24TH
ANNUAL CONFERENCE

FISON PROCEEDINGS Do not take away.

FISHERIES SOCIETY OF NIGERIA

FISON

Conference PROCEEDINGS

VOL. II

Date:
26TH - 28TH OCTOBER, 2009.

Venue:
THE FEDERAL UNIVERSITY
OF TECHNOLOGY, AKURE.

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Theme:
SUSTAINABLE FISH PRODUCTION AND FOOD SECURITY IN A GLOBAL ECONOMIC RECESSION

Venue:
THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

OCTOBER 25-28, 2009

CONFERENCE PROCEEDINGS

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OCTOBER 2009

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PREFACE

The **Fisheries Society of Nigeria (FISON)** held the 24th Annual Conference (FISON Akure 2009) hosted by the Ondo State Chapter at the Federal University of Technology, Akure between October 26 and 28, 2009; with the theme, **SUSTAINABLE FISH PRODUCTION AND FOOD SECURITY IN A GLOBAL ECONOMIC RECESSION**. The Conference theme was coined and developed based on the prevailing global economic phenomenon which commenced in 2008.

An appropriately titled keynote address was therefore delivered by Prof. (Mrs.) Esther Ademoji Adesulu, Ffs, a Professor of Fisheries at the Department of Zoology, Obafemi Awolowo University, Ile-Ife during the Opening Ceremony. The address considered and extensively discussed all the various ramifications of the global recession on fisheries in Nigeria for the attention and interest of all stakeholders in the fisheries sub-sector of the national economy.

225 abstracts were received prior to the Conference and were reviewed and edited prior to their publication in the **Conference Book of Abstracts**. During the Conference, 150 scientific papers were presented orally during the technical sessions. All the papers were compiled, peer-reviewed and editted, out of which 92 papers are published in a two-volume Book of **Conference Proceedings**.

We thank all the contributors for their efforts to submit their work in advance for this publication. We also thank our professional colleagues for editorial assistance. This publication will be circulated as widely as possible to FISON members, contributors, participants, government organizations, academic institutions, national associations of fisheries and aquaculture practitioners, regional and international fisheries organizations and other stakeholders in the fisheries industries.

The editorial team apologizes for any mistakes made while editing papers or adjusting the papers to fit the necessary formats. As the editors of this book of proceedings, we express our gratitude to all members of FISON for their contribution to the preparation of this book of proceedings. Deep gratitude goes to Ondo State Government, Federal University of Technology Akure (FUTA), and Ondo State Oil Producing Oil Commission (OSOPADEC), Akure for funding the two-volume of book of proceedings.

The Editors
October 2009

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OPENING ADDRESS DELIVERED BY DR. OLUSEGUN MIMIKO THE GOVERNOR OF ONDO STATE AT THE OPENING CEREMONY OF THE 24TH ANNUAL CONFERENCE OF THE FISHERIES SOCIETY OF NIGERIA (FISON) ON 26TH OF OCTOBER 2009 AT THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

PROTOCOL

I am highly delighted to be here today, for this opening ceremony of the 24th Ann Conference of the Fisheries Society of Nigeria (FISON). The choice of Ondo State for conference is a welcome development owing to the benefits my people would derive fro and the fact that Ondo State has the longest coastline in Nigeria where unlimited fishe resources abound. It is saying the obvious that Nigeria is amply blessed with unlim natural resources and therefore, it is inconceivable that we have to spend huge amount foreign exchange on importation of food items. Available statistics showed that in 2 alone, Nigeria imported about 740,000 tonnes of fish to supplement the local production 616,507 tonnes of the total of 1.355 million tonnes of the fish consumed. The time to reve this ugly trend which is inimical to the growth of our economy is now.

In our desire to create wealth and reduce poverty among the people, Administration has mapped out policies and developmental programmes that wo encourage both agronomy, fisheries and aquaculture. The State Government, in collaborat with Federal Government and International Agencies such as the Economic Communitie West African States (ECOWAS) has carried out a number of activities that have resulte the growth and improvement of fisheries sub-sector and invariably the economic status of fisher-folk in the coastal areas of Ondo State.

Distinguished guests, in order to improve the productivity and living standard of fishing communities, several units of outboard engines of various horsepower were rece procured for distribution to fisher folks at 30% subsidy. It is to be a revolving process a revolving fund has been set aside for this purpose. I want to enjoin the beneficiaries to m maximum utilization of these inputs so that the purpose of the programme will not defeated. Among other programmes for the promotion of aquaculture in Ondo State are:

- Establishment of Pilot Homestead Fish Ponds in each of the three Senatorial Districts adoption by fish farmers and potential fish farmers. This has translated to development of various homestead fish ponds all over the State. To address the probl of fish spoilage, a mini-processing centre is attached to the pilot projects.
- Establishment of two modern hatcheries for *Clarias* fingerling production. Each hatch has the capacity to turn out five million *Clarias* fingerlings per annum. The third hatch is under construction.

Fellow FISON members, the theme of this conference, "Sustainable Fish Product and Food Security in the Global Economic Recession" was well chosen especially at t period of economic meltdown. The challenge is thrown to you as an organization to critica address the issue of short supply of fish in the country in order to bridge the existing wide between demand and supply and conserve our foreign exchange earnings. FISON should j hands with government at various levels and shun political sentiments and made use of country's vast human resources to formulate policies that would enhance accelera aquaculture development. Nigeria has the potentials to become a huge fish market even the face of the meltdown. It is hoped that this 3-day conference, would translate to more f on the table of the citizenry thereby increasing the protein intake of the people.

Ladies and gentlemen, in furtherance of our overall objective of promoting fi production in a sustainable manner, I have the honour and privilege to declare the 24th Ann Conference of the Fisheries Society of Nigeria open to the Glory of God and for t achievement of food security in Nigeria.

Thank you and God Bless.

WELCOME ADDRESS BY THE PRESIDENT OF FISHERIES SOCIETY OF NIGERIA (FISON) AT THE 24TH ANNUAL CONFERENCE OF FISON

On behalf of Board of Trustees, the Council of Fellows, the Executive Council and the entire membership of the Fisheries Society of Nigeria (FISON), I am very happy to welcome you all to the 24th Annual Conference of the Fisheries Society of Nigeria - tagged "Akure 2009". I welcome His Excellency the Executive Governor of Ondo State, Dr. Olusegun Abayomi Mimiko and his distinguished entourage. I want to show our sincere appreciation and heartfelt gratitude to His Excellency. In a rare display of humility, consideration and understanding, he allowed us to be here, accommodated us and supported us financially. I thank you for your support to the Fisheries Society of Nigeria and for supporting me as the first female President of our great Society in over 30 years and so making this home coming a happy and glorious outing. I welcome the Vice Chancellor of the Federal University of Technology, Akure, Prof. Adebisi Balogun, Fellow Fisheries Society of Nigeria. We are most grateful for your efforts and commitments at ensuring the success of this year's annual Conference. With a deep sense of gratitude, I welcome the Board of Trustees, Council of Fellows, the Executive Council and entire membership of the Fisheries Society of Nigeria. I also welcome Presidents of Professional Associations or their representatives; All Farmers Association of Nigeria (AFAN), Nigerian Trawler Owners Association (NITOA); Nigeria Association of Fish Farmers & Aquaculturists (NAFFA), Catfish Farmers Association of Nigeria (CAFAN); Fish Breeders Association (FBA); Nigeria Union of Fishermen & Seafood Dealers (NUFAS); Association of Fish Farmers & Exporters of Nigeria (AOFFEN); Association of Fish Suppliers of Nigeria (AFISUN); etc.

This year's conference theme, "Sustainable Fish Production and Food Security in a Global Economic Recession", is most appropriate at a time when concerted global efforts are geared towards implementing the FAO's principles of Code of Conduct for Responsible Fisheries, towards sustainance of the increasing role that fisheries play in stimulating and generating economic growth, while providing a pathway out of poverty. I am aware of the global trend to stamp out Illegal, Unreported, Unregulated (IUU) fishing. The EU has further given a directive against January1, 2010 as deadline for all countries exporting their fish and fisheries products to the region, to have in place Fisheries Management structures against IUU. There are plans through Partnership for African Fisheries (PAF), an AU/NEPAD programme, to convene a conference of African Ministers to enhance the contribution of fisheries to the AU-NEPAD key objectives through good governance; sustained economic growth and development using fish as a vehicle of growth; increase sub regional, continental, political and economic integration around fisheries resources amongst others.

Why all these efforts? It is to ensure maximum benefits as property rights in fisheries resources, especially to the coastal states, such as yours- Your Excellency, and to the poor communities who are the real custodians of these resources. We are rest assured however, as a Society, having started with us this way, with an open mind and with your personality as a positive forward looking achiever, that during your tenure, you will avail yourself, the opportunity of the wealth of knowledge and professional expertise of members of the Fisheries Society of Nigeria in developing Fisheries in Ondo State, in a sustainable manner. Ondo State is well endowed with Rivers, a long coastline and very good terrain for aquaculture development, shrimp culture, artisanal and industrial fisheries, but these must be done in a responsible, sustainable and profitable way. I challenge Ondo State to develop fish farm estates, encourage commercial shrimp culture and community based cage culture along the coastline, ensure the profitable use of the Igbokoda Fishing Terminal, enhance artisanal fishermen and fishing communities, empower women in fish processing and marketing to reduce post-harvest losses, and finally, upgrade the State Department of Fisheries to a full fledged Ministry. This will guarantee maximum benefits of the State's resources as their proper rights especially to the poor. By so doing, Ondo State will be able, through fisheries, to attain sustainable food security at this time of global recession. Fish is God's giving antidote to malnutrition, kwashiorkor, poverty, unemployment, malnutrition, maternal ill health and infant mortality.

I welcome our erudite guest speaker, Prof. Mrs. E. A. Adesulu, Fellow of the Fisheries Society of Nigeria, who is a specialist in Fisheries Biology and Nutrition at the Zoology Department, Obafemi Awolowo University, Ile-Ife, and I assure you that she is in a very good position to deliver the lecture on "Sustainable Fish Production and Food Security in a Global Economic Recession". I am grateful to Ondo State Chapter of FISON under the able leadership of Mr. Pat Ajileye as well as the Chairman, Organizing Committee for the Conference, Prof. O.A. Fagbenro, Ffs, for the huge success of hosting this conference. Thank you for listening and God bless.

Deaconess Foluke O. Areola, Ffs

KEYNOTE ADDRESS DELIVERED AT THE 24TH ANNUAL CONFERENCE OF THE FISHERIES SOCIETY OF NIGERIA (FISON) ON OCTOBER 26, 2009

by

PROFESSOR (MRS) Esther Ademoji, ADESULU, Ffs
Professor of Zoology (Fisheries)
Obafemi Awolowo University, Ile-Ife, Nigeria

Protocol

As wehave been told and have seen on the posters and billboards announcing this conference, conference theme is Sustainable Fish Production and Security in a Global Economic Recession. I theme is very ideal and appropriate for this time of global economic melt down, particularly in nation, Nigeria. A short definition of economic meltdown recession is difficult to give, especially someone who is not an economist, but when we see manifestation of the following we know what are passing through is economic meltdown.

1. Low value of Naira against other currencies.
2. Fall in the value of shares of companies on the stock market.
3. Increase in prices especially the imported materials,
4. Reduction in Government spending with resulting low level of economic activities.
5. Lower earning on Agricultural products.

CAUSES OF ECONOMIC RECESSION IN NIGERIA

It is not out of place to see of the causes of economic recession in Nigeria, I have also summar this to include the following:

1. Our reliance on petrol and petroleum products, the prices which have fallen in the w market.
2. The problem in our banking sector where our 'big people' have ruined our economy w their huge loans at times without collaterals.
3. Our reliance on foreign products.
4. The selfishness of some or many of our leaders.

The list is endless. The food crisis, climate change, globalization, biotechnology, prediction of w shortages and others issues are some of the topics that have direct bearing on the lives of everyon the world whether they live in an urban or rural setting. In most developing countries, agriculture in the heart of these issues. A clear understanding of the current trends in the world economic climatic conditions is essential for the people who have a stake or more to hold in agriculture a levels: investors, traders, decision makers, entrepreneurs, scientists, processors, marketers etc.

Nigeria primarily produces a lot of raw materials such as crude oil, cocoa, rubber, pea palm oil, maize, rise, sorghum, millet, cassava (tapioca), yams, rubber, cattle, sheep, goats, timber and fish. Of all these products, Nigeria exports only cassava, cocoa and rubber on a large s 71% of the Nigerian work force works in the Agricultural sector of the economy, and yet only products are deemed exportable. The major export produce of Nigeria for the last three decade more, since the 1970s, has remained petroleum and petroleum products, making up 96% of country's export commodities. Nigeria exported a total of $55.34 billion worth of commoditie 2007. Nigeria's major exporting partners are the United States (47.4%), Brazil (10.7%) and S (7.1%). There is only one live wire that connects Nigeria to the world economy, and that is crude When Nigeria is "sound", it means the oil price is sound. The Nigerian economy is absolutely t the fluctuations of oil prices. Fish production would therefore be a welcomed savior to the econo well encouraged by the government at National, State and Local Government levels.

There is therefore an urgent need to raise interest in other exportable agricultural products, su fish for which Nigerian spends a huge foreign exchange to import every year. Local farmers coul encouraged to carry out integrated agriculture instead of monoculture. The absence of mechan fish farming is largely responsible for the low fish production in Nigeria. This is bec mechanization required higher funding. Culture fisheries is also preferable to capture fish because most of our rivers, lakes (both natural and man-made) are already overfished. We don't allow young fish to contribute to the harvest of the water before killing them. Insight into the va

scientific efforts from the researchers should motivate the government in assisting farmers and reduce poverty levels in Nigeria. It could also serve as political solution to youth unrest through employment in Fish ventures which have been found to be profitable and reliable if well managed.

Knowledge is power, and agriculture is no exception. Those who are involved in agriculture in all levels require adequate information of the operating world conditions to direct their production goals. The main job of the farmer is produce food but he must also be business-like in his approach i.e. following the trend of all factors that could affect his production and sale. The farmer does not operate in isolation but have some environmental and geographical factors that affect his performance.

Food shortages, soaring food costs, fall/decline in oil prices and a global economic recession were the main features of 2008. With the global population set to rise to 9 billion in 2009, there is an urgent need to increase production in fish. Such needed increase could be hampered by reduction in cash availability required in the several stages of fish production. It is therefore imperative that the theme of this 24th FISON Conference 'fish production and security under recessional economy' is geared towards increasing fish production in Nigeria. The conference would therefore explore the effects of the economic recession both on agriculture and on fish production in particular.

To the Nigerian government, my recommendations are:

i. Government should assist with the procurement of soft loans.
ii. The material in the fisheries sector should be heavily subsidized. These materials include, hathery equipments, fish feeds, fishing materials/gears, materials for hypophysation, drugs and antibiotics for fish, freezing materials and vitamin/ mineral premixes.
iii. Dedicated Departments of Fisheries and Aquaculture should be created instead lumping it with other unrelated disciplines
iv. Fisheries should be included in syllabus/curriculum from the secondary schools so that we can catch them young. Some of these ones may never go beyond secondary school education, but may become renowned fish farmers.

There are questions, the answers to which we will receive from this conference:

1. How are the scientists, farmers and other stakeholders responding or coping with economic recession?
2. What are the ways that fish production would alleviate the attendant poverty from the recession?
3. What are the ways out for farmers? Are there value added approaches, gender sensitive plans, preservation and processing methods, improved extension n works, production enhancing techniques that would boost agriculture/fish production in the country?
4. What are the incentives offered by the 3-tiers of the Nigerian Government to the jobless in order to embrace fish production activities?

These and other questions would be answered from different angles during presentations of several scientific works carried out in several states of the country.

I therefore enjoin everybody to be partaker and beneficiaries of the research findings that would boost fish production under the economic recession and give Nigeria security in fish supply and employment opportunities.

Thank you for listening.

COMMUNIQUE OF THE 24TH ANNUAL GENERAL MEETING OF FISON HELD AT THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE, NIGERIA. OCTOBER 26-28, 2009

THEME: Sustainable Fish Production and Food Security in a Global Economic Recession

OPENING CEREMONY

The following underlisted dignitaries were present at the opening ceremony on 26th October, 2009:

1. The Governor of Ondo State – Dr. Olusegun Miniko ably represented by Alhaji A. Olanusi;
2. Commissioner of Agriculture in Ondo State represented by Mrs. Mosun Adesuyi – the Permanent Secretary of Ondo State, Ministry of Agriculture;
3. The Vice-Chancellor of FUTA – Prof. Adebici M. Balogun Ffs;
4. Deputy Vice-Chancellor (Development) of FUTA
5. The Registrar of FUTA;
6. National President, FISON – Deaconess M. Ariola;
7. Chairman, Ondo State Chapter of FISON – Mr. Pat Ajileye;
8. Keynote Speaker – Professor (Mrs.) B.A. Adesulu, Ffs;
9. Chairman, LOC – Professor Dapo Fagbenro, Ffs;
10. Ondo State Cultural Group;
11. Fellows of FISON
12. Other participants and Students

The opening prayer was said by Professor (Pastor) T.A. Afolayan at 12.35 pm. Speeches were made by National President of FISON, Vice-Chancellor of FUTA and then the Ondo State Governor. This was followed by the keynote speaker – Professor (Mrs.) E.A. Adesulu. The President of FISON Deaconess Ariola remarked that she was the first female president of FISON in the last thirty years and that Professor Adebisi Balogun is the first professional fisheries Vice-Chancellor in Nigeria. She advised members of the Society to be more dedicated and focused towards the achievement and development of the Society's goals and objectives.

The Vice-Chancellor noted that all the 30 programmes of the University (FUTA) are fully accredited. He called for collaborative research and linkages between research institutions and the Universities. The Governor said that the choice of Ondo State as the venue for FISON "Akure 2009" is a right one bearing in mind that Ondo State has the largest coastline in Nigeria. He implored FISON to join hands with the Ondo State Government to formulate programmes and policies associated with aquaculture development.

The keynote address was given by Prof. (Mrs.) E.A. Adesulu. She focused on the issue of economic recession with emphasis on the dependence of the Nigerian economy in petroleum as the base of the nation's economic problems. She recommended among others that fisheries be given a separate ministry instead of lumping it up under agriculture for effective delivery of services. Also, there is the need to include fisheries in secondary school educational curriculum so as to catch them young. Mr. Pat Ajileye gave the vote of thanks before the keynote address was given

TECHNICAL SESSIONS

There were three Technicals sessions in which over 100 powerpoint presentations were made, which cut across various topical issues covering different areas of fisheries and aquaculture. The following recommendations were made based on the various presentations made during these sessions:

1. There is need to 'marry' research with development;
2. The communiqué and proceedings of this conference should be made available to the different state governments who are stakeholders in fisheries development
3. Research results should be made available to the users of such results so as to bridge the gap between researchers and end users of research results;
4. there should be collaborative research and efforts between research institutes and universities;
5. Research should be focused towards solving immediate problems of farmers.

Day III 28/10/2009

Excursion/to Idanre Hills.

LYSINE REQUIREMENT OF *Oreochromis niloticus*

OVIE, S.O. & EZE, S.
National Institute for Freshwater Fisheries Research, New Bussa

ABSTRACT

Oreochromis niloticus was reared in 54 litre glass tanks being fed with 35% crude protein diets for 56 days. A basal diet consisting intact protein from groundnut cake and guinea corn (4.56g lysine/100g protein) ,four graded levels of crystalline lysine was added to formulate diets consisting 6.87, 7.30, 7.41, 7.51g lysine/100g protein and a reference diet of intact protein from groundnut cake, guinea corn and fish meal having 5.37g lysine/100g protein was fed to six treatments in triplicate groups. The growth parameters shows there was no significant difference in the mean weight gain, specific growth rate, food conversion efficiency and protein efficiency ratio of fish fed varying levels of lysine. A maxima was obtained from the quadratic equation of food efficiency ratio against graded levels of lysine at 7.3g/100g protein which is the requirement. Carcass ash was higher with the initial fish while crude protein was highest with the the fish fed 7.3g lysine/100g protein

INTRODUCTION

Lysine has one major function in the animal body and that is for protein deposition. It is the second most limiting amino acid (Robinson and Li, 2007). Lysine helps the absorption of calcium, maintain healthy blood vessels, produce antibodies, enzymes, collagen and repairs of tissues, A typical commercial production diet formulated for tilapia or catfish contains approximately 32-40% protein (Miles and Chapman, 2008). Fish do not have a specific protein requirement but rather a definite requirement for essential amino acids that comprise proteins. Lysine is the most important amino acid, accounting for 7.2% of protein. Lysine is the first limiting essential amino acid in many protein sources used for feed and lysine rich-ingredients are often expensive. According to Fagbenro (2000) and Miles and Chapman (2008) fish feed contains the exact amount of EAA required by a fish species then the ideal protein for that species is met, and so no amino deficiency or excess. The growing fish fed such diet would use very few amino acids for energy. The amino acids would be used efficiently for maintenance, health, and synthesis of new structural proteins which would result in maximum feed efficiency and growth. NRC (1993) reported *O. niloticus* require 14g lysine/kg diet while Santiago and Lovell (1988) observed that *O. niloticus* requires 14.3g lysine/kg diet. Other species of fish studied are *O. mossanbicus* 16g lysine/kg diet; *Ictalurus punctatus* 12g lysine/kg diet; *Clarias gariepinus* 23g lysine/kg diet and *Cyprinus carpio* 22g lysine/kg diet. Encarnacao *et al.* (2004) reported increase in feed intake and growth with increasing dietary lysine level, and that efficiency of lysine utilization for body protein deposition was affected by lysine and digestible energy levels.

Pere and Oliva-Teles, (2007) also reported increased weight gain and final body weight with increased dietary lysine levels for *Scophthalmus maximus* juvenile, although they observed that voluntary food intake was not affected by dietary lysine diet. Ruchimat *et al.*(1998) observed that weight gain, feed efficiency, protein efficiency ratio and nitrogen retention increased for *Seriola quinqueradiata* with increasing levels of dietary lysine up to 1.85g/100g and remained nearly the same thereafter. According to Bureau and Encarnacao, (2006), estimates of lysine requirements for rainbow trout varied as widely (1.3- 2.9g/ 100 of diet) and that experimental design and conditions between different laboratories/experiments may be contributory (Kim *et al.*, 1992a; Wilson, 11993; Cowey, 1994; Hauler and Carter 2001a and b). NRC (1993) observed that the lysine requirements of fish range from 5.0 to 6.8% of dietary protein, the highest value being the nutritional requirements of carnivorous fish. According to Bureau and Encarnacao (2006), published estimates of lysine requirements for rainbow trout varied as widely (13-29g/kg diet). They concluded that the variations are as a result of differences in methodology and interpretations between laboratories (Kim *et al.*, 1992a; Wilson, 1993; Cowey, 1994; Hauler and Carter, 2001a & b). Bureau and Encarnacao (2006) also observed that growth rates achieved with the semi purified diets used were much lower than when practical diets were used. Adequate dietary lysine contents improve survival and growth rate and prevent erosion and deformities of fish dorsal, pectoral and ventral fin (Keembiyehetty and Gatlin III 1992). Lysine is beneficial to fish because it helps absorption of calcium, maintain healthy blood vessels, produce antibodies, enzymes, collagen and repairs of tissues, produces carnitine which helps to convert fatty acids into energy and maintain cholesterol in the blood.

MATERIALS AND METHODS

Six diets were formulated, containing 35% crude protein (Faturoti *et al.*, 1986). The diets formulated with ingredients deficient of lysine for *O. niloticus* as the whole body content is 5.3 l The diets consists of a basal diet (Diet I no added lysine), while the test diets (II, III, IV and V 10g, 30g, 50g and 70g lysine/kg of diet respectively. The reference diet was made of clu (mixture of *Pellonula afzeliusi* and *Physalia pellucida*), groundnut cake and guinea corn but no a lysine. The fixed components of all the diets were oil, premix, vitamin C and starch. Tables 1 a show the composition of the ingredients and diets, respectively. The amino acid profile of *O. nil* was used as reference dietary amino acid profile (Table 3).

Table 1: Proximate composition (g/kg) of ingredients

Ingredients	Moisture	Protein	Lipid	Crude fibre	Ash	NFE
Groundnut cake	4.85	41.02	41.30	0.70	5.65	6.48
Fishmeal	4.95	63.44	21.95	0.80	11.49	Nil
Guinea corn	6.93	11.17	17.10	1.60	2.18	61.02

Table 2: Gross composition of experimental diets (g/kg)

Ingredients	Diet I	Diet II	Diet III	Diet IV	Diet V	Diet VI
Groundnut cake	646.68	646.00	644.40	642.80	641.12	235.15
Lysine	0	10.00	30.00	50.00	70.00	0
Fish meal	-	-	-	-	-	235.15
Guinea corn	163.20	163.00	162.6	162.20	161.18	339.70
Oil	100.00	100.00	100.00	100.00	100.00	100.00
Premix	60.00	60.00	60.00	60.00	60.00	60.00
Starch	20.00	20.00	20.00	20.00	20.00	20.00
Vitamin C	10.00	10.00	10.00	10.00	10.00	10.00

Table 3: Amino acid composition (g/100 protein) of *Oreochromis niloticus*

Amino acids	Fry	Fingerlings
Lysine	5.30	7.51
Histidine	2.24	2.39
Arginine	5.01	6.04
Aspartic acid	7.85	8.19
Threonine	3.23	4.03
Serine	3.66	4.01
Glutamic acid	10.23	13.63
Proline	3.87	4.45
Glycine	4.13	7.25
Alanine	4.48	6.46
Cystine	0.79	0.71
Valine	4.10	4.80
Methionine	2.19	2.40
Isoleucine	3.49	3.99
Tyrosine	3.18	7.15
Phenylalanine	3.51	2.86
Leucine	6.25	3.77

The diets were formulated, pelleted and sun-dried for three days. The amino acid composition of diets was analyzed using Technicon TSM- 1 multiple analyzer. Two experiments were conduc using fry and fingerlings. The experiments were in factorial design and they had six treatments e replicated thrice. 540 *O. niloticus* fry (3.8-3.89g) and fingerlings (9.01-11.09g) were obtained fr the National Institute for Freshwater Fisheries Research hatchery complex and randomly distribut into eighteen 35l plastic troughs for each experiment. The fish were fed twice daily (0900 a 18.00hrs) at 3% body weight. All troughs were aerated using air pumps, cleared of feed remnants a faecal materials. Water was replaced daily to make up for that siphoned out, while compl replacement was done on every sampling day. Fish were bulk-weighed biweekly. Samples of five f were analyzed before and after the experiment for carcass composition and amino acid composit

using Technichon TSM – 1 (model DNA 0209) multiple analyzer. Statistical analysis was done using SPSS version 10. Polynomial regression curves were graphically represented for the mean weight gain Food conversion efficiencies, protein efficiency ratio and the specific growth rate. One- way Analysis of Variance (ANOVA), Student Newman Keul's (SNK) and Duncan's multiple range test was used to test for significance.

RESULTS AND DISCUSSION

The physico-chemical water parameters showed that water temperature was 28-31°C; pH 7.4; dissolved oxygen 0.5-7.8mg/l and conductivity 44 - 3100μ cm. The essential amino acid composition of the diets is presented in Table 4. Growth performance of the fry showed that there was no significant difference (P>0.05) in the mean weight gain, specific growth rate, food conversion efficiency and protein efficiency ratio of fish fed the varying diets. The fish fed 7.30g lysine/100g protein had the best growth (Table 5). The regression equation of growth parameters for mean weight gain, food conversion efficiency and protein efficiency ratio when calculated gave 5.53g lysine/ 100g protein for the point where dy/dx is zero while the maxima for specific growth rate was at 7.30g lysine /100g protein. The regression coefficients r^2 for the relationship between the growth of the fish was 0.226, 0.134, 0.248 and 0.226 for MWG, SGR, FCE and PER, respectively.

Table 4: Essential amino acid composition of diets

	Diet I	Diet II	Diet III	Diet IV	Diet V	Diet VI
Lysine	4.56	6.87	7.30	7.41	7.51	5.37
Histidine	2.32	2.19	2.32	2.38	2.57	2.38
Threonine	2.39	2.55	2.72	2.83	2.77	2.66
Arginine	4.76	5.28	4.93	5.44	5.79	4.76
Valine	3.83	3.95	4.24	4.41	4.18	4.07
Methionine	1.67	1.72	2.11	1.77	1.88	2.14
Isoleusine	3.08	3.26	2.89	2.95	3.32	3.14
Leucine	7.58	7.80	8.24	8.34	7.80	8.13
Tyrosine	3.38	3.38	3.61	3.70	3.54	3.31
Phenylalnine	5.92	4.40	4.23	4.40	4.56	4.22

Table 5: Growth performance of *O. niloticus* fed varying levels of lysine in diets

	Diet I	Diet II	Diet III	Diet IV	Diet V	Diet VI
Mean initial wt.	3.80±0.54	3.80±0.54	3.80±0.54	3.80±0.54	3.80±0.54	3.80±0.54
Mean final wt.	6.82±1.57	6.80±2.05	7.61±2.51	5.28±0.61	7.81±3.01	5.54±0.60
MWG (g)	3.02±1.57	2.99±2.07	3.81±2.51	1.48±0.61	4.01±3.01	1.74±0.60
SGR	1.10±0.27	.98±0.52	1.17±0.57	0.57±0.21	1.19±0.68	0.66±0.19
PER	8.63±4.48	8.58±5.86	10.9±7.17	4.23±1.74	11.45±8.6	4.97±1.71
FCE	0.82±0.00b	1.47±0.02a	16.33±0.27a	1.81±0.02a	1.08±0.01b	0.48±0.00a

Mean Weight Gain (MWG) = (Wt – Wo)/Wo; Specific Growth Rate (SGR) (%/day) = 100 x (ln Wt – ln Wo)/t; Feed Conversion Efficiency (FCE) = Weight gain (g)/ dry food intake; Protein Efficiency Ratio (PER) = (weight gain per fish x 100)/ N x 6.25 given per fish

O. niloticus fry have 5.3g lysine /100g protein. There was a steady increase in the growth of the fry up to 7.3g lysine/100 protein and beyond this there was a drop for the relationship between specific growth rate and the level of lysine. On using calculation method with the regression equation for the relationship between weight gain and level of lysine the requirement derived was 5.52g lysine/100g protein. This compares with NRC (1993) and Santiago and Lovell (1988) who reported 5.1g and 5.12g lysine/100g protein, respectively.

The low correlation coefficient observed for the relationship between the level of lysine and MWG, SGR, FCE and PER showed that lysine contributed only 22.6% for the building up of tissue of *O. niloticus* fry (Robinson and Li, 2007). Although, diet I did not have added lysine the response of the fish to the other four diets with added lysine were not significantly different (P>0.05) from it. This is similar to the observations made by Li and Robinson (1998) for channel catfish. In this study, it was observed that there was no outstanding difference in weight by the 4th week as reported in Cai and Burtle (1996) for channel catfish. There was no particular trend in the body weight gain even with the wide range of lysine (4.56-7.51g lysine/100g protein) fed. This does not compare well with *Seriola*

quinqqueradiata (Ruchinat *et al*., 1998) and *Scophthalmus maximus* (Peres and Oliva-Teles, 200 increase in weight as lysine level increased and leveled off at a point. *O. niloticus* fry utilized basal diet better than the reference diet indicating that they have preference for an all plant diet.

Carcass analysis showed that crude protein was highest with fish fed 7.30g lysine/ protein and lowest with fish fed the basal diet (Table 6). The lipid content was highest with fish 6.87g lysine/100g protein and lowest with fish fed 7.51g lysine/100g protein. The ash and contents of all the test fish were lower than the initial. Body protein increased above initial, it ro the highest with fish fed 30g lysine/kg and dropped. No morphological deficiency signs observed in fish fed the varying levels of lysine.

Table 6: Carcass composition (%) of *O. niloticus* fry fed varying levels of lysine

Diets	Moisture	Ash	Crude lipid	Crude fibre	Crude protein
I	81.60	1.20	4.70	0.15	12.95
II	80.00	2.33	4.10	0.10	13.25
III	74.55	2.80	3.53	0.20	18.90
IV	78.90	3.00	2.25	0.10	15.75
V	77.00	1.65	5.44	-	15.88
VI	80.35	2.20	3.00	-	14.35
Initial fish	78.69	3.88	3.80	1.28	12.32

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BODY-WEIGHT VARIATIONS IN FOUR WEEK OLD *Clarias gariepinus*

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ABSTRACT

The variation in size and weight of fry and fingerlings of *Clarias gariepinus* has been a major fac affecting the success of hatchery production of the species. It encourages cannibalism, thus reduc the overall survival. The disparity in weight and population was assessed to determine the necessity sorting as a reliable method of controlling size disparity and mortality in hatchery production. Tw week-old fry with average weight of 15mg and length range of 0.8-0.9cm were randomly sampled a stocked at 200 fry/litre in 30 litre circular tanks. The fish were fed for four weeks on 45% cru protein diet, *ad libitum*. At the end of four weeks, there were three groups; large, medium and sma with mean weight of 4.02g, 1.24g and 0.17g, respectively. The cumulative mean weight was 1.8 population ratio was 1:8:10 for large, medium and small, respectively.

INTRODUCTION

The African Catfish genus *Clarias* (Scopoli, 1777) has a widespread distribution and is found Africa and South East Asia. Some species are of great economic importance both in fisheries a aquaculture. *Clarias gariepinus* (Burchell 1822) is a highly valued commercial fish widely cultured Nigeria and has been cultured at subsistence level from fingerlings sourced from the wild (Sydenha 1997). The development of a reliable method for the production of *C. gariepinus* fingerlings was on of the priorities of aquaculture research in Africa and the success in intensive fingerling productio today is based on such works. Feeding of the larvae, fry and fingerlings of the catfish have been mo studied and may influence growth and survival of the fish. However, some technically related issu like competition, cannibalism and size disparity are still lingering culture problems (Viveen *et a* 1985, Jansen 1985, de Graaf *et al* 1995). The growth of fry and fingerlings of *C. gariepinus* dependent on the quality and quantity of the feed and percentage of body weight, which ofte decreases as fish size increases. Different groups of the same cohort can be identified in hatcher operation consisting of smaller size fingerlings which are more in number than the bigger one (Janssen,1985). This size disparity encourages cannibalism between the two groups as the bigger siz prey on the small ones. Other biological factors such as social dominance, territorial hierarchy an consequently higher relative aggression could result in reduction of survival rate considerabl (Janssen 1985a, 1985b; de Graaf *et al* 1995). This paper evaluates the population ratio of the variou size groups.

MATERIALS AND METHODS

Two weeks old fry (15mg and 80-90mm) were randomly sampled and stocked in 30 litres circula plastic tanks with two replicates. The fry was stocked at 200 fry/litre and fed for 4 weeks on 45% protein diet, *ad-libitum* three times daily with daily water exchange. pH and temperature were monitored using electronic pH and temperature using electronic pH and temperature meter, model pH – 009 {III} with temperature range of 0-50°C resolution and accuracy of ±0.1pH = ±1.0°C while ammonia value was estimated from temperature ammonia monogram (Trussel 1972); Emerson *et al* 1975;). The experimental set up was aerated using model Hp – 116; 30A SUN-SUN aerator. Data were subjected to linear regression analysis.

RESULTS

The weight range of the harvested fingerlings was 2.1-8.3g of large, 0.7-2.0g for medium and 0.1-0.7g for small. The mean weights were 4.02g, 1.24g and 0.17g while R^2 was 0.8676, 0.9564 and 0.8125 respectively (Fig.1). The cumulative average weight was 1.8g. The population ratio of the fingerlings was 1: 8: 10 for large, medium and small respectively, while survival was 30%. Water quality monitored showed that pH was 6.0-7.0 while temperature range was 27-30°C with estimated ammonia valued at 0.0654-0.7991.

DISCUSSION

The result showed a wide variation in the weight of the *C. gariepinus* from 0.1-8.3g with an average weight of 1.8g. This average weight is also considered low. Although, de Graaf, 1995 observed a variation in the weight, a weight range of 2-3g in five weeks old fingerling in earthen nursery ponds was reported. The difference in these findings might be due to variation in stocking rate and management practices such as feed and water holding facilities. The stocking rate is a major factor affecting growth rate in fish. Sahoo *et al* (2000) observed that increasing the stock density decreases the total weight, specific growth rate and % weight gain of *Clarias* larvae. Although three groups of fingerlings, large, medium and small were reported in this work, Ayinla and Nwadukwe (1988) and Adebayo *et al* (2001) observed four different sizes of fingerlings obtained from the same parent stock at every spawning exercise of *C gariepinus* and reported that increasing the brood stock weight resulted in a higher percentage of fast growers. They opined that the significance of size variation in a population of catfish species with high cannibalistic tendency is the attendant adverse effect on the yield. It can therefore be inferred that climatic conditions play significant roles in the survival and production of catfish seed. The medium size (R^2 =0.9564) would be more economical to sell considering the ratio and total biomass.

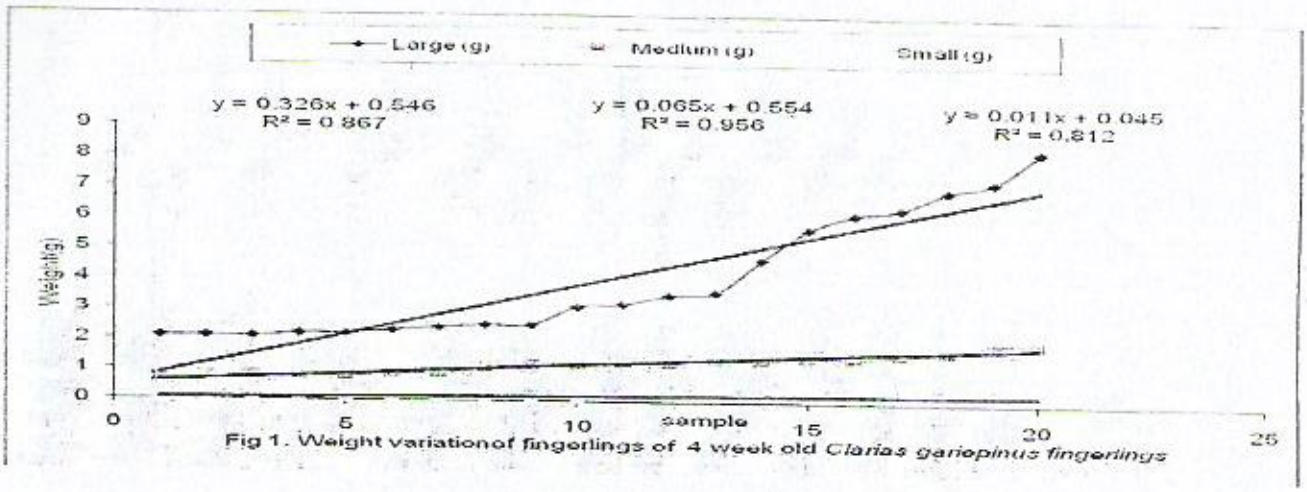

Fig 1. Weight variationof fingerlings of 4 week old *Clarias gariepinus fingerlings*

The disparity in weight encouraged cannibalism, thus leading to 30% survival. It becomes necessary therefore that early sorting after the second week of hatching is necessary to reduce mortality through cannibalism (Viveen *et al* 1985, de Graff *et al* 1989). Feeding difference size groups of the same cohort can affect production as bigger sizes suppress smaller ones due to social dominance, territorial hierarchy and aggression. The success of intensive fingerling production either in water recirculation system or flow-through requires high stocking density with sizeable fingerlings hence early sorting should start from the second week coupled with adequate feeding regime.

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EFFECTS OF BAIT TYPES ON FISH CONGREGATION AND CATCH EFFICIENCY OF CASTNET IN LAKE KAINJI

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ABSRACT
The effect of baits, rice bran (*Oryza sativa* L.) and corn bran (*Zea mays* L.) on fish aggregation and catch efficiency of castnet in Lake Kainji was conducted. 25.4mm stretched mesh size multifilament (PA) nylon net was used for the construction of castnet. The experiment was Complete Randomized Design (CRD) with three replications for nineteen consecutive fishing days. Three treatments were employed; castnetting after baiting with rice bran, with corn-bran, and castneting without bait (control). Thirteen fish species were caught from eight families. The number of fish caught was 336, of which 48.5 and 27.1% were caught with corn bran and without bait while castnetting with rice bran recorded the least (24.4%). The biomass of fish caught was 4627.7g (4.6kg) of which the highest percentages 51.4 and 28.6% followed same trend as that of number of fish caught. Comparison of the overall number and biomass of fish capture indicated that *Tilapia zillii* ranked highest, followed by *Citharinus citharus* and *Hydrocynus forskalii*.

INTRODUCTION
Castnet fishing is regarded as a traditional method of catching fish that has been used since antiquity. The most widely used artisanal fishing gears in Nigerian freshwater and brackish water as well as coastal waters, are gillnets and castnets (FAO, 1969). Castnet are conical falling nets with lead (Pb) weights attached at regular intervals along the perimeter of the cone (Udolisa and Solarin, 1979). It is an active fishing gear; that is it catch fish instantly. Hayes *et al.* (1996) reported that a light or bait is often used to attract the target fish into an area within the castnet's range. Fishing baits lures and attraction devices, are often incorporated into some fishing gears in order to improve their efficiency such fishing gears include handlines, longlines, trolling and traps etc (Ahmed *et al*, 2005). Baits may include rotten meat, dead or live fish, palm nuts or corn bran depending on the feeding and behavioral characteristics of the target fish species. Castnet fishery is the next most damaging fishing method to juvenile fish after beach seines (du Feu and Abiodun, 1999). It caught 34% of the total tilapines, 24% *Citharinus* and 19% of all *Labeo,* at a mean size upto 50% less than gillnets in the case of *Citharinus*. This study assessed the effects of two baits rice bran (*Oryza sativa* L.) and corn bran (*Zea mays* L.) and, without baits on the efficiency of castnet in Lake Kainji.

MATERIALS AND METHODS
The experiment was conducted in the lower basin of Lake Kainji about 6.5 km away from the Federal College of Freshwater Fisheries Technology, New Bussa, Niger State. The description of study area is adequately made in Ahmed *et al*, (2006). The castnet construction was followed by the same method that was used by Udolisa *et al.* (1994) and Udolisa and Solarin (1979). Two types of baits were used corn bran and rice bran and casneting without bait was used as control. A net was cast, a waiting period of five minutes was observed to allow the weight to settle to the bottom of the sampling areas. The experiment was Complete Randomized Design (CRD) with three replications for three nineteen consecutive fishing days. The fish caught were packed in separate labelled container for each treatment. Data were collected on species, number, length (cm) using metric ruler and weight (g) using Ohaus compact scale model CS200 of 200g capacity for each fish caught and recorded according to respective treatments. The fish species were identified following the description of Olaosabikan and Raji (2004). Species diversity index (SDI) was computed following Ahmed *et al*, (2006) modified method.

RESULTS AND DISCUSSION
Types of fish species caught by castnet using different baits
The types of fish species captured comprise thirteen species belonging to eight fish families as shown in Table 1. The fish species diversity index showed that castnetting with corn bran had the highest value of 0.92, while castnetting without bait recorded 0.77 and with rice bran 0.69. Cichlidae family was represented by five species, Characidae with two species and the rest were represented by only

one species each. Baits, lures or attraction devices are often incorporated into some fish
morder to improve their efficiency (Ahmed *et al*. 2005). Fish species that are dispersed o
range area can be congregated or concentrated into a smaller area where an appropriate fi
can be operated to get them. Congregation of fish before harvest had been reported u
methods that are economical and environmentally friendly (Udolisa and Solalrin, 1979; S
Kusemiju, 2003). The fish specis caught are from eight families, this shows that castnet is a
ishing gear for encountering fish species of diverse feeding and behavioral characteristics.

Number and percentages of fish caught by castnet using different baits

Tble 1 shows the number and percentages of fish caught with respect to the different t
(bits). The total number of fish caught was 336, of which 48.5 and 27.1% were caught in
wh corn bran and castnetting without bait (control) respectively, while the least number (24
recorded in castnetting with rice bran. The findings in the present study show low ca
compared to that of Udolisa and Solarin (1979) at Ikorodu beach in the Lagos Lagoon, *Tilap*
caught in large number about 5-10kg by spreading gari (processed Cassava-*Mainhot uti*
marked spots and castnets are thrown over the area. The reason for the low catch in the stud
already been reported by Seisay and du Feu (1997) who observed a reduction in mean si
species and changes in species compositions due t o both requirement and ecosystem over fi

Table : Types, number and percentages of various fish species caught by Castnet using
baits.

Family	Species	BAITS						Ov
		Corn bran		Rice bran		Without bait		
		No	%	No	%	No	%	Tota
Characidae	*H. forskalii*	20	12.3	17	20.7	15	16.5	5
	Alestes baremose	1	0.6	3	3.7	4	4.4	8
Cichlidae	*H. bimaculatus*	4	2.5	2	2.4	1	1.1	
	H. fasciatus	13	7.9	8	9.8	6	6.6	2
	Sarotherodon galilaeus	7	4.3	5	6.1	1	1.1	13
	Oreochromis niloticus	14	8.6	9	11.0	10	10.9	33
	T. zillii.	52	31.9	30	36.6	17	18.7	99
Citharinidae	*C. citharus*	17	10.4	-	-	35	38.5	5
Clarotcidae	*C. nigrodigitatus*	19	11.7	7	8.5	1	1.1	2
Cyprinidae	*Labeo coubie*	3	1.8	-	-	1	1.1	4
Distichodontidae	*Distichodus rostratus*	-	-	1	1.2	-	-	1
Mochokidae	*S. membranaceus*	6	3.7	-	-	-	-	6
Mormyridae	*M. budgeti*	7	4.3	-	-	-	-	7
Total number of fish caught		163	100	82	100	91	100	336
Relative Percentage		48.5		24.4		27.1		
Total species caught		12		9		10		
Species Diversity Index (SDI)		0.92		0.69		0.77		

Comparison of the overall number of fish caught shows that *T. zillii* contributed the
percentage, of 29.5% next by *C. citharus* 15.5%. Moreover, the dominant fish in the ca
castnet with corn bran was *T. zillii* that contributed 31.9%. In castnetting without bait C
accounted for 38.5% while in fish entice with rice bran *T. zillii* accounted for 36.6% ranked
this species was *H. forskalii*.

Biomass and percentages of fish species caught by castnet using different baits

The biomass of fish caught by castnetting using different baits is shown in Table 2. The total weight was 4627.7g (4.6kg) of which 51.4 and 28.6% was captured in castnet baited with corn bran and without bait (control) while castnetting with rice bran recorded the least (20%). *T. zillii, C. citharus*, and *H. forskalii* contributed 25.4, 21.3 and 14.2% of the overall weight of fish caught. Comparison of the overall weight of the fish caught shows that fish entice with corn bran *T. zillii* recorded for 29.3%, followed *by C. citharus* (15.6%). In castnetting with rice bran *T. zillii* accounted for 30.7% followed by *H. forskalii* while in castnetting without bait (control) *C. citharus* contributed 46.4%. The species caught was generally low, this might be due to overexploitation of the fisheries resources in the lake as a result of influx of fishermen and the use of undersized mesh.

Table 2: Biomass and percentages of various fish species caught by castnet using different bait types.

Species	Baits							
	Corn bran		Rice bran		Without bait		Overall catch	
	Wt (g)	%	Wt (g)	%	Wt (g)	%	Total Wt (g)	%
H. forskalii	224.0	9.4	182.2	19.6	253.2	19.1	659.5	14.2
Alestes baremose	25.1	1.1	58.9	6.4	46.8	3.5	130.8	2.8
H. bimaculatus	30	1.3	22.7	2.4	8.5	0.6	61.2	1.3
H. fasciatus	123.2	5.2	130.7	14.1	61	4.6	314.9	6.8
Sarotherodon galilaeus	89.1	3.7	46.8	5.0	32.5	2.5	168.9	3.6
Oreochromis niloticus	223.2	9.4	97.2	10.5	98.7	7.4	418.9	9.1
T. zillii	696.1	29.3	285	30.7	195.6	14.8	1176.8	25.4
C. citharus	371.6	16.6	-	-	614.6	46.4	986.2	21.3
C. nigrodigitatus	310.8	13.1	89.4	9.6	8.3	0.6	408.5	8.8
Labeo coubie	20.5	0.9	-	-	4.7	0.4	25.2	0.5
Distichodus rostratus	-	-	14.5	1.6	-	-	14.5	0.3
S. membranaceus	143.3	6.0	-	-	-	-	143.3	3.1
M. budgeti	119.6	5.0	-	-	-	-	119.6	2.6
Total wt. of fish caught	2376.5	100	927.4	100	1323.8	100	4627.7	100
Relative %	51.4		20.0		28.6			

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GENETIC IMPROVEMENT OF TILAPIA: CHALLENGES AND PROSPECTS IN NIGERIA

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ABSTRACT
The contribution of tilapia aquaculture in Nigeria to world output is negligible due to stunting, poor market value among others. This paper evaluates the aquacultural credentials of tilapia, some genetic improvement technology in cultured tilapia, namely, ploidy, hormonal sex reversal, transgenic, hybridization, and the necessity of Genetic Improvement in accelerating tilapia production in Nigeria. Investigation reveals the presence of *O. niloticus* with the highest growth performance index (ϕ^1 3.11) for Lake Kanji which indicates high growth potential in suitable culture environment and could serve as a good starting point for genetic development. The presence of "wesafu", an ecotype cichlid, endemic to Epe lagoon, Lagos, which grows to 1500g in the wild, appears to be an excellent candidate for genetic improvement of a commercial strain for the growing aquaculture industry. Tilapia Genetic improvement in Nigeria is faced with a number of setbacks. This includes short- term, scattered and disjointed funding, inadequate genetic research facilities, ecological risk, inadequate skilled manpower and poor documentation of tilapia genetic resources among others. Considering the growing importance of tilapia culture, the need to document, conserve, evaluate and utilize tilapia genetic resources is highlighted to enhance the success of food security in Nigeria.

INTRODUCTION
Tilapia is widely recognized as one of the most popular species for culture in a wide range of aquaculture systems worldwide (Beardmore *et al*, 2001). It is one of the most productive and internationally traded fish in the world (Fitzsimmons, 2007). Tilapia has some aquacultural characteristics which include high tolerance to poor water quality, market acceptance, ease of propagation, efficient utilization of diets high in plant protein and resistance to diseases (Jamu, 2001. Culturable tilapia in Nigeria includes *Sarotherodon galileaus, Tilapia zilli, T. guineensis, Sarotherodon melanotheron,* and *Oreochromis niloticus*. However *O. niloticus* appears to be more popular among fish farmers. Globally it accounts for 60% of the world's production of tilapia by weight (Fagbenro, 2002). The Tilapia natural genetic resources are restricted to Africa but the culture industry is predominant in Asia. The Genetic Improvement of Farmed Tilapia (GIFT) project has carried out numerous work in Asia and Africa to establish base population from which genetically improved tilapia strain for farming could be developed (Gupta and Acosta, 2004). In Nigeria application of genetics in fish farming is relatively of recent origin

PRODUCTION AND CONSUMPTION OF TILAPIA IN NIGERIA
The contribution of Africa and Nigeria's tilapia aquaculture to the world output is still at low ebb despite the potential and available resources, the major setback being uncontrolled reproduction in ponds resulting in stunting and low market value (Bombatta *et al*, 2005 and Beardmore *et al,* 2001). Considering Nigeria's population growth, the gap between demand and supply for fish, and tilapia credentials as a good candidate for aquaculture, it is imperative for Nigeria to invest in the development of tilapia culture. Musa *et al* (2005)in a survey carried out in Lagos, Oyo and Ogun states, on the production and economics of tilapia observed that tilapia culture is restricted to extensive and semi-intensive systems only. The economics (capital and operating cost) and ease of culture are perceived to be low and favourable. Consumer preference is driven by the external and internal appearance, mild flavour, texture, freshness and more importantly size. The demand for tilapia in Nigeria is high and fish farms lack the technical skill required to produce favoured size (300g and above). Afolabi *et al* (2000) and Adesulu (2000) had earlier reported that large sizes of tilapia are sold at higher prices than smaller ones of the same weight.

GENETIC IMPROVEMENT OF CULTURED FISH
Agricultural production is presently enhanced through genetic improvement of germplasm leading to a lot of improved varieties. Similarly, aquaculture is increasing its genetic technologies so as to increase production and assist in Fisheries management (Aluko and Olufeagba, 2002). Genetic analysis of natural populations has revealed unique stocks and genetic diversity that were previously unknown. Manipulation of the genome of aquatic species through selective breeding , hybridization, chromosomal manipulation ,sex reversal and gene transfer can now produce fish that are highly

productive which are genetically different from the parent stocks. These technologies are complicating the very definition of 'species'. Terms such as genetically or living modified organism (GMO or LMO) are freely being used to describe products of these technologies. Waple (1991) defined genetically modified organism as organism whose genetic characteristics are changed purposely or otherwise by any captive breeding, selection and genetic management. While these genetically modified fish are being used to increase production in aquaculture sector it also constitutes one of the most significant threat to biological aquatic diversity (Aluko and Olufeagba (2000). Thus these human interventions have made aquatic environments vulnerable to damage. Moreover, the product of these technologies may escape from adjacent waters and beyond, sometimes across natural boundaries (Waple, 1991).

GENETIC IMPROVEMENT TECHNOLOGY IN FISHES

There are a number of genetic improvement technologies to increase production which include polyploidy, hormonal sex reversal, transgenic, inter-specific hybridization among others. Polyploidy can be induced directly or indirectly. Direct induction of triploid typically involves treating the egg with temperature (cold or heat shock) or pressure shock shortly after fertilization, to induce the retention of the second polar body (Aluko and Olufeagba,2002). Such fish have two maternal chromosomes set and show good viability, the author stressed. The alternative approach of inducing triploidy using tetraploid parents is attractive because it avoided the need to apply potentially damaging treatments to fertilized eggs (Meyer and Hershberger,1997). Although tetraploid *Clarias anguillaris* has been induced at Nigeria Institute For Freshwater Research(NIFFRI) Nigeria , the tetraploid fish consistently showed poor viability at least in the initial generation after induction and induction of tetraploidy seemed more difficult than triploidy (Aluko and Olufeagba,2002). Another demerit of using tetraploid to induce triploid was the poor fertility of tetraploid males when crossed with diploid females. This was because the tetraploid's large sperm made it difficult to pass through the micropile of the egg, the author reported.

TRANSGENICS: In recent years, gene transfer has gained popularity as a very active area of fish genetic research as a result of considerable interest in transgenic technology. The principal technique of transferring gene into fish egg is by microinjection (Aluko and Olufeagba, 2002).The author further stated that cloned DNA sequences are injected into the eggs shortly after fertilization. Transfer of gene can then be monitored by the presence of foreign DNA in the progeny. Alternative to microinjection include electroporation of DNA into the eggs shortly after fertilization and the transfer of DNA in the sperm itself. On the growth of transgenic fish, Rahman and Maclean (1997) observed transgenic tilapia to have grown three times more than their non- transgenic siblings.

HORMONAL SEX REVERSAL IN TILAPIA: The treatment of sexually undifferentiated fry by administration of hormones or hormone analogues has been shown to work well under careful controlled condition (Ronald and Thomas, 2000). The common mode of administration is via dietary supplementation with the androgen first dissolved in alcohol prior to mixing with the diet (Beardmore et al, 2001). This method is easy to apply but has a number of disadvantages. The hormone can degrade during storage and lack of uniformity of the hormone in the feed as well as hierarchies among fish can cause significant variability in dose among treated individual making estimate of amount ingested difficult. Excessive doses of some hormone can lead to sterility or paradoxical feminization following aromatization of androgen to oestrogen the author stressed (Ronald and Popma, 2000). Commonly successful hormone treatment (in which the phenotype sex is reversed) produced viable fertile fish although sub-optimal treatment can result in intersexes which have been reported in many species especially in the family poecilidae (Beardmore *et al*, 2001). Furthermore, the author reported that there were occasional post-treatment impacts upon behaviour, survival and growth in the sex reversed fish other than those associated with normal sexual dimorphism. While sex reversal may be used to produce large number of the desired phenotype in ornamental fish, it is only in Nile tilapia *niloticus* that hormonal sex reversal is routinely used in commercial production of monosex males. In tilapia, sex reversal involves administration of the male steroid (17α methyl testosterone) to recently hatched fry so that the undifferentiated gonadal tissue of genetic female develops inter-testicular tissue, producing individuals that grow and function reproductively as males (Ronald and Popma, 2000).The procedure must be initiated before the female gonadal tissue start to differentiate into ovarian tissue which at an average temperature of 24-28°C occurs in *O.niloticus* at a size and age

only 11-14 mm and 3-4 weeks after hatching. Fry were fed diets containing 30-50mg 17α methyl testosterone/kg of feed for 3-4 weeks.

INTERSPECIFIC HYBRIDIZATION: Hybridization of two species may result in monosex population. The phenomenon of all male or nearly all male hybrids has been observed in sun fishes but best known examples are in tilapia (Little, 2001). The bulk of research basis and commercial potential of monosex hybrids has been carried out in tilapia. Many Oreochromis hybrids are characterized by a majority of males. The occurrence of all male broods is relatively common and this is where the major interest of hybridization lies (Lao and Chinwei, 2001). Beardmore *et al.* (2001) summarized the result of inter-specific hybridization in tilapia. A high percentage (98-100%) of males was reported from *O. niloticus X O. variabilis, O. nigra X O. urolepis, O. vulcani X O. hornrum* and *O. vulcani X O. aureus* crosses. The *O. niloticus X O. hornorum* cross was not used commercially because of low and inconsistent fry production and the appearance of the hybrid which was not attractive to consumers (Jamu, 2001). Table 1 summarises hybridization of some tilapia species that produces monosex male progeny.

Table 1: Hybridization of some tilapia species producing monosex male progeny.

FEMALE PARENT	MALE PARENT	MALE PROGENY NOTE
O. niloticus	*O.aureus*	Applied commercially but result inconsistent
O. niloticus	*O. macrochir*	
O. niloticus	*O. hornorum*	Majority of brood are all male
O. niloticus	*O. variabilis*	
O. mossambicus	*O. hornorum*	Some commercial application
O. mossambicus	*O. aureus*	
O. spirulus niger	*O.macrochir*	All progeny monosex
O. spirulus niger	*O.hornorum*	All progeny monosex
O.aureus	*O.hornorum*	All progeny monosex
T. zillii	*O andersonii*	All progeny monosex

SOURCE: Beardmore *et al,* 2001

O. niloticus widely accepted as the best commercial species for the majority of freshwater aquaculture environments, the dilution of its genome with gene from other species tend to reduce performance potential in aquaculture compared to pure *O. niloticus* (Beardmore *et al,* 2001).

GENETIC IMPROVEMENT OF FARMED TILAPIA (GIFT)

The project for genetic improvement of farmed tilapia(GIFT) was undertaken in Philippines (1988-1997) to develop methods for producing improved fish breed using Nile tilapia (*O . niloticus*) as a model species (Gupta and Acosta, 2004). Studies undertaken in the early 80s by the World Fish Centre and its nation research partners in Philippines confirmed the poor growth of fish as one of the major constraints to tilapia aquaculture (Pullin, 1985). *O. niloticus* was chosen because of its short generation time of about 6 months and its suitability for investigation of the application of genetics in Aquaculture (Eknath and Valesco, 1993). It is also an important species for many developing countries because of its many desirable traits, such as hardiness, comparatively high resistance and suitability in a wide range of farming systems (Gupta and Acosta, 2004). Consequently, the WFC, in order to establish a wide genetic base for starting genetic improvement programme , especially in view of the poor genetic status of farmed tilapia in Asia, wild *O. niloticus* population were collected from Ghana, Egypt, Kenya and Senegal, during 1988- 1999 and transferred to Philippines (Eknath, 1995). The collections were held in isolation and subjected to quarantine procedure for 3-7 months in Philippines. *O. niloticus* population used by farmers in Asia (Israel, Singapore, Taiwan and Thailand) were also gathered from Philippines , bringing together a total of eight African and Asia tilapia population for genetic improvement programme (Gupta and Acosta, 2004). The strategy followed by GIFT project in breeding experiments was a combined between- family and within-family selection. The first to sixth generation focused on growth. A second trait (frequency of spawning female) was included from the fourth generation of selection and was combined during the sixth generation selection within the source of the GIFT foundation (Gupta and Acosta, 2004). The study revealed that except for Ghana strain, the other three African strains (Senegal, Egypt and Kenya) performed as well as or better than the domesticated strains in the Philippines. In 1988 after 6 generations of selective

breeding it was observed that GIFT strain had 85% improved growth compared to non-GIFT tila (Gupta and Acosta, 2007).GIFT otherwise known as super male of ICLARM is at present farmed various countries such as Taiwan, Philippines, Thailand and Indonesia.

PROSPECTS OF GENETIC IMPROVEMENT OF TILAPIA IN NIGERIA

Despite the low tilapia production in Nigeria, the prospects of tilapia genetic improvement tremendous. A few findings (Mareau *et al*, 1986 and Bombatta *et al*, 2005 and 2006) have sho strains of tilapia in Nigeria which appear superior in growth. Essentially tilapia has a short generat time (4-6 months for *O. niloticus*) and therefore has the capacity to breed year round (Pullin, 1988) implies that any genetic gain will be rapidly obtainable. The few studies on genetic improvement aquatic species have demonstrated that the potential for achieving rapid genetic gain is in general v high (Eknath and Acota, 1998). This is due to the large genetic variability in most economica important traits, high fecundity of most tilapia and the ease with which they can be bred in captivity

Moreau et al (1986) studied O. *niloticus* from many different waters (native and introdu populations) using the growth performance index (ϕ^1). He observed that this value ranged fr 2.36- 3.11 in all populations studied. The author reported that the value of ϕ^1 for Lake Kanji Nigeria was the highest (Pullin, 1988).The author opined that the possession of a high grow performance index is probably a good indicator of high growth potential in a suitable cult environment. Table 2 illustrates the result of Mareau *et al,* (1986) in Pullin, 1988). Furthermore, th exist an ecotype cichlid, 'wesafu' endemic to Epe lagoon , Lagos (Bombatta *et al* 2005and 200 .The author reported that 'wesafu' is a highly priced fish in Lagos, Nigeria, for its tasty flesh large size of over 1,500g in the wild . He opined that this fish might have a high growth potential culture and genetic development in Nigeria.

Current research reports from Europe and America indicate hope in the horizon for vac production in transgenic tilapia (Aluko and Olufeagba, 2000).According to the report in International file of fish farmer magazine, Fish farmer (1999) there is hope for diabetic in transg tilapia. A team of scientists led by Dr Wright developing tilapia whose genetically altered produce human insulin which is different from that of human by 17 amino acids which necessit the successful transfer of the missing DNA into the tilapia. According to the author ,once the til insulin is transplanted in the diabetic faulty pancreas, daily insulin injection are no longer needed because tilapia and human are not close phylogenetically, cross transfer of disease is much less lik

Table 2: Growth Performance Index (ϕ^1) of two species of *Oreochromis* from different locations

SPECIES/SEX	Φ^1	LOCATION
Oreochromis niloticus	2.4	Lake Alacora
Oreochromis niloticus	2.62	L. Mantason
Oreochromis niloticus	2.52	L. Iasi
Oreochromis niloticus	2.44	L. Marion
Oreochromis niloticus	2.58	L. Mousa
Oreochromis niloticus	2.88	L. Albert
Oreochromis niloticus	3.11	L. Kanji
Oreochromis niloticus	3.07	L. Nassau
O.mossambicus	2.22	L.. Sibaya
O.mossambicus	2.37	L. Limpopo
O.mossambicus	2.36	Njele Dam
O.mossambicus	2.41	Winter Dam
O.mossambicus	2.56	Loskop Dam
O.mossaimbicus	2.47	Sheho Nguba Dam
O.mossambicus	2.46	Haffseesport Dam
O.mossambicus	2.67	Doomsrai Dam
O.mossambicus	2.48	Luphaphe Dam
O.mossambicus	2.80	Egypt pond
	2.71	Hong Kong

Source: Mareau et al, 1986

CHALLENGES OF GENETIC IMPROVEMENT OF TILAPIA IN NIGERIA

Tilapia is abundantly found in the freshwater system of Nigeria. However the contribution of Nigeria tilapia aquaculture to world total output is low. Table 3 illustrates tilapia production in West Africa.

Table 3: Tilapia production (mt) in West African countries.

Country	Inland fisheries Production	Tilapia Production
1.Benin	35,000.0	7,000.0
2.Burkina Faso	7,500.0	1,500.0
3.Cote d'Ivoire	1,650.0	2330.0
4.Gambia	2,500.0	500.0
5.Ghana	75,580.0	14,716.0
6.Guinea	4,000.0	800.0
7.G. Bissau	250.0	50.0
8.Liberia	4,000.0	800.0
9.Mali	111,910.	22,382.0
10.Niger	4135.0	827.0
11.Nigeria	**67,794.0**	**13,558.0**
12.Senegal	47,500.0	9,500.0
13.Sierra Leone	14,500.0	2,900.0
14 Togo	5,000.0	1,000.0
TOTAL	**389,319.0**	**60,578**

Source: Jamu D. 2001

The bulk of tilapia production in Nigeria comes from the wild (Musa *et al*,2005). Genetic improvement of tilapia in Nigeria is facing a major setback due to lack of fish genetic research facilities (Aluko and Olufeagba2000). Genetic resources are global assets. If Nigeria tilapia genetic resources are to be used to improve global tilapia production, then Nigeria Aquaculture research and development must receive commensurate support. information on genetic resources in Nigeria is lacking. It is therefore necessary to first assemble information on the fish through morphometric and biochemical characterization to facilitate tangible genetic improvement programme. A major area of great challenge in genetic improvement is the loss of genetic variability in Tilapia. The first concern is the interbreeding of domestic stock of tilapia with population in the wild. This is of greater concern to geneticist because of the potential loss of genetic diversity that might be utilized in future breeding programme. Interbreeding of tilapia has been a recurring problem in tilapia farming areas around the world (Gupta and Acosta, 2007). The solution is to be sure that individual farmers understand the need to maintain breeding control of their stock. This is the way to keep domestic fish from breeding with native or from breeding indiscriminately on the farm (Anil, 2004).

The preparatory steps of gene isolation and construction of vectors that carries the gene is costly and requires laboratory with specialized skills (Aluko and Olufeagba 2000). Furthermore, concern about the hazards associated with the escape of transgenic fish (tilapia) into the wild raises other pertinent question, such as whether the fish could readily become established and create unforeseen problem as well as public and consumer perceptions. Moreover transgenic fish individual showing the highest levels of growth enhancement exhibited dramatic growth deformity of the body, opercle and jaw (Mareau *et al* ,1986). Another area of potential conflict is that fish derived from genetic manipulation contains novel proteins not normally found in the parent. This may be allergic to some consumers (Aluko and Olufeagba,2000). Consumers may want to avoid biotechnologically derived fish for religious and ethical reasons. In addition, ecological risk is another major challenge to using genetic improvement in tilapia. Ecological risk includes possibility of heightened predation or competitive colonization by or persistence of improved fish in ecosystems outside their native range and possibly alteration of population or community dynamics.

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SURVIVAL AND RESPONSE OF *Oreochromis niloticus* TO DIFFERENT FEEDS

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ABSTRACT
The study determined the survival and the response of *Oreochromis niloticus* to different feeding compositions. 90 *Oreochromics niloticus* juveniles were fed different diets in triplicated treatments inside glass tanks. Treatment I comprised locally compounded diet; Treatment II, imported pelletized feed; and Treatment III - processed feathermeal based diet. Results showed that there was no significant differences ($P>0.05$) in the weight gain, feed intake, survival and feed conversion ratio. However, Treatment I had the highest feed intake, while treatment II had the highest weight gain and feed conversion ratio.

INTRODUCTION
One of the great advantages of tilapias for aquacultures is that they feed on a low tropic level. The members of the genus *Oreochromis* feed on algae, aquatic plant, small invertebrate, detrital material and the associated bacterial films. This provides an advantage to farmer because the fish can be reared in extensive system that depend upon the natural productivity of a water body or in intensive system that can be operated with lower cost feeds. Bowen (2001) showed that tilapia species may ingest animal material but usually doesn't constitute a significant proportion of the fish total food intake. The high cost of supplementary feed has been a source of concern to fish farmers and there is need to feed fish at lowest possible cost and ensure high conversation ratio at the same time in order to meet the need of fish species there is need to develop fish diets that will satisfy the nutritional and physiological requirement of fish species. The increasing costs have made it necessary to search for cheaper but equally efficient and readily available source as a substitute for fish meal. This study determines the response of *O. niloticus* to different types of feed - imported pelletized feed, locally compounded diet and feather meal-based diet.

MATERIALS AND METHODS
The experiment was carried out in three glass tanks, each replicated thrice, having a volume of $0.178m^3$. The tanks were washed, cleaned and filled with water to about three quarter of its volume. 90 *O. niloticus* were used for the experiments. Each of the tanks replicate contained 10 juveniles of tilapias and were randomly assigned to experimental diets treatment. Physiochemical parameters were monitored and analyzed with Bauch and Lamb field analysis kit. pH, dissolved oxygen, temperature and ammonia were analyzed. An aerator was used for effective circulation of oxygen in all the glass tanks for the fishes. Also, changing of water was done every two days by siphoning and adding new water to prevent pollution. The fish was fed with the experimental diets daily for the duration of two months. And they were fed till saturation. Treatment One (control) contained locally compounded feed (fish meal inclusion), treatment two with imported feed and Treatment Three was locally compounded feed with feather meal inclusion (14.5%).The feed was served at a fixed point in the glass tank at each feeding time and was served twice daily. Total weight of feed consumed per each feeding trial and total body weight of fish was recorded every week. Complete randomized design (CRD) method was used. The experiment consists of three treatments each with three replicates.

Table 1: Composition of experimental diets

	Diet 1 (Local feed)	Diet 3 - Feather meal-based diet
Maize	10	12
Wheat Offal	5	5
Groundnut Cake	18	18
Soya Bean	36	36
Fish Meal	20	0
Blood Meal	5	5
Spaghetti	5	5
Salt	0.25	0.25
Fish Premix	0.25	0.25
Vitamin C	0.50	0.50
Feather Meal	0	18

Table 2: Proximate analysis of experimental diets

	Diet 1 Local feed	Diet 2 Imported feed	Diet 3 Feather meal-based diet
Crude protein	44.36	45	44.56
Energy (Kcal)	2806	—	2809.7
Fiber %	3.89	1.5	4
Fat %	3.74	12	4.09
Calcium	1.35	-	0.1
Phosphorus	0.88	1.2	0.33

Weight gain, feed intake, survival rate and feed conversion ratio were measured weekly to the effect of the experimental diet on the fishes. Also data were collected and analyzed usi of variance (ANOVA).

I. Weight Gain = Final Weight – Initial Weight

II. % Mortality = $\frac{\text{Number of Stock} - \text{Number of Remnant}}{\text{Number of Stock}} \times 100$

III. Feed Conversion Ratio =Weight Gain / Feed Intake.

RESULTS AND DISCUSSION

The water temperature ranged from 24 to 30^0 C for the treatment. The P_H ranged from 6.4 the treatment. The dissolved oxygen ranged from 5.0 to 9.0 mg/l for the treatment. The av intake g/fish/week was shown in table 4.1.2 above. Fish on Treatment 1 (Local Feed) had t feed intake of 3.94g followed by T_2 and T_3 with the intake value of 3.06 and 2.38 re Statistical analysis revealed that there was no significant difference (P>0.05) in the overa feed intake of the fishes. It was noted that there was differences in the value with T3 l lowest feed intake. This may be attributed to the low palatability of the feather meal which w reported by Ayanwale (2006), who fed rabbit with feather meal based diet. There was no s difference (P>0.05) in the overall average weight gain of fishes. Fish on Treatment 2 (impo had the highest average weight gain of 3.39g per fish/week. Fish on Treatment 1 had me gain of 2.91g while fish on T3 had the lowest weight gain of 2.06g.

TABLE 3 PERCENTAGE SURVIVAL

	T_1	T_2	T_3
Initial Stocking Rate of Juvenile per Tank	30	30	30
Final Stocking Rate/Number of Juvenile per Tank	18	27	25
Percentage survival (%)	60	90	83.3

Table 3 shows the survival rate of the fishes fed in the experimental diet. Fish on Treatment highest survival rate of 28.5 followed by Treatment 2 and Treatment 3 with survival rate o 22.12 respectively while Treatment 2 had the highest % survival (Table 3). Statistical revealed that there is no significant difference (P>0.05) among the treatment mean. Fish in T 2 (imported feed) had high feed conversion ratio of 1.11 which was followed by T3 and average feed conversion ratio of 0.96 and 0.80, respectively. Statistical analysis revealed t was no significant difference (P<0.05) in the feed conversion ratio of the fishes fed experimental diets.

Table 4: Production costs of experimental diets

VARIABLE	T1	T2	T3
Duration of the study (days)	56	56	56
Number of Fish/Treatment	30	30	30
Number of Fish/Replicate	10	10	10
Cost of 1 Juvenile fish (₦)	10	10	10
Cost/Kg of feed ₦/Kg	150	350	130
Cost/g of feed	0.15	0.35	0.13
Average Feed Intake/Fish (g)	3.94	3.06	2.38
Average Weight Gain/Fish (g)	2.91	3.39	2.06
Average Feed Conversion Ratio	0.8	1.11	0.96
Total feed Intake/fish (g)	31.52	24.48	19.04
Total Cost of feeding ₦	4.73	8.57	2.48
Other Variables ₦	2	2	2
Market Price per Kg (₦)	500	500	500
Market Price per g (₦)	0.5	0.5	0.5
Average Final Weight per fish (g)	23.31	27.1	16.47
Revenue ₦	11.66	13.55	8.24
Total Cost of production	12.15	12.35	12.13
Profit (₦)	9.66	11.55	6.24

Table 4 shows the production cost of experimental diet. Treatment 2 had the highest profit of N11.55 followed Treatment 1 with N9.66 while Treatment 3 had a profit of N6.24, this is as a result of the feather meal that was used to replace fish meal. Fish growth was influenced by various physiochemical parameters and nutrient availability in the water body. The level of nutrient may vary considerably. All fish species has different level of tolerance and lethal values to various environmental conditions prevailing in the ambient water body. Temperature plays a crucial role in fish production as high temperature help in high dissolve of oxygen. Huet (1972) recommended pH of 7.0-8.0 with less fluctuation is best for Tilapia. According to Boyd (1979) natural water that contains high alkalinity support more productivity than water of lower alkalinity. Tilapias are generally hardened and have a high tolerance level for alkalinity. Feed intake of the fish were not uniform from week 1 to 8, fish in Treatment 1 had the highest feed intake than those of Treatments 2 and 3. The high feed intake may be attributed to the protein requirement by juvenile tilapia which is within the range of 30-35% crude protein (Gunasekera *et-al*-1996).The weight gain of the fish in Treatment 2 was higher than Treatments 1 and 3; the high weight gain of the fish in Treatment 2 might be attributed to the palatability and the floating nature of the feed. (NRC 1987, Pompa 1982) reported that high level of anti-nutrient can result in low consumption and high utilization; while treatment 3 had the lowest weight gain this may be attributed to the low palatability as a result of feather meal inclusion in the feed. The feed conversion ratio in Treatment 2 was higher subsequently followed by T3 and T1. The considerable FCR recorded in this study agrees with result of (Maldonado et al (1979), Villarreal (1980) and Pastastico *et-al* (1982)) that fish reared in lower volume consumed less food and convert far less efficiently spending greater energy on surfacing resulting in low growth performance and vice versa. The survival was high in this experiment but the means were not significantly different [P>0.05]. The high survival was partly attributable to the tolerable range of the physiochemical measurements.

The result of production cost showed that Treatment 2 is economical than other treatment in terms of profit gain followed by Treatment 1, while Treatment 3 is lease profit gain because of the feather meal inclusion. However, feather meal is not as profit rewarding in production of tilapia in glass tank as fish meal but the survival rate is considerable. There was no significance difference (P >0.05) in the weight gain, feed intake and feed conversion ratio of fish fed with the experimental diet.

The highest feed cost was recorded in the imported pelletized feed while the lowest cost was obs in hydrolyzed feather meal inclusion feed. However, hydrolyzed feather meal cannot be used inclusion in Tilapia feeding ration as a source of protein because it is not economical in ter production cost and also has low palatability. The result obtained with use of hydrolyzed feather as a fish meal replacer with aqua feeds for tilapia has been more controversial. However, Tacon *et a* (1983), Viola and Zohar (1984) and Davies *et al*, (1989) all reported poor growth in tilapia when fed hydrolyzed feather meal base diet. While Bishop *et-al,* (1995) reported that Hydrolysed Feather Meal could replace up to 50% and 66% of the fish meal within diet for O. niloticus fingerlings and fry with no lost of growth performance. Moreso, Tilapia can be raised in glass tank because survival rate is bearable depending on the management.

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AMINO ACID COMPOSITION OF FOUR TILAPIAS

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ABSTRACT
Adult *Tilapia zilliii, Sarotherodon galilaeus, Oreochromis aureus* and *O. niloticus* were obtained from National Institute for Freshwater Fisheries Research hatchery. They were oven dried at 60^{0}C for 50hours. The dried samples were taken for amino acid analysis using Technichon TSM – 1Ssequential Multisample Auto-Analyzer equipped with a pen recorder for drawing chromatograms. Statistical analysis of the amino acid composition showed significant difference ($P<0.01$) among species. The correlation coefficient showed very high correlation ramong the species and other sizes of *O. niloticus* (0.712-0.933)

INTRODUCTION
Oreochromis niloticus, S. galillaeus, O. aureus and *T. zillii* are commonly and widely cultured tilapia species in Nigeria. The knowledge of amino acid profile of these tilapias is useful in formulating feed for their maximum growth performance and protein deposition. Amino acids are building blocks of protein. They make up about 16% of the carcass of whole fish. According to Miles and Chapman (2007), the ideal protein in fish feed is that which provides the exact balance of amino acids needed for optimum performance and maximum growth. Miles and Chapman (2007) also stated that fish do not have a specific protein requirement but rather a definite requirement for amino acids that the use of such diet reduces the amino acids used for energy, therefore, the feed is efficiently utilized for maintenance, health and synthesis of new structural protein. Earlier studies on the lysine requirement for *O. niloticus* showed that fry and fingerlings require 7.30g and 7.14g lysine/100g protein (Ovie, in press); *O. mossambicus* 4.1g (NRC 1993) and *O. niloticus* 5.1g (NRC 1993). Other studies showed that there is a close correlation between essential amino acid of fish and essential amino acid profile of whole body tissue of the fish (Rumey and Ketola 1975; Arai, 1981; Wilson and Poe 1985; Wilson and Cowey 1985; Cowey and Tacon, 1987; Wilson and Moreau 1996). This study was carried out to ascertain the amino acid composition of four tilapias, forming a framework on which further studies on amino acid requirements of these species would be built upon.

MATERIALS AND METHODS
Adult *O. niloticus* (650g), *S. galilaeus* (300g), *O. aureus* (320g) and *T. zilliii* (120g) were obtained from National Institute for Freshwater Fisheries Research hatchery. They were oven dried at 60^{0}C for 50 hrs, allowed to cool and wrapped in polythene bags. The Technicon TSM-1 Sequential Multisample analyzer (model DNA 0209) was used in the hydrolysis of the samples. Each sample was separately defatted by inserting 10g of the sample into an extraction thimble and extracting the fat with a 2:1 chloroform/methanol mixture using a Soxlet extraction apparatus (AOAC 1980). Extraction was done in triplicates. Extraction lasted 15 hours. Defatted samples were weighed into glass ampoules and 7 ml of 6N HCL was added. Oxygen was expelled by introducing nitrogen into the ampoule to prevent oxidation of amino acids during hydrolysis. The glass ampoule was sealed with burnsen burner flame and put into an oven preset at 105± 5OC for 22 hours. The ampoule was allowed to cool before being broken open at the tip and the contents were filtered. The filtrate was evaporated to dryness to at 400C in a vacuum in a rotatory evaporator. The residue was dissolved with 5ml of acetate buffer (pH 2.0) and stored in plastic specimen bottles in a freezer. 10 ml was poaded and dispensed into the catridge of a TSM analyzer (Technicon Sequential Multisample Amino Acid Analyzer) that separated free acidic, neutral and basic amino acids of the hydrolysate into chromatograms in 76 minutes. At each peak produced by the TSM chart record (each peak represents an amino acid), the half height was measured. The area of the peak was approximated by multiplying the height of the peak by the width at half height. The norleucine equivalent (NE) for each amino acid was calculated using the formular: NE = area of norleucine peak/ area of each amino acid. A constant (S) was calculated for each amino acid in the standard mixture according to the formula: S = NE x mol. Wt x UMAA. Finally, the amount of each amino acid in the sample was calculated in g/16 g N or g/100g protein using the following formula: concentration (g/100 g protein) = NE x width at NE x S x C, where C = dilution/NH x W (nieu). Statistical analysis was carried out by using the computer package SPSS version 10 to correlate bivariates of samples

RESULTS AND DISCUSSION

Table 1 shows the amino acid composition of tilapias and previous analysis done for *O. nil* fingerlings (Dairiki *et al.*, 2007). Nine essential amino acids were available as in previous st conducted on amino acids of three species in northern Nigeria (Sadiku and Oladimeji 1 *Heterobranchus longifilis* (Ovie and Ovie 2007); *H. longifilis* and *C. anguillaris* (Eyo 1 Methionine was the lowest in proportion to other amino acids in all four tilapias. This is similar t findings of Sadiku and Oladimeji (1989), Eyo (1999) and Ovie and Ovie (2007). Glutamic acid highest in proportion to other non – essential amino in the four tilapias. This is similar to other st of this nature for Coho salmon (Arai, 1981); Cherry salmon (Ogata et al., 1983); Atlantic sa (Wilson and Cowey 1985); Channel catfish (Wilson and Poe 1985); three species of northern N (Sadiku and Oladimeji 1989); *H. longifilis* and *C. anguillaris* (Eyo, 1999); *H. longifilis* fry, finge and broodstock (Ovie and Ovie 2007). However, the quantity of glutamic acid in the tilapias is than that available in the fry and fingerlings of *H. longifilis* (Ovie and Ovie 2007; Eyo 1999); salmon (Arai, 1981); Cherry salmon (Ogata et al., 1983); Atlantic salmon (Wilson and Cowey 1 Channel catfish (Wilson and Poe 1985).

Table 1: Amino Acid Composition of tilapias (g/100g Protein)

	Adult *O. niloticus*	*S. galillaeus*	*O. aureus*	*T. zilliii*	Fingerlings *O. niloticus*	*O. niloticus* (Dairiki *et al.*, 20
Lysine	7.51	8.12	7.88	8.27	5.30	6.34
Histidine	2.39	2.59	2.71	2.71	2.24	1.55
Arginine	6.04	5.18	5.18	6.21	5.01	4.36
Aspartic acid	8.19	9.49	9.68	9.68	7.85	
Threonine	4.03	4.58	4.36	4.58	3.23	3.25
Serine	4.01	4.18	3.47	4.34	3.66	
Glutamic acid	13.63	13.93	13.18	14.09	10.23	
Proline	4.45	4.27	4.68	4.60	3.87	
Glycine	7.25	7.50	7.40	7.54	4.13	
Alanine	6.46	4.41	6.38	6.46	4.48	
Cystine	0.71	0.75	0.79	0.80	0.79	
Valine	4.80	4.74	4.68	4.91	4.10	3.50
Methionine	2.40	2.50	2.42	2.55	2.19	2.18
Isoleucine	3.99	3.93	4.00	4.12	3.49	3.22
Leucine	7.05	7.10	6.94	7.32	6.25	5.89
Tyrosine	2.86	3.17	2.85	3.17	3.18	2.65
Phenylalanine	3.77	4.11	3.94	4.28	3.51	3.32

Among the essential amino acids lysine had the highest component of the various species except fingerlings of *O. niloticus* which had leucine as highest. The non- essential amino acids has gluta acid as the highest. Methionine was the least in quantity for the essential amino acid while cystine the least for NEAA. Miles and Chapman (2007) reported that fish feed containing the exact amoun essential amino acids required by the species especially for deposition of lean body tissue, th would be no amino acid deficiency of excess. The essence of this study for Tilapia species is for f processors to formulate diets to meet the exact needs for these species. This would go a long wa reduce the operational cost and reduce the amount of nitrogen released by the fish as ammonia (M and Chapman 2007).

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AQUATIC MACROPHYTES ROLES IN NUTRIENT AND HEAVY METAL REGULATIO

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ABSTRACT
The activities of man have directly or indirectly influenced the aquatic ecosystem by increasin polluting wetlands. Water quality influences the growth of fish. The utilization of aquatic weeds the recovery of nutrients and heavy metals in polluted wetlands is a proffered management strate This paper reviews the role of aquatic macrophytes in nutrients and heavy metal sequestering.

INTRODUCTION
Aquatic macrophytes are plants growing on water, on submerged soil or on soil that is saturated w water (Agbogidi et al 2000). Aquatic plants affect water adversely by blocking canals and pump irrigation project, interfering with hydroelectric production, wasting water through evapotranspirati hindering boat traffic, increasing water borne diseases, interfering with fishing and fish culture; clogging rivers and canals so that drainage is impossible is and flood result (NAS 1976). Aqu plants play a useful role for special purposes. The extents to which aquatic plants are desirable dep on the water user. Eg., a reservoir manager wants clear water that is free of weeds, algae and ot organisms. However, conservationists encourage plant cover on watersheds and along the bank streams, lakes and ponds to control erosion and to protect water quality (Oki, 1994). Plants such water hyacinth and Salvinia in aquatic environment absorb heavy metals and excess dissolv nitrogen and phosphorus released from fertilizer washed off from farmlands and urban sewa systems, which can cause environmental pollution in the absence of effective sinks. This pap reviews the efficacy of aquatic macrophytes in nutrients and heavy metal sequestering.

USE OF AQUATIC PLANTS AS NUTRIENT SINK
Aquatic vegetation absorbs large amount of nutrients and which is an effective means of stripp nutrients from effluents or natural waters. Boyd (1970) reported that nutrients could possibly absorbed from effluents by aquatic plants prior to their release into natural water, or plants could cultivated in lakes and then harvested. A comparative study carried out by Une *et al* (1988) reveal that some plant species grow well in nutrient rich water. N, P and K levels in these species, it w found that the tissue concentration of all these elements was high (Oki *et al* 1989a). Shallo eutrophic, aquatic ecosystems stocked with macrophytes are among the most productive in the wo (Schierup, 1978). The capacity of such systems to decompose organic matter and assimilate nutri has long been recognized (Brix and Schierup, 1989). It is well known that streams, lakes, coastal are and wetlands contain a considerable self purification 'self purification' capacity (Seidel ,19 During the growing season the plants absorb and incorporate the nutrients into their own structu and function as a substrate for microorganism. Brix *et al* 1989 reported that international attention now tilted towards the ability of aquatic macrophytes to control pollution and also to treat munici and industrial wastewater. Therefore, macrophytes can be efficient indicators of water quality, a their presence may enhance water quality due to their ability to absorb excessive load of nutrie (Petr, 1987). It has been demonstrated that aquatic weeds such as *Eichhornia crassipes* , *Lemma sp Salvinia, Typha ssp, Phragmites spp* and *Azolla sp* has been utilized as a means of reducing t nutrient levels of polluted water (Oki, 1994).Table 1 shows the removal efficiency of metal ions some common aquatic macrophytes.

Table 1: Removal efficiency of metal ions by some common aquatic macrophytes

	Metals	Removing efficiency
Eichhornia crassipes	Fe , Cu, Zn , Cd	80.0
Azolla spp	Hg	93.0
Ceratophyllum demersum	Pb, Zn and Cu	80.0
Ipomoea aquatic	Hg	90.0
Lemna spp	Pb	90.0
Ludwigia repens	Hg	99.8
Pistia stratiotes	Cd, Hg and Cr	85 – 90.0
Salvinia herzogii	Cr	70.83

Source: Srivastava,2008

Water Hyacinth

Water hyacinth is a common weed in a eutrophicated water bodies due to its high productivity in the range 106 to 144 tons of dry weight per hectare per year (Reddy and Debusk, 1985; Casabianca, et al 1992).The mean daily production of water hyacinth biomas in tropical areas may be more than 25g m $^{-1}$ day $^{-1}$ of dry matter. Thus more than 0.8 gN and 0.15g P m $^{-1}$ day $^{-1}$ can be removed by harvesting. Similar amount of nitrogen may be removed as a consequence of nitrification, denitrification and volatilisation of ammonia (Brix et al 1989). It has been reported by (Olgiun, et al 1998) that under the climate of Florida, *Eichhornia crassipes* has shown a very high nitrogen (80%) and phosphorus removal (40%). This aquatic plant is suited for nutrient removal systems because it is not rooted and floats on the surface and so can easily be removed by mechanical means and moreover mineral uptake rate per unit dry matter increase are greater in plants in a rapid growth phase (Anonymous, 1969, 1970) in which water hyacinth is one. Water hyacinth is being used in countries such as Brazil as tertiary treatment systems, removing nitrogen and phosphorus. The biomass is harvested frequently to sustain maximum productivity and to remove incorporated nutrients (Mason, 1992).

Water hyacinth can also be used as integrated secondary and tertiary treatment systems, removing BOD and nutrient both decomposition of organic matter and the microbial transformation of nitrogen proceeding simultaneously; in this system harvesting is only carried for maintenance purposes and performance with respect to phosphorus removal is poor (Brix *et al* 1989). Haider *et al* 1981 reported absorption of Pb, Cu, Cd Co Zn, Hg, Cr, Ni, Ca, and Mg from pulp and paper mills by Water hyacinth. The plant has been used in treating palm oil effluents in Malaysia (Abdulahi *et al* 1983). Earlier report of Rachel *et al* (1983) showed the successful utilization of Water hyacinth in the treatment of domestic sewage, nutrient removal from water bodies, sewage and industrial waste. Water hyacinth obtained from Nigerian water bodies contains heavy and toxic metals indicating its high absorbing capacity for these elements (Ogunlade, 1996). NAS (1976) reported that when sewage was passed through a pond at a rate of 2.2 million litres per hectare per day, Water hyacinth growing in the pond removed 80% of the nitrogen compound and 40% of the phosphorus compound in 2 days.

NUTRIENT AND HEAVY METAL REMOVAL BY DUCKWEED

Duckweed can be used for nutrient removal. The dense cover of duckweed on the water surface inhibits both oxygen entering the water by diffusion and the photosynthetic production of oxygen phytoplankton because of poor light concentration. The water consequently becomes anaerobic which in turn favours denitrification. Being relatively thin, the duckweed are readily harvested and used as animal fodder. *Lemma spp* recovers a high percentage of nitrogen from wastewater and may accumulate protein content as high as 40%; it has been used to recover nitrogen and phosphorus from anaerobic effluent from digested pig waste (Hernandez *et al*, 1997). *Lemna spp* has a nitrogen concentration of 200mg/l a fact that may portray this aquatic plant the high potential to treat concentrated effluent such as those that originated from animal production units. *L. minor* has been investigated for the removal of heavy metals from water column (Jain ***et al*** 1990, Wahaab *et al* 1995 and Maine *et al* 2001). *L.minor* can sequester 70-80% of lead in its viable biomass (Sternberg *et al*, 1999). The uptake of metals like Ni, Cd and Zn by different *Lemna* spp. has been reported by Miretzky *et al* (2006).

NUTRIENT AND HEAVY METAL REMOVAL BY *Pistia stratiotes, Ipomoea aquatica*; *Salvinia molesta* and *Ceratophyllum demersum*

Pistia stratiotes is reported to reduce the ammonium ions from the water as it utilizes NH_4-N prior to NO_3-N as nitrogen source and does not switch on the utilization of NH_4-N get consumed entirely (Aoi and Hayashi, 1996). *Pistia stratiotes* has been used to remove metals like Zn, Ni, Cd and Zn from water column (Sridhar, 1986).Studies by Miretzky et al 2006 reveal that *P.Stratiotes* biomass were lower as compared to *Spirodella intermedia* and *L. minor* when grown in water containing metals ions of Cd, Ni, Cu, Zn and Pb. Ipomoea aquatica can accumulate higher content of metals such as Fe, Cu,Cr,Cd,Mn,Hg and Pb (Sinha *et al* 1996). It also sequesters organic form methyl-Hg which is a potential toxicant (Boening, 2000). *Salvinia molesta* is well adapted for the removal Cr from wastewater (Maine *et al* 2004). Azolla spp acts as biofilter as it binds heavy metals and is helpful in the purification of waters polluted by Hg and Cr (Bennicelli et al 2004). *Ceratophyllum demersum* is capabe of removing the different chemical species of phosporus (Dierberg et al, 2002). Studies have equally shown that submerged plants are useful in reducing heavy metal concentrations in water, as biomass of their shoot can accumulate large amounts of heavy metals (Rai *et al*, 1995; Jackson, 1998 and Fritioff *et al* 2005. Ceratophyllum demersum act as effective biosorbent for Zn, Pb and Cu metals

under diluted conditions (Keskinkan *et al* 2004). *Ceratophyllum demersum* is used to assess the level of heavy of heavy metal pollution in aquatic bodies (Srivastava, 2008).

CONCLUSION

Nigerian freshwater ecosystem is constantly polluted by inorganic plant nutrients and heavy metals from urban sources derived from domestic and industrial sewages. Aquatic macrophytes are the cornerstones of an aquatic environment. They have the physiological ability of removing mineral nutrients and heavy metals. There is therefore the need to have a detailed study about the use of Aquatic plants for phytoremediation in Nigeria. This is imperative because phytoremediation is less expensive and environmentally friendly alternative in the control of these pollutants.

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AQUACULTURE INVESTMENT IN NIGERIA: CASE STUDY OF NEW BUSSA

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ABSTRACT
Hunger and malnutrition have remained amongst the most devastating problems facing the majority of Nigerian poor. These challenges and other social and economic objectives are the main forces driving aquaculture development to augment for food deficient, in particular fish, which is the cheapest source of protein. However looking at the aquaculture potential and the demand for fish, more needs to be done in aquaculture sub-sector. Unfortunately, despite the increase awareness, many people still remain skeptical about returns in aquaculture investment. This backdrop prompted the study, which empirically analyzed the situation based on two (2) semi-concrete ponds at NIFFR. The results which were extrapolated for five years shows a cost benefit ratio of 1.8, which indicated worthy investment. The results would essentially serve as guide to practitioners and intended fish farmers.

INTRODUCTION
The growing need for fish supply and increase awareness of aquaculture in Nigeria has led to remarkable investment in aquaculture in resent years. However, the growing population in the country posed a challenge, which requires more investment to fill in the supply gap of 1.6 million metric tones (Fishnetwork, 2009). Apparently, in order to fully transform and harness the potentials of the sub-sector, investors need to distinctively understand the economic and financial benefits attached to aquaculture, which less attention has been given over the years. Generally, in order to decide whether an investment should be undertaken or whether one particular investment should be preferred to another, one needs to have some kind of empirical data or evidences for evaluation. While this study is empirically based, it adheres to the fact of prevailing financial predicaments in the country, and assumed that all money used is the investment was loaned and extrapolation for five years was made. The paper aimed at discussing the 'nitty gritties' involved in financial investment, which are often neglected or unknown to many and causes problems in business.

MATERIALS AND METHODS
Two semi concrete ponds were used, with an area of 360m^2 (18 m x 20m), with depth of about 1.5m. The stocking density of each pond was 10/m^2 therefore a total of 3600 catfish fingerlings were stocked in each of the ponds as well as 1800 Tilapia fingerlings (stocking density of 5m^2), which serve as supplementary feed to the Catfish. In addition, 45% crude protein diet was fed at least for about three months at 5% body weight/day. Thus, 25kg of the feed was given in the first three months, 50kg through the 3rd and 4th month at which the fish has reached a 3% body weight, 75kg through the 5th and 6th , while from 7th to the 9th month 100kg was fed at which the fish was harvested at the end of the 9th month. Cost/benefit ratio was used in determining the viability of aquaculture in the first year, while cost/benefit analysis was used to determine its profitability using the net present value.

C/B = present worth of benefit
Present worth of cost

$$PV = B_0 - C_o + \frac{B_1 - C_1}{(1+r)} + \frac{B_2 - C_2}{(1+r)^2} + \ldots\ldots \frac{B_n - C_n}{(1+r)^n}$$

NPV = PV- Depreciation

Where
C/B net value
B – Benefit
C- Cost
NPV- Net Present Value
r- Interest rate at 5% for 5 years

Evaluation Criteria
There are several tools or measures for evaluation of any investment. However the choice of the tool to use defends on what the investor's main concern in the investment is. In cases where the main

objective is to recover the invested capital in the shortest possible time, 'pay-back period is used as a tool for decision. In other cases the objective is to get the maximum return on owned invested capital. In this study it is assumed that the capital used in the investment is borrowed with interest if both are to be recovered within five years, the aim of the investor is therefore to maximize the return on the total capital invested.

Concept of Present value

The basic reason underlying the present value concept is that money has an earning capacity. The earning capacity varies according to how the money is used. Money may be used to buy shares, deposited with bank or loaned, etc. In most cases the owner of the money expects to receive a return either in form of interest or dividends varying with the time that he does not dispose of the money.

Practical application of Cost Benefit Analysis

Cost benefit analysis is usually used as an economic tool to determine the profitability as well as the viability of an agricultural project to be undertaken. In this case it was used to find out its profitability within the next five years. The cost benefit ratio indicated that the project is viable (1.8) thus worthy of investing into. Hence, the estimated total cost of establishing two semi-concrete pond of 18m by 20m of 1.5m depth is 1,150,000 (table 1), this include fixed capital investment of N445,000 with the operating cost of 705,000. The operating cost decreases in the second year (N80, 000) but gradually increases through the third to the fifth year. The recurrent cost of about N291, 500 was spent in the first year of operation, but this also gradually increases with time and inflation N330, 661 in the fifth year (Table 2). Table 3 shows the depreciation value of the fixed assets for five years although most of which will last for about 50years. Table 4 shows the loan repayment schedule with the highest payment in the first year. Table 5 shows the output sales in the successive 5 years, sales increases due to inflation and the Net Present Value (NPV) is N10,310,593 while the Present Value of N10,492,825.3.

Table 1: Input for Pond (2) Construction/Accessories for 5 Years

Year	Land acquisition &clearing (N)	Excavation/ Concrete (N)	Inlet monk (N)	Fencing (N)	Cast net (N)	Borehole (N)	Total (N)
1	160,000	585,000	120,000	90,000	45,0000	150,000	1,150,000
2		60,000	20,000				80,000
3		70,000	30,000				100,000
4		75,000	30,000				105,000
5		90,000	50,000				140,000

Table 2 Recurrent Cost (2 ponds)

Year	Fish seed	Qty.	Feed (N)	Manure supply (N)	1 attendant	Security	Contingency (N)	Total (N)
1	Tilapia catfish	36,000 72,000	72,000	4000	45,000	36,000	26,500	291,500
2		36,720 73,440	73,440	4,080	45,900	36720	27030	297330
3		37455 74909	74909	4162	46818	37455	27571	303279
4		44946 76407	76407	4245	47755	44946	29471	324178
5		45845 77935	77935	2330	48710	45845	30060	330661

Table 3 Depreciation of Capital Assets for 5years

Year	Annual depreciation (N)	Depreciation value (N)	Remaining balance (N)
1	10% of 445000	44500	400500
2	10% of 400500	40050	360450
3	10% of 360450	36045	324405
4	10% of 324405	32441	291965
5	10% of 291965	29197	26216
Total		**182232**	

Table 4 Repayment of Loan in 5years at 8% Interest Rate

Year	Principal (N)	Total payment (N)	Interest (8%) (N)	Loan balance (N)
0				1441500
1	288300	311364	23064	1153200
2	288300	306751.2	18451.2	864900
3	288300	302138.4	13838.4	576600
4	288300	297525.6	9225.6	288300
5	288300	292912.8	4612.8	

Table 5 Output of ponds for succeeding 5 Years

Year	Tilapia	Catfish	Total output	Present value
1	540000	2160000	2700000	1258500
2	550800	2203200	2754000	2546667
3	561816	2247264	2809080	2457215
4	573120	2292480	2349792	1940686
5	584640	2338560	2923200	2289757
			Total	**10492825.3**

NPV = 10310593.3

CONCLUSION AND RECOMMENDATIONS

Aquaculture is said to be a promising venture in the country, it is now a means of creating employment and more to that income and wealth. It is also a means of sustaining the artisanal fisheries sub-sector. Aquaculture investment is strategically important to meet the expected million metric tones of fish production within the decade so as to meet the expected demand of the ever rapidly growing population in the country; it will also reduce the need for fish importation into the country. The system of aquaculture is important to all developing countries especially Nigeria whom is interested in food security, economic development, poverty alleviation and reduction of unemployment. Therefore, with the on going privatization, all farms that fall short of expectations should be privatized as a means of poverty alleviation and rural empowerment. Research work should be extended to the rural populace most of which are unaware of the golden opportunities in fish aquaculture.

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EUTROPHICATION AS A CHALLENGE TO SUSTAINABLE CAPTURE FISHERIES: A CASE STUDY OF OYUN RESERVOIR

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ABSTRACT
High concentrations of nitrate and phosphate from run-off of nitro phosphate fertilizers from nearby farmlands were recorded from Oyun reservoir, causing cultural eutrophication which affected the catch and fish assemblages; with high abundance of fish in the dry season and dominance of Cichlids while *Heterotis niloticus* and *Barbus occidentalis* were endangered. Management techniques to prevent extinction of its fisheries and sustainable exploitation of the fisheries such as watershed and construction best management practices (BMPs) to control eutrophication and fisheries conservation were suggested.

INTRODUCTION
A reservoir is an artificial basin with a riverine source capable of storing more than 1 x 10^6 m^3 of water. It provides significant contribution to global fisheries (Miranda, 2008). Although reservoirs are built by man and for man, activities in the catchments area affect its functions and biodiversity. The problems that could arise are eutrophication due to run-offs from excessive application of fertilizers, siltation from catchments land erosion, and excessive loading of organic and inorganic particles from domestic and industrial effluents. Eutrophication could present serious problem in the reservoir by causing loss of structural diversity (Scheffer, 1998), bring unpleasant taste and odour to the water when the algae die and decomposed, destroy food web and decrease biodiversity at higher trophic levels (Hauson and Buttler, 1994), loss of socio-economic functions of the reservoir (drinking, swimming, tourism, recreation, fisheries or irrigation). Eutrophication may also induce changes in yield and species composition of fish populations in the reservoir and lead to the disappearance of population of organisms as reported by Gliwicz and Warsaw (1992). According to Rast *et al.* (1989), increase inN or P, one or other which tend to limit productivity usually lead to eutrophication. This study assesses the eutrophication in Oyun reservoir, Offa, Nigeria which poses a serious challenge to sustainable capture fisheries in the reservoir.

MATERIALS AND METHODS
Oyun reservoir is a small, shallow reservoir located in Offa, Nigeria longitudes 8^0 30' 05'' N and latitude 8^0 15' 55'' E. Physico-chemical factors were sampled from three stations designated 1, 2 and 3 for two years between January, 2002 and December, 2003 in the reservoir. Duplicate surface water samples were collected from 10 cm depth into 50ml plastic water bottles that have been acid-washed prior to water analyses. Surface water temperature, pH, electrical conductivity and total dissolved solids were measured *in situ* using Hanna portable pH/EC/TDS/Temperature combined water proof tester model HI 98129. Transparency was determined using a secchi disc, dissolved oxygen was determined by Azide modification of the Winkler method, chemical oxygen demand was measured using the dichromate reaction method, carbon dioxide and alkalinity were determined by titration (APHA, 1995). Nitrate-Nitrogen (NO_3-N), phosphate (PO_4-P), sulphate (SO_4^{2-}), Ca^{2+}, Mg^{2+}, total hardness and silica SiO_2 were measured according to APHA (1995) standard procedures using Hach spectrophotometer model DR-EL/2.

Fish species composition and abundance were estimated through monthly collection of fish samples between January, 2002 and December, 2003 from the three stations. Gill nets, cast nets and lift nets of various mesh sizes ranging between 5.08cm and 17.78cm were used to sample the fishes from all the stations. A variety of mesh sizes was used to reduce species and size selectivity characteristics of gill nets. The fishes were identified using keys compiled by Holden and Reed (1972) and Reed *et al.* (1967), sorted into species and families. General linear models (GLM) procedure of statistical analysis system 9.1.3 (SAS Institute 2003) was used to analyze the results. Raw data (physico-chemical and fish) were log transformed $Log_{10}(X+1)$ for normality parametric statistical test requirements. Two-way analysis of variance (ANOVA) at $P<0.05$ were used to compare the averages and test for significant differences in means of the physico-chemical parameters and fish abundance.

RESULTS AND DISCUSSION

The result of the physico-chemical factors is presented in Table 1. Significant increase ($P<0.05$) in nitrate, phosphate and sulphate concentrations above the normal limit for drinking water (APH, 1995) was observed. These nutrients came from leaching of nitro-phosphate and sulphate fertilizers from nearby farm lands (Mustapha 2008). Other human watershed activities that contributed to the eutrophication of the reservoir include washing and bathing with phosphate based detergents and soaps and run-off of cow dung (Mustapha 2009). Eutrophication was more pronounced in the reservoir as a result of its shallowness. The effects of this high nutrient loads into the reservoir led to deteriorating water quality by producing algal bloom and disrupted the fish assemblages and catch.

Table 1: Mean ranges and seasonal abundance of physico-chemical parameters in Oyun reservoir.

Parameters	Mean ranges and SD	Seasonal abundance
Temperature (°C)	23.1 ±0.5 – 29.6 ±0.1	Dry
Transparency (m)	0.62 ±0.32 – 1.62 ±0.8	Dry
Water velocity (cm/s)	10.12 ±0.8 – 62.4 ±0.2	Rain
Dissolved oxygen (mg/l)	4.8 ±0.25 – 8.2 ±0.30	Rain
Chemical oxygen demand (mg/l)	1.2 ±0.1 – 2.6 ±0.2	Dry
Carbon dioxide (mg/l)	1.6 ±0.2 – 3.9 ±0.6	Dry
Nitrate (mg/l)	1.4 ±0.1 – 6.4 ±0.3	Rain
Phosphate (mg/l)	0.7 ±0.0 – 2.2 ±0.2	Rain
Sulphate (mg/l)	9.4 ±0.2 – 16.9 ±0.4	Rain
Silica (mg/l)	30 ±0.2 – 60 ±0.6	Rain
Calcium hardness (mg/l)	20 ±0.18 – 44 ±0.1	Rain
Magnesium hardness (mg/l)	10 ±0.4 – 28 ±0.6	Rain
Total hardness (mg/l)	32 ±0.5 – 68 ±1.4	Rain
Total alkalinity (mg/l)	30 ±2.6 – 55 ±3.4	Dry
pH (mg/l)	6.8 ±0.5 – 8.2 ±0.2	Rain
Conductivity (µS/cm)	80.4 ±0.8 – 178.8 ±2.0	Rain
Total dissolved solids (mg/l)	53.9 ±0.8 – 119.8 ±2.0	Rain

Fish species composition and abundance are shown in Table 2. A significant decrease ($P<0.05$) was recorded in the abundance of some fish species notably among *Heterotis niloticus, Barbus occidentalis, Hemichromis fasciatus, Hyperopisus bebe* and *Gnathonemus cyprinoides*. The decline among *Heterotis niloticus* and *Barbus occidentalis* was more severe as both species could be described as threatened or endangered in the reservoir. Eutrophication and obnoxious fishing practices were responsible for the decline in fish species abundance. Other noted factors include reduced availability of food, competition between species for food and space, over exploitation of species, loss of vegetation and alterations in the reservoir habitat and possibly the presence of exotic species in the reservoir. Eutrophication was implicated in the decline of fish species because of its ability to destroy food webs, affect dissolution of oxygen, decrease biodiversity (Hanson and Buttler 1994), lead to disappearance of population (Gliwicz and Warsaw 1992) and induces changes in yield and species composition (Miranda 2008). The severe decline of *H. niloticus* and *B. occidentalis* to the extent of being tagged as threatened in the reservoir could be attributed to the combination of these factors.

The challenges posed by eutrophication which does not enabled sustainable capture fisheries to be done in the reservoir could be solved by directing controlling watershed human activities which put high nutrient loads into the reservoir. This include stopping the use of fertilizers on farms located near the reservoir, banning washing and bathing and preventing cattle from coming near the reservoir. Denitrification and other nutrient control measures are also being considered. Agricultural watershed best management practices (BMPs) to reduce nutrient loads by controlling timing, amount and type of fertilizers is also been advocated, in case total stoppage of the use of fertilizers on nearby farm land is impossible or could create conflicts.

Table 2: Fish composition, relative abundance and mean wt of species and families in Oyun reservoir

Family	Species	Number	Weight (g)	Sp % in family	Sp % in population	Sp % wt in family	Species % wt in population
Cichlidae	*Tilapia zillii*	2314	242650	46.47	30	41.63	28.85
	Oreochromis niloticus	1781	228180	35.76	23.09	39.15	27.13
	Sarotherodon galilaeus	790	103910	15.86	10.24	17.83	12.36
	Hemichromis fasciatus	95	8140	1.91	1.23	1.39	0.97
Total		4980	582880	100	64.56	100	69.31
Momyridae	*Momyrus rume*	168	14220	43.98	2.18	37.64	1.69
	Mormyrops deliciousus	132	13415	34.55	1.71	35.5	1.6
	Ganthonemus cyprinoides	21	2450	5.5	0.27	6.48	0.29
	Hyperopsis bebe	61	7700	15.97	0.79	20.38	0.92
Total		382	37785	100	4.95	100	4.5
Mochokidae	*Synodontis schall*	143	13960	33.49	1.85	42.9	1.66
	Synodontis gambiensis	284	18582	66.51	3.65	57.1	2.21
Total		427	32542	100	5.53	100	3.87
Cyprinidae	*Labeo coube*	218	49600	85.16	2.83	89.05	5.89
	Barbus occidentalis	38	6100	14.84	0.49	10.95	0.73
Total		256	55700	100	3.32	100	6.62
Clariidae	*Clarias gariepinus*	221	28200	72.46	2.87	70.07	3.35
	Clarias angularis	84	12045	27.54	1.09	29.93	1.43
Total		305	40245	100	3.96	100	4.78
Osteoglosssidae	*Heterotis niloticus*	17	6860	100	0.22	100	0.82
Characidae	*Brycinus nurse*	1032	48585	100	13.38	100	5.77
Schilbeidae	*Schilbe mystus*	123	11530	100	1.59	100	1.37
Channidae	*Parachanna obscura*	191	24860	100	2.48	100	2.96
Grand Total		7713	840887		100		100

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REDUCING BY-CATCH THROUGH FISHING GEAR MODIFICATION

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ABSTRACT
There have been considerable efforts in recent years to modify fishing gears and practices to target particular sizes and species of fish (fin and shell) and other marine organisms more efficiently. By catch consideration and gear modification play an important role in regulation of several major fisheries and new by-catch reduction devices and other innovative gear modification are continuously being proposed and tested to mitigate against these problems, among which are the turtle excluder device (T.E.DS) in the shrimp trawls to reduce mortality of endangered sea turtle; sorting grids and scaring device in long line fisheries. This paper assesses the incidence of by catch in fisheries, provides a review of successful developments and application of selective fishing techniques that have been used to achieve by-catch reduction. Recommendations were also made on effective monitoring of fishing gears to ensure that devices aimed at reducing by-catch are included and fishermen use only the appropriate gears to limit by-catch and discards.

INTRODUCTION
The world's fisheries resources are been subjected to exploitation at or above their capacity to produce maximum sustainable yields. At the same time as these trends are being felt, there is a very large wastage of fisheries resources from discarding unwanted catches at sea. FAO (2004) reported an estimate of global discard in commercial fisheries of 27 millions tons per year compared to 50 million tons of direct human consumption. Recently, an estimated discards in the order of >20 million tons was reported (FAO, 2007). Commercial fishing involves a wide range of gear and techniques used in environments that are also occupied by organisms that are not targeted by the fisheries. The use of fishing gear in such environment sometimes creates unintended impacts such as removal of organisms that, for various reasons, should not be taken (e.g. juvenile, threatened species). The removal of non-target organisms has been a cause of concern for fisheries management for many years, the extensive capture of juvenile and young fish of commercially important species has frequently been regarded as a threat to recruitment of stocks. Many fisheries harvest individuals of the target species before they reach size in terms of future yield. The use of larger mesh in the collection (cod end) was among the first technical measures imposed by fisheries managers to prevent the capture of juvenile.

A more recent concern, beginning in the 1970s, was the unintended capture and killing of more charismatic animals, like marine mammals, seabirds and turtles, by commercial fisheries in particular, the incidental capture and mortality of endangered or threatened species that are long lived and have low reproductive rates has aroused growing conflict, the unseen mortality due to ghost fishing by lost gear has recently also attracted much attention which has stimulated extensive research and development efforts by many countries to solve the many problems. As the upper limits of production from capture fisheries especially marine have become more obvious, fisheries managers have introduced a variety of new controls, including regulation to limit access to fishing grounds, to limit fishing efforts and to set total allowable catches and by catch limits. Subsequent technological modifications in fishing gears and their operation have proved successful in many fisheries that are facing by catch problems. This paper reviews the incidence of by- catch in Nigeria and the effects of discarding them at sea; and highlights ways of ensuring effective monitoring of the modified fishing gears to achieve sustainability of the resources.

Incidence of by-catch in Nigeria
Past and present studies in Nigerian waters have shown the proliferation of fish by-catches, their species / size composition, and mode of utilization. In Nigeria, efforts have been made to ensure responsible inshore fishing practices through promulgation of sea fisheries law, act of parliament No. 71 of 1992. But effective monitoring and enforcement of these regulations is lacking. The occurrence of small but mature fish species in penaid trawling ground makes a selection within fishing gear rather difficult, even though, trawling for shrimps which attracts the highest incidental catch within the first five nautical miles of the Nigerian continental shelf and in waters shallower than 18m are prohibited and cod end of a shrimp trawl should have more than 44mm mesh size, yet observation of fish landing and activities at sea suggest that these statutory provision of the fishing regulations are not

being strictly complied with. The by- catch problem has been immensely compounded by the concentration of the shrimp trawl industry presently on brown shrimps at grounds, which appears to be nursery ground of young and juvenile fishes, apart from fin fishes, non-fish species are also caught as by-catch:Crabs -*Portunus validus* (smooth swim crab at around 30m depth) and Lobster- *Panulirus regius* (5-40m depth); brown cuttle fish- *Sepia officianalis* (down to 200m) and octopus; Turtle - *Eretmochlys imbricate* (hawksbill), Molluscs e.g snails and bivalves. Ajayi and Adetayo (1982) reported exploratory trawl hauls between November 1980 and March 1981 of commercial boats in the Niger delta area on catch and effort coupled with data gathered by.FDF since 1970 from industrial fleet analysis reveals the major species and composition of fish by catch discarded (Table 1).

Table 1: The major groups and components species of incidental fish catch

Fish Group	Mean composition of commercial landing	Component species
Sciaenidae	16.83%	*Pseudotolithus typus, P. senegalensis, P. elongates*
Cynoglossidae	9.32%	*Cynoglossus canariensis, C. senegalensis, C. monodi*
Ariidae		*Arius huedeloti, A. latisculatus*
Polynemidae		*Pentanemus quinquarius*
		Galeoides decadactylus
		Polydactilus quadrfilis
Pomadasydae		*Pomadasys jubelini, P. suillus*
Selachians		*Raja miraletus*
		Dasyastis margarita
	41.13%	*Charcharias taurus*
Mixed		*Brachydeuterus auratus*
		Illisha africana
		Vomer setapinis
		Drepane africana
		Trichiurus lepturus
		Larimus peli
		Gerres melanopterus

Source: Adebayo and Ajayi, 1982

The sale of discards estimated at about 3 metric tons daily. The species and size ranges of sampled fish by-catch sold into riverine local markets are shown in Table 2. The fish by-catch problem at various depths of some popular fishing grounds in Nigeria confirm high percentage of by-catches accompanying penaeid shrimping in Nigeria, with catch composition varying from one fishing ground to another depending on the targeted species. Table 3 indicates the % composition of shrimping operation at varying depth on major fishing ground in Nigerian waters. Notwithstanding the lower commercial value of non- target small sized fish species, the large quantity of juvenile of commercial species is a serious concern for biological diversity and sustainability of the shrimp trawling fisheries. The estimate based on the assumption of three and four trips/annum for white prawns and brown shrimps respectively is that about 3000mt/year of trash, juvenile and non-commercial species may be caught annually by 200 actively operating vessel (Olaniyi,1999). Some naturally small sized fish species constituted >70% of catch at some grounds, and there were indications of severe impact of shrimp trawling on juvenile commercial finfish resources.

Table 2: Size ranges of fish samples of discards sold at sea by shrimp trawlers in Niger-Delta waters.

Family	Species	Number	Size Range (cm)
Carangidae	*Hemicaranz bicolor*	7	8-14
	Selene dorsalis	17	5-7
Cynoglossidae	*Cynoglossus senegalensis*	81	10-23
Drephanidae	*Drepane Africana*	92	4-11
Ephippidae	*Chaetodipterus spp*	1	6-12
Haemulidae	*Pomadasys jubelini*	26	9-14
	Galeoides decadactylus	27	10-16
Pristigateridae	*Polydactylus quadrifilis*	76	10-15
Scianidae	*Illisha africana*	67	5-23
	Pseudolitus elongatus	10	11-15

	P. senegalensis	183	7-18
Sparidae	*P. typus*	183	12-16
	Pegalus bellotti	2	11-14
	Pegalus spp	40	6-13

Table 3: Percentage composition of shrimping operations at 10-14 meters at various fishing grounds

Fishing ground	Depth (m)	Fish (%)	Shrimp (%)	Crab (%)	By catch (%)
Lagos	10	50.7	4.7	0	41.6
Lagos entrance	14	28.2	0	0.1	71.6
Ibeju	10	27.5	0	0.4	72.1
Lekki	10	55	0	0	45
Escravos	13	36	1.7	4.8	57.4
Sengana	13	43	4.8	1.2	51
Opobo	10	62.8	2.8	0	34.4
Kwa Ibo	10	25.7	24	0	50.3
Calabar	10	69.9	9.1	3.6	17.3

Reasons for discarding fish by-catch

Management Measures

Management measures in some fisheries place a legal obligation on fishermen to discard part of the catch at sea. When the allowable catch quota is achieved for a species, landings of excess catch are prohibited and the fisherman theoretically have no other alternative but to dump the over quota volume at sea. However, in reality over quota catches are often landed illegally and dare termed 'black fish'. Minimum landings size regulations protect juveniles from being landed but those that are caught by fishing gear must be discarded to ensure compliance. In some fisheries a specific small mesh size is allowed for a target species of small size but in order to protect other species being caught, there is a maximum threshold allowed in the landings for commercial non-target species expressed as a percentage to the retained catch. Closed and protected fishing areas are also used to restrict the catch of some commercial species which can not be caught at all or are allowed to be caught in a limited proportion. Some species are protected by regulations or international conventions such as the CITES list of endangered species (marine mammal, turtles) and should be immediately returned to sea when caught.

Economic measures

There is often a strong economic motivation for discarding. Some species have no commercial value locally or seasonally due to poor conditions whilst other species are caught in unmarketable sizes. After the majority of hauls, and especially during long trips, the catch is sorted to retain only that part of the catch which maximizes value. This is commonly referred to as high-grading and discards are made of part of the catch after taking into account the value of species, the processing time on board and the remaining storage space on board. Fish that are damaged during operations are often discarded because of their unmarketable aspects. Catch is sometimes returned to the sea even before it reaches the deck. This can occur on some pelagic trawlers if the species composition in the catch is not deemed to be of sufficient value before pumping process to bring that catch on board is initiated. The economic reasons for dumping fish by-catch are summarized in the following:

Damaged or mutilated fish

- Species with no current market
- Achievement of quota
- Undersized individuals
- Unmarketable species e.g. dolphins, sea turtles.

Technical Reasons

They are usually by-catch of fishing operations which compose of juveniles and those of nettr damage adult individual. The selectivity of fishing operation varies depending on the type of ge being used which often has an effect on the survival rate of the fish being discarded. Using the sa

fishing gear in different areas can induce different discard problems depending on local biodiversity and species abundance of the fishing area.

Effects of discarding fish at sea

Economic Effects

Income that has been forgotten as a result of juvenile and adult target species discards. Income forgone in other fisheries as a result of discarding juvenile and adult non-target species. Costs associated with discarding non-commercial species. The cost of managing discards and measuring their quantities.

Biological Effects

Survival of most discarded species is low. Discards therefore may be a significant part of fishing mortality. Reproductive activities of such fishes may be significantly affected. The populations of endangered species are further threatened. Certain ecological niches are created for scavenging fish.

Social Effects

Varies between nations and sections of society depending on ethical beliefs, cultural differences e.t.c. It affects the dynamics of the exploited stocks in terms of yields per recruits. They can affect other fisheries since the by-catch species in one fishery may be the target of other fisheries

Application of selective fishing techniques

In recent years some technological modifications in fishing gears and their operation have proved successful in many fisheries that are facing by-catch problems. The spectacular decline of the by-catches and discards of finfish in many fisheries have been the result of by-catch reduction device such as turtle exclusion device, sorting grids, square mesh panel, scaring device in longlines, and nordmore grids.

CONCLUSION AND RECOMMENDATIONS

Discarding of unmarketable, restricted species and small sized individual tagged by catch is a global, economic, environmental, and political problem which can be reduced through fishing gear modification. The technologies developed in recent years demonstrate that the impact of fishing gears on non -target species and habitat can be significantly reduced without negative effect on the profitability of the fishing operation. There are currently no universal methods of modifying gears to reduce habitat disturbance, solutions are specific to gears, fisheries and habitat and are strongly influenced by regulatory and economic considerations, understanding the capture process of fishing gear in various environment is the key element in developing modification and practices that can reduce by-catch and ecosystem impact. There is a need for the government to enforce a strong policy to combat by- catch and discards reduction most especially in the wake of eco-labeling in the international market which adhere to strict fishing standard. The following are recommended.

- Enforcement of fishing regulations (use of correct mesh size and other devices) before going to sea, while at sea and on landing.
- Economic reward should be offered for the creation of new types of gear and modification that reduce by-catch and minimize impact on habitats.
- Enforcement of gear regulation for targeted fish species.

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AN INTEGRATED CHICKEN-FISH SYSTEM IN CONCRETE PONDS

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ABSTRACT

Four treatments (in duplicate) were used to determine the optimum combination ratio in the chic fish integrated system in 4 m^2 concrete ponds. Treatment 1 (T1) consisted of a concrete integrated with one point-of-lay chicken while treatment 2 (T2) had two point-of-lay chi integrated over a concrete pond. Treatment 3 (T3), consisted of three point-of-lay chickens inte over a pond and treatment 4 (T4) was the control and involved no integration. Each concrete was stocked with a poly-culture of *Oreochromis niloticus* and *Clarias gariepinus* in a ratio o Compounded fish feed was used to feed the fish in T4 twice daily at 5% of their body weight fish in T1, T2 and T3 fed on wet chicken manure and spilled chicken feed that fell directly int ponds. The daily manure loading rate ranged from 55.80g in T1R2 (treatment1 replicate 2) to 1 g in T3R1while spilled feed loading rate ranged from 2.52 in T2R2 to 9.27g in T3R2. The number of eggs laid was 871 in 84 days. For *C. gariepinus,* fish in T4R1 had the highest mean w gain of all the treatments and T1R1, the lowest. T3R2 had the highest mean weight gain of a integrated treatments. For *O. niloticus* fingerlings, fish in T4 which were fed compounded feed the highest mean daily weight gain and while those in T1 had the lowest. T4R1 fish had the hi mean weight gain while T1R2 fish had the lowest. Fish in T3 had the highest mean weight gain the integrated treatments followed by fish in T2. However, physico-chemical parameters were adverse and survival was lower in T3 than in T2 and so a combination ratio of 20 fingerlings in a concrete tank integrated with two laying chickens (mean weight 1.93 kg) is recommended. translates to 50 laying chickens/100 m^2 concrete pond stocked with 500 fingerlings.

INTRODUCTION

Integrated chicken-fish farming converts two normally separate farming systems into one sy where the waste of the chicken sub-system becomes an input into the fish sub-system (Siaw-Y 1991). Simultaneous production of fish in ponds with chicken rearing in sheds beside or ove ponds constitutes a continuous organic fertilization of the pond by the livestock (Ita *et al.*, 1986). practice increases the efficiency of both livestock farming and fish culture through the profit utilization of animal and feed wastes. According to Gabriel *et al.* (2007), chicken-fish farming i most popular form of integrated poultry-fish farming in Nigeria. Excessive amounts of Nitrates phosphates released from the decomposition of manure can lead to eutrophication which can c algae blooms, impaired fisheries, fish kills, odours and increased turbidity in ponds (Delme 2003). Thus, control of manure load into the system is important and only fish species that can g well and survive in such a system should be used. Fish species like *Oreochromis niloticus* and *Cla gariepinus* that directly consume manure are good for the system.

MATERIALS AND METHODS

Eight concrete fish ponds (area of each, 4 m^2) were used in the experiment i.e. four treatment duplicate. A stocking density of 5 fish/m^2 was used and each concrete pond was stocked with a po culture of *O. niloticus* and *C. gariepinus* in a ratio of 3:1. Six chicken sheds (1.5m x 0.75m) w constructed over six concrete ponds (each 4 m^2) with wood and the sides and floor of each shed v covered with wire mesh. The floors were made with wire mesh so that the faecal droppings a spilled feed can drop directly into the concrete ponds without hindrance. The sheds were 1m abo the ponds. The treatments were allocated randomly to the ponds. Treatment 1 (T1) consisted o concrete tank integrated with one point-of-lay chicken; treatment 2 (T2) had two point-of-lay chick integrated over a concrete pond. Treatment 3 (T3) consisted of three point-of-lay chickens integra over a pond and treatment 4 (T4) was the control and involved no integration but had fish stocked i a concrete pond. Chickens (Nera Brown breed) with similar weights were used for the study.

The weights of fish fingerlings were recorded at stocking and during each sampling perio The weight of each chicken was measured with a top loading balance. Pond water was changed eve two weeks after the integration. The ponds were sampled every two weeks before water change a the weights of fish were taken to determine growth parameters. Wet chicken manure was weighed a air dried before being used for proximate analysis. Proximate composition of fish feed, chicken fe and dry chicken manure were determined according to AOAC (2000). Temperature, pH, conductivit

dissolved oxygen, turbidity, total solids (TS), total suspended solids (TSS) and total dissolved solids (TDS) of the pond water were measured before the fish were stocked into the ponds. Temperature and pH were measured with ATC portable pH/temperature meter. Conductivity was measured with ELE conductivity meter (model DA-1) while turbidity was measured with a Secchi disc of 20cm diameter. Dissolved oxygen was measured with HACH dissolved oxygen meter (model 50175). TS, TSS and TDS were analysed according to APHA (1992). The daily manure and spilled feed loading rates into each pond were determined along with the laying rate of chickens per shed for 84 days.

RESULTS AND DISCUSSION

Table 1 shows the mean weights of chickens and mean daily manure and spilled feed loading rates.

Table 1. Mean weight of chickens and mean daily manure and spilled feed loading rates.

Treatment	Mean weights (kg)	Daily manure loading rates (g)	Daily spilled feed loading rates (g)
T1R1	1.92 ±0	56.05 ± 1.05	2.90 ± 1.2
T1R2	1.95 ±0	55.80 ± 1.23	3.44 ± 0.09
T2R1	1.93 ± 0.03	81.65 ± 1.51	5.09 ± 0.88
T2R2	1.935 ± 0.015	86.80 ± 2.02	2.52 ± 1.95
T3R1	1.95 ± 0.041	117.37 ± 3.11	8.60 ± 1.3
T3R2	2.00 ± 0.056	105.22 ± 1.07	9.27 ± 0.55

The chickens used were of the same age (20 weeks) and had similar weights (1.90-2.08 kg). Mean daily manure load ranged from 56.05 ± 1.05 in T1R1 to 117.37 ± 3.11 in T3R1 while mean daily spilled feed load ranged from 2.52 ± 1.95 in T2R2 to 9.27 ± 0.55 in T3R3. Doubling the number of chickens in a treatment did not necessarily double the amount of manure produced by each treatment. Indeed the amount of manure produced by three chickens was about two times that produced by one chicken in this experiment. The feed spilled by chicken is dependent on the activity of the chickens and not their number. The feed spilled by T2R2 was lowest in the experiment despite the fact that it contained one chicken more than T1R1 and T1R2. However, the chickens in Treatment 3 spilled more than double the feed spilled by those in treatment 1. Proximate analysis of chicken feed, fish feed and dry chicken manure showed that the crude protein content of fish feed (35.89 %) was higher than that of dry chicken manure (25.70%). Over half of the crude protein content of livestock manure is usually non-protein nitrogen like uric acid (Siaw-Yang, 1991) which is not assimilated by fish. However, the fish in the integrated treatments also consumed spilled chicken feed which had a crude protein content of 16.19 %, and this contributed to growth. Table 2 shows growth parameters and survival of *O. niloticus* fingerlings in each treatment.

Table 2. Mean weights (g ±SD) of *Oreochromis niloticus* fingerlings in each treatment

Treatment	T1R1	T1R2	T2R1	T2R2	T3R1	T3R2	T4R1	T4R2
Mean initial weight	6.90 ± 0.14	5.80 ± 0.15	6.35 ± 0.22	6.01 ± 1.02	7.50 ± 0.08	6.80 ± 0.21	5.35 ± 0.02	6.40 ± 0.05
Mean final weight	30.86 ± 0.21	35.25 ± 0.25	45.40 ± 0.17	48.40 ± 0.73	54.65 ± 0.28	51.17 ± 1.06	69.05 ± 1.21	61.49 ± 0.73
Mean weight gain	23.96 ± 0.09	29.45 ± 0.13	39.05 ± 0.19	42.39 ± 1.22	47.15 ± 1.14	44.37 ± 0.83	63.7 ± 0.94	55.09 ± 0.55
Mean daily wt. gain	0.29 ± 0.001	0.35 ± 0.002	0.46 ± 0.002	0.50 ± 0.015	0.56 ± 0.014	0.53 ± 0.010	0.76 ± 0.009	0.66 ± 0.008
Specific growth rate	1.78	2.15	2.34	2.48	2.36	2.40	3.04	2.69
Survival (%)	86.7	100	100	66.7	86.7	60.0	100	93.3

Fish in T4 which were fed compounded feed had the highest mean weight gain and those in T1 had the lowest. T4R1 had the highest mean weight gain while T1R2 had the lowest. T3R1 had the highest mean weight gain of all the integrated treatments. The concrete ponds integrated with three laying chickens (treatment 3) gave the best growth performance among the integrated treatments. However, survival is relatively low in the treatments integrated with three chickens. Table 3 shows the growth

parameters for *Clarias gariepinus*. Fish given compounded feed performed better than those in the integrated system.

Table 3. Mean weights (g ±SD) of *Clarias gariepinus* fingerlings in each treatment

Treatment	T1R1	T1R2	T2R1	T2R2	T3R1	T3R2	T4R1	T4R2
Mean initial weight	6.05 ± 0.09	4.40 ± 0.62	4.75 ± 0.59	5.71 ± 0.07	7.20 ± 0.93	3.15 ± 0.04	2.80 ± 0.13	5.35 ± 0.24
Mean final weight	61.08 ± 1.14	66.11 ± 0.99	70.07 ± 0.87	74.83 ± 0.59	80.17 ± 1.08	78.88 ± 1.12	95.01 ± 1.20	89.92 ± 0.75
Mean weight gain	55.03 ± 0.57	61.71 ± 0.81	65.32 ± 0.34	69.12 ± 0.39	72.97 ± 0.70	75.73 ± 1.08	92.21 ± 0.99	84.57 ± 0.61
Mean daily wt. gain	0.66 ± 0.007	0.73 ± 0.010	0.78 ± 0.004	0.82 ± 0.005	0.87 ± 0.008	0.90 ±0.013	1.10 ± 0.012	1.00 ±0.007
Specific growth rate	2.75	3.22	3.20	3.06	2.87	3.83	4.19	3.36
Survival (%)	100	100	100	100	100	60	60	100

T4R1 had the highest mean weight gain of all the treatments and T1R1, the lowest. T3R2 had the highest mean weight gain of all the integrated treatments and T1R1, the lowest. Mean values of Physico-chemical parameters measured in all the treatments showed that temperature ranged from 20.30 °C in T2R2 to 22.10 °C in T4R2. pH values were generally low with pH in the integrated treatments getting as low as 4.89 in T3R1 which is dangerous for the fish. Dissolved oxygen was lower than the 5mg/lit lower limit usually recommended for freshwater aquaculture. Conductivity ranged from 530 µs/cm in T4R2 to 750 µs/cm in T3R2 while all the turbidity values were below the 20-50 cm recommended by Nath (2003). As expected, total solids and total suspended solids are much higher in treatment 3 than in others due to the higher quantity of manure and spilled feed falling into it. The total number of eggs laid was 871 eggs in 84 days at an average of 10.370 eggs/day. Chicken mortalities occurred in T2R2 and T3R1 towards the end of the experiment when air temperature rose to 28 °C at the onset of the hot season in New Bussa.

The study has shown that integrated chicken-fish farming in concrete ponds is feasible if water is changed regularly. Water was changed every two weeks and the fish still survived though pH, DO and turbidity were at dangerous levels in some cases. Due to the adverse physico-chemical parameters and lower survival experienced in TR 3, it is recommended that 2 laying chickens (mean wt. 1.93 kg) should be integrated over a $4m^2$ concrete pond with 20 fingerlings of *O. niloticus* and *C. gariepinus*. This is equivalent to 5,000 laying chickens and 50,000 fingerlings/ha or 50 birds/500 fingerlings/$100m^2$ pond.

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EFFECTS OF SUPPLEMENTAL SELENIUM IN DIETS OF *Heterobranchus longifilis*

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ABSTRACT
The effect of selenium supplementation into diets of *Heterobranchus longifilis* fingerlings was investigated using a completely randomized design with triplicates in a mini-flow through experimental system. 245 fingerlings (mean wt., 1.5±0.23g) were stocked and fed either normal (Basal) diet (Control group) or diets supplemented with 0.16, 0.24, 0.32 or 0.64 mg sodium selenite Kg^{-1} Selenium addition to the diets and fed to the fish caused a significant increase ($P<0.05$) in weight gain and fingerlings growth rate was accelerated by 18-22% compared to 17-18% in the control group. There were significant differences ($P<0.05$) in survival rate between treatments, indicating that diets are likely to be responsible for increased survival rate, observed in fish fed diets supplemented with 0.24 and 0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1} diet. Results indicated that a diet supplemented with, 0.24 and 0.32 mg of sodium selenite Kg^{-1} diet is important for growth and survival of *H. longifilis* fingerlings.

INTRODUCTION
The intensification of aquaculture development in Nigeria had called for developing highly productive sustainable diets for the common species of catfish cultured in Nigeria. The quantitative dietary requirement for trace elements depends upon the amounts required for growth and reproduction and that which is unavoidably lost by the animal through gut, kidney and by passive diffusion across the gills and generally body surface. Little effort has been made to quantify the relative importance of dietary sources of trace minerals in freshwater (Watanabe *et al.*, 1997). However, freshwater fish depends on an adequate supply of minerals as there is continuous effluent of ions from the body (Cowey and Sargent, 1979).

Selenium is required by the fish for normal growth and physiological function. Inadequacies are associated with low glutathione peroxidase (GSHPx) activity, slow growth and exudative diathesis in rainbow trout (Hilton *et al.*, 1980; Bell *et al.*, 1987). The dietary requirement for selenium (supplied as sodium selenite) for normal growth has been calculated to be 0.38 mg / kg for rainbow trout while levels of 13 mg/kg have been found to be toxic (Gatlin and Wilson, 1984; Lovell and Wang, 1997). Selenium supplementation is a necessity for fish species such as catfish and tilapia, fed grain, oilseed products and fish meal based diets which do not contain adequate amounts of selenium. Sodium selenite is the most common form of selenium used for supplementation to date. Selenium from these supplements is usually passively absorbed from the gut and then reduced in the liver where it is incorporated into cysteine to form selenocysteine. The biological availability of minerals from the diet is marked by the efficiency with which the body utilizes the dietary minerals. It varies depending on the feedstuffs and the form of the nutrient, nutrient interaction which may be synergistic or antigenic, physiological and pathological condition of the fish, waterborne mineral concentration and the species under consideration (Watanabe *et al.* 1997, Hilton 1989 and Steffens 1989). There is a dearth of information of trace mineral requirements of *H. longifilis*.This study was designed to evaluate the growth and feed utilization of *H. longifilis* fed diets supplemented with selenium.

MATERIALS AND METHODS
A Completely Randomized Design with three replicates of 15 *H. longifilis* fingerlings each was used in different levels of dietary $Na_2SeO_3.5H_2O$ (0.0, 0.16, 0.24, 0.32, and 0.64mgkg^{-1}) supplemented into a 42.5% crude protein basal diet. The basal diet comprised Clupeid fish meal 25%, Soybean meal 35%, Groundnut cake 14.40%, Maize bran 16.35%, oil 4%, starch 2%, Bone meal 1%, Premix 1%, methionine 0.5%, salt 0.25% and silica 0.5%. Proximate composition of the diet include crude protein 41.62%, Crude fat 12.7%, crude fibre 2.1%, ash 7.8%, NFE 27.91%. Five dry pelleted diets were formulated from a basal diet. The sodium selenite was first dissolved in water and mixed with the basal diets. 225 fingerlings (mean wt., 1.06±0.24g after acclimationwere fed 5% of body weight. Water temperature, pH, conductivity and dissolved oxygen were monitored during the experiment. 30 fingerlings were taken to determine the initial mineral composition at commencement of the study. Forth-night sampling was carried out for monitoring growth, health status and used for feed adjustments. At the end of the experiment, five fish were randomly taken from each replicate tank for

analyses. Growth performance parameters were determined according to Cho and Kaushik (1985). Blood samples were collected from the caudal vein using heparinized 27- gauge needles and tuberculin syringes (20 units/ml) for determination of hemoglobin (Hb) and total serum protein. Hemoglobin was determined using cyanomethemoglobin method by the total hemoglobin kit (Sigma Diagnostics, Sigma, St. Louis, MO). Data obtained were subjected to one–way ANOVA and where significant difference were observed, the treatments were separated with Duncan's multiple range tests at 5% level of significance (Statistica for Windows, 1998).

RESULT AND DISCUSSIONS

During the experimental period, water temperature ranged from 26.7 to 30.3°C, DO from 4.7 to 6.2mgL^{-1}, pH from 6.1 to 8.2 and total ammonia from 0.02 to 0.04 mg L^{-1}. The water quality parameters were found to be within the acceptable range for fish growth (Stickney, 1979). The results of the experiment (Table 1), indicated that fish fed on diets supplemented with 0.24 and 0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1} diet, gained more weight than those fed control diet and diet 0.64 mg level ($P<0.05$). Numerically higher growth rate was obtained when fish fed on diet supplemented with 0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1} diet, although it was not significantly different ($P>0.05$) from that achieved by the fish fed on diet with 0.16 mg sodium selenite kg^{-1} (Table 1). Poorest growth was recorded for fish fed on diet supplemented with 0.64 mg sodium selenite kg^{-1} diet which was not significantly different ($P>0.05$) from the control. Differences in specific growth rate (SGR) were found to be significant ($P\leq0.05$) between control diets and those fed on 0.24 and 0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1} diet (Table 2). These results agree with the observations of Poston and Combs, (1979) and Hilton and Hodson (1983). There were significant ($P<0.05$) variation in feed intake in all treatments. The fish fed the control diet and diet with 0.64 showed lower feed intake than those recorded in fish fed on diet with 0.24 and 0.32 mg. It appeared that fish intake was affected by the addition of Sodium selenite to the diets and 0.24-0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1} seemed to stimulate fish intake and growth. Optimum performance seems to be attained with 0.24 and 0.32 supplementation level beyond which a decline in general performance sets in. Similar observation was reported by Gatlin *et al.*, 1986. In the study of Gatlin *et al.*, (1986) levels above 0.13-0.15 mg kg^{-1} in the diet channel catfish had toxic effect, resulting to increased mortality.

Supplemental $Na_2SeO_3.5H_2O$ in the diets increased feed efficiency ratio (FER) so that weight gain produced per unit weight of feed consumed was higher for diets supplemented with $Na_2SeO_3.5H_2O$ than control diet. Significantly ($P\leq0.05$) higher value of 38.5% and 39.6% were recorded for fish fed on diets with 0.24 and 0.32 mg respectively compared with average value of 32.7% recorded for control diets. Feed conversion ratio (FCR) decreased progressively ($P<0.05$) with increasing dietary sodium selenite levels and reach minimum at diet with 0.32 then increased at diet with 0.64mg. Kayano et al. (1993) reported that, the production in fish culture is generally dependent on feed consumption.

Table 1 Mineral content in the basal diet for *H. longifilis*

	Dietary Levels Selenite (mg kg-^{1})				
Mineral	0.0	0.16	0.24	0.32	0.64
Ca	0.92	1.14	1.16	1.19	1.23
P	1.38	1.39	1.4	1.43	1.48
K	1.41	1.43	1.45	1.47	1.51
Mg	0.55	0.56	0.57	0.59	0.61
Na	0.40	0.41	0,43	0.46	0.49
Cu	4.62	4.65	4.71	4.76	4.83
Fe	160.	161.5	163.	167.	174.1
Se	47	3	8	5	2
Zn	0.04	0.08	0.12	0.20	0.36
Mn	19.5	19.6	19.8	20.2	20.5
	14.2	14.31	14.3	14.5	14.68
	7		7	1	

Ca, P, K, Mg and Na expressed as (%) and Cu, Fe, Se, Zn, and Mn as mgkg^{-1} dry matter.

Table 2: Effect of dietary selenium on *H. longifilis* after 8 weeks .

Parameters	Dietary Levels Selenite (mg kg-^{1})				
	0.0	0.16	0.24	0.32	0.64
IBW (g)	7.5±0.3	7.5±0.25	7.5±0.31	7.4±0.12	7.6±0.2
FBW (g)	11.8±0.25^{c}	12.4±0.25^{b}	13.4±0.3^{a}	13.6±0.25^{a}	10.0±0.25^{d}
FI (gfish^{-1})	13.1±0.2^{b}	13.5±0.2^{b}	15.1±0.1^{a}	15.3±0.1^{a}	12.4±0.4^{c}
SGR (%day)	1.6±0.1^{b}	1.77±0.06^{b}	2.06±0.08^{a}	2.11±0.04^{a}	1.31±0.18^{c}
FCR (F/WG)	3.06±0.5^{b}	2.8±0.46^{a}	2.59±0.31^{a}	2.52±0.21^{a}	3.31±0.42^{b}
FER	32.7±0.6^{c}	35.7±0.6^{b}	38.7±0.5^{a}	39.6±0.2^{a}	27.1±2.9^{d}
PER	0.99±0.02^{b}	1.08±0.02^{b}	1.16±0.01^{a}	1.18±0.04^{a}	0.81±0.1^{c}
Hemoglobin (g %)	8.87±0.2^{ab}	8.97±0.2^{a}	9.2±0.1^{a}	9.3±0.1^{a}	8.5±0.4^{b}
TSP (%)	2.9±0.1^{bc}	3.0±0.1^{b}	3.3±0.2^{a}	2.7±0.1^{c}	2.7±0.1^{c}
Survival %	55.20±0.2^{d}	75.0±1.0^{c}	78.3±1.0^{b}	86.±0.5^{a}	57.8±0.6^{d}

a-e Means with different superscripts within row are significantly different (P≤0.05). IBW: initial body weight; FBW: final body weight; SGR: specific growth rate; FCR: feed conversion ratio; PER: protein efficiency ratio. TPS=total serum protein

Similar to FER values, differences in PER values between dietary treatments were significant (P≤0.05) (Table 2), indicating that weight gain per unit of protein intake is different in all treatments. The differences in levels of $Na_2SeO_3.5H_2O$ supplement to diets are likely to be responsible for the increased feed efficiency ratio observed in fish fed diets supplemented with 0.24 and 0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1}.

Hemoglobin content increased significantly (P≤0.05) with increasing dietary sodium selenite levels. Total serum protein increased with increasing sodium selenite levels and reach maximum at diet with 0.24 mg sodium selenite kg^{-1} with that significantly different from diet with 0.32 mg. The increasing effects on total serum protein might have been due to selenium availability and its interaction with cystein in protein synthesis and increased gluthathion peroxidase activity (Hilton *et al.*, 1980; Bell *et al.*, 1987). There were significant (P≤0.05) differences in survival among treatments (Table 2), indicating that diets are likely to be responsible for increased % survival observed in fish fed diets supplemented with 0.24 and 0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1}. The experiment showed that supplementation of 0.24 and 0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1}.had determinable effects on fish growth indicating that culture fish in intensified culture require more trace minerals.

From this study, supplementary selenium (0.64 mg kg^{-1} $Na_2SeO_3.5H_2O$ or 0.30 mgkg^{-1} selenium) incorporated into *H. longifilis* diets could be compensated by decreasing the feeding level and the growth rate. There was similar observation by Gatlin, *et al.*, (1986) for channel catfish; they reported that high levels of selenium (levels above 0.13-0.15 mg kg^{-1}) in the diet had toxic effect, resulting to increased mortality. There was a significant differences (P<0.05) on the whole body mineral composition after the feeding trial indicating that there is possibility of one mineral influencing the absorption and utilization of the others as selenium supplementation influenced the other minerals in the body of the fish (Table 3).

Table 3: Effect of dietary selenium on mineral composition of *H. longifilis*.

Minerals	Diets				
	0.0	0.16	0.24	0.32	0.64
Ca	4.54±0.04^{e}	5.04±0.03^{d}	5.37±0.04^{c}	5.64±0.04^{b}	6.03±0.02^{a}
P	2.19±0.07^{d}	2.29±0.06^{c}	2.41±0.05^{b}	2.57±0.04^{a}	2.57±0.05^{a}
K	1.12±0.02^{b}	1.13±0.04^{b}	1.14±0.06^{ab}	1.1±0.02^{a}	1.06±0.02^{c}
Mg	0.11±0.02^{d}	0.14±0.01^{b}	0.17±0.01^{a}	0.17±0.01^{a}	0.14±0.02^{c}
Na	0.63±0.02^{c}	0.67±0.01^{b}	0.7±0.02^{ab}	0.71±0.02^{a}	0.62±0.02^{c}
Cu	4.3±0.1^{d}	4.7±0.1^{c}	5.1±0.1^{b}	5.4±0.1^{a}	4.3±0.1^{d}
Fe	112.7±4.1^{c}	119.4±4.7^{bc}	123.3±5.3^{b}	128.4±4.8^{ab}	134.23±8.3^{a}
Se	1.04±0.03^{e}	1.13±0.02^{d}	1.23±0.02^{c}	1.29±0.02^{b}	1.43±0.02^{a}
Zn	104.4±1.01^{e}	114.3±1.1^{d}	128.6±1.76^{b}	138.7±2.2^{a}	124.3±0.75^{c}

a-e Means with different superscripts within same row are significantly different (P≤0.05). IBW: P, K, Ca, Na, and Mg expressed as % and Fe, Ma, Cu, Se and Zn as mg kg^{-1} of dry matter,

It might be concluded that the reduced growth performance of *H. longifilis* fed die supplemented with 0.64 mg kg^{-1} $Na_2SeO_3.5H_2O$ or 0.30 mg kg^{-1} selenium might be due to the fact th it is compensated by decreasing the feed consumption and growth rate. The significantly better grow of fish fed diets supplemented with 0.24 and 0.32 mg $Na_2SeO_3.5H_2O$ kg^{-1} or 0.12 and 0.15 mg kg selenium would be responsible for increase growth rate more than 18- 22% and feed intake by 1 18% leading to increased feed utilization.

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DESIGN AND CONSTRUCTION OF 2.14 M LOA (ONE SHEET) FLATBOTTOM CANOE (PUNT) FOR POND ACTIVITIES

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ABSTRACT
A 2.14M length overall (LOA) flat bottom canoe (punt), was designed and constructed using locally available materials. The features of the canoe are least cost material, light weight, shallow draft and easy maneuverability. The canoe's light displacement (weight empty) was 28kg, which was less than local canoe of same size. When placed on water a draft of 5.5cm was achieved which is 14.8% of its depth (37cm). The capacity of the canoe was 200kg, and the total production cost of N8, 700.00 which was, not beyond, the reach of an average fisher folks, or any fish farmer. The canoe was easily maneuvered when propelled by paddling as it floated at a shallow draft; this makes the canoe adequate for use on shallow water bodies such as ponds and reservoirs. Such easily maneuvered craft can also be used on pond or reservoirs for recreation which include, sport fishing, canoeing

INTRODUCTION
The term boat refers to a wide variety of water borne crafts. Canoe can be described as a light, narrow boat, generally with identically shaped bow and stern and curved sides, and usually propelled by at least one oar or paddle. The canoe was developed by many early cultures throughout the world. It varies in shape, size, and construction, according to its place of origin. The oldest form of canoe was probably a tree trunk hollowed out by tools or fire (Redmond, 2005). Flat bottom boats are the easiest and cheapest to design and construct, they are also best for use on calm or peaceful and shallow waters (Omorodion, 1983). Despite the fact that flat bottom crafts are not suitable for use on turbulent water bodies such as large lakes like the Kainji lake, local fishermen prefer it as they are easy to build and cheaper. Fish farming in ponds and reservoirs, requires adequate management practices which includes removal of unwanted floating objects, aeration of oxygen depleted ponds, collection of water samples for water quality assessments, feeding of experimental fish in net hapa etc. These activities could be achieved more effectively with the aid of a small craft that could be used on a shallow water body. However, this work was prompted by the need for a craft that could make such activities easier with the following objectives

- Produce a cheap craft that could be used effectively on a shallow water body.
- Enhance pond activities, thereby ensuring increased fish production through aquaculture.
- Boost the utilization of ponds for recreational activities.

MATERIALS AND METHODS
The design materials required included: Drawing-board (half imperial), a HB pencil, a T square about 90mm long, one triangle of hard rubber (set square), a pair of dividers with plain and pencil points, several curve battens of various sizes. A good paper for working drawings, roll scales and metre rule. Others included lead weights, drawing pins, were also needed to fasten the paper to the board. Other materials used were eraser, razor blade and a calculator. The materials used for the construction of the canoe include: Hard wood, plywood, fastening glue, wire nail and basic carpentry tools such as hand saw, chisel, smooth planer, measuring tape, spirit level, try and bevel square were used for the construction work. To obtain the design data, a free hand sketch of the canoe was drawn with a HB pencil, putting in place all the required design lines and making all necessary adjustments. A metre rule was used to measure the specifications of the free hand sketch. This is in accordance with Love (1979). The data obtained from the freehand sketch was then used to draw the canoe to scale (1:15.3). The design guidelines according to Chapelle (1956), were adopted to achieve the design. The canoe's layout was drawn on a sheet of plywood maintaining the required sizes and shape of each part that needed to be put together to make the complete canoe. This was achieved by using a long curve batten to aid making of proper curved line with a HB pencil. First a line was drawn lengthwise in the middle of the plywood sheet. From this centerline, measurements and marks of the bottom on one end of the sheet was made according to the requirements. The side curve was lofted on one side only, and then the measurements were mark with small dots on the other side. Then measured and marked the transom on the other end of the sheet. The transom and bottom meet, there were no left over plywood between them. Iron square was used to obtain the straight lines. The parts marked out on the plywood

include two side planking, one bottom planking and stern transom. The bow transom was not ma it was best to cut it out of a piece of plank for proper strengthening of the bow.

Jig saw was used to saw along the lofted side of the bottom. Then the side strip was fl over, onto the other side of the sheet, and the other edge of the bottom along the sawn edge o side. The drawn curve was checked to confirm if it matches the measured points. The other ed the bottom and transom was then cut. The four pieces of plywood: the bottom, transom and tw strips of rather nonspecific shape were produced. The side strips were cut in two, 1400 mm fro end where the transom came from. The pieces were swapped, and wider ends of the strips connected using butt joints. To the bottom strip 50mmX50mmX100mm hard wood blocks were 200cm apart, then the side strips were stitched after glue was applied and small screws were u fasten the joints. The stern transom, bow transom, and quarter knees were then fixed at their posi 25mm thick hardwood was then prepared and fixed as seating platform (thwart). The gunwales made of 21 x 21 mm pine batten and fixed together with the quarter knees. Quarter knees in the and bow were fitted with 30 mm holes which act as handles, can be used as fastening points for t and they make the canoe look nice. The light displacement (weight empty) was determined by d measurement of weight of the canoe after construction using a spring weighing balance. The cap of the canoe was determined by direct addition of weight to the canoe while floating on water un carried the maximum weight it could carry. The cost of the canoe was estimated based on the market cost of materials used for the construction in respect of their sizes and specifications canoe was conveyed from the college boat building workshop to one of the college ponds (pon for testing. It was gently placed on water then allowed to float empty, while being observed leakage, stability, and draft. The capacity was then tested for by allowing one person at a time, un carried the maximum weight it could carry.

RESULTS AND DISCUSSION

The design sketch is shown in Figure 1. The layout design of the components on a sheet of ply w is shown in Figure 2. Table 1 shows the design data obtained from the free hand sketch. Plate 1 sh the marked components cutout from the layout on the plywood sheet. The steps followed constructing the canoe are presented in plates 1 to 4. The specifications of the canoe indicates that breadth overall (BOA) is 0.75m which is about 28% of the length overall (LOA), while the depth 0.37m about 50% of the BOA. These specifications are within the range of design guidelines Chapelle (1956), The construction resulted to the production of a canoe that is light (28 kg) in relat to its size, such that one person can carry without difficulty. The light weight gives the ca increased dead weight, as it floats at a shallow draft leaving greater part of the canoe above the wa line as free board there by increasing its capacity to carry more loads. The freeboard creates a la volume for displacement, hence increased capacity because the more the volume of water displac the more loads the craft is capable of carrying.

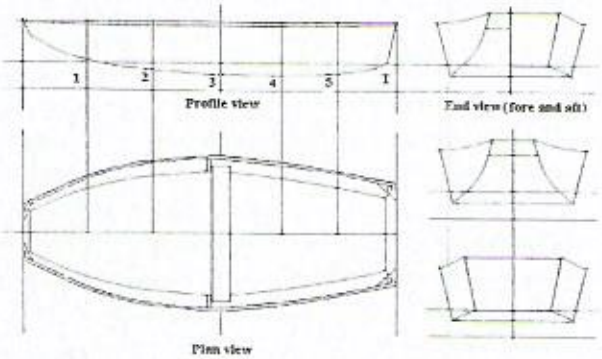

Figure 1: Design sketch

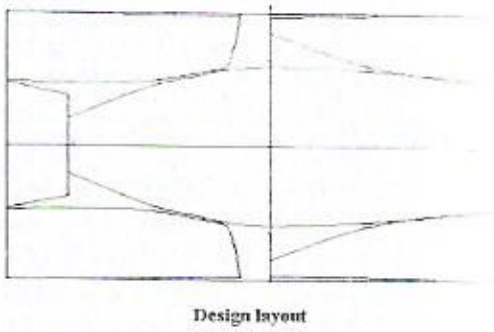

Figure 2: Design layout

The construction process utilized a sheet of ply wood leaving no leftovers, so the work achieved maximum utilization of materials. The cost of construction was N8,700, which is affordable in relation to the cost of local canoe of same size based on NIFFR, (2002). The canoe was easily maneuvered when propelled by paddling as it floated at a shallow draft, this makes the canoe adequate for use on shallow water bodies such as ponds and reservoirs. Such easily maneuvered craft can also be used on pond or reservoirs for recreation which include, sport fishing, canoeing.

Table 1: Design data (cm)

Design ordinates	Sections					
	1	2	3	4	5	T
Keel/chine HA/B	1.1	0.7	0.5	0.6	0.7	1.0
Chine H/B	1.7	2.2	2.3	2.1	1.7	1.4
Sheer HA/B	2.6	2.5	2.4	2.4	2.5	2.5
Chine H/B	2.3	2.8	3.0	2.7	2.4	1.9

Table 2: Specifications of the canoe

Length overall (LOA)	2.14m
Breadth overall (BOA)	0.75m
Moulded depth	0.37m
Draft	5.5cm
Light displacement	28.5kg
Displacement	228.5
Deadweight (capacity)	200kg(3 prs)
Scale	1:15.3

Table 3: Scantling sizes and cost

Material	Size	Qty	Unit	Amount ₦
Plywood	12mm	1	Sht	2,800.00
Hardwood	25X25mm	1	No	600.00
Hardwood	50X50mm	1	No	200.00
Screw	25mm	2	pkt	250.00
Wire nail	Assorted	2	Lb	300.00
Glue	1kg	1.5	Kg	400.00
Primer paint	4lt	0.5	Lt	250.00
Gloss paint	4lt	1	Lt	900.00
Expected labour cost				3,000.00

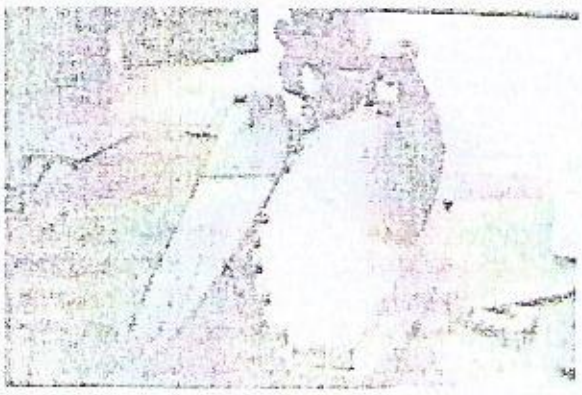

Plate 1: Marked plywood sheet cut into piece

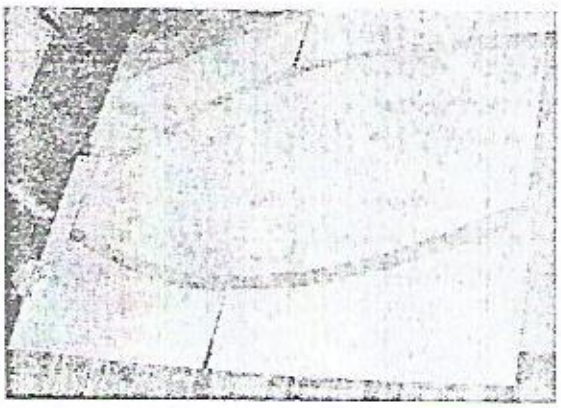

Plate 2: Fixing the side strips to the bottom strip

Plate3: Fixing of the other parts

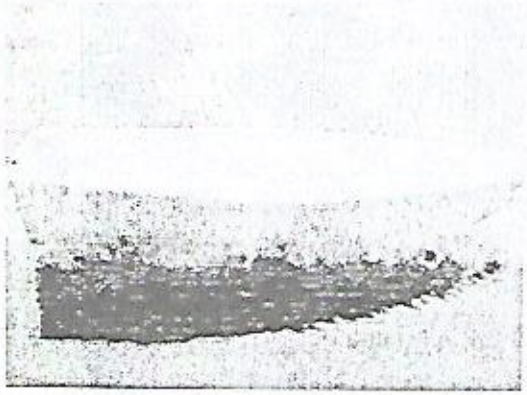

Plate 4: Completed canoe placed on water

The constructed punt, have light weight, least cost, ability to float at a shallow draft, adequate stability and easy maneuverability as its attributes. These important qualities are adequate for a craft needed for activities on shallow water bodies such as fish ponds. This canoe is recommended for use on fish ponds. It is also recommended that the technology be introduced to fishermen operating on calm water bodies as a replacement of the locally built canoes, which does not posses the qualities of the punt. It is recommended that same technology be used to construct larger canoes for use on bigger water bodies, to replace those local canoes that are characterized by short lifespan and low capacities.

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APPLICATION OF HOLISTIC APPROACH FOR SUSTAINABLE FISHERIES: A CASE STUDY OF KAINJI LAKE BASIN

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ABSTRACT
The sustainability of the resources requires much more than paying attention to a single factor, rather looking at it in a holistic manner. Specifically, other economic infrastructure and resources that form the essential components of the fisheries system and fishers livelihood needs to be considered. This to a greater extend will permit choice and mobility of livelihood portfolios, hence reduction in fishing efforts and sustainability of the sector, which eventually translate into development of the sector. However, provision of these facilities are often capital intensive and often left for the government along to provide.

INTRODUCTION
World Bank poverty assessment in Nigeria revealed that sustained long-term growth depends critically upon increasing the access of poor people to quality social services and essential infrastructure in order to enable them to increase human capital and make full use of their assets. Key priorities are health, education, water supply and sanitation, rural roads, availability of capital and credit, adequate market structure etc. These catalogues of infrastructure and economic factors are necessary conditions for economic growth. Increase in per capita income must be accompanied by certain modifications in economic or administrative arrangement or input (Long, 1976). The Nigerian fisheries system has witnessed series of studies, investigations and interventions over the years. However, the sector has not witnessed any remarkable transformation, particularly the actors. Looking at the scenario in Nigerian fisheries, the assertions of the World Bank (1996) and Kurien (2006) whom reported that addressing the problems of fisheries sector requires a holistic approach as opposed to reductionist approach; need to be taken with all seriousness for optimum growth and development of the sector. Generally, the absence of vital infrastructures that would permit diversification of livelihood portfolios often leads to exploitation of fisheries resources which translate to it depletion, low net income and poor well-being.

MATERIALS AND METHODS
The survey was conducted in Jan-Feb. and Aug-Sep. 2008 in order to capture the two flooding regime on the lake (high flood and draw dawn) and the two seasons (Rainy and Dry). The study covered the eight sub-stratums of the lake where 30 villages (10%) were randomly selected using random number generator from 297 (total number of fishing villages on the Lake basin) (Abiodun and Niworu, 2004) and 259 respondents were drawn using stratification technique. Apart from household survey, in each of these villages focus group discussion was conducted among elders and informants, with an average number of 12 respondents per community. Some guided questions were used for unification of results and easy analysis. Simple descriptive statistics were used for the analysis.

RESULTS AND DISCUSSION
The findings revealed that basic infrastructure that would enhance productivity and well-being of the fishers are grossly inadequate in most of the fishing communities around Kainji lake basin. Majority of the communities are without tarred road, electricity and market (86.7%) and majority lack financial institution (96.7%). The findings equally shown that most of the fishing communities are without other basic necessities such as bore hole, pipe borne water, health care centre, and primary school among others, Fig. 1 shows 70% 90%, 70%, and 40% of the communities are without those infrastructural facilities respectively. However, this survey revealed appreciable existence of primary schools in the fishing communities, though higher schools are virtually not in existence, 96.7% and 80% of the communities are without tertiary and secondary schools respectively (Fig.1). The findings conforms with that of Pollnac (1985) where he revealed that small-scale fisheries are generally located in rural and coastal areas near estuaries, often isolated from most development programmes/projects and generally lack infrastructure, which is the engine block for development. Specifically, FAO (2006) indicated that fishing communities often suffer from educational disadvantages due to location and social marginalization. Roads for instance play a vital role in

collection and distribution of goods and services; it allows access to markets and centre/hospital and permits easy delivery of fishing and farming inputs as well as local infor delivery particularly for communities without mobile phones. Absence of market with community may mean traveling long distance, which at times might be difficult and exorbitant fishers, especially during rainy season. Similarly, lack of electricity presents a great impedi engagement into other important livelihood portfolios like services eg barbing, operation of industry; grinding/processing. Access to credit facilities can play a significant role by servi buffer against uncertainty. Credit can as well be helpful in enhancing and expanding the entrepreneurship.

The importance of infrastructure as a catalyst of economic growth has bee acknowledged in the development literature. Infrastructure according to Lopez (2004) can d enter the production function and improve total factor productivity hence well being. The provision of infrastructures such as roads, water supply, electricity, schools among oth essentially vital components that are needed to stimulate rural income by increasing peoples and mobility of livelihood portfolios, hence reduction in fishing efforts and subsequen sustainability and development of the sector.

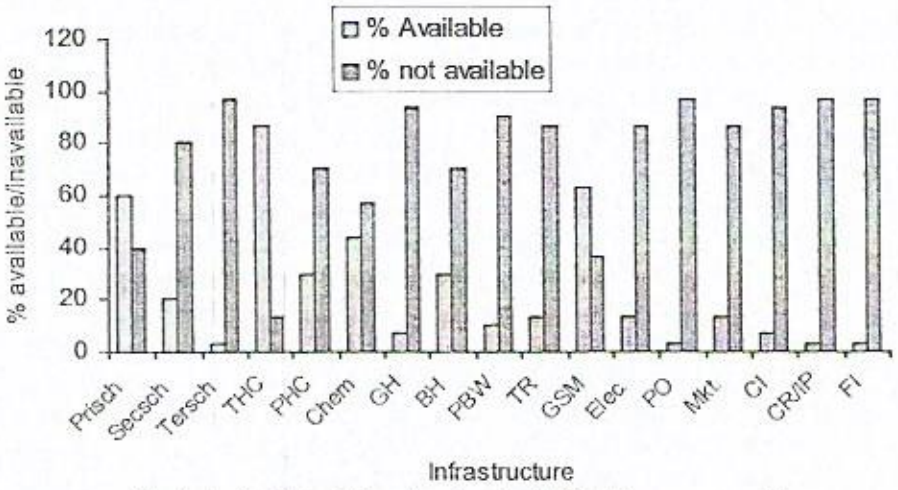

Fig. 1 Availability of infrastructure in KLB fishing communities

Keys: Prisch = primary school, Secsch = Secondary school, Tersch = Tertiary school, THC Traditional Health Centre, PHC= Primary Health Centre, Chem.= Chemist, GH= General Hospita BH = Bore Hole, PBW =Pipe Borne Water, TR = Tarred Road, GSM , Elec. = Electricity, PO= Po Office, Mkt. = Market, CI = Cottage Industry, CR/IP, Cold Room/Ice Plant, FI = Financ Institution, KLB = Kainji Lake Basin.

Providers of Infrastructure in KLB Fishing Communities

Government and private firms/individual are contributing immensely to the development infrastructure in the fishing communities. Most of the infrastructures (100%) are provided by th government, and few such as chemist and GSM by private firms/individual Table 1. GSM for instanc reduce transport cost, provide easy access to market information, increases capital and thereb improve fishers' income.

Need for Holistic Measures

The concepts of sustainable livelihood advocate for consideration of livelihood-related opportuniti and constraints regardless of where they occur (Farrington et al., 1999). They narrated the followi advantages of holistic approach to include the following

- It is a non-sectoral and applicable across social groups;
- It recognizes multiple influences on people, and seeks to understand the relationships betwee these influences;
- It recognizes multiple actors (from the private sector to national ministries, from community ba organizations to newly emerging decentralized government bodies);
- It acknowledges the multiple livelihood strategies that people adopt to secure their livelihoods;

- It seeks to achieve multiple livelihood outcomes, to be determined and negotiated by people themselves.

Table 1: Infrastructure Provider in KLB fishing communities

Infrastructure	Government.	Community.	NGO	Private Firm/individual
Prisch	100	0	0	0
Secsch	100	0	0	0
Tersch	100	0	0	0
THC	0	0	0	100
PHC	100	0	0	0
Chem	0	0	0	100
GH	100	0	0	0
BH	100	0	0	0
PBW	100	0	0	0
TR	100	0	0	0
GSM	0	0	0	100
Elec.	100	0	0	0
PO	100	0	0	0
Mkt.	100	0	0	0
CI	0	0	0	100
CR/IP	100	0	0	0
FI	0	0	0	100

Keys: Prisch = primary school, Secsch = Secondary school, Tersch = Tertiary school, THC = Traditional Health Centre, PHC= Primary Health Centre, Chem.= Chemist, GH General Hospital, BH = Bore Hole, PBW =Pipe Borne Water, TR = Tarred Road, GSM , Elec. = Electricity, PO= Post Office, Mkt. = Market, CI = Cottage Industry, CR/IP, Cold Room/Ice Plant, FI = Financial Institution, KLB = Kainji Lake Basin.

Infrastructures (electricity, school, roads, markets health care facilities etc) are grossly inadequate in many of the communities, and where available are developed by government. This will increase their vulnerability and inhibit their capacity to diversify into other income portfolios.

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CHALLENGES OF FISH FARMERS IN ONDO STATE

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ABSTRACT
This study assessed fish farmers in Ondo State, south west agro-ecological zone of Nigeria using a sample size of 100 respondents, selected through a multi-stage sampling technique. Instrument for data collection was semi-structured questionnaire. Data were analysed using frequency counts and % s of the respondents. Results showed that majority (52.0%) of the respondents are middle aged, 95.0% male, 93.0% married with a higher education (45.0%). The most important fisheries technology adopted by the farmers is disease control management. 67% indicated lack of finance and high cost of fish seed (58.0%) as the most important problems encountered. It was recommended that adequate incentive and grants should be given to farmers to finance fish production.

INTRODUCTION
Aquaculture in Nigeria dates back to about 50 years ago (Miller, 2003). It was born out of the need to check over exploitation of aquatic resource in water bodies, avoidance of extinction of certain fish species and for sustainability of fisheries and other aquatic resources for the teaming population. Studies showed that farmers have adopted backyard fish farming referred to as "homestead fish farming" and improved fisheries technologies (Nwabeze *et al*, 2007). Ayanda (2003) ascertained that the level of aquaculture practices in Nigeria over the years still remains extensive and semi-intensive. In spite of fisheries technology development and adoption, the quantity of fish importation in 2002 was 681, 151.80 metric tones valued at US $ 375,027,917.90 million, thereby making Nigeria the highest fish importer in Africa (Miller, 2003 and Eyo, 2004). Data on domestic fish production (in metric tons) has shown downward decline over the years, thus, 2005 (579,544), 2006 (636,848) and 2007 (615,507) as reported by FDF (2008). This has contributed to deficit of 1.4 million metric tons in fish supply (Fish network, 2009).

In the south west agro-ecological zone, aquaculture technology is a fast growing industry and provides sufficient animal protein supplement and substitute for capture fisheries. Improved fisheries technology is intended to increase productivity and the income earning of fish farmers. According to Federal Office of Statistic (1999), decline in productivity in the country could be attributed to low use of information as well as the improved technologies. The adoption of proven technology is to increase fisheries output which would also increase household disposable income. In order to sustain average domestic production to meet the demand of 1.6 million metric tones per annum (Fish network, 2009); an assessment of challenges faced by fish farmers need to be carried out in order to guide the policy on how best to bridge the gap that exist in fish production. The study's objective is to assess fish farmers in Ondo State, south west agro-ecological zone of Nigeria and in specific terms to;

(i) identify the socio economics variable of the fish farmers in the study area.
(ii) examine production constraints faced by the farmers in the study area.
(iii) assess fish farmers knowledge and adoption of improved production practices.

MATERIALS AND METHODS
The sample of the study was drawn from the population of fish farmer in Ondo State, south west agro-ecological zone through a multi-stage sampling technique. The state is divided into six zones (Akure, Owo, Ondo, Akoko North, Ikare and Okitipupa) according to Agricultural Development Programme (ADP) delineation. Four ADP zones (Akure, Owo, Ondo and Okitipupa) out of the six zones were purposively selected. Secondly, three cells were randomly selected in each block. In absence of the researcher inaccessibility to data on sampling frame 25 fish farmers were selected using purposive sampling in each of the three selected cells in each chosen block. Finally, a sample of 100 fish farmers formed the sample size for the study. Semi-structured questionnaire containing open and closed ended question was used to elicit information from the respondents; this was obtained by interview schedule. Data generated from the study were analysed using descriptive statistics.

RESULT AND DISCUSSIONS

Selected Socio-economic Variables of the Respondents

Table 1 shows that majority (95.0%) of the fish farmers in the study area are males while the rest (5.0%) are females. The low percentage of the female fish farmers could be attributed to limited access to information and credit facilities among others. In fisheries, women are mainly involved in fish processing, fish mongering and fish marketing to mention just a few channels of production. This agrees with the findings of Uchola (2000) and Alamu (1999) that women prefer marketing and distribution. Most (71. 0%) of the fish farmers are middle aged (41 - 60 years) with the potential to sustain fish farming and are more willing to follow the dynamism of fish farming. The findings also suggest that the respondents are economically active and independent. Majority (45.0%) of the respondents have higher education. This will affect respondents' positive responses to improve techniques of fish culture (Nwabeze *et al*, 2007). 93% of the respondents are married. A higher proportion of married respondents have implication on the quantity of labour available for fish farming activities. Most (68.0%) of the respondents operate semi-intensive fish farming system with 58.0% having an average pond size of 250m^2.

Table 1. Distribution of Respondents According to some Selected Personal Characteristics

Characteristics	Variable	Frequency	%
Sex	Male	95	95
	Female	05	05
	Total	100	100
Age	Below 20	0	0
	21 - 40	28	28
	41 - 60	52	52
	Above 61	20	20
	Total	100	100
Marital Status	Married	93	93
	Single	06	06
	Divorced	01	01
	Total	100	100
Educational background	Non formal	12	12
	Elementary	03	03
	Secondary	40	40
	Tertiary education	45	45
	Total	100	100

Production Challenges Faced by the Farmers

Figure 1 shows that the most important problem faced by the respondents are lack of finance (67.0%) and high cost of fish seed (58.0%). This could be attributed to lack of assess to micro credit institution among the respondents. High cost of inputs, lack of capital and credit facility has been found to be the primary constraints facing fisherfolks (DFID/FAO, 2004). The least important problem faced by the respondents' is lack of fisheries information (3.0%) and inadequate knowledge (4.0%). This could be attributed to effective extension delivery services in the area.

Fish Farmers Knowledge and Adoption of Improved Production Practices

Majority (64.0%) of the respondents adopt disease control management while 56.0% adopted water quality management. Disease and poor water quality management adversely account for increased mortality and subsequently low income earned in fish farming (Subasinghe and Bernoth, 2000). Most (50.0%) of the respondents adopted fish feed formulation. In fish farming, fish feeds account for about 60 percents of variable cost (Akiyama, 1988 as cited by Eyo 1989). This could be attributed to 50.0 % of the fish farmers resulting to adopting the technology of fish feed formulation. However, fewer percentages (16.0%) of the respondents adopted the use of natural fish food. This implies increased cost of production that would be borne due to high cost of procuring unconventional feed. The low level of adoption of fish processing/preservation (18.0%) and integrated fish farming (17.0%) shows a high level of unwillingness to adopt the technologies.

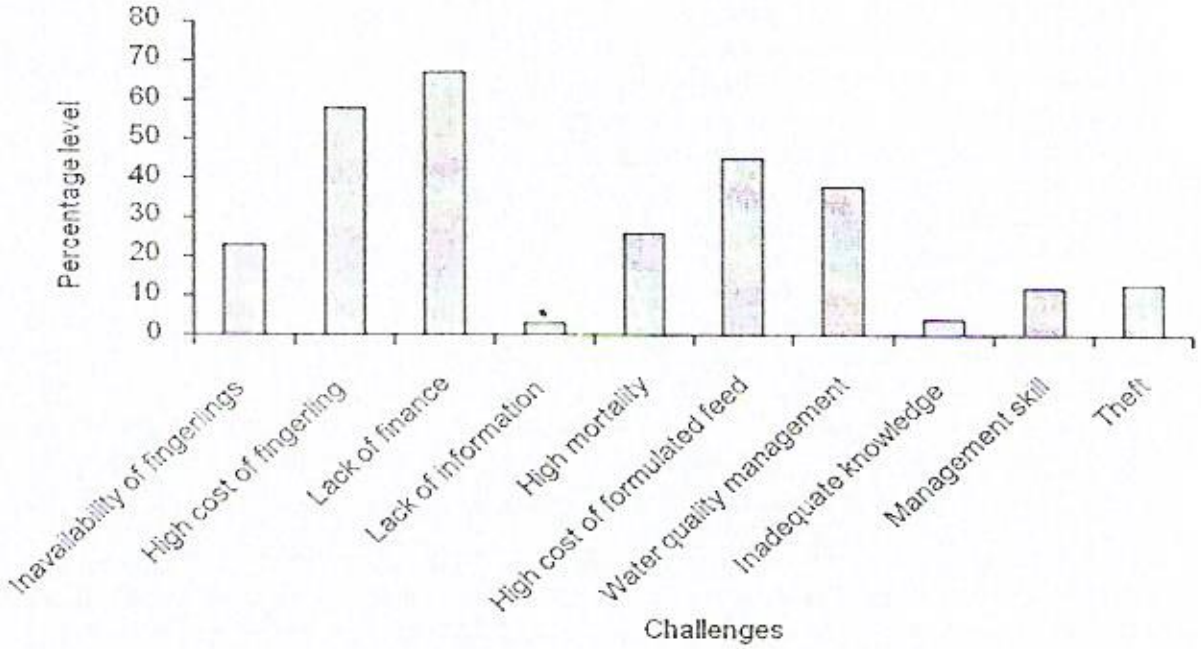

Figure 1: Percentage level of production challenges faced by fish farmers

CONCLUSION AND RECOMMENDATIONS

The study concludes that in spite of the various aquaculture technology adopted by the fish farmers which are disease control management and water quality management, artificial feed formulation, a lot still has to be done in order to fully realize the advantage accruable from fish farming in the study area. However, high cost of formulated feed is a major problem faced by the fish farmers.

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NUTRITIVE EVALUATION OF ENCLOSED SALTED-SOLAR DRIED *Oreochromis niloticus*

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ABSTRACT
This study investigated the effect of enclosed solar drying on the nutritive quality of unsalted and salted *Oreochromis niloticus*. Sensory and proximate evaluations were carried out on the salted and unsalted fish after drying. Acceptability, appearance, colour; odour, taste and texture of salted and unsalted fish differed significantly ($P<0.05$). The moisture, protein lipid and ash contents differed significantly ($P<0.05$). All dried fish samples from the enclosed dryers showed high levels of acceptability and protein content. However, fish samples brined at 25% and dried using Solar Tent Dryer had the highest acceptability and protein content.

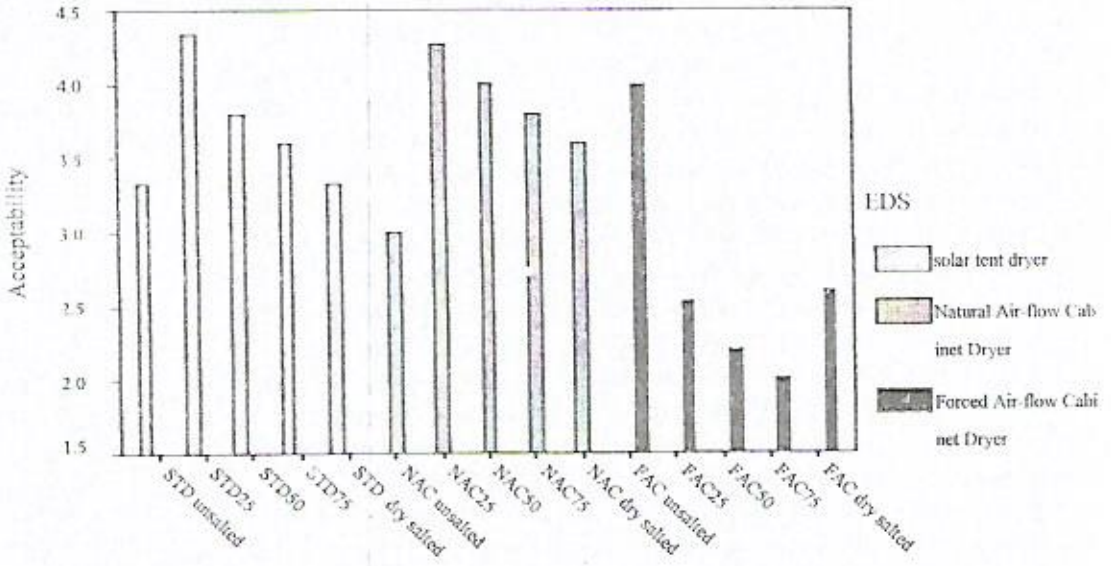
INTRODUCTION
Open air sun-drying of fish has many limitations. These include the fact that long periods of sunshine without rain are required, drying rates are low and in areas of high humidity, and it is often difficult to dry the fish sufficiently. The quality of open-air dried fish is likely to be low due to slow drying, insect damage and contamination from air-borne dust, and it is difficult to obtain a uniform product (Eyo, 2001). Thus, in the search for improved drying techniques using naturally abundant solar energy, the use of enclosed solar drying systems have recently been investigated as an alternative to traditional open-air sun drying. These enclosed systems are called solar dryers. Solar dryers employ some means of collecting or concentrating solar radiation with the result that elevated temperatures and, in turn, lower relative humidities are achieved for drying. When using solar dryers, the drying rate can be increased, lower moisture contents can be attained and product quality is higher. The dryers are less susceptible to variations in weather, although drying is obviously slower during inclement weather, and they do provide shelter from the rain. The high internal temperatures discourage the entry of pests into the dryer and can be lethal to those that enter (Trim and Curran, 1983). Many forms of solar dryer for use with agricultural and fisheries products have been developed in Nigeria. However, only a few of these have been developed specifically for fish. Few workers (Olokor *et al.*, 1997 and Ogali ; Eyo, 1998) have reported respectively on some aspects of biochemical changes in fish dried using tent and box types of solar dryers. In order to improve the quality of open-air dried fish and to provide information on the nutritive and keeping qualities of solar dried fish, this experiment was conducted to assess the effects of enclosed solar drying in the quality of fresh and differently salted *O.niloticus*.

MATERIALS AND METHODS
Three Enclosed Solar Drying Systems (EDS) were used. These were: Solar Tent Dryer, Natural Airflow Solar Cabinet Dryer and Forced Airflow Solar Cabinet Dryer. The Solar Tent Dryer (STD) was made up of polythene sheet stretched over a wooden framework (1.1m wide x 1.1m long x 1.5m high) with side and top vent of (0.25m x 0.25m). A framed wire gauzed rack (1m x 0.54m) with a drying area of $0.54m^2$ was suspended at about 60cm off the ground. Underneath the rack was the heat collector made up of a spread of irregularly shaped granite stones painted black. The Natural Airflow Solar Cabinet Dryer (NACD) has a drying chamber that was painted black both inside and outside. Inside the drying chamber was a framed wire gauzed drying rack (1m x 0.54m) with a drying area of $0.54m^2$ (2).A solar collector made of glass was connected to the drying chamber to produce the drying energy required. Airflow was generated by natural convection through the collector through the drying chamber and moist air leaves the dryer through the upper chimney-like opening. The Forced Airflow Solar Cabinet Dryer (FACD) has drying chamber that was painted black both inside and outside. Inside the drying chamber were a framed wire gauzed drying rack (1m x 0.54m) with a drying area of $0.54m^2$ and an electric powered two blade fan fixed to the ceiling of the drying chamber to force out the moist air. A solar collector made of glass was connected to the drying chamber to produce the drying energy required. Airflow was generated by natural convection through the collector through the drying chamber and moist air leaves the dryer through the upper chimney-like opening. The solar drying was carried out in each EDS simultaneously. Sixty (60) fresh *O. niloticus* were dried in each EDS used for the experiment. In each EDS the fish were divided into five groups and were salted using NaCl at different levels as described by Oyero, (2006). First Level -

Unsalted treatment (US) - The fish were not salted. Second Level – 25% brined treatment (25B) – the fish were immersed in 25% brine for one hour. The brine was prepared by dissolving 250g of NaCl in 1 litre of water. Third Level - 50% brined treatment (50% B) – the fish were immersed in 50 per cent brine for one hour. The brine was prepared by dissolving 500g of NaCl in 1 litre of water. Fourth Level – 75% brined treatment (75B) – the fish were immersed in 75 per cent brine for one hour. The brine was prepared by dissolving 750g of NaCl in 1 litre of water. Fifth Level – 100% Dry Salted treatment (DS) – the fish were rubbed on the surface and inside of the fish. Each level of salting represented a treatment. The drying took place at the Federal University of Technology, Minna. The fish were solar dried for one week. The sensory evaluation of the dried fish samples were evaluated weekly for four weeks by a trained panel of five evaluators. The evaluation was done on Hedonic scale of 5 based on the method of Doe and Olley, (1990). The parameters evaluated were taste, colour, odour/smell, texture, appearance and acceptability. The chemical analyses of proximate composition of the dried samples of *O. niloticus* were carried out using the methods of Association of Analytical Chemists (AOAC, 1990). The parameters analyzed include moisture, crude protein, lipid and ash.

RESULTS AND DISCUSSION

Figure 1 shows the acceptability of the sensory evaluation of differently salted *O. niloticus* dried using Enclosed Solar Drying Systems (EDS). Acceptability, appearance, colour, odour, taste and texture differed significantly ($P<0.05$). There was a direct relationship between the various parameters (appearance, colour, odour, taste texture and acceptability) of the dried *O. niloticus* products from the three solar dryers (STD, NACD and FACD). Dried samples from STD and NACD showed high levels of acceptability especially STD 25 NACD 25 treatments. None of the dried products in these two enclosed drying systems had a value less than 2.5 on the 5 point hedonic scale of measurement. This indicated that all the dried products from the two systems were widely accepted. However, despite this acceptability the unsalted treatment dried products in the STD and NACD showed the least values. The reverse was the case in the FACD. Only the unsalted treatment dried product in FACD showed a high value of 3.80 on 5 point hedonic scale of measurement. This could be attributed to the fact that the initial rate of drying is governed by heat and mass transfer processes external to the fish relative to the air speed all have direct effect on the drying rate. Thus in the early stages of drying the rate can be increased by increasing the air speed and temperature and reducing the air relative humidity. However, according to Doe and Olley (1990), there is a limit; if dried too fast a relatively impermeable layer can develop on the surface of the fish (case hardening) and at temperatures above 40^0C (depending on the fish species) This could be the situation here as it could be deduced that the forced airflow and the salting levels contributed to fast drying of the products.



ENCLOSED DRYING SYSTEMS (EDS) AND SALT LEVELS

Figure 1 Mean values of acceptability of *O. niloticus* differently salted and dried using enclosed drying systems (EDS)

Table 1 shows the moisture, crude protein, crude lipid and ash contents of differently salted *O. niloticus* dried using Enclosed Solar Drying Systems. Moisture, crude protein, crude lipid and ash contents differed significantly ($P<0.05$). All the treatments had moisture content values below 10%. The moisture contents obtained were lower than those obtained by Trim and Curran (1983). Moisture content was 25% was in the brined products and 25-40% moisture content in dry salted products. This low moisture content indicated that the dried fish products have the tendency to be very stable. From Trim and Curran (1983) results, the brined and dry salted products had a shelf life of approximately 100 days. In all the three drying methods, FACD showed the least of the moisture content when compared at different levels of salting. The moisture content decreased respectively in the brined dried products, of 25% brined, 50% brined and 75% brined treatments, according to the level of salting. It was observed that the higher the level of salting of the fish, the lower the moisture content. As expected, the unsalted dried products had the highest moisture contents in all the three drying methods. This was in line with Horner (1994) that the objective of dehydration is to remove water from the deepest part of the flesh quickly enough to reduce water activity below the minimum for microbial growth before significant spoilage takes place, the objective of salting is to ensure that salt penetration is rapid enough to similarly lower the water activity in the deepest parts of the flesh.

Table 1 Mean values of moisture, protein, lipid and ash contents of *O. niloticus* differently salted and dried using enclosed drying systems (EDS)

	SALT LEVELS	MOISTURE %	PROTEIN %	LIPID %	ASH %
STD	UNSALTED	10.01^{k}	58.86^{a}	13.40^{k}	18.09^{k}
	25% BRINED	8.91^{e}	65.47^{i}	13.49^{e}	13.06^{g}
	50% BRINED	8.81^{d}	64.71^{f}	14.22^{i}	12.52^{e}
	75% BRINED	8.65^{c}	64.20^{e}	14.03^{h}	13.10^{g}
	DRY SALTED	9.62^{g}	63.45^{d}	12.35^{b}	13.63^{i}
NACD	UNSALTED	10.03^{k}	59.03^{b}	15.55^{m}	15.44^{j}
	25% BRINED	9.04^{f}	65.95^{k}	12.00^{f}	12.04^{e}
	50% BRINED	8.53^{b}	65.03^{g}	14.42^{k}	12.03^{e}
	75% BRINED	8.52^{b}	64.98^{g}	14.35^{j}	12.23^{d}
	DRY SALTED	9.73^{i}	63.50^{d}	14.35^{j}	12.63^{f}
FACD	UNSALTED	9.80^{j}	60.25^{c}	20.87^{n}	9.03^{a}
	25% BRINED	8.81^{d}	65.99^{k}	13.53^{d}	11.65^{b}
	50% BRINED	8.45^{a}	65.55^{j}	13.95^{g}	12.06^{e}
	75% BRINED	8.44^{a}	65.26^{h}	12.87^{c}	13.43^{h}
	DRY SALTED	9.68^{h}	64.15^{e}	14.49^{l}	11.65^{b}

Data in the same column carrying the same superscript do not differ significantly from each other ($P>0.05$)

There was a strong inverse relationship between the moisture and crude protein contents. The three unsalted dried products had the highest moisture contents. This same trend was observed for all other products. After four weeks of storage, all the dried products showed crude protein contents well above 50% with the highest being that of FACD which was 65.99% and was not significant at $P<0.05$ from NACD 25 treatment which was 65.95%. All the dried products had low levels of crude lipid content apart from FACD unsalted treatment which was 20.87% and could be attributed to the nature of *O. niloticus*, which is classified as a lean fish (ILO-WEP, 1982). The reason for the exceptionally high crude protein content in the FACD unsalted treatment could not be adduced.

There was no consistency in the ash contents of the dried products and could be due to the possible inconsistency in the bone removal of the dried products before milling for analysis. However, the ash contents of all the dried products showed appreciable levels to indicate the dried fish products as good sources of mineral contents. All the salted-dried products from the three enclosed solar dryers showed higher levels of acceptability and nutritive quality in terms of protein content when compared to the outcome of Oyero *et al.* (2006). It is thus recommended that any of the EDS should be used as an alternative to open-air solar drying.

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IMPROVED FLOATING DIETS FOR AFRICAN CATFISH AND NILE TILAPIA

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ABSTRACT

Flotation potentialities of diets bound with Polymethylo-cabarmide and other local starches and *Saccharomyces cerevisiae* floater were investigated in the laboratory. The binders and floater were fixed at 10 and 4% respectively in isonitrogenous 30% crude protein diets for catfish and Tilapia. Flotation were significantly ($P<0.05$) highest (100.00 – 96.67%) in Polymethylo-cabarmide based binder. Wheat grains starch (WGS) was highest ($P>0.05$) among the local agents in the first 10 minutes. Cassava tuber starch (CTS) significantly ($P<0.05$) succeeded WGS from 15 minutes till end of immersion. The least effective was maize grain starch (MGS).

INTRODUCTION

The conventional sinking fish feeds (pellets, crumbles and mashes) are prone to instability and disintegration to the bottom waters at feeding. The resultant effects include significant losses in aquaculture input management and water pollution (Lopez-Alverado *et al*, 1994, Falayi *et al*, 2003). Extruded (floating) fish feed type reduces water pollution and enables fish culturists to observe how much and how actively their fish eat (Mgbenka and Lovell, 1984). Extruded feed is usually imported into the country and this is a drain in Nigeria foreign exchange. It is very expensive and much of the heat labile nutrients (proteins and vitamins) are lost to high temperature and pressure of the heated barrels which subsequently denatures the proteins and vitamins and made them unavailability to fish. The objective of this study is to evaluate the effects of different binding agents and *Saccharomyces cerevisiae* floater in fish diets flotation in waters.

MATERIALS AND METHODS

Four binding agents - starch derivatives from wheat grains (WGS), cassava tuber (CTS), cane molasses (CMS), yellow maize grains (MGS) were produced and fixed at 10 % in diets. Baker's yeast (*Saccharomyces cerevisiae)* (floating agent) was mixed dried with dough at 4%. Whole-wheat grains were de-hulled, milled and sieved to fine particulates and as wheat flour meal (WWM), a carbohydrate feedstuff. Cassava tubers was peeled, washed, tied in sac and soaked in water for 5 days. The left over was rid of the inner stem, pressed in the sac, to reduce water content and sun-dried for 3 days in March at New Bussa, Nigeria. The product obtained was milled and sieved to fine particulates and used as Cassava flour meal (CFM), another carbohydrate source of nutrient. Raw soybean was extruded at 121-130°C and 30 bar pressure gauge following Eyo *et. al*, 2003 methods. Groundnut cake was produced locally. Fresh clupeids (*Pellonula afzeluiisi*) fish was purchased at Fakun, New Bussa. The fish was sun-dried and later toasted at 55-60°C for 5 minutes in electric oven to obtain fragrance flavour, milled and sieved to fine particulates, used as fish meal (FM) fixed at 15%. Blood meal, Vitamins and minerals mix, common salt, methionine-DL and lysine- L supplement were fixed at 5, 2, 0.3, 0.5 and 0.5 % respectively. The carbohydrate and plant protein feedstuffs were formulated by equation methods (Halver, 1989) with the former in ratio 2:1 and the latter ratio 1:1 respectively as in Table 1 to obtain is caloric 37kcal/g is proteic 30% crude protein diets for *O. niloticus* fingerlings and *Clarias gariepinus* juveniles (Ayinla and Akande, 1988, Eguia *et. al,* 2004). All the milled ingredients were weighed and first mixed dried by hand in a plastic container. The floating agent was added and remixed. The binding agent was added and mixed. Vegetable oil was added last before thoroughly hand kneading was observed to obtain homogeneous hard paste texture (dough). The dough was placed in a hand pelletizer and rolled out in wet form via 4mm die holes in different lengths, into a flat waiting tray. The strands were cut into 2cm each after measuring with a pair of callipers. The wet strands were rolled into ball shapes and put in a tray with oil film, covered with lids and wrapped in cellophane sac for 2 hours to undergo maturation. The lids were removed and the expanded diets were put in electric oven and dried at 105oC for 3 hours. Samples (100g) of diets were put in sealed sampling bottles and sent for the proximate analysis following AOAC (1990) methods. Three replicate samples (20 balls) of each diet were dropped in aquarium measuring

60x30x30 cm3, filled to ¾ of it holding capacity with pond water. Aeration was done by electric aerators and air stones. The samples were allowed to remain in the medium for the period of test which covered one hour, and observation were conducted every 5 minute interval. At end of each observation, the numbers of diets remained afloat is recorded as floating diets. The mean number of the floating diets were expressed as % of the initial numbers.

Data obtained from the chemical analysis of diets, feed stability and flotation were subjected to ANOVA and the differences between the means tested for significant using the Duncan multiple range test at 95% confidence level (Duncan, 1955).

RESULTS AND DISCUSSION

The proximate analysis of the diets is shown in Table 1. The little variations in diets composition may have resulted from the differences in the nutrients available in those levels of inclusions of feedstuffs in diets. The results of the flotation are shown in Figure 1. The highest percentage flotation (100%) was seen in Polymethylo-cabarmide based diet (Aquatec-II). Higher flotation was recorded in WGS at 10 minutes and was significantly ($P<0.05$) lost to CTS from the 25th minute to end of test among the starches. CMS ranked 3rd from 5-15 minutes but became the poorest from 20th minutes to end of test. MGS recorded the least in flotation at every time of trial. The general floating tendency of diets may possibly be that during the dough preparation and oven drying processes, between 30-70% of the polar lipids and practically all polar lipids in ingredients interact with gluten in diets, and to a lesser degree, with other cereal proteins (Pomeranz and Chang, 1978) by both hydrophobic and hydrogen bonds. The reaction of polymer on starch particles in forming complexes with amylases (Greveling 1973) also help the sealing of air passages in the diets and subsequent buoyancy and flotation for longer time since the gas cannot escape. Results revealed fish diet can be suspended on water for some of time by involving Bakers yeast as floater at 4% inclusion and when good binders are involved. This could replace the high cost involved in importation of extruded feed and equipment and save foreign exchange earnings.

Table 1: Diets formulation and their proximate composition.

Ingredients g^{100} Dry wt.	DT1 WGS	DT2 CTS	DT3 CMS	DT4 Aquatec-II
Whole wheat meal (WWM)	27.53	25.31	25.36	24.64
Cassava tuber meal (CTM)	13.77	12.62	12.68	12.32
Fish meal (Clupeids)	15.00	15.00	15.00	15.00
Groundnut cake (GNC)	8.70	10.37	10.33	10.87
Extruded soybean meal (ESBM)	8.70	10.37	10.33	10.87
Binding agent	10.00	10.00	10.00	10.00
Blood meal	5.00	5.00	5.00	5.00
S. cerevisiae	4.00	4.00	4.00	4.00
Vegetable oil	3.00	3.00	3.00	3.00
*Vitamin & mins. Mix	2.00	2.00	2.00	2.00
Bone meal	1.00	1.00	1.00	1.00
Methionine-DL	0.50	0.50	0.50	0.50
Lysine –L	0.50	0.50	0.50	0.50
Salt	0.30	0.30	0.30	0.30
Proximate analysis				
Moisture %	7.85	6.90	7.00	5.50
Crude protein	30.10[a]	30.05[a]	30.04[a]	30.03[a]
Crude fibre %	3.20[b]	3.12[b]	3.26[b]	3.36[b]
Crude lipid %	8.53[c]	8.47[c]	9.48[c]	8.30[c]
Ash %	8.55[d]	9.00[d]	8.55[d]	8.20[d]

*Vitamin and Minerals premix contain the following per 100g:- Vit.A. 400,000 (IU), Vit. B_1, 0.0 0.16; Nicotinic acid 0.8, B_{12}, 0.0,D_3 80,000 (IU) K3,0.8, E, 0.8, Folic acid, 0.12, Choline chlo 0.1, Cobalt 0,16, Copper 0.32, Ion 0.28, Iodine 0.32, Manganese 2.56, Selenium 0.0064, BHT 0.0

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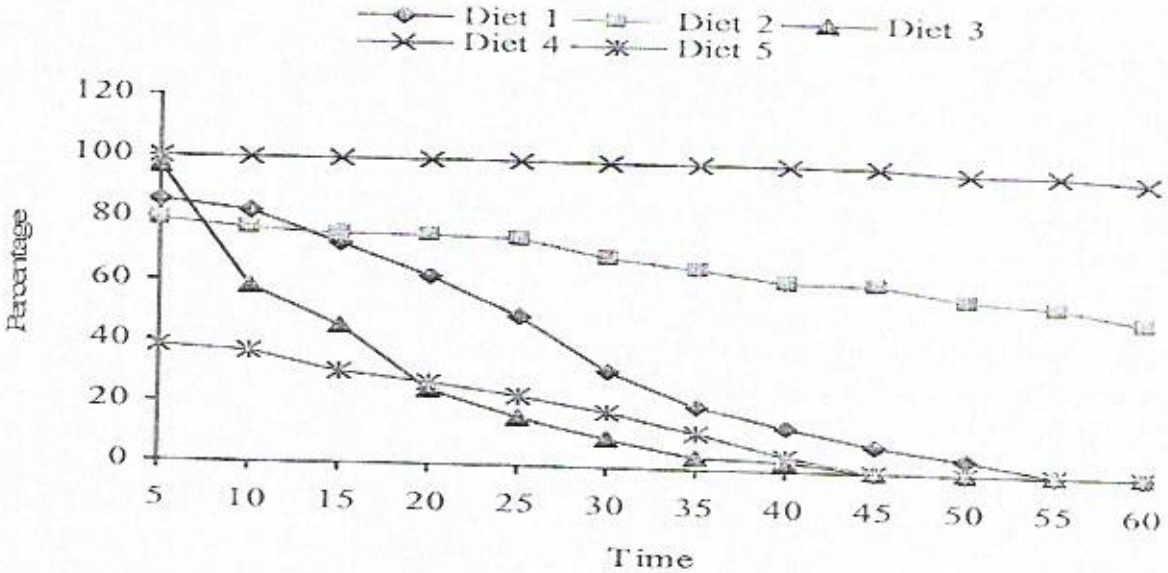

Figure 2: Percentage flotation of diets bound with different agents and *Sacharomyces cerevisiae*

CITRIC ACID AS PRESERVATIVE IN SMOKED CATFISH

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ABSTRACT
This study was carried out to assess microbial quality of smoked catfish (*Clarias gariepinus*) treated with citric acid during 8-week storage at room temperature. Raw catfish were subjected to the following treatments for 5 minutes prior to smoking: 1-5% citric acid. The non-treated catfish served as control. The control samples showed diverse and high microbial load. All treated smoked sample were negative for *E. coli and Streptococcus sp.* and low in their TVC, coliform, staphylococcus and fungi and maintained these low count till the end of the 8th week storage. Treatment with 5% gave the best result but 1 and 2% citric acid are preferred by the consumers. Treatment with 2% was recommended as an acceptable concentration in preserving smoked catfish due to its effectiveness and acceptance by the consumers.

INTRODUCTION
Fish are a very perishable commodity, more than cattle, sheep, and poultry, and get spoiled very easily even in temperate climates. Smoke drying of fish and/or meat products is one of the most ancient processing technologies. It has been for centuries used for preservation, and is still widely used for this purpose among several communities in the third world where up to 70% of the catch is smoked for preservation (Ward, 1995). Consumers are rediscovering the good taste of smoked fish, to satisfy the consumer demand, it is necessary to produce good quality and safe smoked fish. About one-third of the world's food production is lost annually as a result of microbial spoilage. Smoked fish and shellfish products can be a source of microbial hazards including *Listeria monocytogenes*, *Salmonella spp.*, and *Clostridium botulinum* (Heintz and Johnson, 1998). Omojowo and Ihuahi (2006) reported that smoked fish samples from 4 local Markets in Kainji Lake area of Nigeria were dominated by gram-positive bacteria, Potential pathogens, coagulase-positive Staphylococcus, and *Escherichia coli*. Delay or prevention of microbial spoilage of fish may be achieved by different preservative methods that include the use of smoking and chemical preservatives. Citric acid is a natural additive. It works to help keep bacteria and mold from growing on foods. It is found in citrus fruits, such as lemons and limes. Citric acid is also found naturally in the human body, so it causes no side effects in most of the population. This ingredient is used extensively in soft drinks as a preservative. There has been little or no information on its uses in the preservation of smoked fish. Hence this study investigated the impact of citric acid on smoked catfish during 8th week storage times at room temperature on microbial load.

MATERIAL AND METHODS
Clarias gariepinus were randomly assigned to 6 groups of 5 fish each. One group served as control; (2, 3, 4, 5 and 6) treated with 1, 2, 3, 4 and 5% citric acid for 5 minutes. A sample from each group was separated for microbial analysis and moisture determination. Smoking was done according to the methods described by Omojowo and Ibitoye (2005). After smoking and the fish were allowed to cool down and stored in different boxes. This was done to mimic commercial practices. The samples were drawn after 2, 4, 6, and 8t weeks of storage; then subjected to analysis. Total viable count (TVC), coliform, staphylococci and fungi counts were evaluated according to the methods described by Harrigan and McCance 1976; Speck 1984 and Sneath *et. al.*, 1986). Moisture contents AOAC (1980). All samples were done in duplicates. Sensory evaluation was carried out according to the method of Afolabi *et. al.* (1984). Statistical analysis was according to SAS, Institute, Inc, (1992) at $P < 0.05$.

RESULTS AND DISCUSSION
Total viable count (TVC), coliform, staphylococci and fungi count in log CFU/g of fresh and smoked fish samples are shown in Tables 1. TVC of the fresh non-treated (control) catfish was 6.60 log CFU/g but after the sample were subjected to treatments with 1-5% citric acid the TVC in the catfish was reduced to 5.16 log CFU/g in 5% and least in 1% (5.32 log CFU/g. Similarly, coliform count was reduced after the fresh samples were subjected to treatments with the citric acid to 3.74 log CFU/g in 5% and 4.06 log CFU/g in 1%. In the same vein, staphylococci count was reduced from 4.55 log CFU/g in the control to 3.68 log CFU/g in 5% and least in 1% 4.21 log CFU/g. In addition, fungi count in the sample was reduced from 4.52 log CFU/g (control) to 3.73 log CFU/g in 5% and least in

1% which was 4.32 log CFU/g. Smoke-drying sharply reduced the total viable count (Table 1) but the sample treated with 5% had TVC 5.37 log CFU/g. The TVC of smoked control samples was the highest during storage and was completely covered by mold after the 6th week; therefore, no further microbial analysis was conducted. Similar to TVC, the coliform count was also high in the control. Coliform count of the treated samples was <3.0 in the treated samples. This is similar to that reported by Efivuvwevwere and Ajiboye (1996) and Virginia (2002). In the staphylococcus population, the smoked sample treated with 4-5% citric acid reduced the staphylococcus count to 0 and remained 0 until the end of 8th week storage. The population of the Fungi reduced in all the treatments and at the end of the 8-week storage time. The TVC of the 2-5% treated samples were all about $5x10^5$ CFU/g to the 6th week which is an m in a three-class attribute plan and signifies good quality. The control however had TVC higher than $5x10^5$ CFU/g in the second week and higher than the recommended limit 7.0 log CFU/g (ICMSF, 1986) after the 4th week. In addition the coliform count already exceeded 10^3 even in the first week. This finding is of concern as a result of the associated public health implications (ICMSF, 1986).

All treated smoked sample were negative for *E. coli and Streptococcus sp.* The control samples showed the following bacteria flora *Bacillus coagulans, B. cereus, Klebsiella ozanae, Proteus vulgaris, E. coli, Staphylococcus aureus, and Streptococcus sp,* while the fungi isolated include, *Aspergillus niger, A. candidus, A. flavus and A. nidulan while* the smoked untreated catfish sample (control) were dominated by the following organisms *B. coagulans,* (about 70% of the isolates) while the remaining being *S. aureus*. The treated sample showed the microbial load in the following pattern; 1, 2 and 3% citric acid treated samples contained the following isolates *B. coagulans, K. ozanae, S. aureus, A. niger, A. nidulan, A. candidus, A. flavus, and Penicillium verrucosum. But* 4 and 5% citric acid contains the *B. coagulans, K. ozanae, A. niger, A. nidulan, and P. verrucosum.* Moisture contents of the samples weere within 78.2 - 79.4%, and decreased sharply after the smoking process to 19.95-21.35 (Fig. 1.). This decrease was due to loss of water during smoking (Asiedu *et al.*, 1991). The quality of the smoked fish was evaluated immediately after smoking and after storage for 8th week on taste, flavour, texture, appearance and overall acceptability. The fish flesh overall score was given using a hedonic scale of 1- 5. Fish scoring 2 or less being regarded as unacceptable. Table 2 summarizes the taste panel results where 1 and 2% were the most acceptable. The control was not tasted since it was covered with mould indicated by the asterisk (**).

Table 1: Microbial load of catfish treated with citric acid (Log10)

	Microbial group	Control	1%	2%	3%	4%	5%
B/4 Smoking	TVC	6.60^{a}	5.32^{b}	5.24^{b}	5.24^{b}	5.25^{b}	5.16^{b}
After ,,	TVC	4.59^{a}	3.98^{b}	3.91^{bc}	3.79^{c}	3.34^{d}	3.10^{e}
2nd week	TVC	6.04^{a}	4.41^{b}	4.36^{bc}	4.24^{cd}	4.09^{d}	3.87^{e}
4th ,,	TVC	6.52^{a}	5.10^{b}	5.16^{b}	5.12^{b}	5.08^{b}	4.63^{c}
6th ,,	TVC	7.35^{a}	6.03^{b}	5.88^{bc}	5.84^{c}	5.41^{d}	4.96^{e}
8th ,,	TVC	Mouldy	6.90^{a}	6.71^{b}	6.67^{b}	6.48^{c}	6.26^{d}
B/4 smoking	Coliform	4.60^{a}	4.06^{b}	4.00^{bc}	3.88^{cd}	3.80^{d}	3.74^{d}
After ,,	Coliform	3.54^{a}	1.75^{b} *	1.60^{b}	1.38^{c}	1.25^{cd}	1.10^{d}
2nd week	Coliform	4.10^{a}	1.91^{b}	1.80^{b}	1.48^{c}	1.34^{cd}	1.28^{d}
4th ,,	Coliform	4.43^{a}	2.10^{b}	2.06^{b}	1.67^{c}	1.76^{c}	1.63^{c}
6th ,,	Coliform	5.17^{a}	2.60^{b}	2.42^{c}	2.18^{d}	2.32^{cd}	2.19^{d}
8th ,,	Coliform	Mouldy	3.14^{a}	2.90^{b}	2.72^{c}	2.65^{cd}	2.52^{d}
B/4 smoking	Staph.	4.55^{a}	4.21^{b}	4.20^{b}	3.85^{c}	3.80^{c}	3.68^{c}
After ,,	Staph.	3.17^{a}	0.64^{b}	0.40^{c}	0.40^{c}	0.0^{d}	0.0^{d}
2nd week	Staph.	5.06^{a}	0.61^{b}	0.57^{b}	0.50^{b}	0.0^{c}	0.0^{c}
4th ,,	Staph.	5.32^{a}	1.20^{b}	1.10^{bc}	1.02^{c}	0.0^{d}	0.0^{d}
6th ,,	Staph.	5.52^{a}	1.70^{b}	1.62^{b}	1.33^{c}	0.0^{d}	0.0^{d}
8th ,,	Staph.	Mouldy	2.50^{a}	2.30^{b}	1.82^{c}	0.0^{d}	0.0^{d}
B/4 smoking	Fungi	4.52^{a}	4.55^{b}	4.56^{b}	4.60^{b}	4.62^{b}	4.50^{b}
After ,,	Fungi	3.11^{a}	1.80^{b}	1.68^{b}	1.24^{c}	1.10^{c}	0.67^{d}
2nd week	Fungi	5.28^{a}	2.20^{b}	2.17^{b}	2.14^{b}	1.71^{c}	1.24^{d}
4th ,,	Fungi	5.41^{a}	2.82^{b}	2.86^{b}	2.71^{b}	2.46^{c}	1.60^{d}
6th ,,	Fungi	5.70^{a}	3.30^{b}	3.24^{b}	3.26^{b}	2.98^{c}	2.18^{d}
8th ,,	Fungi	Mouldy	3.94^{a}	3.85^{a}	3.85^{a}	3.67^{b}	2.74^{c}

a, b, c, d, e, the means in the same rows with different superscript are significantly different ($p<0.05$).

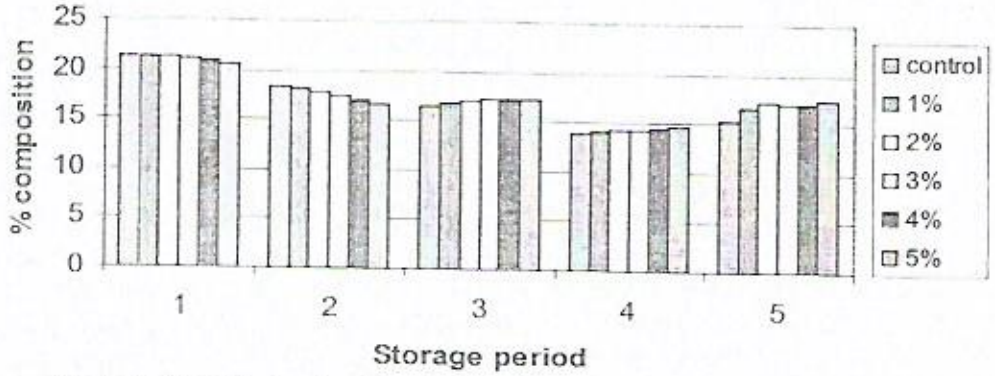

Fig. 1. Moisture Contents of Smoked Catfish Preserved with Citric Acid

Note, in x-axis 1= Day 1, 2= 2nd Wk, 3 = 4th Wk, 4= 6th Wk and 5= 8th Wk

Table 2. Organoleptic attributes of catfish treated with citric acid.

		Taste	Flavour	Texture	Appearance	Overall acceptability
Control		4.6	4.3	4.6	4.7	4.6
Freshly smoked - 1 %		4.6	4.7	4.3	4.8	4.8
	2 %	4.8	4.9	4.3	4.8	4.4
	3 %	3.7	3.8	4.1	3.6	3.7
	4 %	2.6	2.8	2.8	2.6	2.6
	5 %	2.5	2.6	2.4	2.2	2.5
Control (8th wk)		**	**	**	**	**
8th week old	1%	4.0	4.2	4.0	4.3	4.0
	2%	4.2	4.2	4.0	4.2	4.2
	3%	3.2	3.2	3.4	3.0	2.9
	4%	2.2	2.4	2.0	2.2	2.8
	5%	1.7	2.0	2.1	2.5	2.1

5= like much, 4 = like, 3 = neither like nor dislike, 2 = Dislike and 1= dislike.

CONCLUSION AND RECOMMENDATIONS

Though, 5% concentration of citric acid showed the greatest reduction of TVC, fungi, and ever staphylococcus population to 0 in most of the treatments however, organoleptic study has reveals that the samples treated with 1 and 2% citric acid are preferred by the consumers. In most of the various microbial count except Staphylococcus population, the output of 2% treatment is significantly different ($P<0.05$) from 1% treatment except in fungi count at the eight week. Thus, 2% concentration will be highly recommended. This 2% concentration was able keep the fish to ICMSF (1986) standard of good quality till the 8th week without adversely affecting quality in terms of lipid oxidation, color, microbial and nutritional quality for 8 weeks.

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DESIGN AND CONSTRUCTION OF 1.5M CORACLE FOR POND ACTIVITIES

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ABSTRACT
A coracle 1.5m (LOA) was designed and constructed using hardwood for the frame work and plywood for the base and side covering. It is oval in shape and after construction its light displacement was 24kg and with a dead weight (capacity) of 140kg (2 persons) with a cost estimate of N11, 500. When placed on water It floated at a draft of 4.2cm and easily maneuvered by propelling with a paddle. The craft is characterized by light weight, portability, and ability to float at shallow draft, hence could be used on shallow water body like ponds for aquaculture thereby increasing fish production.

INTRODUCTION
A fishing boat/canoe can be described as a floating plat-form used to transport the crew and equipment during fishing operation (NRC 1988). Although well designed fishing boats with adequate in-built fish boxes are in use in developed countries, they are generally not available in developing countries like Nigeria, where fish when caught are thrown into canoe which range from primitive to row-boat or canoes made of floating wood to dugout canoes, which in most case are not mechanized. The importance of water-borne craft in fishing activities cannot be over emphasized. Without a boat/canoe the fisherman is restricted to fishing along the shore hence reduced effective fishing (NRC 1988). One effective craft for shallow water bodies is the coracle. A coracle is a boat made of skin covered wicker work. It is a water-borne craft made in a basket form covered with hide or cloth. A coracle typically seems to be 0.9-1.2m wide, 1.2-1.8m long. Viewed from above, the shape of the coracle varies: some are round, some oval, some quite square with almost a flat transom, some with sharp bows (Stanley 2003).

In Britain coracle was derived from the bitumen-coated guffa of Iraq and the skin-covered coracles of India and Tibet. The coracle is an extremely shallow draft craft which floats on the water like a cork. As a result; it is particularly well suited for catching Salmon in the shallow, rock-strewn rivers of Ireland and the border country between Wales and England (Richard, 2008). Coracles are efficient for shallow water bodies and water bodies that are not turbulent and they are also paddled or more correctly sculled not to the stem but rather forward the bow using a figure eight stroke paddling to one side as one does a canoe (Stanley, 2003). In removing some aquatic weeds in large ponds and reservoirs it is more convenient using a craft rather than going into the water directly, especially those who can not swim can carry their activities on the water body effectively with the aid of a fishing craft.

The coracle is portable and easy to handle by a single fisherman or farmer and over the years it has been modified in such that it could carry three persons and as long as 1.7m. Made of plywood and other synthetic materials used for construction of boats that are more durable, more sophisticated, beautiful and portable that can be carried about easily (Stanley, 1991). The objectives of this study are to

1. Produce a cheap craft that could be used effectively on a shallow water body.
2. Enhance pond activities, thereby ensuring increasing fish production through aquaculture.
3. Boost the utilization of ponds for recreational activities.

MATERIALS AND METHODS
The materials used for the design includes: drawing board, drawing paper, cello tape, eraser, metre rule, and an HB pencil. The following materials were used for the construction: Hard wood, plywood, fastening glue, wire nail, sanding disc and paints while power tools, machines and basic carpentry tools such as planning machine, jig saw, harmer, saw and cramp were used for the construction work. A free hand sketch of the coracle was drawn on a sheet of paper. After which drawing instruments were used to draw the coracle to scale (1:7.5). A sheet of paper was fastened to a drawing board using cello tape, on the paper the margin lines were drawn and the water line and centre-lines were established using HB pencil. The 1m hardwood formed the thwart (seat) of the coracle and it serves as its width. This design is not in line with the design guidelines of Chapelle (1956). A 25mm x 30mm thick hardwood was cut to 1m in length and planned for smoothness. Then a 50mm x 50mm x 3.6m hardwood was cut to 1.5m in length using hand rip saw. The 1.5m hardwood being the length

the coracle was connected temporarily to the thwart by nailing together in a cross section. The 50mm x 50mm hardwood was cut into sizes and planned to reduce the thickness and made the laths flexible for effective bending. Two hardwood laths were wrapped around the ends of the thwart and the lengthwise batten. This was the first, innermost layer of the gunwale. The laths were cut to such lengths, that the ends land on the ends of the seat.

The ends of the laths were glued and nailed into the ends of the seat. The seat and gunwale were upside down. When turned right side up the top of the seat flushed with the top of the gunwale. A second layer of lath was wrapped on the first layer, glued to previous layer; the ends of the laths were nailed to the ends of the seats again. After the glue has hardened, the gunwale keeps its shape and the lengthwise batten was removed. Two laths were used because one could not give a firm framework and if a thicker one was used it would not allow bending. So the frame was held together using G-cramps and it was left on the floor for 24 hours to cure. This is in line with plywood coracle building according to Richard (2008). The floor was marked out on the 15mm thick plywood using the formed frame work. It was then cut out using a jig saw; then, the base was properly faired using spoke shave and smooth planner. A 50mm thick hard wood was cut into small blocks, then secured round the edges of the prepared floor with glue and nailed. A 50mm hard wood was also cut into 3 pieces of 32cm each and used as the supporting frame work for the thwart, one at the middle and two at the sides in series. The frame was then fixed to the base directly on the 50mm x 50mm hard wood, 32cm in height which was secured to the base vertically. To be able to sheet the coracle round, 5mm plywood was placed against the framework then marked and cut out according to its shape. The cut out sheet was used to cover the side round securing with proper application of good quality glue for water tightness. Glue was applied to the outer surface of the plywood and the second layer of plywood was secured round. The need for a double layer was to achieve the required thickness as it was difficult to bend a single thick layer. After this the entire body of the coracle was faired by planning and sanding. The final step was the painting; first, a coat of primer paint was applied to both the inside and outside of the coracle and allowed to dry, then the craft was coated with two layers of red oxide paint and allowed to dry. The canoe was conveyed from the College boat building workshop to one of the College ponds for testing. It was gently placed on water then allowed to float empty, while being observed for leakage, stability, and draft. The capacity was then tested for by allowing one person at a time, until it carried the maximum weight it could carry.

RESULTS AND DISCUSSION

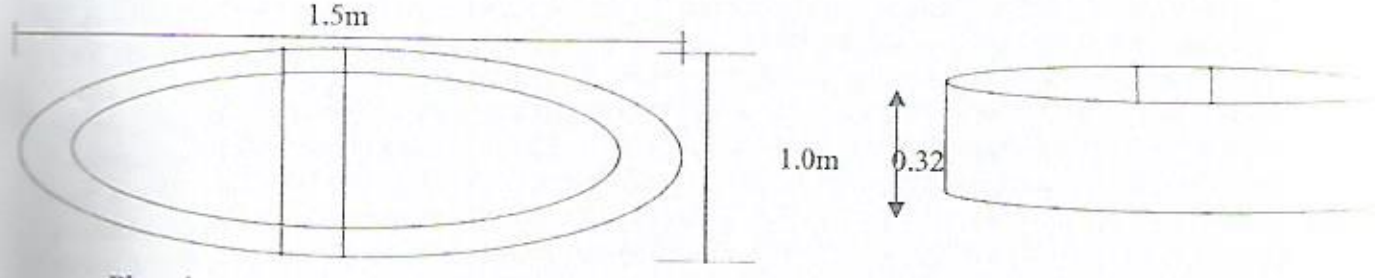
The design sketch (scale drawing) of the coracle obtained from the free-hand sketch is shown in Figure:1 Table 1 shows the specifications of the design obtained from the scale drawing. The steps followed in the construction of the coracle are presented in Plates 1 to 4. Table 2 shows the scantling materials and cost of construction which is within the cost range of local canoes based on NIFFR (2002). When the canoe empty was placed on water, it floated at a shallow draft of 4.5 cm with stable equilibrium where as the draft was 9cm and 14cm while carrying one and two persons respectively. During construction there was problem of covering the sides of the craft round with the plywood. It was not easy achieving this because bending the plywood to the round shape was difficult. The cost estimate of constructing the coracle (₦11, 500) This is an indication that the coracle will be affordable to an average fish farmer. The stability of the coracle from the result showed that the craft can carry two persons conveniently. However the craft carried three persons but the stability on water was poor. The weight of the coracle (24kg) shows that a single person can carry it convenently hence it is portable.

Table 1: Specifications of the canoe

– Length overall (LOA)	1.5m
– Breadth overall (BOA)	1.0m
Moulded depth	0.32m
– Draft	4.2cm
Light displacement	24kg
Displacement	164kg
– Deadweight (capacity)	140kg (2 persons)
Scale	1:7.5

Table 2: Scantling sizes and cost estimate

Material	Size	Quantity	Unit	Amount (₦)
Plywood	15mm	1	sht	2,800.00
Plywood	5mm	1	sht	2,000.00
Hardwood	25x25mm	1	No	600.00
Hardwood	50x50mm	4	No	400.00
Screw	25mm	2	pkt	250.00
Wire nail	Assorted	2	lb	300.00
Glue	1kg	4	kg	1000.00
Primer paint	*1gal*	*0.5*	gal	*250.00*
Gloss paint	*4l*	*1*	*1*	*900.00*
Expected labour cost				3,000.00
Total cost				**N11,500.00**



Plan view

Side view

Figure 1: Design sketch of the coracle

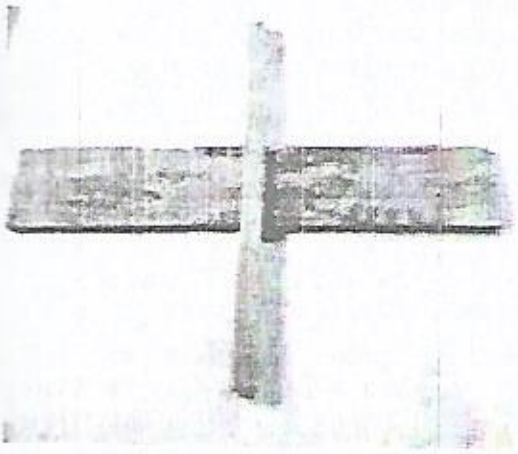


Plate 1: The thwart with a temporary framework

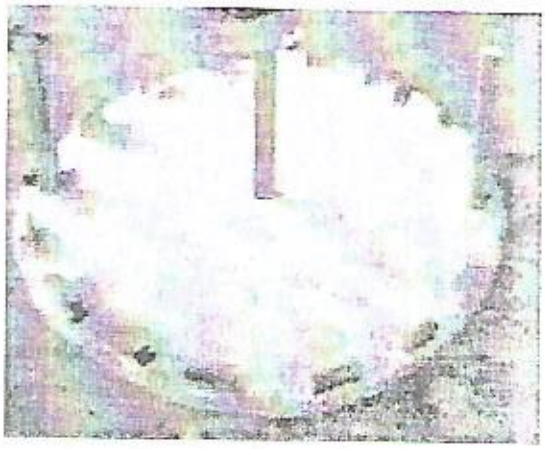


Plate 2: Floor of coracle with wooded block

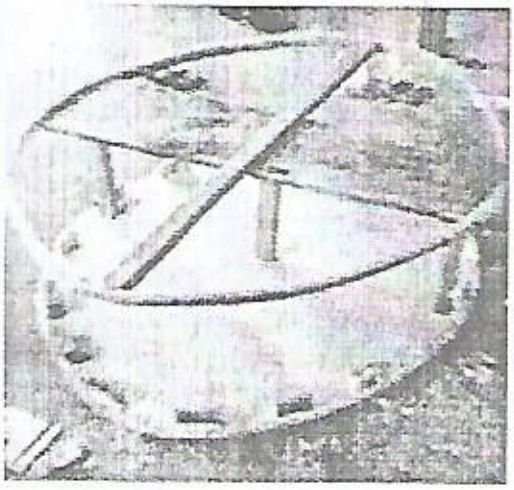


Plate 3: The Main Framework

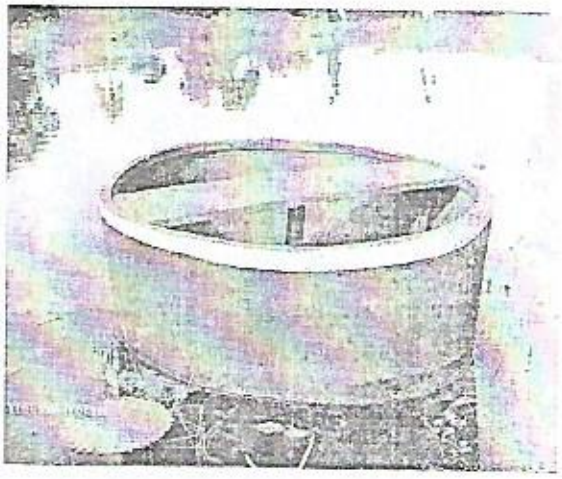


Plate 4: Completed coracle placed on water.

INFORMATION CHANNELS AS TOOLS TO ADOPTION OF AQUACULTURE TECHNOLOGIES FOR FISH FARMERS OF LAKE CHAD BASIN AROUND BAGA AREA

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ABSTRACT

study on contribution of information channels to adoption of aquaculture technologies was carried out in Baga area of Kukawa Local Government Area of Borno State. A total of 144 respondents were sampled with questionnaire in 2008 to generate data which was analyzed with descriptive statistical tools. Contact methods constitute the dominant sources of information to fish farmers while mass methods are grossly under utilized. Extension agents and State ADP championed information dissemination to respondents to attain 67.8% adoption. However, information were found to be less effective to meet fish farmers need for high productivity, thus creating doubt on reliability and accuracy of information. By implication, both fish farmers and EAs need training to improve their knowledge on aquaculture technologies. It entails strengthening linkage between fisheries research and extension for active participation in MTRM and FNT for easy access to information and practical knowledge. This should be supported by public-private partnership for promotion and sponsorship of aquaculture technologies in the mass media with other ICTs like tape, VCD, VHS, GSM for effective coverage and service delivery to fish farmers.

INTRODUCTION

Stagnation and decline in capture fisheries has put pressure in fish farming as an alternative to meet increase in fish demand. Intensification of aquaculture practice is associated with progress in technologies, efficient extension delivery and economic benefit to operators mostly in Asian countries that dominate fish farming. This is an indication that effective agricultural extension service delivery is sine qua non to agricultural development of any country. According to Asibaka (2008), dissemination of agricultural information and practices are central roles of agricultural extension. Extension ensures that proven technologies are disseminated to fish farmers for adoption in production process. Ekong (2003) defined technology as ways of applying scientific and organized knowledge to practical task (in this case fish farming). Dissemination of proven technologies is a communication process of sharing and distributing information to target audience to bridge gap in knowledge and bring change in attitude and skill of the end users. This was established by Talukdar and Sontaki (2005) where extension participation correlated with adoption of technologies in fish culture practice among fish farmers in India. Also Ahmed et al (1995) found that intensive information dissemination and training on technologies have positive effect on adoption rate of aquaculture technologies. Extension delivery depends on mastery of information process and technical competency on the subject matter for effective transfer of technology to fish farmers for application. In support of this, Ogunwale (2004) opined that for agricultural extension agents to fulfill their roles and tasks, they must have adequate technical knowledge to solve farmers' problems, have accurate information and supported with training. Hence, emerging view of extension is not that of service delivery or system, but of knowledge and information support function for adoption of innovations to improve standard of living of people.

Efforts to increase fish production from aquaculture lead to packaging of material and non-material technology in 12 extension guide series by the National Institute for Freshwater Fisheries Research (NIFFR) and disseminated to farmers through the State Agricultural Development Programmes (ADPs). In spite of this effort, fish production through aquaculture has not been proven to reverse the trend in high fish food importation, which is now Nigeria's main source of fish supply. In addition is reported fall in agriculture technologies levels of adoption and scanty studies in aquaculture adoption. Based on this, the study aims at determining level aquaculture adoption among fish farmers in : aga area of Kukawa Local Government Area of Borno State.

METHODOLOGY

This study was conducted in 12 villages namely, Dogon-chukwu, Dumba, Fulkime, Kangarwa, Madayi, Tumbun Barbarim, Tumbun Gini, Tumbun Mata, Tumbun Rago, Tumbun Shanu, Tumbun Yashi, Yobe, along the Lake Chad basin of Baga area of Kukawa Local Government Area of Borno State. In the absence of data on sample population, the researchers adopted convince sampling method

CONCLUSION AND RECOMMENDATIONS

From the results it could be deduced that the coracle, having light weight, shallow draft and equilibrium, is adequate for use on shallow water-body; hence it can be used as pleasure boat other activities on calm water bodies. This technology is recommended for aquaculture which include: removal of unwanted floating objects, aeration of oxygen depleted pon collection of water samples for water quality assessments, feeding of experimental fish in etc.

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from Eboh (1998) to determine sample size. With this method, 12 fish farmers were randomly chosen from each of the selected villages to get a sample size of 144 respondents for the study. Questionnaires were distributed to fish farmers to generate data for the study in the months of July to September, 2008. Data collected were analysed with percentages and frequency counts.

RESULTS AND DISCUSSION

Entries in Table one relates to the adoption behaviour of respondents on the 15 technologies under investigation. Majorities of the fish farmers (50.1) claim to have accepted the technologies whereas 49.9% are yet to adopt. Ekong (2003) attributed acceptance and rejection of innovation by farmers to incompatible experiences. While Oladele (2005) established extension contacts as the foremost factor leading to discontinuance use of technology by farmers. Low awareness and interest on technologies is a sign of passive and weak information dissemination due to low promotion of technologies. Out of 15 technologies examined, level of usage was relatively high whereas 4 recorded low usages among the fish farmers. Technologies withy low acceptance includes pond site selection, practice of poly-culture, stocking density/rate and access to improve fish seed from hatchery. These technologies have serious consequences on fish growth. Productivity and economic benefit derived by the fish farmers. Implication of finding on adoption behaviour suggests that fish farmers need training and promotion for awareness creation to motivate interest and increase levels of technologies usage/adoption in the State. This is a challenge to both Local and State government on proper funding of fishery aquaculture as public goods to benefit the people.

Table1. Adoption behaviour of fish farmers.

Technologies	
Adoption behaviour	%
Not aware	20.9
Heard but never use	25.4
Rejected after use	3.6
Still using technology	50.1

Table 2; Information Sources Adoption

Information Sources	%
Friends	3.3
Extension agents	44.9
Farmers' meeting	21.8
Extension guide	2.7
Seminar	25.5
Newspapers	1
Radio	0.7
Television	0.1

Table 3; Agencies used as Information Sources of Information.

Agencies	%
NGOs	15.3
State fishery Dept.	17.4
Research Institute	0.5
ADP	40.6
No contact with agency	25.2

Table 4; Multiple Response on Effectiveness

Effectiveness	%
Timely contact	11.9
Adequate content	12.4
Clarity of message	13.0
Not Effective	62.3
Aggregate effectiveness	37.7

Table 2 indicates that contact methods of communication (98.2%) are popular sources of information sharing and distribution, while mass methods (1.8%) are grossly under utilized to reach out to fish farmers. Ejembi et al (2006) agreed with the fact that the use of face to face methods to receive information by farmers was high compared to mass methods. The popular sources of information to the respondents are extension agents (44.9), seminars by NGOs (25.5%) and association of fish farmers (21.8%) whereas radio and television were least used to receive information on extension technologies. Studies by Ajayi (2003) agreed on the use of extension agents and farmers meeting as information sources. On low use of mass methods, Ifejika et al (2007) and Odika and Criscent (2008) attributed it to low content of agriculture and fishery in mass media programmes. It can be said that underutilization of mass methods to disseminate information is responsible for awareness of aquaculture technologies and to large extent slow growth and development in the country. By implication, extension agents require training for reliable and accurate technology transfer to fish farmers. It entails strengthening research-extension linkage for active participation in MTRM and FNT meeting supported by public-private partnership for promotion and sponsorship of aquaculture technologies in the mass media.

Data on table three shows agencies involved in the dissemination of aquaculture technologies to respondents in the study area. The state ADP (40.6%) is foremost in advancement of aquaculture to fish farmers. This is followed by little contribution from State Fisheries dept. (17.4%), NGOs (15.3%) and Research Institution (0.5%). The result on ADP is in line with Makun (1992) who opined that effective link for technology transfer would not be complete without the extension service component. This contention is evident in the T & V system and the unified system of the Agricultural Development Projects (ADP). In this system the village extension Agents (VEAs) are the last link between the researchers and the fishermen and as such much emphasis is placed on them since they are the small scale farmers' primary source of information on innovations (Goran. 1983). This goes to affirm the basically communicative nature of the extension agent's work. Consequently, effective communication coupled with a stated knowledge of the technical information he is supposed to transmit are vital ingredients for his success in the field. Effective Communication in this case is connected with effective comprehension of research information by the agent, as well as the level of his ability to impart the knowledge without the introduction of spurious information or loss of vital information. Difference observed on contribution of fisheries research is attributed to distance and non participation in monthly technology review meeting (MTRM) and forth nightly training (FNT) meeting in the State. NGOs are emerging private extension providers that should be mainstreamed and maximize to reach out to rural fish farmers. The projects established by NGO in some of the selected villages spoke for themselves that NGOs supports aquaculture development through extension services. Claim by 24.1% of the respondents on no access to agencies is an indication of weak extension contact and inadequate coverage linked to shortage of agricultural extension personnel particularly in fishery.

Response in table four is on effectiveness of information channels, which is measured by adequate content, timely contact and clarity of message is in agreement with Anderson and Feder (2004). The aggregate effectiveness of information is low with 37.7% response whereas vast majority (62.3%) claims ineffective of information to meet their need. Effectiveness of information to fish farmers is weak in terms of timely contact (11.9%), adequate content (12.4%) and clarity of message (13.0%). The result validates Agwu and Chah (2007) verdict that high ratio of extension agents will obviously affect effectiveness and efficiency of extension delivery through village extension agents. Conventional mass methods of television, radio, should be supported with video compact disk (VCD), tape recorders, GSM, SMS and VHS for wide reach and coverage.

The slow pace of aquaculture development has linkage with information dissemination to support adoption of technologies. The extension agents and the State ADP's contributions are weakened by ineffectiveness of information to satisfy fish farmers need. It entails adequate training of extension personnel, information packaging in modern ICTs and collaboration with fishery research Institutes to bridge the gap in knowledge, Hence, Local, State and private partnership advocacy are needed for financial support to achieve this task and boost fish farming in the state.

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ATTITUDE OF FISHERFOLKS TOWARDS ADOPTION OF EXTENSION ACTIVI
IN LOWER KAINJI LAKE BASIN

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ABSTRACT
This study examined the attitude of fishermen towards extension activities in the lower Kai Basin, Niger State. Simple random sampling technique was used to select five fishing villag which 100 fishermen were drawn for the study. Structured questionnaire was developed in lin the objectives to obtain information from respondents. Data collected were analyzed using freq and % counts. Majority (52%) of the fishermen was in their prime age and 57% had compl formal education or the other. It also indicated that 67% had >20 years experience in fishing a 40% use gill nets that gave 95% of respondents fishing gear maintenance job. About respondents reported irregular extension visits though 72% perceived extension service to b and that information on fisheries were obtained from the research institute (57%) which enha income of 65% of the fisherfolks. Recommendations were made on how to enhance ex delivery and adoption in the lake.

INTRODUCTION
Fish is a vital source of protein in the diet of most Nigerians. Fish also contains a number of and vitamins, which are valuable components of human dietary requirement and animal fe Fisheries provide gainful employment for many Nigerians. Apart from employment in direct many Nigerians earn their living from through processing, preservation and marketing while engaged in fisheries research project (Oladoja, 2005). Fisheries development programme o levels of government in the past failed to make desired impact on the fish production beca design and implementation lacked adequate research and extension (World Bank, 1980). In te extension in fisheries, they were concentrated in captured fisheries (Gaffar, 1990). Accor National Agricultural Extension Research Liaison Service (NAERLS, 1995) prospect for f extension development became brighter since the advent of the nationwide adopted training a extension system of the states. Agricultural development programmes institutional set up in t extension include; the NAERLS, Ahmadu Bello University, Zaria which has the mand dissemination, research findings from research institutes through print and electronic medi whole country and Project Coordinating Unit (PCU) which supervises the state ADP w responsible for grassroots extension delivery. The appraisal of fisherfolks attitudes towards ex activities is important because extension services use education principles to enhance the cap fisherfolks to enable them deal successfully with their problems. The main aim of fisheries ex is to help farmers who receive the service to increase incomes derived from various fishing a by increasing yield, reducing cost, improving exploitations of available resources and desig better mix of products (Keynan *et al.*, 1997).

RESULTS AND DISCUSSION
On age, 52% of the respondents have their age range between 21 and 30 years, while 27% fell 31–40 years, 15% accounted for the age group greater than 20years while 6% were within t range of 41 – 50 years. This implies that, majority of the fishermen are in their productive age it is expected of them to have high productivity. Also, 35% of the respondents have K education, 57% have primary education while only 8% have secondary education. This implie majority of the fishermen can read and write in English and/or Arabic, hence can decode p extension information in either languages. This supports Oladipo (1999) that in addition to education is an important factor in accessing productive resources. Analyses of fishing exper revealed that majority of the respondents (67%) possess a fishing experience beyond 20 years 23% of the fishermen had fishing experience between 11–19 years. Table 1 above shows the va sources by which fishermen obtained their fisheries information. The study revealed that obtained fisheries from the research institute, while 25% obtained from the ADP and 18% from sources varying from "Sarkin ruwa" and colleagues. Table 2 shows how often the respondents re information from extension agents. 72% of the respondents indicated that information on exte services were received yearly, 10% quarterly, 6% monthly while 12% never receive any visit from extension officers. The table also shows that none of the respondents receive informatio

extension services weekly. This implies that the rate at which information is received affects assimilation and hence adoption of innovation.

Table 1: Distribution of Respondents based on source of fisheries information.

Source	Frequency	%
ADP	25	25
Research Institute	57	57
NGO	–	–
Others	18	18
Total	100	100

Table 2: Distribution of respondents based on extension agents' visits.

Rate	Frequency	%
Weekly	–	–
Monthly	6	6
Quarterly	10	10
Yearly	72	72
Never receive visit	12	12
Total	100	100

Table 3 shows that majority of the respondents (64%) had extension services provided as being inadequate while only 23% saw extension services provided as being adequate and 13% saw the services of extension as being moderate. From the result obtained, this implies that extension service delivery is grossly inadequate in the study area. Table 4 shows the perception of respondent to extension service. Many respondents (72%) saw extension service to be useful, while 16% were not satisfied with the extension delivery and also 12% are of the opinion that extension service is not useful. The implication of this is that an increase in the extension delivery and numerical strength of agents can increase the level of acceptability and hence the adoption of innovations transferred to the target population.

Table 3 Distribution of respondents' reactions to adequacy of fisheries extension service.

Reaction	Frequency	%
Adequate	23	23
Moderate	13	13
Inadequate	64	64
Total	100	100

Table 4: Perception of Respondents to Extension Services.

Perception	Frequency	%
Not useful	12	12
Useful	72	72
Very useful	16	16
Total	100	100

With respect to impact of extension service on fishing activities, Table 5 revealed that 65% of the respondents perceived extension services have increased their income level, 7% indicated it enhanced their method of fish processing while 10% opined that it has increase their use of improved technology in fishing. This is indicative of enhanced extension delivery system for the socio-economic improvement of the fishing communities. Table 6 shows the distribution of respondents as

regards to specific extension service they receive from extension agents. It could be observed from the table that majority of the respondents (95%) benefited from service as regards to improved maintenance of fishing gear and craft, while 78% on the use of appropriate fishing mesh and 10% on preventing insect pest menace.

Table 5: Distribution of Respondents on impact of extension on fishing activities.

Impact	Frequency	%
Enhanced Income	65	65
Enhanced fish processing	7	7
Increased used of improved technology	10	10
No impact	18	18
Total	100	100

Table 6: Distribution of Respondents Access to Extension Service on use of innovation.

Activities	Frequency	%
Improved maintenance of fishing gear/craft.	95	95
Hygienic handling of freshly caught fish.	20	20
Use of appropriate fishing mesh size	78	78
Improved fish smoking kiln	12	12
Preventing insect pest menace	10	10
Total	215	215

CONCLUSION AND RECOMMENDATIONS

The study examined the attitude of fishermen in the fishing communities along the Lake B... Niger State towards technology transfer system.Fishermen only had access to extension ... provided by the research institute which was erratic hence they are of the opinion that ext... delivery in the study area is grossly inadequate. Though, some of the anglers were of the opin... extension activities are useful as it enhanced catch, qualitative processed fish, good storage ... and income. The study also revealed that only NIFFR extension agents were seemingly active ... study area. It was observed that irregular contact poor delivery and inadequate personnel resp... for technical ignorance, poor assimilation and hence low adoption and impact of extension d... system in lower Kainji Lake Basin. Based on the findings the following recommendations were ... Fishermen should be given adequate awareness so that they will not find it difficult to und... extension service when brought to them.There is need for regular visit (that is fortnigh... extension agents to the fishermen in other to train and disseminate information on new ... techniques because the rate at which information is receive affect adoption and assimilation ... state and local governments should provide other source of extension service such as Agri... Development Programme should be easily and readily available for fishermen. This will ... increase in the rate of extension service in the study area.

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COLLECTION AND MATURATION OF BROODSTOCK OF THE BLACK TIGER SHRIMP, *Penaeus monodon*

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ABSTRACT
Forty (40) broodstock of the black tiger shrimp, *Penaeus. monodon,* comprising of 16 males and 24 females were collected between November and December 2008 from three Nigerian Fishing Companies namely Karflex Fisheries Nigeria Limited, Honeywell Fisheries and ORC Nigeria Limited. The body weight ranged from 72.5 to 300g, total length from 24.0-34.0 cm and carapace length from 8.0-24.5cm. Abdominal length ranged from 10.3 - 16.0 cm, and telson length from 3.0-5.7cm. The stages of ovarian development ranged between 0 and 3.5 while the percentage of sperm carried by the females ranged from 0 to 100%. The broodstock were stocked in the maturation tanks in the Nigerian Institute for Oceanography and Marine Research shrimp hatchery and fed on squid to enhance gonadal development and maturation. Spawning of *P. monodon* was successfully carried out three times with an estimated production of one to two million nauplii at each spawning. Three hundred and twenty (320) post larvae (PL30) were stocked in concrete tanks for broodstock development. The post larvae have presently attained juvenile stage with average body weight of 16.01g. The availability of broodstock of *P. monodon* in Nigerian coastal waters will ensure successful hatchery production of post larvae for stocking of ponds leading to the development of shrimp farming.

INTRODUCTTION
Shrimp is the world's most important seafood commodity accounting for about 19 % of international trade in value terms. World shrimp production from fisheries and aquaculture has soared over the past 20 years to reach 4.65 million metric tonnes in 2003. Capture fisheries account for 3 million tonnes and are unlikely to increase, while aquaculture has seen a 10% per annum increase over the last decade (Banks, 2002). The family of Penaeid shrimps consists of approximately 110 species, ten of which are important for commercial culture. They occur naturally in the Indo-West-Pacific region, ranging from the eastern coast of Africa, the Arabian Peninsula, as far as South-East Asia, and the Sea of Japan. They also occur in eastern Australia, and a small number have colonized the Mediterranean Sea via the Suez Canal (FAO, 2002). Further invasive populations have become established in Hawaii and the Atlantic coast of the USA (Florida, Georgia and South Carolina). *P. monodon* is now available in Nigerian coastal waters and adapted to the environment (Ebonwu *et al.,* 2007). Juveniles of *P. monodon* occupy shallow estuarine waters sporadically entering rivers, while adults may be found in deeper waters up to 110 m especially over mud or sand bottoms (Grey et al., 1983).

The *Penaeus* species are shrimps that belong to the order of decapods (10 legs), which also includes the crabs, lobsters and crayfish. A main characteristic of the decapods is the fact that they have an exoskeleton which is shed during molting to allow further growth. The Black Tiger shrimp *Penaeus monodon* (Fabricius) is one of the most commercially important aquaculture shrimp species with production increasing from less than 1 000 tonnes in 1986 to 163, 000 tonnes in 1992 (Rosenberry, 1998). It tolerates wider salinity fluctuation, lends itself to domestication and has a well-established foreign market. The global annual average increase of farmed shrimp production rose to 1,087,111 tonnes in 2001 and valued at US $880,068,900 (FAO 2002). The Tiger shrimp ranked 20th by weight in terms of global aquaculture production by species and 1st by value (FAO. 1998). *P. monodon* is now estimated to account for 10% of the trawl caught shrimp in the Gulf of guinea (West Africa), even though it has only a recent introduction to the region. *P. monodon* is the largest of the penaeid species reaching 330 mm or more in body length, and exhibits the highest growth rate (Lee and Wickins, 1992) and suitable for intensive culture systems (Lightner, 1983; Johnson, 1989). Availability of broodstock of *P. monodon* for production of post larvae is a key factor in the development of shrimp farming in any country. Equally, the mode of collection and handling of the shrimp during trawling operations is also critical to their survival. Hence, broodstock collection from the wild is undertaken by trained scientists to minimize mortality and stress. This study investigated the feasibility of collection of live specimens of broodstock of Tiger shrimp from Nigerian coastal waters and subsequent spawning for hatchery production of post larvae.

LIFE – CYCLE OF TIGER SHRIMP

P. monodon are heterosexual animals with females attaining relatively larger size than ma (Primavera, 1988). The males captured from the wild possess spermatozoa at 37 mm carapace leng (CL) or about 35 g body weight (BW), and females at 47 mm CL or about 67.7g BW (Motoh, 1981 The females are highly fecund releasing over 248.000 to 811.000 eggs/spawn (Aquacop, 197 Motoh, 1981). There are five stages in ovarian maturation: undeveloped, developing, nearly ripe; ripe and spent (Primavera, 1980). A ripe ovary is large and lobed, 11-15% of BW, and at the widest por 0.5 the body width, also in the abdominal body. Unripe gonads are thread-like, and only located in th posterior body. A ripe gonad has a granular appearance and is gray-green. (Chen,1990). The adul spawn at sea. A mature male and recently molted female engage in a courting behavior, after whi the male inserts sperm in the female sexual opening, the thelycum. The female can carry the sper with her until she spawns the eggs or until she molts. When the eggs are released from the body, th pass the sperm and are fertilized. Females usually spawn within hours of fertilization, mostly at nigh

The floating eggs, 200-300 micron in diameter, drift with the sea currents and develop in naupplii. This planktonic stage does not look like the adult shrimp; they are almost round in sha with featherlike arms protruding in all directions. *P monodon* has six nauplii stages followed by zoea stages, 3 mysis stages and finally the post-larval stages. The postlarvae finally settle on t substrate in a coastal area and start a benthic life. The juveniles grow up near the coast, in mangro areas or in more inland marshlands and estuaries. *P. monodon* juveniles prefer seagrass and weed be (Chen,1990). Hatching occurs 12-15 hours after fertilization. The larvae (nauplii) are free swimm and resemble tiny aquatic spiders. This first stage in larval development does not feed but lives on yolk reserve and passes rapidly through six moults. The next larval stages (protozoea, mysis and ea post larvae (PL)) remain planktonic for some time and are carried towards the shore by tidal curren Protozoea, which have feathery appendages and elongated bodies, moult three times and th metamorphose into the mysis stage. Mysis which have segmented bodies, eyestalk and t characteristic of adult shrimp, also moult three times before metamorphosing into PL with simi characteristic to adult shrimp.

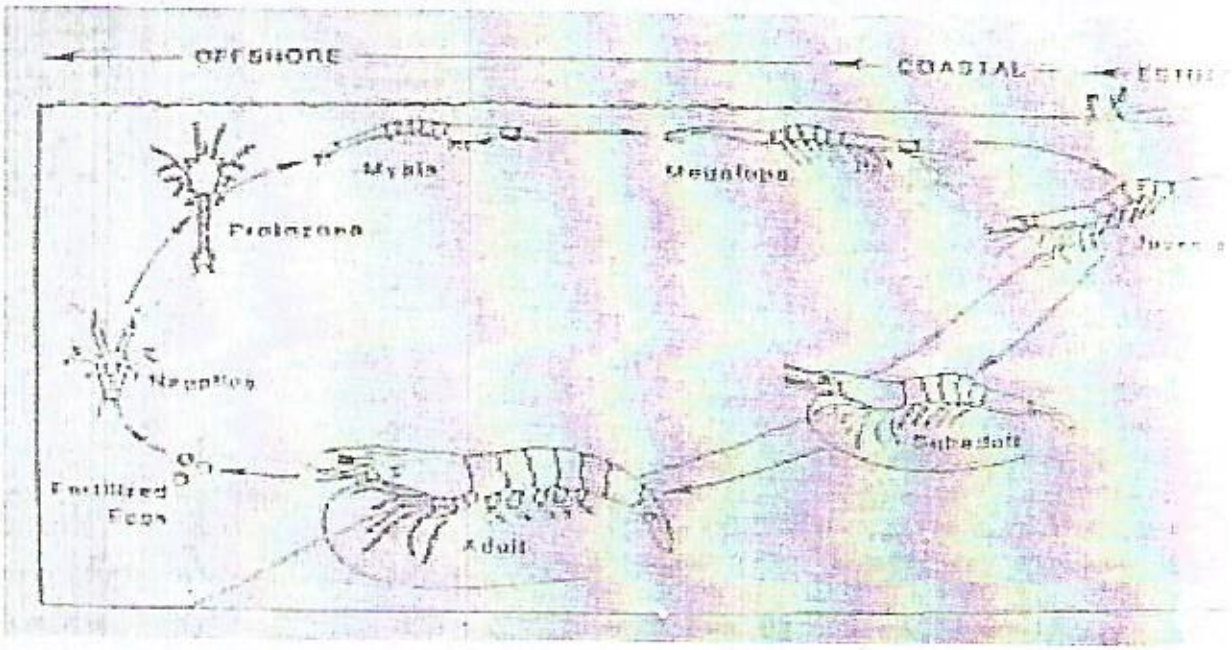

Fig 1. Life- cycle of Shrimp

COLLECTION OF SHRIMP BROODSTOCK

Live broodstock of *P. monodon* were collected from three Fishing Companies namely Honey Karflex and ORC as well as during NIOMR sea trips on - board F/T Susainah, one of fishing tra belonging to Honeywell Fisheries Limited (Plate 1). Most of the samples of the Tiger shrimp caught and collected in the night at depths of 10m, 20m, and 30m (Fig. 1). Activities perfo during the sea trip included:

- Trawling for fish, shrimps and other invertebrates,
- Sampling for Benthos / Plankton,
- Water and sediment physico-chemistry,

- Microbiological sampling, other tasks are
- Collection of live samples *of Peaneus monodon*,

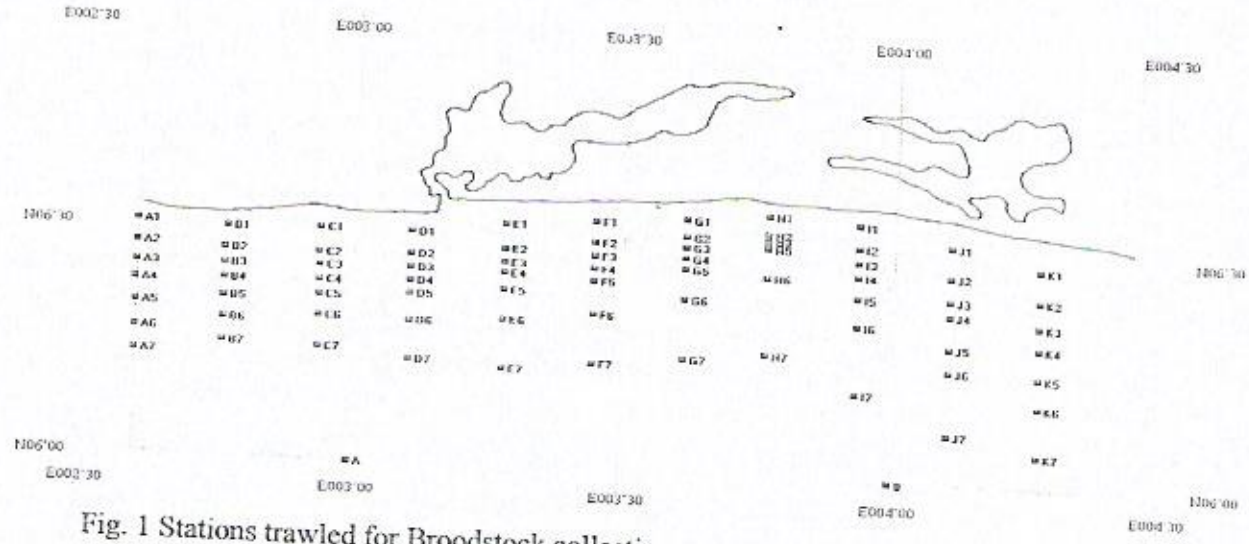

Fig. 1 Stations trawled for Broodstock collections

Three plastic containers were used for the broodstock collection and were equipped with either electric or battery operated aerators to keep the water constantly aerated on board and during transportation to NIOMR Shrimp hatchery (Kungvankij et al., 1985). The boat operateed on side trawl and each time the Captain launched the net in water, the boat will steam for thirty to forty minutes from one station to another before the nets are haulled up (Kungvankij et al., 1985). As soon as the net was hauled up, the caches are immediately released on the deck after pulling out the rope that closes the cod-end of the trawl net. All the catches were discharged on the deck and broodstock of *P.monodon* were quickly picked, examined and put in fresh, clean, and aerated seawater. Due to the long duration of the trip, live broodstock could not be collected and kept in captivity on board for a very long time; therefore, all the samples collected in the first three days of the trip were not kept alive. However, morphormetric characteristics i.e. total length, carapace length, abdominal length and telson length of dead samples were taken and stages of ovarian development determined. Immediately the vessel landed at the Kirikiri Jetty, the containers were discharged and quickly transferred to awaiting truck for final transportation to NIOMR hatchery. The body weights of broodstock of *P. monodon* collected from three fishing companies namely Karflex Fisheries Nigeria Limited, Honeywell Fisheries and ORC Nigeria Limited and stocked in the maturation tanks in the shrimp hatchery ranged from 72.5 to 300g (Plate 9). The total length (TL) ranged from 24.0-34.0 cm, Carpace length (CAL) 8.0-24.5cm, abdominal length (ADL) 10.3-16.0 cm, and Telson length (TEL) 3.0-5.7cm. Forty live specimens were collected comprising of 16 males and 24 females. The stage of egg development ranged between 0 and 3.5 % while the percentage of sperm carried by the females ranged from 0 to 50%.

SCREENING OF BROODSTOCK

Quarantine procedures were carried out before the breeders are introduced into the maturation tanks in preparation for spawning.Broodstock collected from the wild were screened and quarantined before stocking, Formalin (5%) was used for disinfection before transfer to the quarantine tanks. They were held in isolation until their health or disease status was ascertained. The breeders were later transferred to the maturation tanks for conditioning. Water quality parameters monitored in the broodstock tanks during acclimatization and maturation showed that salinity ranged from 30 -32.0 ppt, pH 7.5-7.6, alkalinity 120-144ppm, air temperature, 26.5-34.0 °C and water temperature 28.2 - 30.7 °C. Ammonia and nitrite levels ranged from 0-1.2 mg/l and 0-0.1mg/l, respectively

MATURATION / EYE-STALK ABLATION

Broodstock caught from the wild but still immature were fed with fresh diets (squid meat) to hasten maturation of their gonads. Hormones produced in the eyestalk control the development of the gonads in shrimps. Induction of maturation in the Tiger shrimp was by unilateral ablation of either the right or left eye of the female. Eye stalk ablation was carried out by cutting off ½ to 2/3 of the eye-stalk

with red-hot pincers The process of eyestalk ablation initializes gonadal development begins. The ablated females were checked daily for their readiness to spawn.

SPAWNING AND LARVAL REARING

Gravid females in Stages 3 and above were selected from the maturation tanks and transf spawning tank. The eggs were normally released at night and hatching occurred within 1 The spawning tanks were covered with black tarpaulin (Plate 8). Spawning of *P. mo* successfully carried out three times with an estimated production of 1-2 million nau spawning. The nauplii were transferred to the nursery tanks after hatching and after yolk they were fed with the micro algae *Skeletonema* and *Chaetoceros* from Thailand. The alga bloomed in the laboratory and then transferred to the outdoor tanks for mass culture. I nauplii were also given to the larvae from the mysis stage. The first post larvae of produced in NIOMR shrimp hatchery weighed between 2.0 and 3.5g (Plate 9). The m measurements showed that total length (TL) ranged from 3.5 - 6.5 cm, carapace length (cm, abdominal length (ADL) 3.0-3.5 cm while telson length (TEL) was 1.0. Three hu twenty (320) post larvae (PL_{30}) were stocked in concrete tanks for broodstock developme larvae have presently attained juvenile stage with average body weight of 16.01g.

CHALLENGES

The major challenge encountered during this study was the high mortality rate of broodsto from the fishing companies due to handling stress and power outages. Also landing o specimens was another drawback. The collection of *P.* monodon breeders from the wild is practice in many countries that are just starting shrimp farming. The broodstock are pre territorial waters and gravid females and mature males are often landed. The major deme collection is that there is no genetic background information and pathogens may be transf the wild into the hatchery. Around Taiwan, the supply of *P. monodon* broodstock is betw and November (Chen,1990).. This period was found to be similar to the supply of the speci Nigerian shrimp trawlers.

THE WAY FORWARD

The availability of broodstock of *P. monodon* in Nigerian territorial waters is a positive ind viable shrimp culture industry in Nigeria in the near future. Equally successful hatchery pr post larvae at NIOMR shrimp hatchery fis bold step towards development of shrimp Nigeria. The thrust of future studies will centre on:

- Development of farm raised broodstock to avoid depletion of wild stocks.
- Establishment of earthen pond culture systems.
- Development of management protocols for broodstock production.
- Information dissemination to stakeholders on sustainable shrimp farming and oth environmental issues.
- Development of good quality local feeds for P. monodon broodstock.
- Shrimp genetic research
- Development of disease management protocols in broodstock rearing.
- Development of production certification procedures to meet the international export
- Capacity building.

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DESIGN AND CONSTRUCTION OF A SHRIMP HATCHERY FOR THE BREEDI OF THE BLACK TIGER SHRIMP, *Peneaus monodon*

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AFOLABI, E.S., OGUNTADE, O.R, AYAOBU-COOKEY, I. K., ASIKHIA, G.I.
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ABSTRACT
A shrimp hatchery for the breeding of the black tiger shrimp, *Penaeus monodon* was cons the Nigeria Institute for Oceanography and Marine Research in 2008 by the reconstruct existing old shrimp hatchery. The new shrimp hatchery comprises of the following: water water storage, broodstock maturation, spawning/incubation, nursery and micro-algae design included the construction of a concrete sump for the collection and treatment of w before disposal, in addition to an aeration unit equipped with root blower for adequate dissolved oxygen. The reconstructed NIOMR shrimp hatchery has been successfully us production of post larvae, which are presently being reared to adult shrimp in concrete successful completion of the shrimp hatchery and breeding of *P. monodon* has confirm species can be spawned and reared to adult size in Nigeria for local and export markets.

INTRODUCTION
Generally, design is a process of applying engineering knowledge, skills and point of relations, structures, devices and processes according to some standards in order to perfo tasks. Designs of animal production systems are primarily determined according to the tar production target, and level of financial input (Platon, 1978, Kato, 1980, Clyde, 1982 and K 1982, 1986) . The designs usually take cognizance of the over-all efficiency of the produc in enhancing growth and survival of target species as well as good management protoco and Fox, 1999). Two major hatchery systems are adopted worldwide for animal productio in fisheries i.e. small-tank hatchery and large-tank hatchery (Mock and Neal, 19 commercial operations adopt the large-tank systems and this may or may not in recirculation (Kungvankij et al, 1985 and Van-Wyk, 2001). The re-constructed NIO hatchery is a small-tank hatchery targeting the propagation of *P. monodon*. The wa capacity was estimated based on an approximate ratio between algae culture tanks and l tanks. The design and reconstruction of NIOMR shrimp hatchery was based on the follo parameters according to Suthep (2008).

Water Reservoir Tank	– 44%
Larvae Tank	– 22%
Water Treatment Tank	14%
Algae Tank	– 12%
Broodstock Maturation Tank	– 8%

Total Hatchery Holding Tank Capacity (C_T) = $P_y / R_n P_r$

Where:
- Py – Production target of PL per year
- R_n – production target of PL per cycle
- P_r – production rate of PL per m^3
- PL – Post Larvae

Estimation of NIOMR Hatchery Total Holding Tank Capacity was based on the followin

Production Target	= 1.26 million PL per year
Production cycle per year	= 7
Duration per cycle	= 40-45 days including tank preparation
Production rate of PL	= 3000 PL / m^3

Data analysis
P_y = 1.26 million PL
R_n = 7
Production target per cycle = 180,000 PL
P_r = 3000 PL/m^3

$C_T = 1{,}260{,}000/21{,}000 = 60m^3$

Based on the total water volume of $60m^3$ for the hatchery, the different components were calculated as follows:

Water Reservoir Tank = 44% of $60m^3$ = $26m^3$
Larvae Tank = 22% of $60m^3$ = $13m^3$
Water Treatment Tank = 14% of $60m^3$ = $8m^3$
Algae Tank = 12% of $60m^3$ = $7m^3$
Broodstock Maturation Tank = 8% of $60m^3$ = $5m^3$

MODIFICATION OF NIOMR OLD SHRIMP HATCHERY

The layout of a shrimp hatchery is a schematic design of the locations and the integration of various facilities such as buildings, tanks, pump house, air supply system and powerhouse required for the production system adopted. Other facilities included were, shrimp laboratory, piping of water and drainage canal. The layout of NIOMR hatchery is presented in Fig.1.

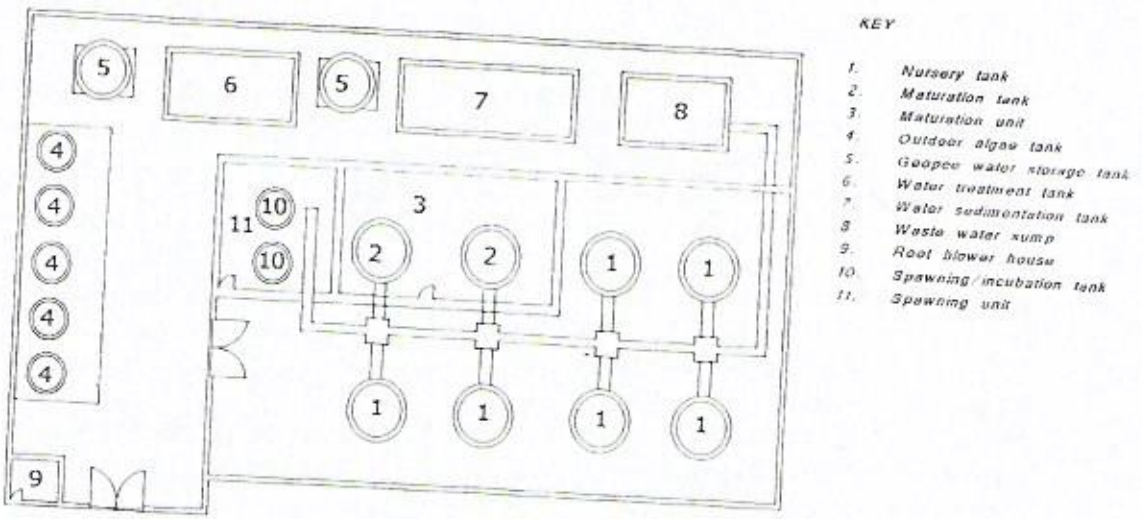

Fig.1 LAYOUT OF NIOMR SHRIMP HATCHERY

The following modifications were made for effective running and operation of NIOMR old hatchery:

- Asbestos roof on the Larvae and maturation tanks were replaced by transparent plastic roof of $25m^2$ This was to allow for 50% light and 50% darkness.
- Larvae and Maturation tanks
- Floors of the tanks were sloped for proper drainage. The drainage pipes were increased from 7.5cm to10.2cm in diameter because of the large volume of waste water that will be discharged.
- Maturation and spawning areas were partitioned with black polythene sheet for effective temperature control and bio-security
- The chambers for harvesting post larvae were made bigger. Grooves for slotting of screens were also constructed to make the harvesting of post larvae easier.
- The PVC pipes supplying seawater to the hatchery were increased from 2.5cm to 5.0cm in diameter.
- The capacity of the waste water sump was increased from 6.0 ton to 9.0 m^3 to accommodate large volume of wastewater for treatment before evacuation.
- Hatchery Wall

- Black polythene sheet was used to cover the outer surface of the wall to effectively control the temperature in the hatchery. Mosquito net was also used as lining on the wall to prevent entry of predators.
- Dips of 50.0cm^2 were constructed at the main entrance of the hatchery and also infront of door to the indoor building. The dips were filled with disinfectant for biosecurity and sanitation of people entering the hatchery.

The construction work was closely supervised and monitored by NIOMR engineers, scientists and FAO shrimp Expert from Thailand to ensure strict adherence to approved design. All the concrete tanks were cast and reinforced with iron rods due to the sandy nature of the soil. The shrimp hatchery was finally commissioned in November 2008. P. *monodon* has been successfully spawned and post larvae produced were stocked in concrete tanks for table shrimp and broodstock production. The hatchery is located at NIOMR Jetty bordering the East-mole of the Lagos harbor.

NIOMR SHRIMP PRODUCTION UNITS

To pioneer the production of shrimp *Penaeus monodom* in Nigeria, Nigeria Institute of Oceanography and Marine Research, Lagos reconstructed her old shrimp hatchery to a modern shrimp hatchery for the spawning of the Africa black tiger shrimp *P.monodon*. The hatchery is made up of the following units:

Water treatment units: This unit involved the sourcing and treatment of sea water. Sea water was sourced from the bar beach using a 4 Hp diesel water pumping machine and six tonnes water tanker. This unit is comprised of the following:

Sedimentation tank (15m^3) - for settling of seawater before treatment.

Treatment tank (8m^3) – for sterilization and chlorination of water.

Plastic reservoir tanks – Two tanks of 7.5 m^3 each for storage of treated water.

Maturation unit: This unit consisted of made up of 2 circular concrete tanks of 3m^{3}each where brood stock from the wild or concrete tanks are acclimatized and kept until final stage of maturation.

Incubation unit: This is where gravid broodstocks are kept for spawning. It is comprised of 4 circular plastic tanks of 0.5 m^3 each.

Nursery unit: This is made up of 6 circular tanks of 3m^3 each for rearing of nauplii to post larvae

Micro- Algae unit: The unit is comprised of an indoor wet lab and 6 outdoor plastic tanks of 1.5 m^3 each for culture the micro-algae *Skeletonema* and *Cheatoceros*. Micro-algae are very vital for requirements for successful spawning and survival of shrimp larval stages.

Laboratory unit: This housed the indoor algae production system. The lab was equipped with many equipment for shrimp propagation (e.g Scope-photo microscope, computer, water distiller, Autoclave, refrigerator, deep freezer, sensitive balance, etc) and chemicals.

Grow-out unit: This is made up of 2 concrete tanks of 10m^3 cubic meters each where post larvae are raised to adult shrimp

Aeration unit: The unit has 2 electrical air blowers piped to all the tanks for constant water aeration and increase in dissolved oxygen content for the sedimentation, treatment, algae, nursery, incubation, maturation and grow-out tanks.

Waste water unit: Waste water from the different units is drained into a concrete Sump of 5m^3 and treated before evacuation.

Power supply unit: The unit has two 5kva generators for constant electricity supply.

OPERATION OF THE SHRIMP HATCHERY

Water Supply

Sea water used in NIOMR hatchery is drawn from the sea through the use of the water tanker and pumped into the sedimentation tank where the suspended solids are allowed to settle down. The top clearer water is pumped into a treatment tank for treatment and chlorination. The treated water was filtered and pumped into an overhead tank and supplied by gravity into various tanks through PVC pipes. Fresh water was sourced from a borehole.

Aeration

Aeration is essential during the entire larval rearing process in maintaining sufficient dissolved concentration in the water and ensuring even water temperature throughout the water column. Two air blowers (3 hp, 1 hp) were interchanged daily to avoid over-heating. The blowers were connected to main line comprising of 63mm PVC pipe, which were then reduced to 50, 32, 25 and 20mm pipes respectively in order to have good aeration in the entire hatchery and grow-out systems

Temperature regulation

Temperature monitoring and regulation is an important activity in shrimp hatchery operations. Optimum temperature for culture of *P.monodon* ranges from 26-32^{0}C (Parado et al, 1996). Temperatures outside the above range for prolonged periods can stress shrimp and reduce growth. In penaeid shrimp, eggs do not hatch at temperatures lower than 24^{0}C. Larvae usually grow and molt faster at higher temperature (30^{0}C) but do not grow well and molting may be prolonged at lower temperature. Black polythene sheets were used to cover the outside of the hatchery wall to conserve heat in the hatchery and control the temperature. Transparent plastic roofing sheets were also installed for penetration of sunlight.

FACILITY MAINTAINANCE

Shrimp production facilities must be maintained to optimize the conditions for growth, survival and health of the broodstock, larvae and PL, minimizing the risks of disease outbreaks. To prevent the transmission of disease agents from one cycle to the next, the set of Standard Operating Procedures (SOPs) that must be strictly adhered to should be drawn up for personnel including procedures for a sanitary dry out after each production cycle (FAO, 2007). Some of the safety and maintenance measures undertaken included

- Tanks and equipment were thoroughly cleaned on a regular basis and disinfected with Iodine (20-30ppm) before and after use to prevent disease transmission between tanks and cycles. They were later rinsed with abundant clean water to remove effect of iodine and then dried.
- Wearing of protective hand and nose gears while handling the chemicals used for disinfection.
- Regular inspection and servicing of all essential equipment such as generators, water pumps, air blowers and water filtration equipment etc
- Generators were situated away from the air blowers to prevent drawing of air from the exhaust.
- The hatchery design and installation of pipes ensured that plumbing work maintained a proper gradient for easy discharge of water by gravity to avoid stagnation of water in the pipelines which could be a major source of entry of pathogen into the hatchery.
- Air and water pipelines were periodically checked for leakages and repaired if necessary.
- All the filters and filter components such as sand, cartridges, etc were backwashed regularly and the media removed, washed and replaced after every cycle. The sand and other filters were regularly replaced with previously clean and disinfected ones.

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EFFECTS OF PRESERVATIVES ON THE PROXIMATE AND SENSORY ANALYSIS OF SMOKE-DRIED *Clarias gariepinus* DURING AMBIENT STORAGE

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ABSTRACT

The effect of food grade chemical and natural preservatives on the proximate and sensory analysis of smoked catfish *Clarias gariepinus* during six weeks ambient storage were determined. Eleven pre-smoking treatments were applied: 25% sodium chloride (NaCl) and 1% ascorbic acid for 1h; 25% NaCl and 1% ascorbic acid for 30mins; 3% sodium lactate for 30mins; 3% sodium lactate and ginger (*Zingiber officinale*) extract for 30mins; 5% sorbic acid for 30mins; 5% sorbic acid for 1h; 3% sodium lactate and *Tetrapleura tetraptera* extract for 30mins; 3% sodium lactate and Ethiopian pepper (*Xylopia aethiopica*) extract for 30mins; *Z. officinale* extract for 30mins; *X. aethiopica* extract for 30mins and *T. tetraptera* extract for 30mins. The samples were smoked, cooled and packed for analysis at 0, 2, 4 and 6 weeks of ambient storage. The values of the proximate analysis ranged between 13.0-19.5%, 3.5-5.5%, 12.3-17.6% and 58.4-68.7% for moisture, ash, lipid and protein respectively. There were no significant change of proximate composition and sensory evaluation ($P<.05$) within each treatment groups during the 6 weeks storage without refrigeration.

INTRODUCTION

...s - *Clarias gariepinus*, *Heterobranchus longifilis* and *H. bidorsalis* are lean and highly ... food commodity with wide consumer acceptance. In Nigeria, catfish accounts for about ...quaculture production. However, catfish like any other fish species, could result in ... economic loss due to its perishable nature, if adequate preservative techniques are not ...cas and Ward 1996). Various food preservation techniques have been utilized to improve ... safety and extend the shelf life of fish in general including freezing, chemical ...lting, and smoking (Nickelson *et al.*, 2001). Up to 70% of the total fish catch in ...tries is preserved by smoking (Clucas and Ward, 1996). Smoking usually extends the ...lue to the reduced moisture content and effects of imparted phenolic compounds ... Ajiboye, 1996). In addition, during hot smoking, high heat results in direct ... (Nickelson *et al.*, 2001). Another shelf life-promoting strategy involves salting ...r curing with chemical preservatives (Ravishankar and Juneja, 2000). Common ... for catfish include antibacterial and antifungal agents such as lactic acid ... sodium benzoate (Efiuvwevwere and Ajiboye, 1996), sodium lactate and ...a *et al.*, 2008) and antioxidants such as ascorbic acid to slow down lipid ...es of smoking processes and added preservatives, subsequent microbial ... stability were also determined by fish type, the quality of fish at ...age conditions. The impact of smoking, chemical and natural ...imes at room temperature on the proximate and sensory quality of ...s) has not been reported.

...ected from a private catfish processing fish farm Azemor ...tives used are food grade and were purchased from local ... of salt to 40kg of fish, dressed and randomly divided ... other eleven groups were subjected to the following ...1) 25% sodium chloride (NaCl) and 1% ascorbic ...for 30mins; (T3) 3% sodium lactate for 30mins ...s; (T5) 5% sorbic acid for 30mins; (T6) 5% ...ract for 30mins; (T8) 3% sodium lactate and ...or 30mins; (T10) Ethiopian pepper extract ...g treatments, all catfish belonging to both ...kiln and slowly cooked for about five ...cooking, the fire was extinguished ...dition of charcoal at a temperature ...cooling, all catfish of each group

were packed in polythene bags, sealed and kept in paper boxes at ambient (30-33°C) temperature. Samples were subjected to proximate and sensory analyses on 0, 2, 4 and 6 weeks of storage. Proximate analysis was determined as described by AOAC (1995). Twenty people were trained to make subjective judgments on the samples on 0, 2, 4, and 6 weeks storage. The samples were scored 10.0 (excellent), 8.0 (good), 6.0 (satisfactory), 4.0 (fair) and 2.0 (poor).

RESULTS AND DISCUSSION

Moisture level ranged between 13.0-19.5%. Moisture content of all treatments remained similar throughout 6 weeks of storage as presented in figure 1.The ash varied from 3.5-5.5% and there is no significant difference in ash within treatment groups as in figure 2.The lipid level ranged between 12.3-17.6% as shown in figure 3 and there is no difference at 5% within treatments. Smoked catfish is lean, which makes it a very good diet. Smoked catfish contain a good percentage of protein, the protein varied from 58.4- 68.7% and no significant difference in protein level for all samples as presented in figure 4. No sample of smoked catfish was scored below satisfactory. The sensory evaluation as presented in figs. 5-9 showed that preservatives and storage for six weeks have no effect on the quality (consumer acceptability) of the catfish samples.

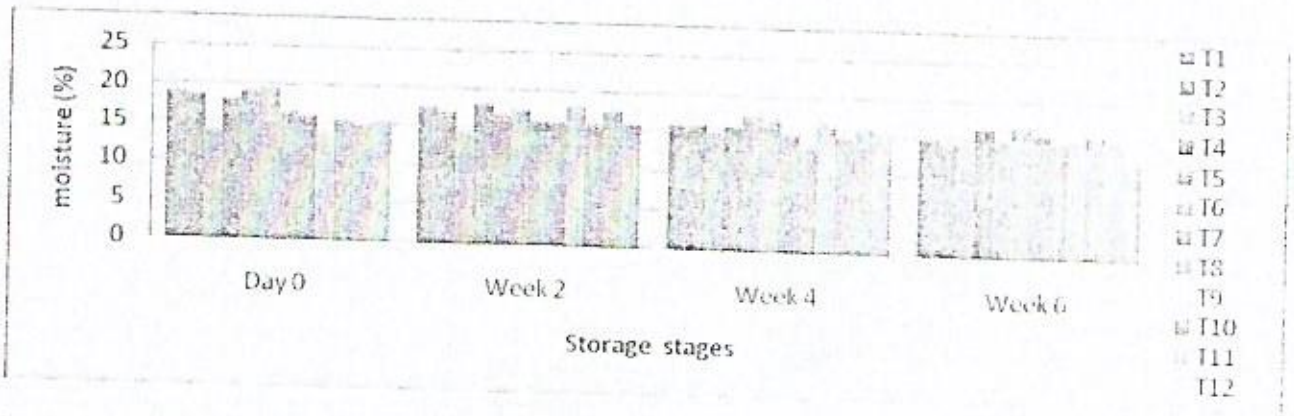

Figure1: Change in moisture of smoked catfish during storage as affected by preservative treatments

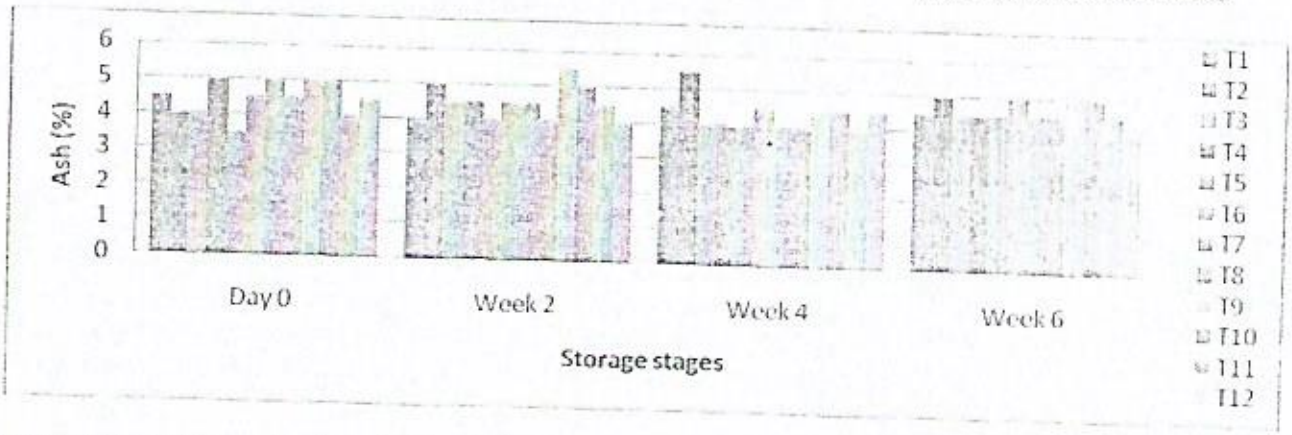

Figure 2: Change in ash of smoked catfish during storage as affected by preservative treatments

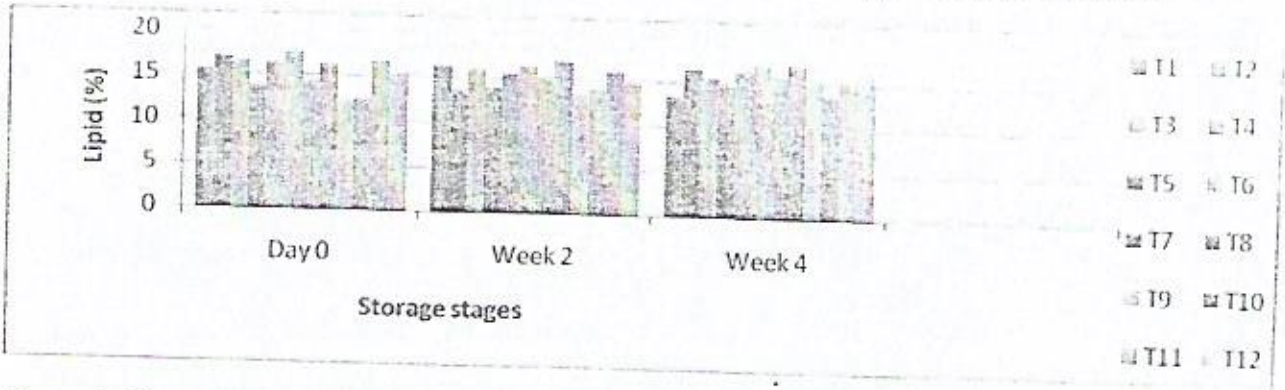

Figure 3: Change in lipid of smoked catfish during storage as affected by preservative treatments

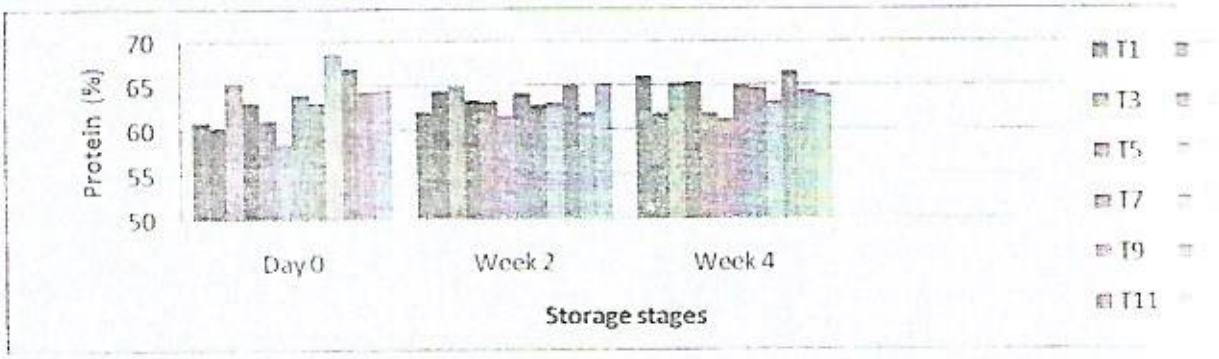

Figure 4: Change in protein of smoked catfish during storage as affected by preservative treatmen

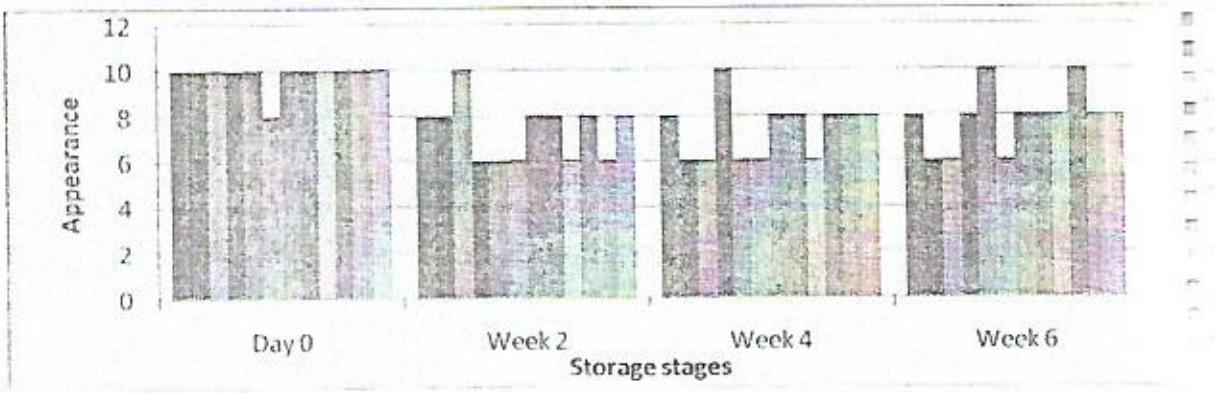

Figure 5: Change in appearance of smoked catfish during storage as affected by preservat treatments

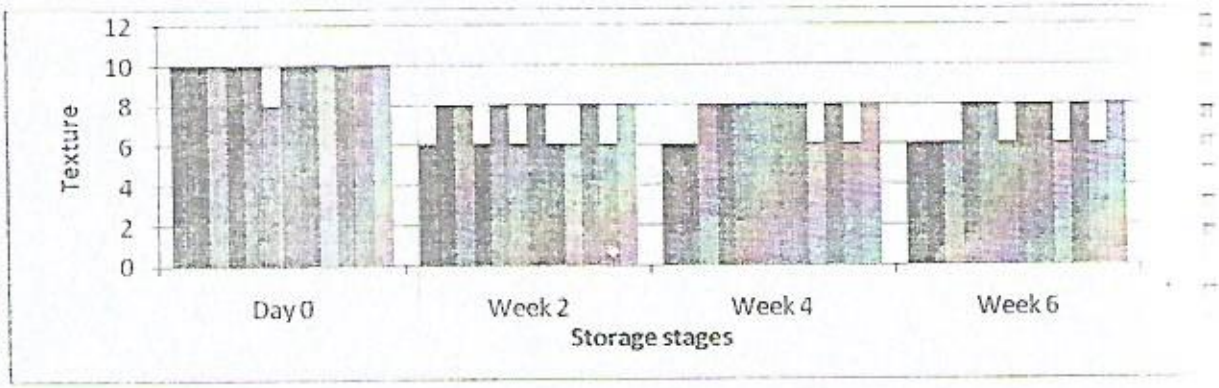

Figure 6: Change in texture of smoked catfish during storage as affected by preservati treatments

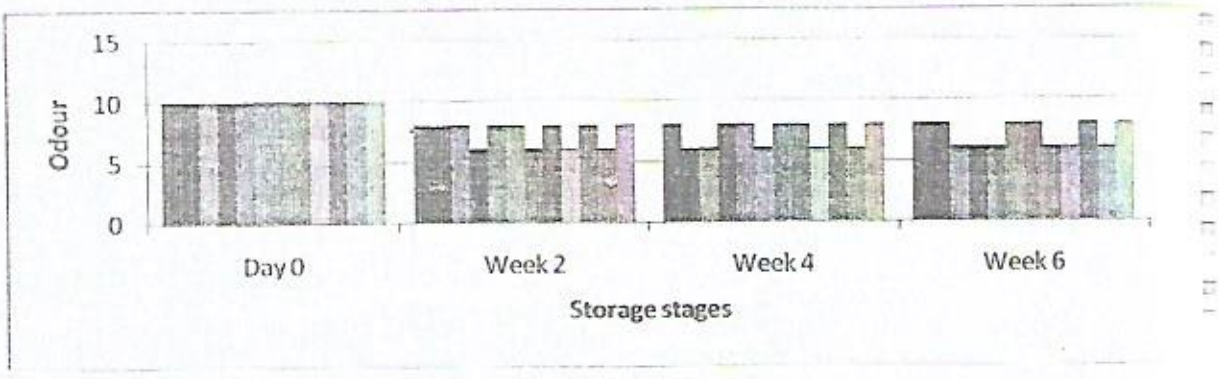

Figure 7: Change in odour of smoked catfish during storage as affected by preservati treatments

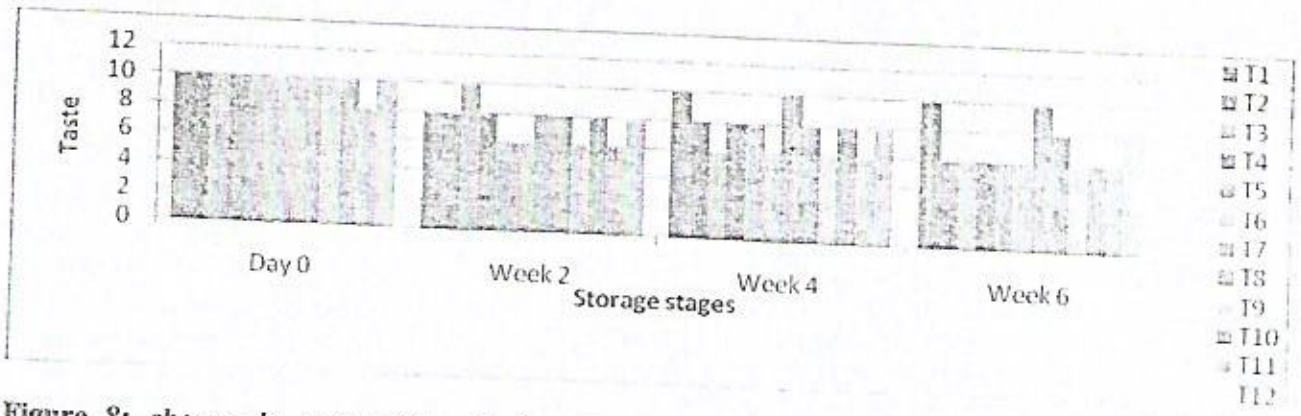

Figure 8: change in taste of smoked catfish during storage as affected by preservative treatments

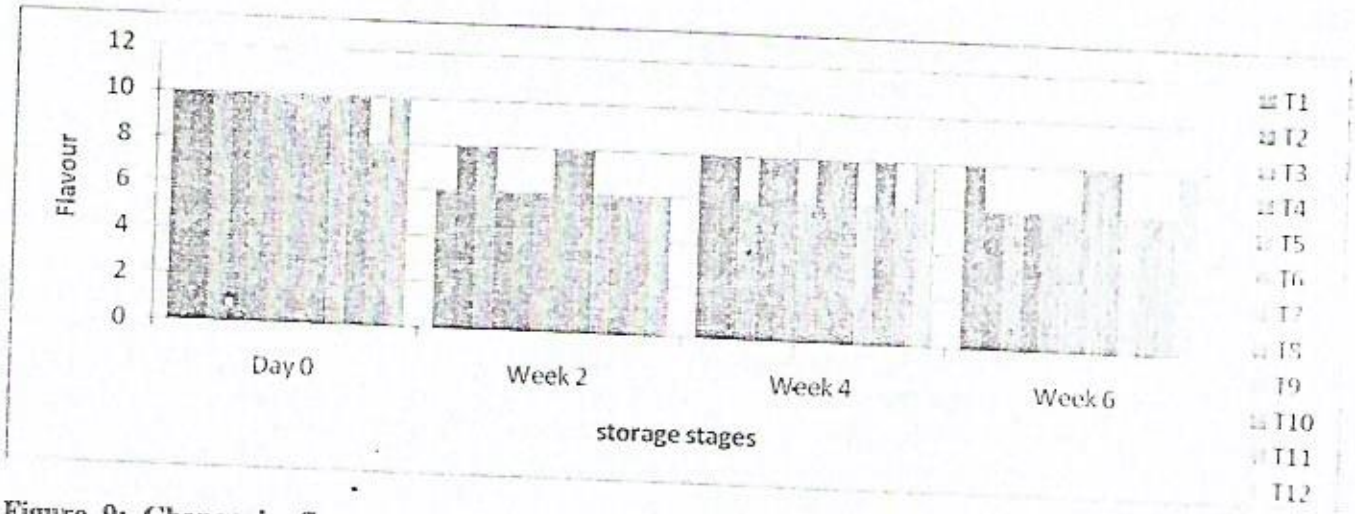

Figure 9: Change in flavour of smoked catfish during storage as affected by preservative treatments

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HEAVY METALS AND SENSORY EVALUATION OF CANNED TUNA FISH

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ABSTRACT

In this study, two heavy metals in canned tuna fish were determined after digestion by the A methods. Mercury and Cadmium levels in canned tuna fish were determined by flame a absorption photometry. The results of this study indicate that canned tuna fish imported in country have concentrations well below the permissible FAO/WHO levels for these toxic m Their contribution to the body burden can therefore be considered negligible and the fish seem safe for human consumption. For the sensory evaluation, tuna flakes in vegetable oil (Starkist) Ghana and light meat tuna chunks in sunflower oil (John West) from Thailand were the preferred while tuna flakes in brine (John West) from Thailand is the least preferred.

INTRODUCTION

There is increasing concern about the quality of foods in several parts of the world. The determi of toxic elements in food has prompted studies on toxicological effects of them in food. Heavy m are considered the most important form of pollution of the aquatic environment because of toxicity and accumulation by marine organisms. While mercury and cadmium can be tolerat extremely low levels, at certain concentrations, they are exceptionally toxic to humans. M mercury may induce alterations in the normal development of the brain of infants and at higher l may induce neurological changes in adults. Mercury contaminates mostly fish and fishery prod Cadmium accumulates in the human body and may induce kidney dysfunction, skeletal damage reproductive deficiencies. Also, it cannot be excluded that it acts as a human carcinogen [2] work is aimed at determination of mercury and cadmium concentrations in canned tuna fish.

Metal pollution of the sea is less visible and direct than other types of marine pollution b effects on marine ecosystems and humans are intense and very extensive. The toxic effects of h metals, particularly arsenic, mercury, cadmium and lead, have been broadly studied [4,6,8,9] distribution of metals varies between fish species, depending on age, development status and physiological factors [5]. Fish accumulate substantial concentrations of mercury in their tissues thus can represent a major source of this element for humans. Fish are the single largest source mercury and cadmium for man. Mercury is a known human toxicant and the primary source mercury contamination in man are through eating fish. Biotransformation of mercury and me mercury formation constitutes a dangerous problem for human health [4]. Metal contamination food, especially in marine products, have been broadly investigated [3,11,7]. Tuna as a predat able to concentrate large amount of heavy metals. Some of them are used for biomonitorin environmental contamination [3,10]. In the present study, we evaluated the total concentration mercury and cadmium in imported canned tuna fish which are frequently consumed by the popu and also carried out sensory analysis on them. Therefore we wish to determine mercury and cadm levels in canned tuna fish. It is expected that the results of this research will assist in acqui information about the level of some toxic metals in imported canned tuna fish.

MATERIALS AND METHODS

Ten canned tuna fish samples imported from four different countries was obtained from the r market. They include:

1. Tuna Flakes in Vegetable Oil (Starkist) from Ghana.
2. Light Tuna Chunks in Oil (Bumble Bee) from USA.
3. Skipjack Tuna Salad (John West) from Thailand.
4. Tuna in Mayonnaise (John West) from Thailand.
5. Tuna Steak in Sunflower Oil (John West) from UK.
6. Tuna Steak in Brine (John West) from UK.
7. Tuna Flakes in Sunflower Oil (John West) from Thailand.
8. Tuna Flakes in Brine (John West) from Thailand.
9. Tuna Chunks in Sunflower Oil (John West) from Thailand
10. Tuna Chunks in Brine (John West) from Thailand.

All glassware was soaked over night in 10% (v/v) nitric acid followed by washing with 10% (v/v) hydrochloric acid and rinsed with double distilled water and dried before using. A Perkin Elmer AAnalyst 100 atomic absorption spectrophotometer equipped with a deuterium background corrector was used for the determination of heavy metals. All reagents used were of analytical reagent grade. After opening each can, oil was drained off and the meat was homogenized thoroughly in a food blender with stainless steel cutters. Samples were then taken and digested promptly as follows: 2g of homogenized sample was weighed and placed into a 150ml conical flask. To this was added 5 ml concentrated sulphuric acid, and then heated at 70^{0}C for 2 hr. (or until the sample was completely digested). The mixture was cooled and 25 ml of 6% potassium permanganate solution was added to the cooled solution. The mixture was heated at 70^{0}C for 2 hr, and then cooled. 10 ml hydroxyl ammonium chloride was added to the solution, to reduce excess permanganate. The mixture was then diluted to 50 ml in a volumetric flask, with distilled water. A blank (distilled water) solution was carried out through the same process. 5ml of 1000mg/l stock standard was diluted to 200ml to give 25mg/l intermediate stock standard. From this, three working standards were prepared in the range 0.001-0.005mg/l. Mercury and cadmium was determined by direct aspiration of the sample solution into the $N0_2$/acetylene flame. The blanks and calibration standard solutions were also analysed in the same way as the sample solutions.

A ten-member taste panel was used for sensory evaluation of ten different canned tuna fish. The samples were scored for appearance, flavour, taste and texture using a 4-point scale in which a score of 4 was given to the excellent product and 1 to the sample that was fair. The samples were presented to the panellists on white plates with the samples coded alphabetically. Each of the panellists was provided with score sheet, a plate, spoon and a sachet of pure water for mouth rinsing after tasting each sample. Statistical analysis was carried out to determine the difference between the samples that was preferred.

Table 1: Mercury and Cadmium contents in some imported canned tuna fish.

S/N	Canned Tuna Samples	Hg (mg/kg)	Cd (mg/kg)
1.	Tuna Flakes in Vegetable Oil (Starkist) from Ghana	<0.01	<0.005
2.	Light Tuna Chunks in Oil (Bumble Bee) from USA	<0.01	<0.005
3.	Skipjack Tuna Salad (John West) from Thailand	<0.01	<0.005
4.	Tuna in Mayonnaise (John West) from Thailand	<0.01	<0.005
5.	Tuna Steak in Sunflower Oil (John West) from UK	<0.01	<0.005
6.	Tuna Steak in Brine (John West) from UK	<0.01	<0.005
7.	Tuna Flakes in Sunflower Oil (John West) from Thailand	<0.01	<0.005
8.	Tuna Flakes in Brine (John West) from Thailand	<0.01	<0.005
9.	Tuna Chunks in Sunflower Oil (John West) from Thailand	<0.01	<0.005
10.	Tuna Chunks in Brine (John West) from Thailand	<0.01	<0.005

EU Permitted levels for Mercury in canned tuna fish = 0.5 mg/kg
EU Permitted levels for Cadmium in canned tuna fish = 0.3 mg/kg

Table 2: Sensory evaluation of some imported canned tuna fish.

S/N	Canned Tuna Samples	Appearance	Flavour	Taste	Texture
1.	Tuna Flakes in Vegetable Oil (Starkist) from Ghana	4	3	3	3
2.	Light Tuna Chunks in Oil (Bumble Bee) from USA	1	2	1	3
3.	Skipjack Tuna Salad (John West) from Thailand	3	3	1	3
4.	Tuna in Mayonnaise (John West) from Thailand	3	3	2	2
5.	Tuna Steak in Sunflower Oil (John West) from UK	3	3	3	3
6.	Tuna Steak in Brine (John West) from UK	2	2	1	2
7.	Tuna Flakes in Sunflower Oil (John West) from Thailand	3	2	2	2
8.	Tuna Flakes in Brine (John West) from Thailand	1	1	1	1
9.	Tuna Chunks in Sunflower Oil (John West) from Thailand	3	4	4	4
10.	Tuna Chunks in Brine (John West) from Thailand	2	3	2	2

Note: 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Fair

RESULTS AND DISCUSSION

Ten samples of canned tuna fish were analyzed for mercury and cadmium (Table 1). The result show that canned tuna fish imported into the country from Ghana, Thailand, USA and UK ha concentrations well below the FAO/WHO permissible levels for these toxic metals. Their contribution to the body burden can therefore be considered negligible and the fish seem to be safe for human consumption. From Table 2, light meat tuna chunks in sunflower oil (John West) from Thailand and tuna flakes in vegetable oil (Starkist) from Ghana were the most preferred. The least preferred was tuna flakes in brine (John West) from Thailand. This is probably due to the packing material in which the tuna was canned. The levels of toxic elements in shellfish are related to age, sex, season and place [5]. It is also reported that cooking reduces the amount of some metals [1]. Moreover, the advances in new packaging technology, especially the use of cans with lacquered walls and mechanical seams reduce or, in most cases, eliminate the leaching of heavy metals into the food. Results of this study shows that the consumption of these imported canned tuna fish is adequately protective and this result will also serve as a baseline for the choice of packing material for the Institute's tuna and tilapia canning.

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FOOD BORNE BACTERIAL PATHOGENS IN SMOKE-DRIED FISH IN LAGOS MARKETS

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ABSTRACT

Fifty samples of smoked fish were obtained from some markets in Lagos and these were analyzed for the presence of *Staphylococcus aureus*, *Vibrio* sp. and *Listeria monocytogenes*. All the samples tested positive for *Staphylococcus aureus*, 27 samples for *Vibrio* sp. and none for *Listeria monocytogenes*. This study reveals that the smoked fish sold in Lagos, could be a potential source of food borne bacterial pathogens and thus the need for improvement in processing and handling are required.

INTRODUCTION

Fish and fishery products constitute an important food component for a large section of world population. Seafood often harbors infectious agents that are present naturally in the aquatic environment or introduced through human activities. The illness maybe due to the infection caused by the microorganism or due to the intoxication by products of microorganisms. Viruses, bacteria and parasites are the agents of human disease associated with seafoods. Some of the microorganisms of human health concern may be native to the aquatic environment such as the members of the genus *Vibrio*, but others like *Salmonella, E. coli* and many viruses are introduced into the aquatic environment through human activities such as contamination by domestic sewage. Most of the outbreaks of illnesses occur in countries where seafood is eaten raw or is inadequately cooked. For example, in Japan where seafood is eaten raw, 70% of food borne human illness is seafood associated (Scoging, 2003). The bacteria species that can cause human illness encountered in seafood fall under at least ten genera which can be classified into three general groups (Reilly and Kaferstein, 1997, Feldhusen, 2000)-bacteria indigenous to the environment in which fish live (marine/estuarine waters) but pathogenic to man (e.g. the members of family vibrionaceae - *V.cholerae, V.parahaemolyticus* and *V. vulnificus*). The 2nd group comprises of bacteria introduced via fecal contamination, which includes members of the family enterobacteriacae such as *Salmonella, Escherichia coli, Shigella* and *Campylobater* spp. The 3rd group consists of bacteria introduced while processing or storage such as *Listeria monocytogenes*, *Clostridium perfringens* and *Staphylococcus aureus*.

The type of microorganism associated with seafood may vary depending upon whether it is fresh or processed. Seafood is also known to have been responsible for a significant percentage of food borne diseases. The illness may be due to the infection caused by the microorganisms or due to the intoxication by products of microorganisms. The safety of seafood is therefore of a great concern to consumers as the major outbreaks from consumption of fish are caused by bacteria. Some food borne pathogens are of vital importance and these include *Staphylococcus aureus, Vibrio*sp and *Listeriamonocytogenes*. *Staphylococcus aureus* is an important.food borne pathogen because of its ability to produce a wide range of extracellular protein, toxins and virulence factors that contribute to the pathogenicity of the organism (Boerema *et al*., 2006). *Vibrio* sp. has been isolated from many seafoods. In recent years, this organism has been responsible for several food borne outbreaks. The organism can readily be destroyed by proper cooking of the seafood. Most outbreaks occur because raw or uncooked seafood is allowed to contaminate and reinoculate cooked seafood (Frazier and Westhoff, 1988).

Listeria monocytogenes has been recognized for many years as a facultative pathogenic bacterium that causes a serious illness in man and animals known as listeriosis (Schuchat et al., 1991; Furowicz, 1992; Anon, 1999). The infection due to *L. monocytogenes* occurs in a particular risk group such as the aged people, pregnant women and infants. The bacterium causes infection of the central nervous system and the severe septicemia which can be fatal in susceptible population especially in older people and newborn babies. The infection of the pregnant women causes stillbirth, abortion or infections of the new born. The latter can result in fatal meningitis of the newborn. The organism is widely distributed in nature and is associated with soil, decaying plant material and abiotic surfaces. *L. monocytogenes* has been isolated from a variety of seafood both fresh and processed, such as frozen seafood, smoked fish, surumi, etc. (Rocourt et al., 2000). The aim of this study is therefore to determine the presence of these pathogens and to educate the public on proper processing and handling of smoked fish.

MATERIALS AND METHODS

50 smoked fish belonging to different species were bought from four markets in Lagos. The ... were collected in separate sterile polythene bags and were transferred to the Nigerian Inst... Oceanography and Marine Research laboratory, Lagos. The samples were analyzed for the p... of *Staphylococcus aureus*, *Vibrio* sp. and *Listeria monocytogenes*. From each of the samples, ... aseptically taken and serially diluted for the determination of *Staphylococcus aureus* and *Vib*... Mannitol salt agar was used for *Staph. aureus* and TCBS cholera medium was used for *Vib*... Twenty-five grams of each of the samples were separately taken for the detection of *L. monocytogenes*. The method described in Bacteriological Analytical Manual (Anon, 1969) wa... for the isolation. The agar used for the detection of *Listeria monocytogenes* was prepared accord... the manufacturer's instruction.

RESULTS AND DISCUSSION

All samples tested positive for *Staphylococcus aureus*, 27 were positive for *Vibrio* sp. and no s... tested positive for *Listeria monocytogenes*. The results are shown in Table 1.

Table 1: Organisms isolated from Smoked fish

Sample Code/ Common Name	Organisms *Staph. aureus*	*Vibrio* spp.	*Listeria*	*monocyto*
A1-7 (Shawa)	+	+	-	
B1-5 (Kote)	+	+	-	
C1-10 (Panla)	+	+	-	
D1-5 (Titus)	+	+	-	
E1-5 (Croacker)	+	-	-	
F1-8 (Sole)	+	-	-	
G1-5 (Big Eye)	+	-	-	
H1-5 (Shada)	+	-	-	

Key: +: isolated
-: not isolated

Twenty- seven samples (which is about 54%) tested positive to *Vibrio* spp., this is supporte... work of Elhadi *et al.* (2004), who also reported the presence of choleragenic *V.cholerae* in ... marketed in Malaysia. Thus for prevention of contamination of seafood with choleragenic *V.*... it is important to adopt hygienic handling and processing. *V.cholerae* O1 is sensitive to cook... the D value of 2.65 min at 60°C (ICMSF, 1996). Therefore adequate cooking could reduce the... getting cholera through seafood consumption. *V. parahaemolyticus* is a marine/estuarine ha... causing gastroenteritis in humans through consumption of seafood. *V. parahaemolyticus* m... rapidly at room temperatures and reaches hazardous levels. Cooking seafood to temperatures ... 65°C rapidly inactivates this organism (FAO, 2004). The result shows that *Listeria monoc*... was not isolated from all the samples. This agrees with the results of Ababouch (2000), wh... isolate *L.monocytogenes* from smoked fish. According to Embarek (1994), the presen... *monocytogenes* in tropical seafood is rare compared to seafood from temperate environment... *monocytogenes* can be readily eliminated from seafood products by applying heat. In th... smoked products, care must be taken to see that the products are not post process cont... Staphylococci especially *S. aureus* is frequently isolated from fish and fishery product... subjected to extensive human handling (Sindhu and Surendran, 2008). Okafor and Nzeak... isolated Staphylococcus from smoked fish bought in the open market. This study shows th... *aureus* was present in all samples. It can be concluded that *Staph. aureus* is a major conta... smoked fish. Most of these organisms are major inhabitants of man and other lower war... animals and their presence in fish and fishery products indicates unhygienic handling. Thus ... processing, hygienic handling and storage of seafood are central to ensuring the safety of sea...

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CRAB VALUE CHAIN IN LAGOS LAGOON COMPLEX: IMPLICATIONS FOR FOOD SECURITY IN A RECESSION ECONOMY

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ABSTRACT
This study aims at bridging the knowledge gap in respect of production and marketing of cra fisheries in Lagos lagoon complex of Lagos State, Nigeria. The data have been collated throu specific survey carried out between August 2008 and April 2009 in each of the five lagoon systems Lagos State including Badagry, Ologe, Lagos, Epe and Lekki lagoon. The production systems a targeted clientele of each lagoon differ greatly. The profit margin per unit weight retained at ea stage of transaction was relatively low. The crab fishery was observed to be economically viab because of the large turnover and small size of individual operations. The crabs play a significant ro in the livelihood of the fisher folks and are very important as export commodity in West Africa.

INTRODUCTION
The crab fishery of Badagry, Ologe, Lagos, Epe and Lekki lagoon is dominated by two commercia important species namely *Callinectes sp.* and *Cadiosoma sp.* (Solarin and Kusemiju, 2003). The exists no exclusive traditional crab farming method in Lagos State, Nigeria in order to meet t growing demand in the international market, which is entirely dependent on the capture fishery. T over-arching objective of the study was to determine the value chain in the crab fisheries a document the social and economic value of crab fishery in Lagos lagoon complex. For most seafo products there are usually numerous intermediaries along the market, or value chain between t primary producer (fisher) and the consumer. Market chain analysis in the resource sector h historically been undertaken in the agricultural sector with information provided on profitability a margins experienced by the various intermediaries, hereinafter referred to as agents, along the mar chain (Kaplinsky, 2000; Stevens, 2001). More recently, considerable research has been undertaken price and margin relationships and transmission of price variability along European seafood cha specifically cod and salmon (Haitmann *et al.*, 2000; Guillotreau, 2003). There is dearth of s studies dealing with crab fishing in Nigeria with the exception of the report by Adeogun, *et al.* (20 which described a research framework for value chain analysis in aquaculture in Lagos State, Nige

MATERIALS AND METHODS
The lagoon system included Badagry, Ologe, Lagos, Lekki and Epe. For the community-based c fisheries study, a multi-stage sampling technique was used. It involved selection of the five lag systems in Lagos State. The second stage of the sampling technique was the stratification of e lagoon system into two on the basis of importance of crab fisheries. From each stratum, two m communities involved in crab fishing were randomly selected for the exploratory study. The su covered commercial fishermen, fish buyers, fishery-support business owners like transporters financial institutions. Additional data were collected through observation and oral interviews us questionnaire for all the key actors in the chain. Interviews were conducted to locate major fish grounds and learn about the different types of fishing gears used in the area. Direct observations w conducted at major fish landing sites to estimate the total catch landed each day and the spe composition as well as information on fish prices and the marketing system.

RESULTS AND DISCUSSION
Crab season varied according to location and species in the five lagoons (Table 1). *Callinectes sp* more abundant from April to October in Badagry, Ologe, Lagos and Lekki lagoons while *Cadios sp.* was more abundant between October and March. In Lekki and Bayeku communities, *Cadios sp.* can be seen all the year round. Men were predominantly crab fishers in all the lagoon system few cases, women were also involved. An estimated 1072 fishers engaged in the crab fishery in al lagoon systems, made up of 60% Beninois (Eguns) and 40% Nigerian (Yoruba). Catch rates fo five major gears(gillnet, castnet, lift net, stow net, ring net) showed some seasonal pattern. the ave overall catch rate was highest around April and October.

EFFECTS OF SQUARE MESH BUNT ON BY–CATCH REDUCTION IN WHITE SHRIMP, *Nematopalaemon hastatus*, FISHERY OF NIGERIA

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ABSTRACT

Simultaneous paired fishing comparison of modified codend against conventional codend was done with shrimp beam trawl in nearshore sea off Lagos.The modified codend was designed to reduce by-catch and was made by incorporating square mesh panel at anterior bunt. Results showed that the square mesh codend significantly reduced the by-catch of juvenile fishes up to 39.35% (T-test, $P < 0.05$; 0.01) with no significant loss (2.9%) in the quantity of the target shrimps *Nematopalaemon hastatus* ($P > 0$ .05; 0.01). Commercially important by-catch species having a total length of 11-30cm were retained by the square mesh codend, while those with total length of 4-10cm were reduced eg; *Pseudotolithus elongatus* (43.96%, $P < 0.05$, 0.01), *P. senegalensis* (49.03%, $P < 0.05$; 0.01), *P. typus* (36.29%, $P< 0.05$; 0.01), *Ilisha africana* (39.09%, $P< 0.05$; 0.01), *Pentanemus quinquarius* (41.02%, $P< 0.05$; 0.01), *Galeoides decadactylus* (48.80%, $P< 0.05$; 0.01), *Lutjanus dentatus* (48.98%, $P< 0.05$; 0.01), *Drepane Africana* (43.13%, $P< .0.5$;0. 01), *Chloroscombrus chrysurus* (55.29%, $P< 0.05$; 0.01), and *Selene dosalis* (34.60%, $P< 0.05$; 0.01). At family level, reduction in the number of 8 out of 13 important by-catch families analyzed were significant, e.g.; Clupeidae, Trichiuridae, Sciaenidae, Serranidae, Polynemidae, Carangidae and Lutjanidae ($P< 0.05$; 0.01). The number of flattened fishes (*Cynoglossus senegalensis*), spinous fishes (*Arius latiscutatus*), shell fishes with morphometric body protection (*Callinectes amnicola*) were not significantly reduced ($P> 0.05$).

INTRODUCTION

In many developing countries like Nigeria, coastal shrimp, trawling is new and is carried out using wooden planked fishing boat powered by 25 or 40 HP outboard engine. The artisanal beam trawl shrimp fisheries targets white shrimps, *Nematopalaemon hastatus*. It is on open access fishery with daily operations and exploits estuarine and nearshore sea within one to two nautical miles from shoreline where their technology could permit. These habitats are reserved for small-scale fisheries exploitation by Nigerian fisheries law and regulations and it form the nursery ground for juveniles of fin and shell fishes. Shrimp beam trawl is an improvised stow net and traditionally contained configured small diamond shaped mesh size of 10mm in the codend (Ambrose and Williams 2003) and are not particularly selective fishing gears. In addition to the targeted shrimps, they often retain non-targeted organisms, collectively termed "by-catch" (Saila), 1983). This by-catch consists of a diverse assemblage of 25 species of juvenile fishes with a total length range of 4 – 30cm (Ambrose, et al,. 2005). In 1994, by-catch from shrimp trawls was 11.2 million tons worldwide (Alverson, et al,. 1994). The mortality of large quantity of juveniles of commercially important species is of major concerns, because it may deleteriously affect the recruitment and biomass of stocks targeted in other Nigerian inshore fisheries and in the neighbouring coastal countries. The regulation of inter-specific selectivity of trawls to manage the 25 species of fishes as well as the two ecological fragile habitats trawled, will help to optimize yield and maintain sustainable shrimp fishery. Investigation that assessed various modifications to traditional trawling gears and practices that minimize the catches of unwanted individuals was therefore carried out.

Many recent efforts to reduce by-catch from shrimp trawls has concentrated on modifications that incorporate by-catch reducing devices (BRDs)(Kendall 1990, Isaksen,*et al,*1992;Broadhurst and Kennelly 1994; Rulifson,*et al,*. 1992). Sometimes the BRD's have not been adopted by commercial fishermen (Kendall 1990) because of their size and complex design (Mounsey,*et al,*. 1995), failure to maintain shrimp catches at the same levels as traditional trawls (Rulifson,*et al,*. 1992). Considering the fact that fishing unit of this fishery is small and crude, the use of a large and solid grid may be difficult to handle during net shooting and hauling and may even increase the drag of the trawl, hence, its acceptance may not be endorsed by most artisanal fishers despite its efficiency in total by-catch reduction reported in NSW, Australia (Broadhurst,et al,.1997) and in Berent sea, Norway (Isaksen,*et al,*.1992). Still in muddy shrimping ground, like off the Niger Delta region of Nigeria, soft-flexible

separator panels may be easier to deploy but may easily be clogged by bottom sediments and del thereby reducing its durability and efficiency. At the moment in Nigeria,there are no governm regulations controlling the fishery, by-catch is legally allowed, the use of BRD's that separate fish catch from target shrimps by employing behavioral differences between shrimps and fish may be f tested and recommended to partially reduce the smallest sizes of by-catch to allow the continuatio by-catch livelihood trades. One such modifications to trawls which in addition is simple to install handle at sea and has been successful throughout the world in reducing by-catches while retaining target catch involves the use of square mesh panels in codends (Broadhurst and Kenelly 19 Broadhurst, et al,. 1996; 1999; Briggs, 1992; Thorsteinsson,1992). The goals of this study were investigate the effectiveness of square mesh panel strategically located at top of anterior codend u normal commercial operations in reducing unwanted by-catch and maintaining catches of ta shrimps.

MATERIALS AND METHODS

The study was carried out from June-September 2004 by two men fishing crew with a wo planked canoe of length overall 8.5 m, powered by 25 HP outboard engine. Near shore Atlantic O with dept ranging from 10-20m off Asoroko, South West Nigeria coast (Latitude 6°N to 6° 30 'N longitude 3° E to 5° E) was trawled. The beam trawl net used is an improvised stow net r effectively for towing, vertical mouth lift, horizontal mouth spread and negative buoyancy. Det design and rigging of stow net to bestow for towing is given by Ambrose and Williams (2003) codends employed for the study measured 454 meshes from anterior to posterior tip, 256 mesh circumference and were constructed from 10mm mesh size netting with a thickness of R.155 tex net has 7 segments joined with a take up ratio of 0.5. Mouth re-enforced panel is thick (R 470 tex mesh size of 38mm to withstand towing stress from the warp and bridles.Two codend designs compared; the conventional codend was designed similar to fisher's net as described above second codend termed "square mesh codend" have similar design specification with the conven codend. It was modified by strategically inserting panel of square mesh constructed by tu diamond mesh 90 degrees in the top of the anterior section of codend. This was to make the mes more open during the capture process, thus allowing fishes to escape. The square mesh specification of PE R3400 Tex and bar length of 22mm. The rectangular shaped panel has 5 along the length, i.e. from anterior towards posterior codend and a breadth bar of 18 (Fig. 1). Th codend were compared against each other in independent paired trials, that is in separate two tows by two adjacent boats fishing at the same time (Thorsternsson,1992; High,*et al.*,1969) established shrimping grounds. Over four months, a total of 30 replicate tows of each comparison were completed.

After each tow in each paired experiment, the two codends were emptied into the m deck of the canoe. Onboard sorting of fishes from shrimps started towards shores and was com upon landing at shore. All organisms were sorted according to species and families. The fol data were collected from each landing;(1) The total weight of shrimps , (2)the total weight of b in kilogram, (3) The weight, number and sizes of commercially important fin and shellfishes were taken using weighing balance and measuring board. Several commercially important b species were caught in sufficient qualities to allow meaningful comparisons. These were; *Penta quinquarius, Galeoides decadactylus,P.elongatus P.senegalenses, P.typus, Cynoglossus senega Drapane africana, Selene dorsalis, Chloroscombrus chrysuru, Lutjnus dentotus, Arius ltis Pomadasys jubelini, Trichiurus lapturus , Carchahinus brachyrus , Callinectes amnicola an africana.* Catch data from 30 replicate landings for each of paired comparison were poo analysis. The total weights of by-catch species from both conventional and modified codend compared. The hypothesis that weight/numbers of landings (shrimps, total by-catch spec commercially important by-catch species) from conventional and square mesh codends does n were tested using one tailed pair T-test.

RESULTS

Compared with the conventional codend, the square mesh codend significantly reduced the of juvenile fishes up to 39.35% (T. test, $p < 0.05$; 0.01) with no significant loss (2.9%) in the

of the target shrimp, *Nematopaleamon hastatus* (P< 0.05; 0.01, table 1). Eleven out of 22 commercially important by-catch species that were caught in sufficient quantities showed high percentage weight reduction (p< 0.05) in square mesh codend (table 2). Small sized fishes with total length range of 4 to 10cm were mostly excluded by the square mesh codend, while large fish specimens with a total length range of 11 to 30cm that could not pass through the square mesh bars of 22mm were highly retained by square mesh codend (Fig.2). The moderate percentage weight reduction of small sizes of abundance and commercially important by-catch species such as; *Ilisha africana* (39.09%, T-test, P< 0.05;0.01), *Trichiurus lepturus* (25 .04%, p< 0,05; 0.01), *Pseudotolithus elongatus* (43.96%, p< 0.05;0.01), *P. typus* (36.29%, P < 0:05;0.01), *P. senegalensis* (49.03%, P< 0.05; 0.01), *Pentanemus quinquarius*_(41.02%, p< 0.05;0.01), *Galeoides decadactylus* (48.80%, P < 0.05;0.01) *Chloroscombrus_chrysurus* (55.29%, P<0.05; 0.01) and *Lutjanus dentatus* (48.98%, P < 0.05; 0.01, table 2) makes fishers to voluntary endorsed the use of square mesh BRD for continuation of by-catch livelihood trades.

TABLE 1: Weight (kg) of target shrimps and total by-catch species from 30 replicate tows, each from conventional codend (C) and square mesh codend (S) that was used in t-test comparison (S versus C; N = 30; XP< 0.05, XXP< 0.01; YP > 0.05; YYP > 0.01

No of Tows	Conventional Codend (C)		Square Mesh Codend (S)	
	Target shrimps	Total by-catch species	Target shrimps	Total by-catch species
1	101.3	7.48	95.8	4.66
2	128	5.92	131.1	4.99
3	85.8	7.00	69	4.59
4	91.8	6.89	106.5	3.94
5	207.2	12.12	187	6.98
6	121	8.2	115.6	5.05
7	96.3	6.89	121.9	4.85
8	265	10.31	201.6	4.91
9	310.8	9.25	280.1	5.13
10	279	9.89	. 280.9	5.13
11	196.5	8.17	201	3.81
12	322	10.15	301.9	5.04
13	222.8	8.77	210	6.74
14	315	11.19	311.9	5.53
15	330.8	10.74	319.1	5.51
16	299.5	12.22	305	6.79
17	321	10.66	303.4	8.35
18	258.2	10.53	291	4.98
19	163	7	198	4.9
20	311.9	10.72	270.5	4.2
21	105	8.62	86.5	6.46
22	98.9	10.98	91.9	5.43
23	211.7	10.98	198.1	6.34
24	190	11.64	210	6.2
25	225.4	10.27	221.1	6.09
26	78.4	7.71	99.3	5.74
27	185.1	11.34	160.2	7.8
28	63	8.17	78.1	6.66
29	98.1	7.08	85	5.47
30	155.7	10.34	139.1	7.27
Total	5838.2	279.39	,5670.6	169.49
Mean	194.606	9.313	189.02Y,YY	5.649 X, XX
Standard error	16.35	0.35	15.4	0.204
% Retention	100	100	97.1	60.65

Reduction in the number of commercially important by-catch families were significances in eight out of 13 families analysed, e.g.; Clupeidae (T-test, P < 0.05;0.01), Trichiuridae (P<0.05;0.01), Sciaenidae (P<0.05;0.01) Serranidae (P<0.05;0.01), Drepanidae (P<0.05;0.01), Polynemidae (P< 0.05;0.01), Portunidae (P<0.05), Lutjanidae (P<0.05) and Carangidae (P< 0.05; 0.01, table 3). In contrast the number of flattened fish species reduced in square mesh codend were not statistically significant, e.g.; *Cacharhinus brachyrus* (P>0.05; 0.01) and *Cynoglossus senegalensis* (P > 0.05; 0.01). In the same way, Spinous fish like *Arius latiscutatus*, and shell fish with morphometric body projections like *Callinectes amnicola* showed poor escape rate from square mesh codend (P>0.05;0. 01, table 3). Except *Callinectes amnicola*, the mean catch (kg) of 13 commercially important by-catch species in square mesh codend were significantly lower (T-test, P< 0.05; 0.01) than in conventional codend and likewise total by-catch (P < 0.05; 0.01), while target shrimps were not significant (P> 0.05; 0.01, Fig 3)

Table 2: Weights (kg) of commercially important by-catch species from 30 replicate tows (N) from conventional codend (C) and Square mesh codend (S) used to t-test comparison (S versus C).

Species	Family	C	S	% reduction in S	Statistical Inference xp < 0p5 xp < 0.01 yyp > 0.05 yyp > 0.01
Ilisha Africana	Clupeidae	21.62	13.17	39.29	x,xx
Sardinella aurita	Clupeidae	2.12	1.69	20.29	y,yy
Trichiurus lepturus	Trichiuuridae	1.69	20.29	25.04	x,xx
Pseudotolithus elongatus	Scieaenidae	14.83	8.31	43.96	x,xx
Pseudotolithus typus	Scieaenidae	22.82	11.63	49.03	x,xx
Pseudotolithus typus	Scieaenidae	26.51	16.89	36.29	x,xx
Epinephelus aenus	Serranidae	6.55	2.33	64.42	y,yy
Cynoglossus senegalensis	Cynoglossidae	14.14	16.89	19.44	y,yy
Drepane africana	Drepanidae	5.61	3.19	43.13	x,xx
Pentanemus qunquarius	Polynemidae	17.37	10.22	41.02	x,xx
Galeoides decadactylus	Polynemidae	26.37	13.5	48.80	x,xx
Sepia elegans	Sepiidae	3.86	3.75	7.51	y,yy
Callinectes amnicola	Portunidae	13.86	12.8	7.64	y
Selene dorsalis	Carangidae	5.49	3.59	34.60	x,xx
Chloroscombrus chrysurus	Carangidae	14.92	6.67	55.29	x,xx
Lutjanus dentatus	Lutjanidae	16.8	8.57	48.98	x,xx
Lagocephalus laerigatus	Tetradontidae	4.4	3.46	21.36	y,yy
Dasyatis margarita	Dasyatidae	5.58	3.64	34.76	y,yy
Carcharhinus brachyrus	Carcharhinidae	5.84	2.48	57.53	y,yy
Myrichthys pardalis	Ophichthyidae	1.96	1.51	22.95	y,yy
Pomadasys jubelini	Pomadasyidae	6.93	3.93	43.29	y,yy
Rhinobatus rhinobatus	Rhinobatidae	2.72	1.7	37.5	y,yy

Table 3: Summaries of one - tailed paired t- tests comparing the number of commercaily important by – catch species from square mesh codend and conventional codend.
S = square mesh codend; N = number of replicate; xxp < 0.01; xp < 0.05;yyp > 0.01;yp > 0.05.

Species	Family	Common name	S versus conventional		
			Paired t – Value(0.05)	P level	N
Ilisha Africana	Clupeidae	African shad	7.7147	x,xx	30
Trichiurus lepturus	Trichiuridae	Silver fish	5.188	x,xx	30
Pseudotolithus elongatus	Sciaenidae	Short croaker	4.6883	x,xx	30
Pseudotolithus senegalensis	Sciaenidae	Normal croaker	4.1158	x,xx	30
Pseudotolithus typus	Sciaenidae	Long neck croaker	4.0012	x,xx	30
Epinephelus aenus	Serranidae	Grouper	2.02106	x,xx	30
Cynoglossus senegalensis	Cynoglossidae	Sole fish	0.5221	y,yy	30
Drepane africana	Drepanidae	Spade fish	5.7956	x,xx	30
Pentanemus quinquarius	Polynemidae	Royal thread fish	4.0664	x,xx	30
Galeoides decadactylus	Polynemidae	Shiny nose	2.6411	x,xx	30
Callinectes amnicola	Portunidae	Blue crab	2.2753	y	30
Arius latiscutatus	Arridae	Cat fish	1.3060	y,yy	30
Chloroscombrus chrysurus	Carangidae	Caranx	7.6260	x,xx	30
Lutjanus dentatus	Lutjanidae	Red snapper	1.6247	x	30
Pomadasys jubelini	Pomadasyidae	Grunter	0.4240	y,yy	30
Carcharhinus brachyrus	Carcharhinidae	Shark	1.3060	y,yy	30

DISCUSSION

This study illustrated the effectiveness of a strategically located panel of square mesh in codends for reducing catches of juvenile fishes (Broadhurst and Kennelly, 1997 and Briggs, 19992) and quantified for the first time in commercial artisanal palaemonid shrimp trawls the utility of panels of square mesh for improving the size –selectivity of the targeted shrimps. The high reduction of 39.35% of by-catch species and insignificant reduction of 2.9% of target shrimps (table 1) is attributed to the differences in ethology of fish and shrimps in their response to stimuli. Fishes were apparently herded together at the taper of the codend, involving an escape response to the sides and top of the net. The location of square mesh panel at anterior codend makes fishes to escape freely due to their behavior to towed gear. A review that summarizes the minimum swimming performance of over 40 species of fish showed that regardless of environmental and biological factors, most individuals 5 to 15cm long could not maintain their normal cruising for longer than 10 minutes (Beamish, 1978). Most of by-catch species encountered in the fishery fall within this total length ranges (Ambrose, *et al.*, 2005). Based on such constraints, it was apparent that to provide an opportunity for fish to escape during towing and haul back delay, the square mesh panel was positioned in an area of the trawl where there is a substantial reduction in relative water flow, this was immediately anterior to the codend (Broadhurst and Kennelly, 1997; Broadhust, *et al.*, 1999) and at location 75% bunt length from codend tip (Watson, 1989). The response of shrimps to these stimuli appeared fairly limited. Other studies have confirmed that shrimps are not capable of maintaining active escape responses to the trawl (Lochhead, 1961; Newland and Chapman, 1989). Shrimps are quickly forced against the meshes and towards the back of the codend where they remain passive throughout the entire towing period. The codend was modified to take advantage of the difference in shrimps and fish behavior by inserting square mesh panel on the top of the anterior codend section only, so that only small sized fishes might escape without a significant reduction in the catch of shrimps (P > 0.05; 0.01, table 1) or of larger commercially important by-catch species (Fig 2).

The square mesh codend was most effective in excluding large quantities of by-catch spec that are relatively fusiform and of a size small enough to pass through the square mesh (table Fig.2). The reduction in total by-catch with the square mesh codend provides a possible explanat for the high retention of 97.1% of target shrimps (table 1). The size range of individual organism the catch has implications for year-to-year and total yield from the resources (Beckett, 1989). quantity, 39.35% and size range of fish by-catch species, 4 to 10cm TL (table 1, fig. 2) excluded a biologically sustainable level to allow for future recruitment of the juvenile into the stock and fishe In the same way, the quantity 60.65% and size range, 11 to 30cm TL (table 1, fig.2) retained is likely to impinge too much on the by-catch livelihood trades of fishers, such that the fishery beco economically unviable. From these results, square mesh by-catch reduction device achieved the ab economic and biological objectives of the present by-catch reduction research work.

In terms of promoting a large voluntary adoption of BRD's like square mesh panel descri in the present paper, it is useful to provide fishers not only with evidence of target shrimps catch r similar to those obtained with conventional gear and by-catch retention for livelihood tra continuation, but also with evidence of additional benefits, such as a potential for increasing durat of tows, improving quality of catches (due to less damage from by-catch in the codend), increa savings in labour and fuel, reducing sorting times and reducing conflicts with other user groups (e commercial otter trawl and gill nets fishermen targeting stocks of by-catch stock). The realizatio these incentives, along with results from the present study have resulted in many commer fishermen showing interest in the use of square mesh BRD throughout the entire artisanal shri trawl fisheries in Nigeria.

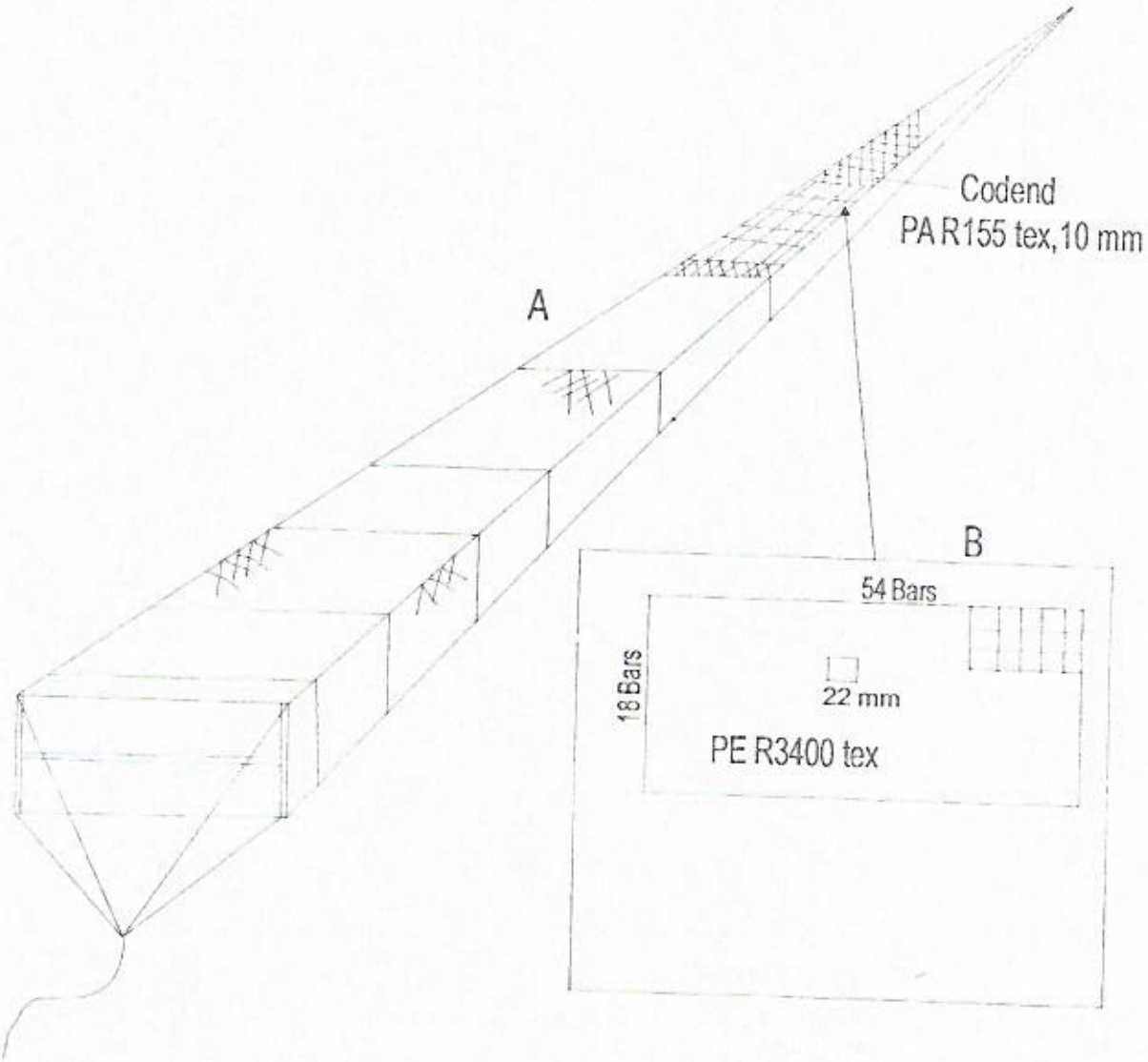

Fig. 1: Diagrammatic representation of; (A) Square mesh panel located at anterior codend; (B) Specifications of square mesh panel

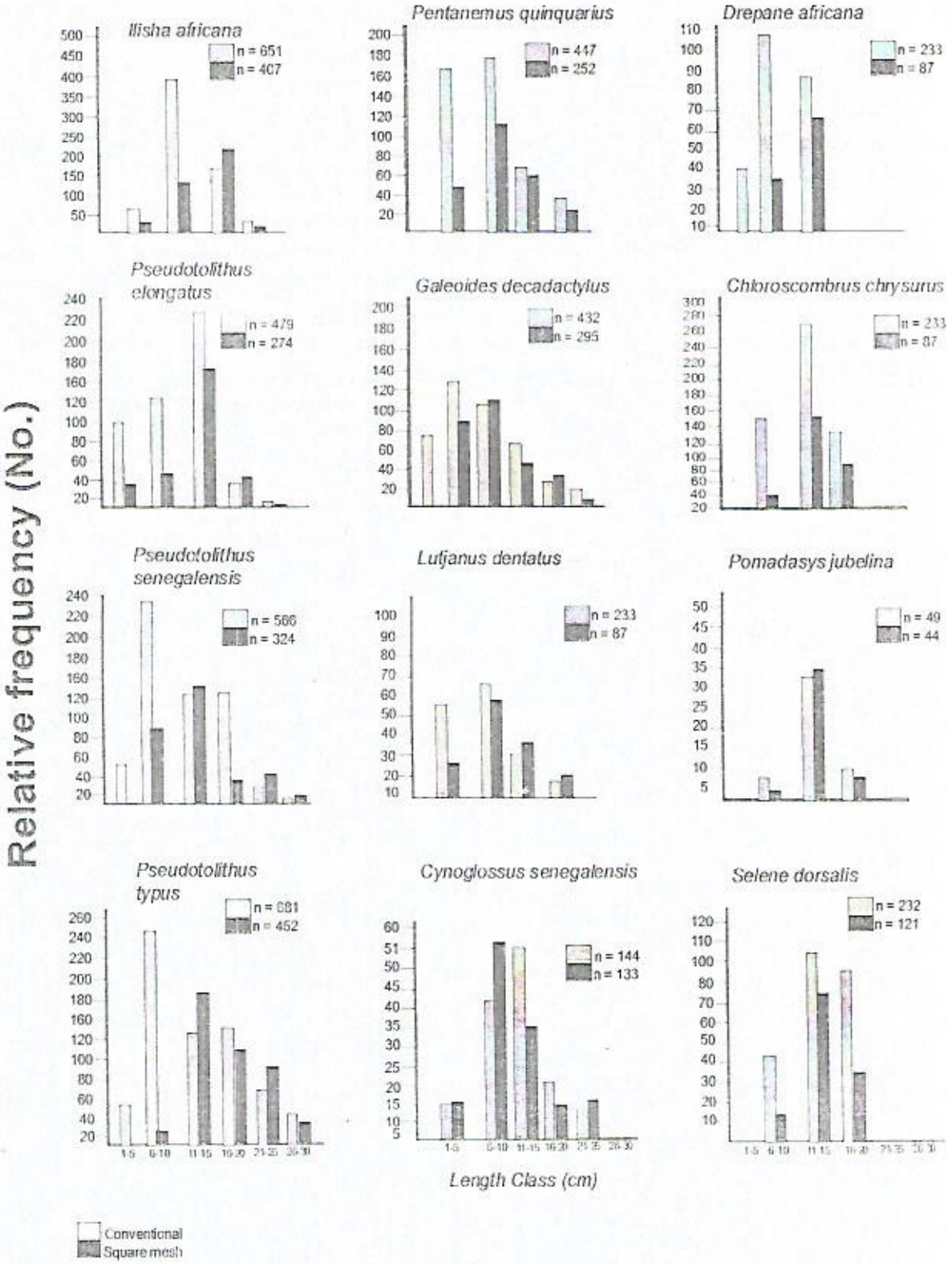

Fig. 2: Size frequency distribution of important commercially by catch species caught by conventional and square mesh codends

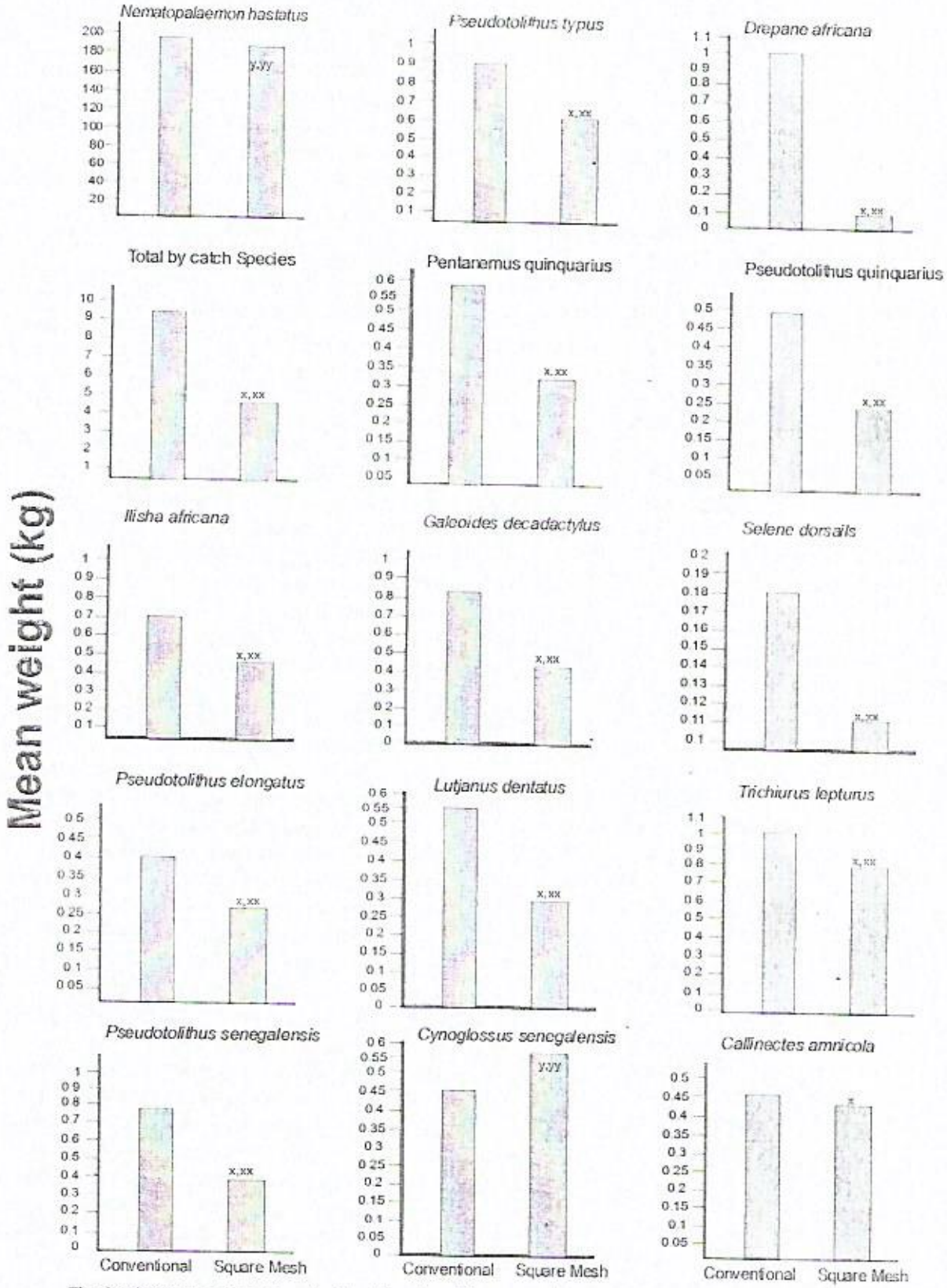

Fig. 3: Differences in mean weight catches (per 2 hours tow) between conventional and square mesh codends. Significance; xxp<0.01; xp<0.05; yyp>0.01; yp>0.05; N=30

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PURSE SEINE OPERATIONS OFF ORIMEDU FISH PORT, LAGOS STATE

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ABSTRACT

Design characteristics and mode of operation of purse seining off Orimedu fish port was investigated between August 2007 and February 2008.Tha fish catch composition was also analysed.The purse seine net has the highest number of bundles. The mesh size ranges from 2.5 to5.0cm.The purse seine net was highly selective fish target specific, catching mostly coastal pelagic fish species. Ten fish species belonging to 5 families were frequently encountered. Total weight of the fish landed was 444.50kg while the average weight of the catch landed per canoe was 30.53kgrespectively. Ethmalosa fimbriata (Bonga fish) and *Sardinella maderensis* (flat sardines) dominated the catch with 211.00kg (45.40%) and 143.00(32.10%) by weight of the total catch. *Chloroscombrus chrysurus* (Atlantic bumper fish), *Caranx hippo* (Crevail jack), *Sphyrna couardi* (hammer head shark) and *Carcharhinus* spp.(shark) contributed between 0.33-3.47% of the total fish landed by weight. Total length of the fish landed also indicated that the purse seine was highly selective and does not deplete the population of sub-adult's \juvenile fish species. Salinity was found to be the most variable factor affecting abundance and subsequent catch of coastal pelagic fishes particularly *Ethmalosa fimbriata* during the dry season. This study revealed that over fishing of fish stocks may be avoided provided the same fishing pressure observed during this study period is maintained in terms of the number of fishing crafts, number of boat days or fishing and mesh-size of the purse seine fishing gear used.

INTRODUCTION

Lagos State is located within the lowly coastal zone which extends from Niger Delta to Kuramo boarder with the Republic of Benin. It is bounded in the South by the Atlantic, in the North and East by Ogun State and in the West by the Republic of Benin (LSMA 2005). Lagos State has an area of 80,000 km2 out of a total land area of 927,262 km2 of the Federal Republic of Nigeria. This area represents 0.4% of the Nigeria's territorial land mass. According to NPC (2006) and LSMA (2005), the state has a population of 9.6 million. Sixty % of all the manufacturing industries in the country are located in the state. It also has the largest sea port in the Federation – the APAPA QUAYS. The state is richly endowed with certain natural resources such as coastal water (sea), lagoons and creek complexes and numerous rivers raminifyings the interior lands (fig 1). The coast land lies in East to West direction, (FAO 1994). There are two long breakers separating the sea from the interways. Domestic fish production in Nigeria from 1995- 2006 ranged from 354,434 – 636,848 metric tons, but slightly decreased to 610,507 metric tons in 2008. (FDF statistics.) The small-scale artisanal fishery sector accounts for over 94% of the total fish captured in Nigeria (Tobor 1994, LSMA 2005 and FISON 2005). The small - scale artisanal fishermen in Nigeria were about 447,550 million. Among these the part- time fisher folks accounted for 43 % (FDF, 2008).

The purse seine is one of the various fishing gears operated by the small -scale artisanal fishermen in some coastal areas of the country. Both the gear and the craft are of Ghanaian origin. The purse seine net is basically an adaptation of the encircling gillnet net; it is very long and deep and fitted with purse rings which make it possible to close the bottom of the net after surrounding a school of fish. The introduction of the purse seine canoes in most West African coastal states appears to be a significant modernization of the small- scale artisanal fishing. It catches mostly bonga and flat sardinella of highly limited size range (Moses, 2000). Ama Abasi et al was the first to report on the semi-industrial purse seine fishery in Nigeria, specifically, the Cross River estuary and the adjacent waters of the Gulf of Guinea. The objectives of this study are to: a) appraise the design characteristics and the performance of fishing gears and crafts used in purse seine operation; b) discuss the mode of operation of purse seining off Orimedu fish port; c) determine the species composition of the purse seine operations with respect to volume of catch and modal sizes of each fish species harvested. provide base data to enable the managers plan for rational exploitation, utilization and management the purse seine fishery in Lagos state; e) enumerate the constraints facing the small scale artisanal fisheries in Lagos state.

MATERIALS AND METHODS

Orimedu is a fairly large fishing settlement stretching some 500m along the east coast of I
entrance. It is located on latitude 6° 25"and 6° 50"East and longitude 3° 25" and 3° 30"North of I
State, Nigeria. The beach is sandy and seems to be stable unlike the Bar beach in Victoria I
which is always eroded by wave action of the sea. The sandy beach serves as the site for landin
marketing of the fish caught. A survey was undertaken to determine the number and type of all fi
crafts at Orimedu port. The socio-economic characteristics of people engaged in all fishing act
with a bias to purse seining were also determined. Water temperature was measured at the fi
sites with a mercury- in-glass thermometer and recorded. DO and salinity were also measured
the aid of DO meter (model) and salinometer (Model) respectively and recorded. An assessment
undertaken to determine the specific design characteristics of the purse seine net and craft us
Orimedu fishing port. The mode of operation of the purse seine nets was also evaluated. Sp
composition of the purse seine operations was assessed. Species composition by weight and m
sizes of each fish species caught were also determined. The landing site cum the marketing of the
landed is on the sandy coastal beach. On arrival from the fishing trip, the Ghana dug –outs w
stationed on the sea behind the tough waves to be well anchored. Fish caught were latter evacuated
medium size fishing canoes measuring between 7-9 meters (LOA) to the landing site. At the lan
beach the fish specimens were transferred from the canoe by big trays to be landed in heaps on
sandy beach. There were approximately 200 pieces of fish specimen per heap. The heaps were t
sold to the middle women fish mongers.

RESULTS

Five hundred small non-mechanized fishing crafts measuring between 5-7 meters (LOA);
medium, plank banana canoes measuring between 7-9meters (LOA); and 19 large Ghana dug –o
canoes measuring between11-17 meters (LOA) were enumerated .The plank and large Gha
dugouts were respectively propelled by 25hp and 40-50hp engines. The number of able fisherme
Orimedu fish port totaled 700. These comprised of old, middle- aged and secondary school boys. T
Ghanaian fishermen operating at Orimedu were about 20% of all fishermen encountered during t
course of the study. Only the Ghanaians operated the purse seines for bonga fishing. They we
itinerant because they changed fishing locations based on fish migration. Purse seine operation
carried out throughout the year except during the heavy rainy season and August break. During t
favorable fishing season a canoe purse seine operation could provide an adequate income for
people. However during the rainy season, the dug-outs canoes are generally rendered unseaworth
and the Ghanaians resort to mending their gears and crafts. Some also may participate in ad h
activities like: poultry cum husbandry, marketing of domestic needs, tailoring or other forms
combination of enterprises. A synopses of the problems faced by the purse seine fishery sector inclu
non-participation of indigenous fishermen in purse seining, inadequate or lack of access to capit
inadequate supply of fishing inputs, lack of modern fish processing and fish preservation equipmen
distant access to gasoline procurement and fuel wastage from searching for schooling clupeid stoc
In addition, the prohibitive costs in the procurement of modern equipments such as the echo sound
and radar for sighting the schooling fish are also serious constraints affecting productivity.

Environmental Factors

The physicochemical analysis recorded at Orimedu fish port is stated below. The lowest and highe
mean range for the parameters like: Water and Air temperature; Dissolved oxygen; Salinit
Conductivity and pH were: 25.90-29.76°C; 25.39-28.35°C; 5.75-6.90mg/l; 28.90 – 33.49‰; 47.0
51.71; and 8.17-8.56 respectively as shown in table 5 below. The table also highlights the mea
variance, and standard deviation of those physicochemical parameters.

Table 1: Environmental Analysis

Parameters	x	∞	S	Range
Water temperature	28.17	1.26	1.47	25.90 - 29.76
Air temperature	27.14	1.56	1.40	25.39 - 28.35
Dissolved oxygen (9 mg/l)	5.81	0.14	0.12	5.75 - 6.99
Salinity (‰)	32.34	1.56	1.47	28.90 - 33,49
Conductivity readings	49.69	1.85	1.71	47.00 - 51 71
pH	8.41	0.13	0.11	8.17 - 8.56

Design Characteristics and Operation of Purse seine Nets and Crafts

The purse seine set net with the exception of beach seine net has the highest number of bundles per set of net. The net is multifilament gill set net. The mesh size ranges from 2.5-5.0 inches. These nets catch fish by surrounding them both from the sides and from underneath, thus preventing them from escaping by diving (Nedelic and Prado, 1994). The purse seine net is characterized by the use of a purse which closes to retain the captured fish. The detailed basic design characteristics of the purse net are presented in Table 2.

Table 2: Basic design characteristics of Purse Seine net off Orimedu fishing settlement.

Design Characteristics	Measurements
Headline	250 -600m.long, made of polyamide and polyethylene.
Net webbing	1, 25 -1.30 multifilament net with 20mmmesh size and R400-500 text twine rope
Hanging ratio	It ranges from 1:1
Floats	It consists of cork, rubber and plastics. About 1500 -2000 floats are fixed to the net at interval of 0 -10cm.
Sinkers The weight	They are made of lead (Pb), zinc (Zn) and stone. The number ranged from 13000 -15000. is between 100 -150gm. They are fixed interval of 40-60mm.

The Ghana dug- outs (canoes) used in purse fishing expedition are among the biggest of the small - scale artisanal fishing crafts encountered in Lagos state. The length ranged between 11-17 meters (LOA). A typical dug-out canoe is propelled by powerful outboard engines (40-50 hp).The engines are technocratically mounted on the right hand side towards the tail end. The canoe is manned by 8 -9 able fishermen. It has sophisticated devices such as the echo sounder box; depth founder and compass.

Mode of Operation of Purse Seine Net

After fuelling, the purse seine net is ferried into the large Ghana dug-out by a medium size fishing canoe measuring between 7-9meters (LOA). The fishermen randomly sail out to search for shoals of bonga fish. On sighting the schooling fish, the engine is slowed down. The canoe then sails with precision towards the direction of the swimming fish. The net is then paved into the water quickly to encircle the fish. After encircling the fish the too ends of the net are tied together. The artisanal fisher folks then use various acoustic methods to frighten the fish into the net. Immediately the net is hauled into the canoe to land the fish caught. On return from the fishing trip, the Ghana dug -outs are well anchored behind the tough waves on the sea. Fish caught were later evacuated by medium- size fishing canoes measuring 7-9 meters (LOA) to the landing site on the beach. At the landing site, the fish caught were transferred from the canoe by big trays to be landed in heaps on the sandy beach. There were approximately 200 pieces of fish specimen per heap. The heaps were then sold to the middle- women fish mongers.

Species composition

A total of three thousand and seventy one fish specimens were sampled at Orimedu fish landing site from August 2007 –February 2008. Ten fish species belonging to five families were frequently encountered during the sampling period as shown in Table 3. The gear was highly selective and fish target specific. The fish species sampled included: *Ethmalosa fimbriata* (bonga fish), *Sardinella*

madarensis (sardines),both belonging to the family clupeid, *Scombromorus tritor*(mackerel), *obesus* (Tuna fish) of the family scombridae, *Chloscombrus chrysurus* (African bumper fish), *hippo* (caranx) and sharks. Total lengths of *Ethmalosa* (bonga fish) and *Sardienella mad* (sardines) sampled measured between 23—31cm (TL) and 17—29cm (TL). *Chlorosc chrysurus* and *Caranx hippo* measured between 13-19cm and 45-69cm respectively. Modal other species are also as shown in Table 3.

Table 3. Species composition, relative abundance and modal sizes from Purse Seine Operat Orimedu.

Family	Species	Common names	Range in TL (cm)	% by N
Clupeidae	*Ethmalosa fimbriata*	Bonga fish	23—31	53 .10
	Sardinella madarensis	Sardines	17—31	40.79
Carangidae	*Chloroscombrus chrysurus*	Atlantic bumper fish	13—19	1.0
	Caranx hippo	Crevaile jack	45—69	1.2
	Alectis alexandarus	Alexandria pompano	45—69	0.40
Scombridae	*Thunnus albacares*	Yellowfin tuna	65—73	1.00
	Thunnus obesus	Bigeye tuna	123- 155	0.51
	Scomberomorus tritor	Mackerel fish	52—83	2.3
Carcharhinidae	*Carchahinus* spp	Sharks	175	0.01
Sphyrnidae	*Sphyrna couardi*	Hammer head shark	113-115	0.09

TABLE 4 Fish weight and percentage by weight of fish species sampled at Orimedu --Lagos state

Fish species	Weight (kg)	% by wt.
Ethmalosa fimbriata	211.00	48.90
Sardinella madarensis	143.00	33.14.
Scomberomorus tritor	27.00	6.25
Thunnus albacares	13.00	3.02
Thunnus obesus	5.00	1.16
Chloroscombus chrysurus	15.00	3.47
Caranx hippo	7.00	1.62
Alectis alexandrimus	0.40	0.09
Carcharhinus spp	1.0	0.23
Sphyrna couardi	3.0	0.67
Total	444	100.00

The total weight of the fish sampled was 444.54kg. The average weight of the catch landed per c was 30.53kg. During the sampling period the most abundant fish species caught were *Ethma fimbriata* (bonga) and *Sardinella madarensis* (sardines). *E. fimbriata* ranked the highest with 21 kg of fish landed accounting for 48.90% by weight of the total fish landed. *S. madarensis* ranked with 143.00kg accounting for 33.14% by weight of the total fish landed. *Scomberomorus t* (mackerel) came third with 27.00kg representing 6.07% of the total weight of fish landed. *Thu obesus* (Tuna fish), *Chloscombrus chrysurus* (African bumper fish), *Caranx hippo* (caranx) sharks were minor components of the total fish landed as shown in (Table 4).

DISCUSSION

The low number of fish species landed shows that purse seine is highly selective and fish ta specific, which accounts for the overwhelming dominance of the two clupeid species in the catch. fishermen maintained that the bonga fish was mostly caught in Forcados water which comes from Eastwards end of Orimedu fish port while sardines (*Sardinella madarensis*) was said to migrate f the Westwards i.e. with the current coming from Benin Republic Moses (1988) and Ama –abasi et

(2003) reported the dominance of clupeids especially, *E. fimbriata* in purse seine catches in South-eastern Nigeria. The high catch of bonga recorded in this survey can also be attributed to the rise in salinity and the abundance at this time of the centric diatom, *Coscinodiscus* on which the bonga fed (Moses, 2000). In contrast, fish species richness from the beach seine is significantly higher and less species selective with bias to its catch. In an earlier study, Abass (1984) observed that 33 fish species belonging to 14 families were sampled from beach seine landings at Yovoyan fish landing station in Badagry, Lagos State. Lengths of the clupeids fall within the ranges of 30-40cm and 13 -35cm as reported by FAO (1990). These ranges are the limits for adult/ mature clupeids. The implication is that purse seine net in Orimedu has not depleted the population of clupeids in the sea. However this is in contrast to Ama- Abasi et al (2003) where purse seining undertaken in the Cross River estuary resulted in over fishing in the bonga stock. Also, juveniles and immature fish species are prominent in landings of beach seines, inshore fish trawlers and shrimpers (Kusemiju, 1992 and FAO, 1992). In separate studies, Udolisa (1984) and Sholarin (1985) also noted that samples of immature *Illisha Africana* (African shad), Vomer setapinis (Moon fish), and *Chloroscombuss chrysurus*(Atlantic bumper) varying between 5-7cm (TL) were caught by beach seines at sea. These problems are not peculiar to the coastal purse seine fishermen at Orimedu fish landing station, but may be applicable to other fishermen in the country.

Purse seine operation is highly selective and does not result in growth-over fishing in the populations of clupeids. Matured fish specimens only were caught by the coastal purse seine net. However, it should be acknowledged that over fishing may set in if fishing levels continue to be immoderate and mesh sizes are reduced. In addition, over fishing may be experienced if fishing for bonga is extended to the estuaries which are the nursery grounds for theses fishes. Training the purse seine fishermen on golden job opportunities like poultry cum integrated fish farming is pivotal and highly needed. Thus, to validate the effects of purse seine operations in Orimedu fishing settlement, in - depth assessments of the population dynamics of the exploited fish stocks would be necessary.

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POTENTIALS OF *Tarpon (Megalops) atlanticus* FOR SPORT FISHERIES AND ECOTOURISM DEVELOPMENT IN NIGERIA

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ABSTRACT
The Atlantic Tarpon, *Tarpon (Megalops) atlanticus* is a marine fish of high commercial importance with a special fishery in western, central and south-western Atlantic Ocean where it is a very important game fish. The species provides sport fishery especially in the western Atlantic coast of America which has generated millions of dollars in tourism, employment and boat charters. Tarpon fishery in America is highly regulated and there are strict guidelines on capture, bag limits and fishing seasons. Tarpon puts up a spectacular fight when hooked, leaping up to 2-3m above water surface and landing with a smacking splash that can be heard one kilometer away. It is the leaping powers that make tarpon a favourite to anglers. In the coastal waters of south-west Nigeria especially for the natives of the coastal communities of Ondo State, *T. atlanticus* is a delicacy and of high economic value. Some local fishermen and fish farmers in the area stock Tarpon in their ponds purely for recreational purposes. Some of these tarpon farms were integrated with snack bars and served as tourist centres. Visitors including individuals and educational institutions frequent the fish farm during excursions and pay a stipulated fee per person as entry permit to the farm thereby generating more revenue to the farmer. This paper highlights the importance of Tarpon as a game fish and suggests strategies for development of its culture both as food fish and for ecotourism.

INTRODUCTION
The species, *Tarpon (Megalops) atlanticus* (Val.) occurs in the warm temperature, tropical and sub-tropical Atlantic Ocean generally from Mauritania to Angola in the Eastern Atlantic and from Nova Scotia to Brazil in the Western Atlantic (Irvine, 1947; Whitehead, 1978; Fischer *et al*, 1981, Whitehead *et al*, 1984 and Schneider, 1990). Tarpon or 'Silver King' as is commonly known is the oldest and first marine species to be declared a game fish (IGFA, 1987). In Western Atlantic, Gulf of Mexico and Caribbean, Tarpon is a famous game fish supporting recreational fisheries, highly appreciated by anglers and fetched millions of USA dollars annually ((Hureau, 1984, Zerbi, 1999, Figueroa and Zerbi, 2002). Although the species occur in Nigerian coastal waters especially in South West Nigeria, the potentials for sport fisheries and eco-tourism are not yet developed. Only very few farmers culture Tarpon now unlike in the 80s and 90s when a booming tarpon-fingerling trade existed in the coastal communities of Ondo State (Ezenwa et al.1985 and Anyanwu, 2004). Nigeria is endowed with natural habitats that can be developed into international tourist centres. Presently many Nigerians are seeking for out-door relaxation centres and aquatic parks or holiday resorts can occupy this niche. This paper highlights the potentials of *T. atlanticus* as a game fish and suggests strategies for development of its culture both as food fish and for ecotourism.

BENEFITS OF ECO-TOURISM
Eco-tourism like any industry has both merits and demerits The International Union for Conservation of Nature (IUCN), defined eco-tourism as a responsible travel and visitation to relatively undisturbed natural areas in order to enjoy and appreciate nature that conserves the environment and sustains the well-being of the local people. The United Nations declared 2002 as the International Year of Ecotourism (IYE - www.mier.org.my/newsarticles/archives). Ecotourism according to the International Ecotourism Society (TIES) covers all travels to natural areas that conserves the environment, contributing at the same time to the welfare of the local society. The benefits of ecotourism can be broadly categorized as economic, socio-cultural and physical. The most direct economic benefits are the improvement in employment and income. The world tourism council estimates that travel and tourism provides employment for more than 100 million people worldwide responsible for over 7% of world capital investment.

The World Tourism Organization (WTO) and The British Columbia statistics reviewed that tourism injected $9.5 billon into the British Columbia economy with 22.5 million visitors and generated 11,980 direct jobs (The British Columbia Statistics, 2000). Domestic and international tourism contributed in net terms approximately $6 billion to the Queensland economy. A tourist dollar is a new dollar injected into the local economy with greater the economic benefits that can come from employment as porters, cooks, and guides in hotels and in transportation, as well as tour operators/guides and travel agencies. Ecotourism is a labour intensive industry and creates many job opportunities, especially for young people and part-time workers. In tourism, hospitality and recreation industries alone, there are 50 categories of employment and approximately 200 classifications of occupations. There are tremendous opportunities for the establishment of new products, facilities infrastructures (road, social amenities etc) which all lead to a major source of local economic input from tourism (Mock and O'Niel, 1996). Eco-tourism involves four sectors: the tourists, the host communities, the environment and the tourism industry. NGOs, such as WWF, the Ecotourism Society, IUCN, etc can produce codes to catalyze and strengthen efforts to promote environmentally responsible tourism.

Tourism highlights the need for proper management of the environment and through effective policies and planning; it can ensure that the environment of an area is preserved. It is also a catalyst for residential development. Ecotourism can stimulate the establishment of a new and improved transport services to and within a regional area. Ecotourism provides economic incentives and promotes conservation of wild lands, generates income for park management and brings needed income to rural populations. It promotes conservation, has low negative visitor impact and provides for beneficially active socioeconomic involvement of local populations (Wall, 1997). Odunlami (2003) reported that the Argungu Fishing Festival is an attraction spot for many tourists now and Kebbi State government is poised to develop it to a world class event.

ECO-TOURISM POTENTIALS OF TARPON

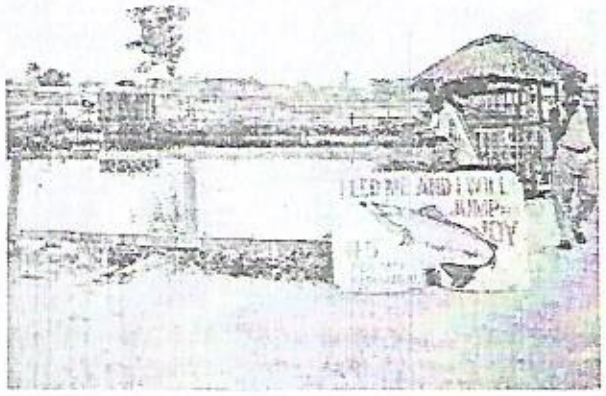
Tarpon are pelagic species and wide ranging animals found in shallow waters, bays, estuaries, mangrove lined lagoons and rivers in the eastern Atlantic. They are euryhaline species and can inhabit marine, brackish and freshwater environments. They are large, beautiful, silvery fish that reach up to 250cm and weigh up to 161kg with average lifespan of about 55 years (Plate 1). Tarpon possess a swim bladder attached to their esophagus which enables them to take in atmospheric air and hence can live in oxygen poor waters (Anyanwu, 2004).

Plate 1: Atlantic Tarpon – *Tarpon (Megalops) atlanticus*

Bond (1979) reported that sport fishing in developed countries provide excellent use of leisure time as well as revenue generation. Approximately US $ 465 million was generated annually in Florida through recreational fisheries which target *T. atlanticus* as the most important game species (Zerbi, 1999). Permit system in the Tarpon Fisheries requires anglers to pre-purchase a $50.00 permit for every one tarpon harvested. This process has resulted in a great increase in catch-release fishing for Tarpon with a legally yearly harvest of approximately 100 fish per year (Crabtree et al. 1995). The world record for tarpon caught using hook and line, weighed 128kg from lake Maracaibo Venezuela. In Africa, Tarpon sport fisheries is not developed. However, sizes ranging from 99 - 112.60kg were commonly caught at Port Michael in Gabon and they won 1st position during the 11th Annual International Game Fish Association Fishing Contest (IGFA, 1987). When hooked, tarpon puts up a spectacular fight leaping up to 2-3 meters above water surface and landing with a smacking splash that can be heard one kilometer away (IGFA 1987). It is the leaping powers that make tarpon a favourite to sport fishermen.

The adult female tarpon is highly fecund producing over 12 million eggs at a time. The eggs, fry, fingerlings, juveniles, and adults are present in the coastal waters of south west Nigeria especially Ondo State (Anyanwu and Kusemiju, 2006, 2007). Tarpon could be cultured in brackishwater, freshwater and marine environment and grow fast when stocked with Tilapia as prey (Anyanwu 2004). The large scales are used in ornamental work and in preparation of artificial pearls. These attributes make Tarpon a good candidate for the establishment of aquatic parks for eco-tourism because it can easily be sighted in the water and would generate revenue for a long period of time.

Some local fishermen in Lagos State stocked tarpon in their ponds purely for recreational purposes. Those tarpon farms were integrated with snack bars and serve as tourist centres (Plates 2 and 3). Visitors to the fish farm on excursions were charged a fee of N50-N100 per person as an entry permit into the farm (Anyanwu, 2004)



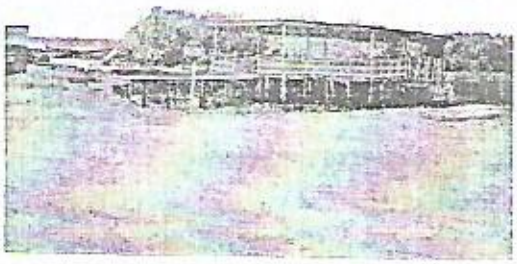


Plate 2: Tarpon pond

Plate 3 Relaxation bar in the Tarpon Farm

(Tarpon Farm established mainly for eco-tourism and relaxation, located near Ojo-Alaba International Market, Lagos State)

STRATEGIES FOR DEVELOPMENT OF ECOTOURISM POTENTIAL OF TARPON

Ecological based tourism in Nigeria is at the early stage of development and its promotion can be enhanced through:

Establishment and maintenance of Tarpon farms for sport fishing and relaxation purpose. Lakes, reservoirs and other water bodies can be re-stocked with Tarpon. Fishing tournaments or festivals like that of Argungu can be organized for such water bodies. Establishment and maintenance of Tarpon farms in our national parks, zoos other games reserves, e.g. Yankari Games Reserve, Obudu Cattle Runch, Botanical Garden in Obafemi Awolowo University, Ife, Zoological Garden in University of Ibadan. Provision of nature-based and eco-tourism facilitates by State Governors, private sector and non-governmental organizations.

Organization of Local and international workshops and seminars on the eco-tourism potentials of Tarpon

Empowerment of the national, state and private institutions responsible for sustainable tourism namely: The Federal Ministry of Commerce and Tourism, The Nigerian Tourism Development Corporation (NTDC), The National Parks Board, Federal Environmental Protection Agency (FEPA), The State Tourism Boards, and The Local Government Tourism Committee.

There are laws and other regulatory bodies which seek to ensure sustainable tourism and have set aside specific areas or reserves for eco-tourism and native-based tourism.

T atlanticus has great potentials for eco-tourism and sport fisheries development in Nigeria. Development of aquatic parks and fountains or ponds stocked with tarpon can contribute positively to the conservation of the ecosystem, natural resources, wild life and fishes as well generation of revenue and creation of employment. There is need to establish well designed Tarpon farms for eco-tourism and production of fish for human consumption.

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FIELD IDENTIFICATION OF *Typha* SPECIES IN HADEJA GASHUA NGURU WETLA

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ABSTRACT

Field identification of *Typha* species in Hadeja Gashua Nguru wetlands Nigeria between Janu June 2008. and July\ October 2008. The study was conducted at Gashua Nguru wetland (Yobe Jigawa states), Nigeria 2008. The three sampling station was established. Aquatic Plant Con information system Table (1996), for identify the species of *Typha species* was used, in t sampling station. Two *Typha* species vwere identified – *T. latifolia* and *T. angustifolia*.Data anal showed that, there was significant difference between *T. latifolia* and *T. angustifolia* ($P<0.05$).

INTRODUCTION

Typha grass can be found in wetland, sedges and meadows streams, rivers banks and lake edges. plant is found in areas of fluctuating water level, such as road sides, ditches and reservoirs (Mo 1975). It is an erect perennial freshwater aquatic herb which can grow up to 3 or more meter height. The leaves are thick ribbon like structure which have a spongy cross- along moving sec exhibiting air channels. Typha are found throughout the world and Southern Africa. It is n common in aquatic situations whether in standing or slow-flowing waters. Marshes stream ba dams and lakes are most commonly inhabited by Typha grass .The muddy substrate of these w bodies help the plants to anchor its rhizomes firmly.(Smith 1999). The subterranean stem arises f thick creeping rhizomes. Flower structure is a dense, fuzzy, cylindrical spike on the end of stem, a gap 1-3 cm of naked stem between the upper, male portion (stamina) and lower, female (pi portion. *Typha spp.* is a clonal monocotyledon with sword-like leaves that grow vertically from shoot base. The leaves are made of aerenchyma tissue and a large portion of biomass allocatio directed toward sexual reproduction. At maturity the spike bursts under dry condition releasing fruits. The fruits have bristly hairs that aid in wind dispersal. When the fruits come in contact water, the pericarp opens rapidly, releasing the seed. The fruits often fall to the ground in dense m Vegetative reproduction occurs through an extensive rhizomes system which is responsible for maintenance and expansion of existing stands (Shekhov, 1974)

The plant is adapted to muddy and wet conditions. The strong fibrous roots that arise from rhizomes help to anchor the plant so that it can withstand strong winds without being swept awa the water. Owing to variation in water content of marsh habitats, the rhizome structure may show h hydro (water) and Xeric (dry) adaptations. In Typha the prominence of mechanical and conduct tissue indicates the plant Mesophytic (plants capable of coping with both extremes of water drought) ability due to the presence of abundant storage parenchyma aerenchyma, and hydroph tissue. (Smith 1999).The thickened endodermic layer affords means of protection against moist loss during drought. Since both the mechanical and conductive tissues are well developed, the pla able to grow erect without being supported by the water. Cattails flower in late May and June sometimes later (up to late July) depending, perhaps on soil and water temperatures as influenced climate and litter in a stand. The wind-borne pollen attaches in the stigmas of female flowe eventually produce achene's fruit. The elongated embryo and stalk are severed with fine, unma hairs that aid in wind dispersal. Fruits are mature in August and September. Seeds are very sm weighing 0.55mg each (Keddy and Ellis, 1985). Typha grass causes a variety of problems in Nige that are broadly similar to those caused by Typha grass elsewhere in the world (Morton, 1975). Ear studies (NIFFR, 2002) revealed that, this plant caused problems in Hadejia|Jama`are, Jigawa, Yo and Kano states. In Nigeria, such problems include interfering with water from flood lan impeding the movement of boats for transport, fishing and recreation among others. It also interfe with various methods of catching fish; competing with rice in paddy systems, leading to degradin water quality by adding taints and odours to the water, thus, decreasing dissolved oxygen content also alters the flora and fauna of aquatic ecosystems as well as a reduction in light penetration wit the aquatic system. This undoubtedly intensified ecosystems degradation with consequent effect the natural resources, due to over population of *Typha spp*. Unless appropriate management strate

are applied, the trend might cause economic and ecological disasters to 15 million people in Nguru wetland. The aim of this study is to identify the *Typha* spp in Nguru Wetland, and to find the best management method to benefit the Nguru wetland community.

MATERIALS AND METHODS

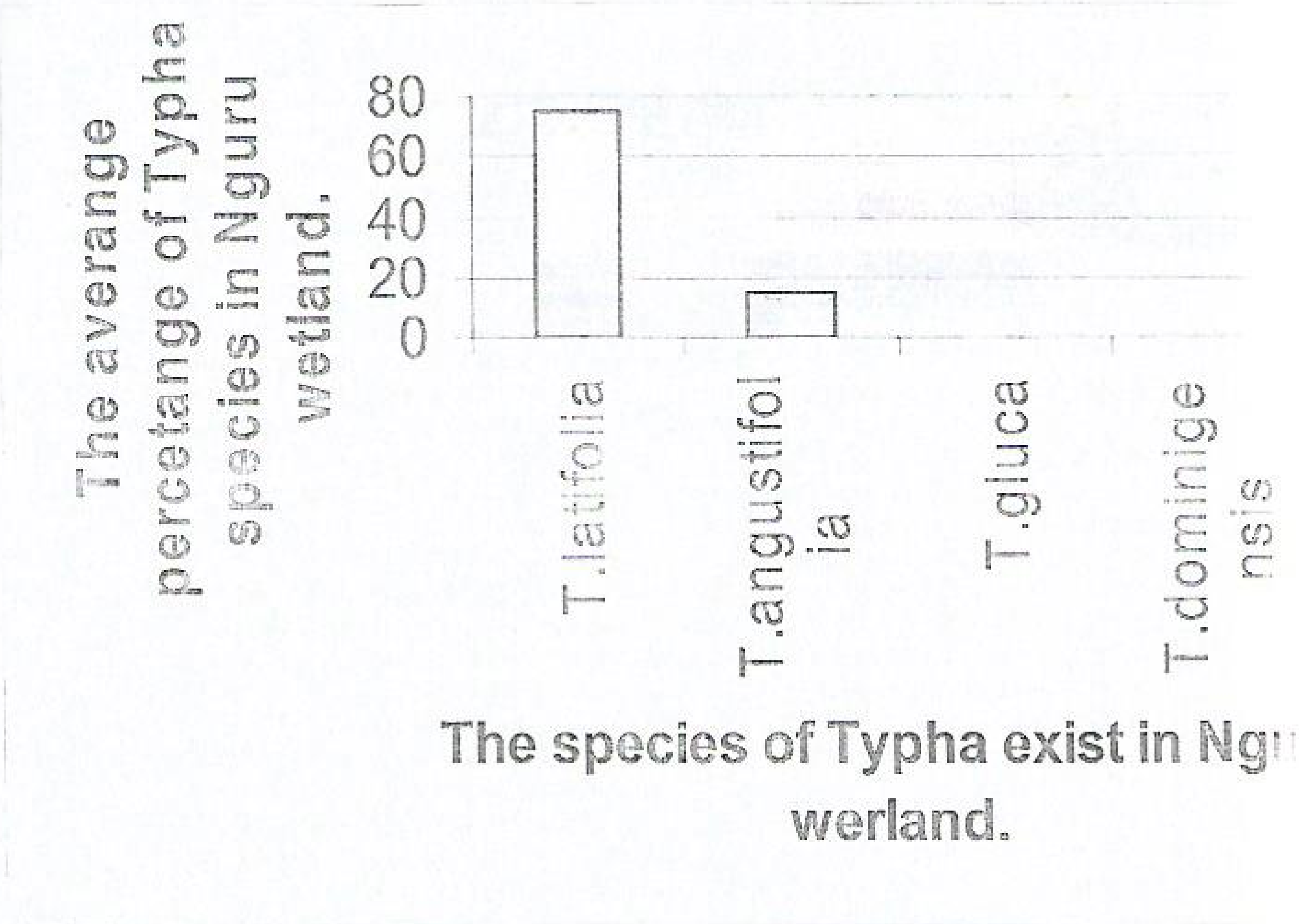
Gashua Nguru wetland is located in the North West Zone of Nigeria, in Yobe and Jigawa states. The vegetation ecology is distinguishable into the Northern Guinea and Sudan savanna. As result of human activities the trees were replaced by shrubs from the South to the Northern boundaries. The area is wholly tropical with abundant solar radiation (400-500 wm-2) incident mostly as beam radiation, 8 hours/day mean and minimum temperature is (17°C) and maximum (40°C) respectively. Jigawa and Yobe states are distinct dry and wet seasons. Maximum rainfall range 305mm to 1048mm (National Agricultural Research Project, 1996). The study was carried out at Gashua Nguru wetland in 2008. The three sampling station was established as showed figure 1. *Typha* species was collected in each sample station. Aquatic Plant Control information system Table (1996), was used for identification of *Typha* species in three sampling station as indicated in table 1.

Table 1 Aquatic Plant information system (1996).

	T. latifiolia	*T. angustifolia*	*T. gluca*	*T. dominigensis*
Appearance	Coarse stout	Slender	Either	Slender
Leaves	Flat	Convex on back	Convex on back	Convex on back
x- section	8-15	5	6-12	6-12
width in mm	Tapering	auriculate	Auriculate	tapering
sheaths		.5-012cm		
Length between female and male	Non		0-4cm	0.7-4.5cm
Pith color at base	White	White	Yellow buff	White
Female flower bract	Non	Dark brown blunt	Non rarely like ang.& dom.	Light brown Ovate & apiculate

RESULTS AND DISCUSSION

The species of *Typha* identified in Gashua Nguru wetland during the two season 70-75% was *Typha Latifolia* follow by ***T. angustifolia*** as shown in figure 58, 6. The result showed that during wet season the population of *T. latifolia* is lower compared to dry season. While ***T. angustifoli*** increased in population during wet season. This may be associated with facts that *T. latifolia* is less tolerant to higher flood (smith 1984). Studies have showed that *Typha latifolia* is found in the most favorable sites compared to *T. angustifolia* and *T. domingensis* (Gustafson 1976). *T. latifolia* seeds are less tolerant to salt (NaCl) concentrations in the substrate when compared to *T. angustifolia* seeds. However, seeds of both species which had been soaked in salt solution would germinate after being returned to non-saline conditions (McMillan 1988). Typha angustifolia seeds showed no significant germination response when sprouted along a moisture gradient which ranged from 5 cm below substrate to 10 cm above (Keddy and Ellis 1985). Though their appearance seems similar, the simple way to differentiate the two species of Typha is the inflorescent. In ***T. angustifolia,*** there is separation between the male organ and female organ in the inflorescent. *T. latifolia* has no separation between male organ and female organ as shown in plate 1and 2. Other Typha species such as *T. domingensis* and *T. gluca* are completely absent it was observed the two species were restricted to less favorable and more saline habitants (Gustafson 1976). *T. latifolia* have numerous leaves compared to *T. angustifolia. T.latifolia* also eliminates habitat and species diversity, and reducing the opportunity for other plants to become established and survive. Shading is a significant effect on other plants (Pianka 1973). In *T. latifolia,* the inflorescent are usually short distinguished from *T. angustifolia,* which is longer (Smith 1999).



. **Figure 2** shown the percentage of Typha species in Nguru wetland During dry season

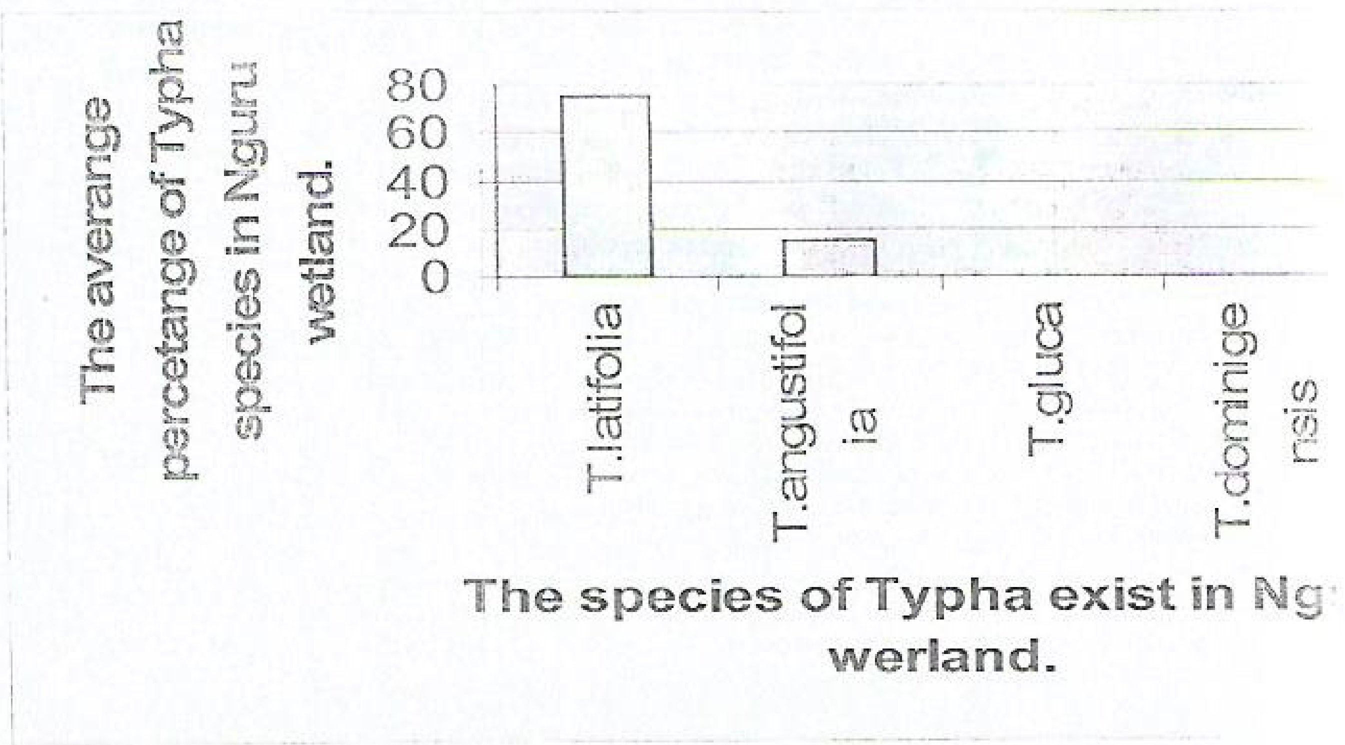


Plate 1 *Typha latifolia*

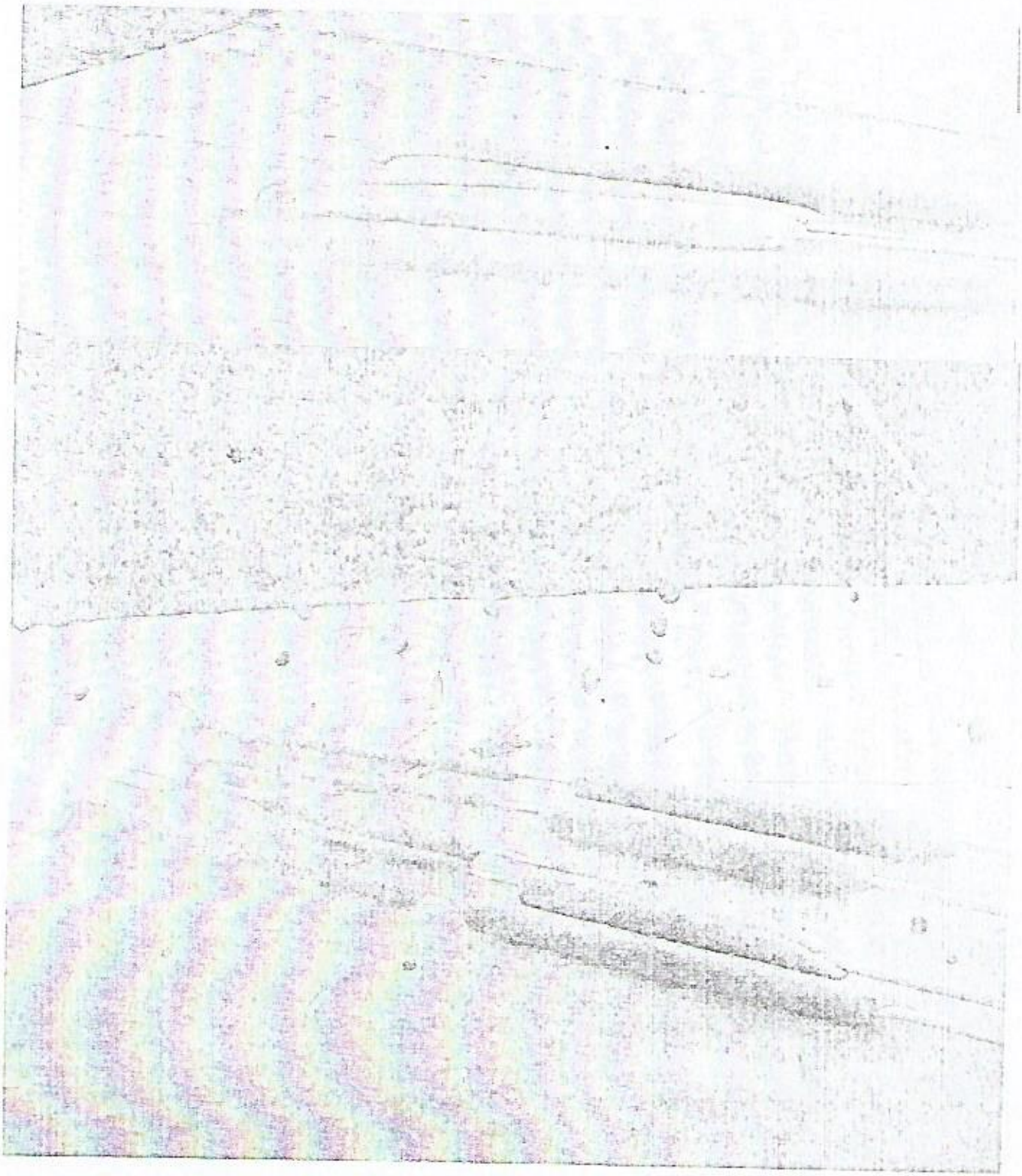


Plate 2 *Typha angustifolia*

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ANAESTHETIC EFFECTS OF POTASSIUM PERMANGANATE ON *Heterobranchus bidorsalis*

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ABSTRACT

Heterobranchus bidorsalis fingerlings were exposed to the concentration of 0.10, 0.15, 0.20, 0.25 and 0.30 g/l of potassium permanganate in replicates.The anaesthesia and recovery rates were studied. The 24 hours LC_{50} of *H. bidorsalis* fingerlings exposed to potassium permanganate was 0.20g/l. The effects of potassium permanganate increased with increase in concentrations and duration of exposure to certain extent, the anaesthetic time linearly decreased as the concentrations and temperature increased while the recovery time increased from 1- 5min as concentrations increased. The effects of potassium permanganate was reflected in the fish swimming pattern, rapid opercula movements, hyperactivities, surfacing and leisions during exposure for 24 hours. pH, temperature, dissolved oxygen concentration, salinity and conductivity of the test media showed slight increases. Potassium permanganate is a potent anaesthetic for *H. bidorsalis* and most effective at the concentrations of 0.10-0.20g/l.

INTRODUCTION

The art of fish culture is an old age practice in Nigeria. Research into fish culture practices has made it possible for mass publicity for the transfer of the culture technology to the general public. However, to enhance the development of agricultural practices in Nigeria, the effects of some chemical substances on fish has to be understood because some of these chemicals have adverse effects on the fish (Madu et al., 1989). Potassium permanganate is an oxidizing agent usually in crystals or powder form; it reacts with any organic matter in a pond including algae, bacteria, fish particulate, dissolved organic and organic bottom sediments. It has been used in fish ponds to treat common fish pathogens such as gill parasites and external bacterial and fungal infections (Moore et al., 1984).

MATERIALS AND METHODS

120 healthy *H. bidorsalis* fingerlings (mean wt. 3.9g) purchased from a reputable fish farm in Akure Ondo State were used for the experiment. The fish were transported life in a plastic bucket to the laboratory where they were acclimated for 248 hours in a 1500 litres bowl prior to the anaesthetic tests. Each bucket was filled with 10 litres of water obtained from the well in the Fisheries and Wildlife Farm, Obakekere. During this period the fingerlings were unfed for 24 hours prior to the test in order to minimize the production of waste, thereby reducing ammonia production from the wastes. The fingerlings were distributed randomly in treatments of 10 fingerlings per bucket. The fingerlings were weighed with Mettler Balance (Mettler PM 360) and the length taken with a measuring board. The following concentrations of potassium permanganate (0.10g, 0.15g, 0.20g, 0.25g and 0.30g/l) were added to 10litres of water in each of the experimental tank this was in replicate before the introduction of *H. bidorsalis* fingerlings. The behaviour of *H. bidorsalis* after the introduction of potassium permanganate was recorded. Temperature, pH, dissolved oxygen (DO) conductivity and salinity were conducted during the experiments. The LC_{50} was determined by using graphical methods (Probit method). Data obtained in the experiments were subjected to analysis of variance (ANOVA); Graphical methods (Probit Method) and Standard Deviation.

RESULTS

The fish were observed to exhibit erratic swimming and after a while swimming weakly to maintain a vertical swimming position, surfacing, peeling if the skin, discolouration, change in behavior, loss of reflex and increase in opercular movement.As the duration of exposure increased, the test fish showed increase weakness, loss of motion and gasping for air. Anaesthesia, recovery time and mortality rate of *H. biodorsalis* exposed to $KMnO_4$ is shown in Table 1. The values showed that there was significant difference ($P < 0.05$) in the mortality rate of the test organism at different concentration

with increasing time of exposure in varied concentrations of $KMnO_4$. In concentrations 0.2-0.5g all the fish reached anaesthesia within 3 hours of exposure and in concentration 0.1g they reached anaesthesia in 6 hours. Table 3 shows the physico-chemical parameters of *H.bidorsalis* exposed to potassium permanganate after 24 hours. Fig. 1 shows the direction and strength in the linear relationship between two qualitative variables showing mortality as dependent factor coefficient (r has possible values between positive and negative one. Concentration 0.1g resulted in anaesthesizing the fish with no mortality, concentration 0.15g caused equilibrium mortality in the fish and anaesthesia occurred within 3 hours of exposures (Fig. 1).

DISCUSSION

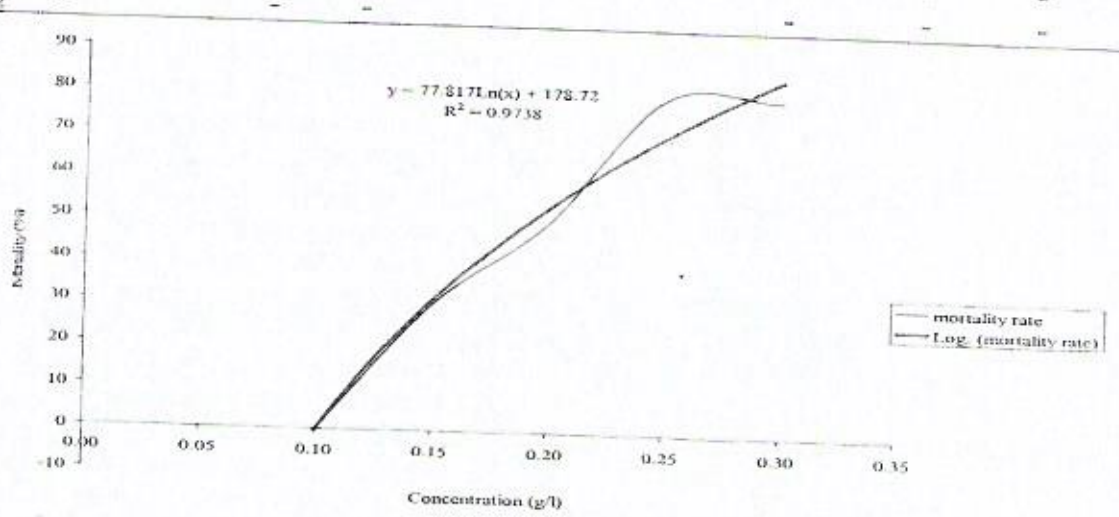
An increased was observed in the dissolved oxygen and salinity level while pH and temperature decreased but conductivity level of the medium varied considerably as it can be seen in (Table 3). Result from various studies revealed that organisms exposed to toxicants or chemicals usually exhibit changes in opercula rate, erratic sudden jerky swimming movement, hyperactivities and different behavioural activities as shown in these experiments, which was demonstrated to be sensitive indicator of stress in fish subjected to sub lethal concentrations of pollutants (Davis 1973). Fish responses in this experiment also agree with Pascual et al. (1994), which noted fish settling at the bottom of experimental tank shows stress or weakness. Stress and hyperactivities of the clariid fishes observed in this study, had been reported in the Brook trout, *Salvelinus fontinalis* (Drummond et al 1973). Similar trends have been reported by White (1980), while working on Atlantic herring, *Clupea harengus* and Ajao (1985) .Clove oil has a narrow margin of safety as was also pointed out by Sladky et al., (2001) in their comparison of different anaesthetic. This agreed with the result of this experiment However, clove oil reduces ventilation rate in *Micropterus salmoides* (Cooke et.al.2004) and alleviated the stress response in salmonella (Iversen et. al. 2003). This agreed with the result of this experiment. The induction time in highest concentration (0.3g), is less than 2 hours 30 minutes and took a long time of recovery (Table 1).The rate of mortality at different concentrations of $KMnO_4$ (0.25-0.3g) were almost equal under similar conditions (fish from the same stock and water source) this agreed with (Sladky et. al. 2001). The higher the concentration, the higher the mortality, the variable factor is being calculated using the regression equation (Fig 1). At the highest concentration (0.3g), the test organisms (fish) reached anaesthesia within 1 hour 45minutes, concentration (0.25g) reached anaesthesia within 2 hours 5minutes and took 10-15minutes to recover, concentration 0.2g reached anaesthesia in 2 hours 15 minutes and it took about 8-10 minutes to recover while concentration 0.1 reached anaesthesia in 3 hours 2minutes and about 8 recovered immediately. Control had no reaction to anaesthetic ($KMnO_4$) but behaved normally during the experimental period (24 Hours) compared to other treatments. The anaesthetic rate of each test organism (fish) is dosage dependent and mortality (Fig 1). The observation is confirmed by the significantly different mortality rates obtained due to dosage as was documented by Ufodike and Omoregie (1994).

Table 1: Physico-chemical parameters of medium containing potassium permanganate

Concentration	0.00g	0.10g	0.15g	0.20g	0.25g	0.30g
pH	7.05 ± 0.00^{b}	7.01 ± 0.05^{ab}	7.02 ± 0.05^{a}	7.01 ± 0.02^{ab}	7.01 ± 0.04^{ab}	7.03 ± 0.0
DO_2	4.90 ± 0.00^{a}	7.10 ± 1.56^{b}	7.60 ± 2.01^{b}	7.47 ± 1.82^{b}	8.30 ± 2.48^{c}	8.90 ± 3.3
Temperature	28.10 ± 0.00^{b}	27.90 ± 0.14^{a}	27.83 ± 0.18^{a}	27.87 ± 0.17^{a}	27.81 ± 0.17^{a}	$28.00\pm0.$
Conductivity	0.0032 ± 0.00^{a}	0.0032 ± 0.00^{a}	0.0032 ± 0.00^{a}	0.0032 ± 0.00^{a}	0.0033 ± 0.00^{a}	$0.0027\pm0.$
Salinity	0.15 ± 0.00^{b}	0.15 ± 0.00^{a}	0.15 ± 0.00^{b}	0.15 ± 0.00^{b}	0.15 ± 0.00^{ab}	0.17 ± 0.0

Table 2: Recovery and mortality of *Heterobranchus bidorsalis* exposed to potassium permanganate

		Time it take to reach anaesthesia		Recovery time intervals		Full recovery time / mortality	
		Time	No	Time	No	Time	Mortality
A	A_1	3 hrs 2mins	10	Recovered slowly after 1 minute	10	24 hrs	NIL
		2 hrs 53 mins	4	Recovered slowly after 1 minute	2		
	A_2	2 hrs 58 mins	6	Recovered slowly after 1 minute	3	24 hrs	NIL
		2 hrs 40 mins	4	Recovered immediately	2		
B	B_1	2 hrs 43 mins	6	Recovered slowly after 1 minute	5	24 hrs	3
	B_2	2 hrs 40 mins	10	Recovered slowly after 1 . minute	4	24 hrs	4
	C_1	2 hrs 15 mins	10	Recovered slowly after 5 minutes	2	24 hrs	5
C		2 hrs 30 mins	6	Did not recovered immediately	-		
	C_2	2 hrs 35 mins	4			24 hrs	4
		2 hrs 5 mins	3	Did not recovered immediately			
	D_1	2 hrs 8 mins	7		-	24 hrs	7
D		2 hrs 5 mins	4	Did not recovered immediately			8
	D_2	2 hrs 10 mins	6	Recovered immediately	2	24 hrs	
		1 hour 45mins	8	Recovered immediately	1		
E	E_1	2 hours	2	Did not recovered immediately	-	24 hrs	8
	E_2	2 hours	10	Recovered slowly after 1 mins	2	24 hrs	8
	F_1	-	-	-	-	-	-
F	F_2	-	-	-	-	-	-



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BACTERIA ORGANISMS IN GROW OUT *Clarias gariepinus* MORTALITY IN JOS AREA

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ABSTRACT
The investigation of bacteria in grow-out catfish was carried out from February to June, 2008. 100 dead *Clarias gariepinus* were collected from ten ponds (A-J) distributed in Jos and its environs. Results from the various ponds showed that *Escherichia coli* were present in all the location found, while 87.0% of the total samples obtained were positive with bacteria isolates. The isolates were shown to include Aeromonas species (11.5%), *Escherichia coli* (35.6%), *Pseudomonas aeruginosa* (15.0%), *Streptococcus faecalis* (13.8%) and *Klebsiella aerogenes* (18.4%) of which pond F had 16.1% of bacteria organisms while ponds B, G and H were both 9.2%, respectively.

INTRODUCTION
All living organisms are likely to get diseases or infections or illness which is a deviation from the normal life. Fish is no exception, in the case of fishes disease situations are more peculiar and different from that of land based animals or organisms in the sense that the interaction of water is so great that it decides the fate of the organism during illness. Therefore, disease in a fish can be said as the end result of an interaction between at least pathogen three factors viz; host susceptibity, pathogen virulence environmental factors (Stressors) (Kumer,2006). The diseases caused by bacteria are of lesser importance in Africa than those caused by other agents. This is probably because of long period of optimum water temperature and the resulting abundance of natural food. Remarked that bacteria are macroscopic organisms which differ from other cells by lacking nuclear membrane, with all it generic material linked to a single chromosome. They multiply by binary fission in living and dead cell host and highly inbignitous because of the diversities in systems and disease they cause. Diseased fish usually exhibits either physical or behavieral signs, or both. In almost all cases, accurate evaluation can only be made at a diagnostic laboratory. The behavioral and physical signs serve as a general guide to indicate presence of certain disease (after Moore *et al*, 1984). This study therefore reports on the bacteria organisms in grow out *Clarias garipinus* in Jos.

MATERIALS AND METHODS
A total of 100 dead fish sample were collected from ten ponds (A-J) and were taken to central Diagnostic laboratory, National Veterinary Research Institute, Vom, Plateau State for bacteria diagnosis. Samples of dead fishes were brought into the laboratory in sterile Cellophane. Bench fish were kept till the proper investigation in a cold place; however, the fish was not allowed to freeze in the refrigerator (Glenn,1977).Areas examined for bacterial infection include skin ,eye,gills, heart, spleen, stomach, intestine, kidney, pancreas, lungs liver, which was aseptically. Using aseptic technique, 1g of various tissues (gills, intestine, skill e.t.c) were weighed and homogenized into 10ml of sterile brain heart infusion broth (LAB m) and macconkey broth (FLUKA). These, however, were incubated at 37°c for 24 hours, subculture onto Blood agar and macconkey agar plates (FLUKA) and incubated at 24hours. Colonies of bacteria developing on the plates were observed, isolated and re-isolated until pure cultures were obtained. The bacterial isolates were then identified using both morphological and biochemical methods (such as catalase, oxidase, urease, methyl red, viques proskauser, sugar fermentation tests) using Colins and Lyne (1987).

RESULTS
The location and samples of fish collected differs considerably. Table 1 presents the figures. The bacterial species isolated from different locations from Jos and its environs are summarized in Table

2. Table 3 and Table 4 shows distribution of bacteria isolates in all farm respectively. Farm F had 1
(16.1%) and 10 (11.5%) of all the bacteria isolates while, *Escherichia coli* 30 (35.6%) were found
be present in all designated farms.

TABLE 1: Location and distribution of samples screened

Location	Distribution of samples screened
A	7
B	12
C	11
D	10
E	6
F	14
G	8
H	8
I	15
J	9

Table 2: Distribution of bacterial isolates from different sample location.

Isolates	Location									
	A	B	C	D	E	F	G	H	I	J
Aeromonas spp	2	1	0	2	1	2	4	0	2	3
Escherichia coli	3	5	1	3	2	6	2	3	4	2
Ps. aeruginosa	1	2	0	1	1	3	0	1	3	1
Kleb. aerogenes	0	0	3	2	2	2	1	3	3	0
Strept. faecalis	1	0	3	2	0	1	1	1	1	0
TOTAL	7	8	7	10	6	14	8	8	12	6

Table 3: Percentage distribution of bacterial each respective farm.

Location	Distribution of bacteria isolates	%
A	7	8.1
B	8	9.2
C	7	8.0
D	10	11.5
E	6	6.9
F	14	16.1
G	8	9.2
H	8	9.2
I	13	15.0
J	6	6.9
TOTAL	87	100

Table 4: Percentage distribution of Bacteria isolate in all farms

Isolates	A	B	C	D	E	F	G	H	I	J	TOTAL	%
Aeromonas spp	2	1	0	2	1	2	4	0	2	3	17	19.5
Escherichia coli	3	5	1	3	2	6	2	3	4	2	30	35.6
Ps. aeruginosa	1	2	0	1	1	3	0	1	3	1	13	15.0
Klb. aerogenes	0	0	3	2	2	2	1	3	3	0	16	18.4
Strept. faecalis	1	0	3	2	0	1	1	1	1	0	10	11.5
TOTAL											87	100

DISCUSSION

The presence of *Pseudomonas species* isolates agreed with Okaeme (2006), that *Pseudomonas species* affect catfish of all ages and the mortality occurs as the result of mechanical injuries, poor water quality and rowdiness conditions.Albert *et al*; (2000) noted that among the six (6) species of *Aeromonas*, A hydrophilia is the only species that are known to be pathogenic in humans, and also to fish. Okaeme (2005) reported that motile *Aeromonas sepiticeme* (MAS) caused by *Aeromonas species* is probably the most bacteria disease of fresh water fish. This disease has been associated with several members of the genus, *Aeromonas*, including *A. hydrophilia, A. sobria, A. carvial, A. schuberti*, and *A. veronil*. Clinical signs range from sudden death with high mortality in per acute cases to superficial to deep skin lesions. *Escherichia coli* has been found in all designated farm which indicate 35.6% (Table 4). *Pseudomonas aeroginosa, Streptococcus faecali* and *Klebsiella aerogenes* shows 15.0%, 13.8% and 18.4% respectively. Ibiwoye, *et al.*, (1990) reported that the study of bacteria microflora of the gills and kidneys of *H. bidorsalis* showed the presence of Gram negative bacteria of General, *Pseudomonas, Klebsiella*, and *E. coli, K. aerogenus*. Although most strains of *Escherichia coli* are harmless, some kinds of *E. coli* cause disease by making a toxin called shiga. The bacteria that make these toxins are called "Shiga toxin-producing" *E. coli* or STEC for short. The must identified STEC in North America is *E. coli* 0157. H7 (often shorten to *E. goli* 0157 or even just "0157). (National Centre for Zoonotic, Vector-Borne, and Enteric Diseases, (ZVED) 2008. The first step in disease prevention is to provide healthy environment for the fish with plenty of food (Gietema, 1992). Other preventive measures includes:-

1. Avoid poor water quality and rowdiness conditions in fish pond.
2. Removal of dead fishes, frogs and excessive weeds that can harbor bacterial disease agents.
3. Research can be carried out to ascertain the pathogenicity and virulence of the bacteria isolates.

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GROWTH OF TWO TILAPIAS IN FLOATING PLASTIC CAGES

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ABSTRACT
A growth trial of *Oreochromis niloticus* and *Sarotherodon galilaeus* fingerlings in floating plas cages was carried out for 180 days. *O. niloticus* (mean wt., 75 ± 0.50g) and *S. galilaeus* (mean w 36.40±1.80g) were stocked at 250 fish fingerlings/m^3. The study was conducted in four 2x2x1 plastic cages with two replicate cages for each treatment. A 25% protein balanced diet was used feed. The mean weight gain ranged from 0.33 to 0.91g/day while the mean final weight ranged fro 60.0g to162.00g for *O. niloticus* and *S. galilaeus*, respectively. Total fish production ranged fro 15.90 to 16.00kg/m^3. The highest survival (100%) was obtained in *O. niloticus* while the lowe (98.4%) was obtained in *S. galilaeus*. The major constraint in the study was the inadequacy of suitabl fingerlings size for stocking the plastic cages.

INTRODUCTION
Cage and enclosure systems are amongst the known modern aquacultural practices and are about the cheapest to operate (Otubusin,1997). These culture systems maximize the use of feeds in enclosures and they can be stocked at higher density compared to the unit area of the cage. The system also permits low mortality and high production potentials. Cage culture also affords better management and results in higher yields per unit area than pond culture. In Nigeria, tilapias are among the most suitable fishes for cage culture. Cage culture of catfish, *Heterobranchus longifilis* has been attempted on a commercial scale in man-made lake Ayame, Cote d'ivoire (Coulibaly *et. al.* 2007). Rahman *et. al.* (2006) in cage culture trials of sutchi catfish, *Pangasius sutchi* (Fowler 1937) suspended in a river – fed channel got a production of 15.2-33.5 kg/cage of 1m^3 within 150 days of culture. The cages were stocked with 5.9- 6.7 g fingerlings at 60-150/m^3 stocking density. According to Otubusin (2000) there is a definite potential for tilapia Cage culture in Nigeria Lakes and Rivers in Nigeria, both on commercial and subsistence levels. The maximum carrying capacity for a cage depends on the mesh size, cage size, and type of fish and level of dissolved oxygen in water. For 1m^3 cages, Otubusin *et al* (1997) recommended 200 fish/m^3 and it is known that as the stocking density increases, the total fish production also increases.Several research works have been documented on the use of cages and enclosures for Tilapia production. The main objective of this study was to grow fingerlings of Tilapias (*O. niloticus* and *S. galilaeus*) to table size in plastic cages using artificial feeds.

MATERIALS AND METHODS
The site used for the studies was the Kigera III Reservoir (about 0.4ha) within the National Institute for Freshwater Fisheries Research Estate at New Bussa, Nigeria and the study was conducted in 2003. Four plastic cages (2 x 2 x 1 m) were used for the study. The study consisted of two treatments below:

(i) 250 *O. niloticus*/Cage
(ii) 250 *S. galilaeus*/Cage.

The cages were installed on Kigera III reservoir. The fish were fed with 25% pelleted feed at the rate of 5% body weight twice daily between 9.00a.m. and 5.00 p.m. The fish daily ration was adjusted bi-weekly by sampling 20% of the fish for body weight changes. The experiment lasted for six months at the end of which the total number of fish in each plastic cages and mean survival were estimated. Dissolved oxygen, pH and temperature measurement were determined according to the methods described by APHA (1990) and the result of the water quality parameters measured during the experiments is shown in Table 2). Mean weight gain and specific growth rate were calculated using the equations described in Dada and Wonah (2003).

Table 1: Ingredients and proximate composition of experimental diet fed to fish .

Ingredient	Composition (%)
Groundnut cake	25
Yellow maize	74.50
Vitamin/premix	0.50
Proximate composition	
Crude protein	25.40
Crude fat	12.55
Moisture	9.80
Ash	4.95

Table 2: Summary of water quality during the culture period.

Parameter	Minimum	Maximum	Mean ±SE
Temperature (OC)	25.40	29.30	27.352±1.95
Dissolved oxygen (mg/l)	2.80	4.80	3.802±1.00
pH	6.90	7.10	7.0±0.1

RESULTS AND DISCUSSION

The summary of results of the study is shown in Table 3. *Oreochromis niloticus* grew from an average weight of 75g to an average final weight of 162g while *Sarotherodon galilaeus* grew from an average weight of 36.50g to an average final weight of 60.0g. The growth rate was highest in *Oreochromis niloticus* when compared with the growth rate obtained in *Sarotherodon galilaeus*. This may be attributed to the size of the fish at stocking. At 75gm, Tilapia is almost table size and the growth rate would be slower than the fingerlings of *Sarotherodon galilaeus* (36.50g). Also, it is on record that O. *niloticus* grow better than S. *galilaeus* in earthen ponds as documented by several authors. The growth rates of fish in this study appeared low compared with the rate of 2.59 – 5.72g per day obtained by Otubusin and Ifili (2000) but better than the values of 0.20-0.49 g/day reported by Otubusin (2000). Total fish production was 16.0kg and 5.90kg respectively. The high survival rate could be attributed to proper management of the stock and the physico-chemical conditions of the water in the reservoir during the culture period (Tale 2). The dissolved oxygen, pH and temperature estimated during the culture period were within the acceptable range recommended for fish production (de Graaf and Janssen,1996).

Table 3: Yield of *O. niloticus* and *S. galilaeus* in floating plastic cages for 180 days.

Items	*O. niloticus*	*S. galilaeus*
Mean no. Stocked	250	250
Mean stocking wt (g)	75.00±0.50	36.40±1.80
Mean harvest wt (g)	162± 1.20	60.0±0.80
Mean wt gain (g/day)	0.91	0.33
Survival (%)	100	98.4
Average production kg/m^3	16.20	5.90

The ccage fish culture experiment embarked upon is aimed at maximally exploiting the water bodies of Nigeria through production oriented research on the culture system. Experience in countries where cage fish culture has been adopted showed several advantages over pond culture. Based on the results, it could be concluded that, there is a definite potential for Tilapia cage culture in lakes and Rivers in Nigeria, both on commercial and subsistence levels. Fish production could be enhanced through this culture system in Nigeria.

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ASSESSMENT OF WATER QUALITY PARAMETERS IN LAKE ALAU

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ABSTRACT
The physico-chemical parameters of Lake Alau were monitored for four months to assess the water quality. Parameters such as temperature, transparency, conductivity, dissolved oxygen, biochemical oxygen demand, Ca, P, etc were studied in five stations (A, B, C, D and E). Water samples were collected monthly from 8:00 to 12:00noon, for four months (July - October 2008, wet season) and analysed. The physico-chemical parameters were within the ranges of unpolluted water bodies. Variation occurs in almost all the months of the study. Significant difference ($P<0.05$) occurred in p^H, transparency and Ca among the stations, and insignificant difference ($P>0.05$) in temperature, conductivity, dissolved oxygen, biochemical oxygen demand, Mg and P. These variations may be due to effects of fertilizer application, herbicides and insecticides in irrigated farms around the Lake.

INTRODUCTION
The quality of water plays a vital role in the productivity of aquatic habitats. The fertility of water is related to its chemical properties and understanding of water chemistry serves as basis for considering whether the water is rich or poor in biological production. The physical and chemical properties of water greatly influence the uses, the distribution and richness of biota (Courtney and Clement 1998). As such, techniques of using physical and chemical properties to assess water bodies are essential. And it will also reveal the concentrations of known environmental contamination which could render such water unfit for human consumption and other purposes. Properties such as high dissolved oxygen in water is an essential pre-requisite for satisfactory aquatic life, while presence of dissolved oxygen and carbon (IV) oxide in water for industrial purposes constitute corrosive agents and threatens the life of most metallic plants (Akpan 1995). The objectives of this study were to assess the physio-chemical parameters of Lake Alau, and compare the water quality parameters with the standard required levels for fish production.

METHODOLOGY
Lake Alau is one of the largest water bodies in Northeast Nigeria. It was sourced from river Ngadda. It is located about 19km from Maiduguri along Maiduguri-Bama road, between latitude $10^0 43^1$N and longitudes $10^0 15^1$E and $13^0\ 17^1$E (BSMLS, 2002). It has two distinct wet and dry seasons; a raining season with mean annual rainfall of about 600mm from July to October, and a hot dry season from March to July. The dry season is preceded by a period of dry Harmattan with very low temperature and dry hamatan wind between November and February (Bankole *et al.* 1984). Monthly surface water samples were collected in duplicate for a period of four months (July 2008 to October 2008) with two litre plastic containers. The containers were washed with detergent, rinsed with 0.1m HCL and finally rinsed with distilled water. Collections were made between 8:00am and 12:00noon. Five sampling stations were demarcated from the lake station A, B, C, D and E respectively. Station A serves as the control which is the inlet of the water body. Standard method from APHA(1998) was adopted for this study. Temperatures were measured with mercury in glass thermometer while transparency was measured with a Secchi disk. Conductivity and p^H were measured using individual meters. DO meter was used to determine the dissolved oxygen and Winkler method was used to determine BOD. The concentration of TDS was determined by evaporation process while that of TSS was by filtration method. Total alkalinity and salinity were analyzed by titrimetric method. Colorimetric method was adopted for Nitrate-nitrogen (NO_3N) and Phosphate phosphorus (PO_4-O).

RESULTS AND DISCUSSION
The monthly mean value of the physicochemical parameters of Lake Alau is given in Table 1, while that of monthly mean by sampling station of physicochemical parameters is given in Table 2. Physicochemical analysis showed that temperature was low in September ($27.42^{\pm}0.29^0$C) and high in

July (28.24±0.34). However, other low values were recorded in August and October with no significant difference (P>0.05). The lowest value was recorded in station C (27.55±0.35) and the highest value in station A (28.00±0.45). There was no significant difference between all the stations (P>0,05). The low temperatures recorded fom August to September which is due to the cloudy weather caused the decrease in temperature. This in accordance with the works of Timms (2001), which noted that climatic factors were the determining factor for increase or decrease in temperature in the arid zone and lake Alau shore the climate of the northeast arid zone. The water temperature of the range in this study falls within the normal range (25.0-35°) of natural tropical waters (Allabaster and Lyod 1980). The aquatic life of the tropics are adopted to these changes (Wood et al, 2002).

Table 1: Monthly mean of some physicochemical parameters of Lake Alau 2008

Months	Temp (°C)	Conduct (N/cm)	pH	DO (mg/L)	Transp (m)	BOD (mg/L)	Ca	Mg	P
July	28.24^{a}	65.80^{a}	8.476^{a}	3.76^{b}	0.852^{a}	2.38^{a}	0.84^{a}	1.20^{c}	0.09^{a}
August	27.92^{a}	51.04^{b}	7.90^{ab}	4.82^{a}	1.204^{a}	2.68^{a}	0.84^{a}	2.50^{a}	0.1122^{a}
Sept.	27.42^{c}	68.00^{a}	7.468^{ab}	3.34^{b}	1.38^{a}	1.20^{b}	0.36^{c}	0.84^{d}	0.212^{a}
October	27.96^{a}	66.40^{a}	7.124^{c}	3.34^{b}	1.18^{a}	1.40^{b}	0.66^{ab}	1.48^{b}	0.28^{a}

Table 2: Monthly mean of some physicochemical parameters of Lake Alau 2008 by Sampling Stations

Stations	Temp (°C)	Conduct (N/cm)	pH	DO (mg/L)	Transp (m)	BOD (mg/L)	Ca	Mg	P
A	28.00^{a}	61.75^{a}	7.0625^{b}	3.525^{a}	1.5375^{a}	1.925^{a}	0.425^{b}	1.40^{a}	0.3025^{a}
B	28.25^{a}	60.77^{a}	7.99^{ab}	3.675^{a}	1.0375^{bc}	1.85^{a}	0.725^{ab}	1.525^{a}	0.155^{a}
C	27.55^{a}	60.75^{a}	7.915^{ab}	4.30^{a}	1.45^{ab}	2.175^{a}	0.90^{a}	1.45^{a}	0.175^{a}
D	27.95^{a}	66.00^{a}	7.0925^{b}	3.70^{a}	1.015^{bc}	1.925^{a}	0.525^{ab}	1.75^{a}	0.11775^{a}
E	27.679^{a}	64.775^{a}	8.65^{a}	3.875^{a}	0.73^{c}	1.70^{a}	0.80^{ab}	1.40^{a}	0.1275^{a}

Key:

A= Akurari (control), B= Usmanti, C= spillway, D= Abbari, E= Ngawofete

- Value with same supper script are no significant different (P<0.05)

Conductivity was low August (51.04±6.52) and high in September (68.00±10.56) during the wet season. In terms of stations lowest value was recorded in station C (60.75±3.77) and highest in station D (66.0±8.68). Also lower values were recorded in station A, B, and E although there was no significant difference between the stations (P>0.05). The specific conductance of the lake water was less than 600u/cm recorded from Kiri dam (Ovie et al., 2000). The maximum value of 82u recorded for lake Alau in wet season is another indication of oligotrophy. It implies low level of dissolved salts, a characteristic feature of "soft" water. pH was low in October (7.12±0.72) and high in July (8.48±1.06) with slight difference compared to the rest of the months. In terms of stations, lowest values were recorded in station A (7.06±0.44) and highest value in station E (8.65±0.77). Very slight variations occurred between the sample stations. There was significant difference (P<0.05) between station A, D and E and no significant difference (P>0.05) between station B and C. The values and status in the p^{H} of lake Alau agree with the observation of Hanson et al.(1990) in Zambezi river, Elemi (1990) in Ona river, Atama, (2003) in Rimco reservoir, but contradicted the trend in some African lakes in which pH is lower in wet season, but rises during dry season (Azionu 1983). The pH ranges of lake Alau were comparatively narrow and fall within the recommended range (6.5-9.0) as sustainable for aquatic life (Boyd, 1979).

The DO concentration in the Lake was low in October (3.34±0.25) and high in August (4.82±1.84). In terms of stations, lowest value was recorded in station A (3.53±0.15) and highest in station C(4.30±1.21). There was no significant difference between all the stations (P>0.05). The pattern of dissolved oxygen varied between stations. Egborge (1979) observe similar pattern of variation in lake Asejire. Oxygen levels in the in the five stations sampled were statistically proved to be significant. Duncan (1975) considered that whereas wind is a major oxygenator in large lakes,

while in smaller lakes, is largely determine by phosynthetic action of phytoplankton. Complete Oxygen depletion was not observed in any of the stations in the lake, apparently because of significant water movement throughout the lake.

Low transparency was recorded in the month of July ($0.85^{\pm}0.20$) and high in September ($1.38^{\pm}0.41$). In terms of stations, lowest value was recorded in station E ($0.73^{\pm}0.13$) while the highest value was in station A($1.54^{\pm}0.35$). There was significant difference between station A, C and E ($P<0.05$), and no significant difference between station B and D ($P>0.05$). Water transparency varied from (0.6-1.87) in five stations. This is very low compared to 0.45-2.8m obtain in Kainji lake, (Adeniji, 1975). The remarkable increase in August after the on set of rains indicates that less floods draining into the lake were responsible for high water transparency within that period rather than phytoplankton production. Biwas (1978) observed in lake Volta Ghana, secchi disc transparency decreased with increased in phytoplanktons.

BOD was low in September ($1.2^{\pm}0.61$) and high in August ($2.68^{\pm}0.77$), other high values were recorded in July. The lowest values were recorded in station E ($1.70^{\pm}1.12$) and the highest in station C ($2.18^{\pm}1.46$). There was no significant difference between all the stations ($P>0.05$). Kolo and Yisa (2000) observed that organic matter decomposition from increased human activities can increase BOD variation. Moore and Moore (1976) reported that BOD is a fair measure of cleanliness of any water and classified values of less than 1.2mg/l as clean, while 4-6mg/l as fairly clean, and 8-10mg/l as bad and polluted. Base on these values, lake Alau water may be considered as clean.

Ca was low in September ($0.36^{\pm}0.05$) and high in July ($0.84^{\pm}0.29$). The value obtained in July, August and September are significantly different compared to the month of October ($P<0.05$). Station A recorded lowest value of $0.43^{\pm}0.01$ and highest value in Station C ($0.90^{\pm}0.42$). The values obtained in Station A and C are significantly different compare to Station B, D and E ($P<0.05$). This agrees with findings of Amuzu et al., (1990) that heavy metals occur in low concentration in aquatic ecosystem. Hart (1993) classified a surface water with <0.2mg/l of calcium as very low, 0.2-0.3mg/l as low, 0.3-0.6mg/l as moderate, 0.6-1.2mg/l as high polluted and >1.2mg/l very high and heavily polluted. As such lake Alau is unpolluted. Mg was low in September ($0.84^{\pm}0.21$) and high in August ($2.50^{\pm}0.22$). There was no significant difference among all the months ($P>0.05$). Station A recorded the lowest value of $1.40^{\pm}0.57$ and highest in station D ($1.75^{\pm}0.76$). There was significant difference between all the stations ($P<0.05$). Odieta (1999) reported that domestic sewage and agricultural effluents has capacity to precipitated manganese salts, which may exert a toxic effect on the aquatic organism. Other sources may be due to localized inputs and sediments transport. Low P was recorded in July ($0.10^{\pm}0.05$) and high in October ($0.28^{\pm}0.25$). The lowest value was recorded in station D ($0.12^{\pm}0.13$) and highest in station A ($0.30^{\pm}0.28$). There was no significant difference between all the stations ($P>0.05$). It has also observed during this study period intensive agricultural activities involve use of fertilizer and pesticides to produces crop vegetables. Some villages where using the water for domestic activities, washing vehicles, which could increase the P level of the lake water. Sandra (2000) observed that P is the most important and limiting substances controlling organic production.

The physicochemical parameters of Lake Alau varied with months and stations, due to their specific properties during the wet season. The limnological features strongly suggest that the water body is maintaining an oligomesotrophic status. The Physio-chemical parameters were within the ranges in unpolluted water bodies. Variation may be due to effect of agricultural activities through fertilizer applications, herbicides and pesticides around the lakes catchments. Furthermore, these findings provide baseline information on some aspects of water quality status as well as the tropic status of the lake. The baseline information will serve as an indicator for ecological problems and action to minimize likely problem with respect to its sustainable management. In order to upheld United Nation Organization standards (UNO, 1992) that all species and habitats should be safeguarded to the extent that is technically, economically, and politically feasible, the following recommendations should be adopted.

1. Settlements around Lake Alau should be encouraged to adopt environmentally friendly initiatives by embracing Low and Non-waste Technologies (LNWT) at all stages of product life.
2. Monitoring of Lake Alau should be encourage as part of environmental management policy, so as to control the effluents that enter each station, through canals, washing, etc, and hence

maintain acceptable units of metal concentration, such as nitrate, nitrogen and phosphor that encourages eutrophication of lake.

3. Substantial limnological research information has accrued from a relatively short period research work, longer period oriented study becomes increasingly vital and desirable. Furth prolonged research should be carried in order to provide a broader understanding of this ve economically and scientifically important water body in the arid zone. In addition, t knowledge derived should be used as an index for other man-made lakes in the arid zones.

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PROBLEMS AFFECTING FISHERS' LIVELIHOOD AND FISHERIES DEVELOPMENT IN KAINJI LAKE BASIN

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ABSTRACT
This paper examines some critical factors related to fishers' livelihood, resource sustainability and development of fisheries sub-sector in Kainji Lake Basin (KLB). Based on empirical study the findings identified some major problems to include, lack of access to finance, deflation of resources, increase in fishers' population, extinction of some important fish species and gross lack of development activities etc. These arrays of problems form the complex nature of artisanal fisheries sub-sector, which impede substantial income generation well-being of the fishers' and development of the sector. The paper made some policy recommendations to serve as guide to relevant authorities in addressing the fishers' problems.

INTRODUCTION
Recent studies on the lake basin indicated series of problems, ranging from overpopulation, exploitation, extinction of some species and inadequate management among others (Raji and Ovie, 2007; Williams, 2007). This therefore suggest that amount of water resources alone is inadequate to determine fisheries productivity without considering other factors. In line with this, Welcomme (2001) in his work expressed the situation of a fisherman as a person who sits within a complex web of social, financial, ecological and administrative influences that condition his life. According to Timothy (1998) fish resources are finite and cannot continue to sustain the trend of ever increasing catches, and further advocate the needs for responsible fisheries to ensure in the future a large number of people can continue to earn their livelihoods from the fisheries sector. In the same vein, inadequate water resources management, under development and misplace form in conservation programme, which exclude the socio-economics development of rural communities have led to wanton exploitation and threat to the existence of biodiversity. This study empirically examined the nature of these problems from individual respondent to community assessment with the view of propounding a holistic picture of the situation and suggests some workable recommendations towards ameliorating the suffering of the fishers. The paper's objectives were to examine the major problems affecting fishers' and fisheries development in Kainji Lake Basin; and to advance policy recommendations that would assist in addressing the problems.

MATERIALS AND METHODS
The survey was conducted between Jan-Feb. and Aug-Sep 2008 in order to capture the two flooding regimes on the lake (high flood and draw dawn) and the two seasons. (Rainy and Dry). The study covered the eight sub-stratums of the lake (Abiodun and Niworu, 2004), where 30 villages (10%) were randomly selected using random number generator from 297 (total number of fishing villages on the Lake basin) and 259 respondents were drawn using stratification technique. Apart from household survey, in each of these villages focus group discussion was conducted among elders and informants, with an average number of 12 respondents per community. Some guided questions were used for unification of results and easy analysis. Simple descriptive statistics and ranking by quantification were used for the analysis.

RESULTS AND DISCUSSION
The results revealed that problems affecting fishers' livelihood and fisheries development on the lake basin are multi-faceted with various manifestations. The causes, just like the problems themselves are numerous and of internal and external origin. In any case, they both have the tendencies of threatening the fishers and the fisheries of the lake. However, the external factors are always more devastating because under most situations the fishers have little or no control over them. The problems as indicated by the fishers are presented on fig. 1. The most important problem appeared to be lack of

access to money (16.5%). Access to money, is highly essential in any rural economy, as it is particularly important and necessary for the fisher to diversify into other livelihood portfolios, purchase fishing and farming inputs as well as handling some emergencies particularly family health issues. Depletion of the resources (15.3%) presents a threat to the fisheries and fishers livelihood. It affects fishers' income and ultimately translates to their inability to send their children to school cater for their basic needs and lead a decent life. For fishery resources to be sustained, it requires that fishers must fish responsibly all times (DFID, 2005).

Another important problem is food insecurity, which equally appeared to be a threat (11.7%) this is because of the subsistence nature of their production; often they experienced some periods within a year where they lack food. This has some effects to their health as well as their productivity. In addition, lack of fishing input also appeared to be a problem (10.5%), this might looked outrageous , however fishers have the belief that type of fishing inputs determines to a greater extent, where to fish, the kind of fish to catch and of course the quantity of catch. These inputs include motorized canoes and good nets among others. Other important problems comprise of inadequate health care (8.1%), marketing problems (7.3%), lack of energy (6.0) and lack of infrastructure (6.0%) Fig 1.

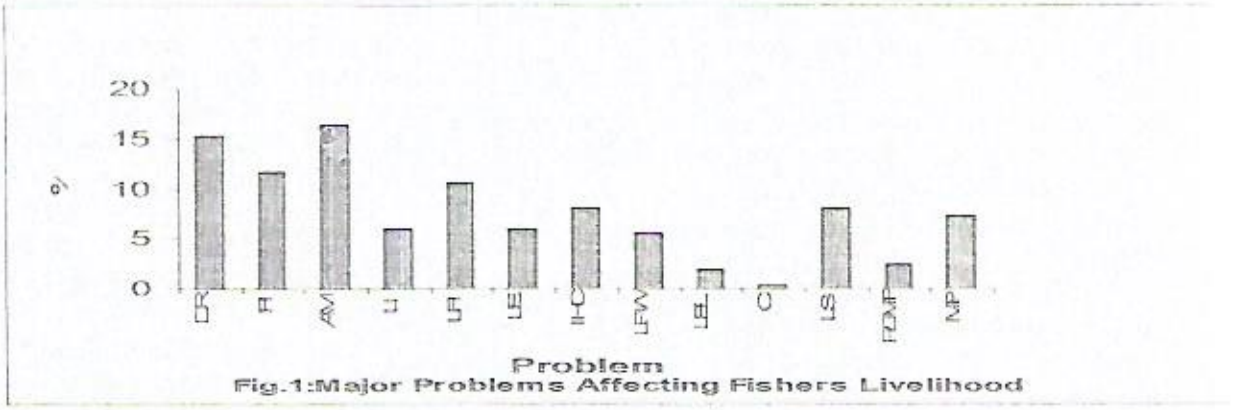

Fig.1:Major Problems Affecting Fishers Livelihood

Key: DR=Depletion of Resources, FI= Food Insecurity, AM = Access to Money, LI = Lack of Infrastructure, LFI = Lack of Fishing Input, LE = Lack of Energy, IHC = Inadequate Health Care, LPW = Lack of Portable Water, LEL = Lack of Efficient Leadership, C = Conflict, LS = Lack of School, PD = Presence of Diseases, MP = Marketing Problem

Increase in fishers' population

The study equally revealed that an average of 50.7% population increase has been registered over 10 years on the lake basin, with maximum of 100% and minimum of 25% (fig.2). Increase in fishers population without control and good management always has some negative effects on the fishery, one of which include increase fishing effort using all sort of methods and consequently exploitation and depletion of the resources, which at present is what the lake is passing through.

Extinction of some fish species

The study revealed that some important fish species on the lake are disappearing over the years these include Polypterus, Ariusgigas, Barbus, Bagrus, Citharidium and ansorgii, among others. The sizes of the fish caught have drastically been reduced by at least 40% following the focus group discussion. Biodiversity is essential in stabilizing the ecosystem, and hence improving fisheries production, low biodiversity reflect high level of interference, which is very delicate to the fisheries (Welcomme, 2001).

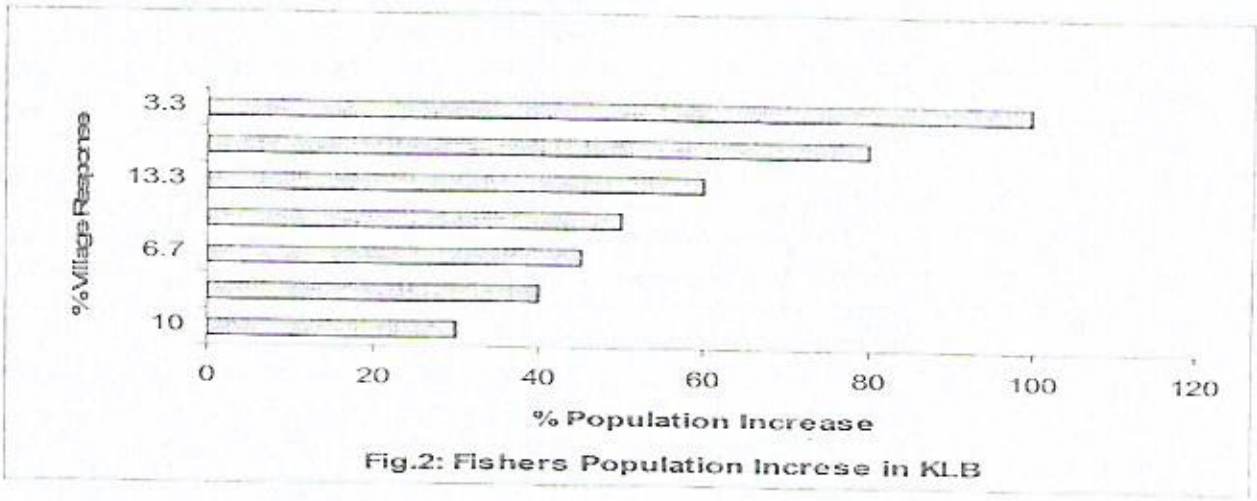

Fig.2: Fishers Population Increse in KLB

Absence of Development Activities

Most of the activities that can easily facilitate production and income among fishers and equally bring about growth and development of the fishery are grossly inadequate in most of the fishing communities around the lake basin. The result shown that 76.7% of the communities are without cooperative societies, 90% are without both NGO and any funded project, 83.3% are without extension workers while 93.3% are without any apprentice workshop for skill acquisition (Fig. 3). These activities are fundamental to the economic development of fisheries. For instance, through the existence of cooperative, fishers would be more coordinated, strong and have a voice in decision making that would assist them is sourcing for their economic needs. Apprentice workshop is significant in rural community's life, as majority of them are illiterates, skill acquisition is therefore relevant in transforming their enterprises, hence increased their income and well-being. Similarly NGOs, existence of projects and extension worker is by no small measure important in fishing communities particularly in terms of provision of scarce needs, financial assistance, organization and linkages to the global community. The inadequacy of these activities in the fishing communities presents an impediment to their development.

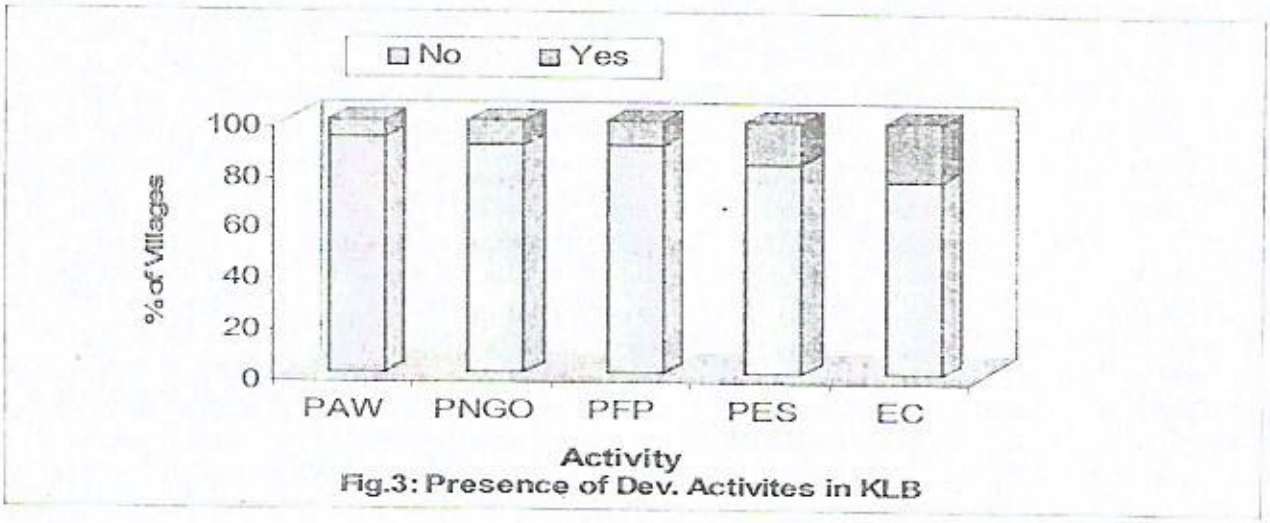

Fig.3: Presence of Dev. Activites in KLB

Keys: PNGO = Presence of Non Governmental Organization, PFP = Presence of Funded Project, PEW = Presence of Extension Worker, EC = Existence of Cooperative, PAW= Presence of Apprentice Workshop.

CONCLUSION AND RECOMMENDATIONS

Understanding the complex nature of the fishers' problems and that of fisheries development is a critical step in identifying the entry point and designing the most appropriate measure to address the problems of fisheries on the lake basin. More importantly, addressing these problems would lead to sustainability of fisheries resource and hence improve income to the fishers, food security and poverty alleviation. Based on the above, the following policy recommendations are provided to serve as guide.

- The problems of fishers and fisheries development are multifaceted and vary in magnitudes; hence addressing them requires clear understanding and holistic approach in order to enhance fishers' productivity, income and development of the sector.
- The Federal and States departments of fisheries still have to enforce fisheries regulations particularly the adoption of Code of Conduct for Responsible Fisheries (CCRF), in order to manage and sustain the resources for immediate and future use.
- There is need to create an enabling environment to facilitate engagement of fishers into diverse income-generating activities in order to improve their well-being. This can be achieved through development of infrastructure, which will encourage investment and hence opportunities entrepreneurship and skills development.
- Empowerment of fishers through formation of cooperative societies and Community Based Organizations (CBOs) would facilitate fishers' easy accessibility to finance, inputs, and educational resources, and even information and bargaining power in marketing their products.

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FROZEN AND SMOKE-DRIED FISH MARKETING IN AKURE METROPOLIS

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ABSTRACT
A survey of the prices of fish in two major markets in Akure was conducted between October and December 2008 to compare the prices of the imported fishes and that of the farmed catfishes and tilapias. The survey covered the Erekesan and NEPA markets, Akure. Both structured questionnaires and oral interview were used in data collection. The results indicated that the price of farmed catfishes was highest and that that of the tilapias was marginally lower than that of the croaker. This is evidence of better acceptability of the farmed fishes. The summary of the results showed good future for aquaculture in Nigeria, as good markets exist for the produced fishes.

INTRODUCTION
Fish contributes significantly to the nutritional needs of Nigerians. The protein contribution of fish to the Nigerian diet is estimated at 4.8% of total contribution of protein from all food consumption, (Olayide et al 1981). In Nigeria, the demand for fish and fishery products has been increasing steadily because fish is one of the relatively cheap sources of animal protein. Fisheries make significant contributions to the Nigerian economy in terms of income, employment opportunity and foreign exchange earnings. Marketing and distribution of fish is as important as its production and involves all activities carried out from landing sites to the point of utilization. Such activities include; collection of fish, transportation to landing site, processing and preservation, packaging, transportation to consumers, pricing, buying and utilization (Kohl 1985). In Nigeria, while the male fisherfolks are mainly involved in fishing, the female fisherfolks involve more in fish marketing. Fishes caught in one part of the country may be marketed in Akre, therefore smoking of the fishes is necessary to maintain high quality product before transporting them to the points of needs. As aquaculture production is increasing in Nigeria, just like in other parts of the world, there is a strong need to access the marketing and prices of the aquaculture products visa-vis the imported fisheries products as a way of justifying fish farming in Nigeria. Therefore a market survey was conducted in Akure between October and December 2008 through oral interview and questionnaire to find out the relationships between the prices of the imported fishes and those produced from fish farms.

RESEARCH METHODOLGY
The study was based on survey of fish marketing and distribution conducted between October and December 2008. The study covered selected markets in Akure. In all, the survey was carried out in two major markets in Akure, namely Oja Oba and NEPA markets. Data collection methods were through primary and secondary sources (personal interviews) and questionnaires and information gotten from relevant textbooks. The personal visit to the selected fish marketers helped not only in getting questionnaires filled out but also in obtaining other relevant information. Language used during the survey was Yoruba to ease the exercise. All the 40 questionnaires distributed were retrieved. The intention of the data collection was to enhance the study focuses most importantly on fish marketing pattern in Akure. The questionnaires pin pointed the inadequacies, problem and proffered possible solutions to the suggested problems of the respondents. The data collection was not without some limitations. This varied from high cost of transportation and hoarding of information by respondent who misconstrued interview for tax collection or a way of assessing their income. Questions were drawn in a structure that would elicit the intended information.

RESULTS
The results showed variations in prices of the same fish products and weight from one location to the other. For instance prices were higher at NEPA market than at Erekesan market. Table 1 showed the prices of 1kg of frozen M.K Titus (sumu), Horse Markerel, Herring and Croaker at Erekesan market. The prices of the same fishes were higher at NEPA market (Table 1) than at Erekesan market. The prices of smoke-dried fishes (Table 1) followed the same trend. However, it was observed that the price of 1kg of farmed catfish was the highest, almost doubling the prices of other imported smoke-

dried fishes. The price of 1kg of smoke-dried Tilapia was also high in comparison with other imported species. The prices of smoke dried shrimp and prawn at Oja-Oba Market were lower than that at the NEPA Market.

Table 1. Types of fish and prices at Erekesan and NEPA markets, Akure.

	Erekesan market	NEPA market
Frozen fish	Price/kg (₦)	
M.K titus (sumu)	400	450
Horse Mackerel (Kote)	320	300
Herring (Sawa)	200	280
Cod (Panla)	-	430
Croacker (Apo)	800	1000
Smoked fish		
Herring (Sawa)	300	370
Catfish (Aro)	1,700	1,700
Titus (Sumu)	700	650
Horse Mackerel	510	-
Cod (Pania)	900	600
Efolo	800	1100
Smoked shell fish		
Prawn	2300	2400
Shrimp	2500	2900

DISCUSSION

Most of the times, the people depend solely on imported fish which raises the market price of the fishes; unlike in Akure where there are many fish ponds owned by individuals, government and corporate bodies which reduces the demand on imported fish. Generally, the prices of the fishes at Erekesan are relatively cheaper compared to NEPA market because it is believed to be owned by the King who influences the price of the commodity in order to make it affordable for the people. The influence might be in terms of collection of little or no rents from the fish marketers compared to other neighbourhood markets. This will in turn lower the market prices of the fishes. Similarly provision of social amenities like water, electricity and well ventilated environments in the market also make buying and selling easier for the fish marketers which makes them to reduce their prices. Also the monthly or annual rent paid by the fish marketers at Erekesan market are less or more affordable to the fish marketers compared to the other markets due to influence of the king. The fish marketers make quicker and more sales compared with sellers in other markets. Finally, the better prices of the farm produced catfishes and tilapia in comparison with the prices of the imported fishes is a source of encouragement to fish farmers in Nigeria. This also means wider and better acceptability of the farm produced fishes (Nwanna and Fatunla 2001).

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POTENTIALS OF POULTRY OFFALS IN AFRICAN CATFISH DIETS

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ABSTRACT
A 70-day feeding trial was conducted to test the effect of partial replacement of fishmeal by poultry offal in African catfish *Clarias gariepinus* diets. Four isonitrogenous ration containing various levels (0%, control), 30%, 60% and 90% of poultry offal were fed to three replicate groups of *C.gariepinus* fingerlings with a mean initial weight of 0.74± 0.15 g. 10 fish/plastic bowl were tested in 15 l capacity plastic bowl. Mean weight gain of the fingerlings fed the control were higher (2.43±0.12g) compared to fish fed 30%, 60% and 90% poultry offal inclusion of fish meal (1.99±0.08g, 1.84±0.06g and 1.14±0.20g, respectively), but there was no significance difference ($P \leq 0.05$) in weight gain of fish. There was no significant variation in feed conversion ratios which varied between 0.46±0.12 and 0.53±0.20 for the control and 90% poultry offal respectively, obtained among the groups. Similarly, specific growth rate and protein efficiency ratio decreased as the level of poultry offal increased in the diet. It was concluded that the replacement of fish meal with chicken offal meal diet at 30% level will enhance growth performance of *Clarias gariepinus*

INTRODUCTION
Fish nutrition is the most expensive component of the intensive aquaculture system representing over 50% of the total operating cost (Falaye, 1992). The protein part of the fish feed represents almost 60% of the cost of the feed. Fish meal is the major protein source in aquaculture feeds. However, the supply of fish meal is not growing worldwide (Rumsey, 1994; Barlow,1997) Moreover, price of fish meal is often high. It is therefore widely acknowledged that fishmeal should be used more sparingly in aquaculture so as to improve the profitability and sustainability of the industry (Sheperds 1998). Beside cost consideration, it is also important that the practical or alternate fish diet contains all the essential amino acids, fatty acids, vitamins and minerals required by a fish for rapid growth, sound health and economic profitability.

Poultry offals are an interesting alternative to fishmeal, either partial or total replacement for economic advantage. According to Cho (1999) chicken offal meal is highly digestible by fish and has a high nutrient composition. It is also very palatable to fish (Cho, 1999). Various studies had been carried out on the uses of poulty by product in some aquaculture species around the globe (Sadiku and Jauncey, 1995; El-Sayed,1998, Nengas *et al.*, 1999). These studies showed that poultry offal can reasonably replaced fishmeal in the diet of fishes. There is however a lack of information on nutritional efficiency of poultry offals produced in Nigeria for diets of *C.gariepinus* a commercially important culture species in Africa. This study was therefore designed to determine the level of poultry offals that could be used to replace fish meal in practical diets for *C. gariepinus* fingerlings.

MATERIALS AND METHODS
120 *C. gariepinus* fry (mean wt.,f 0.74± 0.15 g) were acclimatized in a laboratory for one week and starved for 24 hours before the commencement of the feeding trial. The experimental set up consists of 12 (15 litres capacity) plastic bowl, containing 10 fingerlings each, each experiment was carried out in triplicate form and fed at 3% of their body weight, with formulated feed at 40% crude protein level. The feed quantity was adjusted after taken the weight measurement once weekly. The cleaning of container and removal of the uneaten feeds were carried out one hour after feeding. The gross ingredients were milled, mixed and later pelletized and sun dried for 3 days. Four isonitrogeneous diet with 40% crude protein as recommended *C. gariepinus*. The fishmeal was replaced with chicken offal meal at 0%, 30%, 60% and 90%. The gross composition for the experimental diets is shown in Table 1.

Chicken offal was collected from Zartech farm at Oluyole Area Ibadan, washed, cooked at 100°c for 15 minutes then dried with oven at 60°c for 8 hours; this was later ground into powdery form using an attrition mill. Proximate analysis of the chicken offal meal, experimental diet and composite sample of fish carcass at the start of the feeding trial and at the end of the experiment using

AOAC (1990) and Munro and Fleck (1969) methods. Dissolved oxygen, pH and temperature (tw daily) were determined using the method described by Boyd (1981).

Table 1: Gross composition of experimental diets (%).

Ingredients	Diet I	Diet II	Diet III	Diet IV
Fish meal	20.85	14.6	8.34	2.08
Groundnut cake	25.0	25.0	25.0	25.0
Soya bean	20.85	20.85	20.85	20.85
Chicken offal meal	-	6.3	12.51	18.8
Maize	28.3	28.3	28.3	28.3
Bone meal	1.5	1.5	1.5	1.5
Oyster Shell	0.5	0.5	0.5	0.5
Oil	2.0	2.0	2.0	2.0
Salt	0.25	0.25	0.25	0.25
Vitamin Premix	0.75	0.75	0.75	0.75

Data on weight gain, specific growth rate, feed conversion ratio, protein intake, gro efficiency of food conversion, daily protein intake, protein efficiency ration and % survival we pooled for each treatment computed and analyzed using one way analysis of variance (ANOVA) described by Steel and Torrie (1960) followed by the F-Test at 95% confidence level.

RESULTS AND DISCUSSION

Water quality parameters measured during the study were within the recommended range for *gariepinus* (Viveen *et al.* 1986). The cost and benefits of preparing the diets in term of fin production is presented in Table 1.The proximate composition of the processed chicken offal meal a shown in Table 2 revealed that it was rich in protein and adequately suitable for inclusion in fish fee either as partial or complete ration. Throughout the study, the fish were apparently healthy, a indication that chicken offal meal has no adverse effects on fish production. Carcass composition o the fish at the start and the end of the experiment is shown in Table 3, and Table 4 reveals that the be protein efficiency ratio was obtained in diet 4, having 90% chicken offal inclusion. However, n significant differences occurred among the treatments.

Table 2: Proximate composition (%) chicken offal meal and diets.

	Protein	Fat	Ash	Fibre	Moisture
Chicken offal meal	67.12	12.01	5.65	5.15	0.46
Diet 1	39.9	3.2	11.8	2.5	2.5
Diet 2	39.8	4.2	11.9	3.5	2.4
Diet 3	40.2	4.9	12.6	3.8	2.4
Diet 4	40	6.2	11.2	6.3	2.3

Table 3: Carcass composition of fish before and after the experiment.

Diet	Protein	Fat	Fibre	Ash	Moisture
initial	57.52	6.8	5.78	12.99	9.85
1	60.13	3.15	0.33	14.35	10.72
2	62.41	3.62	0.41	15.19	11.23
3	65.16	3.76	0.45	15.45	11.35
4	67.14	4.05	0.54	16.11	12.10

The gross efficiency of food conversion as an indicator for growth performance and nutrien utilization is presented in Table 6. This showed both the control (0%) and diet 2 (30%) had the be result. The final mean weight gain indicated that the best inclusion was 30% inclusion after diet 1(0%

inclusion level). It was also observed that the final mean weight decreases with increasing level of chicken offal meal inclusion. The specific growth rate also showed that besides the control treatment, the best is the inclusion of 30% chicken offal meal as in treatment diet 2, though the FCR showed that treatment 4 had the least.

Table 4: Growth performance and nutrient utilization of *Clarias gariepinus* fed chicken offal meal diets.

Growth parameters	Treatment			
	1	2	3	4
Initial mean weight (g^1)	0.72	0.75	.82	.76
Find mean weight	3.18	2.7	2.64	1.86
Mean weight gain/day (g)	.03	.03	.03	.03
Mean weight gain (g)	2.43	1.99	1.84	1.14
Specific growth rate (g)	1.82	1.65	1.60	1.1
Food conversion ratio	.46	.46	.47	.53
Protein efficiency ratio	.81	1.53	1.97	.37
Gross efficiency of food conversio	217	217.39	212.97	188.68
Mean feed intake	9.32	8.73	8.73	7.36
Mean protein intake	3.73	3.51	3.51	2.94

Conclusion

This study has shown that the inclusion either partial or complete of chicken offal meal in the formulation of fish feed to supplement fish meal is acceptable and useful in fish industry, though the inclusion of chicken offal meal at 30% inclusion level as a replacement for fishmeal in practical diet appears suitable and cost benefit for *C. gariepinus*.

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CONTROL OF REPRODUCTION IN *Oreochromis niloticus* USING PAWPAW SEED MEA AS REPRODUCTION INHIBITOR

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ABSTRACT

Pawpaw (*Carica papaya*) seed meal (PSM) was added to a basal diet (350g crude protein and 18.5 gross energy/kg diet) at 0, 0.5, 1.0, 1.5 or 2.0 g/kg diets and fed to mixed-sex *Oreochromis nilot* for 60 days to evaluate the effects on growth, feed conversion ratio, reproduction traits, and histol of gonads. There were no variations (P>0.05) in growth parameters and feed conversion ratio. Ind of reproduction traits decreased with increasing dietary PSM levels. Fish fed with the basal diet higher and better indices of reproduction traits (P<0.05) than the fish fed with PSM diets. Fish fed PSM/kg diet showed normal testicular and ovarian tissues, and no lesions were observed. Fish 0.5g PSM/kg diet showed slight increase in interstitial cells in testes. Fish fed 1.0g PSM/kg showed swollen spermatids nuclei, increased interstitial cells and focal necrosis in testes; hydropic degeneration, ruptured follicles, granulomatous inflammation in the insterstitium necrosis in ovaries. Fish fed 1.5g PSM/kg diet exhibited atrophy of seminiferous tubules in tes Fish fed 2.0g PSM/kg diet, there was disintegration of spermatids and necrosis in testes and se atretic follicles in ovaries. Reproduction traits and histological observations of gonads in *O. nilot* fed high dietary PSM levels revealed that pawpaw seeds may be effective as a reproduction inhib in *O. niloticus*.

INTRODUCTION

Pawpaw (*Carica papaya*) seeds had been used as fertility control agents in some animal models even on human beings (Lohiya *et al.*, 2004; Udoh and Kehinde, 1999), respectively. They con active ingredients such as caricacin, an enzyme carpasemine, a plant growth inhibitor, and olean glycoside (Emeruwa, 1982), the last of which caused sterility in male rats (Das, 1980). Histolog observations made by Udoh and Kehinde (1999) revealed that after pawpaw seeds were administe orally at 1 g/kg body weight for eight weeks on male albino (Wistar) rat, degeneration of the germ epithelium and germ cells, and the presence of vacuoles in the tubules were observed; while at a l dose of 0.5 g/kg body weight little effect was observed.

Extracts from different parts of pawpaw tree decreased the testicular weight of Wistar when administered orally for eight weeks. It was however reported that suppression spermatogenesis was observed in these rats following the administration of pawpaw seed ext (Uche-Nwachi *et al.*, 2001). In addition, water extract of papaya seeds, was administered orally Sprague Dawley rats *ad-libitum* for eight weeks and results showed that three weeks a commencement of this administration, the lumina of the semiferous tubules were more prominent empty in the experimental animals with no evidence of spermatids. It also showed that the late walls of adjacent sertoli cells lost contact with each other.

Tilapias are yet to reach their full aquaculture potential because of the problems of precoci maturity and uncontrolled reproduction, which often results in the overpopulation of production po with young (stunted) fish. Population control in farmed tilapias has been reviewed (Guerrero, 19 Mair and Little, 1991); such control methods include monosex culture, sex reversal by androge hormones, cage culture, tank culture, the use of predators, high density stocking, sterilizat intermittent/selective harvesting, and the use of slow maturing tilapia species, among oth However, these population control methods have their limitations; e.g. the use of reproduct inhibitors, such as irradiation, chemosterilants has disadvantages which are: expensive technolo hatchery facilities and skilled labour are required and hormones are expensive and difficult to obta Hence there is need to examine less expensive and appropriate technology to control tila recruitment in ponds using natural reproductive inhibitory agents in some plants.

Over its natural range, *Oreochromis niloticus* (Linnaeus 1758) occurs in Africa and t coastal rivers of Israel; Nile from below Albert Nile to the delta; Jebel Marra; Lake Chad basin a the rivers Niger, Benue, Volta, Gambia and Senegal. It is widely introduced for aquaculture, w

many existing strains. *O. niloticus* is a maternal mouth brooder and becomes sexually matured in 4-5 months at small size (10 cm; 20-50 g) in ponds; each female lays about 1,500-2,000 eggs/spawning and 3 spawnings/year (Balarin and Hatton, 1979). The objective of this study was to investigate the effects of varying dietary supplementation levels of dry pawpaw seed meal (PSM) on some reproduction traits (gonad development stages, gonadosomatic index (GSI), fecundity, egg size (length, diameter, volume), egg weight (wet and dry basis), histology of gonads) in *O. niloticus* fed for 60 days.

MATERIALS AND METHODS

Ripe fruits of pawpaw, *Carica papaya* Linn. (Caricaceae; Voucher No. RUBL 16590) of honey dew variety, obtained from farm settlements in southwest Nigeria, were cut open to remove the seeds which were shade-dried and milled into fine particle size (< 250 μm); and kept in a dry, clean, air-tight transparent plastic container. Feedstuffs were purchased from a local feedstuff market and were separately milled to small particle size (< 250 μm). A basal diet (D 1, 350g crude protein and 18.5MJ gross energy/kg diet) was prepared as formulated in Table 1. Four test diets (D2, D3, D4, D5) were formulated by adding 0.5, 1.0, 1.5 or 2.0g of PSM to 1 kg of basal diet, respectively. Nutrient imbalance caused by the addition of PSM was corrected by adding 2.0g of cellulose (non-nutritive ingredient) to the basal diet (D1) and 1.5, 1.0, 0.5, and 0g of cellulose to test diets D2, D3, D4 and D5, respectively. The feedstuffs were thoroughly mixed in a Hobart A-200T mixer. Hot water was added at intervals to gelatinize starch. All five diets were pelletized using a die of 8 mm diameter. The diets were air-dried at ambient temperature for 72 hours; broken, sieved into small pellet sizes, packed in air-tight containers, labelled and stored.

Table 1: Ingredient composition of basal diet.

	g/kg diet
Menhaden fish meal	280
Soybean meal	370
Corn meal	250
Cod liver oil	30
Corn oil	20
Vitamin-mineral mix[1]	30
Corn starch	20

[1]Fish pre-mix. Colborne Dawes Nutrition Ltd., United Kingdom.: vitamin A, 1600 IU; vitamin D, 2400 IU; vitamin E, 160 mg; vitamin K, 16 mg; thiamin, 36 mg; riboflavin, 48 mg; pyridoxine, 24 mg; niacin 288 mg; panthotenic acid, 96 mg; folic acid, 8 mg; biotin, 1.3 mg; cyanocobalamin, 48 mg; ascorbic acid, 720 mg; choline chloride, 320 mg; calcium 5.2 g; cobalt, 3.2 mg; iodine, 4.8 mg; copper, 8 mg; iron, 32 mg; manganese, 76 mg; zinc, 160 mg; Endox (antioxidant) 200 mg.

O. niloticus fingerlings, obtained from a single spawn, were acclimated for 14 days in concrete tanks during which they were fed with a commercial diet. After acclimation, 10 male and 10 female *O. niloticus* (mean wt., 40.23g) were stocked in each of 15 concrete tanks (2m x 2m x 1.25m) supplied with 400 litres of fresh water (water temperature, 27 °C; pH, 7.3; alkalinity, 50 ppm; dissolved oxygen, 7.6-7.9 mg/L). The diet treatments were replicated thrice and fish were fed at 4% body weight/day in two instalments at 0900-0930 h and 1700-1730 h for 60 days; after which they were removed, sorted by sex and weighed. Sex determination was done through visual examination of the gonad. Fish mortality was monitored daily. Growth and feed utilization indices were then estimated. Six male and six female *O. niloticus* samples were randomly taken from each treatment, dissected, and the testes and ovaries removed and weighed for the gonadosomatic index (GSI) calculations (gonad wt./total body wt. x 10^2). Gonad development stages in male and female *O. niloticus* were classified according to Kronert et al.(1989) and Oldorf et al. (1989), respectively. Fecundity was estimated from gonads of six fishes from each treatment in the final maturation stage from a sample representing at least 50% of ovary weight then reported to the total weight of the ovary.

Egg weight (dry and wet basis) was determined using 50-count egg samples: a sample of 50 egg weighed and oven-dried at 80 °C for 24 hours. Thirty (30) eggs were measured using a micro eye-piece graticule for length (L) and width (H). Egg volume was calculated by the formula:

$V = \pi/6LH^2$ (Rana, 1985).

The gonads were sectioned, fixed for 24 hours in formalin-saline solution made of equal volum 10% formalin and 0.9% NaCl solution. Histological sections of 8μ thickness were prepared follo standard procedures. Photomicrographs were taken with Leitz (Ortholux) microscope and camera

Statistical comparisons of the results were made using the one-way Analysis of Var (ANOVA) test. Duncan's New Multiple Range Test was used to evaluate the differences bet means for treatments at the 0.05 significance level (Zar, 1996).

RESULTS AND DISCUSSION

Growth performance and feed conversion by O. niloticus fed varying dietary PSM levels

Dietary supplementation of PSM but did not reflect in the nutrient composition of the diets a crude protein and gross energy contents were similar for all diets, and satisfied the nu requirements for tilapias (Jauncey, 2000). Water quality during the feeding trial was within acceptable range for tilapia culture (Ross, 2000). No mortality was recorded in all diet treatm Acceptance of the diets was good and fish became accustomed to the diets within the first w Weight gain, growth response, feed conversion ratio (FCR) by fish fed with the experimental die presented in Table 2. The best overall growth response was obtained in fish fed with the basal while weight gain, % weight gain and average daily growth (ADG) were poorer ($P<0.05$) in fis with the PSM diets. A similar trend was observed with the specific growth rate (SGR); as the v decreased with increasing dietary PSM levels while the FCR values showed an inverse relationsh

Table 2. Growth performance and feed conversion by Oreochromis niloticus fed pawpaw seed m (PSM) diets.

	Dietary PSM level (g/kg diet)				
	0	0.5	1.0	1.5	2.0
Final weight (g)	66.53a	66.03a	62.48ab	58.37b	58.18b
Initial weight (g)	40.23	40.23	40.23	40.23	40.23
Weight gain (g)	26.30a	25.80a	22.25b	18.14c	17.95c
% weight gain[1]	65.37a	64.13a	55.31b	45.09c	44.62c
ADG[2]	0.44a	0.43a	0.37b	0.30c	0.29c
SGR[3]	0.84a	0.82a	0.73b	0.62b	0.61b
FCR[4]	1.82a	1.90b	2.05b	2.12bc	2.17c

[1] % weight gain (%. fish^{-1}) = [(final wt. – initial wt.)/initial wt.)] x 100

[2] average daily growth (g) = [(final wt. – initial wt.)/no of days

[3] specific growth rate (%. day^{-1}) = [(ln final wt. – ln initial wt.)/no of days] x 100

[4] feed conversion ratio = feed intake (g)/body weight gain (g)

a, b, c – Mean values in a row followed by dissimilar letters are significantly different ($P<0.05$)

Reproduction traits and histology of testes in O. niloticus fed varying dietary PSM levels

Table 3 shows that GSI values decreased ($P<0.05$) as the dietary PSM levels increased; which similarly reported by Jegede & Fagbenro (2008) and is attributable to the poor development of t tissues. Histological sections of testes in *O. niloticus* fed 0g PSM/kg diet (basal diet) showed n tissue architecture and spermatids distribution (Table 3). Fish fed 0.5g PSM/kg diet sh alterations in the testis architecture and cystic seminiferous tubules. In fish fed 1.0g PSM/kg there was atrophy, while fish fed 1.5g PSM/kg diet showed cystic seminiferous tubules and atr In fish fed 2.0g PSM/kg diet, there was severe tissue atrophy, spermatids disintegration and nec In related studies, Jegede et al.(2008a) obtained similar histological effects in male redbelly t (*Tilapia zillii*, Gervais 1848) fed varying dietary levels (0.5-2.0 g/kg diet) of PSM or (*Azadirachta indica*) leaf meal tested as reproduction inhibitors. However, Ekanem & Okoro

(2003) obtained much severe histological effects in male Nile tilapia fed higher dietary PSM supplementation levels (4.9 and 9.8g PSM/kg diet).

Table 3: Reproduction traits and histological description of male *Oreochromis niloticus* fed PSM diets.

Treatments (g PSM/kg diet)	GSI (%)	Histological description
0	1.75a	normal tissue architecture and normal spermatids distribution
0.5	1.09b	increase in interstitial cells
1.0	0.82c	swollen spermatids nuclei, increased interstitial cells and focal necrosis
1.5	0.73c	atrophied seminiferous tubules
2.0	0.41d	severe disintegration of sperm cells and necrosis

a, b, c, d – Mean values in a column followed by dissimilar letters are significantly different ($P<0.05$).

Reproduction traits and histology of ovaries in O. niloticus fed varying dietary PSM levels

Relative distribution of gonad development stages was very homogenous among replicates in each dietary PSM treatment. As no differences were found in replicate tanks of a same treatment, data from replicate tanks were pooled. However, inter-treatment comparisons revealed significant differences in fecundity among treatments. High percentages of stage 4 was observed in fish fed 1.0g or 2.0g PSM/kg diet; in which several oocytes that were going to be laid were atretic, suggesting that physiological conditions were not optimal for oocyte development and eventual spawning. Dry weights of eggs were similar ($P>0.05$). The reasons for this are unclear, but may reflect differences in the relative moisture content of eggs. Even though egg diameter was not significantly different among treatments (Table 4), GSI and other reproductive traits decreased with increasing dietary PSM levels.

Table 4: Reproduction traits and histological description of female *Oreochromis niloticus* fed PSM diets.

Treatments (g PSM/kg diet)	GSI (%)	Fecundity	Egg traits					Histological description
			Diameter (mm)	Length (mm)	Volume (mm^3)	Wet weight (mg)	Dry weight (mg)	
0	1.95a	465	2.92a	3.05a	7.14a	7.7a	2.8	normal histology and less visible atretic follicles
1.0	1.36b	340	2.70b	2.81b	6.53b	6.0b	2.7	increased atretic follicles and hydropic degeneration
2.0	1.11b	280	2.56b	2.12c	6.31b	5.4b	2.5	increased atretic follicles, ruptured follicles and necrosis

a, b - Mean values in a column followed by dissimilar letters are significantly different ($P<0.05$)

As with the male *O. niloticus*, GSI values as well as other reproduction traits decreased ($P<0.05$) as the dietary PSM levels increased (Table 4); which was similarly reported by Jegede & Fagbenro (2008) and is also attributable to the poor development of ovarian tissues as suggested by Cumaranatunga and Thabrew (1989). In *O. niloticus* fed with the basal diet (0g PSM/kg diet), typical bilateral lobes of the ovaries were evident; and the normal olive green colour was maintained. Sections of ovaries in *O. niloticus* fed with the basal diet showed normal ovary histology. No pathological lesions were observed, atretic follicles were less visible (Table 4). In fish fed 1.0 or 2.0g

PSM/kg diet, there were changes in colour of ovaries, increased atretic follicles, ruptured follicles a necrosis. Similar histological effects were reported by Jegede et al.(2008b) when female *T. zillii* w fed with varying dietary supplementation levels (1.0-2.0 g/kg diet) of PSM or neem leaf meal used reproduction inhibitors.

In this study, the damage done to tissues of the testes and ovaries was minimal at low dietary PSM levels (0.5 or 1.0 g/kg diet), and at higher dietary PSM levels (1.5 or 2.0 g/kg diet). caused disintegration of many more cells, rendering the testes and ovaries devoid of spermatids a oocytes, respectively. This makes dry pawpaw seeds recommendable for use in the control breeding in tilapias. Histological observations of testes and ovaries in *O. niloticus* fed the basal d supplemented with PSM revealed that pawpaw seeds may be effective as sterility-inducing agents they were destructive to testes and ovary tissues; and is useful in the determination of t contraceptive efficacies of dietary PSM in combating problems of tilapia overpopulation in pon Other than infertility, literature did not indicate any adverse reactions from the consumption pawpaw seeds.

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COMPARISON OF DIPLOID AND TRIPLOID *Heterobranchus bidorsalis* USING POLYACRYLAMIDE GEL ELECTROPHORESIS (N-PAGE)

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ABSTRACT
A comparative analysis on biochemistry and Polyacryl Amide Gel Electrophresis was carried out t determine the genetic diversity of diploid and triploid *Heterobranchus bidorsalis*. Sixteen samples o diploid and triploid farm-raised *H. bidorsalis* (mean weight; 512.6g and mean length; 41.6cm) wer collected and the electrophoresis analysis was conducted using 5.5% Polyacryl Amide Gel and serur protein obtained from the blood of the live samples. 0.06% Coomassie blue was used for staining th gel while a mixture of ratio 1:2 of glacial acetic acid, methanol and distilled water was used for de staining the gel. The diploid and triploid possessed an equal total number of 23 electrophoretic prote bands. The molecular phylogenetics of both samples revealed low genetic variability. Results of th study will serve as a baseline analysis on the current genetic diversity of *H. bidorsalis* in Nigeria.

INTRODUCTION
Fisheries biologists in order to study the genetic structures of fish populations have use eletrophoretic methods. Studies of a diverse selection of commercially important fisheries show th there were significant levels of polymorphisms of proteins using serum protein and enzyme marker which were used in the mid 50's to 80's to study various genetic variations in fishes. Sever molecular investigations for species, sub-species and strain variation have generate Deoxyribonucleic Acid (DNA) polymorphism in tilapia, e.g., Restriction Fragment Leng Polymorphism (RELPs) and micro-satellites (Omitogun and Aluko, 2001). Triploidization is th treatment applied to hatching eggs shortly after fertilization, which creates non-productive stock Five minutes old fertilized eggs are usually subjected to cold shock at 5°C for 40 minutes in a co chamber. This process results in the creation of a third set of chromosomes (3N) instead of the usu two sets (2N). Triploidy stocking can result in substantial benefits to angling opportunities includi increased size of fish and minimal impact on populations. Inducing triploidy is widely accepted as th most efficient method for producing sterile fish for aquaculture and fisheries manageme Electrophoresis is a biochemical technique that enables geneticists to determine protein phenotyp and their genotypes and to rely on easily measured phenotypes. The technique of gel electrophore is very important in visualization of protein and DNA molecules of polyacrylamide gels. To da there is no report on the genetic characterization of diploid and triploid catfish, *H. bidorsalis* aquaculture using PAGE. Therefore, this study provides information on the electrophore comparative studies of diploid and triploid *H. bidorsalis* samples using the PAGE method.

MATERIALS AND METHODS
16 farm-raised *H. bidorsalis* comprising 8 diploid and 8 triploid samples (mean wt. and length 51 and 41.6cm) were used. Blood samples were collected from each fish using heparin-lined syring 2ml of physiological solution diluted the 5ml of blood to prevent it from clotting and centrifuged 2500 rpm for 10 minutes. The supernatant, containing the serum protein, was collected and stored 1.5ml Eppendorff microtube and stored. 0.05-0.1ml saline diluted serum was further diluted into in 40% sucrose solution; 2µl drops of bromophenol blue were added as an indicator for electrophoretic mobility. 10µl sucrose protein bromophenol solution was poured into the gel apertu using a micro syringe. Voltage was kept constant in the electrophoretic field at 180V, during the f 30min. allowing a direct current 3mA. Voltage was thereafter decreased to 150V for 45 minu After electrophoresis, the gels were carefully removed and placed in a staining solution composed 3% Coomassie Blue in 1:3 glacial acetic and methanol. The staining was done on a R100TH Rota shaker for 0.5-1hour. Thereafter, the staining solution was removed and the destaining solution then added and allowed to destain for 3 hours on the shaker. Each gel was scored by viewing electrophoretic gel on an intensive light box for the protein bands to be seen clearly. Gels were sco visually. Presence (1) or absence (0) of protein bands classification was used. The position of

molecular weight reference marker helped in scoring of the protein bands on each gel. Frequencies were determined by direct counting and relative banding intensities.

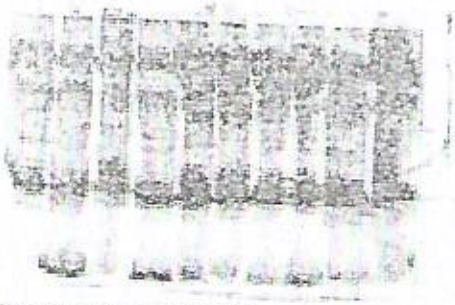

Fig. 1: Diploid (2n) *Heterobranchus bidorsalis*

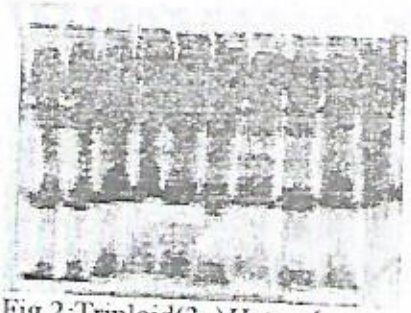

Fig.2:Triploid(3n)*Heterobranchus bidorsalis*

RESULTS AND DISCUSSION

The electrophoretic gel profile of serum proteins of diploid and triploid *H. bidorsalis* are shown in figures I and II, respectively. The fastest migrating bands are the albumins, the intermediate bands are the transferins and the slowest, globulins that stayed close to the well comb. Tables I and II show the mobility of the 23 bands. The highest relative mobility for diploid and triploid (0.13) was found in the three bands (globulin, transferring and albumin), but the lowest (0.05) was found only in the albumin band. Comparatively, the lowest (0.5) was found in all the three bands. The relative mobility of the bands for triploid and diploid samples were 0.1304±4.128E-02 and 0.1078±3.908E-02, respectively. There was a non-significant (P>0.05) relationship between the triploid and diploid *H. bidorsalis*. The low genetic variation observed in triploid and diploid *H. bidorsalis* agrees with Tave (1992), that triploids are created for two reasons, increased growth and sterility. It is an effective method for producing sterile fish for aquaculture and fisheries management. Cassani and Carton (1984) confirmed that triploid fish differ from diploid fish by having faster growth rate and fewer deformities. Apart from low hatchability due to cold shocking effects on eggs, triploid *H. bidorsalis* were as viable as their diploid strain under same intensive management (Tave 1992).

The low genetic variation of diploid and triploid *H. bidorsalis* using N-PAGE is in line with those reported on different fish species using different electrophoretic analysis: Masu salmon (Nakajima et al., 1986); Atlantic salmon (Verspoor, 1988); common carp (Murakaeva et al., 2003) and *Clarias gariepinus* (Betiku et al, 2006). Triploids are as viable as their diploid counterparts, are edible and constitute no health or environmental hazard; unlike the stocks manipulated with hormonal steroids which are not environmental friendly and may be carcinogenic. Triploidization is an effective method of producing sterile fish which is an important tool in controlling overcrowding in tilapias.

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PRIMARY PRODUCTION AND PHYSICO-CHEMICAL PARAMETERS OF A FRESHWATER FISH FARM IN SOUTH EAST NIGERIA

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ABSTRACT
Comparative primary production in Little Stream Farms, near Uyo was investigated in relati physico-chemical parameters of the adjacent perennial stream and the fish ponds. Excep temperature, which showed the same values for both stations, physico-chemical variables ge showed significant difference ($P<0.05$) between the pond water and the adjacent stream. Val silicates, Turbidity (NTU), Secchi Disc Transparency and Total Suspended Solids (TSS) exh significantly variable trends ($P<0.05$), especially in the stream water, in response to the comm sand dredging activities upstream from the farm location. Lowest value of stream transparency (recorded was during the peak of the sand dredging, whereas the stream water showed ab transparency in the absence of the dredging. The water quality parameters also exhibited a g trend of significant seasonal variation ($P<0.05$). Five phytoplankton families: Bacillariophy Chlorophyceae, Cyanobacteria, Euglenophyceae and Dinophyceae occurred in the ponds, while families, Bacillariophyceae, Chlorophyceae and Cyanobacteria occurred in the st Bacillariophyceae showed the highest relative abundance in both stations A and B.

INTRODUCTION
The current spate of global food crisis due to climate change, coupled with the continued dec fish stocks in natural waters from overfishing calls for intensified effort in fish production thr aquaculture, towards meeting the demands of food security. The development of a good cr phytoplankton (which is the primary producers) is central to the proper management of the Phytoplankton productivity is inadvertently tied to the environmental factors (*physico*-che parameters) of the pond (Ezenwa *et al.*, 1994). Light, temperature, dissolved oxygen nu availability, grazing pressure, pollutants and even biological factors of intra and inter-sp competition (Wootton, 1992) all influence the phytoplankton community structure and distribut the pond. Knowledge of this vital component of the pond ecosystem is paramount in fish management towards successful production. Little Stream Farm is a fish farm situated adjacen perennial stream near Uyo, in Akwa Ibom State. The stream, which is the source of drinking wat the rural community there, constitutes the main source of water supply for the fish farm. Ov past two years however, sand dredging activates have been carried out upstream from the farm activity has rendered the water highly turbid, negatively impacting phytoplankton productivit causing untold hazards for the fish farm operations. This study has been carried out to evalua status of phytoplankton communities within the fish pond compared to those of the stream, vi the water quality parameters.

MATERIALS AND METHODS
Little Stream Farms is located in Ibesikpo Asutan Local Government Area of Akwa Ibom

(7°45'E and 8°00'E; 4°50'N and 5°00'N) in the eastern section of the Niger Delta. The farm is a

of diverted ponds based on two perennial streams, which serve as potable water sources f riparian communities in the area. Water samples were taken from the two streams and from th ponds. Six sampling stations were established, three (stations 1, 2, and 3) in the stream cour three (stations 4, 5 and 6) randomly selected in the production ponds. Sampling was carried out months (March 2007 - February 2008) covering both dry season (November - April) and wet (May - October). Stations 1 and 2 were located in the main stream, one above the point of dredging, and the other downstream from the effluent source, while station 3 was located tributary stream, just above the confluence area.

Water samples were collected once a month from the stations using a HYDROBIOS NANSEN type water sampler of 2 litre capacity. Samples for physico-chemical parameters were kept separately in 1.5 litre polyethylene bottles and labelled accordingly. For quantitative phytoplankton analysis whole samples were collected using the water sampler, while trawl samples for qualitative analysis were collected using a standard plankton net, which is a conical tow net (No. 20) of mesh size 76μm made of silk bolting cloth, attached to a slow moving boat. Plankters filtered from each catch were washed into 1.5 litre polyethylene bottles and fixed immediately with Lugol's solution. Samples for Biochemical Oxygen Demand (BOD_5) were collected in BOD bottles, sealed and later kept in the incubator for 5 days at 20°C. All samples were kept in insulated ice boxes at 4°C while in the field and during transportation to the laboratory.

Air and water temperature (°C), pH, turbidity (NTU), dissolved oxygen (Mg/L) and conductivity ($mScm^{-1}$) were measured in situ using a Horiba water checker, model U-10. Secchi disc transparency was measured using a Secchi Disc, while salinity was measured using a Salinometer. BOD_5 was determined by obtaining the difference in oxygen levels before and after incubation of water samples (sealed in air-tight containers) at 20°C for 5 days (APHA 1985). The oxygen levels (mg/L) were obtained by in situ readings using a Horiba water checker. Silicate was determined by the silico-molybdate blue method (Parsons *et al.*,1984). Nitrate Nitrogen (NO_3-Nmg/L) was determined by the Brucine Colorimetric Method (APHA 1985). The samples were compared with a blank Lovibo Comparator disc after the necessary reagents had been added, and the readings taken as NO_3mg/L. Ammonium Nitrogen (NH_4-Nmg/L) was determined by the Nesslerization Colorimetric Method (APHA 1985). A visual comparison was made of colours produced in the samples with ammonia standards. Phosphorus (Po_4^{3-} mg/L) was determined using the Vanadomolybdophosphoric Acid Colorimetric Method (APHA 1985). The absorbance of the sample versus blank was measured at 450μm and the amount of phosphate calculated. Total Suspended Solids (TSS) was determined by filtering the sample through a glass fibre filter paper (APHA 1985), and the residue on the filter dried to a constant weight at 103-105°C. The increase in weight of the filter paper was regarded as TSS.

RESULTS

Results of physico-chemical parameters are shown in tables 1 and in figures 1a to f. Water temperature ranged from 27°C to 32.6°C. Water depth was more or less uniform in the ponds whereas depth of the stream course showed a high degree of variability. Stream water depth reduced progressively downstream, and throughout the sampling period. There was highly significant variation in stream water depth ($p<0.05$) between the start and end of the sampling. pH ranged from 6.0 and 7.2 for both locations. Higher values were recorded in stations 4 to 6 while the stream course recorded lower values. The dry season pH values were significantly higher ($P<0.05$) than the wet season values in both sampling locations (Fig.1a to f). Values were generally higher in the ponds than in the stream course. Mean water depth was 0.58M in the stream, while mean depth in the ponds ranged from 0.47 to 0.50M.Conductivity values were generally low, ranging from 14 to 73$mScm^{-1}$ in the ponds, while values in the stream ranged from 18 to 37$mScm^{-1}$.

Total suspended Solids ranged from 1.8mgL^{-1} to 2.9mgL^{-1} in the ponds while the TSS ranged from 3.8 to 5.8mgL^{-1} along the stream course. Turbidity ranged from 189NTU to 1235NTU/ highest values were observed in the stream during peak periods of sand dredging. Silicate ranged from 11.6mgL^{-1} to 22.5mgL^{-1}in the stream course while pond silicate values ranged from 0.01 to 8.4mgL^{-1}throughout the sampling period. Highest values were observed in the stream during peak periods of dredging. A highly significant difference ($p<0.01$) was observed between silicate concentrations in the stream and the ponds. Nitrates and phosphates generally showed higher values in the ponds than in the stream. Highest values of Ammonium Nitrogen and BOD_5 (4.6$mgL^{-1}$and 6.83mgL^{-1}) respectively, were observed in the pond bottom waters.

Table 1: RANGE, MEAN & STANDARD DEVIATION OF THE PHYSICO-CHEMICAL PARAMETERS IN LITTLE STREAM FARMS

		A					B			
	Range	XA	XAD	XAW	SD	SE	Range	XB	XBD	XBW
Air Tempt. (°C)	28.0-32.8	30.3	31.5	29.0	5.5	±0.9	28.0-32.8	30.3	31.5	29.0
Water temp (°C)	27.0-32.6	29.5	31.5	27.5	5.4	±0.9	26.8-32.4	29.3	31.2	27.3
Depth (m)	0.58-0.58	0.58	0.58	0.58	0.8	±0.1	0.47-0.50	0.48	0.47	0.49
Ph	6.0-6.7	6.5	6.4	6.5	2.5	±0.4	6.4-7.2	6.6	6.8	6.5
Transparency (m)	0.58-0.58	0.58	0.58	0.58	0.8	±0.1	0.60-0.65	0.62	0.61	0.62
TSS (mg/L)	0.2-4.8	1.5	2.7	0.8	1.3	±0.2	0.4-3.8	2.3	3.1	1.6
Turbidity	2.0-1235	451.25	373.1	544.8	624.0	±2.1	247-497	368.25	249.51	85.92
Alkalinity (mg/L)	28-316	32.7	32.0	33.3	5.7	±1.0	44-66	52.0	54.7	49.3
Conductivity (mScm-1)	18-34	27.5	33.0	22.0	5.2	±0.9	14-73	30.7	21.7	39.7

XA = Stream mean, XB = Farm mean, XAD = [illegible], XAW = [illegible], SD = Standard deviation, SE = Standard error

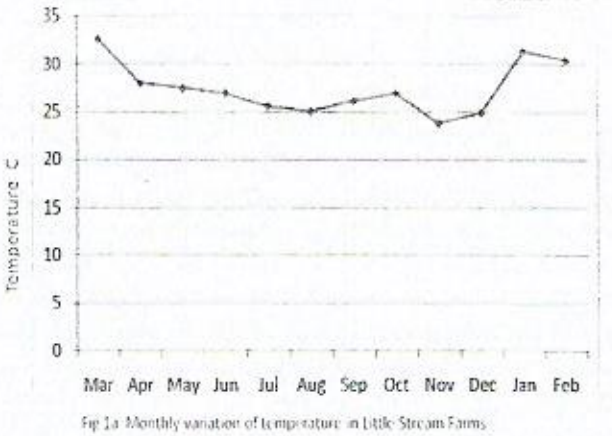


Fig 1a: Monthly variation of temperature in Little Stream Farms

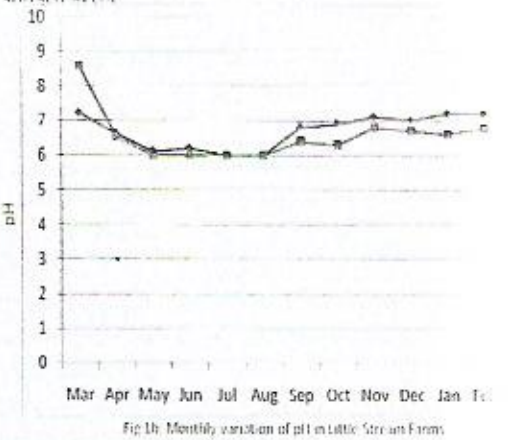


Fig 1b: Monthly variation of pH in Little Stream Farms

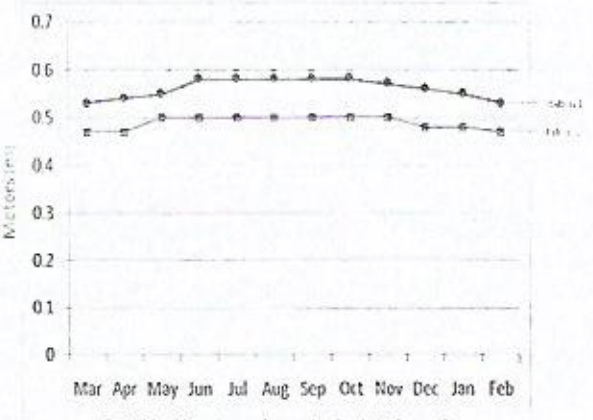


Fig 1c: Monthly variation of mean depth in Little Stream Farms

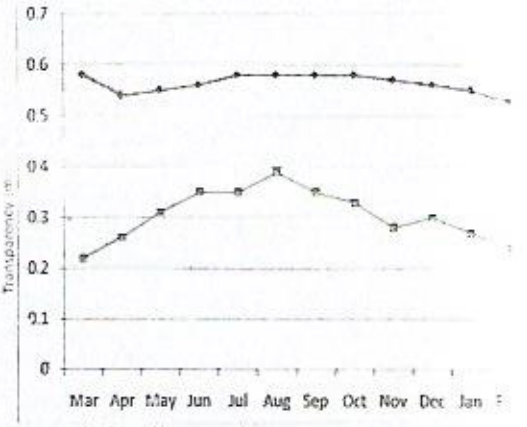
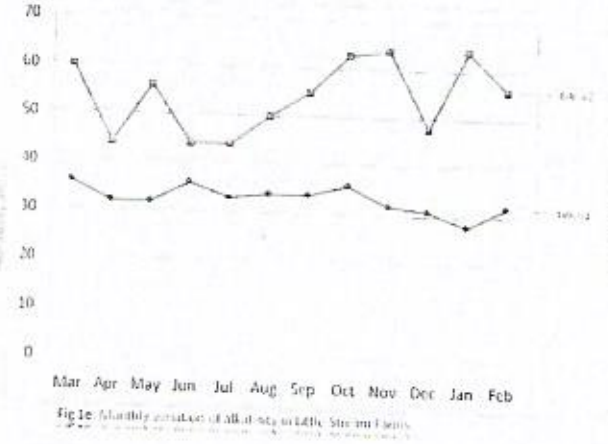
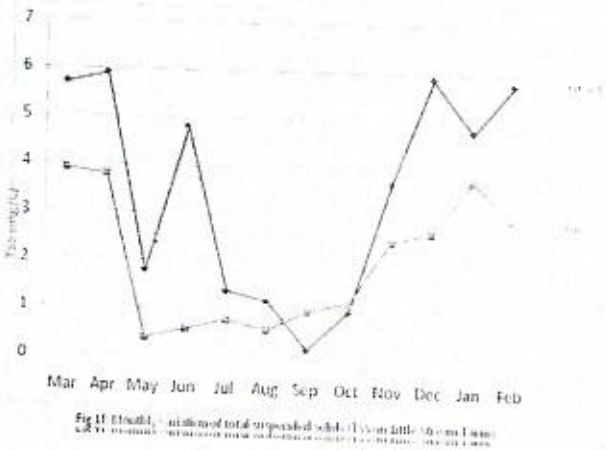


Fig 1d: Monthly variation of Transparency in Little Stream Farms





A total of five phytoplankton families Bacillariophyceae, Chlorophyceae, Cyanobacteria, Euglenophyceae and Dinophyceae were identified (table 1). Of these, all five families were identified in the fish ponds (fig.2b), while three families (Bacillariophyceae, Chlorophyceae and Cyanobacteria) were identified in the stream course (fig.2a). In both sampling locations, Bacillariophyceae showed the highest abundance and species diversity with 15species, followed by Chlorophyceae with 11 species. Cyanobacteria, Euglenophyceae and Dinophyceae had 3species, 2 species and 2species respectively (Table 3; fig.3a, 3b).

TABLE 2: TAXONOMIC COMPOSITION, SPATIAL DISTRIBUTION AND RELATIVE IMPORTANCE OF PHYTOPLANKTON SAME FROM LITTLE STREAM FARMS

Family	Phytoplankton	Station A (NO.)	%	Station B (NO.)	%
Bacillariophyceae					
	Bacillaria auriita	3	0.50	12	2.12
	Coccinodiscus excentricus	38	6.35	32	5.6
	Costatium Sp	2	0.33		0
	Cyclotella stelligra	2	0.33		0
	Fragillaria capucina	3	0.50	5	0.84
	Gyrosigma attenuatum	35	5.85	4	0.71
	Halosphaera viridis	5	0.48	7	1.24
	Melosira granulata	-	0	2	0.35
	Navicula affinis	65	10.87	32	5.65
	Nitzchia closterium	18	3.01	24	1.24
	Pinnularia divergens	86	14.38	98	17.31
	Pleurosigma nobilis	36	6.02	88	15.55
	Synedra ulna	11	1.84	8	1.41
	Tabellaria fenestra	38	6.35	10	1.77
	Thalassionema sp	-	0	3	0.53
		342	57.19	325	57.42
Chlorophyceae					
	Actinastinum gracilium	-	0	2	0.35
	Ankistrosdesmus falcatus	3	0.50	2	0.35
	Chlorella sp	22	3.65	29	5.12
	Cladosphania sp		0	2	0.35
	Closterum cynthia	31	5.06	20	3.53
	Coelastrum sp		0	2	0.35
	Scenedesmus quadricauda	7	1.17	13	2.30
	Selenastrum sp	-	0	2	0.35
	Sphaerocystics sp	4	0.67	11	1.94
	Spirogyra grossa	116	19.40	107	18.49
	Ulothrix sp	56	9.36	25	4.42
		242	39.17	215	37.99
Cyanophyceae					
	Anabaena spiroides	1	0.18	-	0
	Lyngbya birgei	-	0	3	0.38
	Oscillatoria sancta	13	2.1	16	2.83
		14	2.35	19	3.31
Euglenophyceae					
	Euglena acus		0	4	0.01
	Phacus candata	-	0	2	0.01
Dinophyceae					
	Gymnodinium sp	-	0	2	0.35
	Peridinium	-	0	5	0.88
			0	7	1.23
Grand total		598		579	

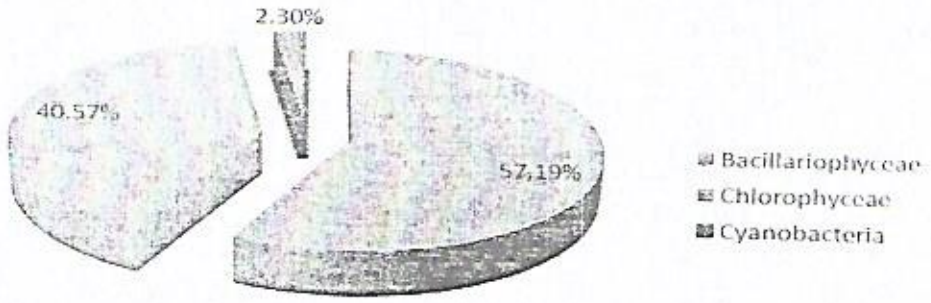


Fig. 2a: Relative abundance of phytoplankton families in Little Stream Farms (Stream)

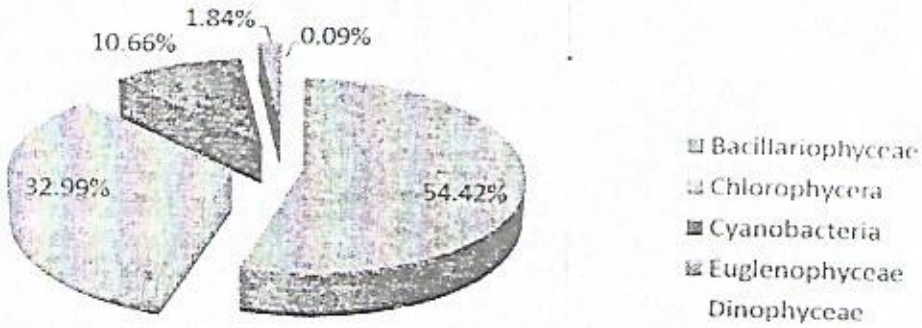


Fig: 2b: Relative abundance of Phytoplankton families in Little Stream Farms (Ponds)

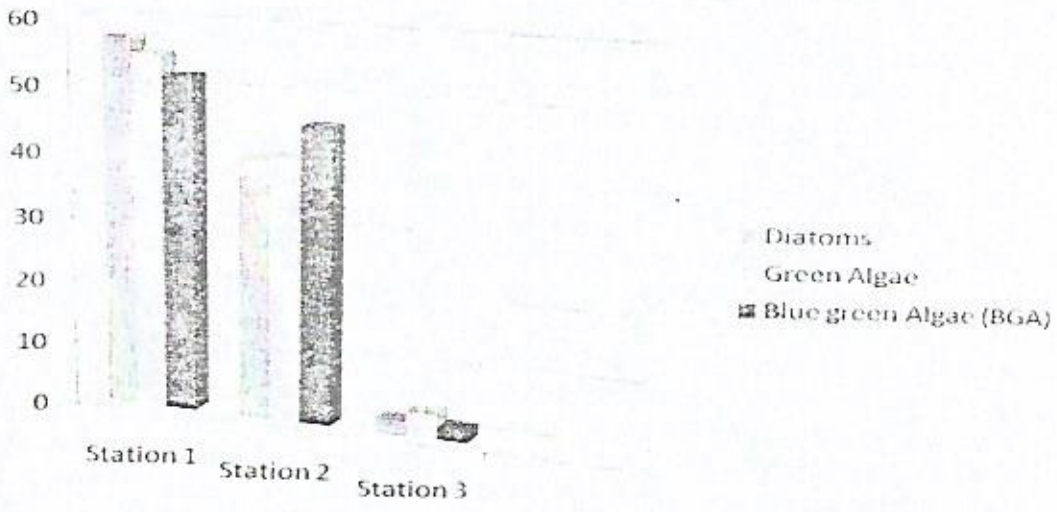


Fig. 3a: Spatial distribution of Phytoplankton in Little Stream Farms (Stream)

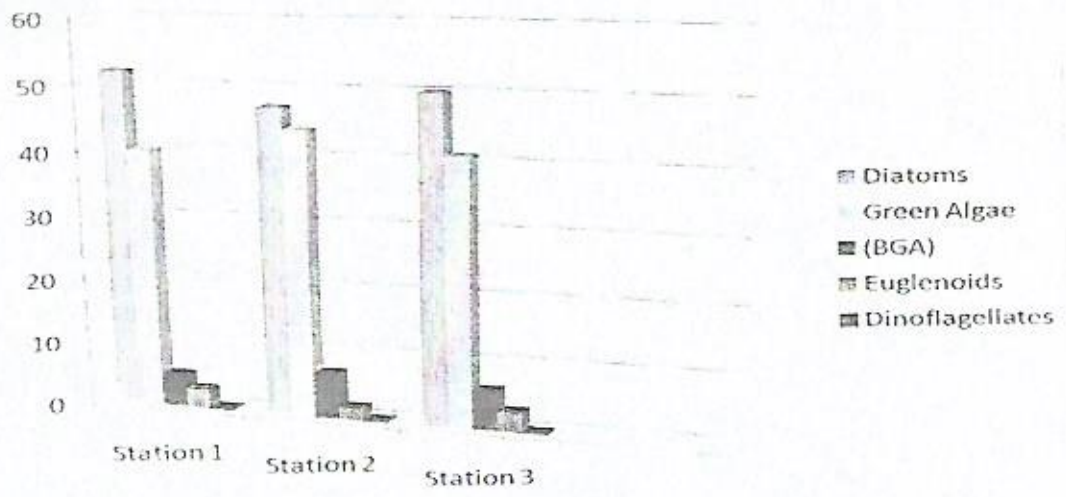


Fig. 3b: Spatial distribution of Phytoplankton in Little Stream Farms (Ponds)

TABLE 3a: SPECIES ABUNDANCE, DIVERSITY AND EVENESS IN THE TWO STATIONS

STATIONS	SPECIES ABUNDANCE	SHANNON-WEINER (H')	EVENESS	MARGALEF
A	22	0.12	0.99	7.56
B	28	0.15	0.99	9.81

TABLE 3b: SPECIES ABUNDANCE AND DIVERSITY OF THE DIFFERENT FAMILIES IN THE TWO STATIONS

FAMILIES	SHANNON-WEINER (H')		EVENESS		MARGALEF	
	A	B	A	B	A	B
Bacillariophyceae	0.32	0.32	0.67	0.67	122.79	117.69
Chlorophyceae	0.37	0.37	0.84	0.86	86.78	77.73
Cyanobacteria	0.09	0.12	0.99	0.99	1.68	0.51
Dinophyceae	0	0.05	0	0.99	0	2.18

DISCUSSION

The general trend of variation in values of physico-chemical parameters between the ponds and the stream course could be due to sand dredging activities in the stream as well as the fish pond management practices. The significantly higher values ($p<0.05$) of silicates, turbidity, total suspended solids and conductivity can be attributed to the commercial sand dredging activities in the stream, upstream from the fish pond area. The high turbidity (1235NTU) in the stream during peak periods of sand dredging could lead to severe problems of clogging of eggs and larvae in the hatchery and breeding ponds, as this is the only source of water supply for the farm. This could lead to heavy mortalities and low productivity levels in the farm.

Influence of environmental factors on hatchability of fish eggs and larval survival has been demonstrated by Onuoha and Nwadukwe (1987), Nwadukwe (1995) and Oladosu *et al* (1999). The low Secchi depth (0.1M) especially during peak dredging periods could hamper photosynthetic activity and hence primary production. Dokulil (1994) reported that high concentrations of abiogenic turbidity could light-limit phytoplankton photosynthesis and thereby restrict biomass development. Wetzel (2001) also established an inverse relationship between Secchi Disc transparency and primary productivity. High downstream values of Dissolved Organic Matter to Particulate Organic matter (DOM: POM) ratio of both allochthonous and autochthonous origin (Akpan and Anadu (1991) also contribute to low transparency. Akpan (2005) stated that DOM is a strong complexing agent for

metals such as Zn, Fe, Cu, Al and Hg and as such high inputs could be implicated in toxicity. The higher values of Ammonium Nitrogen in the ponds could be attributed to waste feeds, manure, inorganic fertilizers and fish droppings in the ponds, whereas the stream water was relatively clean except during sand dredging periods.

Fish production through aquaculture is the most foreseeable solution towards alleviation of protein deficiency problems and enhancing general food security. Little Stream Farms has the potential to contribute immensely to the achievement of this overall goal, given the existing abundant resources of good water supply and high primary productivity. This potential could be greatly hampered by the current spate of anthropogenic perturbations of the very source of water upon which the farm is predicated. Government intervention through the machinery of the Ministry Environment is needed urgently to put a stop to the sand dredging activities that are grossly hazardous to the operations of Little Stream Farms. Barring the present environmental set backs, Little Stream Farms could potentially contribute significantly to increased fish production through aquaculture.

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TOXICITY OF AFRICAN LOCUST BEAN EFFLUENT ON *Oreochromis niloticus*

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ABSTRACT
The effects of 96 h sub-lethal concentrations of African locust bean effluent on *Oreochromis niloticus* were studied using plastic buckets. Packed cell volume (PCV) and histological study of gills and liver were the tissue chemistry parameters investigated. The control buckets contained no effluent. Results revealed increase in ESR (Erythrocyte Sedimentation Rate) decrease in heamoglobin, red blood cell and PCV Value of the fish exposed to all sub-lethal concentrations. Damage to liver and gills were noticed in some of the sub-lethal concentrations of all the effluent. Normal situation was observed in all the examined tissues of fish from the control buckets. The African locust bean effluent is toxic on *O. niloticus* and the lethal concentrations of African locust bean effluent deducted from the 96 hours acute toxicity effect ranged from 3ml.

INTRODUCTION
Effluent discharges constitute the greatest pollution problem that Nigeria has ever experienced (Sikoki & Kolo, 1993). The effluent from these agriculture and industrial products has continued to affect both man and aquatic ecosystems directly or indirectly. Industrial effluent discharges exert great impact on the aquatic system even at low concentrations. Krous *et al.*(1982) and Ofojekwu *et al.*(1990) used different test organisms, different periods of exposure to pollutants, waters of different quality and different ways of reporting the results. The acute toxicity of Rogor® was determined for the juveniles of the freshwater fish, Nile tilapia (*Oreochromis niloticus*) by Annune & Ajike (1999) and it was suggested that osmoregulatory and respiratory incapacitation through mucus accumulation and epithelial detachment were the major causes of fish mortality following exposure to Rogor®. Exposure of the *O. niloticus* to sub-lethal concentrations of malachite green led to severe physiological impairment of fish after a 10 week exposure period (Omoregie *et al.*, 1992).

The African locust bean (*Parkia biglobosa*) is a source of protein in diets of Nigerians, and in the fermented form, it is one of the most important food condiments in the entire savanna region of West and Central Africa. Locust beans are boiled for about an hour to soften the seed coat for removal; the hulls are removed followed by washing besides rivers, and boiling for additional 10-12 hours to soften the cotyledons. The cotyledons are allowed to undergo wild fermentation for about 2 to 3 days during which the characteristic colour (brown) and odour (ammeruated) are developed. The effluents generated during African locust bean production may have harmful effect on water bodies as well as organisms that inhabit such water bodies. The effluent may be introduced deliberately or accidentally into the aquatic ecosystem during washing besides rivers impairing the quality of the water and making it unfavourable for aquatic life. The environment of the fish is often altered by toxic substances and this results in fish kills) especially when the concentration is higher than what the homeostasis of the fish can control. Information on the effects of sub-lethal and lethal exposure of freshwater species to African locust bean and its effluent is limited (Ahmed *et al.*, 2005), hence this study is to evaluate the effects of sub-lethal concentrations of *P. biglobosa* effluent on the behaviour, survival, some haematological parameters, and histology of the gills and liver of *O. niloticus* fingerlings.

MATERIALS AND METHODS
Altogether, 240 live *O. niloticus* fingerlings were purchased from Agricultural Development Project (ADP) fish farm at Alagbaka, Akure. African locust bean effluent was obtained from a local producer at Oke-Aro Titun in Akure. The fingerlings were transported to Fisheries laboratory of FUTA and placed in 100ml of water inside conico-cylindrical plastic containers for 48 hours to acclimate to laboratory conditions. Feeding was discontinued during the acclimation period in order to avoid pollution of the water with feed wastes. The fingerlings were weighed individually using a top-loading Mettler balance and randomly distributed into each container containing 100ml of water at ten fingerlings per container. A range-finding test was conducted using ten containers, each filled with 100ml of water prior to the introduction of the effluent. Each of the five varying concentrations (5ml, 10ml, 15ml, 20ml and 25ml) of African locust bean effluent was introduced with a pipette into the containers at 09.00 hr and the mixture was stirred. Each stock solution treatment was replicated twice.

Two replicates of the control treatment were also prepared by placing ten fingerlings in each of the two containers filled with 100ml of water without the effluent.

This was followed by a 96-hour definitive test conducted using ten conico-cylindrical plastic containers each filled with 100ml of water. Each of the five stock solution varying concentrations (1ml, 2ml, 3ml, 4ml and 5ml) of African locust bean effluent was introduced with a pipette into the containers at 09.00 hours and the mixture was stirred. Stock solution and control treatments were replicated twice. A total of 120 *O. niloticus* fingerlings (mean wt. 2.15g) were used for this test. The number of dead and living fingerlings in each plastic container was recoded every 24 hours starting at 08.00 h, during which the behaviour of the fingerlings was monitored. Observations made include mortality rate, lack of movement and lack of reaction to gentle prodding as described by Ward & Parrish (1982). The percentage mortality in each concentration was determined and the LC_{50} value was determined by the probit-logit transformation method. Water quality parameters such as temperature, P^H and dissolved oxygen (DO_2) concentration were determined at 24 hour intervals using standard methods described by APHA (1989) during 96-hour test. Immediately after death, gills and liver of the fingerlings were excised upon dissecting the fish for histological examination according to standard procedures. Blood samples were collected from two fingerlings from each of the treatment media immediately after death by caudal puncture into 2.5ml syringe already treated with ethylene amino acetic acid (EDTA) to prevent coagulation. Packed cell volume (PCV), haemoglobin concentration, leucocytes count and the erythrocyte count were estimated using various appropriate laboratory methods as described by Blaxhall & Daisley (1973). Data collected were subjected to the two-way analysis of variance (ANOVA) test (P = 0.05). Differences among the means were separated by Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Temperature and dissolved oxygen changed with the time while pH increased steadily. Dissolved oxygen concentration declined continuously, leading to stressful conditions on the fishes (Table 1). Eileen *et al.*(1991) also suggested that fish mortality tests are affected by temperature, dissolved oxygen concentration, pH and the duration of exposure. Fish mortality occurred in all concentrations (1, 2, 3, 4 or 5 ml) of the test toxicant as shown in Table 2. No fish died after 24 hours of exposure. No mortality was observed on exposure of tilapia fingerlings to 1 ml or 2 ml of effluent throughout the experiment however, mortality was found between 24 and 96 hours of exposure to 3 – 5 ml. Generally, after the application of the effluent, most of the fishes gradually became imbalanced and sank to the bottom within two hours of exposure. They later came to the surface and engulfed air by projecting their snout above the water level. At this time they lost their swimming ability. Opercular movements slowed down after one hour exposure.

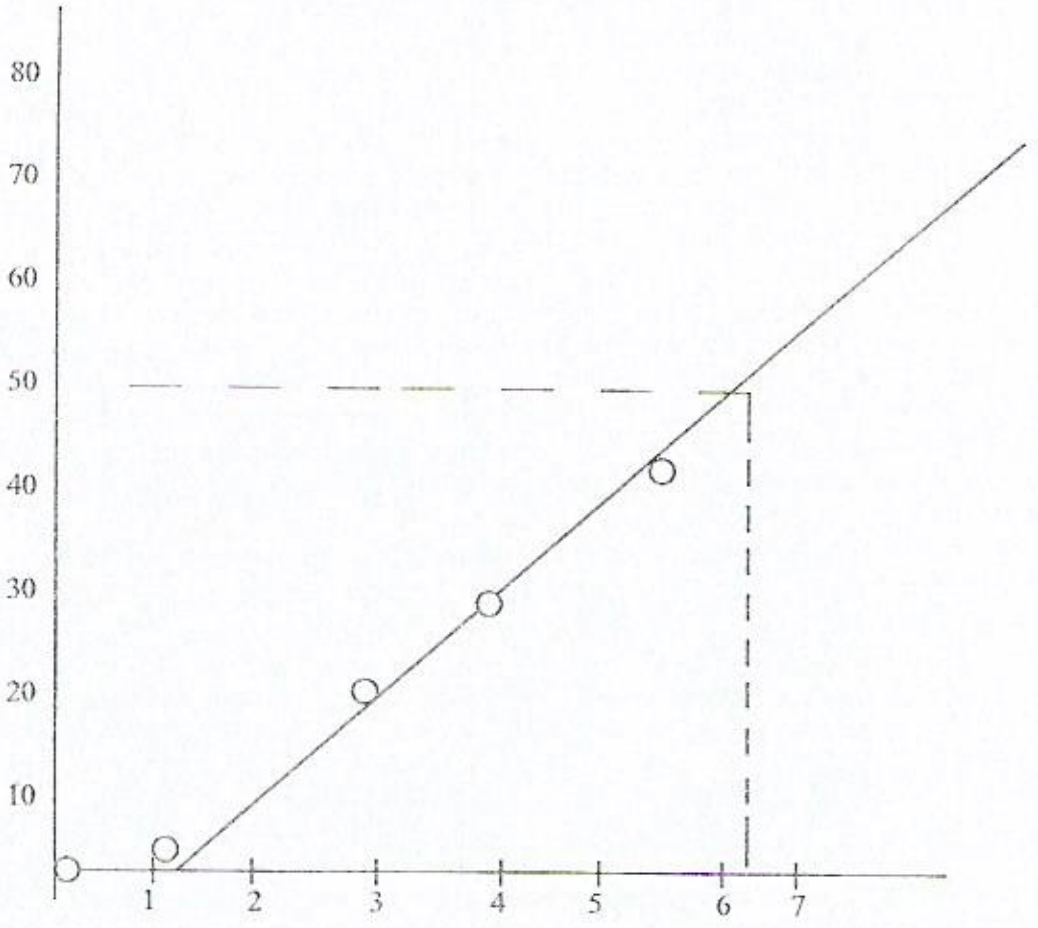
Table 1. Water quality of test solutions containing African locust bean effluents.

Concentration	Day 1			Day 2			Day 3			Day 4		
ml/l	Temp	pH	DO	Temp	pH	DO	Temp	pH	DO	Temp	pH	DO
0	25	7.65	4.8	25	7.68	4.0	25	7.70	3.8	24	7.80	3.1
0	25	7.64	4.4	23	7.62	3.9	25	7.65	3.6	24	7.78	2.9
1	25	8.01	2.6	25	7.85	0.6	26	7.75	1.0	24	7.69	0.9
1	25	7.52	1.7	25	7.55	0.7	25	7.74	1.1	25	7.62	0.9
2	25	7.65	1.4	24	7.63	0.9	25	7.70	0.6	24	7.70	0.6
2	25	7.70	1.2	25	7.65	0.7	24	7.72	0.5	24	7.68	0.6
3	25	7.52	1.0	25	7.53	0.5	23	7.43	0.5	25	7.80	0.3
3	24	7.65	0.8	24	7.65	0.6	23	7.66	0.4	25	7.77	0.1
4	25	7.60	0.9	24	7.73	0.4	25	7.75	0.5	25	7.74	0.2
4	25	8.02	0.7	25	7.75	0.3	25	7.73	0.4	25	7.72	0.1
5	25	7.66	0.3	24	8.01	0.1	24	7.78	0.1	25	8.01	0.1
5	25	7.82	0.2	24	7.98	0.1	25	7.90	0.1	25	8.01	0.1

Table 2. Mortality of *Oreochromis niloticus* exposed to African locust bean effluent for 96 hours

Concentration	% mortality	6 hours		24 hours		48 hours		72 hours		96 hou
		Live	Death	Live	Death	Live	Death	Live	Death	Live
5ml	*20%*	*10*	-	*9*	*1*	*9*	-	*8*	*1*	*8*
10ml	70%	8	2	7	1	7	-	6	1	3
15ml	70%	10	-	7	3	6	1	6	-	3
20ml	90%	8	2	3		3	-	2	1	1
25ml	100%	8	2	3	5	1	2	0	1	-

The exposure of tilapia to 5 and 10ml of African locust bean effluent resulted in 20% and 7 mortality, respectively, within 96 hours while exposure to 15, 20 and 25 ml resulted in 50%, 60 80% and 100% mortality, respectively, within the exposure period. The 96 h LC_{50} obtain graphically (Fig 1) was 8ml. The 96 hr LC_{50} values are shown in Figure 1. No mortality was observ in tilapia exposed to 1 or 2 ml; on exposure to 3 - 5 ml, no fish died between 6 and 24 hours, howev mortality occurred between 48 and 96 hours of exposure. At 5ml concentration, the highest mortali (30%) occurred between 48 and 96 hours of exposure. There was no mortality in the contr treatments and fish in this group did not show any abnormal behaviour.



The 96h effect of African locust bean effluent on *Oreochromis niloticus* fingerlings.

The concentration of the African locust bean effluent used for the haematological test were 1ml, 2ml 3ml, 4ml and 5ml for 96 hours, and theresults are presented in Table 3.

Table 3. Haematological value of *Oreochromis niloticus* fingerlings

Concentration of test media	ESR (mm)	PCV (%)	RBC (mm^3)	Hb (g/mm^3)
Control	4.0	30	15300000	26
1 ml	5.0	28	1470000	24
2 ml	5.5	28	1500000	26
3 ml	6.0	25	13500000	23
4 ml	6.5	24	1348000	23
5 ml	7.5	21	1160000	21

Hb, RBC and PCV values of tilapia fingerlings exposed to 1, 2, 3, 4 or 5 ml of the effluent decreased significantly compared to those of the control fish while the RBC counts increased at the end of the exposure period compared to those recorded in the control. Exposure of *O. niloticus* to sub-lethal concentrations of African locust bean caused a significant decrease in PCV, RBC and Hb of the fish. Similar reduction in blood parameters was reported by Sampath *et al.*(1993) and Omoregie *et al.*(1994) when *O. niloticus* was exposed to polluted environment under laboratory conditions. The significant reduction in these parameters is an indication of severe anaemia caused by the effluent on the exposed fish. Anaemic response could be due to the destruction of erythrocyte production (Wintrobe,1978; Omoregie,1995), haemodilution (Sampath *et al.*,1993), as well as the destruction of intestinal cells (Gardner & Yerich,1970). Similarly, Rambhaskar & Rao (1990) noted that changes in haematological parameters due to unfavourable exogenous factors such as adverse water quality, overstocking, and starvation are indices of ill health in cultivated fish. Ayotunde (1997) also reported that stress factors result in changes in haematological characteristics in fish. It is concluded that some parameters, and organs are affected negatively by increasing concentrations of the effluent and thus will guide in policy formulations against water pollution.

The gills and liver were examined to assess the toxicological effect of the African locust bean effluent on them. The various organs were exposed to different level of concentrations of the toxicants (1, 2, 3, 4 or 5 ml). Mucus accumulation was observed on body surfaces and gill filaments of dead fish. Examination of the gills of untreated (control) *O. niloticus* fingerlings revealed a normal gill filament consisting of primary lamellae with its arrays of delicate secondary lamellae, primary epithelium and secondary epithelium covering the primary and secondary lamellae respectively and no vacuolation. There was little or no discernible change in gill structure of *O. niloticus* fingerlings exposed to low concentrations (1 and 2 ml) of the effluent. At higher concentrations however (3 and 5 ml) plates 10 and 12, the gill structure showed detachment of the epithelial cells in both the primary and secondary lamellae, there was also vacuolation of the filament and influx of cells into the tissue which resulted into degeneration of the tissue. Histological studies revealed that low concentrations (1-2 ml) of the locust bean effluent did not cause any histological damage to *O. niloticus* liver. In higher concentration (3-5 ml), the liver exhibited histological changes as indicated by loss of nuclei in some hepatocytes, which also did not show distinct cytoplasmic boundaries as seen in the control fish liver. There was space formation in the parenchyma tissue and the nuclear cells had thick dark look (pykuosis) as seen in plate 3-5. The cellular arrangement of the liver cells was also distorted. At some places, necrotic zones were observed where complete cell death was evident. Infiltration was also clearly evident. Lesions were more prominent in the central zone of the liver than in the periphery. Histological examination revealed that from the treated fish species, the gills were swollen and the lamellae were extensively fused and congested with blood. Similar observations were made by Onwumere (1986), who expressed that the histology of liver and gills of *O. niloticus* fingerlings exposed to 30, 40 and 50% effluent from the NNPC Refinery at Kaduna showed that the gills were swollen and bulged the opercula. Aderiye (1998) also stated that the gill structure of *O. niloticus* treated with petrol and engine oil mixture was fused together and that there was extensive hyperplasia and separation of the epithelial layer from the supportive tissues. In the liver, degeneration vacuole formation and irregular nuclear was noted and these was observed in newborn guppies, *Lebistes reticulates* (Crandall & Goodnight,1962), disintegration and necrosis in common carp, *Cyprinus carpio* (Wong *et al.*,1977) and vacuolation, necrosis and appearance of some globular bodies in *Puntius eonchonius* (Kumar & Pant,1981) due to zinc toxicity were reported.

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BRIEF PROFILE OF ONDO STATE, NIGERIA

Ondo State was created in 1976 out of the defunct Western State of Nigeria. In 1996 however, Ekiti State was carved out from it. The state at present is one of the 36 states in Nigeria and it is located in the southwestern zone with Akure as its capital. The most striking features of Ondo state include its endowed natural resources such as forestry, fisheries and rich agricultural land, with valuable mineral resources, particularly petroleum, bitumen and Gas; and a stretch of about 80km coastline, along the Atlantic Ocean.

Land area: 15,317 km 2.

Population: approximately 3.24 million (2004 projection).

Local Government Areas: 18.

Climate: Tropical: annual rainfall (1,150mm – 2,000 mm); temperature (21 – 29 °C) .

Language: Yoruba: *Dialects* include Akoko, Ilaje, Ikale, Ondo, Owo, Akure, Ijaw-Arogbo and Apoi.

Major Rivers: Owena, Oluwa, Oni, Awara, Ogbese and Ose.

Agricultural Practice and Potentials:

- 60% of population in agriculture related occupations.
- Cash crops - cocoa, palm produce, rubber, cashew.
- Food crops - cassava, yam, maize, rice, cocoyam, plantain, sweet potatoes, okro, banana, pineapple
- Lumbering: 360,000 ha of forest covered with exotic woods (teak, gmelina) and indigenous trees (iroko, mahogany, obeche).
- Fishing: very lucrative, especially in the riverine areas.
- Livestock: cattle, poultry, piggery and small ruminants.

Mineral Resources:

- Petroleum, Gas, Glass sand, Limestone, Bitumen, Iron Ore and Granite among others.

Major Industries:

- Ile-Oluji Cocoa Processing Company, Ile-Oluji.
- JOF Ideal Family Farms Limited, Owo.
- Stanmark Industry, Ondo.
- Matna Foods, Ogbese.
- Oluwa Glass, Igbokoda.
- Premier Metal, Ondo.
- Ifon Ceramics, Ifon.
- Okitipupa Oil Palm Company, Okitipupa.

Educational Institutions:

- *Tertiary : 2 Universities, 1 Polytechnic, 1 College of Education, 1College of Agriculture*
- *Health Institutions: 3*
- *Technical Colleges: 5*
- Secondary Schools: 281 (public), 115 (private).
- Primary : 1,154 (Public), 302 (private).
- Skill Acquisition Centres: 19 (Public).

Cultural Heritage/Tourist Attractions:

- Rich cultural heritage.
- People: hospitable, friendly and hardworking.
- Notable tourist attractions include Idanre Hill, Igbokoda Water Front, Igbo-Olodumare, Oke Maria,

Deji's Palace, Alagbaka Garden, Isharun Cave of Ashes, Ebomi Lake and Oyemekun Rocks.

Economy:

- Predominantly agrarian.
- Growing and underexploited petroleum and gas industries.

Manpower:

- High literacy rate
- Availability of large pool of skilled labour force.
- 42,000 employed in the State Public Service.
- 53% of population within labour age bracket.

BRIEF PROFILE OF

THE FEDERAL UNIVERSITY OF TECHNOLOGY AKURE

The establishment of the Federal University of Technology, Akure was announced in 1981 to give prominence to training in technology and applied sciences, and to assist in ensuring rapid technological and industrial development of Nigeria. The University which formally took off in 1982 has grown tremendously since its establishment to become the best University of Technology in Nigeria by 2004.

The University Emblem

The University emblem is a shield supported by ivory tusks, in the center of which is a cocoa pod. A bound open book lies in front of a sun shedding its rays of light and wisdom. Isenberg and timber are featured in the shield.

University Motto

Technology for Self Reliance

University Colour

Purple and Blue

Vision of the University

The Federal University of Technology, Akure aims to be one of the best Universities of Technology in the world, committed to carving out an enviable niche for itself as a centre of excellence, epitomized by high quality programmes, products and contributions to the society.

Mission of the University

The mission of the Federal University of Technology, Akure is to promote technological advancement of Nigeria through emphasis on programmes that will engender the development of such products and services in which the Nation possesses great comparative advantage. In doing this, the University is committed to provide a conducive teaching and research environment attractive enough to retain highly motivated leading academics capable of channeling research outputs to meeting peculiar national needs. It will, through its research output, train and produce highly technologically-oriented and self-reliant high level manpower committed to self employment as the basis for national development.

Philosophy of the University

The Philosophy of the University is premised on the strong desire to:

- solve real life problems which require the knowledge of more than one subject area;
- undertake a thorough modification and identification of indigenous technologies;
- identify those that can be upgraded and modernized; and
- harness technological resources (equipment and technical know-how) in servicing as well as providing leadership to the industrial and technological development in the country.

Strategic goals and objectives

The University has set a target of ten strategic goals with clearly identified strateg objectives to be achieved within the next decade. The strategic goals are:

- reviving and improving academic programmes
- capacity building and enhancement of productive capacity
- commitment to research, training and development through a deliberate improvem in post-graduate training
- encouragement of gender sensitivity and participation in science and technology
- outreaching and outsourcing needed resources (human and material), to strengthen t development of the University
- encouraging good leadership, quality and effective governance, through improvem in managerial competence at all levels of University Management
- promotion, entrenchment, and advancement of universal University culture such a academic freedom and independence of thought
- producing high technological oriented and self-reliant graduates through deliber and articulate linkage programmes with industries, research institutions, no governmental organizations, ministries and other community-based organizations
- upgrading and provision of infrastructural facilities through holistic improvement teaching and learning environment
- devotion to the advancement of peace

The University runs a School system, an integrated unit of a group of related subjects or disciplines with common academic interests in teaching and research.Presently, there are six Schools in the University as follows:

- School of Agriculture and Agricultural Technology (SAAT)
- School of Engineering and Engineering Technology (SEET)
- School of Environmental Technology (SET)
- School of Earth and Mineral Sciences (SEMS)
- School of Management Technology (SMAT)
- School of Sciences (SOS)
- School of Postgraduate Studies (SPGS)

A new School is being proposed to take off shortly. This is

- School of Health and Medical Technology (SHMT)

The University has 30 academic Departments spread within the Schools. The School Agriculture and Agricultural Technology (SAAT) has the following Departments:

- Department of Agricultural Economics and Extension (AEE)
- Department of Animal Production and Health (APH)
- Department of Crop, Soils and Pest Management (CSP)
- Department of Ecotourism and Wildlife management (EWM)
- Department of Fisheries and Aquaculture Technology (FAT)
- Department of Food Science and Technology (FST)
- Department of Forestry and Wood Technology (FWT)

All undergraduate programmes are of five-year duration and students spend 6 months i second semester of the 4th year for the Students Industrial Work Experience Scheme (SI programme.

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