the different sampling stations all influenced chlorophyceae abundance (Fig. 1 & 4).

The cyanophyceae and bacillariophyceae were the two most dominant phytoplankton both together contributing 65.78% of the total phytoplankton component. The dominance of these groups would appear to be related to the trophic status of the reservoir. Productive waters exhibit a high nyxophycean index (Nygaard 1949). Positive correlations between phytoplankton production and secondary production indicate that high levels of primary production lead to high levels of secondary production. Although phytoplankton production is basically related to zooplankton production, benthos production seems to be related to the inverse of mixing depth. From a preliminary survey of vertical distribution of temperature, the lake appears to be well mixed due to wind action. Similar observations have been made in the Tiga lake (Abdullahi (1982) . The evidence for good mixing is supported by the non-significance of the analysis of variance test for stations. This feature would favour high production of both phytoplankton, benthos and subsequently fish. For the dinoflagellates, the low species diversity indices suggests that the reservoir was yet unfavourable for their growth. Quantitative analysis of species composition indicate that there is a close relationship between the sequence of dominant species with changes in physico-chmeical parameters and sampling period (Fig. 4).

The analysis of variance estimate shows that there were significant changes in the physico-chemical characteristics of the Shen reservoir during the period of the study. It is further demonstrated that a distinct pattern of variation is in operation in the reservoir such that it exhibits high potential eutrophic status. The turbidity value inspite of the pattern of variation, the minimum values permitted light penetration to depths (minimum depth 25.0 cm) high enough for high phytoplankton photosynthesis and thus primary productivity. The high turbidity recorded between April to June was due to an increase in suspended solids from surface run-off, and river and stream discharge into the lake. The low turbidity values in period I may be due to sedimentation of suspended solids and absence of river run-off. Thomas and Ratcliffe (1973) have recorded similar observations in the Nunguna reservoir Ghana.

Dissolved oxygen values were high enough (minimum 5.00 mg/litre) to maintain active metabolic and physiological activity for fishes of high biomass. It is plausible that the seasonality shown by oxygen has been occassioned by such factors as reservoir volume, phytoplankton development, water temperature, aerating action of wind and mixing brought about by turbulence. The pH was largely alkaline (mean 8.3). The fluctuations were probably due to water volume and river inflow with biogenous material. However, the pH change was generally good for fish production. Carbonate alkalinity was detectable and had a mean value of (36.95 ppm) during the period of study. Thus the reservoir is slightly alkaline and ideal for many biological processes.

Nitrate - nitrogen and phosphate - phosphorous are most important in determining the productivity of waters being both indispensable for biological growth processes. Phosphate - phosphoruous had a mean concentration of 1.0 ug per litre during the period of the study. The very low concentration of this nutrient during the rains makes the possibility of its replenishment from leaching an unlikely occurrence. Thus the maintenance of the recorded level may be from reservoir sediments during occassions of high pH of the overlying waters. Future fish culture development in this reservoir would thus entail the addition of fertilizers to increase the PO_4-P content and enhance phytoplankton growth. Nitrate-nitrogen levels in the reservoir appears to be elevated following run-off from inflowing rivers during the rains. Nutrient concentration and mixing both have management potentials. The control of production through alterations in nutrient imput has obvious management advantage and has been applied to increase production in fish ponds as well as to decrease production in systems where nutrient imput adversely affects water quality.

Fish production has been shown to depend on the production of plankton, benthos, morphometric, edaphic and climatic factors (Rowson 1960). Although Moyle (1956) stressed the importance of total alkalinity, Northcote and Larkim (1956) emphasized dissolved nutrient. Based on the physico-chemical characteristics of the reservoir, quantitative estimate of phytoplankton composition and species diversity indicates that the Shen reservoir has a high potential for fish production.

PROCEEDINGS OF THE 3RD ANNUAL CONFERENCE OF THE FISHERIES SOCIETY OF NIGERIA (FISON)

Maiduguri, 22nd - 25th February, 1983

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CONTENTS

FOREWORD

The Third Annual Conference of the Fisheries Society of Nigeria (FISON) was held for the first time in Northern Nigeria at Maiduguri and hosted by Lake Chad Research Institute (LCRI). The Conference had as its theme "Nigerian Fisheries in the Eighties". Coming barely one year after the Second Annual Conference in Calabar in 1982, FISON has reason to congratulate herself for this successful Conference which was well attended by participants from all over Nigeria. However, it was discovered during the screening of the papers, prior to the Conference, that many of the papers submitted did not address the Conference theme. This had been observed in previous conferences and therefore, to redress this situation, the Executive Council of FISON suddenly decided to organise a Symposium on Aquaculture as part of the 3rd Annual Conference activities. Although this innovation was only partially successful because of inadequate notice and preparation, the experience gained has been very rewarding and the inclusion of symposia in future annual conferences is being recommended for adoption by FISON.

FISON being ten years old since its founding in 1974 has made steady even though slow progress in the achievement of its stated objectives.

The impact of the Society on Fisheries Development has been minimal so far due to lack of recognition by the authorities. It is now widely believed that FISON has to develop a more positive and agressive policy towards influencing government to favour Fisheries Development as it does to arable farming and livestock production.

The impact of drought on reducing Lake Chad's fisheries has further worsened the local fisheries production from the inland waters.

Encouragement and incentives have to be accorded local producers of fish in order to enhance self-reliance in fish production during the eighties and beyond.

The papers presented in the Third Annual Conference of FISON contained in this proceedings are a valuable contribution to our collective knowledge of the Fisheries of Nigeria.

The Lake Chad Research Institute deserves congratulations for hosting this Conference and for contributing to the printing of this proceedings.

FISON needs the support of all its members and the public to continue publishing these proceedings and organising future conferences. The organised private sector, especially the fishing companies are hereby urged to take a more active role and interest in the affairs of FISON by contributing financially and by taking office in the Executive Council. In this way, the voice of FISON can be heard more loudly than it is now.

It is envisaged and recommended that future conferences and symposia will focus more on commercial fish production and less on academic subjects. In this way, it is our hope that FISON can make a better impact on fish production.

V.O. Sagua
Vice-President
FISHERIES SOCIETY OF NIGERIA (FISON)

EDITORIAL COMMENTS

The publication of the proceedings of the 1983 Conference of the Fisheries Society of Nigeria (FISON) was for the second time unduly delayed on account of inadequate funding. Lake Chad Research Institute, the host for the Conference, donated forty percent of the cost of the publication. This was inadequate to initiate the publication by Kainji Lake Research Institute, the publisher, without the balance of the remaining sixty percent of the estimated cost of the publication.

The delay in obtaining the balance was caused by the sudden departure of the former President of the Society to take up an appointment with the Food and Agriculture Organization (FAO), Rome. This brought about a delay in the meeting of the Executive Council and hence the delay in providing the necessary funds for the publication.

The new Executive Council should be congratulated for initiating a call for donations for the publication during the closing session of the 1985 Conference at Port-Harcourt. Members contributed generously following the good example of the new President and so for the first time after the 1983 Conference, there was a renewed assurance for the publication of the 1983 Conference Proceedings.

The Editorial Committee meetings, usually scheduled along with the Executive Council meetings could not take place either, and the Editor-in-Chief was handicapped with only one complete set of the manuscripts from the Local Organizing Committee of the 1983 Conference. Copies of the manuscripts were, therefore, not sent out to other members of the Editorial Committee. The Editor-in-Chief had to use his initiative, therefore, to brush-up the necessary editorial work in order to publish the already over-delayed proceedings. Any faults in the editorial work are therefore, those of the Editor-in-Chief and not of the Editorial Committee.

The delay in the publication also resulted in the withdrawal of some of the papers presented at the Conference by the authors, while others were outdated. Among these are:-

(i) A paper by E.O. Ita and E.K. Sado on "Preliminary Report of Inventory Survey of Inland Waters in Nigeria with special reference to Ponds, Lakes and Reservoirs". The survey was completed in 1984 and the comprehensive report had since been published as a Technical Report of Kainji Lake Research Institute (KLRI) and circulated. Also, another paper by E.O. Ita on "Principles of Reservoir Fishery Management (An outline summary with some examples from Africa): A Challenge for Nigeria's Inland Fisheries in the Eighties" was mostly extracts from work earlier carried out for FAO, Rome and which had since been published in: "Status of African Reservoir Fisheries" edited by J.M. Kapetsky and T. Petr (1984) with copyright reserved to FAO. It was, therefore, omitted in this proceedings.

(ii) A paper by C.S. Nwadiaro on "Laboratory Studies on the Growth and Food Energy Conversion of the Dwarf Cichlid *Pelvicachromis pulcher*" was also withdrawn by the author.

Other authors found alternative publication sources for their contributions, although they did not write to withdraw their publications in the proceedings.

It is hoped that with the new drive for the full participation of the private sector in the activities of the Society, the funding situation would improve for the better and the Society would in future be able to sponsor other publications besides the proceedings.

E.O. Ita
Editor-in-Chief
FISHERIES SOCIETY OF NIGERIA
(FISON)

SECTION 1: OPENING CEREMONY

SPEECH BY ALHAJI A. NDANUSA BIDA, CHAIRMAN OF THE GOVERNING BOARD LAKE CHAD RESEARCH INSTITUTE (LCRI) ON THE OCCASION OF THE OPENING OF THE 3RD ANNUAL CONFERENCE OF THE FISHERIES SOCIETY OF NIGERIA.

Your Excellency, the Governor of Borno State
Your Highness, The Shehu of Borno and members of the entourage
Honourable members of the House of Assembly
Members of the Governing Board of LCRI
The President - Fisheries Society of Nigeria
Delegates - Fisheries Society of Nigeria
Ladies and Gentlemen

It gives me great pleasure and honour to welcome you to Lake Chad Research Institute, Maiduguri and to the 3rd Annual Conference of the Fisheries Society of Nigeria which is holding for the first time North of the Rivers Niger and Benue. It is perhaps significant that LCRI should be the first Institute to host this Conference in the Northern States because it is the only Research Institute of the Federal Government that has a mandate to conduct research into the Fish Fauna, of Lake Chad and to find ways for their rational exploitation and conservation.

In addition to research on the fisheries of Lake Chad, the Institute's mandate covers research on the following:-

(1) Crops Research: This is agricultural research on some selected major economic crops grown in the Lake Chad Basin. The crops include rice, sorghum, millet, wheat, barley, cotton, cowpeas, groundnuts, maize and vegetables. The research aims at developing improved varieties of these crops to obtain higher yields and resistance to diseases, and to develop agronomic practices suitable to the climatic and social conditions in the Lake Chad Basin.

(2) Livestock Research: Borno State produces about 39% of the livestock in the country; however the State lies within areas of low rainfall thereby presenting a problem of inadequate water and pasture for livestock. The research activities of the Institute aims at improved livestock and poultry production through the development of improved breeds of cattle, sheep and goats and development of pastures.

(3) Wildlife and forestry research: The Institute studies the wildlife and forestry in the Lake Chad Basin and assists the State Government in the development of wildlife parks. Studies are going on on the control of elephants and on agro-forestry, fuel forestry and shelter belts.

(4) Public Health Research: This deals with the health implication of irrigation and the studies include water-borne diseases, suc as schistosomiasis and methods of its control and treatment.

Some Research Activities of Lake Chad Research Institute

Lake Chad Research Institute is the main research support agency of the Federal Government for Chad Basin Development Authority and for the farmers, fishermen and livestock producers of Borno State. The Institute has developed complete packages of agronomic practices which have been passed to Chad Basin Development Authority for seed multiplication and distribution to farmers on the following rice and wheat varieties:

- Rice IR 28, IR 30 and TOS 103 with potential yields of 5 to 7 metric tonnes per hectare

- Wheat Indus and Inia 66 and Siete Ceros with yields of 3 to 4 tonnes per hectare

- Barley: The Institute has found a ketch variety to produce high yield of about 2.5 tonnes per hectare which is suitable for growing in the Chad Basin area.

There are some varieties yielding 3 to 4 tonnes per hectare which are still under trial.

Development of Infrastructure

Although Lake Chad Research Institute is relatively young having been established in 1976, it has nevertheless made considerable progress especially in fisheries research. The physical facilities of the Institute have been poorly developed due to insufficient fund and administrative problems of the past. I am happy to say that during the last two years under the direction of the new Governing Board and the new Management, much progress has been achieved in the development of the physical facilities of the Institute. You will see in this headquarters site the development of the essential infrastructure such as headquarters office buildings which were recently occupied by the staff; the development of staff quarters and guest chalets are going on with great determination. The Institute is presently developing 5 blocks of specialized laboratory complexes:

(i) Fisheries and Water Resources Laboratory Complex including a freshwater fish aquarium and fishing gear technology and fish processing;

(ii) Animal Sciences Laboratories

(iii) Plant Sciences Laboratories

(iv) Ecological and Biomedical Laboratories,

(v) Specialized Services Block including library data processing and conference facilities.

The above laboratories projects are expected to be completed before the end of 1984 at a cost of ₦5.0 million.

I do hope you will find time to look around the premises to see for yourselves the tempo of development now taking place in the Institute.

Lake Chad constitutes a valuable animal protein source for Nigeria with a fish yield of 80-100 kg/ha. The current annual production of fish is estimated to be about 80,000 tonnes. No doubt you are familiar with the fact that the Lake Chad has been suffering from the effect of severe Sahelian drought since 1972/73. This drought has caused a reduction in the area of the Lake from the maximum surface area of 25,000 km^2 recorded in the late 1950s' to a minimum of 6000 km^2. Most of the lake is now heavily covered with aquatic weeds which impede fishing and navigation. The Institute is doing research on the control of these aquatic weeds. To clear the weeds in the lake will require huge financial investment. The private sector is hereby called upon to assist the Federal and State Governments in this urgent task.

Achievement of Lake Chad Research Institute in Fisheries Research

The Institute has developed an improved easily assembled fish smoking oven which is more efficient in the use of wood fuel and which produces better product than traditional smoking ovens. The Institute has also designed and constructed improved fishing and transport boats. These boats and improved fishing gears have been introduced into the lake and have received wide acceptance. On fish biology, the

Institute has carried out studies on the commercially important fish species such as Clarias and "dan sarki" Gymnarchus. The Institute is also carrying out pre-feasibility study for the introduction of fish aquaculture at Baga, New Marte and around Lake Alau with the aim of producing fish fingerlings for stocking in irrigation canals, fish ponds and irrigation reservoirs.

Training of Fisheries Workers

The Institute's Freshwater Fishery School at Baga started in 1978 has been training vocational fishermen with a production of about 30 students per year. However, the facilities in the School have been very poor but I am happy to announce that in 1982, the Governing Board of the Institute has awarded contracts for the construction of new classrooms, laboratories, hostels and workshops etc. worth ₦800,000. When completed the Freshwater Fishery School at Baga will provide accommodation for over 120 students drawn from all over the country and will offer courses in fisheries at the Ordinary National Diploma (OND) and Higher National Diploma (HND) levels. The School hopes to graduate about 60 students per year. The main problem envisaged is the inadequate manpower for teaching the various subjects in the School. May I call upon you the fisheries scientists and workers to address yourselves to this problem during your conference.

In conclusion, I urge you, the delegates to this conference to make sure that the conference is not devoted only to academic discussions and papers but you should make definite recommendations on how to solve the problem of shortage of fish production in Nigeria. Nigeria imports a large quantity of fish at a great cost in foreign exchange which cannot be accepted any more. In keeping with the determination of the Federal Government under the Green Revolution Programme to make the Nation self-sufficient in food production, the Fisheries Society of Nigeria owes it a duty to the Nation to find ways of reducing importation and of increasing local production in fish.

I wish you every success in your deliberations and a happy stay in Maiduguri. It is now my pleasure to call upon His Excellency Alhaji Mohammed Goni, the Governor of Borno State to declare the Conference open.

Thank you.

OPENING ADDRESS BY HIS EXCELLENCY THE GOVERNOR OF BORNO STATE, ALHAJI MOHAMMED GONI - DELIVERED BY THE HONOURABLE COMMISSIONER FOR AGRICULTURE, MR. JABANI P. MAMBULA

Honourable Commissioners,
Permanent Secretaries,
Chairman and Members of the LCRI Governing Board,
Directors of Institutes and Professors,
Distinguished invitees,
Ladies and Gentlemen.

It gives me great pleasure to be with you this morning to formerly declare open the 3rd Annual Conference of the Fisheries Society of Nigeria (FISON). I am particularly happy to welcome you to this conference in Maiduguri which I believe is the first time such a FISON conference is hosted in any town in the Northern States. The choice of Maiduguri as a venue of an important conference of this kind is very appropriate because Borno State is endowed with one of the most viable artisanal fisher industry in the world and artisanal fisheries industries contribute a great proportion to the national fish production in developing countries. Our specialised traditionally processed fish products; namely:

"tonkoso" meaning smoked coiled fish,
"banda" meaning smoked chunks of fish, and
"bunyi kiri" meaning sundried putrified fish (a local delicacy) are marketed throughout the country.

The theme of this conference, I am made to understand, is "Nigerian Fisheries in the 80s". Therefore the comprehensive content of your conference programme naturally establishes "Food self-sufficiency as its keynote". The fishing industries like other sectors of our economy, is undergoing transition from the traditional methods to the modern, and we now see many fishing industries operating in our territorial waters; over 10,000 one-man or up to three-man boat units operate from Lake Chad alone harvesting over 100,000 metric tons of good quality tasty freshwater fish annually. The significance of this sector in our national economy could be seen from two major perspectives. First, it is an important cheap source of high quality animal protein for a wider spectrum of the Nigerian population. Second, it provides gainful employment opportunities for many Nigerians especially in the Coastal, Riverine and lake areas of the country.

At this time, I will like to look briefly at our national effort in fish production within the content of Fisheries Development in Nigeria as a whole, the present domestic fish production of roughly 490,000 metric tons falls short of our demand of nearly 1.03 million metric tons. Our 1983 population figure is estimated at 84.634 million, making us a nation of per caput fish consumption figures in kilogra of 5.17. This is very poor, you can agree with me. We have tried to reduce this gap between our demand and production through ever increasing import of frozen fish, stockfish and canned fish. For example, in 1975, the country was importing 120,000 metric tons of frozen fish; in 1980, this figure rose to over 300,000 metric tons. When the quantity of stockfish, canned fish and other fish products are added, our importation of fish must be enormous. Importation in whatever form is a drain on our foreign reserve. Our present economic position may not permit us to meet our demand for fish, rice and other agricultural commodities, by importation. It is my fervent desire, and I hope you professionals share the same sentiment, that this importation should be reduced drastically if not completely eliminated through increased domestic output of fish from both marine and inland water sources. The challenges this task poses on you in this conference cannot be over emphasized. I am personally convinced that the Fisheries Society of Nigeria whose members are professionals in the Fisheries sector can very well cope with the challenges of our national demand of fish. As a source of animal protein, the planners of the Fourth National Development Plan (1981-85) estimated that 40.0 per cent of animal protein consumed by average Nigerians comes from fish. It should be noted that if the potentials of the Nigerian fisheries are adequately developed and exploited the fishery sector is capable of providing many more people, than the present estimated four million, with employment opportunities and thus contributing much to the Gross Domestic Product (GDP) especially in the area of Agriculture and industrial fishing.

The Federal Government as well as the State Governments recognized the importance of fish, and as a matter of fact, agriculture as a whole, and has consequently given priority to fisheries development in the country's Development Programmes.

In Borno State, my Government has given top priority to Agriculture and Fisheries Development. In the sixties, Lake Chad continued to be a source of several thousand metric tons of freshwater fish. Annual fish harvest from this lone source continued to increase from 1962 figures of 40,000 metric tons to 227,000 metric tons in 1974. The 1974 sahel drought has introduced adverse ecological regime into the lake and annual fish harvest figures have continued to reduce visa-vis the lake level.

No doubt, many consumers in far away markets have depended on the fish coming from Lake Chad; much more so, because other fisheries industries had been adversely affected one way or the other. The State Fisheries Section in the Ministry of Agriculture has now looked into other ways to increase fish production in the State, through the development of the river and pond fishing. A fish breeding centre has been established at Ali Gambori Village of Kukawa Local Government Area, where Carp, Tilapia and Clarias species are bred for subsequent stocking of man-made ponds. Other fish production units are sited at the Wesley Dam in Tila Local Government Area which has a 12 hectares of water stocked with Carp.

In spite of these efforts and achievements, the fisheries sector is still plagued by a number of problems which include among others lack of good fisheries management policies to enhance better exploitation of the natural resources in our inland freshwater lakes, lack of infrastructural facilities for fisheries research in processing, storage and distribution; inadequate number of trained personnel at various levels. Other problems include national investments in development of fishery industries which have been adversely affected by ecological changes; for example Lake Chad that was, pre draught of 1974, an open water lake of almost the size of small sea is now fully covered with weeds. This has affected the fish species composition and the quality and quantity of fish in the lake. I hope you experts will address yourselves to these problems during the three days of your deliberations here. I recognise the very vital role you can play through the useful discussions of papers to be presented and free exchange of ideas which you will have at this conference. In this regard, you have my Government's encouragement, and as a token I have directed the Ministry of Agriculture to make a donation of ₦2,000 to the society. I wish you fruitful deliberations, a happy stay in Borno State and safe return to your various States at the end of the conference. I will like you not to confine yourselves only to the conference room during your stay in Maiduguri. You should endeavour to see the many beautiful places of historical and natural interest such as the Shehu's Palace, Sanda Kyarimi Park and the nearby Lake Alau. Finally find time to enjoy the hospitality of the friendly people of this state. I now have the honour and pleasure to declare open the 3rd Annual Conference of the Fisheries Society of Nigeria.

Thank you!

KEYNOTE ADDRESS ON: MILESTONES AND SELF RELIANCE IN THE DEVELOPMENT OF NIGERIAN FISHERIES

by

E.O. Bayagbona
F.A.O. Representative in Liberia.

INTRODUCTION

It is indeed an honour for me to be invited to deliver an address as guest speaker at this conference of the Fisheries Society of Nigeria (FISON). As a previous President of the Society, I know how difficult it is to organise this type of meeting and I think it augurs well for the Nigerian Fisheries in the 80s that this sort of difficulty is being overcome.

This occasion carries an aura of comradeship and common purpose that I am happy and proud to be part of. It is a heart warming experience for me to re-visit Maiduguri to see how the little I did here during my brief posting to Lake Chad Institute has been further developed by others after me.

As we contemplate Nigerian Fisheries in the 80s, because I was there when it really all started in the early 60s, I wish to use the opportunity of this address to draw attention to milestones that our Fisheries have passed since then, so that elements responsible for part achievements can be cherished and nurtured for future development.

It is not generally realised that the growth of fisheries in Nigeria during the last two decades has been faster than that of any other major part of the agriculture sector composed of Agriculture, Fisheries, Forestry and Livestock. This has been so in spite of the fact that traditionally fisheries usually gets less government support than the others. The fast growth rate has in my opinion been due to the fact that it was starting from small beginnings, just like the early growth of living organisms once the impetus for growth has been given.

The attainment of National Independence in 1960 helped to provide the impetus. In addition, all of us here have a right to some pride and satisfaction for contributing to the provision of that impetus whether we be from the private or public sector, whether we be concerned with development, research or training. We however also have the further responsibility of ensuring that the growth is sustained since there is still room for expansion.

Inshore Fishery

Progress in the inshore trawl industry has been particularly dynamic. In 1960 when I started work in Fisheries, there were only eight trawlers, LOA 8 - 22 metres, fishing in Nigeria with an expatriate crew component of about 20% which is really the proportion of senior members of the crew-skippers engineers, mates. I have been away for nearly two years now so I am not sure of the exact present figures but I believe that our present inshore fleet of trawlers is over 100 and that the expatriate crew component is 5% or less.

Major developments that have taken place in this fishery are due to research, dynamic entrepreneurship, the establishment and development of a marine Fisheries School and some measure of good government planning and supervision, mostly through regulatory measures. Research in the form of resources surveys enabled the fishery to grow in a rational manner and to expand into shrimping as soon as the shrimp resources were identified and assessed.

The private sector has been very willing to invest in inshore trawling and so I personally did not see the merit in government forming a company, the Nigerian National Shrimp Company to participate in this fishery. Having regard to the problems which this company has been facing, I am tempted to say "I told you so". However since the Federal Ministry of Industry insisted and established the company it is up to us to hope that in the 80s the company overcomes its difficulties and succeeds.

The further expansion of inshore trawl fishing in Nigeria will depend on dynamic use of sound regulatory measures - mesh regulations and control of fishing effort - and the discovery of new trawling grounds presumably at the edge of the continental shelf. Meanwhile the inshore artisanal fishery continues to form the backbone of the Nigerian Fisheries. It should be the main focus of attention in government fisheries development plans during the 80s. Development in this area leads to improvements in the productivity and quality of life of the rural poor which are important policy objectives of the Lagos Plan of Action.

The milestones to which I wish to draw attention in the inshore fisheries are the following:

(a) The growth of Nigerian entrepreneurship willing to invest in the uncertain and problem sensitive area of fisheries. In the 80s, perhaps more than before, they have to be protected and given better access to credit.

(b) The establishment of formal training facilities for vessel crew. Fishing is very sensitive to the quality of vessel crew (including engine room and refrigeration staff) and so we must ensure that the fishery schools continue to develop and improve the quality of graduates who leave the school, especially in engineering.

(c) Fisheries regulations in the form of controlled entry into the fishing ground, where to fish and the mesh sizes of nets to be used have helped the fishery and should be continually improved. Protection of the grounds from foreign vessels not licensed to fish there is of paramount importance.

(d) Technological advances in the form of better fish drying kilns (e.g. the NIOMR Smoking Kiln), improved set/drift nets, and newly designed boxes for carrying ice to sea and bringing back chilled fish. These and more are now available to improve the catching of fish and to reduce post-harvest losses prior to marketing.

(e) The coming into existence of shrimping for export. The earning of foreign exchange is an important matter in the 1980s and so this activity should not be allowed to degenerate into indiscriminate catching of young fish, with shrimp by - catch, for local sale and quick cash.

(f) During the last twenty years fishery research capabilities were initiated and developed. Good fishery legislations, technological innovations, new fisheries and the discovery new fishing grounds, all derive from the knowledge base got through fishery research. Fishery Research has contributed immensely to our progress so far and will continue to be invaluable in the future.

Distant Water Fishing

It has long been realised that the development of distant water fishing is necessary to bridge the gap between our fish demand and the potentials of our inshore and inland fisheries. Characterised as distant water fishery is by high capital investments and the uncertainties of international relations, it is not surprising that the private sector has been shy to invest in it. This is therefore a good area in which Government investment is welcomes to pave the way for private investment to join in. For example the Government has greater clout to negotiate access to foreign waters than a private company, and the government is more likely to use it if this is necessary to protect its investment, than if it was only to protect private investment.

Government has in fact set up such a company and it is hoped that in the 80s the company will take off properly and prosper in this difficult area.

Cold Store Network

A major development especially in the last decade has been the growth of a network of cold stores for the country-wide storage and marketing of fish. Even though the fish is being imported, the infrastructure and organizations are there to handle locally produced fish as and when local production reaches the sort of quantities required to utilize the facilities.

Inland Fisheries

Inland fisheries developed during the first half of the last twenty years and then has had a set-back during the second half. The Nigerian section of Lake Chad produced about 15,000 metric tons of fish in 1961, over 30,000 metric tons in the early 70s and then because of the Sahelian drought the Lake size is now about half its previous size, with a corresponding reduction of total catch in the early 80s. The construction of Kainji dam changed the water regime of the Niger with resultant adverse effects to its overall fisheries. Inland fisheries aspirations for the 80s depend on what desirable hydrological changes take place in these large water systems.

Fish Farming

However, considerable gains have been made in fish farming. From the humble beginnings in the 60s at Panyam and in areas of the then Western and Eastern Regions, fish farming has in the 80s become more widespread and sophisticated. More attention is now paid to the species selected for culture, and special rations, formulated as pellets, are now available to feed the fish. I was happy to learn of a modern Industrial Fish Farm in Bendel State the other day offering fingerlings of four fish species for sale to other fish farmers

It is a fitting tribute to our progress in aquaculture that the African Regional Aquaculture Centre catering for the whole of Africa in aquaculture research and senior manpower training and development is sited here in NIgeria.

Technology

The last decade saw the birth of fish technology research which has now established itself as an invaluable tool for development. Fishing technology research is also new but making significant contribution to improvements in fishing gear and vessel design. Other desirable developments have been the establishment of fishing net making factories in Nigeria, and the on-going construction of fishing habours/ terminals.

Statistics

In the early 70s a bold attempt was made to establish a fishery statistics collection system based on sound scientific country-wide sampling. At the time it was my dream that this would be a routine data source against which the successes of development efforts will be measured and on which plans for the future will be based. It will be comforting to be assured during the 80s that the system did not get dismantled as a completed one-shot exercise, and that we have not returned to the old proceedure of convenient guess-timates.

Tuna Fishery

A new and exciting development in the 80s is the on-going investigation of the feasibility of a Nigeria based tuna fishery. The prospects appear good and this launches me into a subject that I want to mention as a strategy to be employed in our further development. It is that, like other developing countries, we have to move closer to more regional cooperation in our endeavour to become self-reliant and economically independent.

In seeking to acquire tuna fishing technology, we did not request and then wait for assistance from developed countries. We noted that nearby Ghana had the necessary technology in this field and hired it for the purpose of effecting the necessary technology transfer. This is a good example of regional cooperation and self reliance. Of course, we are in the lucky position of being able to pay for the tuition we receive.

Self-Reliance

In these days of economic distress, no longer can the Third World Countries expect the automatic and/or benevolent transfer of financial resources from developed countries to assist their economies. What assistance is available, from bilateral and multilateral sources, is very severely limited. We therefore have to develop without much of it.

A useful approach is to get into the technology development process right at the start of the development of the new technology. At that stage the entrance fee is cheap - the fare and per diem or estacode to attend meetings, workshops and training courses at which they are being discussed and developed. FAO and other international agencies provide ample opportunities for such participation. New technologies are constantly being developed whether it be in the field of solar energy for drying fish, or energy saving propulsion of fishing vessels, enhancement of the utilization of trash fish, or even new methods of fish stock assessment. Countries which neglect to participate at this state, because they are saving money on overseas travel get left behind, and have to pay dearly later for the purchase of the final products.

For example a World Conference on fisheries management and development is being planned by FAO for sometime in 1984. It is imperative that Nigeria participates in it as effectively as possible. As is usual a few government officials will attend. It is important that the private sector participates as fully as it can, given the expense and time that such participation entails. The contacts to be made, the comparison of experiences and the new ideas that can be picked from such a conference will make participation in it very worthwhile.

Over the years as I have tried to show in this address, we in Nigeria in the field of fisheries which is our concern in this meeting, have developed relevant institutions, relevant technology and manpower with relevant experience. They must be nourished and encouraged to be valuable tools in our further development. This is our only chance of reducing dependence on the traditional sources of assistance and of our taking our rightful place among teams of brilliant workers worldwide whose drive ideas and innovations provide the ingredients for technological progress everywhere.

Thank you.

SECTION 2: SYMPOSIUM ON NIGERIAN FISHERIES IN THE EIGHTIES

NIGERIAN FISHERIES DEVELOPMENT CHALLENGES AND OPPORTUNITIES OF THE 1980's

by

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ABSTRACT

With the momentum generated in Nigeria under the Green Revolution Programme to make the country self-sufficient in food, the fishing industry is poised for very rapid development. It is however, realised that there is no quick magic formula for this development, which has to be preceded by careful planning, evaluation of resources, development of necessary management and technical personnel, introduction of appropriate technology and identification of priorities and the needs of the industry.

This paper attempts to focus attention on the possibilities and priorities for the development of fisheries in Nigeria during this decade and spells out the role of the agencies in the country connected with fisheries to bring about this development.

INTRODUCTION

Fisheries occupy a unique position in the agricultural sector of the Nigerian economy. With fish contributing about 40% of the animal protein intake of the average Nigerian, Nigeria is the largest consumer of fish and fishery products in Africa. Yet only about 70% of the total demand for fish is met by domestic production.

Nigeria is endowed with a fairly long coastline (about 960 Kms) and although the continental shelf is relatively narrow, yet it provides the bulk of the present marine fish catch. The 200 miles Exclusive Economic Zone (EEZ) has generated interest in the pelagic fisheries for tuna and related species. In addition, Nigeria has an intricate net-work of fresh water river systems and vast expanses of brackish water creeks, lagoons and swamps, rich in fish and shrimps. Associated with the river systems are numbers of reservoirs, lakes and ponds.

FISH PRODUCTION AND SUPPLY

There are two main sources of fish supply in Nigeria - domestic production and fish imports. The domestic fish production is derived from three main sources - artisanal inland waters, artisanal coastal and brackish waters and industrial fishing in inshore and off-shore waters.

Despite increase in domestic fish production in recent years, fish import has continued to rise. It has been estimated that the percentage increase in fish import is much higher than the average growth rate of fish production, which indicates a widening gap between domestic production and demand.

Per caput fish consumption has increased at an average rate of 3.4% per annum from 6.970 kg in 1971 to 9.096 kg in 1979. This trend is bound to increase during the 1980's widening further the gap between production and demand. This situation emphasises the need for increased efforts not only to boost fish production, through increased exploitation of the under exploited and unexploited resources, development of artisanal fisheries and fish culture but also minimise post-harvest losses through proper storage, processing and quick transport and attain self-sufficiency in fish at the quickest possible time. This indeed is the challenge.

Table 1 - Nigeria fish production by sectors 1971 - 1981

Year	Domestic Fish Production	Import	Total Fish Supply
1971	409,537	54,416	463,953
1972	437,971	65,063	503,034
1973	465,075	71,410	536,485
1974	473,220	74,905	548,125
1975	466,236	114,186	580,422
1976	494,766	133,977	628,743
1977	504,014	164,449	666,463
1978	518,667	202,208	720,775
1979	535,435	218,000	753,435
1980	479,596	234,000	713,596
1981	496,221	245,000	741,221

Source: Federal Department of Fisheries

DEVELOPMENT OBJECTIVES

In line with the objectives of the Green Revolution Programmes, the Government aims to give a boost to fish production in the country, with the view to bring about self-sufficiency in fish and fishery products in the shortest possible time, to increase foreign exchange earnings through exports of shrimp and other fishery commodities, to provide employment opportunities to school leavers, to develop fishery based industries, and to ensure optimal utilisation of the country's resources through rational management and conservation. These are to be achieved through development of appropriate fisheries institutions, supply of necessary fishing and allied inputs in adequate quantities, provision of suitable infrastructural facilities, and introduction and enforcement of necessary fishery regulations. These are the opportunities.

THE DEVELOPMENT PLAN

The Fourth National Development Plan (1981 - 1985) envisages a capital outlay of ₦172.006 million for fisheries development which is about twice that of the Third Plan allocation.

Table 2 - Fourth National Development Plan 1981 - 1985: Summary of Government capital allocation to fisheries (in millions)

All States	Local Government Areas	Federal Government	Total
63.047	21.629	87.330	172.006

The main components of the projects approved for implementation at the Federal level comprise of: -

- Artisanal Fishery Project - ₦ 8,830,000
- Fishery Infrastructure (industrial) - ₦39,000,000

Aquaculture	-	₦12,000,000
Fish Storage, Processing	-	₦ 5,000,000
Fishery Inspectorate	-	₦ 2,500,000
		₦87,330,000

These Government programmes will have to be supplemented by additional inputs from the River Basin Development Authorities and Research, training and extension support by the National Fisheries Research Institutions and Universities. In addition the active involvement of the private industrial fishery sector is essential to develop both the fishing and allied industries.

FISHERY RESOURCE

For fisheries development plans to be realistic, it is important that they are based on a clear understanding and appraisal of the nature and availability of resources, their potentials, rate at which the resources could be exploited on a sustainable basis, and the appropriate fishing efforts to optimise the inputs.

The Nigerian Institute of Oceanography and Marine Research (NIOMR) has estimated the fishery potential of Nigeria as below:-

Demersal Inshore Industrial Fishery	-	14,000	Tonnes
Demersal Off-shore Industrial Fishery	-	10,000	"
Demersal Artisanal Fishery	-	20,000	"
Pelagic Artisanal Fishery	-	140,000	"
Pelagic Off-shore Artisanal Fishery	-	18,000	"
Shell Fish (Shrimps) Artisanal Fishery (Lagoons and Brackish Waters)	-	48,000	"
Shell Fish (Shrimps) Inshore Inudstirial Fishery	-	3,500	"
Tuna in Exclusive Economic Zone	-	20,000	"
Kainji Lake	-	11,000	"
Lake Chad	-	30,000	"
Rivers and Reservoirs	-	130,000	Tonnes

The on-going fishery surveys by the NIOMR and the resource appraisal of Artisanal and Inshore Fisheries under the FAO assisted Artisanal and Inshore Fisheries Development Project and the resource studies by Kainji Lake Research Institute and the Lake Chad Research Institute are expected to throw additional light on fishery resource situation in the country.

DEVELOPMENT POSSIBILITIES AND PRIORITIES

Marine Fisheries:

Industrial Sector

As demonstrated by several fishing companies operating successfully in Nigeria, good possibilities exist for profitable commercial fishing operations in Nigeria. It is, however, known that nearly half of the licensed fishing vessels are not operating for several reasons, the major constraints being lack of proper maintenance and repairs, inadequate terminal facilities for berthing, landing, storage, processing and marketing of fish, shortage of trained technical manpower to operate the vessels and professional manpower to manage the industry. These, compounded by inadequate information on fishery resources of the territorial waters and EEZ and lack of expertise or advice on choice of the right vessel and gear, have all added up to the problems of the Nigerian industrial fishing sector.

For industrial fishing to develop and make its proper contribution to Nigerian fisheries, it is important that the identified constraints are removed. High on the priority is the need for suitable terminal facilities.

Fishing Terminal

At present, the Federal Government is constructing three coastal fishing terminals located at:

- Ebighu. Cross River State
- Borokiri, Rivers State
- Igbokoda, Ondo State

Work on the Lagos Fishing Terminal at Kirikiri is expected to start shortly.

These fishing harbour complexes will enable a proper execution of most of the activities which take place between the capture of the fish and its consumption - like quick unloading of the catch, cleaning, sorting, storage, selective product handling, processing, marketing and distribution. These harbours, besides providing shelter for vessel against the elements, also enable the shore personnel to attend to repairs maintenance, bunkering and supply of other essentials like food, water etc. The harbours will therefore, attract many service industries like boat-building and repair facilities, mechanical/marine workshops, fishing gear manufacturing and repair units, provision of essential supplies and services, packaging, ice and cold storages, ship-chandlery store etc. In essence, these harbours will form the lynch-pins of the activities of the industrial fishing fleet and will constitute much to the efficient operation and management of the fleet and disposal of the fish catches.

Still, considering the long coastline and the numerous river mouths and creeks, it will not be realistic to expect that all the fishing vessels operating in the country would be in a position to make use of these terminals. It will therefore, be necessary to have additional intermediate level terminals at a few other centres, located midway between the large terminals and also have several other fishing jetties particularly for the small and medium sized fishing vessel.

Ideally, it would be desirable to have at least one terminal or landing facility for every 100 kilometer of the coast line.

Management of Fishing Terminals

Fishing terminals being complex facilities with sophisticated modern machinery and equipment, require highly skilled and trained engineering personnel to operate and maintain the plants and experienced professionals to manage them. Being essentially mini-ports, these present most of the problems associated with commercial harbours. Besides normal management, periodic dredging of the lead channels and jetty water fronts may be necessary. As fisheries organisations in the country do not have the personnel for jobs of this nature, the need arises to set up a separate agency with the necessary expertise. Such an agency designated as Fishing Terminal Management Agency should draw personnel from Ports and Marine mechanical and refrigeration engineering background and experience and preferably have them understudy the team of engineers putting up the facilities at the various terminals. Care should however, be taken not to introduce the rigorous procedures in commercial harbours and run the harbour more as a service facility. To ensure that the terminals are used by the fishing industry, it should be mandatory for all fishing vessels in the area to operate only from the fishing harbour and not from any private jetty.

Fishing Fleet Expansion

Being essentially an industrial activity, the fishing vessels will operate mainly in the private sector, with government providing research and extension support. The decade is already witnessing a spurt in industrial fishing activity with several fishing companies operating successfully. An encouraging trend is the increased collaboration with developing countries, which has yielded highly satisfactory results. However, one disconcerting factor of the operations of these vessels is that almost all of them operate in the inshore waters at depths ranging from 20 to 30 metres and there is seldom any off-shore fishing activity.

Table 3 - Summary of licensed fishing vessels

Category of Vessel	1981	1982
Inshore Fishing Trawlers	45	52
Inshore Shrimp Trawlers	36	34
Distant Water Trawlers	128	147
Inshore Research Vessels	1	-
total	210	233

The Action Programme under the Green Revolution envisages introduction of fifty (50) inshore fishing vessels and 38 distant water fishing vessels in the coming years both in the public and private sector. It is ironic that while the main fishing effort goes into catching bottom fish like Croakers, (Pseudolithus typhus and P. senegalensis) the type of vessel and the gear used are the typical Mexican out-rigger shrimp trawlers. Perhaps, these vessel types which were originally introduced for shrimping, stayed on to catch fish predominantly. One disturbing aspect of this development in the used of shrimp gear for capturing fish, is the predominance of juvenile fish, particularly croakers in the trawl catches. This trend will need to be dscouraged to prevent depletion of stock.

Moreover, as, in any case, the emphasis is on capturing fish, the vessels to be introduced in future should reflect that character. Steps will have to be taken to diversify the fishing methods. With the surveys being conducted into oceanic resources in the country's EEZ, it is hoped that information will very soon be available on the pelagic and other resources and the methodology for their exploitation, which will have great bearing on the expansion of distant water industrial fishing fleet in the country.

Fishing Vessel Development Fund

One of the well known constraints in introducing large industrial fishing fleet is the heavy capital investment involved and the difficulty in raising the capital through normal banking channels because of the risks involved. In most developing countries and in some of the developed countries, the practice is to establish special funds for financing acquisition/construction of fishing vessels - channelled either through banks and government institutions.

In addition to assisting enterpreneurs to acquire fishing vessels, it will also be necessary to establish a revolving fund from which one could draw funds in an emergency.

Trained Manpower

One disconcerting aspect of the operation of the country's industrial fishing fleet is that the majority of the vessels have been manned by expatriate skippers and engineers with until recently Ghanaian crew members occupying most of the lesser positions. This situation needs to be corrected quickly. Advantage should be taken of the recent departure of the illegal aliens to infuse Nigerians into the fishing fleet and train them. It should be made incumbent on licensed operators that within a specified period they will locate and train Nigerian skippers and engineers and replace the expatiate personnel.

The Federal Fisheries Schools should be actively involved in this development.

ARTISANAL FISHERIES

Artisanal fisheries in Nigeria constitute the most significant fishery sector in terms of number of people engaged in or dependent upon it and the very high percentage (66%) this sector contributes to the country's fish production. Yet, paradoxically, this sector is the most impverished one, with the fishermen generally making a subsistence living. Several reasons have been attributed to this situation. The more important ones being remoteness of the fishing settlements and difficulty of access, use of antiquated fishing craft and gear and labour intensive fishing methods, lack of adequate finance and basic infrastructural facilities like ice and cold storage, fish handling and processing centres, storage distribution and marketing net-work and also lack of basic human needs like proper housing, drinking water and sanitation.

Considering that about 450,000 fishermen, operating about 134,000 fishing canoes are dependent on this sector, with their families, the magnitude of the task to improve the lot of these fishermen is indeed phenomenal and challenging.

Approach to Assistance

It has been identified that the artisanal coastal and brackish water sector offered good scope for increased production. Furthermore, being the poorest in the social and economic scale and the most populous, there is special need to support this sector. From a sociologist view, the assistance is also meant to arrest the drift of young school leavers from the fishing settlements to cities and provide them with more attractive fishing occupation.

The assistance that has been provided as a package of fishing inputs to cooperative units of fishermen in selected fishing settlements under the National Accelerated Fish Production Project (NAFPP), supplemented by other infrastructural facilities has been well received and has helped the beneficiaries to increase their earnings and improve their lot. However, this assistance can serve more as a catalyst and an eye-opener for the rural fishing community exposing them to the benefits of modern technology and cooperative endeavour.

Scope of Assistance

Having identified the needs of the artisanal fishermen, a multi-pronged drive is under way to modernise this sector all the way from the primary activity of fish capture to the delivery of the product to the consumer. This programme is being supported with technical assistance from the Food and Agricultural Organisation (FAO/UNDP) under the Artisanal and Inshore Fisheries Development Project.

Improvement of Fishing Craft :

Fishing Craft

The sequence being followed for development of fishing craft varies from inland to marine and in the marine sector itself from State to State because of the topographical conditions.

Inland Waters

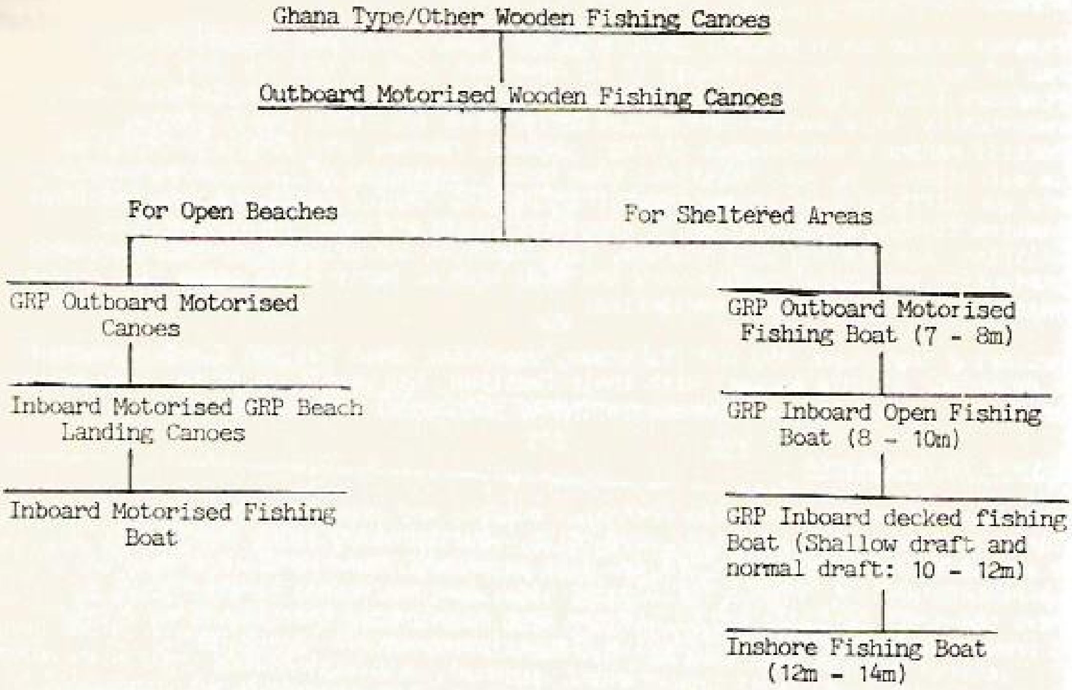
Sailing Dug Canoes

O.B. Motorised Canoe

O.B. Motorised GRP Fishing Boat

Inboard Mechanised Fishing Boat (7m to 10m)

Marine Waters



While considering fishing craft improvement/mechanisation, the logical approach is to make a critical study of the existing indigenous craft and examine how best these could be improved and mechanised as the fishermen are more used to these crafts and would readily accept the improvement. However, in Nigeria, the only craft which lends itself to that type of adaptation is the Ghanaian Canoe which also can be improved only to the extent of reproducing it in glass reinforced plastic for use with outboard motor. Hence, it has become necessary to introduce a new generation of fishing boats, after testing their suitability to Nigerian conditions. For some historical reasons, in the Nigerian marine fishing industry, there has existed a vast technological gap between the beach canoes and the industrial fishing fleet. It is now proposed to fill this gap with a new generation of suitable small coastal fishing boats which could operate from the river mouths, creeks and sheltered bays. While GRP outboard motorised beach canoes are being produced and made available to the fishermen for operation from open beaches, the inboard GRP beach canoes are being tried out.

For sheltered areas, GRP outboard motor boat (8m) popularly called 'Utility' fishing boat are being introduced on a large scale, while efforts are on the way to produce/introduce the inboard open fishing boat. Simultaneously, experiments have been undertaken jointly by the FAO and NIOMR into the possibilities of introducing suitable fishing boats with shallow draught, to operate in areas with shallow sand bars. Based on the success of these experiments, a new generation of fishing boats may be introduced in the next few years.

Inshore Fishing Vesels

To quicken the pace of upgrading the artisanal fishermen and make it possible for the better educated, trained and organised among them to operate larger, modern fishing vessels, the Inshore Fishing Project has been conceived, under which, forty-five (45) steel trawlers of 13.2 m class have been introduced. These vessels are meant to be operated through fishermen co-operatives in the six Marine States and a substantial number of them are already in operation. Through demonstration programmes, operators of the boat have been trained. Experience of private enterpreneurs in Nigeria who are operating fishing vessels of about same class, has also established the profitability of the operations. However, being a coopertive venture, the operation of these vessels have to be viewed against the different situations under which they function, the technical, social and economic background of the operators and the need to have to constantly guide and assist the operators at least in the initial phase. This, is being done both at the Federal and State level and this programme is also receiving technical support from the FAO and bilateral assistance from Poland under the Nigeria - Poland Economic Cooperation Agreement.

The experience gained in implementing this project, will help greatly in formulating future plans for further development of inshore fishing in Nigeria, through governmental assistance.

Fishing Gear

For introduction of improved and modern fishing craft to be meaningful, it is necessary to supply the requisite fishing gear. Steps have therefore, been taken to standardise fishing gear requirements of various areas depending on the fishery and various types of crafts and make available the suitable fishing gear to the fishermen.

Modern fishing gear supplied to the fishermen comprised of Nylon gill net both multi and mono-filament, polyethylene gill nets, fishing floats, marker buoys, sinker leads, for canoe fishermen and fish trawl net and shrimp trawl nets, with alter doors and other accessories.

Through practical demonstration and on the job orientation, the fishermen have been familiarised with the use of modern fishing gear like trawl nets. At the extension units, the fishermen have been taught the advantages of drying synthetic nets in shade and not exposing them to damages through exposure to the sun.

Great scope exists to diversify fishing gear and methods particularly for exploiting the pelagic resources. With the introduction of mechanised fishing boats, more effective fishing gear like, encircling gill nets, mid-water trawl, small purse-seines and long lines and pole and lines will be introduced. Nigerian fishing technicians have already received training in the operation of these modern fishing gears.

FISH STORAGE, PROCESSING AND MARKETING

Fish Storage

In a tropical country like Nigeria, while attempting to boost fish production, one has also to ensure that the benefit of the increased catches of this highly perishable commodity are not lost to the fishermen through depressed prices or post-harvest loss. In fact, in some of the inland lakes, losses due to spoilage accounts at times for more than 50% of the landings. The logical answer to this problem is proper packing of fish in ice on capture and storage in cold storages on shore prior to marketing.

Ice plants and cold storages have been set up in key fishing centres and cold storages in marketing centres. Insulated fish boxes have been developed to be carried in fishing boats with ice. However, for the full utilisation of these facilities much extension work is still required particularly to induce a change from the traditional practice of smoking all the fish.

With greater awareness of the benefit of cold storage of fish and with more quantities of fish diverted from smoking for cold storage, the need will arise for establishing more and large cold-storages in the fishing centres.

However, the key to the success of these installations will lie besides their optimal usage by the fishermen, in the proper maintenance and operation of the machinery and equipment. Located as they are in remote fishing settlements, with only generators to provide electricity and bore-holes to supply water, it would really require competent and well motivated hands to keep the facilites working.

Fish Processing

Fish Smoking

The traditional practice of smoking fish needs to be improved - particularly in terms of extending the shelf-life of the smoked fish and preventing infestation. Lack of adequate capacity for smoking, has often led to the spoilage of the commodity even prior to smoking. Well smoked fish being a wholesome product, with ready consumer acceptance, there is need for considerable extension work to ensure that the fishes are washed and cleaned properly prior to smoking and smoked under hygienic conditions.

Fisherwomen, who mostly handle the fish for smoking, being highly individualistic, still prefer to smoke the fish either inside their house or adjacent to it. Efforts to introduce community smoking kilns have met with only limited success. Several types of smoking kilns are in use from the simple open hearth to the modern NIOMR patented smoking kiln with electrical blowers. They all have their advantages and particularly the indigenous ones, which have been evolved over a period of time by local ingenuity to meet with local needs. Therefore, the idea would be to determine what is best for a certain area and assist in providing it with whatever improvement possible.

Fish Drying/Salting

Although curing of fish by sun-drying and salting are not popular, because of the climatic conditions and the high price of salt in the region, there are yet possibilites of introducing these methods on a trial basis for cray fish and thread fin and similar fishes.

Other Methods

With the likelihood of tuna forming a regular fishery in the years to come, possibility exists for canning of tuna for export and for local consumption.

FISH TRANSPORT AND MARKETING

Transport

Speedy evacuation of fresh fish from the landing centres to the markets or storages is of utmost importance particularly if the fish had not been packed in ice, to fetch better prices and ensure prime quality. However, fishing settlements being so remote and not connected by roads or linking canals, such speedy evacuation of fish has not been generally possible.

A study has been commissioned through the FAO to examine the possibility of forming linking road or canals. The problem is really vast, considering the scattered and remote fishing settlement. However, a solution is necessary at least for the more important fishing centres. In the meanwhile, plans are underway to introduce fish-carrier boats with insulated fish-holds to help to transport fish, wherever canal facilites exist.

Overland transport of fish has not posed much of a problem, with the availability of insulated and refrigerated trucks. However, as fish production increases and as more fish gets evacuated fresh from landing centres, the need will arise to strengthen the fleet of fish transport vehicles.

Fish Marketing

Being a sellers' market and a commodity which is in short supply, marketing of fish in Nigeiria has not posed any serious problem. However, the benefit accruing directly to the fishermen in the sale of his catch has unfortunately, not been what it should be, because of the trade practices. With better transport facilities enabling fisherman to bring his catch directly to the consuming centres and through cooperative marketing, it would be possible to bring about a change in the situation.

ESTABLISHEMENT OF MECHANISED FISHING, EXTENSION AND TRAINING CENTRES

One of the known constraints in mechanising and modernizing artisanal fishing in the lack of trained operators. The larger vessels operating in the industrial fishing fleet are manned by crew, who are required to possess the necessary certificates of competency, under the country's regulations, institutional and on board facilities have been established in the country for their training. The training requirements of the mechanised fishing boat operators are quite different. In most cases the same person will have to handle both navigation and the engine. Furthermore, training of such an operator will have to be more vocational, 'on the job' in boat and workshop than in class rooms.

The training will also have to be localised, not necessitating movement of the trainees too far from the operational base. Three such fishermen training centres have been proposed - the first one located at Uta Ewa is expected to commence the programme shortly. With the establishment of similar centres at Koko and Lagos, the long felt need for training of fishermen at grass-root level, which is a pre-requisite to the introduction of mechanised fishing, would have been met.

FISHERY SURVEILLANCE AND MANAGEMENT OF ECONOMIC EXCLUSIVE ZONE

Realising that the nations' marine fishery resources are not inexhaustible and need safeguard against indiscriminate and unauthorised exploitation, the Federal Department of Fisheries has introduced measures to license the fishing vessels operating in the country to regulate the size of vessel and nets and carry out surveillance and enforcement of the fisheries regulations.

The Department is actively involved in studies to determine the fishery resources of Exclusive Economic Zone and is following with interest the on-going survey by NIOMR of the Tuna resources of the zone, which seems to indicate good possibilities. The Department is also in the process of formulating plans for the management of the resources.

INLAND FISHERIES

Aquaculture has been accepted the world over as one of the most potential means for increasing fish production and a tropical country like Nigeria with her immense water resources offers tremendous possibilities for fish-culture. This activity has however, unfortunately been a late starter in the Nigerian fishery scene, although fish farms have been planned and some have existed for over two decades. With the present drive for increased food/fish production, the potential that aquaculture offers to the country has acquired greater significance.

While it is widely acknowledged and known that fish famring could be successful in Nigeria, the track record of fish farming in Nigeria is not very flattering, in that there are no recorded instances where fish famring has been demonstrated as a complete commercially profitable venture.

Therefore, in establishing the 50 ha pilot fish farms in the States, the Federal Department of Fisheries will lay emphasis on the fact that these farms should prove themselves to be commercially viable propositions, which is the surest way of propagating the message of aquaculture in the country. These efforts are likely to receive technical support from the FAO under UNDP assistance.

The efforts of the State Government and River Basin Development Authorities also must be oriented toward commercial fishfarming.

Training of Personnel

With the African Regional Aquaculture Centre (ARAC) located at Aloo, Port Harcourt, Nigeria is in a very favourable position to benefit both by way of expertise and training of personnel. These supplemented by training of aquaculturists through government's own programmes, should help to produce the fish farmers needed for the country.

ESTABLISHMENT OF FISHERY BASED INDUSTRIES

For a developing country like Nigeria with ambitious plans and ample potential to develop the fishing industry, it is important that the industry becomes self-reliant for most of its development needs. While imported technology and equipment have some relevance in the initial phase of development, it will not help the industry to rely perpetually on them. Therefore, for fisheries development to be meaningfu, the 1980s' should set the pace for establishment of the various fishery based industries in the country.

Synthetic Fish Net Twines

It is anomalous that a petroleum country like Nigeria, should rely on import of synthetic fish net twines from countries like Korea and Japan which are half way round the globe. As a long term measure, indigenous production of synthetic fibres should be taken up, through the petro-chemical complexes likely to be established in the country. However, as a short term measure and as a prelude it would be necessary to establish properly planned fish net manufacturing plants - which can meet fully the requirement of fishing net of the country - both Artisanal and Industrial. These plants should also have the yarn twisting machines besides other net-making and stretching machines so that in the initial phase only yarn fibres need to be imported.

Outboard Engines

It is now known that Nigeria is among the largest importers of Yamaha outboard motors in the world. Besides this make, there are several other brands of outboard motors sold in this country. It is also known that Yamaha outboard engines are being manufactured/assembled in other countries. It will be highly essential that steps are taken for indigenous production of outboard motors in the country, which will also ease the situation of spares, and after sales service.

Simultaneously steps will also have to be initiated for production of small inboard marine engines in the country.

Fishing Boat

Although, there are a few small boat yards in the country, their involvement or interest in building small fishing boat is very little. The only private company (M/s Almarine) which produces the Yamaha GRP utility boat-the [illegible] version of these boats used in fishing has limited capacity.

With hundreds of these small GRP fishing boats needed for boosting fish production, the logical way to meet the need is to resuscitate the dormant government Boat Yards and encourage smaller yards to take up fabrication of GRP boat. The Department, under the FAO Artisanal Fisheries Project has already re-activated the Epe BoatYard and GRP fishing canoes are under production there.

WELFARE OF RURAL FISHERMEN

Along with the technical assistance being extended to the fishermen, it is also necessary to help them to develop their environment, provide them with suitable housing, clean drinking water, inculcate necessary hygienic habits, and generally enable them to participate in and integrate with the development process in the country.

Although, such a community welfare activity may not strictly be a purely fishery development activity and may cut across the activities of several sister agencies in as far as it involves the welfare of the rural fishing community, it will be up-to the fisheries agencies to initaite the process and coordinate the developments.

CONCLUSION

From the foregoing, it will be clear that tremendous opportunities exist for developing fisheries in Nigeria but there are also enormous problems to be solved and challenges to be met. The political will to bring about these developments is very much there, as evidenced by the Federal Government plans under the Green Revolution Programme. The resources are there. The present economic recession will of course call for some belt-tightening. However, with proper planning and concerted efforts of the Federal, States and Local Governments' as well as the private sector the 1980's may well be the pace setter decade for fisheries development in Nigeria.

INFORMATION REQUIREMENTS FOR EFFECTIVE FISHERIES PLANNING IN NIGERIA

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INTRODUCTION

It is now almost a decade since concerted integrative fisheries planning at the national level was initiated. The initial planning effort can best be described as planning without facts, ideology and philosophy. All the plans were essentially allocative in nature in which projects were conceived without detailed studies and budgetary allocations made. Within those years there were more than enough resources for trial and error such that failures could be absorbed or overlooked without any serious repercussions.

While the second and third plans execution were characterized with a high degree of plan distortion (Mabawonku, 1982) it is important, however, that the efforts of the Federal Government be commended at attempting to implement their programmes despite such great odds.

But what lessons have we learnt from this trial and error method of development programming? Answers to this question and the formulation of solutions to them will be of immense benefit in the tasks ahead especially under the present and uncertain economic situation of the country. The present state of affairs in fisheries planning look very disturbing indeed. A close scrutiny of our past and present situation show clearly that a serious rethinking is imperative. For a beginning, what are we planning for an for whom? The major objective underling agricultural planning in Nigeria (fisheries inclusive) is the provision of food and fibre. Towards this end projects regarded as capable of boosting production are conceived and executed. This single-minded pursuit of commodity production to the total exclusion of the welfare consideration of the people and the distributional impact of such programmes has now been found to fail abysmally.

That this is so, should not be a surprise to scholars of development. Development in the true meaning of it should be aimed at increasing the standard of living of the people. In other words a development programme must begin by finding answers to such vexing questions as:-

(a) what is the present standard of living of the producers,

(b) what is the health, medical and living conditions of the people,

(c) what are their basic needs,

(d) are they sufficiently well motivated and in sound physical state to perform the duty or duties which they are being called upon to perform?

Without adequate answers to these questions and programmes designed to meet these ends many production oriented programme will inevitably fail. There is a school of thought, though, which believes that an increase in output will lead to increased income, improve consumption standards and therefore, an increase in the standard of living of the people. It may be asked, which people are we talking about, are they urban dwellers who are mainly the vocal elites and basically consumers or are they those rural dwellers who have no access to health care facilities, good water supply and education? If the latter, how can such increase in income translate into improved standard of living under the conditions they work and live?

It is within this treatise that I think answers to the present situation in fisheries planning can be found. Specifically, a review of our efforts within the last ten years shows the following:-

(1) Many projects were planned but not executed;

(2) Infrastructure were provided which were not utilized;

(3) Projects were started but not completed;

(4) Inputs were procured and distributed without being monitored and so on.

While many may advance other reasons for this situation the most important factor is lack of basic information for programme identification, planning, implementation, monitoring and evaluation.

For the 80's and beyond information for fisheries development are required for the following reason. At the domestic front information are required for the design of programmes and policies and for the evaluation of the various government projects. At the international scene, much controversy surrounds the richness or otherwise of Nigeria's waters. To some, Nigeria's coastline is barren and devoid of any reasonable commercial exploitable species. To others, the little resource available is not sufficient to warrant large scale investment in fishing effort. To another group, available information about the country's fish resources are partially inadequate, misleading and scientifically false. Whatever may be the correct opinion, there is however, overwhelming evidence that total fish imports constitute only about a third of fish disappearance in the country.

What type of information are required to correct existing imbalances. In generaal we can group the types of information required as technical and economic. Technical information circumscribes those bio-chemical research findings that deal with its environment. It include details about the species that will help in utilizing resources most efficiently and others that will help in designing investment patterns. Purely descriptive biological information, by not being problem solving in nature has little use for investors. But data on fish growth characteristics, migration patterns can on the other hand be of immense importance.

More importantly are those economic and social information that will provide a basis for private sector investment decision making and government in formulating meaningful programmes. For classification purposes let us divide the sector into its various component.

ARTISANAL FISHERY

Nigeria is a dynamic growing society, and every component of it responds both to social pressures and economic stimulus. Artisanal fishery in Nigeria involves millions of small scale fishermen. First, they are people ((not fishes) who have production, consumption and exchange opportunities. Available evidences (Mabawonku, 1981) show that a majority of them are illitrates; their communities lack basic amenities such as water, electricity and medical care: they are susceptible to high risks and are often indebted to fish merchants. Their production opportunities are limited by the paucity of their technical know how. Their consumption and exchange opportunities are limited by the closeness and inaccessibility of their communities and their migratory mode of living.

As at present, we are primarily concerned about how much fish they land and what to do to increase their catch per unit effort. Genuine development programme in this sub-sector requires more than that. Additional information is needed in the following areas:-

1. Goals, values and preferences of the fishermen.

2. Employment level, pattern and periodicity.

3. Productivity and income levels.

4. Rate and pattern of migrations.

5. Rate of technological transformation (i.e. rate of increase or decrease in use of outboard engines, nylon nets, rate of graduation from small paddle canoes to larger ones, etc.).

6. Capital formation and investment trends.

7. Production costs and input procurement methods.

8 Product processing and distribution methods.

9. Living conditions and level of indebtedness.

There are some of the multitude of facts that should be provided for any effective development policy.

INDUSTRIAL/COMMERCIAL

This sub-sector of the country's fisheries is the most elusive. Private entrepreneurs, governments and foreigners are the major operators. These groups often collude and provide wrong information about their operations to the detriment of the country. It must be emphasized that the resources they exploit are national resources and as such they must be subjected to close scrutiny by the people. What is more unchecked exploitation can create serious problems for the industry as well as for the generations to come.

In order to effect a comprehensive commercial fishery policy it is necessary that such information as:

1) Compliance with regulations and laws,

2) Level of landing,

3) Types or varieties of fish exploited,

4) Employment and wages,

5) Infrastructural needs and availability should be periodically provided.

AQUACULTURE

Virtually all the governments in the country are engaged in fish farming either as a demonstration or a commercial project. Moreover, fish farming is not a new enterprise in the country. Yet little or virtually no information is available except for a few biological research papers. Practitioners of the trade either at state or federal level have done very little to give us a clear picture of the state of affairs in the country. Various pond construction methods, various species of fish and various practices have been imported into the country. Many have failed, while others succeeded. But lack of information about these projects has often led to the duplication of failure and the rejection of success. Many private investors are scared away after discovering that what is feasible on paper became unrealistic in practice. In essence, situation in this sub-sector can best be described as a zero-datum affair.

To begin with nobody knows how many dams, lakes impounded water and ponds are there in this country. Nor is there any information about the mode of production in these waters. Even in some states where information is available about the number of ponds, it is often found that over a third or more of these ponds have long been abandoned or are no more functioning at all.

What is wrong with the sub-sector is that there is a general lack of purpose, objective and direction. No concensus exists as to the role it has to play in meeting the fishery requirements of the country. Macro goals of self-sufficiency in fish production require that special and more serious attention be paid to fish culture. For this purpose data required for macro planning and appraisal at micro level have to be treated as a matter of urgency.

Among the requirements for an effective fish culture programme include:

1. The number, size, location, and potential of all fish ponds, lakes, reservoirs and impounded water in the country.

2. Types of production, i.e. intensive, extensive, polyculture or monoculture.

3. Potential and actual production of fries.

4. Potential and actual demand for feed.

5. Production levels or yields.

Many areas such as infrastructure for the sub-sector, its special distribution, capacity etc, need to be studied. Marketing and distribution, price trends are other areas where little or no information exist.

At the present it is legitimate to ask what are the methods to be employed in information gathering, collation and dissemination, what is wrong with existing methods, and so on. The honest fact we must face is that no methods exist presently for fisheries data gathering, storage, and retrival. Rather what exists are haphazard and inconsistent data gathering methods. The information gathered by the existing system is neither continuous accurate nor useful for planning purposes.

The only existing information source is the fisheries Production Statistics published by the Federal Department of Fisheries (FDF). At the State level while there are statistical publications on education, health, agriculture and so on, nothing relating to fisheries is ever published even in States where fishing activities are the dominant source of employment. It appears that either the fishery sub-sector is not relevant in the scheme of things or those in-charge of fisheries at the State level attach no importance to data gathering. At the Federal level, lack of direction and absence of effective co-ordination result in the collection of inaccurate and incomplete data.

It may however, be argued on the other hand that there are many factors militating against information gathering. Practitioners are likely to mention such factors as the inaccessibility of the fishing communities, lack of manpower, etc., But the truth is, all these factors can be surmounted only when it is realized that information gathering is the most important project that should be embarked on and that without a data base no project can be meaningfully and effectively executed.

For the following decade, therefore, it is absolutely necessary to regard fishery statistics as a capital project, a project more important than many of those presently slated for execution. The type of data which we have discussed above need to be gathered on a continuous basis such that by the end of the eighties the country will have generated a reasonable amount of time series data.

To do this, however, requires setting up a completely different machinery and adopting a completely different approach. First, because of the scarcity of funds and bureaucratic bottlenecks at the State level, it may be necessary for the Federal Government to be responsible for setting up and financing the gathering and dissemination of fisheries information. This means that data gathering has to be regarded as a capital project for which reasonable allocations are made annually. A precedent to this is the Rural Infrastructure study of the Federal Department of Rural Development. Second, there is no doubt that the present set-up of the F.D.F Fisheries Statistics Division is patently inadequate and unsuitable for this major task. While it may act as an agent for information dissemination, the gathering, processing and collating of data should be taken out of the Division.

For the puposes of gathering, processing and collating of fisheries statistics it will be necessary to establish a Fisheries Information System Unit outside the existing civil service structure. This unit shall work in cooperation with the State Fisheries Divisions, the commercial fisheries sub-sector and the F.D.F. in carrying out its activities. Information gathered by the unit shall be processed on a quarterly or annual basis and turned over to the Statistics Division of F.D.F. for dissemination to various users.

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SMALL-SCALE FISHERIES DEVELOPMENT IN NIGERIA: STATUS, PROSPECTS, CONSTRAINTS/RECOMMENDED SOLUTIONS

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ABSTRACT

The Small-scale Fisheries Sector has been contributing immensely towards domestic fish production in Nigeria. According to official statistical information published by the Federal Department of Fisheries (1981), the Artisanal Sector alone (i.e. coastal brackish-water and inland rivers/lakes) contributed 524,127 metric tonnes (MT) (69.6%) in 1979; 461,346 MT (64.7%) in 1980; and 481,783 MT (65%) in 1981 to the total fish supplies of 753,435 MT; 713,596 MT and 741,211 MT for the three years. The Inshore fishery sector contributed fin-fish and shell-fish to the tune of 11,308 MT, 18,232 MT and 14,438 MT during the same period. Despite these considerable contributions by the small-scale fishermen, with few exceptions, they continue to live at the margin of subsistence. This paper attempts to review the sector and propose strategies of integrated approach towards Small-scale Fisheries Development in order to ensure that efforts at improving the rural fisheries succeed in over-coming identified constraints which include socio-cultural, political, economic, technological and other barriers.

BACKGROUND INFORMATION

Nigeria, with a population of about 80 million people and a total land area of 923,773 km², is naturally endowed with a vast net-work of rivers/flood plains, natural and man-made lakes and reservoirs, as well as brackishwaters, lagoons and creeks. Couppled with these is over 800 km of often surf-beaten coastline with sand and mud beaches with slopes of various gradients and a continental shelf ranging in width from about 14 km in the West to 45 km in the East.

Brackishwaters

With a claim of 30 n.mls (i.e. about 55.56 km; 1 n.ml = 1.852 km territorial sea and about 800 km of coasline, Nigeria has territorial waters of 44,448 km². The first two n.mls of the coastal waters is reserved as a non-trawling zone for canoe fishing operations; thus about 2,963.2 km² coastal waters are reserved for canoe fishermen. The surface areas of Nigeria's estuaries, lagoons, and mangroves were estimated in CECAF/Tech/81/36/(En) (1981) by J.M. Kapetsky to be:

Estuaries (Km²)	Coastal Lagoons (Km²)	Mangroves (Km²)	Approximate Total of Enclosed Area (Km²)
2,267	937	9,700	12,940

The minimum estimate of Estuaries, Coastal Lagoons, and mangroves resources available to artisanal fisheries within the CECAF area is 41,000 km². The break down is as follows:-

- Estuaries 5,000 km²
- Coastal Lagoon 11,000 km²
- Mangroves 25,000 km²

In comparison with the whole of Africa the CECAF Countries possess 65% of the estuarine area, about 50% of lagoon surface and about 70% of the total mangrove area. As for Nigerian brackishwaters, the exact total brackishwater areas i.e. creeks, estuaries and swamps have not been fully determined although Scott (1956) estimated that permanent saline creeks of Niger Delta occupy an area of about 999.7 km², while the extent of the intertidal mangrove swamps is 5,048 km². Scott also estimated the intersection rivers and estuaries together with beach ridges to be 679 km² and 688.9 km² respectively. Thus, the Niger Delta area is in the neighbourhood of 7,415.6 km².

Freshwaters

The Nigerian drainage is principally characterised by the Niger/ Benue Rivers system with major tributaries which include Rivers Sokoto, Kaduna, Anambra etc. Many other rivers e.g. Ogun, Oshun Benin, Owena, Forcados, Cross, Imo, and Qua flow southwards. These rivers, their flood plains and other perennial waters in Nigeria offer considerable potentials for small-scale inland capture fishery. However, these are only partially exploited because of several factors. The potential yield can be up to 40kg/ha (Henderson) if simple impoundment and weir devices are introduced. The Nigerian River Systems etc., should be catalogued to allow for properly planned fisheries development and management. Meanwhile, under the development programme of the eleven River Basin Development Authorities, about fifty-one dams have been completed, while others like Oyan, Shiroro etc are nearing completion (Pers. Comm. with F.M.W.R.). These dams are planned to store 10's of billion of cubic meter of water for irrigation farming and other purposes including fishing. Moreover, the man-made Kainji Lake with a total area of 1,250 km² (about 136 km in length and widest portion of 24 km) supports up to 2,660 artisanal fishing craft from three border States of Kwara, Sokoto and Niger. Comparatively, the natural Lake Chad has diminished in size since the Sahelian draught of 1974 resulting in reduction in size from about 22,000 km² to 7,000 km² (ORSTOM Information).

DEFINITION OF SMALL-SCALE FISHERIES

There is no precise definition of Small-scale fisheries. Gerhardsen (1977) defined the fishery as one (including artisanal aquaculture practices) in which the poorest one half or two thirds of a developing country's fishermen are engaged. Sreennivasan (1978) described the small scale fisheries to include traditional and other fisheries possibly operating up to about 13 m L.O.A. Eventhough, the FAO reports on small-scale fisheries used to refer only to improvements in traditional craft and their motorisation but not mechanisation, yet in the Nigeria context and for the purposes of this paper small-scale fisheries is described to cover both Canoe fishery and Inshore mechanised fishery operating up 13 m LOA Vessels and take cognisance of the linkage of Coastal Lagoon and estuarine fisheries with freshwater fisheries. Thus, the term "Small-scale" fishermen will not only be taken in its literal sense to imply the size of operation but also to recognise the choice of technology, the operators' socio-economic and cultural status. Contrary to the experience in developed countries which have no sizeable traditional fishing communities, and in which fisheries resources have been depleted by aggressive and sometimes too efficient techniques of fish harvesting (this situation has led to the rigid enforcement of quotas for fishing and significantly, wherever possible, the encouragement of small-scale fishing operations), in the Nigerian situation, like in other developing countries, the potentials of resources are yet, in many cases to be fully determined and exploited. Traditional Small-scale Fishermen are still among the poorest sections of the society consequently there is an understandable emphasis on improving their lot. In this paper, the word fishermen is not intended to embrace a very wide and heterogenous section of the fishing community but it applies to the category of persons who earn their living by actively being involved in the process of catching fish using traditional or improved medium-sized craf and traditional modern gear. This clear definition is adopted because the wide and liberal usage of the word "fishermen" has often led to the failure of well-designed and well-intentioned Fisheries Schemes.

The present defunct, dormant or inactive status of most Fishermen's Co-operatives in Nigeria is traceable to the fundamental generalisation of who a fisherman is.

PRESENT STATUS AND DEVELOPMENT PROSPECTS OF SMALL-SCALE FISHERIES IN NIGERIA

Small-scale fisheries can be categorised into coastal mechanised and canoe fisheries, brackishwater/lagoon subsistence fisheries and the capture fishery of man-made, natural lakes, rivers and flood plains. The Federal Department of Fisheries put the number of fishing crafts and fishermen which operated in Artisanal and Inshore Fishery sectors between 1971 - 1979 and 1973 - 1979 respectively as shown in Tables 1 and 2. About 10% of the artisanal craft were fitted with outboard motors of mostly 8, 15 and 25 HP engines for lagoon, lake/river and sea fishing respectively in 1979. Thus, the landing per full-time fisherman was between 1.1 T/Yr and 1.2 T/Yr for all categories of artisanal fishermen. For the inshore fishery sector, each Inshore Trawler lands about 122 Tons annually including fin-fish and shell-fish (Fisheries Statistics of Nigeria, 1971-79).

Table 1 - Fishing crafts 1971-79

Years	Inshore	Trawlers	Artisanal	Canoes
	Fishing	Shrimping	Powered	Non-Powered
1971	13	26	4,204	90,923
1972	26	29	5,364	90,523
1973	27	30	6,224	91,732
1974	33	39	7,856	10,032
1975	33	30	8,240	20,381
1976	30	29	11,704	122,633
1977	43	36	12,187	125,256
1978	38	49	10,118	128,129
1979	44	48	12,510	121,218

Table 2 - Number of artisanal fishermen by category 1973 - 1979

Year	1973	1974	1975	1976	1977	1978	1979
Total	353,939	384,717	399,083	413,832	424,838	425,298	446,152
Full-time	247,806	269,354	279,413	289,682	297,317	293,309	312,306
Part-time	106,133	115,363	119,670	124,140	127,421	121,989	133,846

CHARACTERISTICS OF SPECIES EXPLOITED BY SMALL-SCALE FISHERMEN

The Artisanal brackishwater and marine fisheries can be further sub-divided into three categories; viz:-

The brackishwater canoe fishery which operates in the estuaries, creeks and lagoons. In the artisanal fisheries settlements of various sizes have been established in numerous scattered locations along the coastline, river and lake banks etc. The sizes of the villages which may be permanent or temporary vary according to the intensity of fishing activities and the other factors.

The coastal canoe fishery operates up to and sometimes beyond seven nautical miles of the inshore waters. While the Nigeria Sea Fisheries Decree (Now Act) of 1971 reserves a 2-mile non-trawling zone exclusively for the artisanal fishermen, they normally go farther than this range particularly when operating motorised craft. The distance from the coast depends on the range and size of the motorised or non-motorised canoe and the stocks fished for. The artisanal coastal inshore fishermen can set their fishing gear mostly in waters less than 40 m depth. It is necessary to state here that because of the limited area in some places along the coast, where the artisanal fishermen can set their nets, and because the same stocks are fished in those locations, interference between them and trawlers occur.

The Artisanal Shark Fishery

The artisanal shark fishery usually operates overnight in the high seas quite a distance from home base using drift netting for the sharks, sword fishes, sail fishes etc.

Type of Craft and Gears Operated in Small-scale Fisheries

The brackish water canoe fishery operates from small traditional dug-out canoes of about 6 m LOA using gears such as set nets, cast nets, bonga drift net, as well as lift and scoop nets and hooks. The coastal canoe fishery employs the large Ghana type canoes which is about 9.6 m in length and sometimes motorised. The gear used include beach seines, cast nets, drift and set gill nets as well as longlines and trawl nets. There is room for further development of the Small-scale fisheries with greater degree of motorisation. However, the provision of repair yards for the outboard engines, other basic infrastructure and adequate quantities of fishing equipment should be prioritised. The resources potentials have a bearing, however, on the extent to which Small-scale Fisheries should be expanded. Full-time fishermen in the coastal and brckish water areas fish between 180 - 200 days annually depending on weather conditions and other factors. They are very active during the dry season from January to April, and October to December. However, fishing activity is reduced during the rainy season especially in June and July when the sea is particularly rough.

The distribution of the commercially exploited fish species group is known. Information is also available in respect of the composition of the fish communities and the spatial and temporal distribution. Coastal fisheries resources are multi-species and include shell-fish i.e. Penaeus duorarum etc. There is evidence of migration of species from the open sea to estuaries and creeks and vice-versa.

Brackishwater Species

In the brackish waters including estuaries and creeks, the family Sciaenidae (Croakers) are common including Pseudotolithus elongatus, Pseudotolithus typus and Pseudotolithus senegalensis. P. typus and P. elongatus are the dominant species and their distribution extends to 20 m depth. P. typus and P. senegalensis occur both in the coastal inshore waters and the creeks. Ethmalosa fimbriata (bonga fish) and Ilisha africana exist both in the brackishwater and nearby coastal waters. Clupeids sardinella spp. (family Clupeidae) are also important. It is known that the artisanal fishery catches Sardinella spp. to the west of the country and Ethmalosa spp. in the Niger Delta area to the east. This is the most significant species in this area. Polydactylus quadrifilis (thread fin family Polynemidae) exists in the eastuarine creeks. Chrysichthys nigrodigitatus and Arius spp are important catfishes in the estuaries. Palemon hastatus are the dominant shrimps in the lagoons and are considerably exploited by the artisanal fishermen.

Marine Coastal Inshore Species

Marine species include Polynemus quadrifilis, Galeoides decadactylus, Cynoglossus spp (Soles), Lutjanus dentatus (Snappers), Pamadasys jubelini (Grunters), Arius spp (Marine catfish). Croakers Pseudotolithus spp are also important along with Sphyraena spp

The freshwater fishery resources fall under:-

(i) Riverine Fisheries

(ii) Lake and Reservoir fisheries

(iii) Fish Pond/Farming (Aquaculture,

Major centres of inland fish production areas include Lake Chad, Kainji and a number of large rivers and their flood plain as well as large numbers of irrigation dams. The freshwater species include Clarias lazera, Heterotis sp., Gymnarchus sp., Alestes sp., Tilapia sp., Lates sp. etc.

THE POTENTIAL OF NIGERIA FISHERIES RESOURCES

Since the early 1960's survey works were embarked upon to determine the biomass of Nigerian waters and the potential fish and shell-fish yield of the country's multispecies stocks. Notable among the survey work are those undertaken by Longhurst (1961) which estimated Nigerian Ishore fishing grounds from 5 - 30 m depth with an annual potential of 10,000 metric tonnes (MT). Bayagbona (1965) examined catch and effort data of 1959 - 63 to arrive at a potential yield of 1,036 tons in Cotonon-Lekki grounds. Longhurst (1965) obtained a potential of 11,000 Tons for the supra thermoche Sciaeonid Community, 3,500 tons for the Sparids. An analysis of the 1963 demersal survey which trawled 6 transects off Nigerian coast led to the prediction of 25,000 tons for marine artisanal fishery. Other surveys on some stocks carried out in Nigerian water have yielded useful information eventhough full materialisation of such surveys were hindered by time and vessel size e.g. (Fiolent Survey, 1977).

National efforts by Fisheries Research Institutes have been intensified to assess the potential of fisheries resources in Nigeria Coastal/brackishwaters, E.E.Z. and some inland waters (Ref. World Bank Fishery Sector Report - Nigerian Consultants). Apart from Artisanal pelagic fin fish and demersal Fish, there is also a traditional fishery for shrimps (Pelaemon hastatus) and some Penaeus notialis (P. duoraram) particularly in the estuaries and coastal waters in the Delta areas and eastwards. The shell-fish (Pink Shrimp) P. notialis has a potential yield of 35,000 MT (Bayagbona, 1979; Ajayi, 1982). Furthermore, various surveys have indicated that the stocks of royal red shrimp (Parapenaeus longirostris) in deep water are considerable though, the potential is yet to be evaluated. Squid, Illex illecebrousus, also appears abundant. Potential yield of about 10,000 tonnes is estimated for Kainji Lake based on the biomass 1,400 tons/annum by Otobo (1974), Ita (1982) reported current annual catch rate of about 5,000 tonnes which can be improved upon by improved management. The current estimate of the potentials of Lake Chad is about 40,000 MT. As for the rivers, reservoirs and flood plains it appears that exploitation is only moderate. Though the total freshwater area is vast, yet there is need for adequate inventory of perennial freshwater bodies in order to embark on proper national development planning in these areas. In summary (Ajayi, Pers. Comm.) and FAO/World Bank Fishery Sector Review Mission (Nigerian Consultants) report indicate the following underlisted estimated potentials exploitable by the Small-Scale Fisheries:

			MT
Fin Fish	Inshore	Demersal	21,000
"	Artisanal	"	10,000
"	"	Pelagic	120,000
Shell fish	"		48,000
Kainji Lake			11,000
Lake Chad			40,000
Ri , and Re ervoirs			130,000
			380,000

However, it will be noted that the total landings form Lakes, Rivers Brackishwater and Inshore Fishing were recorded to be 535,435 MT in 1979. It must be noted that both the statistical information and the Fisheries potentials have been the subject of internal and external controversy. Obviously there is room for improvement in the data collection, collation and analysis while a thorough and full assessment of the potentials of the resources of rivers/reservoirs, flood plains, estuaries, creeks and lagoons have to be accomplished. Furthermore, more thought should be given to the appropriate role of aquaculture development in the general management and development planning of coastal lagoons and estuaries. For instance, in many South China Sea Countries, e.g. Thailand, Indonesia and particularly the Philippines, the utilization of lakes and impoundments with a total area of 199,567 ha for fish production yielded an estimated harvest of 99,757 tonnes per year (i.e. approximately 500 kg/ha/yr). The Laguna de Bay in Philippines also has a lot of fish pens yielding large quantities of different fish species.

MAJOR CONSTRAINTS HAMPERING SMALL-SCALE FISHERIES DEVELOPMENT

(i) Eventhough small-scale fisheries contributes immensly towards increased domestic fish production, its annual growth rate is said to average 3%. The current record of overall fish landings from Small-Scale Fisheries is almost if not in excess of presently estimated potential resources for the fisheries. This poses a major problem because fishing efforts should be based on optimum sustainable yield to ensure rational exploitation and good fisheries management.

(ii) A wide differential between the prices that the fishermen received and the prices at which fish is sold in the consuming areas.

(iii) Lack of basic infrastructure such as drinking water, medical and health care facilites and improved fishing equipment and techniques has caused the drifting of fishermen from the remote fishing settlements to urban areas and the unwillingness of fishermen to encourage their off-springs to take up fishing.

(iv) Inaccessibility of remote fishing settlements, and poor communication network.

(v) Use of crude methods of fish preservation resulting in high lossess and hence diminished earnings.

(vi) Many fishing settlements lack shore-based processing and preservation infrastructure such as fish storage and processing plants, repair workshop, net sheds, landing jetties etc. The non-availability or inadequacy of such facilites lead to loss of production time, especially when the fishermen have to carry their outboard engines to the main-land for repairs.

(vii) Even among the coastal States where fishing is the dominant activity in many areas, budgetary allocations to small-scale fisheries appear grossly inadequate when compared with allocations to other sectors.

(viii) Poorly organised and not well-managed fishermen Cooperative Societies.

(ix) Shortage of adequately trained and well-motivated Fisheries Extension Workers.

(x) Inadequate co-ordination in development planning and project implementation particularly with regards to the optimal utilization of supplied production inputs and established shore based facilities.

RECOMMENDED SOLUTIONS TO THE PROBLEMS FACING SMALL-SCALE FISHERIES DEVELOPMENT IN NIGERIA

(i) Conduction of fisheries resources survey of perennial fresh-water bodies, lagoons and flood plains because they are of high potentials for fish production.

(ii) Undertaking as a matter of urgency, acoustic survey of pelagic resources off-Nigeria's Coastline.

(iii) Setting in motion the machinery for mapping Nigerian Territorial Sea, and EEZ as well as fully strengthening all inspectorate patrol services in order to promote an effective protection of our waters from poachers.

(iv) Rational drive towards improvement/modernization of traditional craft and introduction of mechanisation. Traditional fishing crafts operated from open or sheltered beaches, creeks and inland waters require more than mere motorisation because of their limited carrying capacities for fuel, drinking water, gear, crew and catches. This handicap, apart, the stability and buoyancy of these boats coupled with the attendant hazards and incoveniences tend to make them unattractive to young operators. It is therefore, recommended that as the next logical step to succeed the motorisation of traditional craft operated by small-scale fishermen should be their modernisation into fibre glass.
However, this step should be further followed by mechanisation of various types of small and medium-sized craft suitable for operation in difficult coastlines, open beaches and inland waters. These should gradually replace dug-out motorised canoes. These Glass reinforced plastic boats could range from 6 - 10 m LOA and fitted with outboard or small inboard operated engines found economically desirable. Existing boatyards/or boatbuilding activities at the Kainji Lake Research Institute, Lake Chad Research Institute, States Fisheries Division and Federal Department of Fisheries should be strengthened financially and expanded by appropriate authorities to ensure the availability of these boats at prices within the reach of small-scale fishermen.

(v) Establishment of Capacity for Building Fishing Boats in the Country. As a long term measure and in the interest of the fishing industry, it is necessary for the country to organise its own industry either in the public or private sector to build the types of fishing boats required for the fishing industry. This programme should aim at establishing or developing existing boat yards by necessary strengthening for building exclusively fishing boats. These yards need not be gigantic organisations, as they will be building only small fishing boats to start with. The boatyards will also serve as training centres for boat-building technicians. The possibility of assisting small boat builders in the country to take up fabrication of GRP Canoes and fishing boats on a cottage industry basis should be explored.

(vi) Training of small fishing Boats Operators: A very important activity which should precede the introduction of large number of mechanised fishing boats is the training of operators who will man these boats - categorised as motor-men. This training which will be more vocational will be oriented towards teaching the elements of handling of small engines, navigation and fishing. Three such training and extension centres have been proposed for the artisanal small-boat operators.

(vii) Embark on an immediate feasibility study for cage/pen fish culture in lagoons and lakes to complement the harvest from capture fisheries.

(viii) Undertake full statistical survey of the Small-scale Fisheries Sector assessing all socio-economic parameters of Fishermen - total structure of the fishing community household, sanitation, education, social amenities, earners, dependants, non-earners, craft, gear types etc.

(ix) Massive manpower development and training:-

- Fishing Vessel Engine Room Officers
- Fishing Vessel Deck Officers and Skippers
- Ad-hoc courses for Ice Plant and Cold Storage Operators
- Establishment of Fishermen Training Centres (Mechanics, Fishing gear, Fishing boat operators)
- Refresher courses for old Fishermen and Extension workers

(x) Re-framing of statutory rules for manning of fishing vessels in consultation with the Federal Ministry of Transport.

(xi) Review of the policy of allotment of mechanised fishing boats because of the poor performance of most Cooperative Societies in Nigeria. Trained/Practising Fishermen could be alloted boats under guarantee of Government or Private Agriculture financial institutions.

(xii) Increase in fish production, preservation, processing and transportation inputs.

CONCLUSION

To compare the performance of Nigeria's Small-scale Fisheries a case of another developing country is focussed upon in Annex I of this report. It will be observed that different types of craft similar to those operating in or envisaged for Nigeria are already introduced or planned for introduction in Sri Lanka. Their performances are quite encouraging and with the correct institutional arrangements for setting up appropriate modules, comprising capture, landing, processing, transporting, supply and marketing services, for coastal and inland fishing locations the ultimate goal of attaining greater fish harvest from domestic sources and raising the socio-economic status of indigenous fishermen will be achieved. The South China Sea exprerience has shown that past efforts have met with the limited success because they were operated on too broad a scale, thus spreading of Government resources for guidance, management and technical assistance to fishermen Cooperative Societies or groups was too thin. Future effort might be more effective if it was channeled into particular areas i.e., a pilot scheme approach which would provide models for further cooperative development.

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Number of Fishing Boats 1979/83 - Coastal Fishery

	1979	1980	1981	1982	1983
28 - 32 Foot Boats					
1. No. of Boats at beginning year	2,240	2,305	2,505	2,619	2,751
2. No. of Boats going out during year	285	200	286	268	127
3. No. of Boats introduced during year	350	400	400	400	400
4. Total boats end year	2,305	2,505	2,619	2,753	3,026
17 - 24 foot FRP Boats					
5. No. of boats at beginning year	2,850	2,250	3,750	4,250	4,750
6. No. of engines replaced during year	150	250	360	660	610
7. No. of boats introduced during year	400	500	500	500	500
8. Total boats end year	3,250	3,750	4,250	4,750	5,250
Indigenous mechanized Boats					
9. Total boats at beginning year	3,150	4,290	4,750	4,900	5,080
10. No. of engines replaced	160	290	410	750	690
11. No. of engines issued	1,300	750	640	840	890
12. No. of craft mechanized during year	1,140	460	230	100	200
Non-Mechanized Indigenous craft					
13. No. of boats at beginning year	13,800	13,230	13,000	12,885	12,835
14. No. of boats mechanized during	1,140	460	230	100	200
15. Total boats end year	13,230	12,000	12,885	12,835	12,735

Estimated Output 1979-83 - Coastal Fishing Vessels

	1979	1980	1981	1982	1983
3½ Ton Boats					
Catch per boat year (tons)	21	22	22	22	22
Operating craft	2,273	2,405	2,563	2,685	888
Output	47,733	52,910	56,364	59,070	63,536
17-24 foot Boats					
Catch per boat year (tons)	11	12	12	12	12
Operating craft	3,050	3,500	4,000	5,030	5,000
Output	33,550	42,000	48,000	54,000	60,000
Indigenous Mechanized Craft					
Catch per boat year (tons)	7.5	8	8	8	8
Operating craft	3,720	4,520	4,865	5,030	5,180
Output	27,900	36,160	38,920	40,240	41,440
Non-Mechanized Craft including Craft Operating Beach seines					
Catch per boat year (tons	3.5	4	4	4	4
Operating craft	13,315	13,115	12,943	12,860	12,785
Output	47,303	52,460	51,772	51,440	51,140
Total Output	156,486	183,530	195,056	204,750	216,116

AN ANALYSIS OF THE STRUCTURE OF FISH MARKETING AND DISTRIBUTION IN KWARA STATE OF NIGERIA

by

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INTRODUCTION

It is generally recognized from the food balance sheets prepared by experts (NACD, 1972; FAO, 1966; Oyenuga, 1967) that Nigeria is a protein deficient country. Not only is the daily intake of protein low but the contribution from animal sources is extremely low. FAO (1966), calculated animal protein consumption of about 7 gm/caput/day for Nigeria. This is confirmed by the Second National Development Plan which states that "only 7 gm out of the 62 gm of protein available in the Nigerian diet come from animal sources".

Olayide et. al (1979) calculated that in 1975 protein from animal sources was 19.38 gm/caput. Protein from animal sources is often very expensive and beyond the means of an average Nigerian. Since many consumers spend as much as four-fifths of their incomes on food, they could not afford to consume adequate amounts of meat, especially beef and poultry.

It is envisaged that fish holds the promise of reducing protein deficiency in the country. A casual observation in the local markets shows that frozen fish is as much as 300% cheaper than any other meat. Fish (especially frozen fish) apart from being cheap, also has very high protein content and quality surpassing those of other animal proteins.

The bulk of the fish consumed in the country is frozen and are imported. Efficient and effective marketing and distribution of frozen fish is important to ensure that it gets to the hands of the consumers quickly in good quality and at prices they can afford. This undergirds the need for an efficient market structure

Market structure measures the number and size distribution of the existing competitors; it affects the conduct and ultimate performance of the market agents. The key element of market structure is the number of sellers and the total share of a few large firms in the market. As the number of rivals decrease, industry profits increase (due to high prices being charged) and draw nearer those found in monopolistic industries.

Objectives of the Study

The objectives of this study are to:-

1) examine the stucture of fish marketing in Kwara State,

2) examine the conduct of the participants within the market structure,

3) evaluate the performance of the marketing system with the aim of identifying bottlenecks, and

4) suggest ways of overcoming the bottlenecks.

Method of Data Collection

The data for the study were collected through the use of questionnaire schedule to interview fish traders in Offa, Ilorin, Erin and Ajase-Ipo. The markets covered are Oja-Oba market, Erin; Owode market, Offa; Pata and Oja-Oba markets in Ilorin.

The study focused entirely on frozen fish marketing. Fresh and dried fish could not be included because of problems of logistics.

All available cold stores in the study area were covered. The factors or dealers in each cold store were interviewed, and the attached agents and some of their retailers were also interviewed. The study was conducted between October, 1981 and March, 1982.

The relationships between the firms and their agents, the distribution of cold stores and markets around and within the towns studied were also investigated.

ANALYSIS OF THE SURVEY DATA

Structure of Frozen Fish Marketing System

In Figure 1, the structure of frozen fish marketing in the state as it is observed from the study is presented tracing the pattern of distribution from the firm to the consumer.

The Firm

The fishing firm is the sole source and major distributor of frozen fish in Nigeria. Most of these firms engage in chartering arrangements with foreign firms which travel to distant waters to fish. The Nigerian firms pay the foreign firms in foreign exchange for a specified amount and type of fish.

Some of the marketing firms, the Nigerian firm, have at one time or the other, operated their own vessels, but packed it up due to lack of qualified personnel to man and maintain the vessels.

The only Nigerian company that is operating its own vessels is the Nigeria National Fishing Company (N.N.F.C). The company operates in close collaboration with the Nigeria National Shipping Line, which is being financed by the Federal Government.

All other marketing firms engage in vessel chartering. Some of the active ones are Globe Fishing Industry, Trans Continental Fishing Company, Sadia Fishing Company, Ibru Sea Food, Universal Fishing Company, Messu Fish Company, and Intra Fish Company

All these firms have their headquarters in Lagos, with distributors or factors all over the country. In the case of Nigeria National Fishing Company distributors are appointed in each of the 19 states of Nigeria.

Ibru Sea Food and Globe are the oldest marketing firms in the frozen fish marketing. Consequently, they have their factors in many towns in the country.

There is a distributor of N.N.F.C. at Ilorin. And only two of the marketing firms (Ibru and Universal) are actively engaged in the state. The rest of the dealers operate independently.

Intermediaries

From the study, four types of intermediaries were identified in the frozen fish marketing. They include Firm Factors or Distributors, Independent Dealers, Agents, and Retailers.

(i) Firm Factors or Distributors

These are the wholesalers who sell on behalf of the marketing firms on an average commission of 40K per carton of fish sold. They consist of mostly men who have direct contact with the firms. From the discussions with these factors, there exist a sort of relationship between them and their corresponding firms. Some of them are:-

- (1) Former employees of the firm
- (2) Shareholders in the company
- (3) Relatives of the executives of the company who will recommend them.

The first two categories are common within the Ibru and Universal factors.

The N.N.F.C. distributors sells on a wholesale basis to the independent dealers and directly to few agents it has. The other two firm factors sell directly to their agents

No processing is done on their products. But the agents differentiate the fish on the basis of size and type.

Not many types of frozen fish were available on the market in the state during the period of study. Skumbia were the most common, while staverda followed, with small amounts of suban, moro, and stock.

The reasons attributed to this observation were that:

- 1) both skumbia and staverda are easy to come by, that is, from the firms.

- 2) they are relatively cheaper.

The latter reason justifies the high demand for both types in the state.

Entry to the wholesale sector of the marketing system is neither free nor restricted. It is both to some extent. The most important barrier is the deposit of ₦1,000 to ₦1,500 requested by the firms before supplying fish to the factors.

The cold stores for this group of people are at the expense of their corresponding firms. Therefore, any evidence of good market and competence in the handling of the fish are additional qualities the firms request for. This is to justify the existence of such cold stores in the area.

(ii) Independent Dealers

These are also a wholesale group, who buy directly from the firms and sometimes from their factors.

They own their cold stores, and are not in anyway required to buy from any particular firm or factors. Those who do not have licence or permit as factors, buy from licensed factors. Their patronage depends on the type and quality of fish the factor has to offer, as well as the price.

If when going round the factors in Lagos or Ibadan, they are able to negotiate for a lower price they will leave their former factor to buy at the cheaper place. They buy anywhere their choice of fish is available. They have the responsibility of transporting the fish to their station in their cold vans.

They also sell to their agents with a certain mark up. They earn a 20K commission from the factors and give it in return to their agents. They are very predominant in fish marketing in the state.

(iii) The Agents

The agents are the sub-wholesaler. They buy in quantities of about 2 - 10 cartons from their customers (factors or independent dealers), and sell to the retailers. Entry to the market is free as long as one has the money to buy in quantity. Those agents who are close to the factors can buy on credit for a day or two. These are mostly women who stay in front of the cold stores in which they buy. The regular agents do not leave their customers for another, but other agents buy anywhere they can get the fish. All sales in the cold store goes through the agents. They also sell to those household consumers who come to the store.

Some agents come from their various towns and villages to buy at Ilorin.

(iv) Retailers

The retailers are those who sell in small units to the household consumers. They hawk the fish from house to house. Some of them stay in the market place. They are mostly women of various ages.

A retailer can sell up to a carton in a day, but most of them do not sell more than half of a carton per day. They normally buy on credit from their specified agents. Entry is free as long as the agent is willing to take the retailer.

The above structure is rather general for frozen fish marketing in Nigeria.

In some cases these intermediaries are eliminated in the marketing system. The factors, and independent dealers sell directly to some institutional consumers. Such institutions include universities, hospitals, hotels and other schools.

However, the factors sell the fish to the institutions at a price higher than their agents pay. The difference ranges from ₦1.00 to ₦1.50 per carton.

MARKET CONDUCT

Interaction

The fish marketing firms and their intermediaries interact often when performing the marketing functions. The factors are directly in contact with the headquarters of the firms in Lagos. Each factor travels down to purchase his order of fish. He then transports the fish in his own cold van to his town. Those factors who have no cold van can order for an available firm's van to do the job for them. Such factors are charged ₦260.00 as the delivery fare from Lagos to any part of Kwara State by the firm.

The pricing of a carton of each type of fish is done by the firm alone, no negotiations on the part of the factor. The prices at which the factor can sell to the agents are also fixed by the firm. Thus making the factor a price taker. The Inspectors of the firm are sent from Lagos to pay the agents their commission of 20k on each carton purchased. This is deducted from the factor's 40k commission.

With this arrangement, the factor can not cheat the agents. The cordial relationship that used to exist between the firm and the factor is no longer there.

A few years back, if a factor incures some losses due to power failure he must report to the firm. The factor is requested to contact a Public Health Inspector in his area. The Health Inspector is to determine if the fish is good for consumption or not. He will then give the factor a certified copy of his report. If the fish is certified unfit for consumption the factor has to bury or dispose of the fish somewhere. He has to show his certificate to the headquarters of the firm in Lagos. The firm will then reimburse him for the losses. However, the situation has changed. Factors are no longer reimbursed for their losses because of abuse by some factors.

The independent dealers in their own case, have the right to buy anywhere comfortable and cheaper for them. The firm factors who have independent dealers as customers will be struggling to keep them. As a result any problem or complaint laid before him will be dealt with promptly. The independent dealers get their 40k commission immediately after purchase of the fish. In some cases, however, the commission is allowed to accumulate.

Trade Association

The only active trade association existing in the frozen fish marketing system is the Agent Association.

The Association is a very powerful one, which puts both the factors and the retailers at their mercy.

Normally, the firm expects the factors to fix the retail price for the agent. They are expected to add just about 50k mark-up to a carton, but this is not always the situation. A carton of 30 kg skumbia which the agents buy at ₦17.00 is, at least, sold to the retailers at ₦20.00 or ₦21.00.

Any factor who kicks against such a pricing policy or proves to be too noisy, stand the risk of losing his customers hip to another factor who is ready to ignore such antics. Through the association, market information is freely communicated. For example, within 24 hours all members must have known where good fish is available, and where prices are low. With such information, the factors are compelled to reduce their prices. Refusal to do so may mean losing his agents to other factors.

It is against the rules of the Association for any factor to sell directly to any retailer. And it is the responsibility of every agent to refuse sales to another member's retailer.

Though the marketing firm is against such association, the factors can not effect the firm's wish. This they do, so as not to lose their agents to the independent dealers who are less concerned about the Association.

Pricing Policy

At the wholesale level, the price is fixed by the firm. The price is determined by considering the cost of production, freight and other charges, making allowances for profit. The prices vary depending on the type of fish and market conditions. Table 1 shows the prevailing market prices at the various levels of marketing in the state, at the time of study.

The prices from the frim vary from time to time. Pricing depends on the general cost of production by the firm. For example, a factor at Offa bought a carton 20 kg skumbia at ₦12.50, and a week after, the factor bought the same type and size of fish for ₦12.00.

Table 1 - Frozen fish prices at various levels of marketing

Fish	PRICE IN (₦/kg)			
	Firm-factor	Factor-Agent	Agent-Retailer	Retailer-Consumer
Skumbia	0.54	0.57	0.67	0.74
Starverda	0.54	0.57	0.67	0.74
Suban	0.60	0.74	0.80	0.87
Stock	0.60	0.74	0.80	0.87
Mero	0.64	0.74	0.80	0.87
Macrobert	1.20	1.30	1.40	1.50

Source: - Field Survey, 1981

There is not much difference between the firms' prices, even though they set their prices independently. The firms pay an average of 40k commission per carton to their factors, out of which the agent is paid 20k as commission.

The factors usually add from ₦1.00 to ₦3.00 mark-up per carton. The independent dealers have to sell at the same price too because of keen competition in the market.

Table 2 shows the mark-up at each level of marketing. Since we do not know how much it costs the firms per carton, one can not compute their mark-up. The firm's representatives declined to give the necessary information.

The agents add a mark-up of ₦2.00 to ₦3.00, thus leaving the retailers who actually do the marketing with a meagre profit of ₦1.00 to ₦2.00 per carton. The agent also receives an additional 20k per carton as commission from the factors or dealers.

Table 2 - The profit level of the marketing agents

Agents	Average Mark-up (₦/Carton)
Firm	-
Factor	2.50
Agent	2.34
Retailer	2.00

Source: - Field survey, 1981

Selling is by negotiations and haggling by the consumers from the retailers. The profit which a retailer makes depends on her ability to sell and the type of fish she retails. The retailer gains more from a good, big fish.

Special Distribution of Cold Stores

Table 3 shows the distribution of the cold stores in the area of study. Majority of the cold stores are independent of any firm. The exceptions are Intra, Ibru, Universal and Rota cold stores which are owned by Intra, Ibru, Universal, and N.N.F.C., respectively. This partly explains the reason for the relatively high prices of the fish in the state.

Table 3 - Cold store distribution in the study area

Town	Total No of Stores	Rota	Ibru	Intra	Universal	Independent
Erin	1	-	-	-	-	1
Offa	4	-	-	-	1	2
Ajase	-	-	-	-	-	-
Ilorin	5	1*	1	1	1	2

* Supplied about 5 other small independent cold stores.

Source: - Field survey, 1981

Table 4 shows the distribution of factors, agents, and retailers in the study area. It is evident from the table that the independent dealers handle the majority of the marketing intermediaries.

Table 5 shows that over 46% of the retailers in the study area belong to the independent dealers. This explains why they are successful in terms of sales because the retailers are the active marketing intermediaries.

Table 4 - Distribution of factors, agents and retailers in the study area

	Company:- ROTA														
Town	F	A	R	F	A	R	F	A	R	F	A	R	F	A	R
Erin	-	-	-	-	-	-	-	-	-	-	-	-	1	16	50
Offa	-	-	-	-	-	-	1	15	300	1	6	30	2	22	360
Ajase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ilorin	1	20	310	1	10	200	-	-	-	1	8	120	2	21	420

F = Factor; A = Agent; R = Retailer

Source: - From the Survey Data

Table 5 - Distribution of retailers by firm

Firm	Number of Retailers	Percentage
Rota	310	17.32
Ibru	200	11.17
Universal	150	8.38
Intra	300	16.76
Independent	830	46.37

Source: - Field Survey, 1981

Table 6 shows the consumption level of frozen fish in the study area, as evident from the sales of the individual cold stores.

An independent cold store in Ilorin has the highest quantity of fish sold per month, 180 metric tonnes, from the data collected. This is followed closely by 167.25 tonnes from Rota Fish Company also in Ilorin.

Table 6 - Consumption level of frozen fish in the study area per month

Fish	Quantity Consumed/Month (metric tonnes)
Skumbia/Staverda	853.25
Macrobert	4.80
Stock	20.70
Suban	2.50
Mero	2.10

Source: - Field Survey, 1981

From the study, it was also observed that about 853.25 metric tonnes of skumbia and starverda is being consumed per month in the area, 4.80 tonnes of macrobert, 20.70 tonnes of stock, and 2.00 to 2.50 tonnes of suban and mero are also consumed.

The high consumption of skumbia and starverda is due largely to their ready availability in the market, and relatively low prices. They are also, always in small sizes thus giving room for about 4 to 5 fish pieces per kilogram - while only 2 to 3 pieces of mero or macrobert will weigh 1 kg. The local people who believe in number rather than weight then rush at staverda and skumbia.

PERFORMANCE EVALUATION

Distribution System

The distribution of frozen fish is to some extent efficient when compared with the handling and distribution of some other agricultural products in the country.

Fish transportation are relatively on a large scale to the southern parts of the country. This is due to few available sources of animal protein. Moreso, frozen fish is relatively cheap and an average family can afford it, as opposed to beef or mutton.

In the past it was the duty of the firm to take care of the delivery of frozen fish to their factors in various towns of the country; but now each factor takes care of the transportation of his purchase to his destination. Consequently, each factor tries to own at least a refridgerated truck. For the firm to help those who have no trucks, the factor will be charged. The charge is ₦260.00 for a load of 360 carton of 30 kg each from Lagos to Kwara State.

The agents in frozen fish marketing do exploit both the factor or independent dealers and the retailers. This they do by selling to the retailers at prices above the firm's recommended agent-retailers price. And also they share the factor or dealer's commission for fish sold at the factor's cold store, without paying rent for the place used.

The numerous retailers in the frozen fish marketing are the real sellers. They provide place utility to the consumers. Some frozen fish retailers go from door to door to canvass for customers who do come to the market to make their purchase.

Storage System

Fish freezing has been the major source of storage in the marketing system of frozen fish in the country. This system is efficient for fish storage as long as there is constant power supply. As a result, the factors usually instal electric plants to supply power to the cold stores in cases of power failure from NEPA. But then when the fish stays for a very long time it gets soft, becoming stale and stinks. Such fish have to be disposed at any price. However, arrangements are made through the agents to enable the retailers return the left-over fish to the cold store for preservation. If the remaining fish is not much the retailers may prefer to smoke-dry it for sale in the evening market.

Marketing Margin.

The marketing margin in the frozen fish marketing ranges between 37% and 45%.

Table 7 shows the marketing margin at each level of marketing.

Table 7 - Marketing margin at each level of marketing of frozen fish in the study area

Intermediary	Marketing Margin (%)
Factor	14
Agent	12
Retailer	9
Market	37 - 45

Source: - Field Survey, 1981

The marketing margin for the firm cannot be computed from the data collected because the cost price of each carton to the firm is not known.

The factor receives an average of about 14% of the consumers money while the agent and retailers receive about 12% and 9% respectively.

The marketing margin of 37 - 45% is considered high because no processing is done on the fish. The high marketing margin is basically due to the many intermediaries in the marketing system.

The 12% margin by the agents is very high, and in our opinion, exploitative. The agents do not perform active marketing functions. If the agents can be removed, or their excesses minimised, the burden on the consumers will be lightened.

The retailer's 9% could be considered fair. But when an individual retailer is considered with her sales, the marketing margin of 9% is low. A retailer cannot sell more than a carton per day at most. It then means that a retailer, if lucky to sell a carton per day, cannot make more than ₦2.00. Majority of the retailers sell about half a carton per day, and make ₦1.00 profit per day.

On the other hand, an agent can sell an average of ten cartons per day, with a mark-up of ₦2.34 on each carton, or a total of ₦23.40 daily. Comparing the agent's income of ₦25.40 per day with the retailer's ₦1.00 (or ₦2.00) and their respective marketing functions, it is easily observed that the retailer's earning is very low.

The factor makes an average profit of ₦2.50 on a carton. This is not much considering his cost of transportation, power supply, salaries and other costs which he has to bear.

POLICY IMPLICATION

To meet the proposed estimate of 1.5 million metric tonnes demand of fish in 1985 (1) meaningful policies as well as its implementation should be intensified in fish production.

Some of the problems causing the bottleneck are the inadequacy of capital for local fishermen to transform their largely subsistent fishing into commercial fishing; lack of infrastructure, especially fishing terminals; and the shortage of trained manpower. In fact, until very recently, none of Nigeria's institutions of higher learning offered either short-term or full-time courses in fisheries sciences.

The local fishermen have had over the years to cope with crude and make-shift equipment, such as outboard engines, synthetic nets, indicator buoys and boats, were beyond their means.

Re-organization of the Marketing System

The investigation carried out in the study area indicated that profit of all the middlemen in the frozen fish marketing varies between 37% and 45%. There is need to re-organize the marketing system so as to eliminate some of the operatives.

The presence of the agents in the marketing system is a bottleneck to the factors and retailers. Much more embarrassing is their powerful trade association in which they decide their relationship with the factors and retailers.

The firms do not in anyway recognise or have anything to do with the retailers. They recognise, instead, the agents and even pay them 20k commission on each carton their retailers can sell. A lot of risks are being taken up by the factors too because the firms do not seem interested in their operations other than the sales of fish.

To correct the short-comings enumerated above the following policy changes are recommended:-

The Federal Government should endeavour to enforce good management and implementation of its fisheries planning as well as its formulation. More of cold storage and ice-making machines should be purchased. These are expected to reduce losses of fish and fish products due to spoilage. Also, an intensive storage system should be formulated through research and extended to the local fishermen and itinerant traders.

The Federal Government should take more intersest in the activities of the firms, not merely establishing a National Fishing Firm. A network of pricing system should be formulated for each type of fish at which the firms should sell. The price must give fair consideration to the cost of production by the firms. This will go a long way in reducing the price per kilogram of the frozen fish, as well as reducing the heavy burden on the consumers.

The agents should be eliminated from the frozen fish marketing system. In the alternative the factors could be given the power to fix the prices at which the agents should sell to the retailers. This will reduce the high margin presently enjoyed by the agents. In the agents place, the retailers should be recognised by the firms, and the 20k commission being paid to the agents on each carton sold should go to the retailers. This will compensate the retailers for their hard work and improve their standard of living.

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THE ROLE OF RESEARCH AND RESEARCH INSTITUTES IN FISHERIES DEVELOPMENT IN THE 1980s

by

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INTRODUCTION

This paper is merely an outline of some ideas the author hopes to develop further in the near future, and therefore, cannot pretend to have dealt exhaustively with this important subject in a symposium of this nature. If however, it succeeds in generating the expected discussion and if it leads to the formulation of research strategies for fisheries development in the 1980s, it would have fulfilled its immediate objective.

Fisheries research in Nigeria, unlike agricultural, livestock, and forestry research, started rather late. A review of these beginnings and of the earlier works of WAFRO (West African Fisheries Research Organisation) in Freetown, the Federal Fisheries Service etc., is found in ANON (1974). Trained Nigerians were not engaged in actual fisheries research until the late 1950s and early 1960s, and some of the pioneers in this field are with us at this Conference. Perhaps it may be correct to say that organised fisheries research in Nigeria by Nigerians is not more than 30 years old, and the more dynamic and productive periods would be from about 1960 till now. This is, relatively speaking, a very short time. Furthermore, the numbers of research workers devoted to fisheries research has been and is still very small. In 1980, while compiling a register of fisheries research work and researchers it was found that fisheries researchers were less than 200. Some of them could not really be called fisheries scientists because they had not received specialised training on the subject. The traditional base source of many of these fisheries researchers was a first degree in zoology, botany or some related natural science and without further exposure, training and experience one knows little about fisheries after these degrees. Consequently, most of the more experienced fisheries researchers have invariably undergone post-graduate courses in Overseas and more recently in local institutions. However, most of these courses have led to the production of fishery biologists and ecologists. Those who have qualifications and expertise in fish marketing, fish processing and preservation technology, fishing gear and craft technology, and aquaculture technology or any other kind of technology of fish production, are still very few indeed.

Science and Technology

It was the famous Indian scientist, Dr. Swaminathan, FRS, in a lecture at the Research Management Workshop for Directors of Research Institutes at ASCON in 1980, who defined the difference between science and technology as follows:-

- "Science is the advancement of knowledge,

  Technology is the advancement of production".

Although technology progresses from advances in science, without it production is hampered. There is no doubt at all that inspite of the few research workers, inadequate research institutions and funding, Nigerian fisheries scientists have made enormous contributions in advancing our knowledge of our marine and fresh water fishes and fisheries. Some of these achievements especially in knowledge of biology, abundance and distribution of some of the marine continental shelf fish and shrimps have had desired impact on stimulating the growth of industrial and artisanal fisheries. In the fresh water sector a great deal still has to be done in resource inventory survey and on the knowledge of the biology of fish species suitable for culture. By contrast our contribution in the area of technology has been smaller and only in the last decade have some significant achievements been made in fish processing technology.

(3) A third Institute; Aquaculture Research Institute (ARI) should be set up because of the importance of aquaculture in the 1980s with its headquarters in Port-Harcourt (Aluu).

For the effective co-ordination of these three fisheries research institutes, there should be a Director-General of Fisheries Research based in the parent Ministry controlling fisheries Research. The location of the parent Ministry for the time being should be the Federal Ministry of Science and Technology until such a time when a Ministry of Fisheries is created. If this happens then Fisheries Development Department (FDF) and the Research Institutes could come under the same Ministry.

Fisheries Research in Universitites and Institutions of Higher Learning

The Universities will continue to provide a forum for detailed basic research in support of fisheries development. Specialized areas like fish physiology, nutrition, breeding genetics, fish deseases, parasites and their control, fishery limnology and ecology are some areas that come to mind. The primary and most important role of these institutions will be to develop worthwhile fisheries degree programmes to produce functional fisheries officers for the development and research needs of this country. Graduates from our Universities in the traditional zoology, biology, and natural sciences do not have the knowledge to apply in fisheries as for example, Agricultural, Veterinary and Forestry graduates. Even those Universities which have started courses in fisheries still need to revise their course content to produce more functionally effective graduates. The Research Institutes need people who can carry out research if possible with minimum supervision and those seeking to join them should at least have a minimum of an M.Sc. degree in Fisheries. But the Fisheries Development Departments will be happy to have B.Sc. graduates if they are equipped to do fisheries work. It is suggested to increase the length of the B.Sc. Fisheries course to make it a professional course like Agriculture or Engineering i.e. 5 years and such graduates will enter the service in GL. 09 or GL. 10 and be more useful to the development of Nigerian fisheries in the 1980s.

SECTION 3: FISH EXPLOITATION AND CULTIVATION

FISH AND FISHERIES OF BAKOLORI RESERVOIR

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ABSTRACT

This report is an exposition of fisheries activities carried out in Bakolori Reservoir within the context of many and varied functions of Sokoto Rima River Basin Development Authority.

In order to study the fish fauna and its trend, experimental fishing was conducted for 55 days in 1979 when the reservoir was only one year old and the exercise continued in 1980 and 1981 also for 85 and 52 days respectively. During the three years exercise only bottom set gill-nets of 5-10cm mesh size were operated at various depths and the catch per unit effort showed an increasing trend with increasing efforts by four times to that of the initial.

The fish harvest was 1.205 kg per day when 3.8 nets were operated in 1979, this went up to 3.2 kg when the number of nets were increased to 8.37 per day in 1980. This increasing trend continued in 1981 season also when 16.15 nets caught 5.756 kg fish per day. A direct relationship has been observed in the fishing efforts and catch. The catch per 1000 m² net operated also showed a positive trend, as it was recorded 4980.4, 5865.3 and 5567.9 gms for three years respectively. Tilapia, Clarias, Labeo, Schilbe and Synodontis spp, were the most predominant fish species in the catch and contributed more than 97 per cent of the total fish harvest.

Due to high turbidity and resultant low transparency, the production potentials of the lake are likely to remain lower than many man made lakes of Africa. Large number of trees and forest areas left uncleared prior to inundation are now partially or fully submerged and pose serious problems and threat to fishing operations. If the proper benefits are to be realised from the fisheries potentials of the reservoir, it should be stocked adequately with fast growing fish seed. The potential fishing grounds should be improved and the under-water trees and bushes should be cleared for smooth, economic and efficient fishing. Use of all kinds of nets having less than 8cm mesh size should be stopped to prevent over exploitation of juvenile fishes for a period of at least two years after the reservoir is stocked.

INTRODUCTION

Bakolori Reservoir is located between latitudes 12.25 N and 12.35 N and longitudes 6.10 E tp 6.17 E. The reservoir comes under the administrative boundry of Talata Mafara Local Government near Bakolori Village (now submerged) in Sokoto State of Nigeria. The project was first identified by the F.A.O. in 1969 as the first phase of Sokoto and Rima River Basin Development Plan. The feasibility study of this project was completed in 1974 and the contract for its construction was awarded to Messrs Impresit Bakolori (Nigeria) Limited an indiginised Italian company, while the review of detailed design and supervision was entrusted to Messrs M.R.T. Consultants Limited, also an indiginised British Firm. The dam was completed in 1978.

This reservoir has approximately 8000 ha water area at maximum reservoir level with a dendric shore line. Approximately 4000 families (14000 people) were affected by the creation of this water body. They have been resettled in three new villages namely New Maradun - 2700 household units, Gidan Dan Kano - 1200 household units and Kuka Mai Rafu - 100 household unit.

Bakolori reservoir like most other reservoirs in the world was also constructed for well defined purposes such as irrigation. Development of 23,000 ha farm land, water supply, hydro-electric and flood control etc.

Salient Features of Bakolori Reservoir

Reservoir area at maximum flood level	8,000 ha
Gross storage capacity	450 mill m³
Normal pool elevation	334. m.a.s.l.
Maximum pool elevation	320 m.a.s.l.
Maximum flood elevation	338 m.a.s.l.
Length - concret dam	353 meters
Length - earth fil dam	5135 meters
Length of shore line approximately	107 km.
Annual rainfall	689 - 760 m.m.
Air temperature	12.0 - 39.9 C
Hydropower turbines and generation	2 Nos. 1.6 MV each
Irrigation canals	
Supply canal	15 km 35 m³/Sec.
Main canals IL & IR	2 Nos. 45 km Total
Secondary canals	200 km
Tertiary canals	300 km
Field channels	800 km.
Pumping Station	
Irrigation lift	2 Nos.
Sprinklers	25 Nos.
Drainage	2 Nos.
Pumps	160 Nos.
Burried pipe line	500 km.
Mobile Alluminium pipes	800 km.

It is envisaged from the project that in addition to 147,821 tonnes of various food grains, approximately 450 tonnes of fish would also be produced annually from various types of fisheries resources created by the lake formation and irrigation network.

MATERIALS AND METHOD

The data collected and analysed in this paper are of a fishing unit consisting of two fishermen, a boat and varying number of shore set nylon gill nets of 32 meter length and 2 meter depth. The most common and effective mesh sizes, were 5-10cm. The head rope was provided with floats and foot rope with lead sinkers to keep the net in standing position. To have a comparative idea of catching efficiency at times surface gill nets of the same mesh sizes were also operated but found quite ineffective as these nets used to get rolled up due to high speed hermattan winds and wave action. All the data if otherwise not mentioned are refered to shore set gill nets only.

In starting, usually the nets were operated in mid day and collection of fish catch was done in the following morning. In order to minimise the damage in nets they were allowed to remain set on the same fishing ground until the fishing site was changed. The per day catch thus could be refered as catch per 24 hours.

RESULTS

Fishing Operation

During 1979 fishing season, fishing was conducted for 55 days in the month of July, September, October and December and the number of fishing days in each month varied considerably. In July, 79 fishing was conducted for 17 days while in September, October and December it was conducted for 14, 16 and 8 days respectively Table 3. The overall mean catch per fishing day was 1.20 kg, but it varied considerably from first two months to that of last two months i.e. 1.0 kg to 1.5 kg per fishing day respectively.

Like the number of fishing days, the number of nets operated in each fishing month also differed. However when the number of nets were increased to 8.3 nets per fishing day in 1980 from 3.8 nets of 1979, the catch went up by 2.6 times i.e. from 1205 gms in 1979 to 3144.3 gms in 1980. It gave an indication that the efforts could still be increased without endangering the fish population, when the number of nets per day were again doubled in 1981 to 16.15 nets, the catch also followed the same trend with average fish landing of 5756 gms per day. The steady increase in catch per unit effort and stabilised catch rate per 1000 m^2 net i.e. 4980.4, 5865.3 and 5567.9 gms for 1979, 1980 and 1981 fishing seasons repectively. Table 1, indicated that marginal profit could be derived if the fishing efforts are further intensified. The catch per 1000 m^2 net area was quite different from what was observed by Ita et al. 1982, (261 gms per night for the same net area). Inspite of the fact that the number and area of the nets operated daily were almost doubled in previous years, the catch rate also increased accordingly without adversely affecting the catch per unit net area. It was an indication that fishing efforts could be intensified to start commercial fish exploitation.

Table 1 Various fishing parameters for the three fishing years

ITEM	1979	1980	1981
No. of fishing days	55	85	52
No. of the nets operated	208	712	840
Fish harvested in kg	66.3	271.8	299.4
Av. No. of fishing days per month	4.6	7.1	4.3
Av. No. of nets operated per fishing day	3.8	8.37	16.15
Av. net area operated daily in m^2	242	535.6	1033.6
Av. catch per 1000 m^2 net gm	4980.4	5865.3	5567.9
Av. catch per fishing day in kg	1.205	3.144	5.756

As fishing months are different in different years, it is difficult to compare the catch per unit effort of a perticular month to the corresponding month of the following year. However, it has been observed during the examination of commercial fish catches of 1982 that catches were generally higher in rainy season, it may be due to up-stream migration of most fishes in this season for spawning and there they are usually fished with one gear type or the other.

Species Composition

Ita *et. al.* (1982) · identified 17 species in Bakolori Reservoir. During the catch analysis of experimental fishing, five species were found contributing 97 per cent of total catch. In order of predominance *Tilapia*, *Labeo*, *Schilbe*, *Synodontis* and *Clarias* spp, are the important fish species, while the remaining 12 species contributed around 3 per cent of the catch.

When the catch composition of 1980 and 1981 experimental fishing seasons are compared with the commercial catch of 1982, interesting trend in the species composition could be observed. *Labeo* spp. contributd 22 per cent of total catch in 1980, but went down to 20.6 and 14.1 per cent of the catch in 1981 and 1982 respectively. *Tilapia* spp. showed an increasing trend from 12.0 per cent in 1980 to 45.2 per cent in 1981 and 1982 fishing seasons. *Synodontis* spp. appeared to be most affected as it recorded 38 per cent in 1980 but sharply decreased to 9.2 and 8.9 per cent in 1981 and 1982 fishing seasons. *Clarias* spp. made up 11.0 per cent of the catch in 1980, but came down to 7.9 per cent in 1981 and again went up to 19.5 per cent in 1982, while there has been a mixed trend in *Schilbe* spp. Table 2. Though the experimental fishing was conducted with a single gear type i.e. shore set gill nets, the catch composition cannot be said to be a good representative sample of the fish population of the reservoir. Nevertheless it gives an idea as to how the gill net fishery is shapping in the reservoir.

Most species caught during the experimental fishing were less than 100 gm average weight except *Labeo* and *Clarias* spp whose average weight varied between 200 - 300 gms. Though at times some specimen of *Clarias* had been caught weighing 5 to 6 kg by private fishermen, their frequency was low. Most of the important species which could attain a good size are yet to be recorded such as *Lates niloticus* (Giwan ruwa), *Gymnarchus niloticus* etc. Probably they do not exist in the reservoir and need to be introduced.

DISCUSSION

It is observed from the last three years study that there is a general paucity of fish species in the lake and the position is not likely to change remarkable until the economically important fish species are stocked intensively in the reservoir. As there is no perennial river emptying into the reservoir there is hardly any chance of natural recruitment of new species other than what already exists in the lake. Table 2 shows the pattern of the fishery. It appears that *Tilapia* is increasing in number while its average size and weight in decreasing year after year. This species contributed approximately 45 per cent of the total landings within the last two years. However, the average size and weight has decreased from 19.6cm to 17.0cm and weight from 93.9gms to 89.4gms. It shows that more fish have been caught per unit weight.

The same trend has been observed in the case of *Labeo* spp also which appears to be the most affected one. The average size of Labeo has reduced considerably from 31.4cm in 1980 to 22.5cm in 1981 and every specimen has gone down by 100.3. gm in weight. Not only the average size is affected but its percentage contribution has also gone down to 14.1 per cent in 1982 from 22.0 per cent of 1980. *Synodontis* species although they did not reduce in average size its contribution in the total landings has significantly gone down from 38.3 per cent to 9.2 and 8.9 per cent in 1980, 1981 and 1982 respectively. Most *Synodontis* caught from the reservoir were of the uniform size i.e. 19.0cm. The decreasing trend in average size of the important species is probably the direct result of inadequate natural food in the reservoir. Bakolori reservoir has very high turbidity round the year which has normally been observed to be about 360ppm. The high turbidity causes low transparency and low light availability to

Table 2 Morphometric Data and catch composition including commercial fishing of 1982

Species	Av. Length in (cm)		Av. Wt. in (gm)		Catch Composition per cent by Wt.		
	80	81	80	81	80	81	82
Labeo spp.	31.4	22.5	297.3	197.0	22.0	20.6	14.1
Tilapia spp	19.6	17.0	93.1	89.4	12.0	45.8	45.2
Clarias spp.	34.2	29.9	318.5	279.6	11.0	7.9	19.5
Schilbe spp.	22.0	21.4	87.2	92.7	12.9	14.4	9.5
Synodontis spp.	19.0	19.1	128.0	83.3	38.3	9.2	8.9
Others	18.7	18.9	85.8	75.5	3.8	2.1	2.8

Table 3 Details of Fishing efforts

Month	1979 Number of			Catch per Net in gms	1980 Number of			Catch per Net in gms	1981 Number of			Catch per Net in gms
	Fishing Days	Nets Used	Fish Caught kg		Fishing Days	Nets Used	Fish Caught kg		Fishing Days	Nets Used	Fish Caught kg	
January	-	-	-	-	-	-	-	-	19	208	62.5	300.4
February	-	-	-	-	-	-	-	-	7	120	51.5	429.1
March	-	-	-	-	13	88	18.7	212.5	6	120	32.8	273.3
April	-	-	-	-	6	32	6.6	206.2	-	-	-	-
May	-	-	-	-	12	107	44.0	412.2	20	392	152.6	389.2
June	-	-	-	-	19	177	94.5	533.8	-	-	-	-
July	17	51	16.0	313.7	18	164	60.3	367.0	-	-	-	-
August	-	-	-	-	6	48	8.0	166.6	-	-	-	-
September	14	62	15.8	245.8	-	-	-	-	-	-	-	-
October	16	63	231.4	731.2	-	-	-	-	-	-	-	-
November	-	-	-	-	-	-	-	-	-	-	-	-
December	8	32	11.1	346.8	11	96	39.7	413.5	-	-	-	-
Total	55	208	66.3	318.7	85	712	271.7	381.6	52	840	299.4	356.4

subsurface water layers and subsequently it leads to low photosynthesis and primary productivity in Bakolori than other Nigerian reservoirs, such as Tiga and Kainji Lakes. The low primary productivity results probably in tough competition for food among different plankton and phyto-phagous fish species and thus the average size of fishes is adversely affected.

Large scale destruction of fully gravid fishes have been noticed in rainy season when mature males and females are migrating upstreams for spawning. The fishermen normally catch these fishes by crude fishing methods and in times to come it may adversely affect the natural recruitment. It is therefore necessary that a complete close fishing season from 15th of May to 15 of July, is observed every year, and catching of all kind of fishes declared illegal. For this purpose a suitable legislation should be enacted at National level to provide protection to the natural fisheries resources, which are now being exploited indiscriminately. The law should be supported by vigorous extension exercise among the fishermen community to enlighten them about benefits of not catching any fish during this period. Though it would be difficult to enforce the law at the beginning the fishermen might cooperate with the law enforcement agency after seeing the results.

Commercial Fish Exploitation

When the reservoir was first filled the fishermen living around the reservoir started operating different kinds of fishing gears and their catch varied from a few grams to a few kilograms/day. A systematic approach was adopted during 1982 commercial fishing season to collect the various statistical data of fishing operations. Out of 80 fishermen living around the reservoir (Ita 1982) only 43 fishermen on an average were engaged in daily fishing and caught approximately 98.8 kg of fish per day and 2.3 kg fish per fisherman. Approximately 36.068 metric tonnes of fish were harvested at an average production rate of 4.5 kg of fish per ha per year.

There are three main fish landing centres around the reservoir namely Dam site, New Maradun and Kuka Mai Rafu. The data were recorded normally once a week at every centre. The catches were comparatively lower in the reservoir and the average size of individual fish species was smaller in comparison to other African reservoir. The low catch per unit effort probably does not encourage the fishermen to intensify the fishing efforts.

CONCLUSION

The individual size of different fish species caught from the reservoir is comperatively smaller and it has been observed that it is decreasing year after year.

The average catch per unit effort is rather low. Probably there are more fishes around submerged trees and bushes because fishermen prefer to operate their nets around bushy areas. The under water trees and bushes pose serious problem in fishing and navigation. At times it has been found that the new nets operated once are damaged badly and thus making them unservicable. Fishes attaining large sizes such as *Lates niloticus* and *Gymnarchus niloticus* are absent in the lake.

The fishermen generally fish with old and traditional fishing gears. The catch is usually sold in fresh condition to the middle men operating around the landing centres who transport it to the local markets in unpreserved and uniced condition.

RECOMMENDATION

The reservoir should be stocked heavily with the fast growing fish species. Plankton feeders should be preferred for stocking. Fishing in the reservoir with less than 8cm mesh size should be prohibited in order to prevent over-exploitation of juvenile fishes. Submerged trees and stumps should be cleared off from the potential fishing grounds as and when such areas are exposed due to the draw down of the water.

Proper and modern fishing gears such as, gill nets, cast nets, drag nets and hook and lines should be provided to fishermen for smooth and efficient fishing operations.

A close fishing season should be observed from 15th of May to 15th of July every year in order to increase the natural recruitment of fishes through breeding and protection.

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FISH PRODUCTION FROM AQUATIC WEEDS

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ABSTRACT

The Nigerian fish demand is increasing tremendously and possibly has to be met by aquaculture. Irrigation in the eleven River Basin Authorities and in particular in the South Chad Irrigation Project and the Baga Polder Project is also increasing and demands high yearly investments for aquatic weed control in canals and drains. If the weeds are biologically controlled by the grass carp (Ctenopharyngodon idella Val.), the costs will be turned into profit, particularly when the fish production (resident fish plus grass carp) is harvested and sold for food. The use of irrigation canals and drains for aquaculture in the form of fish polyculture will be a wise step towards increased fish production. This paper highlights the concept of fish production from aquatic weed control and concludes that it is a proven profitable venture in several countries.

INTRODUCTION

In most river basin irrigation schemes in Nigeria, many of the kilometers of ditches, canals and reservoirs are known to be overgrown with submerged, emerged and floating weeds and by filamentous algae partly due to increasing eutrophication. In order to maintain water flow and irrigation, most of the weeds in these waterways have to be removed by one method or by a combination of methods.

All weed control practices can be broadly classified into three (Akobundu, 1980). These are chemical, cultural and biocontrol methods.

CHEMICAL CONTROL METHOD

Although submerged, emerged and floating weeds in the waterways could be removed by chemical means, many chemical control methods are hazardous to ecological balance of the aquatic ecosystems and to the farmer himself.

CULTURAL CONTROL METHOD

The traditional method of removing water weeds is cuttingby hand and raking out. However, hand weeding cannot be applicable in channels filled up by dense masses of submerged filamentous algae and species like Ceratophyllum demersum L. This weed has been reported to be present in Lake Chad (Okafor, 1980). The usual thing will be to employ a system of mechanical cutting from a boat.

Both hand and mechanical cutting have the serious disadvantage in that weeds begin to grow again as soon as they are cut, and with many water weeds regrowth can be rapid. Vegetative fragments of most aquatic weeds will grow rapidly if they are left in the water unless removal operations are very thorough. Indeed attempts at mechanical control may merely serve to spread the infestation. Such work is very time-consuming particularly in raking out cut weeds, and arduous. It is therefore becoming increasingly difficult to find men willing to undertake work of this nature and the cost of employing them is rising continually.

BIOCONTROL METHOD

It is recognised that grass carp (Ctenopharyngodon idella Val.) a herbivorous fish can control growth of aquatic plants. It has been successfully used in the Netherlands (Boquet, 1977; Van Zon, 1977; Riemens, 1982), Switzerland (Muller, 1979), United Kingdom (Scott and Robson, 1970; Scott et al, 1971 and Buckley, 1981), East Germany (Janichen, 1973), the Soviet Union (Aliev, 1976) and Egypt (Gharably et al, 1982).

Reasons for the considerable interest in this Asiatic herbivorous fish or phytophagous fish all over the world include:-

(a) First of all, and what seems to be of essential importance is the fact that it is a plant-feeding species. The grass carp feeds on macrophytes and algae and is not a highly selective consumer for it eats quite a number of aquatic weeds

(b) Another important thing is its ability to adapt to various climatic conditions since it comes from a continental zone with hot summers and severe winter conditions.

Other important factors are:

(c) its fast rate of growth

(d) its big size

(e) its resistance to handling

(f) easy to culture including artificial propagation

(g) its good taste when used for food.

It is primarily used for biological control of the overgrowing water reservoirs, canals and channels.

In Egypt, Gharably et al (1982) demonstrated that the use of grass carp for the control of weeds in canals and drains forms an attractive alternative to the traditional means of weed control: manual, mechanical and chemical; and is indeed more economical; and that the growth of grass carp stocked in canals and drains enables a considerable annual harvest to be cropped without affecting the capacity needed for proper weed control. In this way the grass carp can contribute to the protein consumption of the people. Van Zon (1980) reported that the grass carp shows most perspective because of its fast growth and good marketability, and that it is not bound to one food source but it is a polyphagous, non-selective feeder, especially in temperatures over 20°C.

FISH PRODUCTION/HECTARE

Maembe (1981) reported that Lake Chad is one of the richest fishing grounds in the world with 80-100 kg/ha yield. However, it has been shown in Egypt that growth of grass carp will result in a yield of 360 kg/ha/year (Khattab et al, 1982) for human consumption without interfering with the control of aquatic weeds. Van Zon et al (1982) reported that even if the purpose of grass carp production in irrigation systems will be limited to weed control and some extra protein production, the yield could easily be around 500 kg/ha/year (without additional feeding or fertilization).

ECONOMIC GROWTH

The grass carp obtains its nutrient requirements completely from eating aquatic plants and does not require any expensive dry pelleted fish-food.

DANGER IF ANY

In some countries, the method of biological control with grass carp is not allowed because of the danger of the possible reproduction and naturalisation of the species, following introduction. In 1975, a new triploid sterile hybrid of grass carp and bighead (Aristichthya nobilis Rich.) was developed (Marian and Krasznai, 1978) which can be used for the control of aquatic vegetation without the risk of unwanted overpopulation. This is cheaper, more effective and more acceptable in view point of environmental protection.

SUMMARY

In the river basin schemes of Nigeria, it is common practice to control aquatic weeds in irrigation canals, channels and drains manually and mechanically. In order to avoid the hazards of cheaper chemical weed control on human health, fish production and the quality of irrigation water, and to reduce costs and increase the efficiency of aquatic weed control, the grass carp could be introduced as an alternative method. The development of a sound weed control programme with grass carp, adjusted to the specific conditions existing in most river basin irrigation systems will result in enormous increases in fish production. This will be a desirable situation as the strongly increasing Nigerian fish demand has largely to be met by aquaculture. This successful venture has been found profitable even in African countries.

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A PRELIMINARY INVESTIGATION INTO THE EFFECTS OF A SEX-REVERSAL ANDROGEN, METHYLTESTOSTERONE, ON FOOD UTILIZATION AND GROWTH OF *Sarotherodon niloticus* (L) Fry

by

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ABSTRACT

Three groups of Sarotherodon niloticus fry were fed for 8 weeks on diets either treated with 17-&-methyltestosterone (MT), alcohol (CA), or untreated (CO). Growth rate and food utilization in the different groups were compared. Results indicate that the best growth, Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and Mean Growth Rate (MGR) were obtained with the MT diet. There was no significant difference (P 0.05) in growth and food utilization of the CA and CO fry, nor in the mortality rate of the three treatments. The androgen, methyltestosterone promotes growth and protein anabolism without producing toxic effects in S. niloticus.

INTRODUCTION

One of the major set-backs in the intensive culture of Sarotherodon niloticus and other tilapia species is their prolific fecundity (Lowe, 1955; Hickling, 1960). This leads to over-population of ponds and high competition, and hence production of tiny fish. To overcome this, procedures such as combined stocking with piscivorous fishes, irradiation, monosex culture, cage culture, gynogenesis and sex reversal have been tried. Of all the methods researched into, sex reversal involving the use of either an androgen o r estrogen seems to be the most modern and the most acceptable (Yamamoto, 1953; Guerrero, 1975; Fontaine, 1976; Tayamen & Shelton, 1978; Balarin, 1979; Nagy et al., 1981; Donaldson & Hunter, 1982). However, Yashouv and Eckstein (1965) found that a female hormone like ethynylestradiol caused high mortalities and growth retardation in fish. Guerrero (1975) using S. aurea observed that androgen treated fish had a better growth than estrogen treated fish or the untreated fish. He suggested that this was due to the hormonal effect on metabolism. Using other species of tilapia or sarotherodon, similar results have been obtained by other workers (Dadxie, 1974; Tayamen & Shelton, 1978). Odunze, (1981) obtained 100% sex-reversal efficiency with either 60mg of ethynyltestosterone/kg of feed or 30mg of methyltestosterone/kg of feed in S. niloticus.

It is striking that there is no available literature on the influence of sex reversal hormones on food utilization in S.niloticus. Work by Shackley and King (1978) in which they observed that high molecular weight protein was transfered from the liver to the ovary and accumulated in developing oocytes in Blennius pholis (L) suggests that protein efficiency ratio in fish could be greatly affected by hormone treatment.

It would therefore be useful to determine the effect of methyltestosterone on food conversion and growth of S.niloticus fry. This knowledge would be useful in deciding whether this hormone could be used on long term basis to "fatten" S. niloticus. Such an exercise would of course depend not only on the economy, but also on the fish tissue residue of the androgen on withdrawal of hormonal treatment.

MATERIALS & METHODS

Commercial pelleted fish feed from Nigerian Institute for Oceanography and Marine Research (NIOMAR), Lagos, was crushed and sieved through a 0.5 mm mesh-size sieve. The hormone, 17-&-methyltestosterone (Sigma Chemical Co. Ltd., USA) was dissolved in 95% solution of alcohol and mixed with diet at 30mg hormone/kg diet. Homogenisation was accomplished with a food mixing machine. Two control diets, one treated with only alcohol (CA), the other treated with neither alcohol nor hormone (CO) were similarly prepared. All diets were dried over a fan heater in a drying cabinet at 30°C.

Approximately 1000 fry of <u>Sarotherodon niloticus</u> collected from Panyam Fish Farm near Jos were used for this investigation. Fish measured between 9-12 mm and weighed 68.83 mg ± 2.08 mg at the start of the experiment. During quarantine treatment which lasted one week, fish were fed 3 times daily on a total of 3% of their body weight on the NIOMAR diet. On the first and fourth days of quarantine period, fish were dipped for 10 seconds in 1ppm solution of potassium permanganate. Fish were weighed and stocked at 60 fry/tank in 12 green plastic tanks held in a water recycling system of Jos University Applied Hydrobiology and Fisheries Aquaculture Unit (Madu, 1982), care being taken to balance out the weights of fish in the tanks. Each tank contained 16 litres of water and flow-through rate was 2L/minute. The water temperature was same as that of the Aquaculture lab which was maintained constant at 25°C ± 1.0°C with a thermostatic air-conditioning unit. Each diet was fed to fry in a set of 4 tanks, thus providing 4 replicates per treatment. Each tank received 10% body weight of fish daily at 8 am, 12 noon, 4 p.m and 8 p.m, a little at a time till fish picked up all the feed. All fry in each tank were weighed weekly, and weight fed was adjusted in the light of the new weight of fish in each tank. During weighing, fry in each tank were netted, quickly dried on soft filter paper and weighed in water contained in a small plastic beaker on a top loader metterler balance with an accuracy of ± 0.1mg. Using this value and the number of fish per tank, the mean weight of each fish per tank was computed. Mean weight of fish per treatment was then worked out and used in plotting the growth curve. At the end of the 8 week experiment, 10 fry per tank were netted, killed in a solution containing 0.5g benzocaine (predissolved in alcohol) in 2L water and then separated randomly into 2 sections, each containing 5 fish. Each group of 5 fish were then analysed for moisture by oven-drying at 105°C for 48 hours, Kjeldahl protein, proximate fat composition by the either extraction method using soxhlet apparatus and ash as detailed in AOAC methods (AOAC, 1980). The commercial diet was similarly analysed.

Data Analyses

The Mean Growth Rate (MGR) was computed after the method of Wayne and Davis (1977). Food Conversion Ratio (FCR) was worked out suing the formula:

$$\frac{\text{Weight of food consumed per week (g)}}{\text{Weight gained by fish per week (g)}}$$

Protein Efficiency Ratio (PER) was also computed after the method of Osborne, et.al (1919). This is the efficiency with which fish utilise dietary protein. Analyses of variance (ANOVA) was done using Duncans multiple range Q test (Duncan, 1955).

Table 1:- Proximate composition of commercial diet and fry carcass (% weight)

Components	Diet	FISH				± SEM
		Initial	M T	C A	C O	(for fish)
Moisture	8.9	75.00^{a}	77.00^{a}	79.50^{a}	80.20^{a}	4.51
Crude Protein	47.5	9.20^{a}	6.00^{b}	12.50^{a}	12.00^{a}	1.22
Crude Fat	18.5	0.69^{a}	1.50	1.00^{a}	0.90^{a}	0.42
Ash	9.6	1.50^{a}	1.00^{a}	1.30^{a}	1.25^{a}	0.27
Sub-totals	84.5	96.39	95.50	94.30	94.35	
N F E[1]	15.5	3.61	4.50	5.70	5.65	

For fish composition, figures in the same row having the same superscript are not significantly different ($P > 0.05$).

[1]Nitrogen Free Extract; computed as difference between subtotals and 100.

RESULTS & DISCUSSION

The best growth (Fig. 1) was recorded in fry on M T diet. There was no significant difference (P >0.05) in growth of the C A and C O fry. There was no significant difference (P >0.05) in the moisture, crude fat and ash contents of the M T fry was significantly higher (P >0.05) than the rest (Table 1). The food conversion Ratio (F C R) with the M T was 0.403 and was approximately 0.30 with the C A and C O diets (Table 2). The results obtained for the Protein Efficiency Ratio (P E R) and Mean Growth Rate (M G R) follow the same pattern as those for F C R, with no significant difference (P >0.05) occuring between the values obtained with the C A and C O diets, and values obtained with the M T diet were significantly better (P>0.05). No particular diet produced significantly higher mortality (P >0.05). Rather, mortality in each group during the 8 weeks experimental period was approximately 28% (Table 2) and must have been due to stress during weighing.

From the results obtained, it would appear that the incorporation of the androgen methyltestosterone in the diets of the fish enhanced protein anabolism, and growth. Similar growth patterns were earlier observed by Guerrero (1975) in Tilapia aurea, Tayamen and Shelton (1978) in Sarotherodon niloticus and Donaldson and Hunter (1982) in rainbow trout. The M G R obtained in this work was lower than values obtained by Tayamen and Shelton (1978). This could be due to differences in both quality and quantity of feed. Tayamen and Shelton's diets and fish were however not analysed. Results obtained for F C R and P E R indicate that the M T fry metabolised their food better than the C A and C O fry. It is not likely that this could have been at such an early stage, due to differences in growth rates of males and females. The anabolic effect of the androgen must have been an over-riding factor. The similarity of results obtained with the C A and C O diets confirm that the use of alcohol as a solvent for the androgen did not affect the quality of the diet. It is also confirmed that unlike some estrogens (Yashouv & Eckstein, 1965) androgen treatment or the use of alcohol for its desolution does not lead to mortalities in the fry of S. niloticus. However, since there could be some danger to the consumer of fish "fattened" with androgens a long-term study of the effects of this hormones on tissue metabolism of fish is necessary. This should involve monitoring residues of androgen in fish tissue after treatment. Cost-benefit ratio should also be considered before this hormone can be used for increasing the size of harvestable S. niloticus, whose tiny size at maturity often renders it a thrash fish.

Table 2:- Food utilization and mortality rate of methyltestosterone treated and untreated fish

	TREATMENTS			
	M T	C A	C O	± E M
F C R	0.403^{b}	0.290^{a}	0.298^{a}	0.030
P E R	2.52^{b}	1.99^{a}	1.98^{a}	0.116
M G R[1]	30.28^{b}	27.71^{a}	28.13^{a}	0.734
% Mortality	28.00^{a}	28.25^{a}	28.00^{a}	0.166

Figures in the same row having the same superscripts are not significantly different (P >0.05).

[1]In mg/g/day.

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NUTRIENT DIGESTIBILITY AND GROWTH RESPONSE OF RAINBOW TROUT (Salmo gairdneri) FED DIFFERENT CARBOHYDRATE TYPES

by

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SUMMARY

Seven groups of fingerling rainbow trout (Salmo gairdneri) were fed for 10 weeks on 0%, 10%, 20% and 30% of cassava or rice in isonitrogenous diets.

Optimum growth and food utilization was at 20% dietary cassava. High fiber content of the control diet did not supress protein digestibility in this group. Rather, at all levels, protein digestibility was good and remained between 84.4% and 90.1%. However, in the control group, carbohydrate digestibility was very poor. The cassava diets which had the highest digestible energy as carbohydrate produced the best growth performance, food utilization and protein sparing. At the levels studied, the dietary carbohyrates produced no hyperglycamic effect on the fish. There was no evidence of drastic adverse effects on the tissue and liver composition of the fish receiving these carboydrates.

INTRODUCTION

Some difficulties have been encountered in trout nutritional studies when this fish is fed with carbohydrate containing diets. Phillips, et al., (1948) using glucose, maltose, sucrose, cooked corn starch and raw corn starch as dietary carbohydrate sources for trout reported high glycogen in livers of trout fed these carbohydrate diets. They then recommended 9% and later between 9-12% (Phillips, et al., 1956) of dietary digestible carbohydrate for trout. The ability of their fish to utilize the different carbohydrate sources, of course, varied. More recently, (Abel, et al. 1979), starch more than glucose was observed to promote glucokinase activity and to decrease phosphoenolpyruvate carboxlkinase in trout liver. Rainbow trout has also been shown to utilise efficiently, higher levels of dietary carbohydrate (Luquet, 1971; Furuichi & Yone, 1971; Bergot, 1979; Lin et al, 1977, 1978). Edwards, et.al. (1977) using diets which contained 31.9% 35.5% and 43.6% of digestible carbohydrate (NFE) showed the best growth, condition factor and food conversion efficiencies in the group receiving 31.9% of NFE. They however, reported a healthy condition in all the fish.
Cassava and rice are relatively cheap carbohydrate sources in the tropics (Onwuka, 1980). If well utilized by trout, these carbohydrate sources could be economical in the production of trout diets. Isonitrogenous diets with varying levels of cassava and rice were therefore fed to rainbow trout for 10 weeks, and the response of the fish to these practical diets monitored.

MATERIALS AND METHODS

Rainbow trout (Salmo gairdneri) fingerlings collected from Midland Fisheries, Nailsworth, Glaucestershire, were quarantined for 10 days (Onwuka, 1980) and then used for this investigation. Seven experimental diets were formulated as shown in Table 1. Before the formulation, the cassava (non-toxic variety obtained as dried chips from Malaysia) and rice (long-grain prefluff, Overseas Trading Co., Bradford) were milled and analysed. Each contained 73.99% and 75.09% respectively of hydrolysable carbohydrate. The 7 diets were analysed (Table 2) and fed twice daily at a total of 2% body weight per day for 10 weeks to the experimental fish.

Before the onset of the experiment, the fish were individually marked by cold-branding with liquid nitrogen, given five days to acclimate and then weighed, and stocked at 20 fish per tank in white plastic tanks contained in a water recycling system (Ufodike & Matty, 1983). The temperature of the system was maintained at 12°C ± 1.0°C. Weighing of fish was carried out fortnightly thereafter, during which time they were stripped antero-posteriorly for faeces (Windell et al., 1978). Faeces for each group per fortnight were pooled, dried in an oven (present at 105°C) for 24 hours, and used for digestibility estimation after the method of Furukawa and Tsukahara (1966). Before each handling, fish were anesthetised using benzocaine (Onwuka, 1980). At the end of the 10 weeks experimental period, a random sample of 10 fish per tank were taken for blood plasma glucose estimation and proximate tissue assay.

Blood, liver, muscle and faecal hydrolysable carbohydrate were determined using the method of Murat and Serfaty (1974), or slight modifications of this method (Onwuka, 1980). The liver and carcass moisture, crude fat, protein and total ash were determined using slight modifications of the standard AOAC methods (AOAC, 1975) as earlier discussed (Onwuka, 1980). Crude fibre was estimated by difference. Energy in the diets (Table 2) was computed using standard values for enegy of combustion of fat, protein and starch (9.4, 5.6 and 4.2 cal/g respectively), and the nutrient digestibility values obtained in this research. Fat was assumed to be 95% digested.

RESULTS

All fish fed actively and appeared healthy.

Growth performance

The growth response of rainbow trout fed cassava and rice are respectively shown in Figs. 1 and 2. With the cassava diet the best growth response was achieved at 20% inclusion. A 30% dietary cassava when compared to 20% cassava significantly ($P > 0.05$) depressed growth rate of fish. When compared to the control 10% dietary cassava does not significantly ($P > 0.05$) affect growth rate.

With the rice diets, no significant difference ($P > 0.05$) in growth is obtained at the different levels of inclusion (Fig. 2). Thus at levels between 0% and 30% rice does not appear to be toxic to rainbow trout. The highest specific growth rate (SGR) was obtained in fish on 20% and 30% cassava.

Food utilization

The Food conversion Ratios (F.C.R.'s) were good in all fish (Table 3) the best value being obtained with 20% dietary cassava. There was no significant difference ($P > 0.05$) between the FCR's of the control fish and the RC-5 group. The trend of results obtained for the protein Efficiency Ratio (PER). and Apparent Net Protein Utilization (NPU) very closely follow those obtained for the FCR.

Blood glucose values (Table 3) reveal no evidence of prolonged hyperglycaemia in fish fed cassava and rice.

In the control fish plasma glucose is significantly ($P > 0.05$) low. This could possibly be due to lack of sufficient digestible carbohydrate in the diet. The composition of the liver and rest of the carcass (Table 4 & 5) show no evidence of drastic changes brought about by the carbohydrate diets.

Results from digestibility studies show that the carbohydrate in the cassava diet is better digested than that in the rice diet (Fig. 3). The control diet contains only a trace quantity (1.34%) of digestible carbohydrate (Table 2). With the inclusion of cassava or rice to the diets, carbohydrate digestibility increases by at least 70% The apparent digestibility of dietary protein appears good in all groups, and ranges between 84.4% and 87.5% (Fig. 4).

Table 1. - Composition of test diets fed to rainbow trout (g/100g diet)

Components	Diets designations						
	Cc-1	Cc-2	Cc-3	Rc-4	Rc-5	Rc-6	Oc-7 (control)
Cassava	10.00	20.00	30.00	-	-	-	-
Rice	-	-	-	10.00	20.00	30.00	-
White fish-meal	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Casein	10.00	10.00	10.00	10.00	10.00	10.00	10.00
D-Cellulose	20.00	10.00	-	20.00	20.00	-	30.00
Mineral Mix[1]	4.00	4.00	4. 00	4.00	4.00	4.00	4.00
Vitamin Mix[1]	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Corn Oil	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Cod Liver Oil	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Chromic oxide	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Carboxy methy- Celluse (binder)	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[1]As in Ufodike & Matty (1983).

Table 2. - Proximate composition of experimental diets from biochemical assay (% weight)

Ingredients	Diets						
	Cc-1	Cc-2	Cc-3	Rc-4	Rc-5	Rc-6	Oc-7 (control)
Moisture	5.49	5.95	6.26	5.36	6.48	6.82	5.04
Protein	41.76	41.35	41.63	43.46	43.57	42.85	41.34
Fat	12.28	12.32	12.09	12.25	11.97	11.97	10.61
Carbohydrate[1]	11.15	18.25	26.62	9.18	19.51	26.01	1.34
Ash	9.86	10.02	10.38	9.01	9.07	9.41	8.76
Su-totals	80.54	87.89	96.98	79.29	90.60	96.96	67.09
Fibre[2]	19.16	12.11	3.02	20.71	9.40	3.04	32.91
Cr_2O_3[3]	0.50	0. 49	0.51	0.53	0.53	0.52	0.50
Energy[4]	344	370	379	344	354	371	299

1. Hydrolysable carbohydrate
2. Computed as difference between subtotals & 100
3. Presented on dry-weight basis
4. Kcals/100g of diet.

Table 3. - Growth and food utilization of rainbow trout fed different levels of cassava and rice for 10 weeks

Mean values | Diets

	Initial	Cc-1	Cc-2	Cc-3	Rc-4	Rc-5	Rc-6	Oc-7	± SEM
Initial weight (g)	-	28.75^{a}	29.63^{a}	31.06^{a}	31.32^{a}	32.17^{a}	32.58^{a}	30.86^{a}	2.370
Final weight (g)	-	79.92^{a}	95.78^{d}	78.86^{a}	84.97^{c}	85.88^{c}	83.37^{b}	80.12^{a}	0.929
Weight gain (%)	-	177.80^{b}	224.00^{c}	153.90^{a}	171.30^{b}	166.96^{b}	155.89^{a}	159.62^{a}	3.268
S.G.R.[1]	-	1.12^{a}	1.34^{d}	1.36^{d}	1.13^{a}	1.23^{c}	1.28^{b}	1.24^{c}	0.033
F.C.R.[2]	-	1.44^{d}	1.14^{a}	1.42^{d}	1.38^{c}	1.24^{b}	1.30^{bc}	1.27^{b}	0.037
P.E.R.[3]	-	1.69^{a}	2.00^{d}	2.03^{d}	1.74^{b}	1.84^{c}	1.78^{b}	2.04^{d}	0.028
Apparent NPU[4] (%)	-	34.60^{b}	43.71^{c}	35.95^{b}	37.60^{b}	35.62^{b}	29.72^{a}	46.10^{c}	1.085
Blood glucose (mg%)	59.90^{b}	57.90^{b}	65.10^{b}	68.70^{b}	56.71^{b}	60.90^{b}	66.90^{b}	36.00^{a}	1.817
H.S.I.[5]	1.58^{c}	1.43^{a}	1.61^{c}	1.81^{d}	1.60^{c}	1.40^{d}	1.61^{c}	1.48^{b}	0.019

Figures in the same row having the same superscript are not significantly different ($P > 0.05$)

1. Specific growth rate
2. Food conversion ratio
3. Protein efficiency ratio
4. Net protein utilization
5. Hepato-somatic index.

Table 4: - **Initial and final composition of liver of rainbow trout fed different levels of cassava and rice**

Final (% wet weight basis)

	Initial	Cc-1	Cc-2	Cc-3	Rc-4	Rc-5	Rc-6	Oc-7	± SEM
Moisture	75.50^{a}	76.53^{a}	75.56^{a}	75.61^{a}	77.68^{a}	76.51^{a}	77.09^{a}	74.55^{a}	0.56[1]
Carbohydrate[1]	7.80^{d}	6.02^{b}	6.95^{c}	7.80^{d}	5.59^{a}	7.50^{d}	6.80^{c}	5.55^{a}	0.09
Fat	0.65^{b}	0.94^{d}	0.89^{cd}	0.61^{ab}	0.83^{c}	0.66^{b}	0.54^{a}	0.93^{cd}	0.10
Protein	14.26^{a}	14.59^{a}	14.31^{a}	13.91^{a}	14.90^{a}	13.82^{a}	13.26^{a}	14.52^{a}	0.50
Ash	1.55^{a}	1.95^{a}	1.51^{a}	2.88^{b}	1.76^{a}	1.62^{a}	2.59^{b}	3.78^{c}	0.03
Total	99.76	100.03	99.22	100.81	100.76	100.11	102.08	99.33	

Figures in the same row having the same superscripts are not significantly different (P 0.05)

[1]Total glucose and glycogen

Table 5: - Initial and final carcass **composition** of rainbow trout **fed different** levels of cassava and rice

Final (% wet weight basis)

	Initial	Cc-1	Cc-2	Cc-3	Rc-4	Rc-5	Rc-6	Oc-7	± SEM
Moisture	73.20^{a}	74.15^{a}	73.19^{a}	73.86^{a}	73.98^{a}	73.19^{a}	75.14^{a}	71.34^{a}	0.862
Carbohydrate[1]	0.70^{b}	0.72^{b}	0.72^{b}	0.87^{c}	0.74^{b}	0.74^{b}	0.65^{b}	0.46^{a}	0.038
Fat	4.85^{a}	5.08^{a}	4.87^{a}	4.96^{a}	4.24^{a}	4.97^{a}	4.74^{a}	4.35^{a}	0.184
Protein	18.45^{b}	17.61^{a}	19.17^{c}	18.15^{b}	18.69^{b}	18.92^{b}	17.40^{a}	20.95^{b}	0.080
Ash	2.86^{a}	2.54^{a}	2.39^{a}	2.30^{a}	2.56^{a}	2.40^{a}	2.25^{a}	2.72^{a}	0.569
Total	100.06	100.10	100.34	100.14	100.21	100.22	100.18	99.96	

Figures in the same row having the same superscripts are not significantly different (P 0.05)
[1]Total hydrolysable carbohydrate.

DISCUSSION AND CONCLUSION

Some of the previous works in which the unavailability of carbohydrates to Rainbow trout was reported have been conducted using diets consisting either wholly or partially of semipurified or poor quality protein. Such protein sources have been shown to cause nutritional disorders. The use of some refined carbohydrate sources have been shown to cause growth retardation (Inada, et al., 1963; Hastings, 1968; Austreng, et; al. 1977) However , the dietary inclusion of up to 50% starch and/or dextrin or 20% glucose has been shown to be well tolerated by salmonids, and the differences in tolerance levels has, in the main, been attributed to the intestinal carbohydrate digesting ability of the animals (Buhler & Halver, 1964, Luquet, 1971). The poor carbohydrate digestibility in our control fish probably suggests that a "threshold" quantity of digestible dietary carbohydrate was necessary to trigger off amylase digestive activities in the gut of rainbow trout. Such low carbohydrate digestibility in fish fed diets containing only trace quantities of digestible carbohydrate (2%) have been previously observed (Ufodike & Matty, 1982, 1983) Low protein digestibility has been reported in fish fed high fibre containing diets (Kitamikado, et al., 1979). It however appears unlikely that the high fibre content in some of our diets had an over-riding effect on the protein digestibility. Besides, examination of the rectal contents of the fish revealed no evidence of diarrhoea or inconsistency of the rectal content of fish on the high fibre diets. The results from food and protein utilization (Table 3) tend to suggest that an optimum level of dietary digestible carbohydrate is required for best conversion of feed into flesh. That is at a certain level of inclusion of digestible carbohydrate into the diet, maximum energy is trapped from the dietary carbohydrate to enable most of the energy from protein to go in body building. The value of carbohydrate to the fish, which is basically for the supply of metabolic energy is thus important.

Metabolic energy produced as heat is usually regarded as being a waste to the fish (Cowey & Sargent, 1979). With an adequate supply of dietary carbohydrate, the process of gluconeogensis (evidenced by the presence of tissue carbohydrate in the control fish whose trace quantities of dietary hydrolysable carbohydrate were very poorly digested), would be minimised. Hence, dietary protein would be spared, as shown in this research.

Cassava could be a good and cheap source of dietary carbohydrate for trout.

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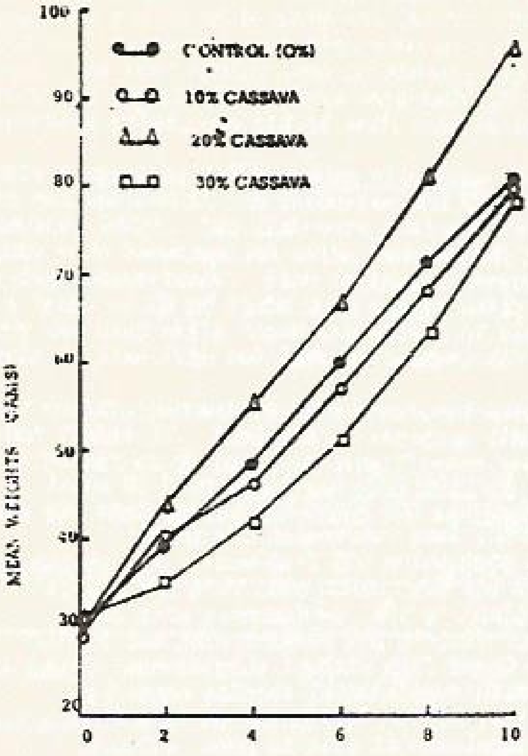
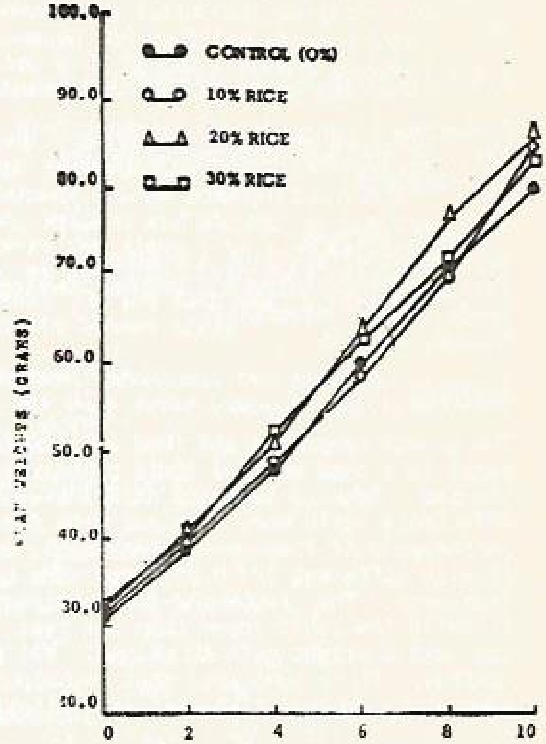


Fig. 1 Effect of different levels of dietary cassava on weight gain of Rainbow Trout



Effect of different levels of dietary Rice on weight gain of Rainbow Trout

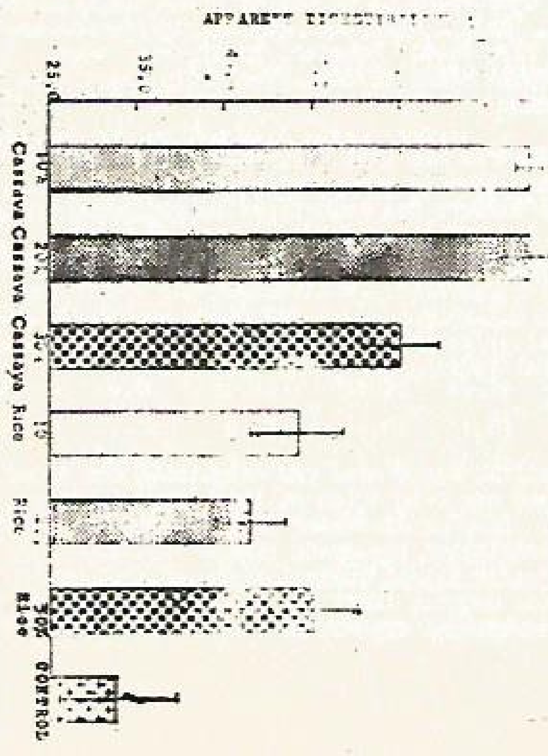
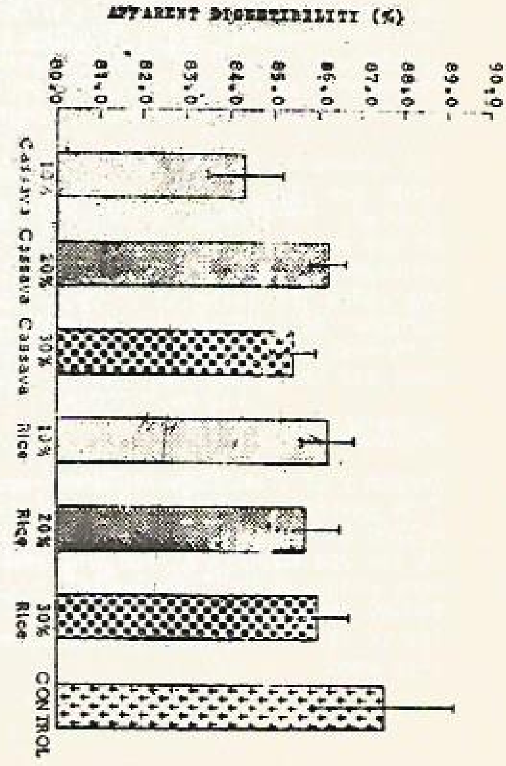


Fig. 3 Apparent digestibility of dietary carbohydrate in Rainbow trout fed cassava and rice



[illegible] digestibility of dietary protein in Rainbow Trout fed cassava and rice

EFFECTS OF FISH-MEAL, COW BLOOD-MEAL AND SORGHUM DIETS ON FOOD UTILIZATION AND GROWTH OF CAGE CULTURED *Sarotherodon niloticus*

by

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ABSTRACT

The growth responses and feed utilization of *Sarotherodon niloticus* held in metal cages in a pond and fed diets containing fish-meal, cow blood-meal or sorghum was studied. Results indicate that the best growth, feed conversion and protein effeciency ratio were obtained with the diet containing 60% fish-meal. The growth performance of fish on 40% fish-meal, and 40% and 60% blood meal were not significatly different ($P < 0.05$), and were quite close to the performance with 60% fish-meal. The growth and food utilization of fish on 84% sorghum diet was significantly ($P < 0.05$) lower than the rest. The Caged fish without supplemental feeding had a slight gain in weight. All fish with supplemental feeding appeared healthy. It is concluded that cow blood meal at 40% or 60% inclusion in diet can adequately replace fish-meal in *S.niloticus* supplemental diet in pond culture.

INTRODUCTION

Though Nigeria is the sixth greatest oil producer of the World, and is regarded as a rich country, there is insufficient protein in the food of many Nigerians. In 1975, a total of about three hundred thousand metric tonnes of fish were imported and the nation spent approximately ₦99m in foreign exchange in the fisheries sector alone that year. Despite the abundance of fresh, brackish and salt water in Nigeria, scarcity of fish feed has been observed to be a great hindrance to the development of intensive fish culture, (Ezenwa, 1979). Warm water fish such as carp has been shown to be able to efficiently metabolise up to 45% of crude carbohydrate in isonitrogenous diets (Ufodike & Matty, 1983). Fish meal may be regarded as the traditional source of dietary protein in fish feed. However, in Nigeria, even "thrash" fish for the manufacture of fishmeal could be expensive while blood from cow is usually discarded at slaughter houses.

The intensive culture of *S.niloticus* in Nigeria has been unencouraging mainly because the fish is highly prolific and hence tend to overcrowd ponds and to be stunted. To salvage this situation, cage culture has been tried in different parts of the world and recently in Lake Kainji in Nigeria, (Coche, 1976). The major problem in cage culture is food losses and silting up of cage net. This experiment was therefore designed to study comparatively nutrient utilization and growth performance of *S. niloticus* held in cages in a fish pond when fed diets containing fish meal, cow blood meal and sorghum meal. The group of fish fed only sorghum meal and the group that had no supplemental feeding served as controls.

MATERIALS AND METHODS

Thrash fish from Nigerian continental shelf in Lagos area and coagulated cow blood from government abattoir in Jos were cooked and oven dried at 105°C for 24 hours, milled and used for the diet formulation. Sorghum purchased from the open market in Jos was equally milled and used for formulating the diets (Table 1). The diets were analysed for proximate Composition using slight modifications of AOAC methods (AOAC, 1980; Ugwuzor, 1982). Nitrogen free extract (NFE) was computed by difference (Table 2). Diets were stored in sealed polythene bags at 20°C in a deep freezer till used.

Four metal cages were constructed with tubular frames and metal net of 2mm mesh size. Each cage had two compartments each of which measured 45cm x 60cm x 80cm. Cages were coated with white oil paint. Three quarters of the 80cm axis of the cages were submerged in a fish pond at Federal Government Girls College (F.G.G.C) Buachi, the pond having been originally dried, cleaned and refilled three months before the experiment. Cages were held in position with cables attached to metal supporting poles. one end of each pole being anchored into the floor of the pond.

Ninety fingerling Sarotherodon niloticus collected from Panyam fish farm near Jos were quarantined in the Fisheries and Hydrobiology Research Unit of Jos University, (Ugwuzor, 1982). Ten fish were analysed for proximate tissue composition while eighty were anesthetised using benzocaine, tagged, weighed and stocked at ten fish per cage compartment. Fish in cage 1 through 7 were fed diets 1 to 7 respectively at a total of 2% of their body weight daily at 9. am and 5 pm. Fish were weighed every ten days while under the effect of anesthesia. On the 70th day, a random sample of five fish per tank were taken for proximate tissue assay.

Water quality parameters were monitored every ten days throughout the experimental period (Table 3). Analysis of variance (ANOVAR) was done using Duncan's multiple range F-test at 5% level of singificance (Duncan, 1955).

Table 1:- Composition of diets fed to caged S. niloticus (g.%)

Ingredients	Diets						
	1	2	3	4	5	6	7
Fish meal	-	20	40	60	-	-	-
Blood meal	-	-	-	-	20	40	60
Sorghum	84	64	44	24	64	44	24
Vitamin mix[1]	2	2	2	2	2	2	2
Mineral mix[1]	4	4	4	4	4	4	4
Cod-liver oil	2	2	2	2	2	2	2
Corn oil	6	6	6	6	6	6	6
Cellulose (binder)	2	2	2	2	2	2	2
TOTALS	100	100	100	100	100	100	100

[1]Composition as in Ufodike & Matty (1983).

Table 2:- Proximate, composition of S. niloticus diets from biochemical assay (% weight)

Ingredients	Diets						
	1	2	3	4	5	6	7
Moisture	9.21	8.50	9.11	9.13	9.80	10.61	10.00
Protein	9.65	20.47	36.30	44.24	19.80	34.95	42.97
Fat	11.10	9.57	11.81	11.89	8.24	8.68	3.75
Ash	6.45	7.47	9.10	10.35	3.51	3.68	3.75
Sub-totals	36.41	46.01	66.32	75.61	41.35	57.92	66.17
NFE[1]	63.59	53.99	33.68	24.39	58.65	42.08	33.83

[1]Nitrogen free extract: Computed as difference between subtotal and 100.

Table 3:- Mean water quality monitored every 10 days during the experimental period

Days	Dissolved O_2 (mg/1)	Free Co_2 (mg/1)	Water temperature (°C)	Turbidity (m)
0	4.10^{a}	4.30^{a}	29.00^{c}	1.28^{bc}
10	5.05^{a}	4.33^{a}	29.30^{c}	0.83^{a}
20	5.15^{a}	4.61^{a}	28.60^{bc}	0.94^{ab}
30	5.10^{a}	4.67^{a}	29.00^{c}	0.68^{a}
40	5.55^{a}	4.79^{a}	27.60^{ab}	0.70^{a}
50	5.75^{a}	5.65^{a}	26.85^{a}	1.15^{b}
60	6.05^{a}	5.10^{a}	26.60^{a}	1.46^{c}
70	8.40^{b}	4.84^{a}	26.89^{a}	1.23^{bc}
±SEM	0.65	0.51	0.49	0.08

Figures in the same column having the same superscript are not significantly different (P 0.05).

RESULTS AND DISCUSSION

The best growth was obtained in fish on diet 4 (60% fish meal). However, no significant difference ($P > 0.05$) was obtained in the Mean Growth Rate (MGR) of fish on diets 3. 5 and 6. Poor growth was manifested in fish receiving no animal protein supplement (group 1) (Figures 1 and 2).

The best Food Conversion Ratio (FCR) was obtained with diet 4. There was no significant difference ($P > 0.05$) between the FCR of groups 3, 5, 6 and 7 Table 4). FCR of groups 1 and 2 which were not significantly different ($P > 0.05$) were the poorest. Protein Efficiency Ratio (PER) increased with increase in percentage protein, with diet 4 having the highest PER. Some feed utilization parameters could not be computed for fish in cage 8. This was because the amount of food consumed by this group could not be determined. However, because of the small mesh size of the cages, influx of large planktons was obviated. This group had marginal but fluctuating weight changes (Figure 1) and a mean weight increase of 4.66% (Table 4).

From these results, the 60% fish meal diet resulted in only slightly better fish growth and feed utilization than the 40% and 60% blood meal diets. Variations in water quality (Table 3) was within the tolerance range for warm water fishes. However, the sharp rise in the oxygen content of the water in the last 20 days and the corresponding drop in water temperature probably contributed to the faster growth during this period (Figs. 1 & 2).

Attempts to spare dietary protein using cheap carbohydrate sources have been quite successful especially in recent times (Ufodike & Matty, 1983). In this attempt however, the quantity of fish meal in diet was not reduced. From this present investigation, it is obvious that though fishmeal diets might be more palatable to fish and resulted in better growth, blood meal at 40% or 60% inclusion in diet could be an adequate substitute. In view of the cost differences between these two protein sources, which has been discussed earlier, it is recommended that blood meal rather than fishmeal be used in the formulation of S.niloticus supplemental diets.

Table 4:- Food utilization of caged S. ***niloticus*** fed for 70 days on differen diets

Cages	1	2	3	4	5	6	7	8	± SEM
Initial weight (g)	43.12^{a}	42.06^{a}	43.22^{a}	43.17^{a}	43.24^{a}	42.82^{a}	42.35^{a}	43.11^{a}	0.89
Final weight (g)	55.90^{b}	56.40^{b}	61.10^{c}	75.80^{d}	59.50^{c}	60.09^{c}	61.79^{c}	45.12^{a}	1.01
Weight gain (%)	32.93^{b}	34.09^{b}	41.37^{d}	75.58^{e}	37.60^{c}	40.33^{d}	45.90^{d}	4.66^{a}	1.04
MGR[1]	4.03^{b}	4.16^{b}	4.91^{c}	6.37^{e}	4.52^{bc}	4.79^{c}	5.33^{d}	0.39^{a}	0.08
FCR[2]	0.18^{a}	0.20^{a}	0.27^{b}	0.32^{c}	0.22^{ab}	0.24	0.27^{b}	-	0.03
PER[3]	0.92^{a}	1.89^{b}	3.46^{c}	5.19^{e}	1.90^{b}	3.39	4.18^{d}	-	0.28

Figures in the same row having the same superscript are not significantly different (P 0.05)

MGR = Mean Growth Rate
FCR = Food Conversion Ratio
PER = Protein Efficiency Ratio

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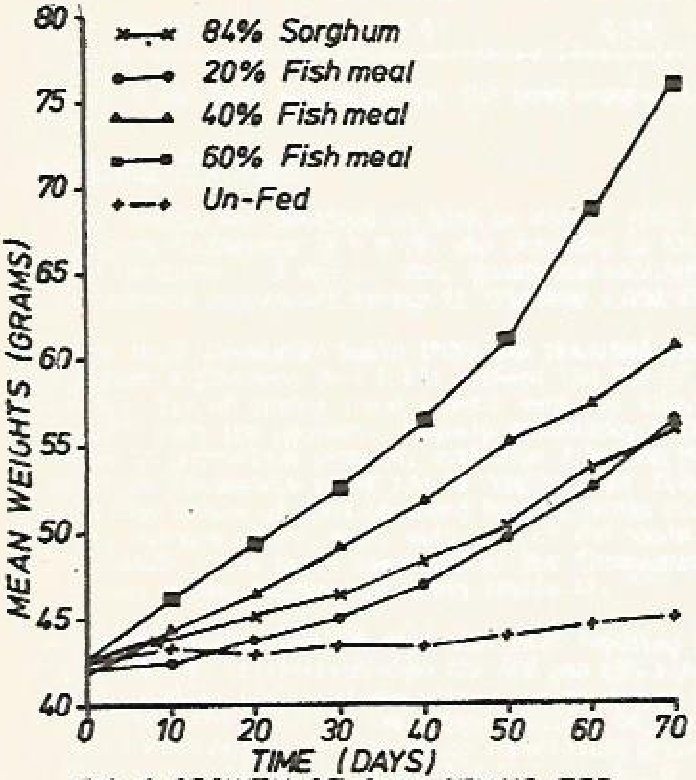

FIG I GROWTH OF S. NILOTICUS FED SORGHUM AND FISH MEAL DIETS

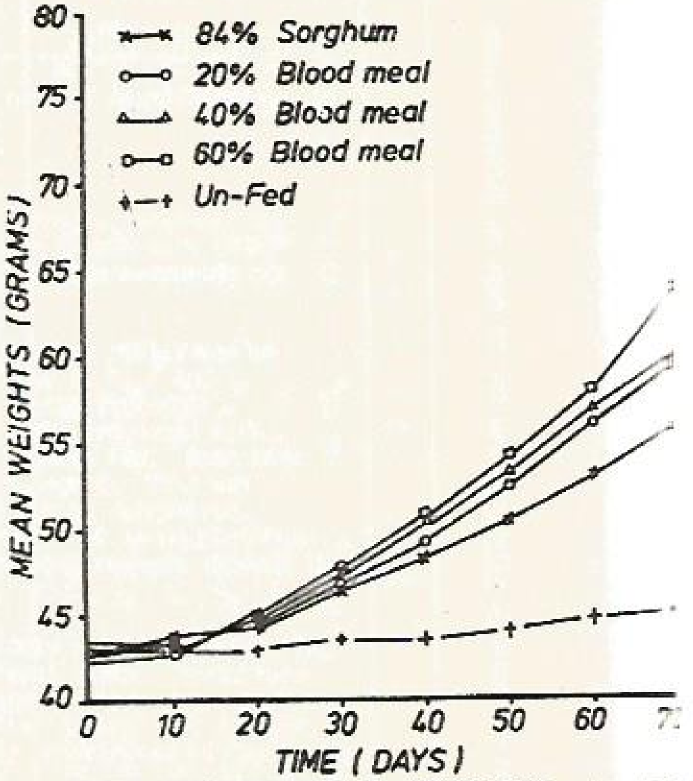

FIG.2 GROWTH OF S. NILOTICUS FE[...] SORGHUM AND BLOOD MEAL DIETS

MODERN AQUACULTURE PRACTICES FOR

INCREASED FISH PRODUCTION IN NIGERIA

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ABSTRACT

Various modern aquaculture practices applied in fish production especially in Asia are reviewed.

The vast Nigerian aquatic medium of numerous water bodies like rivers, streams, lakes, reservoirs, flood plains, irrigation canals, coastal swamps offer great potentials for aquaculture production, if optimally utilized. But the constraints to modernization of aquaculture in Nigeria amongst other factors are:

Serious shortage of trained manpower;

lack of knowledge on profitability of aquaculture as an industry;

limited availability of fund (or capital);

non-recognition of indigenous trained aquaculture personnel;

inadequate data base on the biology and ecological requirements of endemic fish species with aquaculture potentials;

insufficient data on production and management techniques; and

lack of rational aquaculture development planning.

Recommendations are made towards combating these contraints such that aquaculture can be proven technically and economically feasible as in some countries reviewed.

In the final analysis, concerted efforts at institutional and public sectors need to be mustered for modernizing aquaculture practices for increased fish production at economical level in Nigeria.

INTRODUCTION

Traditionally, aquaculture has been restricted largely to Asia where practices have been developed through trial and error, and passed on through generations. Almost all forms of aquaculture are practised in Asia. There are variations, however, in the size of the farms, level of operations as well as production objectives. Some fish farms combine both the hatchery and fish production activities, while others are either for hatchery or grow out operations. Most of the aquaculture activities are land based involving ponds, rice paddy, and raceways, whilst other fish culture practices are conducted in the natural water bodies like cage, pen, stake, on-bottom, or raft for fin and shell-fishes.

HATCHERIES

Economically productive aquaculture, like agriculture, is heavily dependent upon an adequate supply of seed, of fertile eggs and juvenile fish, with which to stock the ponds, enclosures, and other cultivation systems. Most hatcheries in the region (Asia) are established by the governments although, there are increasing private hatcheries being established recently. The government hatcheries are mainly for the production of freshwater fishes, especially carps, for stocking of open water and for supply to rural fish farms. On the other hand, private hatcheries produce specific species like sea bass (Lates sp.), Paenus sp. and Macrobrachium sp., mainly for supply to local aqua farmers. The target species as well as capital inputs often determine the scale and level of hatchery operations. The hatchery operations can either be an open-door (extensive or semi-intensive) or in-door (usually intensive) depending on the scale of operations and other factors. For example, for Tilapia hatchery, seed can be produced in net enclosures, rice paddies, ponds or in-door under controlled condition. For breeding Nile tilapia, an enclosure which is 1.5 m long, 1 m wide and 1 m deep has been found practical (Anon, 1982). The enclosures are installed in ponds, lakes or along river banks with slow moving water. Breeders (50 - 100 g in weight) are stocked at the rate of three females to one male per enclosure. They are fed with pelleted diet consisting of 25% fish meal and 75% fine rice bran at 3% of fish weight per enclosure in the morning and afternoon. In a period of two weeks, 500 fry per enclosure can be expected. For a 200 sq. m paddy stocked with 50 breeders (40 females and 10 males) and fed rice bran at the rate of 2.5% body weight twice a day for the first month but 5% for the second month, fingerlings yield can be as much as 50 pieces per square meter in two months. Breeding Tilapia in ponds is the most extensive method. It is applicable where ponds are available and when labour is limited. For a 500 sq. m. pond, 200 females and 50 males are needed (5,000 breeders/ha). If natural food is not adequate in the pond, supplemental feeding with fine rice bran at 5% of fish weight per day may be applied. Well managed breeding ponds can yield up to 100 fingerlings per square meter in four months (Anon, 1982). In the case of indoor hatchery, the breeders are stocked at the ratio of 1 male to 4 females in fibre glass tanks or any other suitable container under aeration at the rate of 5 breeders per square meter. They are then reared separately and fed on lab-produced or propagated natural food (plankton) at specific feeding rate (No. of plankton cells/ml). This hatchery operation method yields the highest number of seed/unit area in time if well managed.

In some countries such as Philippines, Thailand and Taiwan, there are numerous "backyard hatcheries" operated by experienced small farmers contributing significantly to the national total fry supply. Modern but large hatcheries are increasing rapidly in view of the vast potential in the fish seed industry. To date, several big enterprises whose primary trades are not fish culture have been involved in establishing large fish hatcheries in many parts of Asia. Since some fish would refuse to breed in captivity, the method of induced breeding playing on the physiological (endocrinological in particular) activities of the fish is gradually being utilized in hatchery operations. Gonadotropin induced breeding is now being widely studied and used in the breeding of carp in China and India, and of other species (e.g. Mullet, Mugil sp in Hawaii). In India, 260 million carp seed were produced in 1978 - 79 from induced breeding (Davy and Chouinard, 1980).

In prawn hatchery, eye-stalk ablation is practised to induce spawning in Penaeus monodon (the giant prawn) (Primavera et al 1978). The larval rearing from nauplii to post larvae is then carried out under intensive method feeding them on plankton like Chaetocerus calcitrans, Brachionus plicatilis etc.

In line with aquaculture hatchery operations, the techniques of handling, incubating and hatching of fish eggs have been developed. These techniques are varied amongst major cultured species and are described in standard texts for fish culture (Hickling, 1971; Hora and Pillay, 1962; Huet, 1970). A variety of incubators and hatching facilities are being used for different and even for the same species of fish. These include ponds, hapas, tanks, jars, troughs, tray etc. Each of them has its advantages and disadvantages, since the use of specific incubators or hatching facilites would depend greatly upon the species of fish and on financial constraints.

Also, notable amongst fish seeds production practices is the artificial sex reversal of genotypic female Tilapia by the use of hormones (Guerrero, 1975; Shelton et al, 1978). Two synthetic androgens, enthyltestosterone and methyltestosterone have been used for masculinizing genotypic female tilapia. This is done by oral administration for varying period (18 - 60 days) in tanks 10 - 60 mg/kg diet (Guerrero, 1979). The "all-male" seeds so produced have definite advantages over mixed-sex culture for the following reasons:

(i) Eliminates unwanted reproduction of tilapia;

(ii) Results in faster growth and higher survival (Van Someren and Whitehead, 1960; Guerrero, 1974); and

(iii) High stocking rates can be applied.

In line with advancement in hatchery operations is the nutritional project for fish seed production especially the Natural Feeds Propagation. The activities often involve isolation, culture, propagation and determination of the efficiency of the natural food source for larval rearing. Organisms commonly utilized as natural food for larval rearing include Brachionus sp, Chaetocerus sp, Chlorella sp, Moina sp, Artemia sp, Oscillatoria sp, Chroococcus sp etc.

PRODUCTION OF MARKETABLE SIZE FISH

Marketable size fish are produced in various ecological habitats using different culture techniques: pond culture, integrated fish farming, intensive fish farming by recirculating and running water using race ways and tanks, pen culture, cage culture (land based or floating), off-bottom culture using raft, on-bottom culture on mud flats and stake and tray culture in intertidal zones.

Pond Culture

This is one of the earliest and widely practised aquaculture systems. About 3.7 million metric tones of fish were produced from brackishwater and freshwater ponds in 1973 (Shang, 1976). Most of the ponds used in Asia are small, ranging from 0.10 ha (catfish farm in Thailand) to about 250 ha (milkfish farm in the Philippines). On the average about 0.5 to 2.5 ha farm size are operated by one or two farmers. In many instances the farms are operated at the family level.

In Asia, most fish-ponds are of earth and mud which promotes natural food productivity for culturing fish low in the food chain such as carps and milkfish. In some cases, the sides of the ponds may be sealed with cement to prevent leaching of acid water from acid sulphate soil as seen in Thailand, or plastic sheets to prevent escape of walking catfish (Clarias sp) or mud crabs (Scylla serrata). In Japan and Taiwan, cement ponds are used for intensive farming of fish and shrimps where running water and a high feeding regime are needed to ensure high production rate.

The shape and arrangement of the ponds are often determined by the topography of the sites. Since large scale fish pond engineering inputs are often used, the ponds are usually rectangular in shape and more systematically arranged with proper system for water management. Most ponds are about 1 meter deep. Swamp, estuarine flats, burrowed pits, marshes, agricultural low land and reservoirs are often converted into fish ponds.

Management and operation of fish ponds depend highly on the nature and characteristics of the ponds (stagnant, tidal flushing or drainable), species and stages of the stocking materials, level of operations (mono culture, extensive or intensive) and finally, the

the environmental conditions of the ponds (temperature, evaporation rate, salinity in brakishwater ponds, pH etc). For milkfish culture in the Philippines p nds, are usually fertilized to enhance growth of "lab-lab" (Rabanal, 1977), a complex mixture of microscopic plant and animal organisms which develop as a pond scum on the pond bottom. Production can be as high as 3 tons/ha in intensive culture of milkfish (Tang, 1967). For carnivorous fish such as the walking cat-fish which are heavily fed, production could be as high as 174 tons/ ha (FAO, 1976). Yield from milkfish pond culture varies with the level of management but production higher than 2 tons/ha is not uncommon (Chen, 1976).

Integrated Fish Culture

Integrated farming generally contributes to the maximum utilization of resources such as farm land, labour and capital and thus results in higher income, higher productivity and more equitable distribution of farm labour (Lee, 1971). The Chinese are well known to have integrated fish culture with livestocks: carp-cum-fish culture producing fish at the rate of about 5 - 6 tons/ha. In the Philippines, integration of tilapia with pigs yielded about 3.5 tons of fish per hectare in 180 days (Hopkins and Cruz, 1980). From a fish polyculture system (silver carp, grass carp, common carp and tilapia) receiving liquidated cow-manure, Moar et al (1977) reported a daily weight gain of 35 kg/ha i.e. 8t/ha/240 days. Wohlfarth (1978) on the other hand recorded a daily yield of 32 kg/ha (7.6t/ha/240 days) in ponds receiving only duck droppings. Integrated farming using tilapia and carps as stocking materials for ponds and pigs and poultry as the livestock are becoming more popular among rural and even industrial fish farmers in many countries in Asia.

Fish Culture in Rice Paddy

This culture system has been practised in Asia for many centuries. In many countries such as Thailand, India, Malaysia, China and Indonesia, rice paddy fish culture has developed into an important inland fishery not only for the supply of animal protein but also for contributing some income. In India peripheral canals are dug around each plot of paddy and fish production between 700 - 1000 kg/ha can be attained. In the Philippines, the fields are flooded with about 25 cm of water but central canals are built at regular intervals for fish and to facilitate harvesting.

Running Water Culture

This system of aquaculture utilizes adequate supply of well oxygenated water and the efficient means of waste removal for heavy stocking of fish in limited areas such as raceways, troughs, tunnels and tanks. The fish are heavily fed with inexpensive but nutritious feeds. Production from this system of aquaculture is usually high. In Japan, at a flow rate of about 100 kg/litre/sec, 1000 - 4000 tons of carp/ha/yr were produced, whilst at a flow rate of 170 kg/litre/sec, rainbow trout production of 2000 tons/ ha/yr was recorded in the United States (Bardach, 1972).

Raceway culture is less practical in the developing countries because of the high cost of production.

Recirculating Systems Culture

Fish culture in recirculating systems have been practised in commercial scale in developed countries. The systems involve technical processes in reconditioning used water and recirculating it. Economy of water and full control of water quality are the obvious advantages of these systems. Under these systems, fish can be reared in very high densities. In Germany, 10 carps can be grown in 40 litres of water in aquarian tanks with fast flow rate of water and strong aeration. Results from Japan show that as high as 4000 kg of common carps can be raised per cubic metre of water (Bardach, 1972). Cost of production using recirculating systems is usually higher than conventional method of fish farming in ponds.

Cage Culture

This enclosure method of fish farming is a productive aqua-farming system. Enclosures of varied types have become widespread in use in Asia involving rigid bamboo cages as well as floating net pens of varied shapes, in freshwater estuaries and in the sea. Cage culture utilizes little physical facilities and space. It is moderately cheap to operate. The cage is either land based (in ponds with regular water exchange rate) or water based (in large body of water such as lakes, rivers etc). The cage could be floating (floating cage) suspended in water as a single cage or a module of net-cages or fixed (stationary cages) which are tied to poles at their corners. Floating cages are popularly used for fish rearing in fresh and coastal waters. Fish farming in cages has been practised for many years in Kampuchea (Cambodia) and Vietnam for raising freshwater fishes (Pantulü, 1976). The technology was later introduced to the Philippines, Indonesia and Thailand where large areas of inland waters are utilized for cage culture. The most recent practice is marine cage culture suitable for sheltered coastal water and lagoons. The marine cage culture of yellow-tail in Japan, Serranids in Hong Kong, Salmons and trouts in Norway and Great Britain are very famous. A production rate as high as 131 kg/m^3 in channel catfish in U.S.A. (Collins, 1972).

Fishpen Culture

Fishpens are one of the most popular culture systems for milkfish (Chanos chanos Forskal) in the Philippines. Fishpens are normally constructed in semi-enclosed bay where the water in the pen can be renewed through flushing generated by tidal current or wind force. The seabed is the bottom of the pen and is not covered. Pens ranging from 5 to 50 hectares at 1 - 2 m deep are very common in Laguna de Bay (Philippines), a eutrophic lake (surface area, 900km^2; average depth, 3 m) with tidal flushing twice a day. Milkfish fingerlings are first kept in the nursery pen then transferred to the grow-out pen at a stocking density of 20,000 - 40,000 fingerlings per hectare. The fish are usually not given any supplemental feed. However, in some situations, supplemental feeds like rice bran, ice cream cones are fed to the fish. An average production from some 5,000 fish pens in laguna de Bay is 4 tons per hectare (Anon, 1979).

Pen culture in the Philippines commenced since 1967, and the number of fish pens has been increasing to cover more than 5,000 hectares of the lake indicating the high profitability of the enterprise. According to Anon (1979), a fish-pen owner in the lake Laguna realizes an average income of P24,863 (US $3,315) whilst the caretakers bag about P8,085 (US $1,078). However, the average income for pen (1 - 5 ha) is about P1,941 (US $259) per hectare.

Molluscs Culture

The intertidal area of the coast is often utilized for the production of bivalves such as oysters, mussels and clams. The bivalves can be cultured directly on the seabed or using poles or stakes, racks and trays. In deeper water, floating rafts of long-lines are used. Hatcheries have been successfully developed for the production of seeds of some species but most culturists still find it more economical to collect the seeds (spat) from the wild. Culture of estuarine oysters directly on the bottom is being practised but are limited due to high predation, turbidity and difficulty in harvesting.

Culture of oysters using bamboo poles is a common practice in Asia especially in the Philippines and Taiwan because of simplicity and low investment. Production depends on the managerial skill of the oysters growers.

In Sabah, oysters are cultured in wire trays supported by wooden frame work.

Culture of oysters by hanging them from floating raft has been a common practice all over the world. The raft is usually 14 - 15m by 7 - 8m made of bamboo or woods and are suspended by floats. Hollow cement drums, tarred wooden floats, styrofoam floats or tarred oil drums are suitable for floats. Oyster spat collected from the wild are transferred to the growing site where they are hung on the raft. The oysters are allowed to grow for about 8 - 10 months (depending on the temperature of the water) before marketing.

Oyster culture on long-line has been recently practised in Japan, Korea, Taiwan and some other Asian countries. The long-line method is gaining popularity because of the lower initial cost and they can be operated in areas where the sea is rough where raft culture cannot be used.

In Taiwan, the long-line method has been further modified for culture of oyster in shallow waters.

Other Aquaculture Related Practices

The fact that production from aquaculture is related to manageable inputs (such as feed etc) has led to the search for alternative sources of inputs at very cheap cost. Studies were carried out on the culture of earth worm (Vermiculture) for commercial production as a substitute for fish meal.

Guerrero (1980) grew juveniles of the earth worm species, *Perionyx excavatus* in six concrete tanks (2,000 juveniles/tank) to harvestable size (0.3 - 0.5 g). A combination of Murrah bufalo manure and ipil-ipil leaves (2 : 1) was used as bedding material. A total of 126,000 worms, weighing approximately 42 kg fresh weight was produced in 7 months.

Culture of frog (*Rana* sp.) is also practised in some Asian countries to combat the rising cost of high protein fish feed.

AQUACULTURE PRACTICES IN NIGERIA

Nigeria, even though blessed with several bodies of water (lakes, reservoirs, streams, flood plains, swamp land etc) is yet to tap the potentials offered by aquaculture.

Preliminary experiments in fish culture in brackishwater ponds started at Onikan in Lagos in the early 1940s' by a fisheries organization which was a branch of the Agricultural Department of the Colonial Office (Anon, 1974). A small Fisheries School was also established at Onikan. Some other recorded aquacultural practices include those of Sivalingam (1972; 1974) on the fish culture possibilities around Lagos lagoon and guide to construction of fish ponds respectively. In an earlier trial with Carp fed on groundnut cake, Sivalingam (1968) obtained a yield of approximatel 1,400 kg/ha. In another trial, stocking a 0.203 ha pond with 943 specimens, average weight 43 g of *Chrysichthys nigrodigitatus* and fed a feed composed of groundnut cake, maize, beans, gari and palm oil, a yield of 184 kg of fish was obtained, with a food co-efficient of 1.7 (Sivalingam, 1972). He noted that lack of information on the natural growth rate of *C. nigrodigitatus* was a constraint to estimating the effect of feeding on this fish species. However, he recommended the popularizing of aquaculture by the Government subsidising the entire capital at the initial stages. Some literature also recorded the establishment of some demonstration ponds and commercial fish farms by government agencies in Nigeria more than three decades ago (Anon, 1963; FAO, 1965). Attempts have also been made recently to point to the management roles, potentials and profitability of aquaculture in Nigeria (Sagua, 1976; 1977; Ezenwa, 1979; Igonifagha, 1979; Ita, 1976; 1980). Konikoff (1975) attempted cage culture of Tilapia sp in Lake Kainji using local availble feed ingredients like guinea corn bran, roasted groundnut, yam flour and dried clupeids (abundant yet unexploited fish of Lake Kainji) Otobo, 1977). Konikoff (op.cit) concluded that there was great potential for aquaculture in Lake Kainji area (surface area, 1270 km²) and made recommendations towards achieving these goals.

International organizations especially Food and Agricultural Organization have been fully involved in fisheries development in Nigeria. The most recent and notable was the establishment of the African Regional Aquaculture Centre at Aluu in River State. The objectives of this centre are:-

(a) To develop through research and training, a sound technical base for organized growth of aquaculture in the region, both as small-scale ventures and as large-scale commercial enterprises.

(b) To increase food production in the form of fin fish and/or shelf fish in the region.

(c) To promote rural employment.

(d) To make aquaculture a strong medium not only for saving but also for earning foreign exchange.

One of the immediate objectives of the Centre is to train each year 40 senior aquaculturists from the participating countries. But only 36 trainees were recorded in the first year, 7 (27%) from Nigeria (Anon, 1980). The centre was availed of the entire facilities at the Buguma Brackishwater Fish Farm.

Aside from the FAO assisted project like this, the Government both at the State and Federal levels seemed to have made some attempts or proposals at establishing aquaculture as a means of fish production (Anon, 1974). Even though there are some demonstration fish farms at places like Panyam, Odeda, Oyo, Agodi (Ibadan), Maska, Bagauda, Wuya, Akure, Okigwe, Oluponna (Iwo) etc., the impact of aquaculture is yet to be felt in the country. Certainly, the annual fish production in the country is far below the demand. The shortage therefore, necessitated importation of fish: the value (₦) of stock fish and other fish and fish preparations imported increased from ₦7.3 million in 1974 to ₦38.5 million in 1975, ₦78.6 million in 1977 and ₦141.4 million in 1978 (Table 1). On the other hand, the total fish catch in the country is not increasing appreciably even though, there is some increase in the estimated number of fishing crafts and fishermen (Tables 2 & 3). This is an indication of fish stock depletion in the wild (increased fishing effort with no appreciable increased fish catch). This situation is already evident in the fishery of Lake Kainji (Otubusin, 1978; Ita, 1982). As expected, the population of Nigeria is on the increase (Table 4) signifying also an incrased demand for food. The crude oil production (the nation's major source of income) has steadily increased over the year from approximately 400 million barrels in 1970 to about 651 million in 1975 and approximately 842 million barrels in 1979 (Table 5). In 1982, Nigeria earned ₦8 billion from oil (Business Times, January 24, 1983). The effect of higher private consumption expenditure (PCE) therefore was expected to raise per capital·fish consumption demand (PCD) in Nigeria from 10.5 kg/annum in 1970 to 13.2 kg in 1980 and 14.4 kg in 1985 (Anon, 1974). Based on this scenario, what then could be the problems and/or constraints to modernization of aquaculture for increasing fish production in Nigeria?

CONSTRAINTS TO MODERN AQUACULTURE IN NIGERIA

(i) Manpower

The major constraint to aquaculture development in Nigeria is the serious shortage of competent trained personnel. However, aquaculture is both a science and art. Apart from the scientific basis, an aquaculturist depends on in his decision in the management strategies. his success is highly subject to his mastery of the art. Even though there is gradual proliferation/proposal of fish farms all over the country, without adequate trained manpower the projects may not be productive.

(ii) Funding

The National Development Plan of the country gives a degree of priority to Agriculture and food production related projects including aquaculture but the eventual release of funds could be problematic or not forth-coming. The project soon become grounded and cannot be carried out to fruition. Pond culture for example, often requires high capital input for pond engineering and construction especially for large scale commercial fishculture. Banking institution on the other hand, are very reluctant to fund aquaculture projects because they doubt the profitability of the venture.

(iii) Lack of Knowledge on the Profitability Of Aquaculture Industry

Since aquaculture is not yet established as an industry in Nigeria, many private enterpreneurs who could have invested heavily in the ventrue are very hesitant. The Government institutions likewise are doubtful of fully funding the project for lack of data to prove the profitability of aquaculture.

(iv) Insufficient Data on Aquaculture Production and Management Techniques

The lack of experimental approach to aquaculture projects in Nigeria is quite evident in the paucity of literature on aquaculture in the country even though 'modern' aquaculture was reported to have begun in Nigeria since four decades ago. Ita (1980) also noted this set back in aquaculture development in Nigeria.

(v) Inadequate Data Base on the Biology and Ecology of Candidate Aquaculture Species Endemic In Nigerian Waters

Whereas the vast bodies of water (total drainage area excluding Lake Kainji, 275,000 km^2) in Nigeria contain over 100 endemic fish species which could perform very well in aquaculture production, not much is known about their aquaculture potentials. For example, the techniques for mass fingerling production of the catfish Chrysichthys nigrodigitatus 'Obokun' are yet to be achieved. The lack of knowledge on the fish to becultured, therefore, makes the aquaculture planning, management and development unrealistic.

(vi) Lack of Rational Aquaculture Development Planning

Lack ofrational planning is one of the major set backs to orderly development of aquaculture industry and leads to non-fruition of the projects. On the other hand, in the planning stage of aquaculture projects, indigenous trained aquaculturists are not fully involved. For instance, an aquaculture planning committee made up basically of non-fisheries or related personnel is bound to be faulty in its planning.

(vii) Non Recognition of Indigenous Trained Aquaculture Personnel

Often than not, serious doubts have existed in some quarters (especially in developed countries) on the ability of developing countries to produce enough food (also fish) to keep pace with rising population and economic demand. Even though the Nigerian is a competent and trained aquaculture personnel, expatriate fish culturist (called an 'expert' but may not be as competent) is preferred by the Nigerian labour employer. It should be realized that the Nigerian fish culturist owes more to his country at least by virtue of being a bona fide and also a bumper harvest of fish from Nigerian pond etc., will be progress and better life for him and the community (who were taxed to train him).

RECOMMENDATIONS

For increased fish production using modern aquacultural practices, all these constraints and all other unlisted set backs and problems to aquaculture in Nigeria must be seriously tackled.

(i) Manpower

More aquaculture personnel at both degree and non-degree levels must be trained. It should be noted that aquacultural practices embrace: Marine Biology, Water Chemistry, Oceanography, Fish Nutrition, Fish Pond engineering, Hatchery Management, Economics, Sociology, Genetics and various sciences and Humanities. The production of degree, diploma and certificate holders in Natural Sciences and Agricultural Studies by Nigerian Universities is not adequate (Table 6). Apart from training more of higher cadre Aquaculture personnel abroad, more middle and low cadre personnel should be trained locally. Nigerian Agricultural institutions should therefore, be expanded to train these highly needed manpower. At least six Nigerian Universities should establish College (or Department) of Fisheries which could be attached to the existing Faculties of Agriculture. Applied fisheries is recommended for inclusion in the curriculum of primary and post primary institutions to animate them with the roles and potentials of aquaculture. Along side with this, every school farm should integrate aquculture with their agricultural projects.

Established Department of Fisheries and other fisheries institutions (e.g. Federal Freshwater Fisheries School, Federal Fisheries School, NIOMR etc) should collaborate with River Basin Development Authority in their localities for aquaculture teaching and practical needs. This collaboration will go a long way in optimal utilization of human and material resources.

National Youth Service Corps members who are graduates of Natural Science, Agriculture or related fishery sciences should be attracted to aquaculture project and given proper orientation at any of the collaborated Fisheries Institutions for a few weeks, then given on the job exposure at aquaculture projects sites. On completion of his National Service he should be absorbed and made to render services to the aquaculture project for about one year before he is sent to an aquaculture institution for further training. This is recommended to be a continuous exercise.

Interested school certificate holders should also be attracted to the aquaculture projects and trained to fill the manpower needs as appropriate.

These trained personnel will eventually fill the different cadres of and at the same time serve in the subsequent aquaculture training, research, development and extension projects.

(ii) Fund

With more trained manpower, aquacultural practices will be more productive at least the profitability will be more evident when data and other economic information are produced. Banking institutions can then be convinced about the profitability of the venture. Government participation however, should come first and foremost in form of funds to aquaculture projects. In the case of pond culture, it should be realized that cost of pond construction alone constitutes more than 50% of the total production cost, therefore, any loan given may not be amortized until after some years of operation.

Homestead ponds can be constructed for families or communities more or less free of charge by the government and then managed by the group concerned.

(iii) On Profitability of the Industry

Full government and institutional participation as recommended above would have gone some way to yield the needed results to the aquaculture industry.

(iv) Data on Aquaculture Production and Management Techniques

With trained aquaculture personnel (fish nutritionist, water chemistry, Hatchery Management, Pond Management, Aquaculture Economist etc) and all other factors for aquaculture production and management, more orderly and planned development of aquaculture can be achieved producing the needed data which will serve as guide lines for further development of the industry.

(v) Indigenous Trained Aquaculture Personnel

Nigerian aquaculture personnel should be challenged by being given the responsibility to research on and develop the aquaculture of this country. Even though collaboration with foreign aquaculture personnel should be encouraged for exchange of technical know-hows, the onus will lie on the Nigerian aquaculturist if more fish cannot be produced using our vast water resources.

(vi) Data Base On Biology and Ecological Requirements of Endemic Fish Species

Some amount of work have been done on the biology and ecology of Nigerian fish species but more studies need to be done specifically on how such fish species can be exploited for aquaculture production. Such studies should normally include the distribution, abundance, seasonality, growth rate, fecundity, hardiness, and all other parameters that are pointers to acceptance of the fish species for cultural purposes.

(vii) Rational Aquaculture Development Planning

With specialists trained in all facets of Aquaculture, it will become evident that with the assistance of the qualified specialists the Government will be able to draw up workable plans for aquaculture development. The plans will be such that show the concrete objectives to be achieved and the right procedures to be followed.

CONCLUSION

It is the view of the author that serious shortage of competent trained aquaculture personnel is the main constraint amongst others to aquaculture development in Nigeria.

Many trained and experienced aquaculture personnel abound in most Asian countries where fish culture started as a tradition. Currently, the region (Asia) produced 80% of the world's total of 6 million tons through aquaculture (Wagel, 1977). Other main Asian countries that contribute significantly to world fish production through aquaculture are Japan, Indonesia and the Philippines. A very large proportion of the fin fish production (75%) is from freshwater ponds, lakes and reservoirs. The total drainage area of the rivers and ponds (except Lake Kainji) in Nigeria is 275,000 km² (27.5 million hectare), added to this is the vast coastal brackish-water neglected swamp land. A judicious exploitation of all these available water bodies in aquacultural practices (pond culture, integrated aquaculture, pen and cage culture, raceways, aquatic ranching etc) will surely contribute immensely to increased fish production in Nigeria.

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Table 1 - Imports of stockfish and other types of fish, 1974-78

Commodity	Values (N millions)				
	1974	1975	1976	1977	1978
Stockfish	2.1	24.3	39.3	13.9	19.5
Other fish and fish preparations	5.2	14.2	37.3	64.7	121.9
Total	7.3	38.5	76.6	78.6	141.4

Source: Review of External Trade, Nigeria, 1978. Federal Office of Statistics, Lagos, Nigeria.

Table 2 - Annual fish catch by weight (tons) in Nigeria

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979
Catch (tons)	409,537	437,971	465,126	473,220	406,236	494,766	504,014	518,567	535.435

Source: Federal Department of Fisheries, Nigeria

Table 3 - Estimated number of fishing crafts and fishermen

Year	Inshore Trawlers		Artisanal Canoes		Fishermen	
	Fishing	Shrimping	Powered	Non-Powered	Full-time	Part-time
1971	13	26	4,204	90,923	n.a.	n.a.
1972	26	29	5,364	90,523	n.a.	n.a.
1973	27	30	6,224	91,732	247,806	106,133
1974	33	39	7,850	10,032	269,354	115,363
1975	33	30	8,240	20,381	279,413	119,670
1976	30	29	11,704	122,633	289,682	124,140
1977	43	36	12,187	125,256	297,317	127,421
1978	38	49	10,118	128,129	293,309	121,989
1979	44	[illegible]	12,510	121,218	312,306	133,846

Source: Federal Department of Fisheries, Nigeria

Table 4 - Estimated population of Nigeria

Year	Thousand
1963	55,670
1970	66,331
1971	68,003
1972	69,732
1973	71,484
1974	73,308
1975	75,139
1976	77,152
1977	79,010
1978	80,991
1979	83,020
1980	87,002
1981	89,612
1982	92,303
1983	95,071
1984	97,923
1985	100,860

Source:- National Population Bureau and Anon, 1974.

Note: 1963 Estimates are derived from the census taken at that date. Subsequent years figures are projections by the National Population Bureau.

Table 5 - Production of crude oil

Year	Production
1970	395,835,689
1971	558,678,882
1972	643,206,685
1973	750,593,415
1974	823,317,838
1975	651,506,761
1976	758,058,380
1977	765,937,709
1978	692,269,121
1979	841,634,055

Source:- Nigerian National Petroleum Company

Note: + July to December 1977.

Table 6 - Degree awards by Nigerian Universities at first degree, post-graduate, diploma and cetificate levels in Natural Science and Agricultural studies

Type of Course	1971	1972	1973	1974	1975	1976	1977
<u>Natural Science</u>							
1st Degree	448 (18)	416 (15)	525 (16)	620 (18)	685 (15)	621 (13)	800 (13)
Post-Graduate	20 (11)	26 (15)	23 (10)	21 (9)	6 (2)	4 (2)	7 (6)
Diploma & Certificate	-	26 (15)	-	-	-	21 (2)	5 (0.5)
<u>Agric. Studies</u>							
1st Degree	128 (5)	260 (8)	214 (7)	285 (8)	326 (8)	421 (9)	326 (5)
Post-Graduate	29 (22)	4 (2)	9 (4)	8 (4)	6 (2)	43 (18)	7 (6)
Diploma & Certificate	2 (0.5)	4 (2)	1 (0.2)	2 (0.3)	25 (2)	24 (2)	7 (0.7)

( ) - In brackets are corresponding percent of total awards of all Universities courses e.g. in 1971, 18% of all 1st degree awards by Nigerian Universities was in Natural Science.

<u>Source</u>: National Universities Commission

CHEMICAL NARCOSING OF FISH IN NORTHERN CROSS RIVER

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ABSTRACT

Chemical narcosing of fish was found to be one of the fishing techniques used for harvesting fish stocks in northern Cross River. The preparation of the fish poison has been described in this paper. The Ichthyotoxic plants used for the fish poisoning were identified and Derris elliptica recommended to be used for the development of piscicides for the removal of unwanted fish in the fish farms.

INTRODUCTION

The artisanal fishery in Cross River State is based on riverine, estuarine as well as coastal fish stocks. There are different types of fishing methods and techniques used in cropping these fish stocks in the 129km coastline as well as in the Cross River basin which covers an area of 54,000km^2 (Moses 1980). Among the techniques in use, is the chemical narcosing of fish.

Fish narcosing is the use of poisons for killing fish in small bodies of water and is practised not only in Nigeria but also in other countries such as India, Sudan and Ghana. Dalziel (1955) in his account of useful plants of West Africa, listed fifty plants used for fish poisoning. Some of these plants include Balanites aegyptiaca, Tephrosia vogelii, Paulowilhelmia polysperma, Mimusops djave, Tetrapleura tetraptera, Mundulea sericea and Adenia cissampeliodos. Reed et al (1967) also identified such plants as Tephrosia vogelii and Boevhavia coccinea which were being used by the fishermen of the Lake Kainji area, particularly of the tribes of Larawa, Kamberi as well as Gungawa. Bhuyan (1967), Shingur (1975) and Jhingram (1982) studied the uses of plant poisons for the removal of unwanted fish from ponds. Das (1969) and Shingur (1972) reported on the toxicity of Derris spp as well as the development of indigenous Derris powder in India.

This study was aimed at identifying some of the ichthyotoxic plants used for the chemical narcosing of fish in the northern parts of the Cross River in the Cross River State.

METHODS

Trips were made fortnightly to the riverine areas of the northern Cross River covering Obubra Local Government between 27th September 1980 to 30th October, 1982 during both low and high flood seasons.

Oral interviews were held with the local fishermen on the methods used for the preparation of the plant poisons and the mode of applications. Occasionally, fishermen were followed during their fishing exercises and plant samples were collected for identification and the species of fish caught were noted.

Mode of Preparation and Operation of Fish Poisons

The plants' parts were all collected from the surrounding bushes and pounded in a mortar with some local dried pepper. Clay soil was also added during pounding in order to bind the contents together. Moulds of the mixture were then tied to the tips of palmfronds and then introduced into the water. Intoxicated fish were collected by means of scoop nets.

RESULTS AND DISCUSSION

Observation made during the study showed that chemical narcosing of fish was carried out in this area during the low flood. The preparation of the fish poisons involved the use of pounded roots, leaves and bark of some Icthyotoxic plants. These plants were collectively called 'Ilem' in the local language (Legbo) and belonged to the families of Papilionaceae and Mimosaceae as shown in Table 1.

Table 1 Icthyotoxic plants used in the preparation of fish poisons

Scientific Name	Local Name	Parts of Plant
Tephrosia vogelii	Ilem	Succulent branches and leaves
Derris elliptica	Su-yolo	Roots
Acacia pennata	Ekum-si	Bark of stem
Boerhavia coccinea	Sali-sali	Leaves
Mundulea sericea	Baba-ikpi	Leaves

The Icthyotoxic Plants

Tephrosia vogelii

These are very common and widely used in the preparation of fish poisons, in the area. The poisonous ingredient is Tephrosin ($C_{23}H_{22}O_7$) which is a crystalline substance only slightly soluble in water. Tephrosin is closely related chemically in its action to the commercial piscicide, rotenone ($C_{23}H_{22}O_7$). According to Dalziel (1956), it has an odour which is due to a volatile oil known as tephrosal.

Tephrosin in its mode of action intoxicates fish by adversely affecting the respiratory system causing immediate death (Reed, 1967). It is very effective in small amounts such as 1 part to 50 millions parts of water (0.02ppm) Tephrosin molluscicide is used in the elimination of schistosome-carrying snails (Reed 1967).

Derris elliptica

It has 2 - 5% rotenone content and is widely used also as a piscicide. It acts as a contact poison and damages the respiratory system of fishes as well as causing death finally. The poisonous effect of Derris powder persists for 4 - 12 days and is very effective in shallow waters up to about 1.5 metres depth with water temperature above 25°C (Jhingran, 1982). The action of the poison is comparatively slower in colder waters.

Acacia pennata

The active ingredient is the tannin from the stem of the plant and this affects the respiratory organs of fish.

Boerhavia coccinea

This is a common weed and it is not considered to be poisonous but it tends to remove slime from the body of the fish (Reed, 1967).

Mundulea sericea

The active ingredient is a glucoside called mundulone ($C_{26}H_{26}O_6$) which is more toxic to fish than that of Tephrosin vogelii.

Observation showed that in the open waters, fish were initially dazed, encircling on the surface of the water from 5 - 15 minutes after the introduction of poison. They recovered later if they were not scooped out. The fingerlings were the first to be affected, followed by other juveniles, then species of the family Mormyridae. In the rocky areas with many enclosures, the potent poisons were concentrated and so the fish stocks as well as other aquatic organisms were killed. Some dead fish were seen floating around the area of application the next day. The fish caught by fish poisoning were consumed by the people living in the area. No adverse effect was observed although this might be cumulative.

While some of the plants parts were eaten in some areas the same plants were used as fish poisons in other areas. In the northern parts of Nigeria, Adenium houghel is used for medical purposes whereas in Sudan, it is used as poison (Irvine, 1947). Fish poisoning practices are useful for harvesting fish stocks which are inaccessible to other fishing gears but they destroy the ecological balance of an environment. Although it is illegal to use the technique in riverine areas the local fishermen continue to use it. The use of plant poisons to kill fish for human consumption should not be encouraged.

However, some of the toxins are useful in fish farming. Derris elliptica contains 1 - 5% of rotenone which is commonly used in fish ponds as piscicides. Shingur (1975) found out in India that indigenous preparation from Derris elliptica and other plants such as Balanites roxburghii, Randia domentorium as well as Albizzia lebbeck were suitable substitutes for imported Derris powder. Suitable piscicides can therefore be developed from extracts of Derris elliptica and used commercially in Nigeria in future for the removal of unwanted fish stocks in ponds.

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INDUCED SPAWNING OF AFRICAN CAT FISH CLARIAS LAZERA (C. and V.) USING ACETONE DRIED CARP PITUITARY EXTRACT, DEOXY-CORTICOSTERONE ACETATE AND HUMAN CHORIONIC GONADOTROPIN

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INTRODUCTION

The procurement of young fish of cultivable species for stocking ponds has been a major set back in the development of fish culture. This problem can be solved through induced or artificial breeding by the application of varied hypophysation methods and other inducement materials.

Houssay (1931), first demonstrated the effectiveness of crude pituitary extract for induced breeding. Recent reviews include Donaldson (1975), Shehadeh (1975), Chaudhuri (1976), Fontaine (1976), Harvey and Hoar (1979), Pulline and Kuo (1980). Hypophysation or injection of pituitary extract is the traditional method of induced fish breeding. This method is still widely employed particularly for major Indian and Chinese carps: Catla catla, Labeo rohita, Cirrhinus mrigala, Mylopharngodon piceus and Cyprinus carpio: Chaudhuri (1976), Chaudhuri et al (1967), Shehadeh (1975) Pruginin and Cirlin (1975), Harvey and Hoar (1979), Tavarutmaneegul et al, (1979). Purified piscine pituitary extract or gonadotropin preparations such as the Salmon gonadotropin SG-100 (Donaldson and Yamazaki 1969, Donaldson et al 1972) have proven to be very suitable for experiments on induced spawning in several species including: Carassius auratus (Yamazaki and Donaldson 1968). Heteropneustes fossilis (Sundararaj et al 1972). Oncorhynchus gorbuscha (Donaldson et al 1972), Mugil cephalus (Shehadeh and Kuo, 1972)

Human Chorionic Gonadotropin (HCG) has been very effective to induce spawning in fish (Chaudhuri 1968) (Shehadeh 1975), Pulin and Kuo (1980) HCG was reported to be either ineffective or partially effective in inducing spawning in some species such as grass carp (Ctenopharyngodon idella, (Anon 1977 a and b), grey mullet (Kuo et al 1973, Pullin and Kuo 1980).

Success was reported for Corticosteroids in Indian cat fish (Sundararaj and Goswami 1966), for Corticosteroids and Progesterone in gold fish (Yamazaki, 1976) for Cortisol in ayu (Hiros and Ishida, 1974) and for deoxy corticosterone acetate in cat fish Clarias lazera (De Kimpe and Micha 1974). The role of endocrine system on reproductive cycle of fish species has been well reviewed by Hoar (1959), Jhingran (1969), Singh (1969) and Lam (1982). Many workers have succeeded in maturing many species of fish by controlling both photoperiod and temperature (Yamamoto et al 1966). The reviews of Jhingram (1969), Singh (1969) and Bruton (1978) cited a number of similar studies and discussed the effects of various other environmental factors such as rains, floods etc and water conditions like pH, NH_3 CO_2, and turbidity on the controlled breeding of cultured fishes.

Efficacy of carp pituitary extract, deoxycorticosterone acetate and human chorionic gonadotropin in inducing spawning of Clarias lazera are discussed in the present paper.

MATERIALS AND METHODS

The brood fish Clarias lazera used for the experiments were collected from Panyam fish farm and Lafia Agricultural Development Authority fish ponds, Plateau State, Nigeria between the middle of June and August 1982. These dates coincided with the breeding season of the fish. Matured females and males ranging from 0.126 to 0.963 kg were collected and kept in the holding concrete tank of the hatchery at Panyam fish farm. The choice of brood fish was based on morphological structures. The male exhibits a conical genital papilla and female presents a longitudinal groove on the oviduct. The females were selected when they display a rounded soft abdomen, a reddish vent and appearance of few eggs upon slight pressure on the abdomen.

Three hormones were used in the experiments. They are crude acetone dried carp pituitary extract, deoxycorticosterone acetate (DOCA) and human chorionic gonadotropin (HCG).

Eighty four female carps (Cyprinus carpio) ranging from 0.4 to 1.0kg body weight were used as the pituitary gland donor for the preparation of crude pituitary extracts. The female gland was used because of its greater ovulation inducing potency than that of the male. Acetone dried pituitary glands were properly ground in small mortar with a minimum volume of 0.6% saline solution. The preparation was brought up to the desired volume of 2ml., 4mg of acetone dried pituitary glands were prepared for one kilogram body weight of fish. All the experiments were carried out in the hatchery at Panyam fish farm. Twelve smaller concrete compartments of 3m long, 1m wide and 1m deep were used for the experiments. The compartments were disinfected with 100ml per 10 litre of "Losan" a disinfectant made by CIBA-GEIGY limited, Switzerland, and later thoroughly washed with clean water.

The bottom of each compartment was laid with spawning mat made from synthetic fibres and twine. To avoid floating of the mat on water, disinfected and washed stones were used to press the mat properly down to the bottom of the compartment. The females were injected intraperitoneally with acetone dried carp pituitaty extract at a dose of 4mg/kg body weight. The male received ½ of the dose given to females. Control brood fish were injected with calculated dose of 0.6% saline solution.

As DOCA is only soluble in oily solutions, local arachis oil (Groundnut oil) was used as carrier for the crystalline DOCA. The oil was partially purified by boiling for 10 minutes and later the impurities were allowed to settle down to the bottom of the glass beaker container on standing for almost 30 minutes. The clear upper layer of oil was carefully removed for use, 10mg of DOCA was dissolved in 1ml of oil in a glass tube with lid. DOCA was administered to the females at a dose of 5mg/100g body weight. The injections were administered intraperitoneally just caudal to the pectoral fin. Injection of the males with DOCA is not necessary because DOCA only acts as stimulus for the laying of eggs and not for maturity of egg and milt. The males were alternatively injected with pituitary extract at a calculated dose of ½ that of the females. Control brood fish were injected with groundnut oil.

HCG was administered intraperitoneally at a dose of IU/g (Lam 1982) for the 1st three experiments, and two times the dose of the first three for the next three experiments. Control brood fish were injected with distilled water.

The weight of the females were taken before the injection and after spawning. The drop in weight was used to calculate the number of eggs spawned using the equation for estimating the fecundity of Clarias lazera by Hogendoorn (1977): Total number of eggs = 66.6 x female body weight (g). The percentage fertilization was estimated from the number of unfertilized eggs by the equation: % fertilization = $\frac{N - n}{N} \times 100$

where N = Total number of eggs spawned; n = number of unfertilized eggs.

RESULTS AND ANALYSIS

The experimental design employed is combined experiments having six series of simple experiments. Each experiment has four treatments and two replicates per treatment (Table 1).

Table 1. Percentage fish response to inducement for analysis.

Inducement	Expt. 1		2		3		4		5		6	
	FISH 1	FISH 2	FISH 1	FISH 2	FISH 1	FISH 2	FISH 1	FISH 2	FISH 1	FISH 2	FISH 1	FISH 2
CPE	100	100	100	100	100	-	100	100	100	-	100	100
DOCA	100	100	100	100	100	100	100	100	100	100	100	100
HCG	-	-	-	-	-	-	-	-	-	-	-	-
CONTROL	-	-	-	-	-	-	-	-	-	-	-	-

CPE = Carp Pituitary extract
DOCA = Deoxycorticosterone Acetate
HCG = Human Chorionic Gonadotropin

The use of DOCA and carp pituitary extract was successful in inducing spawning of *Clarias lazera* with DOCA exhibiting higher potency than pituitary extract. All the fish induced with DOCA spawned, while 83.3% of those treated with pituitary extract responded positively. The use of human chorionic gonadotropin was not successful as no single spawning was recorded. The mean number of eggs spawned by induced spawning for fish treated with carp pituitary extract and DOCA were 1698 ± 145 and 1837 ± 164 respectively.

DISCUSSION

The 1st two hormones in this experiment namely carp pituitary extract and DOCA were successful in inducing matured *Clarias lazera* female. The third one namely Human Chorionic Gonadotropin was not successful as no spawning was recorded. DOCA was found to be very potent, even more potent than pituitary extract but it is not readily available for use and costly as it has to be imported from abroad. Other shortcoming of DOCA is that it has no effect on egg or milt maturity unlike pituitary extract. It can only act as a stimulus for ovulating.

The result obtained with the induced spawning of *Clarias lazera* conformed with earlier experiments as reported in literature (Micha 1973; Hogendoorn 1979) in which they achieved spawning in *Clarias lazera* with DOCA and pituitary extract. On the basis of works carried out in the far East on *Clarias batrachus* induced spawning experiments attempted in 1970, with injection of human chorionic gonadotropin gav negative results and cases of the death of genitors or brood fish wer reported (Micha 1973). However, catfish *Clarias macrocephalus* was reported to spawn by the administering of HCG (Carreon et al 1976).

Appreciable number of eggs were ovulating through induced breeding using DOCA and pituitary extract. The mean number of eggs estimated for CPE was 1698.4 ± 145.4 and for DOCA 1847 ± 164 incubation of these eggs with care should lead to a large production of *Clarias lazera* fry.

From the results it appears that DOCA is more potent than pituitary extract in inducing spawning in *Clarias lazera* however, the difference is not significant.

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SECTION 4: FISH PRESERVATION MARKETING AND DISTRIBUTION, FISHERIES EDUCATION AND EXTENSION

THE SIGNIFICANCE OF FISH HANDLING, PRESERVATION AND PROCESSING IN THE DEVELOPMENT OF NIGERIA INLAND FISHERY WITH SPECIAL REFERENCE TO KAINJI LAKE

by

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ABSTRACT

The traditional approach to fish handling, preservation and processing technology in inland fishery is critically examined using the experience in Kainji Lake as a model. The need to uplift the fishermen technology is emphasised with the ultimate expectations of improvement in fish quality.

INTRODUCTION

The inland waters of Nigeria comprise many rivers, lakes, ponds and reservoirs situated within the 923 square kilometre land area. Compared with inshore, coastal and brackishwater fishery, this subsector is generally marked by low productivity. For example, out of the estimated 482,000 metric tonnes of fish produced in the artisanal sector, fish production from brackishwater was over 286,000 metric tonnes, while production from rivers and lakes were estimated at 125,000 and 71,000 metric tonnes respectively (Anon, 1981).

In Kainji Lake area, gradual depletion of commercial fish landings has been reported from an estimated 30,000 metric tonnes during the early post-impoundment period (Bazigos, 1972) to 5,000 metric tonnes in 1978 (Ekwemalor, 1978). Some authors (Meyboom, 1975) have estimated losses arising from poor fish handling, preservation and processing techniques as reaching an alarming 15%. On a national scale, this loss is colosal and if not subjugated would further aggravate the apparent paucity of this protein rich resource. There is therefore, an urgent need to improve the artisanal fish handling, preservation and processing technique in inland waters with the hope of increasing fish production and supply through improved techniques. This report is intended to appraise the present fish handling, preservation and processing methods in Nigeria Inland Fishery using Kainji Lake as a model and recommend ways and means of improving on this practice in order to markedly reduce wastage associated with conventional practices.

CATCHING AND HANDLING

Fish are caught in inland waters by the use of gill-nets, hooks, cast nets and various traps. The fish when caught are thrown into canoes or boats which range from primitive row - boats or canoes made of floating woods to dug out canoes which in most cases are not mechanized. In Kainji Lake, out of the estimated 5,000 fishermen operating on the lake, less than 300 of them have outboard engines (Ekwemalor, 1978)). There are no fish handling facilities on board canoes and the fish when caught are left on the bottom of the canoe, under the intense sunlight, struggling there in a pool of warm filthy water in which they later die of asphixia (Eyo, 1977). It has been observed (Eyo and Ita, 1977) that the shelf life of fish preserved in the shade was longer than those immersed in water or exposed to direct sunlight. In order to minimize spoilage, fishermen should endeavour to shade their catches rather than expose them freely to intense sunlight or stack them in dirty water. By this practice and the fact that the fish are not gutted after hauling fishermen lose a good percentage of their catch through the invasion of bacteria into the tissues of the fish before they are landed.

a) Significance of Gutting

Gutting involves the removal of the viscera which harbour spoilage bacteria and digestive juices which attack the flesh of the fish post mortem. These bacteria and enzymes are ever present in the living fish. While the enzymes are involved in the digestion and the general enzymatic activities of the living fish, the bacteria proliferation is inhibited by the general metabolic reactions of the fish which includes the low pH of the gut, the anerobic environment obtained in the gut and the enzymes and acid in the viscera which digest the bacteria and cause the condition of the gut to become unfavourable for their growth. At death these metabolic activities are slowed down, the bacteria lining the gut penetrate the nearby tissues causing putrefaction. The enzymes also penetrate the tissues causing autolysis and putrefaction. It is the need to stop these changes arising from the presence of the gut, that the gut is frequently removed in freshly caught fish.

Watanabe (1965 & 66) working on Tilapia in East Africa observed that gutting of this species is of value in reducing spoilage of the fish. However, when gutting is carried out it should be done in such a manner that the guts are fully removed as remains of the gut if not removed hastens spoilage. The remedy is to wash the gut in clean potable water.

With the distance from the point of harvest to the fishing camp generally far apart, fishermen often lose a good percentage of their catch before they arrive at the fishing camp. About 2 to 6% of the total catch are lost through spoilage prior to landing by a sample of 46 fishermen operating in stratum I on Kainji Lake (Table 1). These losses include spoilage arising from fish entangled over-night in gill-nets. Such losses would be minimised if improved handling techniques are available to the local fishermen.

Table 1 - Fish lost through spoilage among fishermen landings in statum I

Type of Canoes	No. of Fishermen Sampled	Average Catch	Quantity of Fish spoilt at landing (Av)	Loss through Spoilage (%)
Mechanized	21	38.48	2.14	5.56
Non-Mechanized	25	32	0.76	2.34

b) Influence of Rigor Mortis

The rigor mortis is associated with the stiffness of the entire body of the fish post-mortem. The duration of rigor is considered an important phenomenon in the shelf-life of fresh fish since bacterial spoilage is arrested during rigor until the resolution of rigor or tenderizing of the flesh. The onset of rigor mortis has been associated with the disappearance of Adenosine Triphosphate (APT) which energises the muscles (Bendall, 1951). Since the more glycogen the muscle tissue contains at death, the later the rigor mortis,; it follows that death by exhaustion which deplets the glycogen content will also speed-up the onset of rigor.

This is very important in the small-scale fishery where fishermen inadvertently rely on the duration of rigor for fish handling. In the usual practice where fish are allowed to struggle and die of exhaustion, the duration of rigor mortis is reduced and the shelf-life of the fish is affected. Table 2 shows the duration of rigor in some species from Kainji Lake.

Table 2 - Differences in the duration of rigor mortis in some species from Kainji Lake

Species	No. of samples	Mean Duration of Rigor (hr)	Temperature Range (C)
Sarotherodon galilaeus	9	5.14	30
Sarotherodon nilotica	7	5.14	30
Auchenoglanis occidentalis	6	3.15	29 - 34
Tilapia zilli	4	3.18	35
Bagrus bayad	4	3.51	29 - 35
Hyperopisus bebe	2	3.68	30 - 34

The fish were caught alive, stunned by piercing a needle into the cranium and kept under identical conditions in the laboratory and the rigor mortis duration observed by subjective method. From this preliminary work, it could be noticed that fish if properly handled by fishermen by stunning after capture and shading the canoe will keep in a wholesome condition for a minimum of 3 hours after capture. This period should be adequate for fishermen to transport their catches in inland fishery from the point of harvest to the fishing camp or port.

c) Cooling Facilities

Artisanal fishermen are also faced with losses arising from the absence of cooling facilities at the landing site. Since the high ambient temperature encourages proliferation of bacteria, cooling the fish will inhibit multiplication of spoilage bacteria thereby extending the shelf-life of the fish before they are sold to consumers. Roach (1974) recommended the use of flake ice machines in small-scale fisheries; however, care should be taken in the use of flake ice to avoid bridging-creating air space between the ice and fish. Disney *et.al* (1969) reported that one hour's storage of East African *Tilapia* species at ambient temperature (24°C to 30°C) is roughly equivalent to one day's storage in ice. Using four West African species, Amu and Disney (1973) observed a storage life of more than three weeks. It follows that the presence of ice will reduce spoilage in small-scale fishery but could the returns from the artisanal fishermen meet the purchase of ice plant? Apart from the fact that fishermen are obviously peasants, the location of many fishing villages far form electricity supply render it impossible for fishermen to consider any advantage they could derive from the use of ice. An ice plant producing 600 kg/24 hours of flake ice costs ₦3,700 as at 1975.

Species	Number of Sample	Total Weight (gm)	Mean Weight (gm)	Mean Weight Loss Resulting from Dressing (%)	Mean Wt. Loss Resulting from Smoking (%)	Mean Total Loss in Weight (%)
Lates niloticus	18	221550	12308.33	15.50	39.13	54.64
Sarotherodon galilaea	99	39425	398.23	20.47	51.84	72.31
Hydrocynus forskali	6	3930	655	13.48	47.2	60.69
Tilapia zillii	3	835	278.33	20.36	51.5	71.85
Sarotherodon nilotica	2	335	167.5	19.40	56.71	76.12
Citharinus citharus	2	250	125	20.00	64.00	84.00
Distichodus rostratus	2	330	165	18.18	57.58	75.76

FISH PRESERVATION

The preservation methods commonly encountered in inland fishery are curing and freezing. Fish curing is usually done by smoking and sun-drying whereas, freezing is carried out using cold-store or domestic freezers.

1) Traditional Curing of Fish

(i) Fish Smoking

This is by far the commonest and perhaps the oldest method of fish preservation in the country. Earlier observation that 90 - 95% of the total fish catch is being processed into the dried fish by fishermen (Meyboom, 1975) appears to have been overtaken by events. Recent evidence (Ita and Eyo, 1982) indicate that most fishermen would rather sell their catches in the fresh state than process them. The reasons are not far fetched.

1. The inevitable loss in weight following dressing and smoking which also affect the market price (Table 3). This loss accounts for 50 - 80% of the fresh weight.

(2) Additional labour needed for wood collection and additional cost if wood is to be purchased.

(3) The possibility of getting the fish charred through neglect and the use of traditional and obsolete smoking methods. This tends to produce smoked fish with matt surface and charred appearance often rejected by consumers.

It is not uncommon, however, to observe some fishermen living in fishing camps without access roads being fully engaged in smoking because of the absence of a ready market. In Kainji Lake area, most smoking is conducted by fish mongers in fishermen camps and the processed products are transported to the southern markets where they are marketed.

It is not intended to elaborate on the traditional fishing methods as this has been done elsewhere (see Meyboom, 1975; Rawson, 1966; or the Chemistry of Fish Smoking (Eyo, 1980), suffice it to mention here that two smoking kilns have been developed in the country whose performances have been found suitable for adoption by the fishermen: the NIOMR kiln and the Kainji gas kiln (Eyo, 1981) (patent No. RP: 5137). The former uses firewood for heat and smoke production, while the latter uses the common cooking gas for heat production and woodshavings and sawdust for the production of smoke during the smoking process. However, a fisherman may not be able to afford any of these smoking kilns inspite of their obvious advantages, unless the kilns are sold at subsidized rate.

(ii) Fish Salting and Sundrying

This practice is limited to the arid parts of the country where dry season extends to most parts of the year. In the Lake Chad area, *Alestes* sp. is sundried for local consumption (Osuji, 1976).

In Kainji Lake region, the potential for the production of salted sundried fish was investigated using the following species:- *Hydrocynus* sp., *Tilapia* sp., *Lates* sp., *Alestes* sp., *Mormyrus* sp., and *Gymnarchus* sp., *Chrysichthys* sp. and *Bagrus* sp.

It was reported that the production of salted sun-dried fish is feasible in this region in the dry season and will help to reduce wastage if practiced by the artisanal fishermen (Eyo, 1979 & 1980).

b) Fish Freezing

Freezing techniques as practiced in intensive commercial fishery is virtually unknown to artisanal fishermen engaged in inland fishery. A few well-to-do fish mongers within Kainji region acquire Cabinet Freezers for freezing of fresh fish before they are transported in Cold-Vans to distant markets. Since the cabinet freezers are not designed for freezing but for short term stor of products, freezing is characteristically slow and in some instances fish tend to show signs of incipient spoilage, while still in the cabinet freezer.

The Blast and Plate Freezers which are specially designed for fast freezing are expensive and unavailable in our local shops. They have to be imported into the country. Furthermore, fishermen catches may not warrant the use of such sophisticated equipment which are designed for fishing industries with enough profits to meet operational cost.

c) Cold Storage

Cold stores are expensive and beyond the capability of the average fisherman (the price of a cold store of 23 tons capacity is about ₦23,000.00). A few fish mongers and government corporations tend to use the cold store as freezing equipment rather than for storage of frozen fish. Inability to comply with the mechanism of cold store management as shown by the absence of equipment necessary to maintain the 'Cold Chain' result in products from the cold store lacking in appearance, flavour and texture when thawed. The performance of the cold store is affected by poor cold store management and frequent breaking down of the cooling equipment is common occurence. Scarcity of fish in certain seasons also keep some cold stores idling for a long period.

FISH PROCESSING

Fish processing which includes canning, production of fish meal and fish protein concentrates (F.P.C.), fish silage and comminuted fishery products are absent in inland fishery. The reason is not far fetched. The high capital needed in setting up a fish processing complex coupled with absence of organized fishery in this sector, militate against embarking on viable fish processing technology. For example, it would be uneconomic to set up a fish meal plant when fish offals are not abundant in commercial quantity to keep the machinery working all year round. Adequate source of fish is paramount when considering improvements in the utilization of fish and fishery products in inland fishery.

RECOMMENDATIONS

From the foregoing it would be observed that the quality of fish available for consumers is dependent on the operational techniques adopted by the artisanal fishermen. Still, little has been done to improve their technology which invariably will enhance fish quality and quantity. Based on this, the following recommendations are considered applicable to the present status of our inland fishery.

1. Government intervention to salvage the current technology of the fishermen through the River Basin, and other authorities should be intensified through the setting up of a well coordinated pilot scheme in strategic locations. Such a scheme should show special concern in the inovation of fishing gear methods, and handling and preservation practices by providing improved technology at subsidized rate to fishermen.

2. It is becoming increasingly obvious that the price being paid for technology transfer is gradually excalating, thus fisheries research should aim at improving the traditional methods rather than borrowing costly exotic technology which in many cases are neither practicable nor applicable to our indigenous inland fishery.

3. Research findings already available should not be locked up in drawers, but should be translated into simple terms and made available to the artisanal fishermen through active extension and laiason services. Unlike extension workers in agriculture, the fisheries extension workers have not been seen so far to make the much needed impact.

4. Recommendations on improvement in fisheries technology cannot be implemented unless the stock is available. Given the low production from the domestic sector, greater emphasis should be placed on the management of the existing stock as reported by Ita (1982) and aquaculture practices should be intensified to boost fish production from the inland sector.

CONCLUSION

The method adopted by the artisanal fishermen in fish handling, preservation, and processing technolgy, lends itself to wastage through spoilage during handling; and poor quality product following preservation. Efforts aimed at improving the current traditional practice should be made by a joint participation of fisheries research technologists and extension workers. Technology transfer with its resultant high cost may not meet the aspirations of the traditional fishermen.

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DRYING OF FISH - FACTORS TO CONSIDER

by

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ABSTRACT

Although one of the best possibilities for raising the animal protein of the diets of Nigerians is to increase the consumption of fish; particularly through the use of several methods of long term preservation techniques, such as drying, no radical approach has yet emerged. Although, a great deal of the artisanal fish catch is dried for the huge consumer and distant markets, the traditional methods of fish preservation need improvements to cope with demand for increased quantity, shelf-stable, and improved quality of fish products. There is therefore, a great need to structurally transform the mode of fish drying.

The paper discusses drying requirements, heat and mass transfer, consumer acceptance, fuel sources, storage and marketing of dried fish products; and suggest ways and means of structurally transforming the artisanal technology of fish drying.

INTRODUCTION

Fish Resources of Nigeria

The major proportion of landed fish in Nigeria is by the artisanal sector (Talabi, 1977). According to a recent study (Uboma et al, 1981), the average yearly total domestic fish production between 1971 and 1980 was 486,747 metric tonnes (mt). This figure represented production from coastal and blackish water (55.5%, rivers (28.4%) and lakes and ponds (13.9%); all of which accounted for 97.8% of the total fish catch. Inshore fishing (industrial) represented only 2.2%. However, not much seems to be known about the proportion of this catch which is actually preserved either by drying or smoking.

The growth rate of the various subsector of fisheries (Mabawonku, 1981) are:-

Artisanal:

a) coastal and blackish water, 3.2%

b) inland rivers and lakes, 2.7%

Industrial (Commercial Trawlers)

a) coastal fishing, 9.18%

b) coastal shrimping, 6.82%

The total average annual growth rate is therefore 5.5%. The average estimated fish production (mt) from Kainji Lake, Lake Chad and rivers and reservoirs are 11,000 40,000 and 130,000 respectively.

It is also estimated that fish represents about 40% of Nigeria's animal protein resources (Uboma et al, 1981). It is clear, therefore, that fish production and processing could play a significant role in meeting the protein needs of Nigerians.

Nigeria imported on the average about 200,000 mt of fish annually between 1971 and 1978. Infact, fish imports rose from 54,416 mt in 1971 to 218,000 mt in 1978 at a rate of 300%. The estimated fish consumption (mt) is shown in Table 1.

Table 1 - Fish consumption in Nigeria

Year	Projected Estimate x 1000 (mt)
1980	993.2
1981	1037.8
1982	1084.6
1983	1133.4
1984	1184.4
1985	1237.7

Source: Federal Department of Fisheries (Mabawonku, 1983)

The level of fish consumption shown above is based on the assumption of:

(a) an income elasticity of demand for fish of 1.0;

(b) 2.5% rate of population growth, and

(c) 2.0% rate of growth of real income.

To what extent Nigeria can meet this huge protein demand will greatly depend on her ability to reduce the massive post-harvest losses of fish through a deliberate and conscious application of science and technology by way of upgrading the artisanal sector of the fisheries industry.

Fish Handling in Nigeria

The marketing of fish includes two broad systems:-

(a) the modern chain distribution system principally for imported frozen fish;

(b) the traditional fish collection and distribution system.

The latter involves the collection, processing and transportation of fish from the canoe fishermen at remote production areas to the major consuming centres. At the retail level, fish are displayed in open shelves in the markets. This display method attracts flies and leads to rapid deterioration of the product. There is therefore, considerable amount of spoilage through autolysis, decomposition, insect infestation and such losses are estimated as between 20 and 60% depending on season and location. To reduce such huge losses, and preserve fish, artisanal fishermen and their families engage in either, smoke drying or sun-drying of fish.

Smoked fish form the bulk of the retailed fish products. It is estimated that 95% of the total artisanal landings are smoked or sun-dried. The smoking is carried out at different stages of the distribution chain. In majority of cases, the fish is smoked in the fishing settlements by the fishermen's wives or family. Smoking is also done by wholesallers and even at retail levels. In areas close to fishing settlements, the fish is light-smoked or semi-dried. In the hinterland, hard smoked fish predominate which have longer shelf-life but command higher prices than the semi-dried or lightly smoked ones.

In the northern drier parts of the country, olar drying has been very important because:

(1) the relative humidity is low; and

(2) wood as a source of heat smoke is relatively scarce and expensive.

A great deal of the fish landed in the Lake Chad shores, are sun-dried but with associated problems. Traditional sun-drying of fish as practiced, is relatively slow, and because fish is highly perishable, losses through spoilage are high and products are not uniformly dried. Another major problem encountered with open-air sun-drying is fly infestation. In the absence of intense sunlight maggots develop and cause disintegration of the fish. Eggs laid on exposed fish could hatch and cause damage to the products during subsequent storage (Capio, 1982). Handling the materials during unexpected rains presents anohter problem. To alleviate such problems there is need for controlled procedures and appropriate equipment to ensure the maximum yield of sun-dried fish with a satisfactory storage life.

Post-Harvest Fish Losses

Food wastage from the farm level to the "dinner table" has been recognised as a significant constraint in achieving the much desired self-sufficiency in food and fibre production in Nigeria (Akinrele, 1977). Efforts to quantify the magnitude of such losses have encountered difficulties; both in definition and in magnitude. Losses of fish foods post-harvest have been estimated as 50%, at least in the Lake Chad area of Borno State. Much of the existing catch is either under utilized, malused or misused; leading to considerable wastage after capture. Microbial spoilage represents the most serious loss of wet fish. Further serious problems can also arise from contamination by pathogenic microorganisms.

Although technologies for control of spoilage of fish are well established, Nigeria has been unable to apply such technologies. Substantial spoilage losses also occur in processed (smoked, and sun-dried) products. Problems arise particularly in the dried fish industry as practised by artisanal fishermen. The problems include microbiological and lipid oxidation, leading to off-flavours and poor storage stabilities. Dried fish represent a significant source of low-cost protein among Nigerian consumers. There is also the problem of large scale insect infestation as a result of inadequate drying, poor handling and inadequate packaging, storage and retail. Losses as high as 50% are reported for dried-fish products.

Optimal Handling of Fish

Fish is a notoriously perishable commodity (Jones and Disney, 1977). In the tropics, at ambient temperatures, spoilage is rapid, occuring within 24 hrs. Tropical fish often spoil more rapidly than cold water fish. Freezing of fish or the iced distribution of fish for the internal markets has become widely practiced and holds much prospects in Nigeria. Canning has also been successfully applied to fish processing in many countries, and canned fish products abound in Nigerian markets. However, canning, freezing and icing, which are simple and relatively cheap methods of preserving fish in Europe and North America, are generally too expensive to adopt in Nigeria for various reasons. On the other hand, socio-cultural as well as conservative attitudes regarding consumers acceptance of frozen or canned fish should be considered.

The drying of fish, using the sun's thermal energy or wood fuel as means of preservation, have been carried out for centuries throughout the world in general and in Nigeria in particular. Fish drying has therefore, become very popular in Nigeria (Mabawonku, et,al, 1982) because it is within the socio-economic levels of the fishermen and also a meaningful technological input. Above all, there is an insatiable market for dried fish products in Nigeria (Mabawonku et. al, 1982). Nevertheless, consumers are interested in the characteristics of fish processed. In relation to that is the fact that there are various species of fish sold in the Nigerian market and each has different characteristics. A particular consumer will purchase fish in relation to the distinct characteristic which that consumer attaches to what he buys.

Unfortunately however, fish drying as a technology has not improved in Nigeria due to several factors; some of which are related to the level of technological developments within the artisanal subsector of the conomy. Two major phenomenon have taken place in Nigerian fisheries in the last two decades. The first began with the modernization of the fishing boats, the increase in the number of inshore fishing vessels, and the growth of refrigerated or frozen fishes in the market, all within the industrial sector of the fishing industry. However, no radical change has taken place as far as preservation of fish by drying is concerned. Fish processing by drying is not standardized and there is a wide variation in quality.

Processed fish products in the markets include salted-dried; unsalted-dried/half salted; unsalted-smoke-dried/salted smoke-dried; sun-dried (salted/unsalted) and fermented dried. Given the array of dried fish products on the market, one would hope that given the dynamic and growing economy of Nigeria, consumers attitudes could greatly influence the type and quality of dried fish available on the market. This could then lead both to a change in techniques of product processing and product delivery as well as to changes in consumers preferences.

Studies of consumers preferences and attitudes to dried fish should aid in the improvement of the technology of fish drying such as:-

(1) buyers preferences,

(2) reasons for those preferences,

(3) the quality of the dried fish and their shelf life, and

(4) constraints in selling and suggestions for product quality improvements.

Such information is required to guide the development of improved processing and drying technology. There is also a need for a marketing survey to identify important characteristics for marketing dried fish; regarding salt content, species of fish, and storage life including packaging.

Technology of Fish Dehydration

Fish drying has become more of a science than an art, considering the present-day technological development in drying as a science. Drying in food is referred to as the removal of moisture so that environment is unfavourable for the development of moulds and bacteria (Hall, 1957). It is therefore, to minimize the chances of spoilage by microbial action. The problems facing fish drying in Nigeria include the low level of technological development in the science and art of moisture removal to conserve fish resources and produce qualitative dried products.

Drying of Fish

Drying and smoking are widely used in fish preservation. In the process of drying and smoking, much of the moisture content of the fish is extracted through heat, thus inhibiting the action of the microorganisms and prolonging shelf life. Furthermore, the fish while being smoked becomes impregnated with wood smoke, and is thus given a distinctive flavour and becomes less liable to spoilage, since many components of the wood smoke act as antiseptics.

Depending on the type of contact of moisture with the product, we may distinguish surface moisture which clings to the body of the fish by adhesion, capillary moisture which fills up the pores of the colloidal particles, and moisture which is chemically linked with the cells of the fish. In the process of drying and smoking, practically all the surface and capillary moisture is extracted from the fish. According to the principle by which heat is applied, drying installations may be divided into atmospheric dryers, vacuum dryers and special dryers in which the product is exposed to high frequency currents and infra-red rays. Similarly, smoking installations may be divided into cold-smoking plant (with temperature not exceeding 40°C) and hot-smoking plant (with temperature between 80 and 140°C).

In the course of drying and smoking, the amount of absolutely dry matter remains constant (provided there are no mechanical and other losses) and may be expressed by the formula:

$$Gd = G_1 \frac{100 - W^1}{100} = G_2 \frac{100 - W^2}{100}$$

Where G_1 = amount of moist material admitted to the dry and smoking installation, kg/hr.

G_2 = amount of dehydrated material, kg/hr.

Gd = amount of absolutely dry matter in the dehydrated material kg/hr.

W^1, W^2 are respectively, the moisture contents of the material before and after drying, %.

The amount of moisture extracted during drying and smoking is $W = G_1 - G_2$

The amount of moisture extracted in relation to 1kg of moist material can be expressed as:

$W = G_1 \frac{W - W2}{100 - W2}$; similarly the amount of moisture extracted in relation to 1kg of dehydrated material can be expressed as:

$$W = G_2 \frac{W1 - W2}{100 - W1}$$

Allowing for losses in the drying and smoking installations, the yield of the finished product may be determined from the formula:

$G_2 = EG_1 \frac{100 - W^1}{100 - W2}$; where E is the coefficient of conservation of the product. E equals 0.98 for drying and 0.97 - 0.99 for smoking.

Drying, either without or after salting and with or without smoking is a widely accepted traditional practice of preserving fish. Salting, smoking and drying are processes that can be employed with the minimum of equipment and operated by semi or unskilled workers. However, as "pressures" mount to seek new ways and means of improving the animal protein intake by Nigerians, it has become imperative to "advance" the processes of fish drying from minimum equipment to maximum equipment and from semi-skilled to skilled workers. The quality of life of the fisherman and his family also adds urgency to the need to improve the returns on his hazardous labour, through the infusion of the relevant technology.

Evidence of both social and structural transformation of the Nigerian society can now be found not only in the advances in the techniques of production; but more especially in the areas of urbanization, commercialization of the economy and the demand for high quality products by Nigerian consumers. In the area of fish processing, the traditional methods of fish preservation, (smoking/drying, salting or sun-drying) need improvements or should be modernized to cope with the increasing consumer and national demand for fish products.

The improvements required include increased quantity, shelf-stable and improved quality of preserved fish products. Technological innovation (the scientific study of a practical art) in the drying of fish holds much prospect; but who initiates, prosecutes or executes such innovation? Should the innovation originate from Government, the industrial sector of fishery industry or the artisanal fishermen? My thesis is that it will be unrealistic to expect technological innovation alone to contribute a decisive input; coming from the artisanal subsector. Any effective action to upgrade the technology of fish drying must be taken by governments, their agencies, private enterprise or industry; action which should lead to a structural transformation of the "practical art" of fish preservation.

"The Nigerian Fishery Industry has developed into a mere fish importer or shore based frozen fish-handling institution with little or no plans for upgrading its role into a manufacturing industry as a means of qualitatively and quantitatively improving its outputs" (Talabi, 1977). The artisanal subsector, which accounts for about 98% of the total fish catch is totally incapable of upgrading the quality of processed dried fish and fish products. Herein lies the dilemma facing the fishery industry. Prospects of the Nigerian Fisheries in the Eighties" lies in our ability to structurally transform the industry into a viable and enduring enterprise. However, this calls for a systematic series of studies specifical on Nigerian fishes and which must be backed by the goodwill of government and other agencies charged with the destiny of this country. Meanwhile, some fundamental work need to be done on important "Nigerian" fishes.

AREAS OF WORK REQUIRING ATTENTION

a) Equilibrium Moisture Content

The isotherms of a number of Nigerian important species of fish, salt or fresh water varieties within the relative humidity range of 20 to 80% should be studied scientifically regarding the attainment of desired equilibrium moisture content (MCe). This is essential and fundamentally necessary.

b) Rate of Drying

As indicated earlier, the whole idea of fish drying is centered on the removal of sufficient moisture (free moisture) to ensure the preservation of the food material. The rate at which the free moisture is removed from the product does not remain constant. Jason (1962) and Burgess et.al (1967) described the drying process as composed of the constant rate period where moisture is removed at uniform rate until it reaches a critical moisture (MCc) after which the rate of moisture removal decreases as the drying process enters a falling rate period. In the case of fish muscles, which initially have a water content of about 4 g/g of dry weight, the moisture evaporates at a constant rate until it falls to about 1 g/g of dry weight (Jason, 1962).

Henderson and Perry (1955) have described the free surface evaporation of moisture during the constant rate period in the equation:

1) $(dW/dt) = 4.39 \times 10^{-5}\, fvA\, (Ps - Pa)$

2) $\quad = 0.4536\, K_f\, A\, (ts - ta)/hfg$

Where: (dW/dt) = drying rate, kg of water/hr;

fv = water vapour transfer coefficient $kg/(m.m^2 kg/m^2$;

A = water surface area, m^2;

Ps = water vapour pressure at ts, atm;

kf = thermal conductance of air film, Kcal/(m.m² °c);

ta = air temperature, °c;

ts = water temperature, wet bulb, °c; and

hfg = latent heat of vaporization, Kcal/kg.

The mass migration equation (equation 1) describes the rate of drying as being dependent on the vapour pressure difference between the product surface and the bulk of air and on the mass transfer coefficient. The constant rate of drying may also be evaluated in terms of the heat transferred to the product to evaporate the surface moisture (equation 2).

Usually, at the end of the constant drying rate, the hygroscopic material has reached the critical moisture content that can sustain a uniform rate of flow of free water to the surface which is equal to the maximum rate of water vapour removal from the surface (Capio, 1982). The moisture diffusion within the fish decreases below that needed to replenish the moisture at the surface, and as such, the rate of moisture removal from the product slows. The falling rate period is largely controlled by the movement of moisture within the material to the surface by liquid diffusion and removal of moisture from the surface (Hall, 1957).

The drying rate at this stage may be described by the Fick's law of diffusion:

3) $(dMC/dt) = DL(S\ ^2MC/S\ x^2$

Where: DL = liquid phase diffusion coefficient applicable for movement through the solid phase, m^2/hr;

MC = moisture content, dry basis;

t = time and

X = distance along travel of moisture, m

The foregoing has important practical applications for us. The equations are of practical value in that for the drying of fish to be efficiently carried out, we need to determine the drying constant for the different species of fish of commercial value.

One cannot therefore, over emphasise the importance of scientific appraisal in the much needed upgraded large scale commercial drying required today and in the decades ahead, to be able to exploit our fish resources.

c) Design of Suitable Equipment

Dehydration is defined as "drying under controlled conditions of temperature and humidity to a specific end point in a given time" (Parker et al, 1954). There are several means of drying fish products; the most important of which is air convection dryers since they are relatively simple to operate and are in expensive. The work done at the Nigerian Institute of Oceanography and Marine Research (NIOMR), Lagos, which lead to the design and development of a smoking Kiln is in the right direction. This effort should however, be seen as only setting the stage for a greater task ahead if Nigeria is to be able to improve the quality of dried fish available to consumers.

Consequently, this calls for a radical approach which can lead to a structural transformation of the erstwhile backward primitive technologies practised by artisanal fishermen to the application of modern techniques of fish dehydration. Such a radical approach should lead to:-

(i) The development of smoking Kilns which stress simplicity, low cost with some measure of control of the main variables in smoking - smoke quality, volume, air volocity, temperature and humidity;

(ii) The introduction of dryers which are simple to construct, operate and maintain; made of local material, acceptable to the users, cost effective and capable of drying a variety of commodities;

(iii) the evolvement of shorter-time smoking procedures vis-a-vis savings in wood and fuel;

(iv) Development of adequate salting as per species of fish;

(v) Evaluation of consumer attitudinal preferences for processed fish products and their keeping quality;

(vi) Evaluation of the chemical, nutritional, toxicological, flavour and colour qualities of smoke dried, dried, and sun-dried fish products; and

(vii) Evaluation of the best procedures/methods of packaging, marketing and storage of heat preserved fish and fish products.

The realisation of the set objectives calls for a multi-disciplinary and team approach to drying as a technology. The steps that should be taken in the development of a drying system include:

(i) cooperation between the Engineer and the Food Scientist/ Technologist to determine the quantity and nature of the fish product to be dried and specific consumer requirements;

(ii) determine drying requirements, heat and mass transfer phenomena and fuel sources. Following the development of drying equipment, the Home Economist could begin consumer-acceptance testing, while the Food Scientist looks at product quality, storage and packaging.

Such a team approach with interactive feedback is then used in prototype modification until the prototype is suitable for the drying of high-quality products acceptable to the consumer.

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HIGH TEMPERATURE SALTING OF FISH MINCE

by

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ABSTRACT

Freshly caught miscellaneous fish were transported to the laboratory, gutted and washed before mechanical separation into bone and mince. Seven batches of the mince were then treated with seven different concentrations (Wt/Wt) of sodium chloride before cooking. The cooked mince was divided into two groups, pressed and unpressed. Percentage residual salt of the salted cooked mince, cooked water and salted pressed mince was determined. Also, the moisture content of the salted cooked mince and salted pressed cake was determined.

The moisture content of both the salted cooked mince and salted press cake decreased with percentage added salt and an equibirium was reached around 20% level of added salt. However, the moisture content of the pressed cake was lower than that of the cooked mince after 10% level of added salt. It is interesting to note that the residual salt in both the cooked and pressed mince increased with increase in added salt up to 20% where there was an equibirium in the pressed mince. Furthermore, there was a direct relationship between percentage residual salt in salted cooked mince and percentage salt in the cooked water.

INTRODUCTION

There is an abundant potential of small sized fish species which are under-utilized in most parts of the world, the extent of which is estimated at over 6,000,000 metric tonnes, but most of these fishes are mostly regarded as trash. Because of the need to increase the protein consumption of the developing countries such as Nigeria, it is necessary to examine ways of utilizing these so-called trash fish.

Fish is an important nutrient as it is high in proteins, lipids, minerals and vitamins. However, these nutrients vary with species. Because fish deteriorates quite rapidly, unlike meat, it is necessary to prevent various stages of deterioration so as to make it available for human consumption. Preservation techniques that are designed to prevent deteriorative processes include icing, freezing, canning, drying, smoking and solutes particularly salt.

Solutes are used to reduce the water activity of fish tissue. Scott (1953; 1955 & 1957) introduced the concept of water activity as a quantitative approach to the influence of water on microbial proliferation in foods. Essentially, the solutes must be compounds that have good solubility in water and must be able to exhibit very large negative deviation from Raoulth Law (Benmergui et al, 1979). Benmergui et al (1979) have also shown that many compounds including calcium chloride, magnessuim chloride, calcium iodide, sodium chloride, potassium acetate and sodium formate are all able to exhibit negative deviations from Raoult Law thereby, depressing water activity. However, these workers pointed out that no single electrolyte can provide adequate depressions of water activity when applied at a level that is organoleptically acceptable.

Inspite of this theoretical consideration, it is possible to use sodium chloride at low levels to inhibit bacterial growth and at high levels to prevent their growth. The mechanisms of the action of salt as a preservative are more complex and there appears to be a conflicting understanding of the process involved. However, Scott (1957) reported that salt acts by lowering the available water to micro-organisms. It has been observed that halphilic bacteria are able to survive high salt concentration because they need sodium chloride to maintain the stability of their cell walls (Moht and Lorsen, 1963).

Duer and Dyer (1952) revealed that the myosim fractions of fish muscle proteins were denatured when a critical salt concentration of approximately 8 - 10% was reached and that the rapid denaturation was accompanied by a sudden increase in salt uptake and moisture loss. Thus in practice, it is necessary to use levels above 10% salt to lower the water activity of fish as a means of preservation.

Penetration of fish muscle by salt cannot be over emphasised. Thus, high temperature has been employed in salting process of fish mince and muscle because the penetration of sodium chloride into and the removal of water from fish mince have been found to be faster (Taylor, 1922; Dyer, 1942; Talabi, 1982). These workers revealed that the critical salt concentration was reached in a much shorter time at higher temperatures. Furthermore, Kroemer and Knumbholz (1931) observed that the maximum salt concentrations in which growth occurs is greater at lower temperatures.

Because the underutilized fish are generally thrown away, we have attempted in this laboratory to develop a process whereby these fish can be fully utilized and made available for human consumption but the various properties of products from this process using high temperature, salting and pressing have not been elucidated. Thus, the specific objective of this work was to make a preliminary investigation into the effects of high temperature salting on the moisture and residual salt contents of the mechanically separated fish meat in the fully understanding that the amount of salt retained by the products and their moisture content can be used to predict to a large extent the keeping quality of these product.

MATERIALS AND METHODS

Fresh miscellaneous fish caught off Lagos area coastal water using Federal Argonaught were washed with seawater and stored in ice before transporting to Nigerian Institute for Oceanography and Marine Research (NIOMR)'s processing room. The fish were gutted and washed before being mechanically deboned using Boader 694 separator. The mince was collected and divided into seven batches which were mixed thoroughly with different salt levels (0, 5, 10, 15, 20, 25, 30, and 35% wt/wt).

Each batch of salted mince was passed through a cooker/press system with facilities for collecting:-

(a) the free at 80°C water produced during cooking, and

(b) the press water.

The cooked mince was divided into two groups. One group was not pressed (cooked mince) while the other group was pressed into cakes (salted preseed cake: SPC). Liquid samples were collected when salted mince was steaming, when it was cooked and the cooked mince was being expressed and finally when mechanical pressure was applied to the cooked mince. The cooked and pressed mince were put in polythene bags, while all water samples were put in vials and stored in the refrigerator for salt and moisture analysis.

Determination of Sodium Chloride

The salt content of the salted cooked mince (SCM), SPC and cooked water was determined by a modified A.O.A.C. (1975) silver nitrate titremetic method.

Determination of Moisture Content

The moisture contents of the SCM and SPC were determined by direct distillation (A.O.A.C., 1975).

RESULTS

The effect of varying levels of salt on the moisture content of the cooked mince and the pressed cake are presented in Figure 1. Between 0 and 5% added salt, the cooked and pressed cake produced did not show much difference in their residual moisture since approximately the same levels of moisture was observed. At a level of 10% added salt, the residual moisture content of the pressed cake fell to a level (70%) that was lower than that of cooked mince (75.25%). In general, between 0 and 10% added salt, the effect of salting can be said to be directly related to a gradual loss of water with increasing addition of salt to the raw mince. Between 10 and 20% added salt, there was a drastic drop in the residual moisture level of the cooked mince and pressed cake after which equilibrium appeared to be attained. It is, however, interesting to point out that the residual moisture levels in the SPC beyond the 5% level of added salt were consistently lower than in the cooked mince. This appears to be due to the effect of pressing and it seems that the effect appeared to be taking place beyond 15% added salt.

The effects of salting on residual salt in cooked mince and pressed cake are shown in Figure 2. The variation of added salt with the residual salt in the cooked mince was up to the level of 20% added salt. Between 20% and 35% added salt, there was a step-wise increase in the residual salt content. Almost a linear relationship similar to what was observed in the cooked mince was also noticed in the pressed cake between 0 and 20% added salt. Beyond 20% salt, there was an equilibrium in the residual salt content of the pressed cake. The salt levels were consistently lower in the pressed cake than in cooked mince and the effect of pressing appeared to be fairly constant until 25% salt was added to the mince. At this point and beyond, the effect of pressing became significantly pronounced. The shaded portion in Figure 2 represents the effect of pressing.

While 20% appeared to represent the equilibrium in pressed cake in respect of residual moisture and salt (Figure 3), the moisture and salt equilibrium in respect of the cooked mince material seemed to be less well defined. For instance, the moisture equilibrium point was 20% whereas, in the salt, two equilibrium points (20% and 30%) appeared to have given rise to the step-wise curve in Figure 2.

The repression curve (Figure 4) shows that there was a direct relationship between residual salt in the cooked mince and the residual salt in the cooked water.

DISCUSSION AND CONCLUSION

Salt as a preservative has been widely used for several years. Unfortunately, with the development of refrigerative technology, research efforts for food preservation has continued to decline. This is even true of the tropical third world countries which can least afford the luxury of refrigeration. In the preliminary work of Del Valle and Nickeson (1968), the equilibrium consideration relevant to fish mince were examined in respect of ambient temperature and considerable fundamental knowledge were established which were later applied in products development studies (Bellos and Pigott, 1979; Young et al, 1979). Salting of fi at room temperature facilitates an energy efficient removal of water from fish muscle thereby lowering the water activity and the susceptibility of such product to microbial damage. Duerr and

Dyer (1952) observed that salt denaturation point of cod protein was at 10% and this corresponded to the point at which high moisture loss began during salting.

There has been a few publications on the application of these concepts by Del Valle et al (1973) at fairly elevated temperature. The most notable of these publications was by Talabi (1981) in which meat analogues were salted at high temperture and which resulted in a reduction to traditional ambients temperature salting time when compared to traditional ambient temperature salting. The approach has now been adapted to the salting of mechanically separated fish mince and forms the basis of this study.

Results presented in Figure 2 clearly shows that an almost linear relationship exists between the amount of salt added and the residual salt that could be obtained when such a mince is subjected to cooking. The ensuing product is, however, considered fairly wet since it still contains a high moisture content when a high level of salt (35%) is added (Figure 1). Such a material containing a high level of salt (over 20%) would contain a minimum of 13% salt as Figure 2 shows. However, it is felt in this study that it will be possible to remove part of the moisture by a process of pressing in order to remove the possibility of the microbial damage. When pressing was carried out on the cooked minces in Figure 2, some degree of loss of salt was experienced and the shaded protein shows the effect of the application of pressing. The technological significance of pressing is that it enables a reduction in the amount of moisture that is available for microbial growth so that the salt level that will be required to prevent such growth will become considerably reduced. The overview of Figures 1 and 2 i.e. Figure 3, clearly shows that because equilibrium is attained with pressure at 20%, it seems logical to suppose that at that level of salt, increasing the pressure on the pressing equilibrium may result in a lower level of moisture. But this was not investigated in this study. It is apparent from this results, however, that the cooked mince has a maximum capacity of salt and water relation (subject to the pressing conditions which for the salt was 11% and for moisture 15%).

Theoretically, this salt level (20%) will still have not saturated the residual moisture of 51% and as such, the product may not be stable to some microorganisms. It appeared from Figure 3 that theoretical saturation has been achieved only in the cooked mince at a level above 30% added salt which corresponded to 16.8% salt and 55% moisture. The theoretical saturation point of sodium chloride (salt) used is 26.6% at 20%. This condition allows a salt saturation of sodium chloride in water at 20°C. Theoretically, this condition will adequately prevent bacterial growth.

Under the condition prevailing in the equipment used in this study, it was not possible to produce pressed cake of microbiologically free quality, since it would not be possible to saturate the residual moisture in pressed cake with salt. It is, therefore, felt that the pressure may be increased for improved product.

However, it is possible to produce a microbiologically stable cooked mince by the addition of a minimum of 30% sodium chloride prior to cooking. Alternatively, it should be possible by direct addition of salt to the pressed cake to increase the salt level to a level that will prevent microbial growth. Further work is being contemplated along this direction.

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AN INVESTIGATION OF THE ORGANIZATION OF CANOE FISHERIES IN NIGERIA: A CASE STUDY OF ILAJE/ ESEODO LOCAL GOVERNMENT AREA OF ONDO STATE

by

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ABSTRACT

In this paper, the effects of some socio-economic variables on the performance of artisanal fishermen were investigated. The variables include the age-structure of the fishermen, level of investment, educational background, membership of co-operative societies and marketing arrangements. All these variables were found to be crucial to productivity in the artisanal fishing sector.

INTRODUCTION

An F.A.O. document (FID:CRA/71/6) estimates the per capita private consumption expenditure (P.C.E) for Nigeria in 1985 as ₦63.60. This estimate, based on modified extrapolations of past trends should be considered minimum. It has not allowed for the accelerated development of the petroleum industry or other factors which have significantly speeded up the rate of economic development and consequently the growth in P C E. Based on this trend of extrapolation, however, the effect of higher private consumption expenditure is expected to raise per capita fish consumption demand from its 1970 level of 10.5 kg per annum to 14.4 kg in 1985. The estimate also assumes that there is a relationship between increases in available PCE and increase in fish consumption. For most countries, fish consumption is sensitive to changes in income and elasticities approaching or exceeding unity have been assumed (that is, a 10% rise in income will generate a 10% increase in fish consumption).

Nigeria's Fishing Industry is classified into Artisanal Fishery and Industrial Fishery. Artisanal fishery is carried out in coastal and brackish waters as well as inland in lakes and rivers while industrial fishery is carried out in deep coastal water as well as deep sea water and includes shrimping.

The artisanal fishermen numbered more than 400,000 in 1975 and judging from the trend in national population growth rate, this number is likely to rise. They are scattered all over the country using traditional and out modeled canoe - fishing method with very low output. Their activities are limited to the creeks, brackish water, lagoons and rivers all over the country.

The percentage contribution of artisanal fisheries to domestic fish supply has dropped steadily over a five-year period from 84.72% in 1974 to 69.41% in 1978 (Table 1). This is because while inland fishery catches have remained fairly constant, there have been big jumps in the amounts of products of industrial fishing especially coastal (shrimp) and distant water (imports). Considering the extent of the Coastline and the Continental shelf, it is felt that the present production from artisanal fishermen can be doubled. Production per canoe per fisherman operating in the coastal and brackish water environments is comparatively low, ranging between 0.5 and 7.1 tonnes per capita per month (F.A.O. Report No. FAO/SP: 74/NIR6,190). Several reports have demonstrated the profitability of small canoe fishing business. It is thus, anomalous that this fishing sector remains stagnant and depressed. Hence, the decision to carry out this sample survey to investigate the organizational arrangements in fish catching and marketing operations.

More specifically, this study is concerned with:-

(1) Identifying the impact of various socio-economic variables on income of artisanal fishermen;

(2) Investigating the problems confronting or hindering the development of the fishery industry in the sampled area; and

(3) Making useful suggestions on improving the existing organizational and operation activities of the fishermen.

Table 1 - Nigerian fish production by sector 1974 - 1978 (Unit-metric tonnes)

Sectors			1974	1975	1976	1977	1978
Grand Total A + BC			548,100	580,001	621,591	633,243	727,381
1.	Artisanal						
	(i)	Coastal and brackishwater	257,288	247,620	281,128	248,958	287,978
	(ii)	Inland:					
	a.	Lakes	67,275	67,975	71,468	68,590	76,091
	b.	Rivers	140,764	140,418	133,558	136,950	143,957
A)		Sub-Total Artisanal	465,327	456,013	486,154	490,498	508,026
2.	Industrial (Commercial)						
	(i)	Coastal (Fin. Fish)	5,768	8,057	8,725	13,767	15,245
	(ii)	Coastal (shrimp)	2,098	2,117	1,763	2,225	1,910
B)		Sub-Total Inshore Industrial	7,866	10,174	10,488	15,992	17,155
C)		Distant water (imports)	74,904	113,84	124,879	126,753	202,208
Local Production (Figs A + B)			473,193	466,187	496,645	506,490	525,181

Source: Federal Department of Fisheries

METHODOLOGY AND SOURCE OF DATA

Data for this study was obtained from a sample of 130 fishermen in Ilaje/Eseodo Local Government Area of Ondo State. Towns and villages sampled include Igbokoda, Mashin, Ugbo, Ugbonla, Idiogba, Aiyetoro, Igbeunrin, Ilepete, Oroto, Apata Itebu-Manuwa, Igbobini and Mahintedo. The fishermen were mainly Ilajes, Ijaws and Bendelites. The data was collected between October and November, 1981. The technique employed in data collection was structured questionnaire administered to a random sample of fishermen.

The method of analysis is mainly descriptive, where necessary tabular presentations and statistical analysis are employed.

ANALYSIS OF FINDINGS

Approximately 80% of respondents fall within the age range 20-40. This suggests that the majority of these fishermen are virile since they are still well within the working age bracket. Thus, they can be hardworking if given the necessary incentives.

About 74% of the fishermen either did not have any formal education at all or just went through the primary school. This suggests that literacy level may be somewhat low for the adoption of more sophisticated technige in canoe fishing. For example, the Japanese have already perfected computerized operations in canoe fishing. They have perfected automatically operated fishing boats remotely controlled from robot ships fully equipped with automatic fish detector, automatic steering devices, automatic net control systems and various other electronic gadgets. The ability of our fishermen to take advantage of this up-to-date technology will definitely be limited by their educational attainments.

Evidences from this study indicate that, the majority of the fishermen still operate with the simplest of technology comprising of small paddled canoes, baskets traps and nets. Only 27 - 28% of respondents use specialised nets like those for bonga and shrimp in addition to the simple nets. The majority of the farmers also employ canoes without outboard engines which do not permit movement far into the sea. This study has shown that this affects adversely, the volume of catch of the fishermen. Only about 32% of respondents possess motorised canoes with an average income of over ₦3,000 compared with an average income of over ₦2,000 earned by fishermen with non-motorised canoes.

It is not surprising that the majority of the fishermen cannot use motorised vehicles since these fishermen cannot secure loans from any institutional sources of credit. Only 14% of the fishermen interviewed claimed to have received loans from the State Agricultural Credit Corporation. All others claimed that they finance their business with their personal savings or join different Fishery Co-operative Societies where they are aided to purchase motorised canoes. 36% of the respondents belong to Co-operative Societies and 60% of the Co-operators possess motorised canoes. In other words, about 70% of total respondent with motorised canoes are co-operators' or belong to Fisheries Co-operatives.

Marketing was found to be a major constraint to enhance income. Many of the fishermen sell locally to fish-mongers who come from far and near at rock-bottom prices for lack of suitable storage and preservation facilites. There are no standard measures in marketing fish. Sales are done in baskets while prices paid are subjectively derived. The most common storage and preservation methods are smoking and sun-drying which are done by 92% of the respondents. Only 4% of the sampled fishermen make use of deep freezers. The drying and smoking methods are not modernised as a result of which heavy losses occur during processing due to over-smoking. This reduce the value of the catches. The few fishermen who freeze their fishes are those that can afford standby generators as the area is not supplied with electricity.

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR IMPROVEMENT

In this paper, the effects of some socio-economic variables on the performance of artisanal fishermen were investigated. The variables include the age-structure of the fishermen, level of investment, educational background, membership of cooperative societies and marketing arrangement. All these variables were found to be crucial to productivity in the artisanal fishing sector.

In order to modernize the fishing industry and enable it to make positive contributions to the development process, certain categories of inputs must be provided. These are:-

(i) Capital through credit facilites,

(ii) Fishing equipment such as outboard engines, ancilliary gears such as warps, floats, twines etc.,

(iii) Fishing terminals that are fully equipped and modernized,

(iv) Trained andcompetent manpower, and

(v) Meaningful research results to ensure continuing progress.

Suffice it to close this study by reminding policy makers that traditional coastal and brakish water canoe fisheries provide employment for most of the people in the delta swamps and as such this industry needs to be protected and aided so that productivity can rise thereby encouraging these people to stay on the job rather than migrate to the big cities in search of wage employment that are just not there. Basic infrastructural facilities like electricity should be supplied and the marketing system also must be modernized. The pricing system need considerable re-organisation. A suitable system of weights and measures must be introduced. All these will go a long way to enhance fishermen's income and ensure growth in this sector.

THE POWER OF FISH TRADER ASSOCIATIONS IN THE MARKETING OF FISH IN LAGOS STATE

by

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ABSTRACT

This paper focusses on the activities of trade associations in the marketing of fish in Lagos State. The study covers six different markets in Lagos State of Nigeria.

Analysis indicates that 86% of the traders are members of the associations. The ages of the traders range from 21 to over 55 years. However, majority are between the ages of 31 and 45 years. Traders secure their initial capital mostly from trade associations and Esusu/Ajo. Most raders have no working capital to maintain a regular series of outlets, so wholesalers turn to associations for funds, while retailers turn to wholesalers. They eventually pay back when they sell to consumers.

The fish industry is found to be imperfectly competitive mostly because of the actions of fish trader associations. The fish marketing system is highly personalised and loyality exists between wholesalers and retailers and their customers.

INTRODUCTION

Nigeria is richly endowed with abundant fish resources which, if adequately exploited will increase the present level of fish supply in the country. This will inevitably imporve the so called low per capita animal protein consumption in Nigeria. Fish is known to be the most important food commodity handled by the market women of Lagos. This is due to the fact that Lagos State is almost surrounded by water, hence the predominant occupation of the local market women (Obileye, 1982).

Many researchers (Ladipo et al, 1981; Adeyemo, 1982, and Ekpi, 1982) have worked on different areas of fisheries. But only few works are available on the fish seller associations. There is need to study the activities of thes associations so as to know the role they have been playing and what to expect in the 1980s.

The pupose of this paper is therefore, to investigate the power of fish seller associations in the distribution of fish to consumers in Lagos State. Specifically the objectives of the study are to examine the nature of the associations; to analyse the economic functions performed by them; and to explore the effect of the associations on the performances of the markets.

The study covered six markets in Lagos State. These are Oyingbo, Makoro, Aiyetoro, Obalende, Mushin and Agege markets. The markets in Lagos State are being studied because Lagos State is an important commercial state and controls the highest number of both State and Federal paid employees. Therefore, most of the inhabitants buy their needs from the markets.

The field survey of the study was conducted between September 1981 and March 1982. The sampling procedure involved a random selection of markets in Lagos State and these samples were in turn used as determinants of fish traders in the areas of study. Also, personal interviews from precoded questionnaires were used and answers recorded on the spot. Traders were interviewed during the less busy hours in the markets (between 1.00 p.m. - 3.00 p.m. in the afternoon).

FEATURES OF FISH SELLERS TRADE ASSOCIATIONS

Trade associations are organizations formed by traders dealing in the same trade commodities for their mutual interest and cooperation in enhancing the selling of their commodities (Adeyokunnu, 1969). In the areas of study, there is one big apex organization called "Egbe Eleja" in which primary fish market societies belong. Also, there are other primary organizations in which fish sellers are members, for example at Oyingbo, there is Irepodun Fish Sellers Association, in Aiyetoro market, there is Omoniyi Fish Sellers Association, and also in Mushin, there is Ifelodun Fish Sellers Association.

Membrship of sellers in these associations is wide spread in all the markets. During the investigation, out of 240 fish distributors interviewd (Table 1), 217 indicated that membership in the associations was compulsory while 23 indicated that membership was optional. A breakdown of the indication in all the markets is given in Table 1. It was however, noted that those that indicated membership to be optional were young traders and apprentices who had just finished their apprenticeship.

Table 1 - Membership in trade associations

Markets	Numbers that Indicated	
	Compulsory	Optional
Oyingbo	36	4
Maroko	32	8
Aiyetoro	40	-
Obanlende	32	8
Mushin	37	3
Agege	40	-
Total	217	23

Source:- Field Survey - 1982

Further analysis of data indicated that ages of the 240 fish sellers interviewed in all the markets ranged from 21 and above 55 years. None of the respondents was under 20 years of age. The highest frequency of trader ages fell within 31 to 45 years and findings in the markets revealed that the traders having the largest bags of rice were those within this range. The fact that there was no respondent under 20 years is an indication that most of those age groups are students in higher institutions. This was confirmed by the answers given by the respondents as regards their children. Most of them confessed that their children often helped them during summer holidays. The lowest frequency within the age range were traders over 55 years. The table also shows that only four of the traders interviewed were not married and the average number of children per trader was six. The total number of household as used in the table represents average number of children plus average number of dependents per family living together.

It is interesting to note that members of the associations have the obligation of supplying fish to their families free of charge. The amount or volume of fish supply depends on such factors like family size, whether the trader is a retailer or wholesaler and the number of times fish is prepared per week. As shown in Table 3, 55% of the fish distributors prepare fish five times per week, 35% of the sellers prepare fish 3 times per week, while 9% of the fish sellers prepare fish 2 times per week. Investigation revealed that those that supply fish to their families five times a week were sellers that are well established and those not well established only supply two times per week. The later sets of sellers were not married and had less dependants. It was understood that the general pattern of consumption changes greatly during festivities.

Table 3 - Fish consumption by families of Association members

Weekly Consumption	Number of Traders	Percentage of total fish sellers
7 times	11	4
5 times	125	52
3 times	84	35
2 times	21	9

Source: Field Survey 1982

ECONOMIC FUNCTIONS OF THE FISH TRADER ASSOCIATIONS

The associations perform different kinds of economic functions to their members, these include transportation, storage, financing and market information.

Transportation

Transportation provides the physical link between producer and consumer, because of its cost, it has a considerable influence on marketing. At every stage of distribution process there is some dependence on transport. In the areas of study, trade associations do help members directly to transport their supplies. The associations arrange for trucks to move fish from every depot to different markets in Lagos State. The volume of fish handled per trader at any particular batch of supply can be used as the yard-stick for the volume of trade undertaken by the associations. As shown in Table 4, 25% of the traders handle between one to three packages of fish, while 19% of the traders control between 11 and 20 packages and 21% of the fish sellers command between 21 and 30 packages of fish.

Table 4 - Volume of trade per batch of supply

Number of Packages Handled	Number of Fish Traders	Percentage of Total
1 - 10	88	37
11 - 20	46	19
21 - 30	51	21
31 - 40	34	14
41 - 50	21	9
Total	240	100

Source:- Field Survey 1982

Investigation revealed that wholesalers handle more volume of fish than the retailers. This proves why wholesalers need more capital than those in the retail trade. Members show their satisfaction in the work done by the associations, they indicated that the associations have arranged substantial amount of money to purchase two vehicles to transport their supplies from the depots and neighbouring markets.

Storage

Storage is an important function performed by the trade associations. The importance of efficient storage may be better perceived when it is realised that successful operation of fish distribution depends on adequate facilities. The fish seller associations supervise members' storage periodically. The associations usually help members to purchase store in a market so that they can have room to store their packages of fish.

Financing

Financing is an important marketing function without it the distribution process cannot operate effectively. Fish sellers need money to buy fish and as long as they do not sell fish immediately after purchase, capital becomes tied up in the distributing process.

The associations require members to pay enrolment fees and dues. These fees and dues form the sources of funds to the associations. Others include fine impose on members, interest on loans and any special levy on mambers. The associations help any member financially on the occasion of a marriage or funeral ceremony.

Market Information

Market information is the collection interpretation and dissermination of a large variety of data for the smooth running of thè marketing system. An efficient marketing system can not operate in an information vacuum. Adequate information on supply and demand conditions are necessary if fish is to be distributed efficiently.

In all the markets surveyed, fish sellers associations disseminate market information to members but the rate of dissemination is not as extensive as developed countries. In confirmation with Kohls assertion, it is revealed that the primary purpose of majority of these organizations is to gather, evaluate and disseminate information of value to the members. During the associations monthly meetings, considerable part of the information obtained by each trader from private and public sources are tabled, discussed and strategy planned. In these meetings, all aspects of the business feature prominently in the discussion held.

THE PERFORMANCES OF THE MARKETS

In this last section the effect of fish seller associations on the performance of the market is focussed upon. The approach often adopted in analysing the performance of a marketing system is to examine some costs prices and profit relatonship. Measuring efficiency by this approach involves comparing the marketing system with the requirements of a perfectly competitive markets which include freedom of entry and exit from the market, homogenous commodity, few sellers and buyers from influencing the market and impersonally determined market prices. These are rigorous criteria, many of which are empirically difficult to apply, but consideration of a few of them can be useful in providing insight into the performance of the market.

Size of Buyers and Sellers

In all the markets, there were large number of buyers and sellers. No single buyer or seller was able to influence the market price of fish.

Freedom of Entry and Exit

Many factors are known to influence freedom of entry and exit from fish trade. They include:-

(a) Initial capital

(b) Availability of market facilities (e.g. stalls)

(c) Trade association.

Initial Capital

In the retail business, capital does not appear to constitute any important barrier to entry in the fish trade in Lagos. The initial capital requirement is quite low and credit is secured within a short time. The situation with respect to the wholesalers is different. Capital requirement for entry into the wholesale is generally high. Those wholesalers that have joined the associations and are in good standing (that is, at least paid enrolment fees) can secure credit from the associations. However, for non-members, capital requirement constitute a relatively effective barrier to entry at the wholesale level.

A breakdown of traders by sources of credit is summarized in Table 5. Fifty-five percent of all traders interviewed secured their credit through trade associations, while 18% of the sellers got their credit from Esusu/Ajo. Analysis of the data shows that fish sellers do not go to banks for credit. They reported that even when banks are willing to give them loan, they usually charge exorbitant interest. Retailers indicated that as a result of non-availability of easy credit, they often purchase from wholesalers on credit and pay back after sale of the product.

Table 5 - Fish traders sources of initial credit

Sources	Number of traders	Percentage of total traders
Personal Savings/Relatives	30	13
Cooperative Societies	24	10
Esusu/Ajo	44	18
Trade Associations	132	55
Commercial Bank	-	-
Money Lenders	10	14
Total	240	100

Market Facilities

The inadequacy of market facilities particularly market stalls in Oyingbo, Agege, Mushin and Aiyetoro is considered an effective barrier of entry. Market stalls are rationed by the "Egbe Eleja" association in Lagos State. The problem is, if a trader is not a member of any of the associations, he is not entitled to get a stall in any of the markets studied. So, it is very difficult for new entrants to secure facilities in any market.

Trade Associations

Apart from those actions mentioned earlier, fish seller associations have other attributes that contribute to the imperfection of the fish marketing system. In most cases, a trader cannot establish himself in any of those markets until he has joined a trade association, paid the enrolment fees and agreed to abide by its bye-laws and regulations. As detected during the survey, the procedure for filling paper work is time consuming. There was a case of an intending member that applied for form for enrolment during the survey of this study and who finally got the form after three months. Six months later, at the time we were completing the survey, he was notified of his acceptance into the association.

Price Determination

Prices in all the six markets are arrived at through complicated process of hangling. It is a process which sometimes require skill and experience. The situation is further complicated by the fact that prices are influenced by seller's own assessment of the buyers' economic and social status (as revealed by the dress and jewelry put on) and the extent to which the buyer can be classified as "regular customer".

Fish Sellers Quoted Profit Levels

The use of profit in the fish trade is rather a very sensitive issue in Nigeria markets and as such many traders were not willing to discuss it during the survey. However, 28% of fish sellers indicated their profit levels while 72% indicated that they do not have the idea about the amount of profit they make in a month. In any case, they believed that they were not making any loss. Among the sellers that reported their gains, 50% of those 35% reporting profit indicated that they normally make between ₦5 to ₦20 profit in a month, while the remaining half normally make between ₦25 - ₦45 every month. However, from observations fish distributors are not doing badly when compared to other marketers in the study areas.

SUMMARY AND CONCLUSION

This paper examined the nature of fish seller associations, functions performed by them and effect of these associations on the performances of the market. Most of the traders (86%) were members of the associations and the functions of the associations were both social and economic in nature.

Analysis shows that nearly all the initial capital in fish marketing business comes from trade associations and Esusu/Ajo. Funds are hard to secure from commercial banks. Many traders have no working capital to maintain a regular series of outlets, so wholesalers turn to trade associations to finance their stocks while retailers turn to wholesalers. They eventually pay back when they sell to customers.

The fish industry is found to be imperfectly competitive mostly because of the actions oftrade associations. The common procedure of pricing is by hangling between buyers and sellers. The marketing system is highly personalized and loyalty exists between wholesalers, retailers and their customers.

However, for more efficient distribution in the 1980s, it is recommended that there should be clear statement in the certificate of registration of the fish trader associations as to their functions and limitation of their actions. Efforts should made to educate members of the associations in the basic principles, organization and operation of the associations. Also, the Government and commercial banks should endeavour to give credit to the fish sellers to enabe them increase their volume of trade and for the smooth running of the fish marketing system.

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THE MARKET FOR PROCESSED FOODSTUFFS IN NIGERIA: THE CASE OF CANNED FISH

by

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ABSTRACT

The main objective of this paper is to highlight the potential contribution of the porcessed food industry, especially with regard to prepared and preserved fish, to the domestic industrial sector. Data for the study were collected from a sample of eighty-five retail canned fish sellers in South-Western Nigeria (45 and 40 respondents in Oyo and Lagos States respectively). Approaches were also made to government officials and merchant-agents connected with the importation, trade-regulation and distribution of fish in Nigeria. The study examined, in considerable detail, the marketing channels, services, prices and margins of canned fish in the area of study. The paper concludes that efforts should be made to encourage local processing and canning of fish not only to save on foreign exchange and importation costs but also to be able to meet the rapidly growing demand for this product in the country.

INTRODUCTION

The economics of food processing especially fish processing in Nigeria have not been systematically studied and there is a real need for such an investigation so that future investments in processing facilities can be made in the ways most suitable for marketing efficiency. To this end, probably the first step that needs to be taken is an examination of the market potentials and characteristics of products from the processing facilities envisaged.

From the consumption point of view, it is obvious that the use of processed foods in commercially significant quantities is a growing phenomenon in Nigeria especially in urban and semi-urban areas. This development is accentuated by increasing level of education of the average Nigerian, rapidly growing urbanisation and increased economic opportunities and income.

In the rest of this paper, the supply of canned fish to meet market demand is closely investigated. Areas examined include market characteristics and channels, prices and margins and importation levels. The paper identifies constraints to improved performace and makes suggestions towards contributing a more significant proportion to the total canned fish available in the country from local resources.

IMPORTATION

Canned fish are not currently produced in Nigeria except in Research Institutes. Internal demand has always been covered exclusively by imports from all over the world. Imports come mainly from outside Africa, including Japan and Spain. Varieties of canned fish imported from these countries include sardines (such as Titus, Queen of the Coast and Geisha) and other preserved or prepared fish.

The year 1978 was the year when the largest quantity of the canned fish was imported; during that year, about 43.1 million kilogrames of sardines and about 67.7 kilogrammes of other preserved or prepared fish were imported into the country (Figure 1). Tables 1 and 2 show the import figures for sardines and other prepared and preserved fish into Nigeria between 1970 and 1979.

Table 1 - Import quantities and values of sardines to Nigeria, 1970 - 1979

Year	Absolute Trend		Percentage Changes	
	Quantity (kg)	Value (₦)	Quantity	Value
1970	79,288	178,854	-	-
1971	50,050	443,547	1.60	1.55
1972	77,452	719,242	0.54	0.62
1973	4,615,588	1,580,474	58.59	1.20
1974	3,749,377	1,915,932	-0.19	0.21
1975	12,965,464	7,985,110	2.46	3.17
1976	31,468,329	21,398,761	1.43	1.68
1977	30,110,258	26,300,084	-0.04	0.23
1978	43,105,555	45,592,857	0.43	0.73
1979	25,306,218	25,821,639	-0.41	-0.43

Source: Nigeria Trade Summary (various issues)

Table 2 - Import quantities and values of other prepared/preserved fish, Nigeria, 1970 - 1979

	Absolute Trend		Percentage Changes	
	Quantity (kg)	Value (₦)	Quantity	Value
1970	3,507	27,740	-	-
1971	17,455	146,970	3.98	4.30
1972	63,525	544,288	2.64	2.70
1973	4,615,588	1,580,474	71.66	1.90
1974	3,607,627	1,791,971	-0.22	0.13
1975	9,622,678	4,462,660	1.67	1.49
1976	31,468,329	21,398,761	2.27	3.80
1977	38,280,733	27,595,224	0.22	0.29
1978	67,713,242	50,124,147	0.77	0.82
1979	13,376,242	8,670,476	-0.80	-0.83

Source: Nigeria Trade Summary (various issues)

Up till 1978, the trend was of increasing proportions both in terms of quantity and value of imported canned fish, except in 1974 (for sardines alone). The quantity of sardines (4.6 million kg) imported in 1973 was nearly 60 times the importation figure for 1972; for other preserved/prepared fish, the 1973 volume was about 73 times 1972 import figure. Indeed, between 1970 and 1978, importation had increased 2,235-fold (for sardines) and 19,308-fold for other preserved/prepared fish.

In money terms, the country committed ₦95,717,004 to the importation of sardines and other prepared and preserved fish in 1978, 475 times more cash outlay than was so committed in 1970. Thus, the importation of fish has increasingly drained the country of a large amount in foreign exchange earnings.

Up till 1978, the trend was of increasing proportions both in terms of quantity and value of imported canned fish, except in 1974 (for sardines and other canned fish) and in 1977 (for sardines alone). The quantity of sardines (4.6 million kg) imported in 1973 was nearly 60 times the importation figure for 1972; for other preserved/ prepared fish, the 1973 volume was about 73 times 1972 import figure. Indeed, between 1970 and 1978, importation had increased 2,235-fold (for sardines) and 19,308-fold for other preserved/prepared fish.

In money terms, the country committed ₦95,717,004 to the importation of sardines and other prepared and preserved fish in 1978, 45 times more cash outlay than was so committed in 1970. Thus, the importation of fish has increasingly drained the country of a large amount of money in foreign exchange earnings.

Countries from which supplies are received include Morocco (in Africa), Spain (in Western Europe), Bulgaria (in Eastern Europe), Japan (in the Far East) and the United States of America. World-wide, Japan has been the largest supplier of canned fish to Nigeria. In 1979, Japan supplied about 82.6% of the total quantity of sardines and 82.3% of other preserved or prepared fish imported into the country, These amounted to a total of ₦21,711,674 (for sardines) and ₦6,076,261 for other prepared fish.

Morocco has been the largest African supplier of canned fish to Nigeria accounting for about 29.2% of total sardine importation in 1979. The distribution of countries which supplied canned fish to Nigeria, by quantities supplied and values of supply, during the period 1970 - 1979 is shown in Appendixes 1 and 2.

MARKET CHARACTERISTICS

Canned fish is consumed by a wide cross-section of the society. Sales occur mainly in urban and semi-urban centres, mainly to the middle-income group. The canned fish marketed come in lithographed tins of 155 gms (Geisha) or 125 gms (Titus) net weight, in olive or edible oil (Titus, Queen of the Coast) and tomato sauce (Geisha). However, about 82.4% of the retailers interviewed mentioned that consumers, especially bachelors, prefer high-quality fish in "thick" tomato sauce.

Among the advantages that encourage the purchase of canned fish in general are:-

(1) high degree of storability - by this is meant that canned fish can keep for several months without going bad,

(2) readiness for consumption - this allows for a greater degree of "kitchen freedom", and

(3) easy access - that is, availability at almost every retail shop.

MARKETING CHANNELS

The Nigeria National Supply Company (NNSC) is one of the most important distributors and importers of canned fish in Nigeria. NNSC is a non-profit, governmental agency established in 1972. It has been given the task, among others, of procuring commoditities in short supply at relatively low prices to stabilise the market. Like NNSC, others involved in the importation and distribution of canned fish are private individuals, manufacturers' agents and trading houses such as G.B. Ollivant, John Holt Ltd., Kingsway Stores of Nigeria, Leventis and CFAO (Nigeria) Ltd.

The goods that are traded, are distributed at both wholesale and retail outlets. Figure 2 shows the general pattern of canned fish distribution in Nigeria.

Imported canned fish find their way to consumers through any of the several types of intermediaries that operate concurrently in the open market. Supplies from abroad get through the NNSC, long-established foreign-based trading houses or independent local importers/distributors as mentioned earlier to consumers through an array of wholesalers including appointed distributors, central and secondary cooperative associations, supermarkets, and retailers including street vendors and hawkers.

The NNSC marketed the bulk of its goods through local cooperatives (50 per cent) and appointed distributors (30 per cent), the balance was sold direct to Government employees (20 per cent) in 1978[1]. The trading houses on another hand, maintained a broad and efficient marketing network, covering most cities and towns, that enabled them to channel about 80% of imported canned fish to the country through local agents.

PRICES AND MARGINS

Average wholesale and retail prices and margins for two varieties of canned fish in our area of study (Oyo and Lagos States where 45 and 40 retailers respectively were interviewed) are given in Table 3. It is shown that, for Geisha, 32.5% of landed cost or 17.5% of average retail prices was received as margins by importers/distributors during the period of our survey which lasted one month (January 1983). In the case of Titus sardines, 15.0% of average retail price was received as margins by importers/distributors; the shares of retail price which went to wholesalers and retailers were 7.5% and 17.5% respectively.

Table 3 - Wholesale and Retail prices and margins of Geisha and Titus sardines in Oyo and Lagos States, January 1983

Items	Geisha			Titus		
	Absolute Share per tin (Kobo)	% Share of Retail Price	Cumulative Cost (%)	Absolute Share per tin (Kobo)	% Share of Ret. Price	Cumulative Cost (%)
Landed cost	27	-	67.5	24	-	60.0
Importers' margin	7	17.5	-	6	15.0	-
Wholesale Cost Price	34	-	85.0	30	-	75.0
Wholesale margin	4	10.0	-	3	7.5	-
Wholesale selling price	38	-	95.0	33	-	82.5
Retailers' margin	2	5.0	-	7	17.5	-
Retail Price	40	-	100.0	40	-	-

Source: Field Survey

1 International Trade Centre UNCTAD/GATT (1978) The Oil-Exporting Developing Countries: New Market Opportunities for other Developing Countries. Vol.IV. NIGERIA. Geneva.

Basically, Government's objective with respect to the fishery subsector is to boost fish production and move the country towards self-sufficiency in fish at the earliest possible time. Specifically, fishery policy objectives during the Fourth National Plan period, 1981-85 are aimed at the following:-

(i) increased domestic fish production,

(ii) increased foreign exchange earnings through exportation of shrimps. To this may be added, the need for conservation of foreign exchange earnings through import-substitution strategies.

(iii) optimum utilisation of the country fisheries resources through rational management and conservation measures, and

(iv) development of fishery-based industries (Fourth National Development Plan)[1]

It is indeed encouraging that emphasis will continue, as per the Plan to be placed on the development of fishery-based industries. In the past, emphasis was placed mainly on the local manufacturing of fish meal and often time dehyrated fish. Such an emphasis was not misplaced. The point must, however, be driven to its logical conclusion by actively encouraging self-sufficiency in dehydrated fish, tinned/canned fish including sardines and otherwise prepared and preserved fish. The eventual aim is to eliminate imports along this line and save on foreign exchange earnings.

In 1980, 28.6% of total fish supply in the country was imported. Yet, as Table 4 shows, fish of all livestock products available supplied the highest amount of protein (3.1 gm) and calories (22 kcals) per caput per day in Nigeria in 1980. Given the importance of fish therefore, it is disheartening to note that by 1985, planners estimate that 25.2% (or 200,000 tons) of fish supply in the country will still be imported. About 40% of the projected imports is expected to consist of stockfish (dried cod) and the balance will include chilled, frozen, salted, dried or smoked fish, tinned fish and other prepared or preserved fish.

When planning figures are compared with actual figures, however, one finds that actual import figures often exceed planned import figures. For example, in 1979, about 35.4 million kg of fish were imported (Table 5); this actual import figure was about 77% greater than the import quantity planned for that year. This points to the fact that if measures to discourage imports are not fully implemented, it is likely that future imports of canned fish will be significantly higher than the quantity drawn in 1979.

CONCLUSIONS

As West (1982) rightly observed, "the current demand for food fish is estimated at a little over 1 million tonnes per annum as against a total supply of about 800,000 tonnes. Seventy per cent (70%) of this supply comes from domestic production and the rest is imported in various forms. By 1985, which is the target year for the "Green Revolution", the demand is expected to increase to as much as 1.5 million tonnes which is almost 200% of current level of consumption, and we are no doubt, asking ourselves how we are going to meet this large shortfall without relying too much on importation, with its associated drain on the nation's foreign exchange". The task is not an easy one but the bull has to be grapped by its two horns.

Efforts should be intensified to establish local fishery-based, import substituting indsustries such as fish canning factories. The establishment of such factories would be one of the most economic and surest ways of increasing the supply through preservation and form

Table 4 - The supply of livestock products in Nigeria, 1980

Livestock Products	Domestic Production (000'tons)	Imports ('000 tons)	Food Supply ('000 tons)	Calories/ Caput/Day	Protection/ Caput/Day
Fish	500	200	700	22	3.1
Milk	215	170	385	7	0.4
Beef	140	50	190	14	0.9
Smallstock	140	10	150	13	0.7
Poultry	80	-	80	3	0.3
Other meat	80	5	85	3	0.3
Oil and Fats	1	39	40	10	-
Butter	7	3	10	3	0.0
Cheese	6	2	8	1	0.1
Eggs	185	-	185	10	0.7
Total	1,334	479	1,833	86	6.5
Grain Equivalents	620	275	895	-	-

Source: Fourth National Development Plan, 1981-85

Table 5 - The quantities and values of fish types imported into Nigeria in 1979

Fish Type	Quantity		Value	
	Absolute (kg)	Percentage	Absolute (kg)	Percentage
Salted, Dried or Smoked Fish	685,235	1.9	1,958,515	5.7
Fresh, Chilled or Frozen Fish	4,204,220	11.9	3,499,440	10.2
Stockfish	13,411,562	37.9	18,297,838	53.3
Sardines	3,749,377	10.6	1,915,932	5.6
Other Prepared or Preserved Fish	13,376,242	37.7	8,670,476	25.2
Total	35,426,636	100.0	34,338,201	100.0

Source: Nigeria Trade Summary, 1979 Issues changes) of food fish in the country, from capture fisheries. It would also promote economic development because it would help to generate social and economic benefits to those involved in the fish trade in general and canned fish marketing in particular.

Possible constraints to the realisation of the potential benefits discussed, include the following:-

(i) Lack of funds on the part of indigenous businessmen to run capital-intensive operations;

(ii) Lack of infrastructural facilities;

(iii) Shortage of trained "skilled" manpower (managerial and technical);

(iv) Initial consumer resistance to new products (new brands).

Indeed, the marketing system, credit arrangements and defective institutional arrangements can constrain improved performance. In these areas, government assistance will be most required. Every encouragement must be given to private individuals, fishermen cooperatives and agro-industrial concerns to set up fish canning factories in the country. The products of such factories, if of high enough quality, are likely to meet with consumers' acceptance, with time.

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Figure 1: Quantities of Sardines and Other Preserved/Prepared Fish imported into Nigeria, 1970 - 79

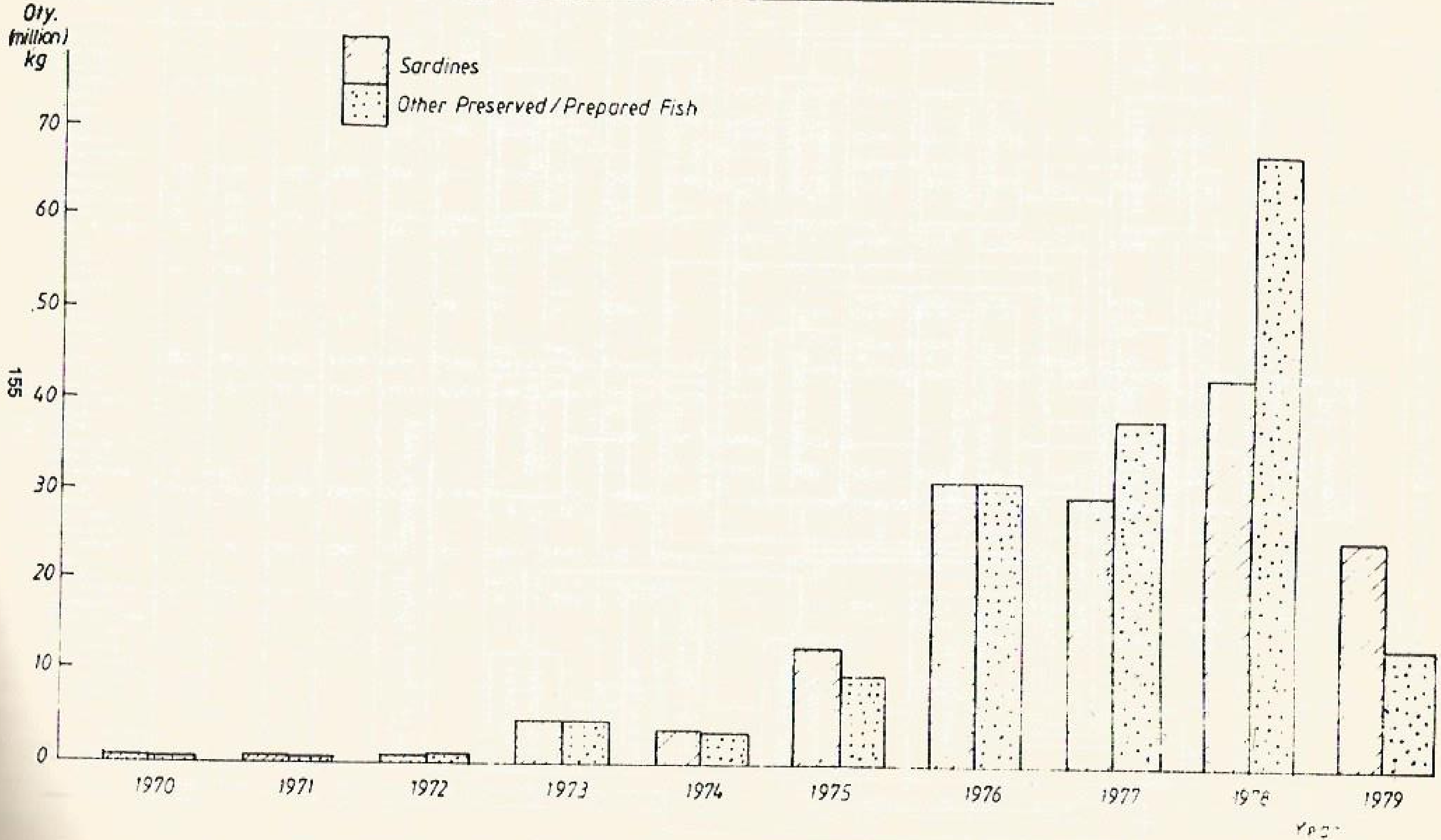
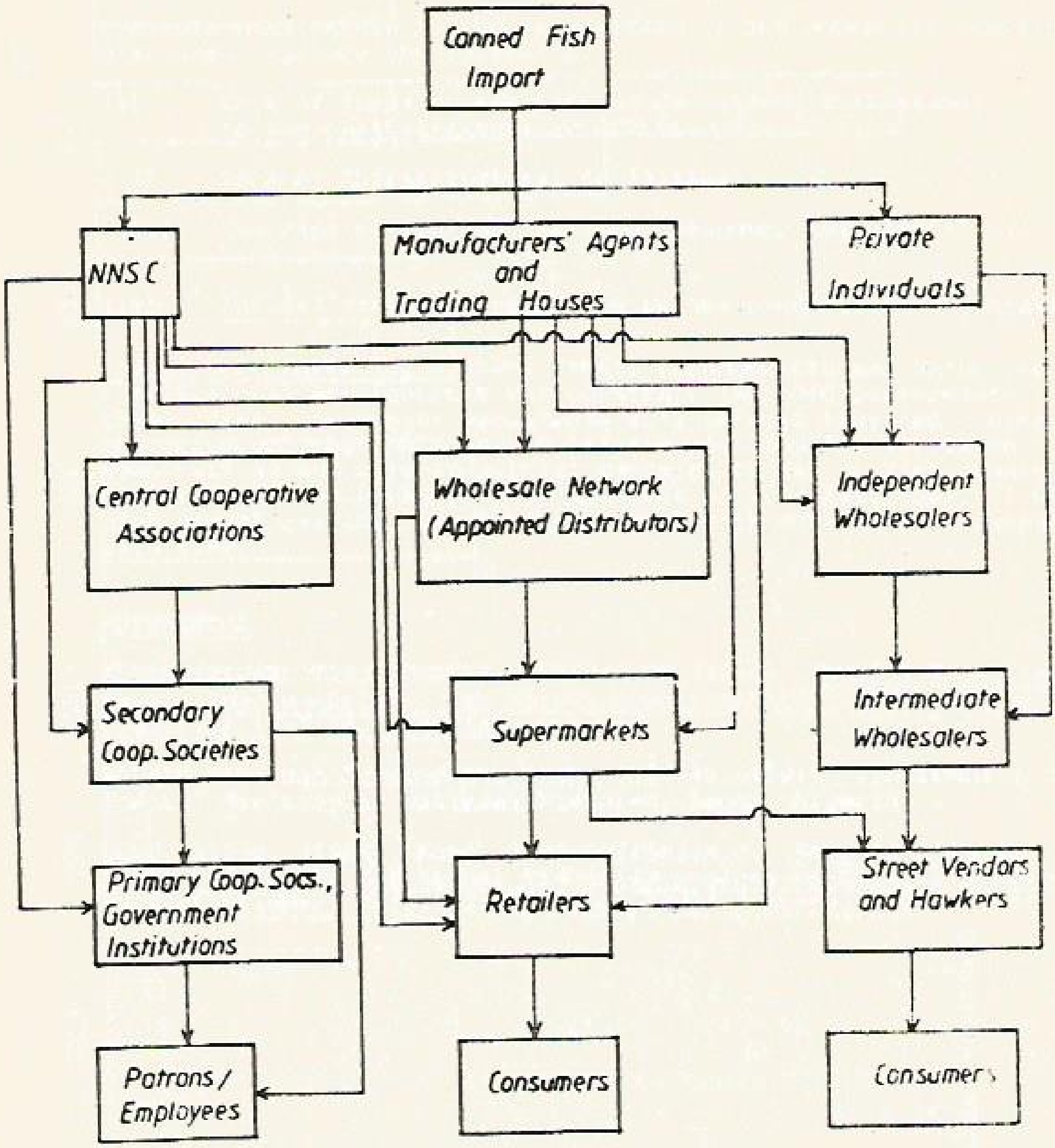


Figure 2: General Pattern of Distribution of Canned Fish in Nigeria



Source. Field Survey, January, 1983

APPENDIS TABLE 1: Nigerian Imports of Sardines by Country of Origin, 1970 - 1979.

COUNTRIES	1979 QTY (kg)	VALUE (N)	1971 QTY (kg)	VALUE (N)	1972 QTY (kg)	VALUE (N)	1973 QTY (kg)	VALUE (N)	1974 QTY (kg)	VALUE (N)	1975 QTY (kg)	VALUE (N)	1976 QTY (kg)	VALUE (N)	1977 QTY (kg)	VALUE (N)	1978 QTY (kg)	VALUE (N)	1979 QTY (kg)	VALUE (N)
Austria					46	417											334264	321851		
Australia					46	417														
Belgium											206740	681084	173640	65572			128125	139739		
Bulgaria	439	5379																		
Brazil									255	98	28804	1913								
Canada							15851	6344	2169	1956	32304	15199	266310	165721	241905	165473	417051	223521		
China					143	1360	56453	21828												
Cameroun				4									18750	19559						
Czechoslovakia													13145	10858	18319	24617	30607	31361	277	554
Denmark	739	6554	1039	9358	324	3111	13612	8141	3650	3469	1442	1379								
Dahomey											344	1509								
Europe N.E.S	59	902							2295	905	2547	3299	303199	220812	115291	119169	1851867	2611619	311385	350,646
France	35	419	147	1288	2167	19314	2078	748	1368	778	22939	14619	28909	22118	161840	139520	190901	161918		
Fed. R. Germ.	102	924			69	691	2937	1103												
Ghana							2295	977			34000	27382								
Greece																				
Hungry	48	435											157000	97840	3300	1750	67305	133807		
Hongkong							926	339					33292	20477	1419	1498	26138	77777		
Italy					3	28	30	12	3860	739	31916	33310					2663	7598		
Indian			194	1713																
Iceland													67230	53800						
Ireland							9000	4395					46	136	333719	265699	1230	4042		
Japan	888	8173	4129	37013	8401	73909	504978	171634	649969	309856	3102622	1136223	6205310	1368386	9710600	6610677	18756397	16189388	20898965	21711674
Malaysia																	100000	61715	80468	80509
Morocco	7171	66035	15149	122451	33117	309693	2187472	608663	1093680	493635							73718	269136		
Netherlands									510	213										
Norway									13650	5461	28236	20238								
Poland																	19020	15327		
Portuguese G.																				
Portugal											6975	7664	10927	6556	64933	49193	2476	7480		
Sierraleone	1	40																		
Spain	8664	78041	27692	238332	31984	300688	1716133	715101	1831960	1025337	6181044	4809970	13699805	10228370	11480073	11176716	11785047	14472101	1670224	1840071
Sweden							6	13					46	136	333719	263699	1230	4042		
Switzerland													2618	1309			53363	161009		
Singapore																				
U.Kingdom	222	1661	781	7390	635	5594	92399	36973	22733	10973	101316	80675	561137	334307	126935	203081	753296	681595	328534	377546
Togo											810	583								
U.S.S.R							2907	918	16600	9980										
United State	597	5379	60	541	19	168	8211	3734	117	65	700	514	83866	59326	24538	330892	73095	132639	5153	30510
Yugoslavia													1322810	601408	1303672	1173349	1580068	1292398		
N,unspecified											1035323	230402			252311	256521	103805	207289		
Africa n Nes			61	556													12313	21096		
Europounsp																				
African unsp.									108	65			36000	25620						
St. Area in Am									50000	13479			46203	27295	51000	39319				
Oth court in Oceania									4743	1689					11868	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" " in Asia																		6731	31910	
" " America																				
America unsp.																				
Total	15289	173851	[illegible]	143547	77152	719242	1615568	1567474	3749377	1915932	12965464	7975110	31468329	21398761	[illegible]	[illegible]	13105595	15592057	25306218	25801638

Appendix Table 2: Nigerian Import of Other Processed/Preserved Fish by Country of Origin 1970 - 1979

Countries	1970 Qty.	1970 Value	1971 Qty.	1971 Value	1972 Qty.	1972 Value	1973 Qty.	1973 Value	1974 Qty.	1974 Value	1975 Qty	1975 Value	1976 Qty	1976 Value	1977 Qty	1977 Value	1978 Qty	1978 Value	1979 Qty	1979 Value
Asia Nes	3	21	-	-	-	-	1856	581	-	-										
Australia	31	556	168	1434	179	1364	15754	6035												
Angola	-																			
Bulgaria	-	-	-	-	375	2065	-	-	16211	6174	1321359	416358	173440	69972	352124	704236			412[illegible]	1[illegible]0080
Brazil	-	-	-	-	-	-	-	-	-	-	-	-	104582	53365	-	-	42518	127956	-	-
China Inmaila	-	-	-	-	357	3266	49596	20286	20316	13615	104467	38219	266737	189721	[illegible]	280[illegible]	387	408	255184	149584
Cameroon	-	-	-	38																
Canada	-	-	442	5668	66	662	9906	4343			16116	13858					2140	5437		
Cyria	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600	1800		
Czechoslo	-	-	-	-	-	-	-	-	-	-	25	300	18730	19539						
Dahomey	-	-	5	69																
Denmark	-	-	617	5424	1134	8956	41602	161414	24633	11732	26976	59852	23145	10858	261647	206904	66552	84136	12927	6099
Europe Nes.	22	179																		
Europe Unspecified	-	-	-	-	20	170														
France	-	-	1335	11787	2841	3737	21773	10546	7661	6648	8910	21427	305199	220812	19566	19292	48858	69748	309474	219[illegible]2
Fed Malaya	-	-	14	118																
Fed. Rep. Germany	-	-	320	2727	389	3472	7701	5015	9325	8254	10196	20187	28929	22148	220704	321777	48805	62097	50897	27971
Gld. St. Hellen	-	-	3	26									291	185	12					
Ghana	-	-	-	-	-						1000	300								
Greece	-	-	-	-	-						1500	2247	-	-	800	1506	513	1843	2000	2205
Hong Kong	4	37	233	2127	-	-	-	-	2632	998	70178	51898	137000	97840	7382	15599	324549	[illegible]	5081	11490
Italy	-	-	885	7079	218	1806	1994	1637	1317	971	14363	7996	33292	20815	35440	23849	4632			
India	-	-	-	-	-	-	-	-	-	-	1080	340	-	-	2417	9047	47740	25870		
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	198000	137992						
Ice land	-	-	-	-	-	-	-	-	1615	895	-	-	67290	33800	-	-	-	-	20741	10998
Japan	2143	16502	73334	8448	59296	473436	3225159	107783	1967814	1313789	7560636	3489638	6205310	3368386	33713331	23069963	64685300	47192, 720	7005, 014	6076281
Lebanon																				
Morocco	1134	9673	2266	17910	2858	20905	4390	1815	162273	741943	127657	71029	7520268	4943832	1027977	749175	317450	276368		
Malaysia	-	-	-	-	-	-	-	-	969	343	19	34								
Misc. Unspecified	-	-	-	-	-	-	-	-	2448	979	5	48	-	-	-	- -	8940	99441	184333	418519
Malagasy	-	-	-	-	-	-	-	3468	1346											
Netherlands	1	7	38	320	25	202	918	289	3769	2732	25139	16644				269	25360	20139		
Norway	-	-	43	366	24	232	8600	3454	8234	32947	63445	43357	610794	673613	1605	5049	3427	10281		
Poland	-	-	-	-	-	-	-	-	-	-	27129	17849								
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pakistan	-	-	-	-	-	-	-	-	158	505	-	-	-	-	-	-	-	-	-	-
Persian	-	-	-	-	-	-	-	5499	1032	-	-	-	10727	6556	-	-	-	-	-	-
Other country in Cosma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	220421	298580	-	-
in Asia	-	-	-	-	-	-	-	-	-	-	-	-	1378	3583	8333	6593	46142	42148	182308	73107
Rumania	-	-	-	-	-	-	-	-	306	120	-	-								
Sweden	-	-	-	-	-	-	-	-		-	-	240	120							
Switzerland	-	-	-	-	44	355	-	-		-	500	200								
Spain	-	-	-	-	466	4196	630	792	149733	45047	10318	7332	13799805	10228340	940023	1058443	32891	45686	[illegible]	4016
Ster Area in America	-	-	-	-	-	-	-	-	-	-	58000	14301	46204	27295	230000	217924				
Singapore	-	-	108	979	-	-	-	-	-650	263		600								
SierraLeone	-	-	5	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
U.K.	14	132	1052	6951	1985	1432	135700	61335	135241	58865	45099	95771	561137	554307	936130	619919	416,708	298062	26058	17235
U.S.A.	-	-	11434	10138	192	1398	1805	1147	8999	4714	52900	54135	83066	53526	29827	64467	112023	94344	1797	2654
U.S.S.R.	-	-	-	-	16	110	-	-	2615	1540	-	-	-	-	-	-	-	-	-	-
Yugoslavia	-	-	-	-	-	-	-	-	-	-	-	-	1322810	661405	-	-	-	-	-	-
American unspecified	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	814806	313191	-	-
Africa unspecified	-	-	-	-	-	-	-	-	-	-	-	-	36004	23620	-	-	-	-	-	-
Total	3507	27740	17455	146970	63525	544288	4615580	1580474	3607627	1791, 971	9622, 678	[illegible]62660	31165329	21399761	[illegible]	27595, 224	6773, 242	50124, 147	13376, 242	6670476

ECONOMIC ANALYSIS OF FISH IMPORT DEMAND IN NIGERIA

by

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INTRODUCTION

The Place of Fishery in the National Economy

The significance of the fishery sector in the National economy could be seen from two major perspectives. First, it is an important source of animal protein for a wider spectrum of the Nigerian population. Second, it provides gainful employment opportunities for many Nigerians especially in the coastal, riverine and the lake areas of the country.

As a source of animal protein, the authors of the Fourth National Development Plan (1980-85), estimated that 40.0 per cent of animal protein consumed by average Nigerians comes from fish. Olaiyide et.al (1969) showed that the per caput consumption per day of fish is higher than that of any other livestock productions in Nigeria. They estimated that the per caput consumption of fish per day was 29.1 gm - yielding 2.6 gm of animal protein and representing 35.0 per cent of the per caput consumption of livestock products and 30.8 per cent of ingested animal protein.

Osajuyigbe (1981) estimated the average retail price for fish (for 1964-74) in the former Western State of Nigeria as 24 kobo per 100 gm as compared with 45 kobo per 100 gm for beef and 100 kobo per 100 gm for chicken. The relatively higher per caput consumption of fish per day was attributable to the easy availability of fish at comparatively cheaper prices than other livestock products. Thus, it is quite obvious that any serious attempt to raise the consumption of animal protein among the masses of the Nigerian people should necessarily give fish production top priority.

As regards the generation of employment opportunities, a lot of Nigerians directly or indirectly depend on fisheries as a means of livelihood especially in the coastal, riverine and the lake areas of the country. According to Bayagbona (1976), about two million people depend directly or indirectly on artisanal fishery alone in Nigeria. Other sub-sectors in which many Nigerians are gainfully employed are the aquaculture and industrial fishing. Apart from employment in direct fishing, many Nigerians earn their living from fish processing and/or marketing, while some others are engaged in fishery research projects and manpower training in the country. Thus, the authors of the Fourth National Development Plan (1981-85) claimed that about for million people are engaged in the fisheries directly or indirectly.

The terms of contributions to the Gross Domestic Product (GDP), the fisheries have recorded substantial increases in recent years. According to the Fourth National Plan (p.129), the fishery sector has recorded the fastest growth rate in the relative contributions of the agricultural sector to the GDP. For instance, the contribution of the fishery sector to the GDP at the 1973/74 factor cost rose from N465.00 million in the 1973/74 fiscal year to N743.60 million in the 1979/80 fiscal year. That of livestock declined from N488.00 million during the same period. These represent an average annual growth rate and decline rate of about 10.0 per cent and 1.6 per cent respectively. The contributions of the crops production and forestry sub-sectors rose from N2,183.80 million to N2,486.60 million and from N215.00 million to N443.20 million respectively from the 1973/74 fiscal year to the 1979/80 fiscal year. These represent an average annual growth rates of 2.3 per cent and 17.7 percent respectively.

It should be noted that if the potentials of the Nigerian fisheries are adequately developed and exploited, the fishery sector is capable of providing many more people with employment opportunities and thus, contributing much more to the GDP especially in the areas of aquaculture and industrial fishing.

Sources of Domestic Fish Production in Nigeria

In Nigeria, domestic fish production comes from four sources, namely; coastal and brackish water, lakes and ponds, rivers and inshore fishing. The quantities of fish produced from each of these sources from 1971 to 1980 are presented in Table 1.

Year	Coastal& Brackish water	Lakes and Rivers	Rivers	Inshore	Total Domestic Production
1971	22,614	58,221	120,321	6,381	409,537
1972	246,974	63,414	129,976	5,759	446,123
1973	258,687	65,304	135,676	5,459	473,193
1974	257,620	67,275	140,764	7,866	473,193
1975	247,620	67,975	140,418	10,174	466,187
1976	281,128	71,468	133,558	10,488	496,645
1977	284,956	68,590	136,950	15,992	506,490
1978	287,978	76,091	143,957	17,155	525,181
1979	303,228	70,050	150,988	11,308	535,430
1980	318,238	71,801	155,367	12,518	551,493

Source:- Uboma et.al (1981)

It could be observed from Table 1 that the bulk of domestic fish production in the country has come from the coastal and brackish water (55.5%), rivers (28.4%) and lakes and ponds (13.9%) - all of which put together account for 97.9 per cent of total fish production in Nigeria during the period of study. Only 1.2 per cent of total domestic fish production in Nigeria was obtained from inshore fishing. The contributions made by the various sources of domestic production are a reflection of the areas where efforts are concentrated. For instance, the coastal and brackish water fishery, the riverine, lake and pond fisheries constitute the artisanal sector which in terms of employment generation and output is the most important sub-sector of Nigerian fisheries. Operated on small-scale, family-unit basis, the artisanal sector is characterized by low capital investments and labour intensive practices (Uboma, et.al, 1981). However, it should be noted that productivity from this sector is still very low due to a number of constraints, some of which are the difficulty of access, inadequate fishing inputs, environmental pollution and lack of proper water management and the molestation of fishermen by nationals of neighbouring countries (Uboma et.al, 1981).

The other sub-sectors of the Nigerian fisheries are the industrial and aquaculture. The industrial sector which comprises inshore and distant water fishing is the commercial sector. It is characterized by capital intensive ventures and the use of highly sophisticated equipments which require specially trained and skilled personnel. Thus, the sector is still dominated by foreign-owned vessels especially in the distant water fishing - operating under chartered arrangements with Nigerian Companies (Third Plan 1, 1975). Although, the industrial sector has the fastest average annual growth rate (10.7%), is contribution to total fish supply is still quite small (about 2.2%). According to Uboma et.al (1981), the problems militating against increased industrial fish production in the country include inadequacy of good landing facilities, insufficient vessels drylocks, spares and maintenance facilities, shortage of competent management and technical manpower and the geographical location of the fishing areas which make development very difficult. However, given the required capital and available manpower, industrial fisheries provided the surest means of bridging the gap between local demand and domestic fish production in the country (Uboma et.al, 1981).

The aquaculture or fish farming sub-sector involves the building of dams and reservoirs to raise fish. Although, fish culture has been known in Nigeria since the 1950's, the low priority which the sector has been accorded has not enabled it to have much impact on domestic fish production in the country. According to Sagua (1976) the problems facing aquaculture in Nigeria are numerous. They include, among others, manpower shortage for the design, construction and management of fish ponds, high costs of labour which make the construction of fish ponds very expensive, the unwillingness of local entrepreneurs to invest in fish farming, inadequate supply of fish fingerlings coupled with scarcity of cheap and suitable fish feeds and insufficiency of technical information on the requirements of local cultivable fishes.

Government Fish Production Programmes in Nigeria

Prior to the Third National Development Plan (1975-80), the various levels of Nigerian Governments especially at the Federal level concentrated efforts on fishery development in the country mainly in the area of research. However, the drought in the Sahelian savannah zone of the country in the 1972/73 growing season which caused great decline in agricultural and livestock production led to increased pressure on fish consumption and production. Thus, the fisheries development policy objectives of the Third Plan emphasized:-

(a) increased exploration of Nigeria's fishery resources to meet the rapidly increasing demand for fish,

(b) encouragement of the development of fishery-based industries,

(c) provision of employment opportunities for young school leavers in the coastal and riverine areas of the country, and

(d) increased generation of foreign exchange through shrimp exports.
As a result of these objectives, the sectoral allocation to the Fisheries sector rose from ₦11.60 million in the Second National

Development Plan (1970-74) to ₦101.55 million in the Third Plan. The allocation to fisheries in the Fourth National Development Plan (1981-85) was increased to ₦170.99 million which was 68.4 per cent over and above that of the Third Plan.

One of the major programmes aimed at boosting fish production in the Third and Fourth National Development Plans is the National Accelerated Fish Production Project (NAFPP) which was designed to bring the benefits of modern fishing technology to artisanal fishermen along the country's coastline, lagoons and the inland waters. It also involves organising small-scale fishermen into fishery cooperatives, the provision of credit and the supply of fishing inputs at subsidized rates. Other programmes in the artisanal sub-sector include Inshore Fishing Project (IFP) to bring a change from small canoes to medium sized inshore fishing vessels; the Special Fisheries Development Project for the supply of fishing and fish pond construction equipment at 50.0 per cent subsidy and the Fish Storage, Processing and Marketing of fish with a view to reducing losses due to spoilage in the distribution of the commodity in the country.

A major strategy of increasing fish production through the aquaculture sector is the Fish Seed Multiplication Scheme which aims at producing high quality fish seeds for distribution to the various fish farms in the country. Others include the establishment of Fish Feed-Mills and the building of Fish Farming Centres to train people in the management of fish ponds, dams and reservoirs all over the country.

For industrial fisheries, government's fishery development projects are mainly concerned with research, the development and provision of shore facilities, the design and the provision of suitable small-sized inshore fishing vessels and the provision of facilities for fish processing, storage and distribution. In terms of research, there are three Research Institutes carrying out investigations and studies applicable to fisheries in the country. They are the Nigerian Institute for Oceanography and Marine Research (NIOMR), the Kainji Lake Research Institute (KLRI), and the Lake Chad Research Institute (LCRI). Of these Research Institutes, only the NIOMR is involved in industrial fisheries research.

In addition to the public sector programmes discussed above, there are a number of semi-private sector programmes owned jointly by the government and private ventures. Under these are the Nigerian National Shrimps Company Limited which exploits the shrimps and fish resources of the inshore waters and the Nigerian National Fish Company Limited which exploits more distant fish resources on Nigerian waters as well as those on international waters where fishing rights are obtained.

In spite of all these efforts, available data reveal a substantial shorfall between domestic fish production in the country and the national demand for fish. The deficit so created has resulted in a steady increase in the quantity of fish imports within the past decade as shown in Table 2. Unless something urgent is done, Nigeria may well be importing greater quantity of fish than it is producing, thus worsening the already depleted foreign exchange reserves.

Table 3 is a further testimony to the fact that there is a great and urgent need to step-up domestic fish production in the country. It could be observed that the proportion of Nigeria's fish imports to domestic fish production which was about 2.0 per cent in the early 1970's has risen to about 27.0 per cent in the late 1970's.

The objective of this paper is to undertake a quantitative analysis of Nigeria's fish import from 1971-80. In doing this, we shall estimate the parameters of the quantifiable factors which are responsible for the expansion in the quantity of fish imports. In addition, we shall derive the income elasticity of demand for fish imports as well as the marginal propensity to import fish for the national economy. From the evidence, useful suggestions will be

Table 2 - Imports of fish and stockfish in Nigeria, 1971-80 (Metric tonnes)

Year	Fish (a)	Stockfish (b)	Total Imports (a+b)
1971	6,006	1,661	7,667
1972	14,708	1,857	16,565
1973	9,731	3,409	13,140
1974	12,432	1,745	14,177
1975	26,828	13,161	39,989
1976	68,315	16,697	85,012
1977	87,658	6,539	94,197
1978	148,638	3,930	155,568
1979	143,840	17,822	161,693
1980	146,840	21,546	168,386

Source: Computed from the Nigeria Trade Summary, Federal Office Statistics, Lagos, December Issues, 1971-80

Table 3 - Fish imports as a percentage of domestic fish production in Nigeria, 1971-80 (Metric tonnes)

Year	Fish Imports	Domestic Fish Production	Fish Imports as Percentage of Domestic Fish Production
1971	6,006	409,537	1.5
1972	14,708	446,123	3.3
1973	9,731	470,585	2.1
1974	12,432	473,193	2.6
1975	26,828	466,187	5.8
1976	68,315	496,645	13.8
1977	87,658	506,490	17.3
1978	148,638	525,181	27.8
1979	143,871	535,430	26.9
1980	146,848	551,493,	26.6

Sources: Computed from Uboma et al (1981, p.23) and Nigeria Trade Summary, Federal Office of Statistics, Lagos, December, Issues.

made both as to the regulation of fish imports to conserve foreign exchange as well as removing the constraints on the expansion of domestic fish porduction in Nigeria.

SOURCES OF FISH AND STOCKFISH IMPORTS OF NIGERIA

The major sources of supply of fish and stockfish imports of Nigeria for the 1970-79 decade are presented in Table 4. From the table, it could be observed that about 75.0 per cent of Nigeria's fish imports and 97.0 per cent of its stockfish imports were supplied by non-African, industrialized nations of the world with Spain leading the supply of fish with 23.4 per cent. With about 75.0 per cent supply, Norway could be termed a "sole" supplier of Nigeria's stockfish imports for the 1970-79 decade. With only 18.3 per cent of the fish imports, African countries supplied very little (if any) of the stockfish imports of Nigeria for the period, 1970-79. The reason for this is not far fetched. Like Nigeria, many African countries' fishery resources do no include stockfish. It should be noted, however, that unlike those of stockfish, the sources of supply of Nigeria's fish imports were diversified during the study period.

Table 4 - Major sources of fish and stockfish imports of Nigeria by percentage of total quantity supplied

1970-79

Sources/Commodities	Fish	Stockfish
United States of America (USA)	-	1.8
Netherlands	8.0	-
German Democratic Republic (GDR)	2.6	6.9
Norway	7.4	74.6
Iceland	22.3	13.8
United Kingdom (U.K)	4.5	-
Spain	23.4	-
Bulgaria	7.0	-
African Countries*	18.3	-
Total % supplied	93.4	97.1

Note: - means nil or negligible

* These include Benin Republic, Camerouns, Niger, Morocco Tanzania, Liberia and Mozambique among others.

Source: Computed from Nigeria Trade Summary, Federal Office of Statistics, Lagos, December Issues, 1970-79.

Expenditures on Fish and Stockfish Imports of Nigeria

The amount of foreign exchange reserves spent on the importation of fish in Nigeria has risen steadily in recent years after an initial fall in the 1960-69 decade as shown in Table 5. For instance, the value of fish imports rose from ₦0.68 million in 1970 to ₦121.08 million in 1978 - accounting for 1.1 per cent of and 12.6 per cent of the total value of Nigerian food imports for the respective years. Although, the expenditures on the importation of stock fish had increased, the various import restrictions to which the commodity was subjected caused much fluctuation in the amount of foreign exchange reserves spent on its importation - resulting in tremendous reduction in the relative importance of the commodity in Nigeria's food import bill.

Table 5 - Expenditures (million Naira) on fish and stockfish imports into Nigeria by decade

Food Commodity	1951-59	1960-69	1970-79
Fish	41.77 (15.29)	12.47 (3.04)	327.94 (8.56)
Stockfish	77.37 (28.33)	98.12 (23.95)	142.12 (3.84)
Sub-total	119.14 (43.62)	110.59 (26.99)	470.06 (11.81)
Total Value of Food Imports	273.15	409.70	3,980.31

Note: Figures in brackets are percentages of total value of food imports for the decade

Source: Computed from data obtained from the Nigeria Trade Summary, Federal Office of Statistics, Lagos, December Issues, 1951 - 1979.

It could be observed from Table 5 that both fish and stockfish have been important items on the food import bill since the Fifties. In the first period, 1951-59, import bills on the two items amounted to ₦119.14million or 43.6 per cent of total food import bill for the period. During the second period, 1960-69, the total bill of the two commodities fell to ₦110.59 million, representing about 27.0 per cent of the total expenditure on food importation for the period. Although, the total expenditure on fish and stockfish imports during the 1970-79 decade rose to ₦470.06 million, this was only 11.8 per cent of the total food import bill of Nigeria during the period partly because of the various restrictions in the importation of stockfish and partly as a result of the general increses in expenditures on the importation of other food stuffs, especially rice, sugar, wheat and milk.

STATISTICAL ANALYSIS OF NIGERIA'S FISH AND STOCKFISH IMPORT DEMAND MODEL SPECIFICATION

An economic model is a simplified construct designed to provide a framework within which real world economic phenomena may be analysed. Having given due consideration to the postulates of economic theory underlying empirical import demand analysis and operations of the Nigerian economy, we hypothesized a functional relationship for the Nigerian fish and stockfish import demand as expressed in equation (1):

$$(QFI)_t = f \left\{\frac{ULC}{FCPI}\right\}_t, \left\{\frac{GNI}{FCPI}\right\}_t, \left\{\frac{FER}{FCPI}\right\}_{t-1}, (PL)_t,$$

$$(IDFP)_t, U_t \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where:

(QFI)t = quantity of fish and stockfish imported in year"t" (in metric tonnes)

$\left\{\frac{ULC}{FCPI}\right\}_t$ = unit landing cost of fish and stockfish imported in year "t", deflated by the consumer price index for food,

$\left\{\frac{GNI}{FCPI}\right\}_{t-1}$ = real national income in year "t" =

$\left\{\frac{FER}{FCPI}\right\}_{t-1}$ = deflated external reserves in year "t-1",

$(PL)_t$ = population estimates in year "t",

$(IDFP)_t$ = index of domestic fish production in year "t" with 1971=100, and

U_t = stochastic error term in year "t".

The algebraic forms of the function fitted are simple

Linear and Cobb-Douglas type of function. The latter gave the best fit to the data and is expressed as in equation (2):

$$(QFI)_t = A\left\{\frac{ULC}{FCPI}\right\}_t^{a_1} \left\{\frac{GNI}{FCPI}\right\}_t^{a_2} \left\{\frac{FER}{FCPI}\right\}_{t-1}^{a_3} (PL)_t^{a_4} (IDFP)_t^{a_5} e^{u_t} \;\ldots\ldots(2)$$

The estimating equation was linearized in lograrithms as expressed in equation (3):

$$\text{Log } (OFI)_t = A + a_1\text{Log } \left\{\frac{ULC}{FCPI}\right\}_t + a_2\text{Log } \left\{\frac{GNI}{FCPI}\right\}_t + a_3\text{Log } \left\{\frac{FER}{FCPI}\right\}_{t-1} +$$

$$a_4\text{Log } (PL_t + a_5\text{Log } (IDFP_t + u_t \;\ldots\ldots\ldots(3).$$

The data used for empirical analysis in this paper were obtained from many national and international publications. Data on fish and stock fish imports were obtained from the Nigeria Trade Summary, while the Digest of Statistics provided data on food price indices. The Central Bank of Nigeria's Economic and Financial Review furnished the foreign exchange figures while the population estimates were derived from Olayide et al (1969). Lastly, the index of domestic fish production was computed from Uboma et al (1981).

Empirical Results

The results are presented in equations (4) to (8) which are the outcome of step-wise regression analysis performed to detect the order of importance of the explanatory variables in determining the quantity of Nigeria fish imports from 1971-80. The standards errors are in parenthesis below the estimated coefficients. We have chosen 5 per cent level for the "t-test" and 1 per cent level for both the "F" and Durbin - Watson Statistics.

Step 1: $\text{Log } (OFI)_t = \underset{(0.419)}{-43.248} + \underset{(0.534)}{12.453} \text{ Log } (PL)_t \;\ldots\ldots\ldots\ldots(4)$

$R^2 = 0.891$, $F = 65.19$, D.W. = 1.89, MSE = 1.406

Step 2: $\text{Log } (OFI)_t = \underset{(0.371)}{-30.966} + \underset{(2.256)}{9.219} \text{ Log } (PL)_t + \underset{(0.121)}{0.253} \text{ Log } \left\{\frac{FER}{FCPI}\right\}_{t-1} \;\ldots\ldots\ldots\ldots(5)$

$R^2 = 0.925$, $\bar{R}^2 = 0.904$, $F = 43.33$, D.W.= 1.89, MSE = 1.961

Step 3: $\text{Log } (OFI)_t = \underset{(0.380)}{-45.[illegible]18} + \underset{(6.424)}{14.957} \text{ Lod } (PL)_t$ [illegible] .392 Log $\left\{\frac{FER}{FCPI}\right\}_{t-1}$ ([illegible].123)

$$1.196 \text{ Log } \left\{\frac{GNI}{FCPI}\right\}_t \quad \text{.........(6)}$$
$$(0.470$$

$R^2 = 0.933$, $\bar{R}^2 = 0.899$, $F = 27.71$, D.W. = 1.89, MSE = 0.866

<u>Step 4</u>: $$\text{Log (OFI)}_t = -46.575 + 12.940 \text{ Log (PL)} + 0.391$$
$$(0.400) \quad (4.556) \quad (0.140)$$
$$\text{Log } \left\{\frac{FER}{FCPI}\right\}_{t-1} + \underset{(0.587}{1.197} \text{ Log } \left\{\frac{GNI}{FCPI}\right\}_t + \underset{(1.065)}{2.117} \text{ (IDFP)t} \quad \text{....(7)}$$

$R^2 = 0.935$, $\bar{R}^2 = 0.882$, $F = 17.88$, D.W. = 1.89, MSE = 0.841

<u>Step 5</u>: $$\text{Log (OFI)}_t = \underset{(0.458)}{-46.596} + \underset{(5.909)}{12.759} \text{ Log (PL)}_t + \underset{(0.165)}{0.382} \text{ Log } \left\{\frac{FER}{FCPI}\right\}_t$$
$$+ \underset{(0.575)}{1.190} \text{ Log } \left\{\frac{GNI}{FCPI}\right\}_t + \underset{(1.0.49)}{2.224} \text{ Log (IDFP)}_t \quad \text{.........(8)}$$

$R^2 = 0.935$, $\bar{R}^2 = 0.853$, $F = 11.46$. D.W. = 1.88, MSE = 0.850.

The results presented in equations (8) indicate that postulated explanatory variables explain between 85.0 per cent and 90.4 per cent of the variability in Nigeria's fish imports for the period, 1971-80. The "F" tests showed that the overall model is significant at 1 per cent while the Durbin-Watson showed that the residuals are not serially correlated. Thus, the values of the $\bar{R}^2$ (or R^2), the "F" and D.W. statistics, all showed that we can be confident to use any of the models for policy recommendations.

We had however chosen equation (7) as our lead equation on basis of its having the least MSE value (0.841) - implying that the estimates have the least dispersion around the true values of the parameters. With $\bar{R}^2 = 0.882$ and $F = 17.88$, the model was adjudged to be quite acceptable as the lead equation.

All the individual coefficients of the explanatory variables are statistically significant at 5 per cent level in equations (4) to variables was very strong at 1 per cent level.

The coefficients of $\log (PL)_t$, $\log \left\{\frac{FER}{FCPI}\right\}_{t-1}$ and $\log \left\{\frac{DNI}{FCPI}\right\}_t$ all have the correct (positive) signs in accordance with a priori expectation, implying that an increase in any of these factors will lead to an increase in the volume of the fish imports, all things being equal. The positive sign on the coefficient of $\log (IDFP)_t$ is normally contrary to the postulates of economic theory because it indicates that an increase in domestic fish production will cause fish imports to rise, <u>ceteris paribus</u>. In the Nigerian context or situation, the quality and tastes and preference factors might be at play, here because it is common knowledge that many people prefer stockfish and other fish preparations such as sardines to locally produced fish. Thus, as more fish is produced locally, increasing number of people are likely to prefer imported fish preparations.

The step-wise regression analysis showed population to be the single most important determinant of Nigeria's fish imports during the period of study with a contribution of 89.1 per cent to the change in the coefficient of determination (R^2), followed by external reserves (3.4%) then by national income (0.8%) and then by index of domestic fish production (0.2%). The variable representing relative price contribu virtually nothing to the change in R^2.

In terms of elasticities, the results indicate that Nigeria's fish imports for the 1971-80 period were responsive to population, national income and the index of domestic fish production, while they were inelastic with respect to foreign exchange reserves and price. With income elasticity[2] greater than unity, we can infer that fish (and stockfish) are "high-priced" food import items. This implies that as the incomes of the Nigerian people rise, they tend to spend a larger proportion of the increase in their incomes on these food commodities, all things remaining the same.

The marginal propensity to consume imported fish (MPCIF)[3] was computed as 0.0025 for the period. This indicated that Nigerians have high marginal propensity to consume imported fish and stockfish in that an increase of one million Naira (₦1million) in national income will lead to an increase of 250 metric tonnes in the volume of fish and stockfish imports of the country, all things being equal.

The results of our empirical analysis clearly indicate that the volume of Nigeria's fish and stockfish imports is very responsive to changes in socio-economic factors such as population, national income and the index of domestic fish production which are amenable to policy manipulations both in the short and long-runs. In respect of the income factor, we suggest a policy of income redistribution in favour of the masses of the Nigerian people as a short-run solution to curb fish imports in the country. It is a common knowledge that most imported food imports in Nigeria are purchased by the high-income urban dwellers who have acquired strong tastes for foreign foods. If income is redistributed more evenly, the purchasing power of the powerful rich will be reduced in relative terms while that of the masses of the people who consume locally produced fish will increase. It is however, recognized that as income becomes more evenly distributed, the masses of the people may tend to acquire sophisticated tastes - "catching up with the Jonesses" and therefore, demand more imported foodstuffs. This of course, may not be true of all, especially the Nigerian rural populace.

As long-term solution, we recommend population control measures to reduce the demand for fish imports while making more concerted efforts to increase the domestic fish production to raise domestic supply of fish. A National Population Control Policy (NPCP) should be formulated and charged with the responsibility of executing Family Planning and Birth Control Programmes all over the country. Education campaigns should also be carried out to enlighten the public on the "threats" of unchecked birth rate.

In terms of increasing the level of domestic fish production, we recommend that efforts should be geared towards drastically improving the productivity of the artisanal fisheries in the Country by providing motorized canoes and other fishing inputs to the small fishermen in groups at subsidized rates. They should be encouraged to pool their resources together for the processing, handling and marketing of their produce so that they can enjoy economies of scale. One of the problems of the Fishermen Cooperatives especially, in the Lake Chad area is that they do not obtain the supply of the necessary inputs in time. This often makes their performance poorer than that of the individual local fishermen who rely on the local financiers for credit needs and/or input supply. This problem should be solved by timely supply of fishing inputs and credits so as to encourage many fishermen to join fishermen cooperative societies.

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2. The income elasticity of demand for fish imports measures the percentage change in the volume of fish imports associated with 1 per cent change in national income, *ceteris paribus*.

3. The MPCIF is defined as the change in the volume of fish imports occasioned by a unit change in national income, all things being equal.

It is also recommended that the River Basin Development Authorities (RBDA)s should integrate fish culture in their projects. They should develop fish hatcheries to serve their areas as well as embark on fish farming. However, this will entail training the skilled manpower in fish farming management.

With regards to the industrial fishery, a survey of Nigeria's territorial waters is recommended to determine her fish resources endowment. The establishment of Industrial Fishing Terminals as well as that of Shipyards is also recommended. In addition, private sector efforts should be encouraged in Industrial Fisheries by providing the necessary incentives to attract private concerns to the sector by giving them loans and tax incentives.

As regards stockfish, we are in complete support of Government recent policy prohibiting its importation on two major grounds. First, it is an elitist food which only the rich can afford. Second, it is an unnecessary drain on scarce foreign exchange. However, should the Government want to reopen the issue after the current economic recession might have improved, fresh negotiations should be entered into between the Nigerian Government and the exporting countries such that a more favourable term can be won for Nigeria. In this way, the price of the commodity would go back close to the pre-war levels, a situation which would make the price of stock-fish come within the reach of the masses.

Lastly, it is strongly recommended that the training of manpower be stepped up to provide the necessary skills especially, in the aquaculture and industrial fisheries. Besides, adequate research should be carried out to determine ways of processing, packaging, marketing and distribution of locally produced fish so as to minimize losses and improve quality. In this connection, it is recommended that the Government should encourage the Departments of Food Science and Technology in the Nigerian Universities to research into better techniques ofpreserving, processing, storing and packaging locally produced fish in Nigeria. In addition, greater efforts should be put into providing refregerated vehicles for transporting frozen fish from State to State to avoid wastes due to spoilage while in transit.

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PRELIMINARY ECONOMIC EVALUATION OF 10 METRE (LOA) SHALLOW DRAFT VESSEL IN DAILY FISHERY, OFF IMO RIVER, CROSS RIVER STATE

by

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ABSTRACT

Scientist from the Institute with the collaboration of Food and Agricultural Organisation (FAO), Rome designed and built a 10 metre (LOA) shallow draft vessel. The prototype vessel was tried at Uta-Ewa, Ikot Abasi, Cross River State. The paper deals with the preliminary economic analysis of the performance of prototype vessel. An analysis of the annual return has shown that 43.66% of the annual gross income was paid to labour; 15.91% was spent on repairs and replacements; 7.76% on fuel and lubricants; 24.38% on maintenance costs and the return of investment, 6.2%.

This low return of investment is attributable to high percentage of labour costs as well as low fishing intensity.

INTRODUCTION

Natural coastal conditions in many developing countries such as Nigeria, and India constitute an important restraint to the development of coastal and inshore fisheries with modern as well as improved mechanised fishing vessels. In the coastal areas of Bendel, Rivers and Cross River States, the mouths of the sheltered rivers are often blocked by sand bar which allow only vessels with shallow draft to pass through at low tides. Sand bars are submerged mound of sendiments lying across the riverine estuaries with the crests at their lowest point lying 1.83 - 3.66 metres. The geometry of the bars are determined by a resolution between the waves, the longshore drift and the power of the discharging rivers. The annual discharge of River Niger through its estuaries has been estimated to be 21,800 cubic metres (Scott, 1966).

The mouth bar of Imo River, for example has been described as strongly curved in shape with a width of 12.0 km and a maximum depth on the bar crest of 1.83 metres (Allen, 1964). Turbulent foaming waters, called plunging breakers from directly over the bars, causing fishing vessel accidents at riverine mouths. Any vessel that has to be developed for usage in these areas, must have shallow draft as well as the ability to withstand and manoeuvre the plunging breakers.

Scientists at the Institute and those of the Food and Agricultural Organisation (FAO), Rome, have therefore through research established a fishing vessel design that is capable of crossing sand bars as well as fishing in Nigerian coastal waters. Fishing trials were therefore, conducted at Uta-Ewa, Ikot Abasi in Cross River State between November 1981 and November 1982 with the prototype vessel in order to establish whether the vessel is economically viable.

METHOD

Fishing trials were conducted off Imo River with the 10-metre (LOA) prototype fishing vessel known as "Shallow Draft 1 (SD1)".

The vessel has the following main particulars:-

Length over all (LOA)	9.83m
Length DWL	8.73m
Beam moulded	3.50m
Beam DWL	3.41m
Depth moulded	1.21m
Displacement to DWL	12.30m³
Fish hold capacity approximately	5.80m³
Engine	63 HP

The vessel did daily fishing with a demersal trawl-net of 18 metres headline length and flat rectangular Otter boards.

RESULTS AND DISCUSSION

The investment cost, annual revenue and total operating outlays are shown in Table 1 and calculated on the method used by Fyson (1980).

a) Investment Costs

The prevailing market price of N53,00.00 for the prototype vessel was obtained from the boatyard, where the vessel was built.

b) Annual Revenues

These were obtained from catch volume and market values of the different species of fish caught. Catch volume is a function of catch rate and fishing intensity. The latter is calculated by number of daily trawling hours (6.5) multiplied by number of fishing days in the year (170 days). The annual revenues were calculated to be N39,780.00.

c) Total Annual Costs

The total annual costs have been divided into sections II and III of Table 1. The costings for the individual headings are as follows:-

i. Labour: These include the cost of maintaining a fleet manager (shore captain); the salaries of the crew (four) as well as their bonuses and food. These total labour costs accounted for 43.66% of the gross annual income.

ii. Repairs and replacement costs: The costs are for engine overhaul for the year, hull repairs, gear repair as well as replacement and miscelaneous charges. These accounted for 15.91% of the gross annual revenues.

iii. Fuel and lubricants: The total cost for fuels and lubricants amounted to N3,085.50 which accounted for 7.76% of the gross annual income.

iv. Maintenance costs: The costs include depreciation values which have been estimated to be 10% of the total investment costs of the vessel, since the econbmic life time of the vessel is ten years. The insurance rate and vessel hull maintenance costs have been included under this headings. The insurance rate is 5% of the sub-total costs of the hull and machinery. The total maintenance costs accounted for 24.38% of the gross annual income.

v. <u>The Return of Investment</u>: This has been calculated to 6.2%.

The low return of investment is due to high labour costs and low fishing intensity which was 1105 fishing hours for a year.

Table 1 - Revenue and expenses analysis of SD 1

i)	**Investment Costs**	
(a)	Hull equipment	₦35,000.00
(b)	Machinery and Installation	18,000.00
(c)	Sub-total, Hull and Machinery	53,000.00
(d,	Fishing Gear	9,000.00
	Total Investment	₦62,000.00
ii)	**Annual Fixed Costs**	
(a)	Depreciation 10% 1(c)	₦5,300.00
(b)	Insurance	2,650.00
(c)	Vessel Hull Maintenance	1,750.00
(d)	Crew Basic Salary	7,440.00
(e)	Fleet Management	6,560.00
	Total Fixed Costs	₦23,700.00
iii)	**Annual Revenue**	
(a)	Hourly Catch Rate	30kg/hr
(b)	Average daily catch	195kg (6.5hrs/day)
(c)	Annual catch	33.150kg
(d)	Average price of fish	₦1.20k/kg
(e)	Total annual revenue	₦39,780

Return on Investment $\frac{3298.5 \times 100}{53,000} = 6.2\%$

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SECTION 5: FISH BIOLOGY, ECOLOGY AND MANAGEMENT

AN EVALUATION OF THE TROPHIC STATUS OF THE SHEN RESERVOIR BY AN ANALYSIS OF PHYTOPLANKTON COMPOSITION AND WATER CHARACTERISTICS

by

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ABSTRACT

In an effort to evaluate the production potential of an artificial impoundment, the phytoplankton of the Shen reservoir was sampled from November 1981 to June 1982 at three stations during three periods of distinct seasonal hydrographic characteristics. The samples were subsampled and quantified. Most of the phytoplankton were identified to the species level. There were in all fifty-three species comprising Chlorophyceae contributing 36.70% with species of Volvox, Pediastrum, Closterium, Staurodesmus and Ankistrodesmus as dominant species in this group. The cyanophyceae contributed 30.00% with species of Microcystis, Nostoc, and Oscillatoria as the dominant species. The bacillariophyceae and dinophyceae contributed 21.70 and 8.30% respectively. The former group had species of Navicula, Nitzhia, Synedra, Tabellaria and Melosira as the dominant individuals.

An analysis of temporal and spatial changes in composition and abundance of the various groups showed that these were influenced by water temperature, sampling period and station.

Based on the trophic status of the most abundant species, the composition of the phytoplankton is indicative of a tropical reservoir with a moderate productivity for fish culture.

INTRODUCTION

Effective utilization of large inland water impoundments is based on adequate knowledge of their pre and post impoundment status. In Nigeria many reservoirs have been constructed either for irrigation or city water supplies but a great majority of them have been inadequately monitored and studied. The Shen reservoir created by damming the Shen river is subject to considerable climatic and temperature fluctuations. The reservoir was first filled in 1978 without a pre impoundment biological study. Subsequently there has been no systematic post impoundment study prior to the present work.

As a correlate of potential productivity of the Shen reservoir, we have examined the occurrence and species composition of the phytoplankton and their distribution in relation to changes in the physico-chemical characteristics of the reservoir. Similar studies have been made in Nigeria by Imevbore (1968) who observed that the dominant phytoplankton in the Eleiyele reservoir in the rainy season was Melosira sp. However, Egborge (1979) noted that following impoundment, 78% of the phytoplankton species originally present in Asijere Lake were displaced by immigrant species. Biswas (1978) observed a positive correlation between phytoplankton abundance and dissolved oxygen in the Volta Lake Ghana.

MATERIALS AND METHOD

Phytoplankton samples were collected with a square mouthed bolting silk plankton net number 21 (70 meshes per linear centimeter diameter) sunk beneath the surface of the reservoir and towed for a distance of five metres for each sampling operation. Samples were either examined live or immediately preserved and stored in a drop of concentrated iodine solution for subsequent examination.

The volume of water sampled by the tow-net was determined by a modification of the relation recommended by Lipsey and Malcon (1981). Numerical estimation of the phytoplankton was made by the drop method of Lipsey and Malcon (1981) in which 5 drops of 0.5 milligrams of well shaken subsamples were examined under the microscope.

The abundance of the various taxa in each sample was determined by the method of Shannon and Weaver (1963).

The reservoir trophic status was evaluated for phytoplankton using the compound index according to Nygaard (1949).

Surface water samples for physico-chemical parameters were collected with the closing type bottle between the hours of 8.00 & 11.00 every forthnight from the three stations.

The dissolved oxygen was estimated by the WINKLER method and values presented both in milligrams per litre and as percentage saturation according to Welch (1960).

The surface water temperature and pH were taken during sampling occassion. Turbidity was monitored by Secchi disc transparency. Alkalinity was determined by titration with 0.02N H_2SO_4. Nitrogen as NO_3 was determined using the phenoldisulphonic acid method. Total phosphorous was determined after the Deniger method.

RESULTS

Four classes of phytoplankton, chlorophyceae, dinophyceae, cyanophyceae and acilariophyceae are present in the Shen reservoir. There are twenty two species of chlorophyceae. The pattern of their occurrence showed variations both in species and total organism number for station and sampling period (Fig. 1). The results show that the dominant species were Volvox, Pediastrum, Chlorella, Closterium, Scenedesmus and Akistrodesmus. An analysis of the pattern of occurrence of the class showed that the highest percentage abundance of 57.95% occurred during the third period (Fig. 2). Based on total phytoplankton organism, the chlorophyceae has a mean of 15.88%.

The dinophyceae accounted for 18.32% of the total phytoplankton. In all, five species were encountered. The dominant members of this group were species of Ceratium, Peridinium and Chlorococcus.

The cyanophyceae were represented by twenty species. Based on total phytoplankton composition, they contributed 33.13% (Fig. 3). Dominant species of the group were Microcystis, Nostoc and Oscillatoria. An analysis of variance indicated that the group was influenced by water volume and temperature.

The bacillariophyceae contributed 32.67% of the total phytoplankton population. They were represented by thirteen species of which the dominant ones were Navicula, Nitzchis, Synedra, Tabellaria and Molosira.

Variations in the water characteristics of the Shen reservoir indicate some degree of change both with sampling period and station (Fig. 5). From this, it will be seen that for a tropical system, the surface water temperature was low (18.50 - 20.60°C) during November to January. However, during April to June, the temperature ranged between 32.0 - 37.5°C. The periods of minimum and maximum surface water temperature corresponded with that of the air temperature fairly closely. The distribution of other physico-chemical features of the lake during the period of study is presented in Fig. 5. From this we note that the turbidity of the reservoir was low from November to January increasing gradually through intermediate values to higher values from April to June. Inspite of the foregoing pattern of turbidity, absolute values indicate that light penetration did not fall below 25.00 centimeter. Hydrogen ion concentration fluctuated between 6.2 and 10.5. The mean pH was 8.35 indicating that the reservoir is generally alkaline. Dissolved oxygen values varied from 5.10 - 6.95 milligrams per litre, while percentage dissolved oxygen saturation values similarly varied from 56.80 - 85.96%. The phosphorous content was very low and showed very little variation with season and sampling period. The nitrate nitrogen values ranged from 55. ug per litre to 85 ug per litre and exhibited marked seasonality in all sampling stations.

DISCUSSION

The phytoplankton density showed significant direct relationship to both water temperature and percentage dissolved oxygen (Fig. 4). The chlorophyceae were the least abundant plankters but show high species diversity. The low occurrence of the group is indicative of the eutrophic status of the reservoir. Though the chlorophyceae showed high species diversity only Pediastrum, Scenedesmus, Closterium and Staurodesmus occured throughout the period of study. An estimate of the evenness value suggests that both seasonal water characteristics and specific features of

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PRELIMINARY OBSERVATIONS ON THE FEEDING, HABITS AND REPRODUCTION BIOLOGY OF GYMNARCHUS NILOTICUS FROM LAKE CHAD[a]

by

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ABSTRACT

The preliminary results obtained from the study of stomach contents of specimens of Gymnarchus niloticus of a size ranging from 56cm (600 grms) to 152 cm (12.0kg.) from August to December, 1982 indicate for these sizes an exclusively piscivorous diet. The predominant prey species in Lake Chad are Tilapia/Sarotherodon, and Clarias. The prey is often cut in two parts before it is swallowed. Small prey may be swallowed whole. The implication of this prey capture method on preypredator relationship and therefore the impact of the predator is discussed.

The breeding season of Gymnarchus nilcticus in Lake Chad has been deduced from observation of changes in gonad maturitystages and the results indicate that breeding takes place between August and November.

Data is also presented on the fecundity, size of ripe eggs and probable size at maturity.

INTRODUCTION

Gymnarchus niloticus is one of the most important commercial fishes in Lake Chad that attains a fairly large size; specimens of up to 12 kg in weight and over 150cm in length are found. The fish is endemic to Africa, and the genus is monospecific. It is like many of the mormyrids an electric generating fish and is known to emit continuous electrical signals from its tail (Lissmann, 1951). It has been shown to be able to use the electrical mechanism in the location of objects such as its prey (Lissmann, and Machin, 1958). Apart from studies of the electrical mechanism and its function and anatomy very little is known of its biology in the Lake Chad. Before the sahelian drought of the early 1970's which caused a reduction of Lake Chad's level and area G. niloticus was rather insignificant being less than two percent by weight of the gill net catches recorded by HOPSON (1964) while Lates niloticus, Labeo sp and Heterotis were dominant.

The Post Sahelian drought era brought about changes in the species composition of the Lake and consequently Clarias lazera, Tilapia/Sarotherodon and Gymnarchus niloticus now constitute the major economic species while Lates niloticus has become a rarity in the Lake.

The observations recorded in this paper on the feeding and breeding of G. niloticus are part of a study begun in August 1982 on the general biology and ecology of G.niloticus in Lake Chad which aims to provide information essential for the management of this important fish in the Lake and to investigate its suitability for fish culture in irrigation canals, reservoirs and fish ponds in the Lake Chad Basin.

MATERIALS AND METHODS

Fresh Gymnarchus specimens ranging in size from 56cm (600g.) to 152cm 12.0 kg were obtained from gill nets and hook and line catches of LCRI in Lake Chad at Baga; but additional specimens were purchased from local fishermen in the Lake at Baga and from nearby islands. The specimens were chilled and transported in a cold chest to Maiduguri where they were weighed.

Lenghths were taken with a standard one metre measuring board and then dissected. The stomach contents were identified and counted. Both the lengths, weights and volumes of the food items eaten were recorded for each specimen containing food. Portions of prey species were identified from visible identifiable remains of the prey.

The gonads were examined to determine the sex and stage of gonad development. The lengths, voluems or weights of the testes and ovaries were measured. A simplified 5-stage gonad maturity key based on actual observation of the gonads of Gymnarchus is described below:

i Immature - Young virgin fishes never previously engaged in breeding. Gonads are very small and transparent; not easily differentiated into males or females as eggs not yet visible to the naked eye.

ii Mature - Gonads developing or Opaque and developed; in females oocytes clearly visible to naked eye; in males in breeding season milt may be exuded when cut.

iii Gravid - Females with swollen ovaries, but eggs not yet ripé; eggs Yolky with maximum diameter of about 5mm; together with other smaller eggs of 2.5mm to 3.5mm in diameters testes swollen full of milt exuded on pressure.

iv Ripe/Running - Females with very large swollen ovaries; large spherical, golden yellow yolky eggs (8mm to 9mm in diameter) constituting about 80% to 90% of the eggs in the ovary. Fewer (10% - 20%), of the eggs are about 5mm in diameter. Testes full of milt, exuded on light pressure. The eggs may be easily separated and milt may flow from the vent freely with the slightest pressure on the abdomen.

v Spent - Ovaries and Testes empty or nearly empty. Recently spent ovaries are flabby and few residual eggs of 3mm to 5mm diameter may be found. The testes are depleted of milt and in both sexes the gonads are reduced, from the size attained in stages III and IV. As recovery proceeds residual eggs are reabsorbed and the ovary reverts to stage I.

The numbers of ripe eggs in stage III and IV females were determined by preserving the ovaries in Gilson's fluid for two weeks and then the large sized eggs were washed clean in water and the numbers determined by both volumetric method and direct counting.

RESULT:

1. Food and feeding behaviour of G. niloticus

of the 35 specimens examined between August and December, 1982 two had been eviscerated and their stomachs removed before arrival in Maiduguri.. Of the 33 stomachs examined, 26 (78.8%) contained food items while only 7 (21.29%) were empty.

The most important items of the diet of G.niloticus. were Clarias lazera and the Cichlids (Tilapia and Sarotherodon) which occurred in 48.4% and 38.7% respectively of the food stomachs as shown in Table I. The only species of Cichlilidae identified specifically was Sarotherodon niloticus.

The only other fish prey species found was Ctenopoma sp. while some unidentified highly-digested fish materials were believed to be either Cichlids or Clariids.

2. Prey capture by G. nilotics

The condition of the prey fishes in the stomachs of G. niloticus gave an insight into the probable prey capture method of this predator in Lake Chad. As shown in Table 2, nearly 60% of all the fish prey had only their tail ends swallowed compared with only 7% head ends swallowed. Whole fishes constituted 26% while about 5% had been cut in two but both halves were found in the stomach. It is concluded that G. niloticus attacks its prey from the rear end and cuts the tail end off with its sharp incisor-like teeth and swallows it. The head end of the wounded prey may swim away or die instantly and be lost. but sometimes it may still be caught and swallowed.

It is usually a small prey that is swallowed whole. Examination of the triangular-shaped cut on the prey, a reflection of the pointed snout of Gymnarchus, shows the apex of the triangle to be pointing towards the anterior region of the prey which confirms the rear approach of the attacking predator.

The number of fish prey species found in individual stomachs of G. niloticus (Table 3) indicates that it generally feeds on one fish prey at a time. 42% and 31% of the stomachs contained only Cichlids or Clarias while only 15% were having both Clarias and Cichlids. It is concluded from this that Gymnarchus takes its fill from the available prey species immediately available to it.

Table 1: Occurrence of Food items in stomachs of Gymnarchus niloticus from Lake Chad

Food item	Number of Stomachs food item occurred	Percentage Occurrence
Tilapia/Sarotherodon	12	38.7
Clarias lazera	15	48.4
Ctenopoma sp.	1	3.2
Unidentified highly digested fish	1	3.2
Mud, sand, pieces of vegetation	2	6.5
TOTAL	31	100
No. of stomachs examined	33	
No. of stomachs containing food	26;	78.8%
No. of empty stomachs	7%	21.2%

Table 2: The condition of prey fishes found in stomachs of Gymnarchus niloticus from Lake Chad

Fish prey species	Tail end only	Head end only	Head and tail ends	Whole fish	Undetermined	Total
Tilapia/Sarotherodon sp.	7	2	2	6	-	17
Clarias lazera	18	1	-	4	1	24
Ctenopoma sp.	-	-	-	1	-	1
Total	25	3	2	11	1	42
Percentages	59.5	7.1	4.8	26.2	2.4	100

LENGTH-WEIGHT RELATIONSHIP AND THE DIETS OF Clarias lazera (CUVIER AND VALLENCIENNES), FAMILY CLARIIDAE (OSTEICHTHYES: SILURIFORMES) IN ZARIA, NIGERIA

by

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ABSTRACT

The length-weight relationship and the diets of Clarias lazera were investigated in Zaria, Nigeria between July 1981 and June 1982.

About 450 specimens were examined. The standard lengths of the fish ranged from 8.5 cm to 42.2 cm. Significant differences were found between the standard lengths of the males and females with the latter slightly shorter. Somatic weights varied between 10 g to 502 g. Lenght-weight regression analysis gave a "b" value of 3.02 for both males and females combined; thus indicating an isometric growth.

Analysis of the food in the stomachs showed that the fish is an omnivore although, it fed more on insects and fish than other food items.

INTRODUCTION

The Family Clariidae is a group of catfish found in most African and Asian minor freshwaters (Mills, 1966). There are two genera in this family, Clarias and Heterobranchus.

The genus Clarias has a wider distribution than Heterobranchus. Over ten species of Clarias have been described in West Africa (Lowe-McConnel, 1972, Sydenham, 1977). Recently Sydenham (1980 & 1981) described three new species of Clarias from River Ogun in southern part of Nigeria.

In Zaria, two species of Clarias are found. These are Clarias anguillaris and Clarias lazera. The latter is the more common of these two species. C. lazera is a highly priced fish. It is of considerable economic importance in Zaria area. They are found commonly in the market throughout the year. According to Holden and Reed (1972), C. lazera often attain large size of up to one metre in length and a weight of about seven kilogram. This fish possessed specialized structures which enable it survive outside water for several hours. Welman (1948) observed a shoal of C. lazera migrating from a cut-off pond to a river covering a distance of about 62 metres.

The biology of this species had been studied by various workers which include Moussa (1957), Bolock and Koura (1960), Nawar and Yoakin (1963 Mill (1956), Abdel-Magid (1971) and Ishak et. al (1977), and Ejike et. al (1982). Many of the work cited above were conducted elsewhere outside West-Africa. There is no published account of the biology of of this species in Zaria despite their commercial importance. The great commercial value of this fish has brought an increasing pressure on its population. This might result in a decline of annual catch. Such downward trend in annual catch can be stopped through sound management practice which requires a thorough understanding of the biology of the species.

In this paper, the length-weight relationship and the dietary composition of Clarias lazera are discussed.

MATERIALS AND METHODS

Fish samples were purchased once a week from fish landings at Sabongari Central Market in Zaria, between July 1981 and June 1982. A total of 450 specimens were examined. In the laboratory, the total length, standard length and weight of each fish were measured as described elsewhere (Olatunde, 1977). The sex and the gonad condition were also determined after dissection and visual examination. The gonad maturity levels were determined according to a scale modified after Nikolsky (1963). Stomachs with food were later removed from the fish and their fullness classified according to a table prepared by Olatunde (1978). The stomachs were either examined immediately or kept in 5% formalin until when needed. Two methods were used for analysis of the stomachs. These are the Points and Frequency of occurrence methods. A full description of these methods can be obtained from Hynes (1950). The condition factor and length-weight relationship were calculated using conventional formulae (see results).

RESULTS

Length Distribution

Table 1 shows the length and weight ranges of the specimens examined. The value obtained for the mean total lengths, standard lengths and weights show that the males were generally larger than the females. Statistical tests (Table 2) show that there are significant differences between the lengths and weights of the males and females ($P = 0.1 - .001$) The length frequency distribution of males and females were also plotted as seen in Figure 1. The figure shows two peaks at around 14 cm and 15cm for the females; while the males show one distinct peak also at around 14 and the second which is less distinct between 24 - 27 cm. This figure probably indicates either the presence of two population groups or two age groups in the samples.

Length-Weight Relationship

The length-weight relationship was calculated using the formla described by Le Cren (1951):

$$W = a\ L^{b} \ldots\ldots (1)$$

The data were transformed into logarithms before the calculations were made. Thus equation (1) was transformed into:-

$$\text{Log } W = \text{Log } a + b \text{ Log } L \ldots\ldots (2)$$

where W = weight of the fish (g)

L = standard length of the fish (cm)

a = contant

and b = an exponent.

The results of the regression analysis are shown in Table 3. The 'b' values for males and females and both of them combined were very close to 3, thus indicating an isometric growth. This however, assumed that the specific gravity of the fish remained constant (Tesch, 1968). The correlation of co-efficients were found to be very high and highly significant (Table 3). Graphs of the length-weight relationship using log conversions were drawn (Figures 1 and 2).

Condition Factor

The condition factors ('K' values) were calculated, using the formula

$$K = \frac{W \times 100}{L^3} \ldots\ldots\ldots\ldots (3)$$

where K = condition factor

W = weight of the fish (g)

and L = standard length of the fish (cm)

The results obtained for each month are as shown in Table 4. The results show a fall in condition factor from October to February during the dry season period, whereas during the rainy season the fish were generally in good condition.

Dietary Composition

Table 5 shows the dietary compositon of the fish. The bulk of the food were made up of adult and immature insects. The coleopterans and orthopterans featured prominently among the adult insects, while chironomid larvae and pupae were the most utilized immature insects. On the whole, the insects formed about 41% of the total food consumed.

Fish and bottom deposits contributed significantly to the diets. Over 25% of the population consumed fish and about 40% fed on bottom deposits. Molluscs, Crustaceans, and Plant debris including some diatoms were also found in the stomach samples. These formed important parts of the diets. The dietary composition shows that *Clarias lazera* is an omnivore feeding principally at the bottom of the river.

DISCUSSION

The analysis of size ranges of *Clarias lazera* showed that generally, the mean lengths and weights of males are generally higher than those of the females. In some catfishes, the females exhibit faster growth rates than the males (Olatunde, 1979). Thus, the mean weights and lengths of the females are usually higher than those of the males. The size ranges found in the samples depend on the types of fishing gears used for the capture, the season of the year and other structural and physiological adaptations which might make one fish more vulnerable to catch than others. The specimens used for this work were purchased from the market. The sizes met and purchased from the market were usually influenced by a lot of factors which were beyond the control of the researcher. Thus, analysis of sizes based on market samples may not give a true picture of the size ranges present in the wild population. Such results should, therefore, be accepted with caution.

The length-weight relationship showed as expected that as the fish grow in length, the weight also increase. Figures 2 and 3 showed that the weights increase faster at the lower lengths than at the higher lengths. This indicates that growth proceeds faster at the earlier part of life than the later part. The regression analysis showed that males and females exhibited isometric growth. This is based on the assumption that the specific gravity of the fish remained constant (Tesch, 1968) The mean condition factors showed that the fish were in good condition during the rainy season and there was a fall in the dry season. The fall in condition during the dry season might be due to several factors which might include physiological stress due to changes in physical and chemical conditions of the habitat. Inadequate feeding may also contribute to loss of condition. It was observed that most of the fish samples had empty stomachs during the dry season. According to Lagler (1952), the "K" values of fish can also be influenced by sexual differences, age, changes in seasons and the gonad maturity levels of the fish.

Analysis of the stomach contents revealed that *Clarias lazera* in Zaria are omnivores utilizing a lot of food items ranging from insects to bottom deposits and vegetable matter. Studies from other water bodies within and outside Nigeria, also depicted the fish as an opportunistic feeder, feeding on what-ever comes its way. Ejike *et al* (1982) reported that *C. lazera* from Jos area fed on a variety of food items which

Table 1 - Size ranges of Clarias lazera from Zaria

	Sex	Number of Fish Examined	Maximum	Minimum	Mean	Standard Deviation	Standard Error
Total length (cm)	M	115	41.3	13.7	23.7	7.2	0.93
	F	335	44.2	11.2	22.4	6.7	0.55
Standard length (cm)	M	115	40.2	12.2	20.7	6.3	0.81
	F	335	42.2	8.5	19.8	8.1	0.66
Body Weight (g)	M	115	430	18	112.8	96.5	12.45
	F	335	502	10	015.4	91.5	7.48

Table 2 - Statistical analysis for significant differences between lengths and weights of males and females Clarias lazera from Zaria

	Sex	Degree of	Mean	"t"	Mean significantly different?	Level
Total length (cm)	M	448	23.7	3.421	Yes	0.001
	F		22.4			
Standard length (cm)	M	448	20.7	6.000	Yes	0.001
			19.8			
Body weight (g)	M	448	112.8	1.489	Yes	0.1
	F		105.4			

Table 3 - Length-weight regression analysis of females and males of C. lazera from Zaria

	Number of Fish examined	Log a	b	Standard Error of b	Correlation Co-efficients
Males	115	-1.94	2.94	0.05	0.90 (P = 0.001)
Females	335	-2.00	3.01	0.08	0.99 (P = 0.001)
Both	450	-1.98	3.02	0.07	0.98 (P = 0.001)

Table 4 - Monthly mean condition factor for <u>Clarias lazera</u> from Zaria

Month	Total Fish Examined	Condition Factor	
		Mean	Standard Deviation
July 1981	36	1.06	0.14
August 1981	45	1.64	
September 1981	38	1.24	
October 1981	40	0.83	
November 1981	60	0.91	0.24
January 1982	20	0.93	0.20
February 1982	72	0.98	0.28
March 1982	56	1.11	0.13
April 1982	30	1.02	0.21
May 1982	10	1.04	0.14
June	28	1.05	0.22

Table 5 - The dietary composition of *Clarias lazera* from Zaria

Dietary items	% Frequency of Occurence	% Total Points
Adult Insects		
Orthoptera	6.5	4.2
Hemiptera	12.4	3.5
Isoptera	3.0	0.5
Dictyoptera	10.8	3.5
Hemiptera	5.4	1.5
Coleptera	15.2	7.4
Immature Insects		
Chironomid larvae	10.8	5.2
Chironomid pupae	5.5	3.4
Chaoborus larvae	3.5	2.2
Trichoptera larvae	5.4	1.4
Dragonfly nymph	4.0	2.2
Unidentified insect remains	10.0	5.5
Total Insects		40.5
Fish remains	40.0	21.5
Molluscs	8.5	4.0
Crustaceans	10.8	6.0
Plant debris	15.0	5.5
Bottom deposits	25.0	19.5
Total		100.0

included crustacea, immature insects, bottom deposits and diatoms. Holden and Reed (1972) reported the fish as one of the best example of an omnivore which eat almost anything found in its habitat. They found stomach samples to contain fish remains, mud, vegetation, insects and occasionally zooplankton. Welman (1948) mentioned that their food consisted of fish, mulluscs, insects, frogs and weeds. Worthington (1932) describeed the Ugandan specimens as piscivores but found also small animals and plants in their stomachs. Those found in Lake Edward and Kivu were found to feed regularly on zooplankton, chironomid and ephemeropteran larvae. Algae and other vegetable matters were also found in their stomachs (Verbeke, 1959). Sandon and El-Tayib (1953) found only fish remains in the stomach of samples examined from the Nile. Imevbore and Bakare (1970) also reported the River Niger species in Nigeria to be mainly piscivorous, while Lewis (1974) reported C. lazera from Lake Kainji to feed on small fish and carrion. The ability to feed on anything coupled with their ability of air-breathing are adaptive features which probably contributed to the wide distribution and great success of the fish and hence their commercial importance.

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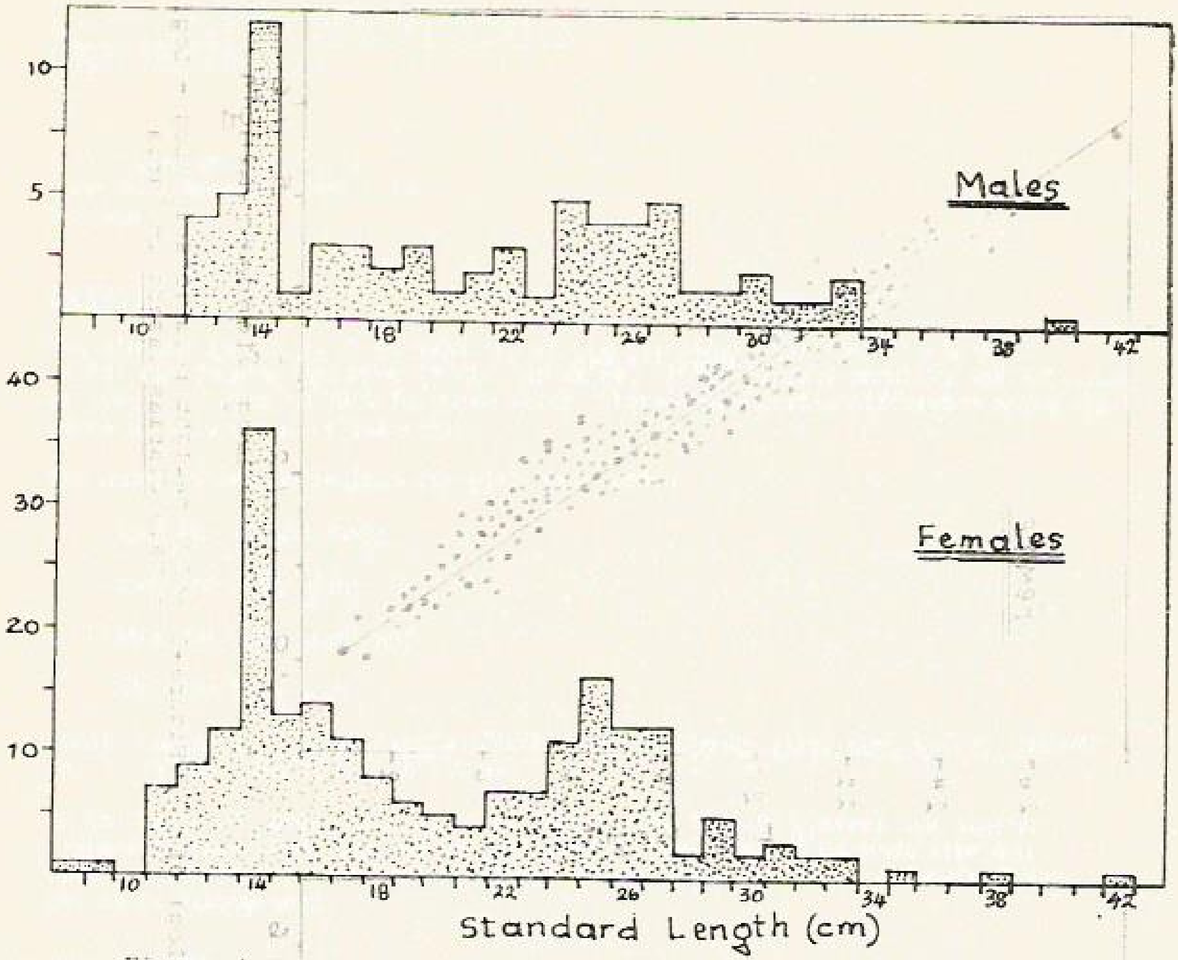

Figure 1 - Length frequency distribution of Males and Females of *Clarias lazera* in Zaria

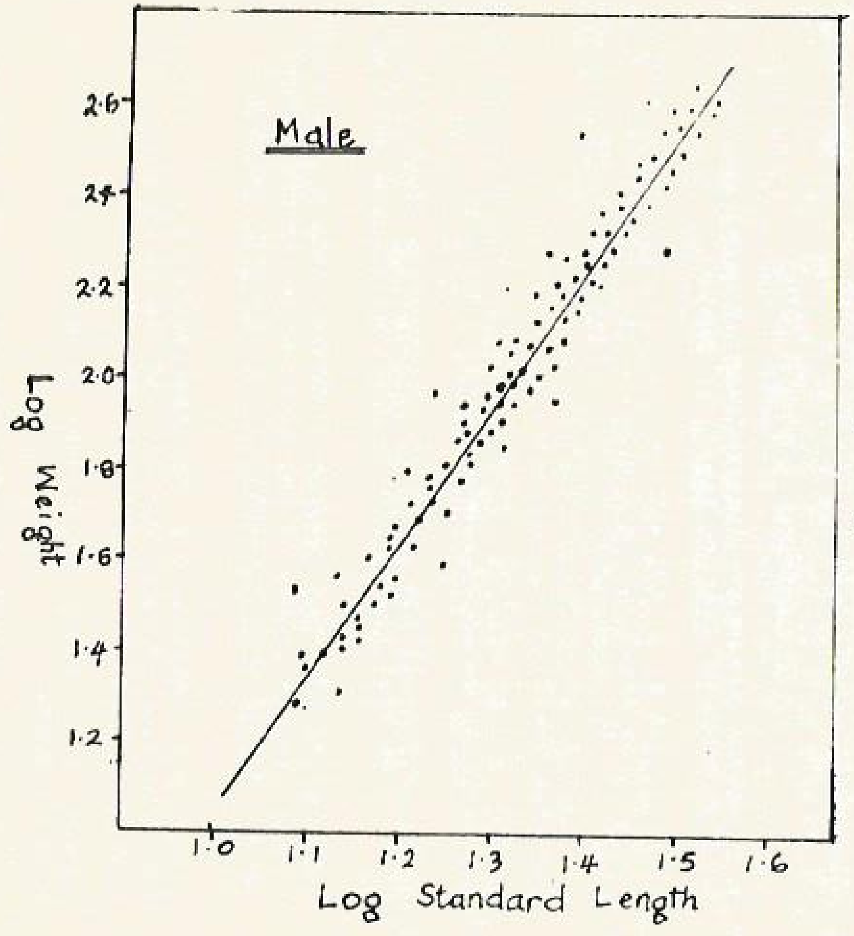

Figure 2 - Length-Weight relationship (Log - Log) of Male _Clarias lazera_ in Zaria

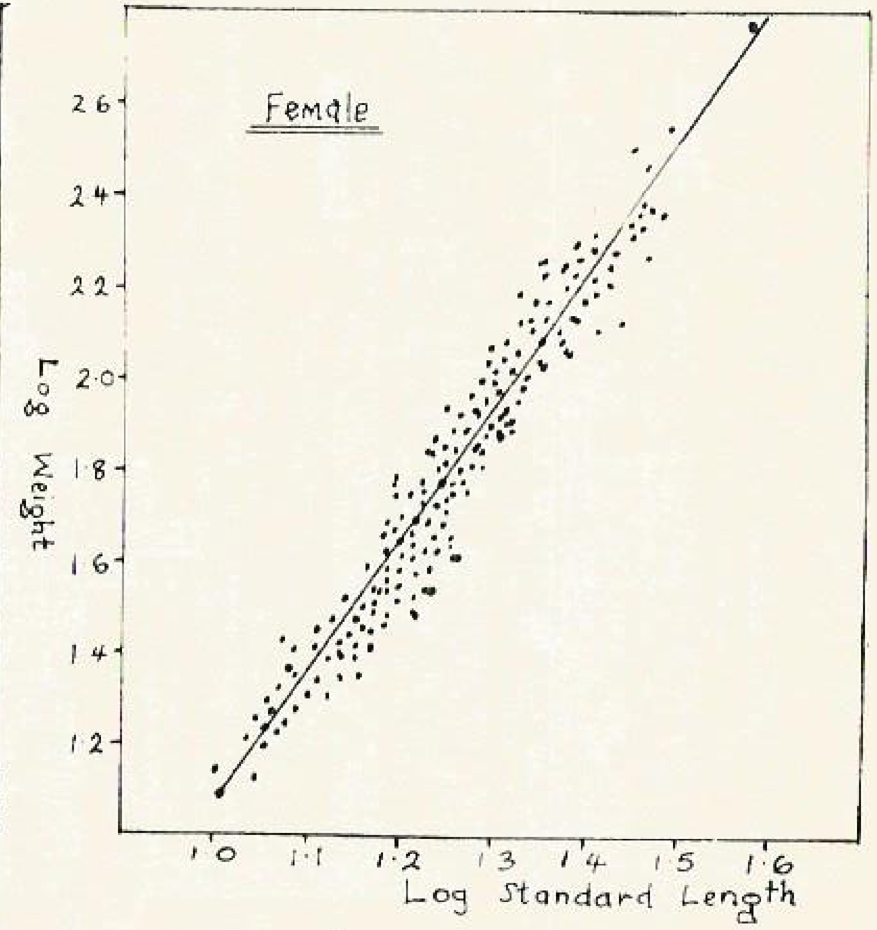

Figure-3 Length-Weight relationship (Log - Log) of Female _Clarias lazera_ in Zaria

25.5mm, 32.0mm, 57.0mm and 76.0mm mesh, and hooks Nos. 10, 11, 15 and 16 which were set overnight. These provided 5746 fish specimens ranging from (13-44cm TL.) between January and December, 1977 and from December, 1978 to March, 1979. Total lengths in cm were measured but the data was grouped in 5 cm length classes. Each gill net was hung on 50% slack. Each fresh fish specimen was eviscerated and the gonad was examined to determine its sex and stage of development.

Gonad Maturity Stages

For the pupose of this study, a simplified 4-stage gonad maturity key modified from Kesteven (1960) and Nikolsky (1963) as reproduced in 3rd Edition of IBP Handbook No.3, T. Bagenal (Editor) (1978); was used. The stages described as follows were found more useful in the field:

i) Immature: Young individuals which have never engaged in reproduction. Gonad generally of very small size and transparent and eggs not visible to naked eye. Difficult to distinguish the sexes from the gonads alone.

ii) Mature: Gonads thick, opaque and developed; in females ocytes clearly visible to naked eye; in males milt may be exuded when cut.

iii) Ripe and Ripe/Running: Ovaries swollen and full of mature eggs. Testes swollen, full of milt. When pressed eggs and milt do not extrude freely in Ripe; but will extrude on light pressure of the abdomen, in Ripe/running stages. (It may be convenient to separate "Ripe" from "Ripe/Running" stage and in which case the latter becomes state IV).

iv) Spent: Female gonads empty of large mature eggs but few residual smaller eggs may remain; in males, the testes are depleted of milt. In both sexes the gonad size is reduced from the larger size attained in stage III and may be flabby.

The spent gonad after recovering reverts to stage II.

RESULTS

Maturity

The sexes in *C. lazera* were distinguishable at a length of about 15cm. In *C. laze* sexual dimorphism exists; the sign of sexual differences appearing by the presence of an elongated genital papilla which is clearly seen from about 15cm length in the males.

The data on the lengths at various stages of gonad maturity are shown in Tables 1 and 2.

It is shown that the smallest mature females were 24cm (4.8) in length, while corresponding length for males was 20 cm (1.8%). From Table 2 and Figure 1, the length at 50% maturity for females and male *C. lazera* lies between 28 cm and 30 c 47.7% maturity in females is attained at 28 cm (202 gm) compared with 42.9% maturity in males. For the ripe/running gonad stages, 56.9% maturity in females was reached at 28 cm length compared with 48% maturity in males. The mean weight of male and female *C. lazera* at the lengths of 20 cm, 24 cm, and 28 cm to 30 cm are shown in Table 3. The females are slightly heavier than males of the same length.

Gill Nets Mesh Selectivity

Table 2 shows the length distribution of *C. lazera* from gill nets of four mesh sizes. The 25.5 mm mesh caught fishes with modal length of 15 cm, the 32 mm mes had a mode of 18 cm, while the 57 mm and 76 mm mesh nets had modes of 28 cm and 38 cm, respectively.

Table 4 shows the percentage length frequency distribution of *C. lazera* caught i gill nets of four mesh sizes, 25.5 mm, 32 mm, 57 mm and 76 mm. The modal reten lengths of the gill nets were 13 cm (25.5 mm mesh); 18 cm (32 mm mesh); 28 cm (57 mm mesh) and 38 cm (76 mm mesh).

Table 1 - Numbers of Clarias lazera from Lake Chad at various maturity stages in length classes (December 1978 to March, 1979)

Length Class in 2 cm	Immature	Females (N = 149)			Males (N = 119)		
		Maturing	Mature	Ripe and Running	Maturing	mature	Ripe and Running
10	-	-	-	-	-	-	-
12	2	-	-	-	-	-	-
14	6	1	-	-	-	-	-
16	-	-	-	-	1	-	-
18	-	1	-	-	-	-	-
20	-	3	-	-	4	1	-
22	-	3	-	-	1	-	1
24	-	2	3	-	2	3	-
26	-	4	11	5	3	6	3
28	-	-	16	14	2	14	0
30	-	3	18	14	-	14	10
32	-	1	10	11	-	11	7
34	-	-	2	5	-	3	6
36	-	-	-	4	-	1	9
38	-	-	1	4	-	1	1
40	-	-	1	2	-	-	1
42	-	-	1	-	-	2	1
44	-	-	-	-	-	-	1

Table - Percentage length frequency distribution of mature and ripe-running gonad stages of <u>Clarias lazera</u> from Lake Chad December, 1978 - March, 1979

Length Classes	Percentage Mature		Percentage Ogives Mature		Percentage Ripe/Running		Percentage Ogives Ripe/Running	
	Female	Male	Female	Male	Female	Male	Female	Male
10	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
20	-	1.8	-	1.8	1.7	-	1.7	-
22	-	-	-	1.8	-	2	1.7	2
24	4.8	5.4	4.8	7.2	-	-	1.7	2
26	17.5	10.7	22.3	17.9	8.3	6	10.0	8
28	25.4	25.0	47.7	42.9	23.3	20	33.6	28
30	8.6	25.0	76.3	67.9	23.3	20	56.9	48
32	5.9	19.6	92.2	87.5	18.3	14	75.2	62
34	3.2	5.2	95.4	92.9	8.3	12	83.5	74
36	-	1.8	95.4	94.7	6.7	18	90.2	92
38	1.6	1.8	97.0	96.5	6.7	2	96.9	94
40	1.6	-	98.6	96.5	3.3	2	100.7	96
42	1.6	3.6	100.2	100.1	-	2	-	98
44	-	-	-	-	-	2	-	100
Number Examined	63	56	63	56	60	50	60	50

Table 3 - Mean weights (gm) of males and females Clarias lazera at lengths of attaining maturity

TL	Females		Males	
	Mean Wt. (gm)	STD	Mean Wt. (gm)	STD
20	78.3 N = 3	± 19.7	62.8 N = 4	± 1.7
24	137.3 N = 8	± 19.3	92.2 N = 5	± 6.8
28	202.1 N + 17	± 22.8	204.1 N = 22	± 24.1
30	221.2 N = 18	± 32.8	219 N = 14	+ 21.8

Table 4 - Percentage length - frequency distribution of Clarias lazera caught by gill nets of various mesh sizes in Lake Chad

Length Classes (5cm)	Gill net mesh size			
	25.5mm	32.0mm	57.0mm	76.0mm
13	*33.33	25.16	-	-
18	22.46	*34.70	0.86	0.33
23	*31.52	29.28	11.76	2.98
28	9.42	7.22	64.15	6.62
33	2.17	1.14	22.37	42.38
38	1.09	1.32	0.76	46.03
43	-	0.16	0.11	1.66
Number Examined	276	608	1855	302

* Indicates modal frequency

Table 5 - Percentage length frequency distribution of Clarias lazera in hooks of different sizes used in Lake Chad

Length Classes	Hook No. 10	Hook No. 11	Hook No 15	Hook No. 16
13	0.31	-	0.11	10.76
18	4.01	4.70	9.02	33.18
23	15.43	18.18	27.28	*34.12
28	*33.33	26.96	*35.75	*34.12
33	30.86	*30.88	22.16	17.71
38	12.96	13.32	4.79	3.54
43	1.54	3.76	0.78	0.24
48	0.93	0.94	0.11	0.12
53	0.62	0.78	-	-
58	-	0.16	-	-
63	-	0.13	-	-

* Indicates modal frequency

The percentage numbers of immature fishes, under 28 cm length, caught by these meshsizes were as follows: - 25.5 mm (87.31%); 32.0 mm (89.14%); 57.0 mm (12.62%) and 76.0 mm (3.31%).

Selectivity of Fishing Hooks

Table 5 shows that the modal lengths of the Clarias lazera caught by hook No. 10 was 28 cm; hook No. 11 had 33 cm while hooks Nos. 15 and 16 each had lengths of 28 cm. However, the total percentage numbers of immature fishes of less than 28 cm length caught by various hooks were No. 10 (19.75%); No. 11 (22.88%); No. 15 (36.41%); and No 16 (43.99%).

DISCUSSION

The length at 50% maturity of males and females of C. lazera in Lake Chad during the period of the study was between 28 cm and 30 cm. The mean weights at length 28 cm and 30 cm were 202 gm and [illegible] gm respectively for females; and 204 gm and 219 gm for males respectively. The minimum size at first maturity was between 20 cm and 24 cm; but these fishes constituted only 2% to 5% of the mature population. There was no significant difference in the lengths at 50% maturity of females and males in this study. Welleher and Vincke (1975) observed in Central African Republic that ripe female Clarias varied in size from 26 cm to 65 cm with weights from 175 g to 1,[illegible] g.

To protect the Clarias fishery in Lake Chad it is recommended that Clarias lazera of less than [illegible] should not be caught to enable the fishes to reproduce themselves and attain [illegible] table size. Gill nets with meshes less than 57mm which catch C. lazera [illegible] than 28 cm are injurious to the fishery and mesh regulation prohibiting the use of gears with such meshes will benefit the Clarias fishery in Lake Chad.

With respect to selectivity for hooks, it is recommended to use Hooks Numbers 10 and 11 which catch fewer fishes of less than 28 cm while the use of Hook Number 16 should be discouraged.

In recent times, the use of conical Malian origin traps for catching fingerlings of Clarias lazera in large numbers during certain periods of the year has been observed at Baga on Lake Chad. The traps have a nylon mesh cover of 25.4 mm mesh which will retain up to 87.31% of immature C. lazera.

It is recommended that these traps should only be used in the season when fingerlings of C. lazera occur for catching them as stocking materials of fish ponds and irrigation canals. The regular use of the traps of 25.5 mm mesh for fishing in the Lake should be banned or strictly controlled. The traps meshes should be increased to 57 mm.

The appropriate authority to enact fishery managment regulation in the Nigerian sector of the Lake is the Borno State Government but the enforcement of this regulation will require international cooperation of the countries bordering Lake Chad.

It is, however, suggested that similar studies of mesh selection and size at maturity should be conducted for the other major economically important fishes of the Lake before a comprehensive management procedure of mesh regulation can be recommended. This is because the gill nets recommended for Clarias will catch other fishes as well as C. lazera. A compromise regulation may then be made to favour the most abundant economic species while not altogether depleting the others. In addition, a knowledge of habitat preferences of the various fishes will enable different meshes to be prescribed for different habitats in the Lake Chad.

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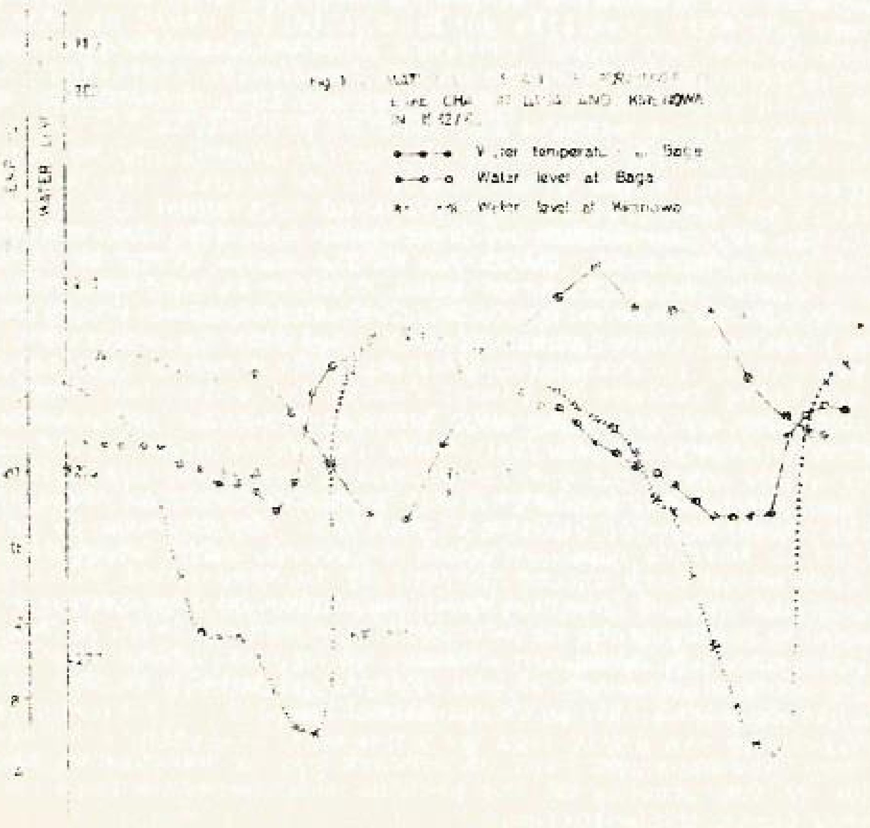

TRACE METALS - A POTENTIAL THREAT TO OUR FISHING INDUSTRY

by

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ABSTRACT

Trace metals constitute a major form of water pollutant that can adversely affect fish production. Studies have shown that trace quantities of metal pollutants disrupt metabolic processes, reproduction, development and growth of aquatic animals including fish. The potentially toxic metals have been identified as lead, zinc, copper, arsenic, antimony, mercury beryllium, bariu, cadmium, chromium, nickel, selenium among others.

With the proliferation of chemically-based industries and the collosal increase in automobiles in Nigeria, the rate of metal pollution in our rivers is expected to affect fish production within a very short time. Other sources of metal pollution include mining, tanneries and domestic wastes.

Among the areas of fisheries and hydrobiology in which relatively little work has been done is on the concentrations and the effects of the toxic metals in our waters.

Preliminary studies in our laboratory have been directed to the determination of traces of lead in the aquatic biota and its toxicity. There are indications that the levels reported in effluents from some of our industries may be above the tolerant limits of local fish species and organisms that make up their food.

Although there is not yet enough evidence that metal pollution has posed a serious problem in relation to our freshwater fisheries, it could become so in future as a result of increasing urbanization and industrialization, unless efforts are made to prevent it.

INTRODUCTION

In Nigeria today, the importance of protein is becoming greater as our meat production declines. Although only a small fraction of the fish consumed by the nation is from local sources at present, effort are being made towards increasing local fish industries. Among the many factors that may negate this effort is pollution. While the demand for protein is increasing enormously with growing population, our rivers are being reduced to sewage depots for poisonous chemicals which kill our fish and other aquatic forms. One major pollutant in our freshwater is heavy metals.

It is more than fourteen years since researchers announced that some Canadian fish contained up to 10ppm of mercury. Subsequent investigations in America also revealed abnormally high leves of mercury in fish which were traced ultimately to industrial sources. This discovery has turned international attention on the numerous other potentially toxic trace metals such as arsenic, lead, zinc, copper, cadmium etc. However, in Nigeria as in most other developing countries the state-of-the-art of the effects of metals in the environment has received little or no attention.

The reason for this apparent lack of concern may be because we have yet no notion of the gravity of the problem and therefore have no cause to worry about the solution.

Today, however, we are faced with rapid growth in population, urbanization, the oil boom and the subsequent expansion of industries, all of which contribute to the increase in environmental pollution. Besides the natural sources of these metals, other major sources of toxic metals in our water systems resulting from technological advancement are domestic, municipal, industrial wastes and trace metals contained in organic wastes from pulp and paper industries.

Only a few studies have so far been carried out in this country on the levels and impact of heavy metals on the aquatic ecosystem. Among these are the study by Akueshi (1980) which indicated the presence of lead, mercury and zinc among others in effluents being discharged into River Dilimi (Jos) from local mines. A number of studies by Beetseh (1982) indicated presence of abnormally high levels of lead, mercury, zinc and cadmium in effluents discharged from a number of industries in Kaduna.

This paper therefore highlights the risk inherent in permitting indiscriminate dumping of wastes containing heavy metals into our water systems.

SOURCES OF TRACE METALS IN OUR WATER

The major sources of trace metals pollution in our freshwaters are mining, sewage and wastes from food processing plants, particularly from sugar refinery, pulp and paper mills, textile factories, automobile industries and tanneries. Efflents from all these industries have been known to contain one form or another of trace heavy metals.

(i) Mining

Most trace metals exist in the earthscrust where they may be harmless until released by human interference. Human activities, particularly mining, have increased the availability of trace metals in the aquatic ecosystem. The smelting, and refining of tin in Jos mines in particular have resulted in higher concentration of lead, mercury and zinc in River Dilimi into which effluents from the mines are discharged (Akueshi, 1980).

(ii) Industrial and Domestic Wastes

In most of our industrial towns, municipal effluents are discharged untreated into drains which subsequently empty into rivers. Only a few of our industries have any form of treatment or drain their effluents underground. Some of these industries use one form or another of heavy metals which ultimately find their way into our streams and lakes. Table 1 shows levels of heavy trace metals in discharges from some industries located in Kaduna. Besides the trace metal contents of effluents from automobile industries, tetraethyl lead is used as an anti-knock in gasoline.

On combustion, smoke containing lead particles is emitted into the atmosphere. When it rains, these particles are washed either directly into the water system or on the soil from where it leaches into the rivers and streams. Table 2 shows concentrations of lead in the water, sediment and biota of ponds located near the Zaria-Kaduna bypass which carries a heavy traffic.

One other major source of trace metals in our water systems are the tanneries. A number of our tanneries still use sodium arsenate to protect leathers against attack of insects and microbes, inspite of its having been banned in developed countries due to its carcinogenicity. Typical concentrations of arsenic and other trace metals in a number of tanneries in Kano State are presented in Table 3.

TOXICITY OF METALS TO FISH

Many metals which are essential to fish health (Cu, Zn, Mn, Cr etc) in minute concentrations, are highly toxic to fish and other aquatic organisms when present in excess, even if at low concentrations. This is due to the fact that even when their levels in the water are low, heavy metals are known to be concentrated along the food chain. The capacity of some components of the food chain to accumulate metals is so high that levels of the metals in them may be a thousand times as high as that in the water. For instance, Day (1965) reported that some species of freshwater algae growing in mine effluents contained 6,600 ppm Pb, 2,900 ppm Zn and 920 ppm Cu on a dry weight basis. In passing through the food chain, otherwise harmless concentrations may accumulate to levels injurious to fish.

Here in Nigeria, very little has been done to estimate the hazard of trace heavy metals on aquatic life. However, toxicity of heavy metals to temperate fishes is well documented. This paper will therefore highlight the available information which can be useful to us in deciding what levels of heavy metals can be tolerated in our waters without wiping out our valuable aquatic population. In the absence of data on the water quality criteria for African or similar freshwater species, information available for temperate species will be used as a guideline. Examples of the toxic levels of some metals are presented in Table 4.

A quick glance at this table which shows the acute toxicity concentrations, and comparison with the metal contents of the effluents from some of our factories (Table 1, 2 and 3) indicate there may be no cause for alarm as yet if the receiving streams provide large amount of dilution. However, 'safe levels' of metals based on acute assays alone may be misleading as concentrations so low as not to kill an organism within a short period may still depress its reproduction and growth indirectly. This is illustrated by effect of lead on fish cited by Fromm (1965).

When in high concentrations, lead ions combine with mucus which covers the gills resulting interference with respiration and causing immediate death by suffocation. Dawson (1935) however showed that fish exposed for a prolonged period of low concentrations of lead were affected internally, causing some changes in the blood, liver and spleen.

Effects of heavy metals on a number of other life processes of other fish species have also been demonstrated. Lloyd (1960) reported a cytological breakdown in the gill epithelium of trout exposed to 3mg/l zinc for 48 hour. Unspecified, but lower concentrations of lead and copper salts were also reported to have affected the gill lamellae in trout.

Crandall and Goodnight (1962, 1963) observed that new born guppies exposed to tapwater containing 1.15mg/l zinc grew less rapidly than the controls raised in zinc-free water. After 90 days only one male of the 79 test fish had a well-developed reproductive organ compared to 30-40% of the male of the 54 control fish.

Subsequent observations made by Sangalang and O'Halloran (1972) on brook trout threw some light on Crandall and Goodnight's result. Brook trouts which had been exposed to 25 ppb of cadmium, showed marked damage to testicular tissues and as such had lower reproductive capacity.

The concentrations of trace metals in effluents from our industries and water systems (Table 1, 2 and 3) may therefore pose a threat to our fishing industry, particularly if the dilution is low. Moreover, observations indicated that some of these industries discharge into streams which are reduced to small separate stagnant ponds particularly during the dry season. At these times very little dilution of the effluents take place. Besides, metal concentrations in aquatic organisms are typically several orders of magnitide higher than the concentrations of the same metal in water as metals become progressively concentrated at higher trophic levels in aquatic food chain. This magnification may result in elevated metal concentrations in edible fish. The observations made above on the concentrations of metals in effluents discharged from some of our industries into the water systems (Table 1, 2 and 3) indicate that the levels of most of these metals may still be sublethal. However, the observations made above on guppies and trouts are of significant application here as the studies show what may happen to fishery in a water system receiving insufficiently treated metal wastes. Even if it does not result in an immediate fish kill, the population may decline to such an unproductive level that several vital organs are gradually destroyed jeopardizing the survival of that species in the environment. Failure to achieve sexual maturity, for instance, would mean a low recruitment to the population.

CONCLUSION AND RECOMMENDATIONS

(a) While it is recognized that the level and diversity of industrial pollution in Nigeria is very much below those of developed countries, it is high time we did more of the identification of the metal pollutants in our streams and ponds while the situation is still under control.

(b) In view of the ever-increasing importance of fish as a source of protein, as our meat production declines, it is time to make an estimate of the hazards posed by these metals to aquatic organisms in general and fish in particular. The objective of this 'hazard assessment' will be to provide information from which we can make a valid judgement regarding the safety of these metals to fisheries.

(c) Unless hazard assessments are made and a swift move made by the various state governments, better still by the National Assembly, to legislate permissible levels of heavy metals in effluents from our industries and the receiving bodies of water, most of our fish species may be in danger of extinction.

Table 1 Trace Metal Contents[a] of Discharges from some Industries in Kaduna State.

Parameters	Textiles				Oil Depot	Automobile Industry
	A	B	C	D		
Temp. °C	31.30	33.08	31.07	35.74	-	26.52
pH	9.93	9.88	11.16	11.32	-	7.29
Chromium mg/l	0.68	0.51	0.75	0.49	-	1.20
Zinc	0.48	0.45	0.57	0.49	0.15	5.08
Lead	0.78	0.67	0.79	0.46	0.30	7.97
Copper	0.80	0.80	0.98	0.38	0.14	0.10

Table 2 Automobile-related Lead content[b] of ponds along Zaria-Kaduna (by-pass) Highway.

Water (ug/l)	Sediment (ug/g)	Aquatic Plants (ug/g)	Fish (ug/g)
2.4-7.8	2.87-4.33	0.58-1.20	0.15-0.40

Sources a Beetseh 1982
b Abba, H. 1983 Determination of lead was carried out by Atomic Absorption spectrophotometry.

Table 3 Trace metal contents of effluents from some Tanneries in Kano and Sokoto State

Parameters Measured	Tanneries A	B	C	D	E	F
pH	8.56	.8.55	11.50	8.45	8.25	8.20
Alkalinity mg/dm³	1,090	2,400	3,400	1,600	3,000	5,400
Hardnes ($CaCo_3$)	360	1,600	300	640	1,940	400
Zn (ppm)	4.46	0.85	1.55	4.12	0.44	3.41
Cr (ppm)	36.63	27.00	80.00	13.50	11.30	0.13
As (ppm)	1.31	ND	ND	ND	ND	ND
Cu (ppm)	0.20	0.18	0.10	0.25	0.20	0.13

ND = Not determined

*Source : F.A. Lawal (1979)

Table 4 Toxicity of heavy metals in freshwater

Metal	Lethal Concentration (mg/litre)	Organism
Cu	0.01-0.02	'Fish'
Cu (as $CuSO_4$)	0.14	Trout
(as $CuSO_4$)	0.75	Perch
(")	2.1	Black bass
(")	0.1	Blue-green algae
Zn	0.15-0.7	'Fish'
Be	0.2-(TL_m 96 in soft water)	Fathead minnows
Cr (as $NaCrO_4$)	0.1	Water Fleas
(as $NaCrO_4$)	20.0	'Fish'
Pb	0.01-10.0	Water Fleas
Pb	3.3-10.0	Tadpoles
Pb (as $PbCl_2$)	3.0-60	Green algae
Pb	2.4 (TL_m 96 in soft water)	Fathead minnows
Pb	75 (TL_m 96 in hard water)	Fathead minnows
Pb (as Pb $(NO_3)_2$	2.40 (TL_m 96 in soft water)	*Tilapia niloticus*
"	3.35 (TL_m 48 in soft water)	
PB (as Pb $(NO_3)_2$	1.80 (TL_m 96 in soft water)	*Clarias lazera*
"	2.70 (TL_m 48 in soft water)	

* Upper set of values from Down and Stocks (1977)

* Lower set of values from Offem and Oladimeji (1983)

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SECTION 6: APPENDICES

The 3rd Annual Conference of the Fisheries Society of Nigeria was held in Maiduguri, Borno State from 22nd - 25th February, 1983.

Over 200 delegates from the Federal Fisheries Agencies, Research Institutes, State Government Fisheries, Universities, Private Fishing Companies and from Overseas attended and deliberated on the theme of the Conference title "NIGERIAN FISHERIES IN THE '80s".

The following communique was issued at the end of the Conference:-

1. The major challenges of the Fisheries sub-sector in Nigeria which are:-

(a) Insufficiency of local fish production

(b) Acute manpower shortage

(c) Lack of adequate data base for planning purposes,

were exhaustively deliberated upon. In order to meet these challenges, the Conference emphasized the need for proper co-ordination of all Fisheries Development, Research and Training activities involving Federal and State Fisheries Development Agencies, Research Institutes and the Universities.

2. To promote rational Fisheries Development, Planning and Research, the setting up of a Fisheries Data Bank was strongly recommended. In this connection, emphasis was laid on the need to give appropriate training and motivation for data collection, monitoring and evaluation.

3. Faced with increasing foreign exchange expenses on Fish Importation, Fish Production and Preservation impacts, the Conference strongly recommended the commissioning of fishing terminals under Terminal Management Company. Furthermore, the establishment of Fishery based industries such as Fishing Vessel Boat yards, Net Manufacturing and Outboard Engine factories was highly recommended.

4. The Conference stressed the need for the vigorous pursuit of resources survey in the Exclusive Economic Zone (EEZ) in order to promote rapid development of industrial fisheries.

5. Recognising the immense contribution of the Artisanal Fisheries Sector to the overall domestic Fisheries production, the Conference recommends the modernization and mechanization of the sector by the introduction of improved and diversified modern Fishing Craft, Gear and Methods.

6. Considering the potential of inland fisheries resources (including aquaculture) the Conference emphasized the need for rapid turn out of trained manpower in aquaculture at all levels from relevant institutions; as well as detailed inventory and hydrobiological study of all bodies of inland waters both natural and manmade.

7. The Conference noted the widening gap between domestic fish production/demand and viewed with serious concern the huge loss of fish due to spoilage. It therefore, strongly recommends necessary measures be taken urgently to reduce post-harvest loses.

8. To ensure effective co-ordination of all research and development activities in fisheries, the Conference strongly recommended institutional reform and re-organisation to enable all existing Federal Fisheries Agencies to be under the same supervisory Ministry preferably under an exclusive Ministry of Fisheries.

9. In conclusion, the Conference recommended the updating of the previous scientific works on the Fisheries of Nigeria including further surveys of the pelagic and mesopelagic fisheries resources particularly along the continental slope and the EEZ; and the establishment of a Fisheries Journal.

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REPORT OF THE PRESIDENT OF THE FISHERIES SOCIETY OF NIGERIA (FISON), MR. B.F. DADA TO THE THIRD GENERAL MEETING HELD IN THE LAKE CHAD RESEARCH INSTITUTE, MAIDUGURI ON THURSDAY, 24TH FEBRUARY, 1983

1) Council and Meetings

The present Council was elected at the Second General meeting held in Calabar on 26th January, 1982. The Council started work soon after the election. The first meeting was held in Calabar before members dispersed after the annual conference. Three other meetings were held in Lagos, Sokoto and Maiduguri respectively.

2) Sustaining Momentum

My Council worked hard to see that the Fisheries Society of Nigeria did not return to the dormant condition in which it found itself during the period 1976 - 1981. Major developments during the year were quickly communicated by the Secretariat to members.

3) Third Annual Conference

During the last General meeting and following the acceptance of the Director of the Lake Chad Research Institute, it was decided that the Third Annual Conference would be held in Maiduguri in January 1983. A Local Organizing Committee (LOC) was set up early to plan for the Conference. As you can see, the LOC has performed its duties well. The Conference, however, had to be shifted from January to the end of February to avoid inconveniences to participants landing in Maiduguri airport during the hamattan.

4) Publication of Proceedings

The proceedings of the 2nd Annual Conference held in Calabar is being printed by the Kainji Lake Research Institute (KLRI) Press. The work is now in an advanced stage and it is believed that copies will come out in about two months time. This publication is being sponsored by the Federal Department of Fisheries (through the help of the Director) that has already paid the sum of ₦5,000 to the KLRI. I should mention that the quotation from the Institute for the printing and publication of the Proceedings was ₦7,910.00. The KLRI has decided to forge the balance as its sum contributed (or subsidy) for this first publication.

5) Decisions of Council Requiring Ratification by the General Meeting

During its meeting in Sokoto in August 1982, the Council decided that membership fees should be increased on the following grounds:-

(a) The Society is young and is faced with financial difficulties;

(b) Subventions are not being received from State governments;

(c) The cost of running annual conferences is high;

(d) The cost of publications (Proceedings, Journals, etc) are high.

(e) Other societies e.g. Agricultural Society of Nigeria, Science Association of Nigeria, etc) have increased their membership fees considerably to be in tune with the present trends in the country's economy.

The increases which the General meeting is called upon to ratify are as follows and should take effect from 1st January, 1983:-

- Ordinary Membership fees from ₦5.00 to ₦15.00
- Corporate Membership " " ₦20.00 to ₦50.00
- Student Membership " " ₦2.00 to ₦5.00
- Associate Membership " " ₦3.00 to ₦10.00

5.1.) Council also request the General meeting to approve that the Chairman and Secretary of the LOC become coopted members of the FISON Executive Council for the particular year during which such Committee is preparing to host the Annual Conference.

6) Financial Matters

6.1.) Detailed Statement of Account relating to the 2nd Annual Conference held in Calabar in January 1982 was presented by the Secretary (who was the Chairman of the LOC) to the FISON Executive Council meeting in Sokoto. The request showed that a total of ₦8,997.00 was received (₦4,000.00 from FISON Secretariat, Lagos and ₦4,997.00 from Local collection), while expenditure was ₦8,767.00. The report was accepted by Council.

6.2.) It was reported during the last meeting that the Account of Society in the Falomo Branch of the First Bank, Lagos could not be operated because the former Treasurer (Mr. Fadayomi) could not obtain the cheque book. For that reason, Mr. Fadayomi had to advance his own money for the activities of the Society. I am happy to announce that following the election of a new Treasurer, the signatories have been changed. A cheque book is now available and Council directs that the ₦5,000.00 advanced by Mr. Fadayomi be refunded to him.

6.3.) The Lake Chad Research Institute donated the sum of ₦5,000.00 towards the holding of the 3rd Annual Conference. The FISON Treasury sent ₦3,500.00. The detailed accounts of receipts and expenditure is expected from the LOC.

7) Aknowledgements

Finally, I wish to thank members of the Executive Council and indeed all members of FISON for their cooperation throughout the year.

Thank you.

B.F. Dada
President
FISHERIES SOCIETY OF NIGERIA (FISON)

THIRD ANNUAL CONFERENCE OF THE FISHERIES SOCIETY OF NIGERIA - 22ND to 25TH FEBRUARY, 1983

SUMMARY OF RECOMMENDATIONS

Noting that the gap between domestic fish production and demand has continued to widen in Nigeria necessitating increased fish importation with attendant foreign exchange drain,

Realising the need to narrow this gap by increased fish production and reduction of post-harvest losses,

Further realising the country's objectives to become self-sufficient in fish production within the shortest possible time (Noting this objective cannot be achieved without proper co-ordination of Research development and Fisheries man-power training activities in the Country):

The Conference recommends:

I. FISHERIES PLANNING

1) The establishment of a separate Ministry of Fisheries as a major institutional reform aimed at bringing the different bodies dealing with fisheries under one umbrella for better coordination.

2) The establishment of a joint working group comprising of the concerned personnel from the fishery institutions in the Country - both research and development to continuously monitor and collate the data collected and transmitted to the agency compiling the data.

3) The setting up of a Data Bank for Fisheries. The arrangement being made by the Federal Government to have the facilities established along with the National Data Bank for Aquaculture was welcomed.

4) Data Collectors should be given appropriate training and necessary motivation. The need for proper monitoring on the part of supervisory staff was stressed.

III. INDUSTRIAL MARINE FISHERIES

The early commissioning of Fishing Harbours and incorporation of a Fisheries Terminal Management Company and the setting up of a Fishing Vessel Development Fund.

2) The expansion of the industrial fishing fleet and stressed that this expansion should have relevance to the available resources and should take into account the results of the on-going Surveys in the EEZ.

3) The early commisioning of the patrol vessel for survillance and inspection of the Nigerian Waters and effective implementation of this programme with the support of the Nigeria Navy and the Marine Police and other concerned Agencies.

4) The Industrial Fishing Fleet which are being manned by expatriate officers be replaced by Nigeria personnel, taking full advantage of the present situation created by the exit of the alien crew from Nigeria.

In this connection, the need for accelerated programme for training of Fishing Vessel Officers and the desirability of permitting expatriate Skippers and Engineers to be hired only for limited periods within which time necessary Nigerian staff will be trained was stressed.

5) That the indiscriminate destruction of juvenile fishes particularly croakers by inshore fishing vessels operating shrimp trawl gear should be stopped, and the existing regulations relating to the fishing and licensing be strickly enforced.

III. ARTISANAL MARINE FISHERIES

The rational development and management of artisanal fisheries in Nigeria and commended the several efforts of the governments to develop this important sector with assistance from the F.A.O.

2) The need for modernising and mechanising artisanal fishing and diversifying fishing efforts.

3) Recommends the need for diversification of fishing methods by the inshore fishing vessel being introduced in the Country.

4) That the trials which have been conducted by NIOMR with shallow drought fishing vessels be followed-up with a view to introducing suitable vessels of this type for commercial fishing.

IV. INLAND FISHERIES AND AQUACULTURE

1) Recommends that in view of the importance of developing inland fisheries to increase fish production in the country, pilot fish farms should be established on commercial basis to prove conclusively that fish farming can be successfully practiced in the Country.

2) The need for rapid development of trained manpower in aquaculture at all levels utilizing fully the facilities established in the Country, particularly at the African Aquaculture Research Centre (ARAC).

3) The importance of intensive fish seed multiplication programmes for successful aquaculture and also the need to develop proper fish feeds.

4) The need for detailed hydro-biological studies of the new reservoirs and other water spreads to determine their suitability for development of fisheries.

V. FISH PROCESSING AND MARKETING

1) The urgent need to prevent post-harvest losses which if successfully addressed will help to increase the fish supply from domestic sources indirectly.

2) The importance of proper handling, storage, processing and rational utilization and welcomed the steps being taken to establish necessary infrastructure facilities like cold storages etc.

3) That Fish Technology should be emphasised in the curriculum of Post-Secondary institutions and that regular workshops in the different areas of fish technology should be conducted for extension workers.

4) The following fiscal measures to ensure better preservation of fish in Nigeria:-

(a) Removal of Customs and Exercise duties on Fish Processing equipment

(b) Granting of appropriate subsidy on fuel used for all post harvest technological processes.

(c) Award of soft loans for industries involved in processing of fish and for fishing companies which wish to establish fish collection storage and marketing.

(d) Provision of technical advice and assistance to local governments (by FDF and State Governments) for the establishment of mini-fish processing plants and fish markets and extension of the benefits of appropriate subsidy for agencies setting up NIOMR Kiln or any other suitable smoking kilns.

5) The active involvement of existing food processing and marketing establishments in the country in the industrial processing of fish as food.

VI. THE ROLE OF RESEARCH AND RESEARCH INSTITUTES IN FISHERIES DEVELOPMENT IN THE 1980's

1) The need for greater collaboration between National Research Institutes and the Universities in the joint utilization of Research facilities.

2) The need to intensify fisheries biological and technological research in the country which has direct bearing on increased fish production and preservation.

3) The release of relevant information on the on-going fishery resources survey in EEZ, particularly on the Tuna Fishery Resources.

4) Further surveys on other possible pelagic and meso-pelagic fishery resources, particularly along the continental slope.

5) The updating of the Atlas of Nigerian fisheries.

6) The establishment of a National Jounal of Fisheries.

[illegible], the Symposium emphasised the need for a Jounal of [illegible] Fishery Society of Nigeria.

RAPPORT'S REPORT ON:

1. Keynote Address by Mr. E.O. Bayagbona

2. Paper on:- Preliminary Observation on the Feeding Habits and Reproduction Biology of Gymnarchus niloticus from Lake Chad.

Topic:

MILESTONE AND SELF-RELIANCE IN THE DEVELOPMENT OF NIGERIAN FISHERIES

The Conference appreciated the extent of the Keynote Address and further noted the following:-

1. With reference to the author's comments on the problems now facing the National Shrimps Company, the Conference identified the initial faults in its establishment as the insistence of the Ministry of Industry to go ahead with the formation of the Company contrary to professional technical advice. The following recommendations were therefore, made:-

(i) That the Federal Ministry of Agriculture should be the supervisory Ministry for the Company.

(ii) That care should be taken in the selection of technical partners in future establishment of Companies.

(iii) Adequate managerial and supervisory provision should be ensured before establishing Government-sponsored Companies.

2. The need to control gear sizes and measurements as a means of controlling further depletion of our resources but noted that further research in these areas was necessary because of the multi-species nature of our fisheries resources.

3. As an intervention to the Keynote Address, it was noted that foreign participation in fish importation should be controlled so as to allow more local participation. It was recommended that the Government should encourage more local participation by tying fish importation to oil sale.

4. That the Government should encourage the usage of our petroleum bye-product for the establishement of petro-chemical industry to cater for the establishment of more fishing gear equipment in order to make them cheaper and readily available.

5. That relevant research institutions should be consulted before dams and reservoirs are constructed for effective integration of fisheries into these projects and should (the institutes) be encourage to continue the already started research into these new areas of fish culture.

6. That attendance at relevant national and international Conferences and seminars, workshops etc., should be encouraged as a means for further exposure to current developments and modern technological innovations in the fishing industry.

FISHERIES SOCIETY OF NIGERIA (FISON)

MINUTES OF THE GENERAL MEETING OF THE FISHERIES SOCIETY OF NIGERIA (FISON) HELD ON 26TH JANUARY, 1982

OPENING

The meeting opened at 12.50 p.m. with Mr. B.F. Dada (the former Secretary of FISON) presiding.

2 AGENDA

The following agenda was adopted:

(1) Introductory remarks by the President/Secretary of FISON Council.

(2) Report of the Conference Planning Committee.

(3) Report of the Activities of FISON 1976 - 1981 by the Secretary.

(4) Election of Officers.

3. INTRODUCTORY REMARKS BY THE CHARMAN OF THE MEETING

The Chairman expressed delight in seeing FISON revived. He said that it would be better not to try to apportion blame for the apparent dormancy of the Society during the past six years, but to deliberate on how the Society can be kept alive now that it has been revived.

4. REPORT OF THE CONFERENCE PLANNING COMMITTEE

The report was made by Messrs Sagua and Moses.

At its session in Owerri in September 1981, the National Fisheries Development Committee (NFDC), concerned about the fate of FISON, set up a five-man Committee to plan an annual conference of the Society to be held in January 1982. The members of this Committee were:-

Professor O.O. Ladipo

Mr. V.O. Sagua

Mr. E.E. Ojo

Mr. B.S. Moses - (Secretary)

Mr. V.O. Adebolu.

The Committee held its first meeting on 15th October, 1981 at the Federal Department of Fisheries during which it elected Mr. V.O. Sagua as its Chairman. At this meeting the Committee decided:-

(a) That the 2nd Annual Conference of the Society should be held in Calabar.

(b) That a Local Organizing Committee be set up at Calabar to plan the conference.

(c) That in this regard the approval of the Permanent Secretary, Ministry of Natural Resources, Cross River State should be sought.

(d) That Dr. W.Q-B. West of F.A.O., Accra and Professor A.M.A. Imevbore of the University of Ife should be invited to give keynote addresses.

The Committee also drew up the outline of the programme for the Conference

Following this meeting the L.O.C was set up at Calabar with Mr. B.S. Moses as the Chairman and this local committee immediately set to work to publicise the Conference to raise some funds locally by appealing to companies for donations and advertisements in the programme booklet and individual membership registration.

The second meeting was held at Lagos on 7th December, 1981 during which the Chairman of LOC briefed the Committee on the type of arrangements being made at Calabar and the facilities available; specifically the LOC sought approval from the Committee to buy pre-arranged air ticket and arrange accommodation for Dr. West and to hire a conference hall since it was not possible to get such accomodation free. The two requests were approved.

The third meeting of the Conference Planning Committee took place in Calabar on 24th January, 1982 and considered mainly the arrangement of the conference papers and problems connected with the opening ceremony and field trip.

The financing of the Conference was effected through:

(a) The sum of ₦4,000.00 given to the LOC by the Old Secretariat.

(b) Locally raised funds.

Full account was to be submitted to the New FISON Council.

5. FINANCES OF THE SOCIETY

Mr. Dada reported that as at October 1981, the account of the Society in the First Bank, Falomo Branch, Ikoyi, stood at ₦3,600.00. Later the Federal Government paid in a subvention of ₦2,940.00 bringing the total to ₦6,540.00. However, the Society should not consider this as their balance because the money given to the LOC came from Mr. Fadayomi's (Treasurer) personal account. The Society would therefore, be having much less than ₦2,540.00 to its credit.

6. COMMENTS FROM MEMBERS

(i) Dr. Fagade (University of Ibadan) expressed appreciation for the work of the LOC; stressed the need to have the Conference annually preferably in January.

(ii) Professor C. Ejike (University of Jos) thanked both the Conference Planning Committee and the LOC for making the Conference a success. He suggested that the new executive should be so selected as to reflect the Federal character of the Society.

(iii) Mrs. Onabanjo (Federal Department of Fisheries) regretted the thin representation of private companies at the Conference and urged the Society to find ways of inducing them to come.

(iv) Mr. Odiong (Fisheries, Cross River State) stressed the necessity of electing the right people (who are able to keep the Society going) into the Executive Council.

(v) Dr. Olatunde (Ahmadu Bello University, Zaria) stressed the importance for regular communication of what is going on by the Secretariat to the members. To this end he suggested the publication of Newsletters at regular intervals, the formation of regional chapters of the Society and the publication of a fisheries journal.

(vi) Mr. Bakare (Lagos State Fish Board) suggested the opening of a permanent Secretariat of FISON in Lagos (Federal Department of Fisheries).

(vii) Mr. Adesanya (Ogun State Fisheries) stated that FISON should contact Mr. A.D. Onyia, the former Editor and ask him to return the papers presented at the innaugural Conference of the Society to the new Editorial Committee for publication.

7. DECISIONS TAKEN

After further deliberations, the meeting decided that:-

(1) The Conference of FISON shall be held in January of every year.

(2) The Secretariat should be where the Secretary is. But that there was no harm in getting a permanet office in Lagos as a point of reference; that the Director, Federal Department of Fisheries (FDF) should allocate a room in his Department for this purpose.

(3) Effort should be directed towards strengthening the Society as it is at present before considering the formation of regional chapters (which was regarded as a good idea).

(4) The publication of a journal was already in the consttitution; the first issue of such a journal should be published soon.

8. TIME AND PLACE OF CONFERENCE

The Third Annual Conference of FISON was tentatively fixed for the last week of January 1983 in Maiduguri. Mr. Sagua was to confirm this later.

9. ELECTION OF NEW OFFICERS

After electing returning officers (Professor O.O. Ladipo and Dr. Q-B. West), the old executive stood dissolved and an election by secret ballot took place.

The following were elected into the new Executive.

President	- Mr. B.F. Dada
Vice-President	- Mr. V.O. Sagua
Secretary	- Mr. B.S. Moses
Assistant Secretary	- Mr. A.A. Olaniawo
Treasurer	- Mr. Bakare
Editor	- Mr. E.O. Ita
Publicity Officer	- Mr. V.O. Adebolu
Ex-Officio Members	- Mr. Z.A Adesanya
	[illegible] Ijike.

10. POST ELECTION SPEECH

After the election, the new President, Mr. B.F. Dada in his short post-election speech, thanked the Society for electing the new Council and urged the new Council to work hard and translate our deliberations and dreams to reality. He foresaw the need for and possibility of the Council calling on other members of the Society for help from time to time.

11. CLOSING

The meeting rose at 3.00 p.m.

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