all the Staff of the Students' Affairs Unit and all former Student Union Executives, I appreciate you all for being part of the success achieved during my years as the Dean, Students' Affairs. There was no recorded student riots or disturbance during my period as the Dean of students. You all contributed to this success, thanks to you all.

To all my wonderful academic family, I cannot easily forget your contribution to my academic growth : - Prof Dayo Fasakin (Rector, Federal Polytechnic, Ile Oluji), Prof T. I. Ofuya (FUTA), Prof Adebayo (FUTA), the Late, Prof Biyi Daramola (former VC, FUTA), Prof Segun Osinowo, Prof I. T. Omoniyi, Prof Bamidele Omitoyin (UI), Prof Dapo Fagbenro (FUTA), Dr Okweche (Unical), Prof Austin Ogogo (Unical), Prof Kola Adebayo (Unaab) Dr F. Oyekanmi (College of Education, Ilesa), Dr Sola Babalola (LASPOTECH), Prof Chinedu Mafiana, Prof A. M. Aduradola, Prof Clement Adeofun, and Prof Tosan Fregene (UI). My appreciation to you all.

To all my former HODs, both retired and still active, Prof S. O. Otubusin, Prof Ezeri, Prof I. T. Omoniyi, Prof W. Alegbeleye, Prof S. Obasa, Prof (Mrs) F. A. O. George, Prof (Mrs.) N. B. Ikeweinwe, Prof A Akinyemi, Prof (Mrs.) O. T. Agbebi and Dr A. Idowu (my current HOD). Thanks for all your love and support.

Thanks to all my students, especially the young men and women that I was opportune to supervise their major research projects, dissertations and theses. I thank God for your success and hard work. Dr Deji Adeoye, (now in the UK) was very useful when I was on sabbatical, thanks very much. I want to thank God for some of my postgraduate students/colleagues that are now Professors in their various chosen areas of specialization. They are Prof. F. I. Adeosun (current Dean of Students), Prof D. O. Odulate, Prof W. O. Abdul and Prof Benedict Offem. To all my undergraduate and Masters' students, I appreciate you all.

I want to acknowledge all my spiritual fathers, most especially, Pastor Prophet Samuel Adebayo Aluko, (founder, CAC, Power of His Voice Ministry, Ile Aanu, Ibadan and Worldwide. To all Pastorate and members of CAC Ile Aanu (Ondo, Ibadan, Lagos, Ilorin and Worldwide). Thank you and I pray that God will continue to keep us till the coming of Christ.

At this point, I want to specially thank my family, starting from my wife, Mrs Olubunmi Modupe Akegbejo-Samsons. Thanks for the love and care you have showered on me and the children, these years of our marriage. I also want to appreciate our three wonderful children namely, Mrs. Oluwatoyin Lawson (Nee Akegbejo-Samsons), Mr. Oluwatosin Akegbejo-Samsons and Mr. Oluwatomiwa Akegbejo-Samsons. I thank my son-in-law, Engr Olatunde Lawson, the grand-daughters (Darasinmi Pearl and Dasimi Petra). My appreciation to my daughter-in-law, Glodys Akegbejo-Samsons (Nee Omasombo) and our beautiful grandson (Paul). You are all very wonderful.

My siblings are highly appreciated, notably, Mr. Stephen

Oluwarotimi Akegbejo-Samsons, Mrs Bridget Tale Olowonefa, Mrs. Feyisitan Yussuf (nee Bamigbele), Mr. Fola Bamgbele, and Mr. Remi Bamgbele.

Mr. Vice Chancellor Sir, Ladies and gentlemen, this is my story, this is my song, praising my savior all the years long. Thank you for your time. Thank you for listening.

Please can you all help me to thank God with this popular song:-

Great is thy faithfulness

Great is thy faithfulness

Morning by morning, new mercies I see

All that I have thy Hand has provided

Great is thy faithfulness

Oh Lord my God.

REFERENCES

Afigbo, A E (1975) The flame of History blazing in Ibadan. A reviewed work. History and Histrory-makers in Modern Nigeria, an inaugural lecture delivered at the University of Ibadan. *Journal of the Historical Society of Nigeria, 7(4), 715-720.* Historical Society of Nigeria stable. Retrieved from https://www.jstor.org/stable/41971224.

Akankali, J.A. & Jamabo, N.A. (2011). A Review of Some Factors Militating Against Sustainable Artisanal Fisheries Development in Niger Delta, Nigeria. *Asian Journal of Agricultural Sciences,* 3(5): 369-377.

Akegbejo-Samsons, Y. (1995): Ecology of the Fisheries Resources of the Coastal Wetland of Ondo State and its Management Implications. PhD Thesis. Federal University of Technology, Akure, Nigeria. Pp 287

Akegbejo-Samsons, Y. (1996) Introduction to Wildlife Management in Nigeria. Natural Resources Series # 1. Goad Publishers, Nigeria. Pp 55.

Akegbejo-Samsons, Y. (1996). Some technological innovations in Fisheries Production and Preservation in Nigeria: A review. Jour of Voc. Educ. 1: 69-79.

Akegbejo-Samsons, Y. (1997) Introduction to Aquaculture and Fisheries Management in Nigeria. Natural Resources Series # 2. Goad Publishers, Nigeria. Pp76

Akegbejo-Samsons, Y. (1997). Establishing Marine Reserves with subsistence Communities in the coastal/marine areas of Nigeria. The Nigerian Field 62(3,4): 140-149.

Akegbejo-Samsons, Y. (1997). Ecological Education as a Production strategy in Natural Resources Management and Conservation: *Issues and Actions. Jour of Sci. Educ.* 2 (1,2): 31-34.

Akegbejo-Samsons, Y. (1998). Nigeria's Coastal Environment: *A need for Integrated Coastal Zone Management. Nig. Jour. of Forestry.* 28 (1,2): 56-59.

Akegbejo-Samsons, Y. (1999). The Resources of Ilaje/Eseodo Coastal area of Ondo State, Nigeria. The Nigerian Field 64: 31-42

Akegbejo-Samsons, Y. (1999). The use of Cassava flour as a partial substitute for Yellow maize in diets for *Clarias gariepinus* fingerlings. *J. Aqua. Trop.* 14(3) : 247-253.

Akegbejo-Samsons, Y (1999). Growth response and Nutrient digestibility by *Clarias gariepinus* fingerlings fed varying levels of dietary Periwinkle flesh as replacement for Fish meal in low cost diets. *Appl. Trop. Agric*. 4 (1): 37-41.

Akegbejo-Samsons, Y. (1999). Community-based Coastal Resource Inventories: A basis for Integrated Coastal Zone Management, in Nigeria. *J. Trop. For. Res*. Vol 15(1):166-174.

Akegbejo-Samsons and A. M. Gbadebo (2000) Nutrient fluxes between land and Ocean, and effects of human-induced activities: case study of Ondo state coastal wetlands, Nigeria. In: Arthur, Kremer, Odada, Salomons and Crossland (Eds) African Basins: *LOICZ Global Change Assessment and Synthesisof River Catchment-Coastal Sea Interaction and Human Dimensions. LOICZ Reports &Studies No 25: ii+344 Pages, LOICZ Texel, The Netherlands. Pp157-162.*

Fagbenro. O and **Y. Akegbejo-Samsons** (2000). Optimum protein requirements of diets formulated for economical growth of *Heterotis niloticus* (CUVIER 1829). *J. Fisheries Technology* 2:20-29.

Akegbejo-Samsons, Y and J. Olagunju (2002). Growth response and nutrient digestibility of *Clarias gariepinus* fingerlings fed varying levels of *Parkia biglobosa* slurry as energy source. *Applied Fisheries & Aquaculture* II:1-6.

Alegbeleye, W.O; A. Oresegun; **Y. Akegbejo-Samsons and S.O. Obasa** (2004) Replacement of ground nut cake with rubber (Hevea brasiliensis) seed cake in diets for Nile Tilapia, *Oreochromis niloticus*. *Journal of Aquatic Sci*. 19(1): 27-31.

Akegbejo-Samsons, Y, O.B. Oyewole, S.O. Olayinka and T.O. Olaniyan (2004) Chemical composition and binding power of slurry concentrates produced from the African locust bean *(Parkia biglobosa)* pulp in low-cost fish diets. *Ife Journal of Science:*6 (1):30-34

Akegbejo-Samsons, Y and J.N. Ojinni (2004) Use of the African locust bean *Parkia biglobosa* waste slurry as energy feedstuff in practical diets for Tilapia, *Oreochromis niloticus*. *Nig. J. Anim. Prod*. 31(2): 279-285

Akegbejo-Samsons, Y, FAO George and AO Agbon (2005) Studies on the growth, reproduction and aquaculture potential of the African bony tongue fish (*Heterotis niloticus*) in ponds and reservoirs in coastal south-west states of *Nigeria Asset Journal Series* A :65-71

Akegbejo-Samsons, Y. (2005) Comparative ecology of the African bony tongue fish, *Heterotis niloticus* and the catfish, *Clarias gariepinus* in the Lower Oluwa River and adjacent floodplains *Ife Journal of Science.* 7(1):15-20

Akegbejo-Samsons, Y and Tunde Omoniyi (2006) Evaluation of pineapple crush waste meal as an energy feedstuff in the diets of tilapia, *Oreochromis niloticus Nig. Jour.Anim. Prod*. 33(2):308-312

Akegbejo-Samsons Y, Odedoyin A J and Odulate DO (2017) Growth, feed utilization and blood composition of *Clarias gariepinus* fed bamboo charcoal diet at various inclusion levels. *MAJANDS*, 2 : 21-27

Akinrotimi, O.A., Abu, O.M.G. and Aranyo, A.A. (2011). Environmental Friendly Aquaculture Key to Sustainable Fish Farming Development in Nigeria. *Continental Journal Fisheries & Aquatic Science*, 5 (2): 17 – 31.

Anyanwu, P. E., Gabriel, U.U., Akinrotimi, O.A., Bekibele, D. O. and Onunkwo D. N. (2007). Brackish water aquaculture: a veritable tool for the empowerment of Niger Delta communities. Scientific Research and Essay (8), 295-301, August 2007 Available online at http://www.academicjournals.org/SRE

Ateme, M E (2021) Developing marine and coastal resources in Nigeria: Prospects and challenges. Maritime Technology and Research 3(4):335-347

Balogun, A.M. and Akegbejo-Samsons, Y. (1992): Waste Yield, Proximate and Mineral Composition of fish resources of Nigeria's coastal waters. Biores. *Tech. 40: 157- 161.*

Beveridge MCM, and Phillips M (1993) Environmental impact of tropical inland aquaculture. In: Pullin RSV, Rosenthal H, McLean J (eds) Environment and aquaculture in developing countries, vol 33. ICLARM conference proceedings, Philippines, 33:171–197

Blueprint (2014) What hopes for the Nigeria Fishery sector. https://www.blueprint.ng/what-hopes-for-the-nigeria-fishery-sector

Boyd CE, and McNevin A (2014) *Aquaculture, resource use, and the environment.* Willey, New Jersey.

Brummett, R.E, J. Lazard and J. Moehl (2008). African aquaculture: Realizing the potential. Food Policy 33 (2008): 371-385.

Charles, O M A (1960). The study of History. An Inuagural lecture. Oxford. Clarendon Press

Crawford, M.A., M. Bloom, C.L. Broadhurst, W.F. Schmidt, S.C. Cunnane, C. Galli, K. Gehbremeskel, F. Linseisen, J. Lloyd-Smith, and J. Parkington. 1999. Evidence for the unique function of docosahexaenoic acid during the evolution of the modern hominid brain. *Lipids* 34: S39–S47.

De Silva, S S (2012). Aquaculture: a newly emergent food production sector—and perspectives of its impacts on biodiversity and conservation. **Biodivers. Conserv. (**2012) 21:3187–3220

De Silva, S S and F B Davy (2010) Aquaculture successes in Asia: Contributing to sustained Development and Poverty alleviation. In: S S De Silva and F Brian Davy (Eds) *Success stories in Asian Aquaculture. NACA. Springer,* NY Pp 1-14.

Department of Health, Washington, USA. Fish Advisories Program.

Dharmendra Kumar Meena (2011) Fish and its role in Human Nutrition. http://aquafind.com/articles/FIIArticles.php. 3pp

Diop E. S (1993). Conservation and Sustainable Utilisation of Mangrove Forest in Latin America and African regions. Part II-Africa

International Society for Mangrove Ecosystem and Coastal Marine Project of UNESCO. *Mangrove Ecosyst. Techn. Rep.*,3.

Dosdat A (2009) Environment impact of aquaculture, Fisheries ed. EOLSS Publishers

Fagbenro. O and **Y. Akegbejo-Samsons** (2000). Optimum protein requirements of diets formulated for economical growth of Heterotis niloticus (CUVIER 1829). *J. Fisheries Technology* 2:20-29.

Fashakin, E.A., S.J. Davies and **Yemi Akegbejo-Samsons** (2006) Efficacy of maize gluten supplemented with crystalline L-Lysine in the diets for the African Clariid catfish, *Clarias gariepinus* (Burchell,1822) J*ournal of Animal and Veterinary Advances* 5(3):237-243

FAO, 1999. The state of world fisheries and aquaculture 1998. Food and Agriculture Organization of the United Nations, Rome

FAO, (2010). Food and Agricultural Organization (FAO) 2010. Report of the fifth session of the sub-committee on aquaculture Report 950, Rome. ISBN 978-92-5-006716-2, 2010.

FAO (2011). The state of the world's land and water resources for food and agriculture: managing systems at risk. FAO/Earthscan, Rome

FAO (2016). Map Accuracy Assessment and Area Estimation: A Practical Guide. Food and Agriculture Organization of the United Nations. 60 pages.

FDF, 2019. National Forest Reference Emission level (FREL) for the Federal Republic of Nigeria. Federal Department of Forestry, Abuja, Pp 54.

FORMECU, 1998. The Assessment of Vegetation and Landuse Changes in Nigeria. Geomatics International Inc. for Federal Department of Forestry, Abuja, Nigeria.

Galawat, F. Yabe, M. 2012. Profit Efficiency in Rice Production in Brunei Jerusalam: A stochastic frontier approach. *Journal of ISSAAS* 18(1): 100 – 112.

HLPE, 2014. Sustainable Fisheries and Aquaculture for Food

Security and nutrition. A report by the High Level Panel of Experts on Food security and nutrition, June 2014. Pp 119

Ibe, C.A., 1998. Perspectives in Integrated coastal Areas Management in the Gulf of Guinea. Cotonou, CEDA (Center for Environmental and Development in Africa).

Ifeyinwa, C.O., 2000. Coastal Challenges and the Challenges of Coastal Education in Nigeria.Integrated Coastal Management Planning Strategies Part 2 General Principles of Coastal ZoneDevelopment Planning.

Izah, S C, 2018. Ecosystem of the Niger Delta region of Nigeria: Potentials and threats. *Biodiversity International Journal.* Vol 2(4): 338-345. DOI:10.15406/bij.2018.02.00084.

Keith Brander (2010). Impact of Climate Change on Fisheries. *Journal of Marine Systems*, 79: 389-402.

Lahsen Ababouch (2015).Fisheries and Aquaculture in the Context of Blue Economy. United Nations Economic Commission for Africa. Background Paper. Feeding Africa. Pp16

Mmom P C and Chukwu-OKeah G O 2011. Factors and processes of coastal zone development in Nigeria: A Review. *Res Journal of Env and Earth Sciences* 3(6): 625-632.

Nakazawa N, Komatsu M, Court B.(2013) Fisheries in Nigeria. Report to the Federal Ministry of Agriculture Nigerian Government. 2013. 11 p

Nigeria Environmental Study Team (NEST) (1991) "Nigeria's threatened environment". A National profile, Intest Printers Ltd, Ibadan, Nigeria.

NEPAD, 2014. The NEPAD Agency Fisheries and Aquaculture Programme. Pp 18

Nwaehukwu J (2000) Nigeria Environment in the 20th Century, NCF 20th Anniversary Public Lecture Series No: 2, Nigeria Conservation Foundation, Nigeria

Nwafili, S and T. Gao, 2007. Structure and dynamics of fisheries in Nigeria. *Journal of Ocean University of China,* 6 (3):281-291.

Odulate, DO., **Y. Akegbejo-Samsons** and IT Omoniyi (2006) Diversity and distribution of fish species in the coastal areas of Ogun waterside, Ogun state, Nigeria. *Ogun Journal of Agric. Sciences* 4: 95-102.

Odulate, DO., I T Omoniyi and **Y Akegbejo-Samsons** (2013) Assessment of fish catch composition of marine artisanal fishery in the Gulf of Guinea, Southwest, Nigeria. Nigerian *Journal of Animal Production,* 40 (1):197-206.

Odulate, DO., **Y Akegbejo-Samsons** and IT Omoniyi (2014) Multivariate Analysis of fish species and Environmental factors in Marine Coastal waters of the Gulf of Guinea, Southwest Nigeria. *Croatian Journal of Fisheries*, 2014, 72: 55-62.

Odulate D. O., F. I. Adeosun, W. O. Abdul, **Y. Akegbejo-Samsons,** C. O. Ojelade, G. C. Obinani and G. I. Akintunde (2016) Some Limnological Characteristics of Asejire Lake, Asejire, Southwest Nigeria. *Journal of Aquatic Sciences* 31 (2b):509- 520 (2016.

Offem, B.O, **Y. Akegbejo-Samsons** and I T Omoniyi (2007). Biological assessment of Oreochromis niloticus (Pisces: Cichlidae; Limne, (1958) in a tropical floodplain river. *African Journal of Biotechnolgy* 6 (16): 1966-1971.

Offem, B. O., **Akegbejo-Samsons, Y** and Omoniyi, I. T. (2008). Stock assessment and management implications of inland Fisheries in the floodplain of the Cross River, Nigeria. *Nigerian Journal of Fisheries* 5(2): 85-97.

Offem, B. O., Akegbejo-Samsons, Y. and Omoniyi, I. T. (2008). Diet, size and reproductive biology of the silver catfish, Chrysichthys nigrodigitatus (Siluformes: Bagridae) in the Cross River, Nigeria. *Rev. Biol. Trop. (Int. J. Trop. Biol.)* 56 (4): 1785-1799, December 2008

Offem, B. O., **Y A-Samsons** and I.T. Omoniyi (2008) Reproductive aspects of common freshwater fishes in the Cross River, Nigeria. *J. Anim. and Pl. Sci.* 18(4): 130- 138.

Offem, B O., **Y.A. Samsons,** I.T. Omoniyi, G.U. Ikpi (2009) Dynamics in the limnological features of a tropical flood river and the occurrence of common zooplankton species. *Knowledge and Management of Aquatic Ecosystems* (2009) 393, 02

Offem, B. O., Y A- Samsons and I.T. Omoniyi (2009) Trophic ecology of commercially important fishes in the Cross River, Nigeria. *The Journal of Animal & Plant Sciences* 19 (1):37- 44

Offem, B. O., **Akegbejo-Samsons, Y.** and Omoniyi, I. T (2009) Fish composition and abundance in the wetlands of Cross River, Nigeria. Aquatic Ecology March 2009

Ogbe M G (2011). Managing the environmental challenges of the oil and gas industry in the Niger Delta, Nigeria. *Journal of Life Science*. 2011;1(1):1–17.

Ohimain E I (2012). Environmental impacts of petroleum exploration dredging and canalization in the Niger Delta. In: Akpotoe AS, Egboh SH, editors. *Five decades of oil production in Nigeria: impact on the Niger Delta*, 2012; pp. 391-405.

Omoniyi, I.T., Oyekanmi, F.B., and Akegbejo-Samsons, Y. (2012) Abundance, Length–Weight Relationship and Fecundity of Macrobrachium vollenhovenii and Caridina africana at Asejire Lake and Erin – Ijesa Waterfalls, Nigeria, *Obeche Journal* 30(1): 466- 471, 2012

Omoniyi, IT, Oyekanmi, FB and **Akegbejo-Samsons, Y.** (2012) Dynamics of Limnological features of a man- made lake and a waterfall in relation to Prawn abundance. *Inter Journal of Sustainable Dev,* 4(6): 31-38

Osagie, C. (2012). Aquaculture as Path to Thriving Agriculture. Acessed online 5th October 2012 from http://www.thisdaylive.com/articles/aquaculture-as-path-to-thriving-agriculture/124614/

Oyekanmi FB, Omoniyi IT and **Akegbejo-Samsons Y** (2017) Gut Contents and Feeding Pattern of *Macrobrachium vollenhovenii* (HERKLOTS, 1857) and *Caridina africana* (Kingsley, 1882) at

Asejire Lake and Erin-Ijesa waterfalls Southwest Nigeria. *Madridge J Aquac Res Dev.* 2017; 1(1): 18-23.

Payne I. (2000). The changing role of fisheries in development policy. Natural Resource Perspectives, ODI/DFID. 2000

Tacon AGJ (2001). Increasing the Contribution of Aquaculture for Food Security and Poverty Alleviation. In: A. Tacon (ed) Aquaculture in third Millenium. Technical Proceeding of the Conference on Aquaculture in the third Millenium. Bangkok, Thailand, 20-25 February 2000. NACA, FAO, Rome. pp. 67-71.

Tobor, JG., Okpanefe, MO., Oladoye, JO., Ekwemalor, AI., Oladipo, O (1977) Fishery statistical survey report of Nigeria (1975-1976)NIOMR, Lagos. 45p

WACA, (2019) West African Coastal Area Management Program. www.wacaprogram.org/country/nigeria

Waite R, Beveridge M, Brummett RE, Castine S, Chaiyawannakarn N, Kaushik S, Mungkung R, Nawapakpilai S, Phillips M (2014) Improving productivity and environmental performance of aquaculture, pp 1–60.https://doi.org/10.5657/FAS.2014.0001

Wikipedia (2006). Petroleum in Nigeria. Retrieved December 12, 2007 from Http://en.wikipedia.org/wiki/petroleum.

World Bank Group, (2012). Africa Program for Fisheries. Pp12

WorldFish Center. (2005). Fish and Food Security in Africa. WorldFish Center, Penang, Malaysia. Pp12.

World Fish Center. (2009). WorldFish Center Policy Brief prepared by C. Béné and S. Heck. Africa and West Asia Programme, The WorldFish Center, Cairo, Egypt. Pp

University Senate Building

ISBN: 979-978-799-676-1