MARINE FISHERIES RESOURCES

PROJECT TITLE:

IDENTIFICATION OF FISH SPECIES IN THE TRAWL SURVEY OF THE GULF OF GUINEA


INTRODUCTION:

A fisheries survey planning workshop was held in Accra Ghana from 6th to 10th November 1995 to decide the trawl survey systems to be executed by scientists from the United States of America, Ivory Coast, Ghana, Togo, Benin, Nigeria and Cameroun. The Workshop was the result of a recommendation from the first meeting of the GEF/LME Working Group held in Abidjan from 14th to 16th August 1995.

The Workshop deliberated on many issues. Activities were funded by the GEF and supported by the NOAA as part of GEF's large marine Ecosystem Project for Gulf of Guinea. A review of all Trawl Surveys earlier conducted in the Gulf of Guinea (GOG) revealed that only the Guinea Trawling Survey (GTS) executed in the early sixties covered the entire region. In connection with this observation it was decided that another survey covering the entire region is very high priority and that the GTS data should be retrieved. Staffing of the first survey, survey timing the possible use of a second Research Vessel, Sarkin Baka for the Productivity Module were also discussed.

The workshop agreed that the trawl survey should be conducted in two phases, a west sector covering the waters of Cote d’Ivoire to Togo and an east sector covering Benin to Cameroun. There shall be three surveys each year to correspond with the seasonal periods of hydrographic regions namely the major and minor upwelling and the warm season. Each of the surveys shall last 28 days, and random procedure is to be employed in the selection of trawl sites, stratified by depth, substrate type and geographical area.

The success of the project will ensure more food for the growing population in the sub-region and preserve the diverse species of the region’s biological resources. Also, the alarming loss of biodiversity resulting from overfishing and other environmental pressure shall be prevented.

OBJECTIVES:

i. The project set out to determine the stocks in the Gulf of Guinea;

ii. Determine the structure of fish assemblages;

iii. Describe the spatial and temporal changes in the fish stocks by examining variability and trends attributed to environmental conditions, changes in
fishing technology and socio-economics; and;
iv. To predict the future status of fish stocks both in the short and long run.

MATERIAL AND METHODS:
Samples of fish caught during the trawl survey were stored in the coldroom. Length frequency measurement and weight were recorded and later analysed. Also food and feeding habits were studied using numerical method.

RESULTS:
The table shows the families and species of fish caught from different countries and their length ranges. Analysis of the data indicated that 47 different species, the highest number were recorded on the Nigerian coast during the survey. The least number of species - 7 was observed in Republic of Benin waters. Others were 44, 35, 34 and 33, 7 in Cote D’Ivoire, Cameroun, Ghana and Togo respectively. Bigeye (Brachydeuterus auritus) was the only species that occurred in the entire Gulf of Guinea. Analysis of the results also showed that carangid (Caranx bicolor) was observed in Ghana while spard (Pagellus bogaraves), Rypticus saponaceus, Umbrina canariesis, Pomadasys rogerii and P. peroteti were observed in Cote D’Ivoire only. Specimens of Dentex macrophthalmus, Decapterus macerellus were found only in Cameroun. Samples of Decapterus rhoncus and Exocoetus volitans were recorded only in Nigeria.

The results of the food anlayses shows that there were variations in food item consumed according to the size of the fish using the numerical method. Some species preferred certain organisms found within the immediate environment. The families of fish examined included Sciaenidae, Carangidae, Polynemidae, Sphyraenidae, Pomadysidae, Arridae, Drepanidae and Cynoglossidae.

Food item consumed by fish of size range 7-10cm were Gamarus sp, Nauplius Larvae, Biddulphia spp, Lucifer sp, fish egg, mysis, megalopa larvae, Peridium, Pyrocytis spp,'Nerites sp., Zoea larvae, mysis, terebellid, Chaetoceros spp., Sargitella spp., Coscinodiscus spp.

Also fish of length range 11-30 cm were found to consume mostly Fish fry, Brachyuran Larvae, hyperis sp, Phyllosoma larvae, Octopus, Squid, Squilla mantis larvae, Gastropods, Shrimp larvae, Nematopaleomon hastatus, Tubiculous polychaeate, crab, Snopia sp., Hyperia sp., tubifex.

The large fishes (size range 31-55 cm) consumed fish, Parapenopsis altlantica, Penaeus notialis, Octopus vulgaris, Squid,
gastropods, bivalves, *Penaeus kerathurus*.

**CONCLUSION:**
There is need for 2 or 3 more surveys to be carried out to confirm the results.
# Fish Species Recorded in Coastal Waters of Some West African Countries and Their Size Ranges

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AQUACULTURE SECTION

PROJECT TITLE:
DEVELOPMENT OF RELOCATED IKOYI FISH FARM AT IJOYI - BADORE

RESEARCHERS:  B.I. EZENWA, P.E. ANYANWU

INTRODUCTION
The Institute's Research Fish farm at Ikoyi park, Lagos, was established in 1967/68 under the FAO/Federal Government assistance to conduct research into brackish water fish farming. Rapid urbanization, land reclamation and over-flooding around the farm created drainage and pollution problems. Under these circumstances, relocation of the farm at a site most unlikely to experience the same urbanization process in future became inevitable. A more convenient site of 25ha. was selected at Ijoyi/Badore, approximately 30 kilometers from Institute's Headquarters in Victoria Island. Establishment of Research Infrastructure started in 1995 continued to date.

SOME OF THE INFRASTRUCTURE COMPLETED AT THE NEW SITE INCLUDE

i) Laboratory/Office complex
ii) Four earthen ponds (0.2ha each)
iii) Two earthen ponds (1ha each)
iv) Five concrete tanks (4m x3m 1.2m each)
v) Four concrete tanks (5m x 4m x 1.2m)
iv) Staff quarters for junior staff - 3 (No) one bedroom units.

MAJOR ITEMS REQUIRED FOR OPTIMUM RESEARCH WORK ARE

i) Four units staff quarters (of 3-bedroom bungalow for senior, and one bedroom for junior
ii) Transformer to link to NEPA grid
iii) 250KVA generator for staff quarters, laboratory and offices
iv) Laboratory equipment
v) Borehole to serve members of senior and junior staff.

PROGRESS REPORT ON RESEARCH ACTIVITIES AT THE NEW SITE

During the period under review, 1999, 60% of the completed infrastructure was put under use. Some of the major research projects carried out there included pilot project on integration of fish farming with production of vegetables with a major aim of making fish farming attractive through diversification of income generation; fish fingerling production; research on live feeds with emphasis on pilot production of maggots for table sized fish etc.

The infrastructure at new site was also used for on farm training of Aquaculturists on 12 week practical course in the Institute; students from tertiary institutions in Nigeria on a three month industrial attachment to NIOMR; and also
students from Secondary Schools in Lagos State also paid regular excursion study visits to the new station.

**PROJECT TITLE:**

**PROPAGATION AND CULTURE OF MARINE SHRIMP, *PENAEUS NOTIALIS***

**RESEARCHERS:**

B.I. EZENWA, P.C. PEPPLE, B.I. EBONWU, O. OGUNTADE, H.K. OUNBADEJO, A. IRERE, F. IHIMEKPEN

**OBJECTIVES**

1) To develop and popularize shrimp culture in Nigeria in order to relieve pressure on the exploited shrimps from the wild.

2) To develop and raise shrimp culture to a commercial scale for foreign exchange earning.

3) To develop hatchery techniques for mass production of juveniles of *Penaeus notialis* for sale to shrimp farmers.

**TARGETS**

- establishment of research infrastructure for shrimp propagation and culture
- development of technology on formulation and production of shrimp feeds from locally available feed ingredients.
- perfection of techniques on production of table sized shrimps (3-4 tons/ ha/yr) for domestic and export market.

**METHODOLOGY**

i) Collection of broodstock and juveniles from the wild twice a week at different locations within and around Lagos and its coastal waters.

ii) Acclimatization of broodstock and juveniles in the hatchery complex and laboratory.

iii) Development of least cost shrimp feeds from local materials for growth trials.

iv) Preliminary trials on controlled breeding by means of eye-stalk ablation.

v) Weekly determination of physico-chemical parameters of lagoon and coastal waters: areas of concentration of adult and juvenile shrimps.

**RESULTS**

i) Completion of shrimp hatchery at NIOMR Headquarters:

The shrimp hatchery complex at the jetty of Institute's headquarters was completed with installation of most of the research facilities. Such facilities included root blower; two overhead tanks (2,500 litres each) and eight (8) grow out concrete tanks (2m diameter and 1.2m depth) etc. The hatchery complex has a capacity for an estimated five million post larvae of marine shrimp, *Penaeus notialis*

ii) Broodstock procurement and management:

Broodstock (500) of *Penaeus notialis* collected within Lagos environs were successfully acclimatized in the indoor laboratory to a salinity level of 35 ppt (standard salinity level for controlled breeding of marine shrimp). Preliminary exercises on eyestalk ablation for controlled breeding was carried out. A range of 75-85% success was achieved.
iii) Formulation and preparation of least cost effective shrimp feeds: Formulation and preparation of least cost effective shrimp feeds for sub-adults were done using two major items - Soya beans and shrimp head wastes. Growth trials in outdoor concrete tanks of post larvae indicated 60% growth at the end of eight weeks. Further trials are in progress.

iv) Formulation and development of improved shrimp feeds for juveniles using four ingredients - Soya beans, maize, shrimp head wastes and vitamin premix. The feed was well tolerated by early larval stages of the species and trials are still in progress in the grow-out tanks.

v) Training of research officers, technicians, and students (both undergraduate and postgraduate level) of tertiary institutions in the country on the culture techniques and biology of the species, *P. notialis*.

vi) Three ponds were completed (40m x 30m x 1.2m each) for on-farm growth trials of the juveniles in the Institute's Research Fish Farm at Badore.

**DISCUSSION**

Considerable progress was made in the shrimp research after completion of the hatchery at NIOMR headquarters. Formulation and development of shrimp feeds for both juveniles and adults was perfected. Major ingredients were Soya beans, maize, shrimp head wastes and vitamin premix. The feed was accepted by the shrimp larvae in the hatchery concrete tanks. Three earthen ponds (40m x 30m x 1.2m each) completed at the Institute's Research Fish Farm at Badore are to be stocked with juveniles of *P. notialis* for further experimentation on production costs using the formulated feeds.

**PROJECT TITLE:**

**INTEGRATED FISH FARMING AND ENTERPRISE COMBINATION**

**RESEARCHERS:**

P.E. ANYANWU, P.C. PEPPLE, B. EBONWU

**INTRODUCTION**

Integrated fish farming is the culture of fish in combination with either animal husbandry and/or crop farming. The benefits of the system include diversification of income generation farmers' fish food self-sufficiency, maximum utilization of land and increased output per unit area of land. Integrated farming also ensures that natural resources or waste from one system is recycled and utilized in another system leading to a more sustained and profitable production system.

**OBJECTIVES**

Project objectives include

- Making fish farming attractive through diversification of income generation.
- Establishment of a flexible farming system with low input cost.
- Ensuring efficient land use and better utilization of agricultural wastes.

**JUSTIFICATION**

The potential for development of fish farming as an industry is quite
high especially for rural farmers in coastal and inland areas of Nigeria. The Chinese integrated fish farming system has been instrumental to the high level of fish/food production in the country. Consequently, there is need to incorporate and integrate fish farming into Nigeria's agricultural farming system. This will make fish culture attractive to rural farmer due to crop diversification and recycling of waste. Integration of fish farming with vegetable and crop production will increase level of food production and reduce unemployment in the country.

**SCOPE OF WORK**
- Growing of suitable vegetables and selected crops.
- Determination of their growth and yield patterns.
- Identification of resource or waste that can be recycled.
- Identification of constraints and impacts of the production system
- Cost-benefit analysis.

**TARGET**
The project is to develop and perfect a technology for fish farmers for optimum production of fish and vegetables within a given space of time and limited resources.

**IMPLEMENTATION PROCEDURE**
- Market survey to determine economically important vegetables and crops.
- Land preparation and field establishment
- Tank preparation and stocking of brooders of tilapia
- Fertilization of vegetable and crops and fish ponds periodically with manure.
- Weeding and irrigation of vegetable farm.
- Harvesting and marketing of vegetable, crops and fish.

**ACHIEVEMENTS**
During the period under review (1999), the following activities were undertaken near the earthen ponds and concrete tanks:
- Clearing of 1 hectare land at Institute's new research station at Ijoyi, Badore
- Planting of cassava stems in ½ acre portion of the land.
- Planting of pineapple suckers in another ½ acre of the land. Growth of the three items planted was in good progress as of December, 1999.
- Preparation of three concrete tanks (5m x 4m x 1.5 each) for the introduction of Clarias fingerlings for growth to table sizes.

**FUTURE PLAN**
- Economic analysis of the production system to determine viability of each item.
- Participation of rural women in the adoption of this technology in the surrounding villages.

**PROJECT TITLE:**
**RESEARCH ON PRODUCTION TECHNOLOGY OF MAGGOT (LARVAE OF MUSCA DOMESTICA) AS LIVE FEEDS FOR SELECTED CULTURED FISH SPECIES**

Researcher: P.C.G. Peppe

**OBJECTIVES**
This project is designed to partially:

i) replace more costly formulated fish feeds with live feeds.

ii) to popularize the technique to rural fish farmers who cannot afford high cost of pelleted feeds.

iii) to increase fish production from 2 tonnes per hectare per year (2t/ha/yr) to 6 tonnes per hectare per year (6t/ha/yr) using live feeds as major feed ingredient.

JUSTIFICATION

Increasing cost of formulated diets and raw materials are major constraints to large-scale production of popular fish feed. There is therefore need for live feeds for cultured fish such as Clarias, Heterobranchus and other fish predators

SCOPE OF WORK

The project involves:

i) Studies on simple technology for mass production of maggot (Musca domestica)

ii) Growth performance of Clarias fingerlings fed on maggots.

iii) Water quality monitoring

TARGET

The project is to produce 100kg of maggot in six months for fish production with good performance.

IMPLEMENTATION PROCEDURE

A simple maggot production technology experiment was carried out at the Badore fish farm with 5kg of different substrates, namely chicken waste, pig waste and sawdust. The substrates were mixed with water and cracked eggs.

RESULT

Out of the three substrates used, the chicken waste gave a yield of 20g of maggot after 3 days. In 24 days 800g of maggot was produced. In conclusion, the chicken waste served as the best substrate for large-scale production of live maggots (Musca domestica). Subsequent experiments in the laboratory and outdoor concrete tanks will determine conversion ratio of live maggot using Clarias fingerlings.

PROPOSAL FOR COMPLETION

Subsequent experiments will concentrate on collection of growth data (conversion ratio, etc) on Clarias fingerlings fed with live feed compared with the ones fed with artificial feed.
FISHING TECHNOLOGY SECTION

PROJECT TITLE:

TREATMENT OF WOODEN CANOES TO PREVENT INFESTATION

RESEARCHERS:

R.E.K. UDOLIS, SOLARIN, B. B.
E.E. AMBROSE, F. ANIEBONA,
S.C. OPURUM

INTRODUCTION:

The fishing crafts used in the small scale fisheries are mostly wooden canoes. They include the dug out, planked and the planked dug out (half dug out) canoes. The useful life spans become drastically reduced by borer’s infestation. A lot of fishing time is lost in order to effect canoe repairs and maintenance. Consequently there is a reduction in fish production resulting in low financial returns. Accidents also occurred due to leakages in wooden- parts that have been badly damaged leading to loss of lives, fishing gear and fish catch. The need to improve the preservation technique and prolong the service life of the canoes is all the more desirable due to log scarcity, deforestation as well as economic consideration.

OBJECTIVES:

- Identification of borers and agencies of bio-deterioration.
- Identification of improved canoe construction materials.
- Enhancement of the life span of canoes by different preservation methods.

SCOPE OF WORK:

It involves the development of improved techniques for the preservation of canoes to prevent infestation of borers.

(a) Field work includes

(i) The inventory of canoes and the investigation of the degree of infestation.
(ii) The study of the wood types and their characteristics.
(iii) The collection and identification of organisms and Agencies responsible for bio-deterioration.
(iv) The treatment of wooden canoes.

(b) Laboratory work includes:

(i) The preparation of chemicals and other treatments for the prevention of borers.
(ii) The experimental application of chemicals on infested wood and planks.

RESULTS:

Survey of wooden canoes in the coastal water, creeks and lagoons of Lagos and Ogun States recorded 95% borers infestation. Density of hull infestation per canoe ranged between 25 and 75%. The borers included Teredo sp. Mytilus spp. Crassostrea gasar and Pachymelina spp. The highly resistant wooden materials for canoe construction included Opepe Nauclea diderrichii, iron wood Lophira alata and Mahogany Khaya Invorensis and Triplochiton scleroxylon.

Preservation methods of the wooden canoes against the eggs, larvae and adults of the teredo worms, molluscan and crustacean wood borers included any or a combination of the following with different degree of success.

(a) Dry-docking, sun drying, scrapping and coating with coal tar.
(b) Soaking the wooden surface with petrol for burning off the barnacles and other borers.
(c) Application of ground pepper mixed with local black soap to kill the larvae and the eggs of borers.
(d) Application of cotton smeared with quick lime and palm oil mixture for caulking of the wooden canoe.
(e) Cementing, painting with coal tar or marine paints or nailing aluminium sheets to cover the hull up to the water line.

Storage techniques should include the following:

(a) Washing the wooden canoe of all debris.
(b) Lifting the canoe out of water.
(c) Application of any of the preservative methods which are mentioned above. The canoe should be overturned and placed on wooden platform or raised with other suitable material above the ground.
(d) The storage should be under the shade where there is free flow of air.

CONCLUSION

Borers infestation can be minimized by pulling or dragging the wooden canoes out of water whereby the hull is frequently rubbed against the beach. A few of the preservation methods, especially the use of aluminium sheets, were observed to increase the useful life span of the wooden canoes from about 1 year to a minimum of 10 years. However aluminium sheet cover may be chafed or damaged where the canoe is constantly dragged on the beach out of water.

Future work should focus the application of anti fouling chemicals and wood preservatives as well as fibre glass reinforced plastics to prevent borers infestation.

PROJECT TITLE:-
DEVELOPMENT OF EXCLUDER DEVICES FOR USE IN SHRIMP TRAWLNETS IN NIGERIA

RESEARCHERS:-

UDOLISA, R. E. K., SOLARIN B. AMBROSE, E. E., ANIEBONA, F., OPURUM, S.

INTRODUCTION

Turtle excluder device (TED) consists of a solid grid fitted with netting and installed in shrimp trawl net to exclude the endangered sea turtles from being captured while the shrimps pass through grid and are collected in the trawl net codends.

Nigeria exports shrimps worth U.S. $70-80 million annually. The U. S. Government made it mandatory for all nations exporting shrimps to the American market to install the TED in the shrimp trawl nets in order to exclude the endangered sea turtles from being captured. Consequently the export of Nigerian shrimps into the American market was banned with effect from 1st May, 1996. There was a stock pile of imposed on Nigeria. Nigeria did not have the technology for TEDs. There was the need to develop a locally made TED for usage in Nigerian shrimping industry.

OBJECTIVES

To inventory and standardize basic designs of shrimp trawl nets and vessels.
To establish a catalogue of industrial fishing gear.
To design and construct improved TED prototypes with local materials.

SCOPE OF WORK

(i) The standardization of basic designs of Nigerian shrimp trawl nets and vessels.
(ii) The fabrication of local TEDs and fishing trials.
(iii) The introduction of certified TED to shrimping companies.

RESULTS

Investigation of the industrial fishing/shrimping fleet at jetties or landing facilities in Lagos State showed three major vessel categories.

(a) Out rigger vessels which operated simultaneously 4 shrimp trawl nets with 2 nets attached to the boom on each side of the vessel.

(b) Out rigger vessels which operated simultaneously 2 shrimp trawl nets with each net attached to the boom on each side of the vessel. The small try net (at the stern) was used to sample the shrimps in the water.

(c) Stern trawlers operated one big trawl net used mainly for fishing.

The technology for converting the fishing stern trawler to shrimping out rigger vessel has been perfected in a few of the fishing companies.

The major characteristics of the shrimp trawl nets are as follows:

(a) Length of headrope = 19.43 -27.6m
(b) Length of ground rope = 23.98 – 31.3m
(c) Material of head/ground rope = combination wire 16-18mm
(d) Total length of trawl net body 16.59-25.6m
(e) Netting material (main body) = Polyethylene (PE), Polypropylene (PP) or polyamide (PA) R 1200 TE-R 1500 Tex.

(Polyamide netting material was preserved mainly with coal tar)
(f) Mesh size of netting (main body) 45-60mm
(g) Mesh size of codend = 25-45mm

The ‘super shooter’ TED grids constructed locally with solid mild steel or iron rod have been adopted by the Fishing companies and installed in the codend extension of the shrimp trawl nets.

It is pertinent to reiterate that the following modifications and adjustments should be carried out to improve the performance of the TED so that the TED will be able to withstand the stress of the 3-hourly trawling period.

(a) Bracing of the deflector hars on the side facing the codend for reinforcement.
(b) The angle of inclination of the solid grid should be 40 – 45 degrees.
(c) Increase the buoyancy force of the floats which has a direct bearing on the positive floatation of the TED in order to create good ground clearance for the escape route especially where the latter is at the bottom.

The monitoring survey conducted during the period indicated that the TEDs were installed in the shrimp trawl nets. This positive report encouraged the U.S. Govt. to reaffirm and certified the exports of the Nigerian shrimps to the U.S. markets in 1999.

C O N C L U S I O N

TED grid constructed with smooth iron rod was observed to be more environment friendly and caused less damage to the resources as compared with twisted rod. It is also desirable to investigate the performance of TED grids constructed with steel tube pipes, stainless steel rod and aluminium tubing.

Workshops on TED in the aspects of technical design details and operational requirements for optimal efficiency should be conducted on yearly basis in order to continue to educate the industrial shrimp trawl fishermen. Survey and investigation of the shrimp gear which started in Lagos area should be extended to cover Portharcourt, Calabar fishing terminals.

These recommendations should guarantee that Nigeria, will continue to meet the standards required by the American Govt. for obtaining the yearly certification to export shrimps to the U.S.A. markets.
DEVELOPMENT OF IMPROVED FISH HARVESTING IMPLEMENTS AND CONSTRUCTION MATERIALS IN PONDS, BRUSH PARKS AND OTHER CULTURE SYSTEMS

RESEARCHER
B. B. SOLARIN

INTRODUCTION

Fish culture systems both intensive and extensive such as ponds and brush parks complement the capture fisheries in fish production to meet the demand. There is always the need to transfer or harvest the fish in the culture systems after raising or allowing them to grow to a specific size as fingerlings, sub-adult or adult. The approach varies from partials or total harvest and may entail certain intractable gear related problems and difficulties leading to loss of revenue. The culture systems contain relatively fewer species compared to the wild but may demand greater care in their harvesting procedure in order to maintain the specimens live or in a whole some condition which will attract high market value. There is also the need to use materials that are environmental friendly in the construction of brush parks fish cages, pens and other culture system.

Due to a dearth of published data and information in those areas the project seeks to investigate the pond harvesting gear as well as the brush park construction materials and the component reef structure in order to promote increases in fish production.

OBJECTIVES:

It involves the development of improved harvesting gear and construction materials for the culture system.

(a) Field work includes:
(i) The inventory of the harvesting gear types.
(ii) The construction of improved prototype gear/materials and the field experimental trials with the active participation of the fisher folk.

(b) Laboratory work includes the design and construction of the model harvesting gear and trial tests in the flume tank.

RESULTS

The baby seine net was the only harvesting gear used in four out of 12 fish farms that were sampled in Lagos State during the period. The nets with the headline length ranging between 10.0m and 52.5m were made of polyamide (nylon) multifilament netting materials with R150-250 tex twine thickness and 5-15mm stretched mesh size.

The catching efficiency expressed as the weight (kg) of fish caught by the net relative to the total weight of the fish harvested after complete draining of the 0.02-0.1ha pond ranged between 15.0% and 26.4%. The poor performance was attributable mainly to
design defects and poor construction of the nets especially the codend. The fish hardly collect in the codend, it is recommended that angular panel of netting should be attached to each side of the wings in order to facilitate herding of the fish into the buntor codend. The minimum length of the seine net should be equal to maximum width of the rectangular pond or the diameter of the circular pond to allow for total harvest. The minimum height of the net should never be less than the maximum depth of the pond. Table 1 highlights fishing gear that are useful in aquaculture.

Biofouling and clogging of the fire meshed netting material was observed to be a major problem. There was rapid deterioration of the nets which necessitated frequent replacement and the associated cost implications.

Polypropylene rope streamers have been introduced as cheap environment friendly materials in the construction of the brush parks in the Lagos lagoon. The project which is in progress is being carried out in collaboration with the Lagos State Agric. Development Authority (LSADA). It should be suitable substitute for the plant parts and should prevent the destruction as well as the rapid erosion of the mangrove area which serves as the breeding and nursery ground to fish species.

**FUTURE PLAN**

(1) The project which is still in progress will investigate more fish farms in Lagos and Ogun States.

(2) Local sourcing of suitable materials for fish cages and pens will be considered.

(3) The introduction of a few other fishing gear for partial harvest of the fish farms will also be given due consideration.

(4) The project will also study the use of cheap environmental friendly materials in the construction of the brush parks in order to alleviate depletion of the mangrove (which serves as breeding and nursery grounds to some species) and minimize soul erosion.

**CONCLUSION**

The improvement of the catching efficiency of the harvesting implements should facilitate better catches and increase in revenue generation to the fish farmers. Regular draining of the pond during fish harvest and the corresponding loss of nutrients and biota will also be removed. This is very crucial to aquacultural practices especially in the more arid parts of the country.
FISH TECHNOLOGY/ BIOTECHNOLOGY DIVISION

BIOTECHNOLOGY SECTION

PROJECT TITLE:

BROODSTOCK DEVELOPMENT AND MANAGEMENT OF CLARIAS GARIEPINUS

RESEARCHERS :

O. A. AYINLA, A. ORESEGUN M. O. OGUNTADE B. C. MBAWUIKE B. AJETUNMOBI

INTRODUCTION:

Clarias gariepinus is an economically important food fish. It has a national acceptance and it is most widely cultured fish apart from Tilapia sp. Its method of propagation is well understood but fingerlings supply is abysmally below fish farmers’ demand. One of the major constraints to the mass propagation of C. gariepinus is lack of genetically improved fingerlings. Development of viable broodstocks of C. gariepinus has therefore become crucial and urgent. Currently, there is no organization, private or public engaged in this important aspect of aquaculture in Nigeria. NIOMR’s intervention will go a long way to satisfy the yearning need of producing fast growing and uniformly sized fingerlings for fish farmers.

OBJECTIVES :

(a) Collection of six populations of C. gariepinus from Ogun, Osun, Anambra, Imo, Niger and Kaduna river systems
(b) Determining the reproductive capacities of the six populations and electrophoretic characterization of each fish population.
(c) Development of viable intrageneric hybrids of C. gariepinus.

SCOPE OF WORK :

The procurement of broodstock of C. gariepinus has commenced. We now have a genetic line of improved C. gariepinus imported from Holland while the acquisition of other lines are in progress.

IMPLEMENTATION ROCEDURE :

Clarias gariepinus broodstocks are being acquired and kept in our concrete tanks. The six genetic lines being acquired will be subjected to biochemical meristic morphometric analyses to characterize the different strains for further improvement.

The project is on-going.
PROJECT TITLE:

INTENSIVE AQUACULTURE TRAINING PROGRAMME FOR FISH FARMERS

RESEARCHERS:

O. A. AYINLA, M.O. ORESEGUN
O. OGUNTADE, A.AJETUNMOBI

Nigeria, though well endowed with large expanse of inland freshwater and brackish water ecosystem which are suitable for fish production especially through aquaculture has not been able to bridge the wide gap between the domestic fish production of about 0.3 million tonnes and the projected fish demand of about 1.5 million tonnes. Part of the reason for this is inadequate knowledge in aquacultural practices. It has been observed that small holders farmers are major players central to subsistence and commercial fish production in the country. The Institute has therefore decided to organize periodically the intensive aquaculture training programme designed to equip and empower prospective investors in aquaculture.

OBJECTIVES:

(a) To expose the trainees to the facilities and expertise available at the institute
(b) To disseminate on-shelf technologies in the various aspects of aquaculture to the trainees
(c) To empower fish farmers for increased fish production through the training of investors in aquaculture.

SCOPE OF WORK

In response to our advert in the newspaper, a total of 11 prospective fish farmers applied for the training programme which commenced on the 6th September, 1999, and ended 12 weeks later.

IMPLEMENTATION PROCEDURE

A faculty staff of 25 was assembled. Twenty were NIOMR staff and five from outside The participants were taught for a period of six weeks and exposed to fish farming activities through visits and fish farm attachment for involvement in real fish farm situation.

RESULTS AND DISCUSSION:

Assessment of the participants at the end of the training to determine the acquired knowledge and understanding of the course showed that 27.27% had distinction, 54.54% with credit and 18.18% with ordinary pass. The performance of the participants showed a very high level of understanding of the course.

BIOTECH SECTION:

COMMERCIALISABLE PRODUCT.

1. PRODUCT NAME: FISH FEED

Fish feed for fingerlings at 40% crude protein and juveniles - 32% crude protein are available for sale at the Institute.

The aqua feeds are formulated and compounded to meet the nutrient requirements of Catfishes.

2. PRODUCT NAME

Improved catfish fingerlings:
Genetic improvement on C. gariepinus to produce strains that are fast growing and uniformly sized is in progress.

FISH TECHNOLOGY SECTION

PROJECT TITLE

A STUDY OF THE UTILISATION POTENTIAL OF THE BIG EYE (BRACHYDEUTERUS AURITUS)

RESEARCHERS:

M.A. KING, S.B. ADENIYI

INTRODUCTION

Growing world demand for more seafoods, together with the recognized urgency to conserve fish stocks, is signaling all nations not only to reduce post-harvest fishery losses but to better utilise landings as human food. One of the ways to achieve this is by adding value to low value or under-utilized fish species by the use of technology.

GTS survey of 1968 showed that the Big eye is one of the most valuable components of the trawl fish catch in the Gulf of Guinea because of its relative abundance. However, its small size, even at maturity, makes the conventional method of utilization a problem. Thus development of new fish products from this species would encourage the exploitation of this particular resource and make it more marketable.

OBJECTIVES

a) To develop various value-added products from B. auritus.
b) To test the consumer acceptability of the various products.
c) To determine the nutrient content and the economic viability of the developed products.

TARGET FOR 1999

Development of organoleptically acceptable fish crackers from B. auritus.

IMPLEMENTATION

The big eye samples used in this study were obtained weekly from July to December 1999 from Obelawo Facha Fishing Company courtesy of the Economics and Statistics Section.

The weight and length of samples randomly selected from the batch were measured. The weight composition was obtained by separating each fish according to its anatomy; scale, fins, head, flesh and visceral organs.

The proximate composition of B. auritus has been extensively studied by Talabi et al, (1983) so it was not addressed in this study.

PRODUCTION OF FISH CRACKERS

Fresh Big eye was cleaned by gutting, nobbing and washing before being passed through a flesh and bone separator (Badder 964). The mince obtained was mixed with tapiocal flour (manihot
utilissima at a fish to flour ratio of 40:60, 50:50, 60:40, sugar, salt, monosodium glutamate and 20-30% water were added to the mixture. All the ingredients were mixed mechanically to form a smooth paste which was moulded and steamed for about 90 minutes. The moulded pastes were cooled in cold water to prevent shrinkage and refrigerated overnight at 1°C to 5°C. The chilled paste were sliced into a thickness of about 2-3 mm and dried in the oven until a moisture content of about 10% was obtained. The dried slices were deep-fried in vegetable oil frying made the slice expand and increase in size to obtain a low density porous product known as fish crackers.

The linear expansion, sensory attributes and nutrient content of the three different combinations were compared.
RESULT

TABLE 1
RELATIONSHIP BETWEEN LENGTH AND WEIGHT IN B. AURITUS

<table>
<thead>
<tr>
<th>MONTH</th>
<th>AVERAGE LENGTH (CM)</th>
<th>RANGE (CM)</th>
<th>AVERAGE WEIGHT (G)</th>
<th>RANGE (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>13.7</td>
<td>12.0-15.5</td>
<td>39.1</td>
<td>26.6-56.3</td>
</tr>
<tr>
<td>August</td>
<td>15.6</td>
<td>13.0-18.0</td>
<td>59.7</td>
<td>32.3-86.6</td>
</tr>
<tr>
<td>September</td>
<td>14.4</td>
<td>12.5-19.0</td>
<td>52.0</td>
<td>27.1-78.1</td>
</tr>
<tr>
<td>October</td>
<td>15.8</td>
<td>12.5-19.0</td>
<td>63.9</td>
<td>46.3-117.0</td>
</tr>
<tr>
<td>November</td>
<td>16.6</td>
<td>15.0-19.5</td>
<td>70.0</td>
<td>46.3-117.0</td>
</tr>
<tr>
<td>December</td>
<td>15.1</td>
<td>15.0-18.5</td>
<td>54.9</td>
<td>23.7-09.4</td>
</tr>
</tbody>
</table>

TABLE 2
WEIGHT COMPOSITION OF B. AURITUS

<table>
<thead>
<tr>
<th>%</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flesh</td>
<td>19.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>15.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeleton and other bones</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fins</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scales</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visceral organs</td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>99.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 3
NUTRIENT CONTENT OF DRIED AND FRIED SAMPLES OF CRACKERS MADE FROM B. AURITUS AND TAPIOCA FLOUR

<table>
<thead>
<tr>
<th>*combination</th>
<th>Protein</th>
<th>Fat</th>
<th>Energy (kcal/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 Fried</td>
<td>8.30</td>
<td>0.45</td>
<td>8.30</td>
</tr>
<tr>
<td>Dried</td>
<td>10.01</td>
<td></td>
<td>10.01</td>
</tr>
<tr>
<td>A2 Fried</td>
<td>12.71</td>
<td>0.46</td>
<td>12.71</td>
</tr>
<tr>
<td>Dried</td>
<td>14.46</td>
<td></td>
<td>14.46</td>
</tr>
<tr>
<td>A3 Fried</td>
<td>16.85</td>
<td>0.80</td>
<td>16.85</td>
</tr>
<tr>
<td>Dried</td>
<td>19.27</td>
<td></td>
<td>19.27</td>
</tr>
</tbody>
</table>

*A1 = 40:60  (Fish:flour)  
A2 = 50:50  (Fish:flour)  
A3 = 60:40  (Fish:flour)

From table 1, the average length of B. auritus ranged from 13.7 to 15.1 cm. It is therefore suitable for processing using the flesh and bone separator to produce the fish mince because of its small size, it could also be canned whole and headless like the commercially available canned sardines in the market.

The edible portion obtainable from B. auritus is about 19% while the rest could be converted into fish meal.
The proximate composition of crackers made from different combinations of Big eye and tapioca flour is presented on Table 3. The protein content of the dried and fried crackers increased with increase in the proportion of fish added to the flour. Frying lowered the protein content by 12% in both A₁ and A₂ and 17% in A₃. The fat content of the fried and dried samples also increased with increase in proportion of fish added to the flour (Table 3). Frying increased the fat content by 97% in both A₁ and A₂ and 91% in A₃. Frying increased the energy values of A₁ and A₃ by 21.6% and 12.0% respectively while that of A₃ remained almost constant.

In conclusion, formulations for fish crackers from *B. auritus* has been successfully developed. The response from laboratory-based taste panels and preliminary large scale sensory evaluation trials were encouraging (unpublished data). The acceptability of the crackers would increase the economic value of *B. auritus* and supplement the diet of needy children as well as adults in Nigeria. Further work on the production of canned fish sauce from *B. auritus* is in progress.
The Fisheries Statistics and Economics Programme has the following main objectives:

A) To research into suitable statistical sampling methods of fisheries data collection, analysis and presentation with particular attention to marine and brackish water of Nigeria.

B) To undertake socio-economic studies of fish exploitation in the marine and brackish water of Nigeria with a view to providing baseline data capable of assisting the management of the marine fish resources.

C) To obtain, process, store and retrieve fisheries data essential for proper understanding of the fisheries.

In order to achieve the above goals, the programme is organized into two: - Statistics and Economics. The Statistics part is responsible for researching into suitable sampling techniques and estimating procedure for fisheries data accumulation. The Economic Part is responsible for sampling commercial fishing trawler landings to gain better understanding of the trawl fishery, monitoring the fisheries and conducting studies of the industrial and artisanal fisheries.

In the year 1999 the thrust of the section’s programme was on the sampling of commercial fishing trawler. The project aims at providing production data for the fishery industrial sector and to monitor the size of fish landed. This project is justified by the necessity to have a better...
understanding of the performance of the sector and to provide advice based on facts for the management of the fishery resource.

Sampling was done at Obelawo and Farcha Fishing Company in Lagos. The contents of four boxes taken at random from the vessels were sorted into species and length and weight measurements were recorded. The croakers (Pseudotolithus senegalensis, P. Typus, P. elongatus, P. brachignatus, P. moorii and P. epipercus) were the most abundant. This was followed by the soles (Cynoglossus monodi); thereadfin (Galeoides decadactylus); other species of relative abundance in the catch sampled were caranx Caranx hippos and Caranx cyrsos) grunter (Pomadasys jubelini); African sicklefish (Drepane africana) barracudas (Sphyraena guachancho, S. barracuda, S. afra and S. sphyena). Table I shows the sample weight of the fish species encountered in the samples collected in the period under investigation.
The croakers accounted for 84.18% of the production by weight while next to it was the sole with percentage contribution of 5.25, this was closely followed by the threadfin accounting for 4.14%. The percentage contribution of the various species encountered in the catch of the industrial trawl are given in Table II while the average length of the different species are shown in Table III.
The average length of the different species fluctuated from month to month, however a striking feature of this is the fact they all in the range of what is classified as small to medium size for the various species. Large samples were rarely encountered in the catch and this is a very definitive pointer to the pressure exacted on the inshore fisheries resource.

**Constraints**

It is pertinent to note that fishing in the industrial sub-sector was not carried out throughout the year. During the period of study fishing was intermittent due mainly to acute shortage and high cost of AGO. This in some occasions put the company out of business for periods lasting as long as one or two months.

**MARINE GEOLOGY / GEOPHYSICS**

**PROJECT TITLE:**  MARINE GEOLOGY AND GEOPHYSICS OF THE NIGERIAN CONTINENTAL MARGIN

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The Marine Geology/Geophysics Capital project covers the entire Nigerian Coastal zone and the adjacent Continental margin (continental shelf, continental slope, continental rise and abyssal plain). The overall scope of the project involves the collection, analysis and interpretation of geologic, geophysical, oceanographic data (e.g. shallow seismic, side scan, wave, tide currents, sediment characteristics, near shore processes etc.) and environmental data from the entire. The division investigates different aspects of the programme under the following projects:

- Geophysical survey and bathymetry of the continental shelf.
- Research into coastal erosion and ocean dynamics
- Sea level rise monitoring and effects on the Nigerian coastal zone.
- Shipboard Environmental Data Acquisition System (SEAS)
- Geological study of estuaries in the Nigerian Coastal zone.
- Remote Sensing and Geographic Information System.
- Study of main runoff drainage systems of Victoria and Ikoyi Island in Lagos and their response to tidal and sea level changes.

- Geological survey and environmental assessment of enclosed/semi-enclosed water bodies along the Nigerian Coastal Zone for Aquacultural purposes.

**PROJECT 5.1:**

**GEOPHYSICAL STUDY OF THE NIGERIAN CONTINENTAL SHELF**

**RESEARCHERS:**

L.F. AWOSIKA, C.O. DUBLIN-GREEN, R. FOLORUNSHO

**INTRODUCTION**

The geophysical mappings employing seismic, gravity and magnetics methods constitute major tools for understanding the earth including the bottom of the ocean and the subsurface. The Nigerian continental shelf is rich both in fuel and nonfuel minerals. Fish and fisheries resources are also abundant. These geophysical methods are used to explore and exploit these resources.

**OBJECTIVES**

The objective of this project is to unravel the shallow subsurface geology of the Nigerian Continental shelf using geophysical techniques (Seismic, Gravity and magnetic). Other objectives include using side scan sonar and remote sensing techniques to understand geological/physical processes of the coastal and marine environment. Knowledge of such processes is relevant to shelf sediment dynamics, mineral exploration, tectonic hazards and exploitation as well as development of an Integrated Coastal Zone Management plan.

**JUSTIFICATION**

Apart from using these geophysical methods to understand the ocean bottom morphology, dynamics and subsurface structure, it is also expected that geophysical information derived from this project will constitute part of the data to be used in the delimitation of the Nigerian Continental Shelf. This will be in line with the implementation of the Law of the Sea Convention Article 76 paragraph 9 which states that: "The Coastal States shall deposit with the Secretary-General of the United Nations, Charts and relevant information including geodetic data, permanently describing the outer limits of its continental shelf. The Secretary General shall give due publicity thereto".

**SCOPE OF WORK**

- Collection of bathymetric data from the Nigerian Continental shelf.
• Shallow Seismic and side scan survey of the Nigerian Continental Shelf.

• Processing and analysis of gravity data collected during the gravity survey of 1988 in collaboration with the United States of America Geological survey.

TARGET FOR 1999

• Collation and digitisation of bathymetric data collected from the Nigerian continental shelf as well as from estuaries and lagoons.

• Shallow seismic and side scan sonar survey of selected areas of the Nigerian continental shelf.

• Analysis of gravity data from the western arm of the continental shelf.

IMPLEMENTATION PROCEDURE

• The Nigerian continental shelf is broken into four geomorphic zones -Western shelf (Badagry to Ajumo), Mahin Mud Coast, Niger Delta shelf and the eastern shelf (Imo River to Rio Del Ray)

• Historical geophysical and geological data of the Nigerian Continental shelf will be compiled.

• Geophysical survey (bathymetry, shallow seismic, gravity, magnetic and side scan sonar) will be conducted to fill gaps in information highlighted in the historical database.

• Data will be analysed to reveal the nature and structure of the sea bottom and subsurface of the Nigerian Continental shelf

RESULTS

Due to lack of vessel no oceanographic cruise was conducted during the period. Preliminary limits of the 200nautical-mile limit of the proposed Nigerian Exclusive Continental Shelf were appraised from the GEBCO Digital Atlas of the world. Data on sediment thickness especially in the Niger Delta was compiled. Acquisition of seismic data continued. Side scan data acquired from the Escravos data was analysed and morphology of bottom was derived from the sonograph.

CONCLUSION

Work is progressing in the analysis of compiled seismic data. A high-resolution shallow seismic survey is planned for the year 2000/2001 to reveal elements of sedimentary processes off the Victoria beach and east of the beach. Sediment thickness data, historical bathymetric and geophysical data will be compiled for use in a desk study for the delimitation of Nigeria extended continental shelf.
PROJECT 5.2:

RESEARCH INTO COASTAL EROSION AND OCEAN DYNAMICS

RESEARCHERS:

L. F. AWOSIKA,
C. O. DUBLIN-GREEN,
R. FOLORUNSHO

INTRODUCTION:

The project is designed to cover the entire Nigerian coastline stretching over 850km. Coastal erosion is a major environmental problem along the entire Nigerian coastline and is caused by both natural and anthropogenic activities.

OBJECTIVES:

1. To identify sites that are most vulnerable to beach erosion and determine the rates of erosion.
2. To identify and measure physical processes of the ocean such as waves, tides, current, sediment load as well as meteorological parameters of air temperature, wind speed and direction, wind gust and barometric pressure.
3. To establish a data bank for coastal and ocean dynamics.
4. To carry out mathematical models of the Nigerian coastal dynamics with the ultimate objective of predicting future morphological trends of coast and coastal processes.
5. To use the data collected and other environmental data as input into an integrated coastal Zone management plan.

TARGET:

Monitoring of beach erosion rates at Victoria beach and at the following out stations along the Nigerian coastline: (Awoye, Forcados, Escravos, Bonny, Ibeno Eket, Inua Abasi and Kulama)

Compilation of tide gauge data from the analogue tide gauge.

Downloading of tidal data and other ancillary data from the acoustic tide gauge (Next generation water level measuring system).

Establishment of a tide gauge and meteorological stations at Bonny and Escravos in the Niger delta.

Collection of historical maps, remotely sensed data for coastal zone trend analysis as input into integrated coastal zone management.

IMPLEMENTATION PROCEDURE:
The project involves monthly beach profiling at the 14 established stations and littoral observation including coastal processes data along the Victoria beach Lagos and at other out stations along the entire Nigerian coastline.

Weekly downloading of tidal and meteorological data continued during the year. Compilation of tidal data from the analogue tide gauge.

Downloading oceanographic data collected by the Voluntary observing ship Clipper Sao Louis with Shipboard Environmental Data Acquisition System (SEAS II)

RESULTS:

A. BEACH EROSION

Profiling along the Victoria beach during the year showed that almost all the sand dumped on the beach during the 1997 beach nourishment had been washed away with the waves breaking almost at the edge of the Ahmadu Bello way. The situation was so critical that the Japanese Government had to come to the rescue to save the buildings of the Federal College of Fisheries and Marine Technology by constructing a beach parallel breakwater along the beach fronting the College to the NITEL building.

As usual erosion continued along its characteristic format. Preliminary results of the 1999 Victoria beach post nourishment survey revealed the width of the nourished beach was less than 2m in some areas. Stations 1, 2, 3, and 4 recorded very high erosion rates averaging 3.5m per month. The beach downdrift of the east mole stations 12 to 14 was rather stable with no dominant erosion or accretional patterns.

Littoral observation along the beach showed that wave climate at stations 1 to 4 is less dynamic than those farther eastwards. Wave heights ranged from .7 to 1.5m west to east along the beach.

Due to lack of funds the outstations were not visited during the year.

PRE - NOURISHMENT BEACH SURVEY

An Interministerial Committee on the permanent solution to the Bar Beach erosion problem was inaugurated by Mr. President in September 1999.

As part of the mandate of the Committee, NIOMR embarked on pre-nourishment data collection to be used for modeling the permanent solution to the erosion problem.
The pre-nourishment survey included beach configuration delineation and beach profiling along the Bar beach and the Lighthouse beach.

NIOMR carried out the survey at the already 14 established stations and other newly established 100 stations at intervals of 50m between the 14 primary stations. The total length of the beach covered in this survey was 5km. All heights were tied to the primary beach mark of BM1, which are 2.51m above mean sea level. Along the Lighthouse beach, a total of 3km stretch of beach was surveyed using a total of 60 stations also at intervals of 50m.

The survey led to the production of a pre nourishment survey plan of the beach.

**B. TIDE GAUGE DATA SEA LEVEL RISE STUDIES**

Compilation and analysis of tide gauge data continued during the year. The Next generation tide gauge had a technical problem during the year hence down loading of the data was seriously hampered during the year. However, analysis of already compiled data continued. All 1996 data were analysed during the year.

**C. SEAS III - SHIPBOARD ENVIRONMENTAL DATA ACQUISITION SYSTEM**

The SEAS III project is an International project in support of the Tropical Oceans and Atmosphere (TOGA/World Ocean Climate Experiment (WOCE) to collect oceanographic and meteorological data with prompted data entry and transmission. Marine Geology/Geophysics Division is responsible for the for the TOGA/WOCE route AX 14 - Lagos - Rio (Brazil) with equipment onboard a voluntary observing ship CLIPPER SAO LOUIS,

Unfortunately the ship owners assigned the Ship to another route in Mediterranean, hence no data was compiled during the year. Arrangements are on going with find a new ship that will run this line. Analysis of already existing data continued during the year.

**PROJECT 5.3: GEOLOGICAL STUDY OF ESTUARIES ALONG THE NIGERIAN COASTAL ZONE**

**RESEARCHERS:**

D. O. DUBLIN-GREEN  
L. F. AWOSIKA, R. FOLORUNSO

**OBJECTIVES**

The objective of this project is to carry out a desk-study of existing scientific information on all the estuaries and barrier islands along the Nigerian Coastal Zone. Major gaps in scientific data will be identified and addressed, while issues on sustainable management will be highlighted.
JUSTIFICATION:

The Nigerian Coastal zone is characterised by a network of estuaries separated by narrow barrier islands. The estuaries are sites of various anthropogenic activities especially those related to oil exploration and exploitation. Besides, the estuaries provide breeding and nursery grounds for commercially important fish and shrimp species. The estuaries and the near shore marine environment are rich fishing grounds and have mostly sustained the artisanal fisheries in the Nigerian coastal zone.

Current trends of increased human activities in the estuaries have been responsible for the degradation of the ecosystem, particularly deterioration of water quality due to pollution, loss of bio-diversity, depletion of marine resources and loss of habitat.

In view of these problems, there is great demand for scientific information on this fragile ecosystem to enable a sustainable management of the estuaries.

SCOPE OF WORK:

Collation of existing scientific data on all the estuaries and barrier islands along the Nigerian Coastal zone. Identified gaps in scientific information will be addressed.

IMPLEMENTATION PROCEDURE

The study will focus on the following:

- Geology and geomorphology of estuaries and barrier islands along the Nigerian Coastal zone.
- Estuarine dynamics including, tides, currents, sediment distribution and transportation.
- Physico-chemical parameters
- Living and non-living resources
- Anthropogenic activities and environmental problems in the estuaries.

RESULT:

The desk study has revealed that there are 24 estuaries along the Nigerian Coastal zone, from the Commodore Channel (mouth of the Lagos lagoon) to the Cross River estuary in the east. In the Niger Delta, these estuaries are separated by sandy barrier islands.

The following data are being collated in respect of each estuary, geology, morphology, vegetation, size of barrier island and beach ridges, width and depth of estuary, tidal range, volume, fresh water discharge, waves, currents, sediment texture and distribution, annual littoral drift, physico-chemical parameters, fish species, distribution and abundance, anthropogenic activities and environmental problems.

CONCLUSION:
The study is in progress. A comprehensive report on all available information on estuaries along the Nigerian Coastal zone will be produced. Various maps on the different themes will be compiled.

PROJECT 5.4:

THE USE OF REMOTE SENSING AND GIS TO ASSESS SHORELINE CHANGES BETWEEN THE LIGHTHOUSE AND VICTORIA ISLAND BEACHES.

RESEARCHERS:

R. A. Folorunsho,
L. F. Awosika,
C. O. Dublin-Green

OBJECTIVES:

The project aims at using satellite imageries and Geographic Information system coupled with ground truth data to assess and evaluate the general changes in the morphology and ecology along the lighthouse and Victoria beach coastline. Analysis of Satellite images covering the project area will assist in the assessment of coastal dynamics and associated hazards with a regional perspective to compliment NIOMR’s in-situ data.

TARGET

♦ Assess general changes in the morphology
♦ Compare historical shoreline changes and trends using GIS.

SCOPE OF WORK

The study covered the Victoria and the lighthouse beaches. It involves

♦ Establishment of new profile lines and collection of other ground truth data like water line, foreshore gradient, beach configuration and beach sand grain size.
♦ Georeferencing and rectification of satellite images covering the study sites
♦ The overlaying of the satellite images on the digital topographic map.

IMPLEMENTATION PROCEDURE

One digital file of satellite imagery (Badagry – Maiyegun) and topographic maps were acquired for the study area. The Topographic maps were then digitized, georectified and coastal attributes added.

Historical beach profiles and littoral observations of the Victoria bar beach and the lighthouse beach were compiled. Five new primary and secondary benchmarks were established on the lighthouse beach. These benchmarks were leveled and profiling along the station
were accomplished. Ground truth information consisting of:

♦ Attributes of coastal morphology have been created using arc view
♦ Foreshore like slope gradient was determined
♦ Additional coastline positions were geo-referenced
♦ GPs position of coastal attributes and settlements were added and rectified.

RESULTS

Preliminary assessments of the data compiled have shown the general historical accretional pattern of the Lighthouse beach. Patterns of beach dune migration are being assessed. Spatial changes in intertidal zone are being mapped.

CONCLUSION

Work is still progressing on the analysis of the satellite images. A final report and maps showing rates and extent of shoreline changes of the lighthouse beach and Victoria beaches in Lagos would be completed after the second phase of the project.

PROJECT 5.5:

STUDY OF MAIN RUNOFF DRAINAGE SYSTEMS OF VICTORIA AND IKOYI ISLAND SYSTEMS IN LAGOS NIGERIA

AND THEIR RESPONSE TO TIDAL AND SEA LEVEL CHANGES

(CSI (UNESCO) SPECIALLY FUNDED PROJECT)

RESEARCHERS

L. F. Awosika, R. Folorunsho, C. O. Dublin-Green, A. Adekoya, J. Lawal

INTRODUCTION:

Within the overall objectives of the UNESCO Project on Environment and Development in Coastal Areas and Small Islands and specifically its component related to sustainable development of continental coastal regions, and as contribution to the Disasters Reduction Programme, the CSI Division of UNESCO funded a project to study the drainage channels in Victoria and Ikoyi Islands. The study also includes examining the impacts of flooding and conduct public awareness campaign on the reduction of flooding in Lagos (Victoria and Ikoyi Island) Nigeria.

Victoria and Ikoyi Islands in Lagos Nigeria constitute the main barrier island complexes containing both residential, commercial and tourist facilities in Nigeria. In fact, Victoria Island is generally regarded as the 'Hollywood' of Nigeria. Both islands are part of a barrier-lagoon complex, which stretch from Cote d' Ivoire to the Niger...
Delta in Nigeria. There are no topographic highs but general elevation is about 3m above mean low low water. There are many huge drainage channels built about five to eight decades ago, which channel runoffs on the islands to the lagoon. Recent observations have shown that many of these drainage channels now lack enough drainage heads to discharge runoffs into the lagoon. This is because these drainage channels were built without proper information on tidal and sea level rise. Rising sea level, increased rainstorm and ocean storm surges accompanied by astronomical high tides are now making these drainage channels ineffective. This often results in a backup of runoffs in the drainage channels and eventual flooding of the Islands. Such occurrences are most apparent and disastrous especially during the rainy season and when storm surges coincide with high tides resulting in astronomical high tides.

The direct dumping of domesticated refuse into the drainage channels exacerbates the problem of seasonal flooding of the islands. This human activity results in the blockage of the channels resulting in eventual flooding of the residential and commercial areas of the islands.

B. OBJECTIVES

The objectives of this survey will be:

1. Map the drainage channels on the islands.

2. Survey the main drainage channels from their heads to their discharge points to estimate their capacity to discharge water to the lagoons.

3. Collect and collate past (from old tide gauge station and the next Generation tide gauge) tidal data to determine the most recent mean sea level.

4. Conduct bathymetric survey of the Lagos lagoon and estimate changes in water depth over a period.

5. Collect dredging data in the lagoon.

6. Collect meteorological data over time in the area to determine the meteorological conditions and predict storm surges.

7. Collate meteorological and storm surge data.

8. Determine the efficiency of the present drainage systems and make recommendation to government.

9. Organise a public enlightenment campaign exposing the adverse effects of dumping refuse in drainage channels, through a mass media meeting followed by a campaign in the local news media.

SCOPE OF WORK:
Collection of topographic, runoff drainage maps aerial photographs of Victoria and Ikoyi Islands.

Determination of gradient of drainage channels on the maps.

Topographic survey of drainage channels and tying to the national bench marks. The topographic survey will involve establishment of benchmarks at specific points in the drainage channels and along the beach.

Collection and analysis of long term tidal data from the Lagos tide gauge station No. 259

Collection and analysis of long term meteorological data from the Lagos met station.

Preparation of maps of proposed new drainage channels based on results of study.

Undertaking of a selected house by house survey of methods of refuse disposal systems in the Lagos and Victoria Islands.

Public enlightenment campaign on the adverse effects of dumping refuses in drainage channels. Organising a press meeting (electronic media, newspapers and television) will do this on the impacts of refuse dumping in drainage channels

Submission of final report and recommendations.

**ACHIEVEMENT**

1. A total of 8 drainage channels in Ikoyi and Victoria Island have been heightened.
2. Floodable areas have been identified in both areas
3. Historical and drainage hydraulic charts have been compiled and analysed
4. Meteorological and storm surge data over time have been compiled and analysed.
5. Questionnaire have been compiled and analysed
6. Drainage charts have been digitised.
7. Hydraulic analysis of levelled drainage channel was done.
8. Bathymetric survey of the relevant parts of the Lagos lagoon has been done. A total of 10 lines off drainage channels emptying into the lagoon were sounded.

Analysis of all the above data is continuing. A draft final report is been prepared for UNESCO.

**RESULTS**

A total of 14 drainage channels have so far been heightened and levelled. Tidal data have been collated and
mean sea levels are been determined. Pictures of levelled drainage channels have been taken. Questionnaires to be completed by residents usually affected by floods have been made and are to be circulated.

Preliminary assessment of the drainage channels shows that most of them lack drainage heads while some have reverse gradients. Analysis of rainfall data also shows that excessive rainfall which might coincide with high tided result in backup of water in the channels leading to flooding. Analysis of bathymetric data in conjunction with tidal data revealed that mean sea level is about 1m from the outfall of most channels.

The media and public forum is planned for June 6, 2000.

CONCLUSION

It is hoped that the results of this project will be useful to the planning and works ministry of Lagos State in solving the perennial flooding problem in Victoria and Ikoyi islands.

PROJECT 5.6:

GEOLOGICAL SURVEY AND ENVIRONMENTAL ASSESSMENT OF ENCLOSED AND SEMI-ENCLOSED WATER BODIES ALONG THE LEKKI BARRIER ISLAND FOR AQUACULTURAL PURPOSES

RESEARCHERS

C.O. DUBLIN-GREEN
L.F. AWOSIKA
R. FOLORUNSHO

INTRODUCTION

Enclosed and semi-enclosed water bodies in coastal depressions, creeks, lagoons and channels are utilized worldwide for aquacultural purposes. Examples could be found in Europe and Asia especially in Malaysia and Thailand. The Lekki Barrier Island is dotted with naturally occurring enclosed and semi-enclosed water bodies, which could be utilized for aquacultural purposes.

OBJECTIVES

The objective of the project is to carry out a detailed geological and environmental investigation on enclosed and semi-enclosed water bodies on the Lekki Barrier Island and determine their potentials for aquacultural development.

JUSTIFICATION

Aquaculture in Nigeria is developing at a very slow pace due to the fact that would-be-entrepreneurs are unable to raise the capital needs for the construction of fish ponds
and bore-holes. Utilization of these water bodies in the coastal zone for aquacultural development will drastically reduce costs.

**SCOPE OF WORK**

The project covers the Lekki Barrier Island and involves the collation of existing geological and environmental data to identify enclosed and semi-enclosed waterbodies along the Lekki Barrier Island.

**IMPLEMENTATION PROCEDURE**

- Study and analysis of historical data from aerial photographs, remote sensing data, video mapping tapes
- Field trips to locate water bodies
- Selection of water bodies showing good potentials for further study
- Geological, chemical and biological assessment of identified water bodies
- Investigation of the seasonality and flooding regime of the water bodies
- Production of maps, charts and reports

**RESULT**

A recognisance survey carried out in 1998 identified some water bodies showing good potentials for aquacultural purposes. Further scientific investigations planned include perimeter survey to determine aerial extent, depth and bottom topography, geological, chemical and biological characteristics and seasonality of the water bodies. However, these investigations could not be carried out during the report period due to lack of funds.

**PHYSICAL AND CHEMICAL OCEANOGRAPHY**

**PROJECT:**

**ESTABLISHMENT OF AN OCEANOGRAPHIC AND FISHERIES DATA BANK**

**SUB-PROJECT:**

**ESTABLISHMENT OF AN OCEANOGRAPHIC DATA BANK.**

**RESEARCHER**

E. O. OYEWO
J. P. UNYIMADU
INTRODUCTION:

This project was initiated about 10 years ago to establish a National Oceanographic information base which could be used for scientific research, industrial and technological development, planning and decision making in the relevant areas. In principle, it was established as a centralized facility for storing Oceanographic data originating from a network of national programmes. The facility acquires, processes and disseminates data products nationally and internationally.

The format adopted for Oceanographic data is that of the Intergovernmental Oceanographic Commission of UNESCO. This ensures that the data centre can conduct international exchange with other National Oceanographic Data Centres (NODCs) in the International Oceanographic Data Exchange (IODE) programme.

OBJECTIVES:

The project aims at:

(i) establishing a computer system to cope with the processing, storage and retrieval of oceanographic data
(ii) establishing marine meteorological stations to monitor sea level rise, wind, current variation etc.

(iii) collecting, examining and measuring levels of toxic chemical species in different environmental matrices
(iv) acquisition and installation of 3 micro computer units
(v) acquisition and installation of a high pressure liquid chromatograph,
(vi) acquisition and installation of water distillation unit, freeze-dryer, and deep freezer.

JUSTIFICATION:

(i) There is a dearth of data on basic marine meteorological and oceanographic conditions of the Nigerian Coast.
(ii) The data collected so far as a result of the Institute's efforts need to be properly collated, stored and available for easy retrieval for dissemination to numerous end-users.

(iii) Data products could be developed as services to the end-user at reasonable cost;
(iv) individual scientists, ships-of-opportunity, and mariners in general need to be encouraged to contribute meteocean data for the benefit of all
SCOPE OF WORK:
(i) daily monitoring of some meteocean conditions of air temperature, sea surface temperature, rainfall, salinity, conductivity, turbidity, pH around the Harbour entrance and the Victoria beach.
(ii) Weekly monitoring of basic oceanographic parameter at Ikorodu, Julius Berger Jetty, Maroko and Osborn location of the Lagos Lagoon
(iii) Monthly lagoon research cruises to designated stations in the Lagos Lagoon for the vertical profiling of basic oceanographic parameters and the collection of water, sediment and biological samples for subsequent analyses.
(iv) Quarterly trips to offshore stations for vertical profiling of basic oceanographic parameters and the collection of water, sediment and biological samples

IMPLEMENTATION PROCEDURE:
Our meteocean monitoring programs provided data on a daily basis for sea surface temperature, salinity, conductivity, turbidity, pH and air temperature in two stations, the Victoria beach and Lagos Harbor near NIOMR Jetty. There were also research trips to 4 established stations in the Lagos Lagoon in March, April, and July. During each trip, vertical profiles of temperature, salinity and conductivity were determined.

In addition animal samples were collected to be examined for critical contaminants like organochlorine pesticides and algal toxins. Provision for relevant equipment meant for purchase have been included in the 1999-2000 rolling plan.

RESULTS AND CONCLUSION:
The pattern of variations of meteorological and oceanographic conditions as well as their interplay at the beach and the NIOMR jetty stations are summarized in Tables 1 and 2. The PSP shellfish toxin profiles in the Lagos Lagoon are shown in Table 3. The organochlorine pesticide (OCP) and polychlorinated biphenyls (PCB) levels in Hemichromis faciatus and Tilapia quineensis from the Lagos Lagoon are displayed in Table 4.
The pattern of sea surface temperature at Victoria beach in the study period shows a clearly defined maximum average temperature of 30.12°C in April and clearly defined mean minimum temperature of 28.08 in July. The pattern of surface temperature in the Lagos Harbour station is basically similar.
The salinity and conductivity cycle especially in the Harbour was found to be critically dependent on rainfall. The lowest salinity and conductivity values of 17.89 ‰ and 22,843US/cm in August recorded at the Harbour station correspond to high rainfall in July. The effect of rainfall on sea surface salinity was expectedly less significant. Turbidity and pH showed no particular trend in both the sea and Harbour stations.
Paralytic shellfish toxin profiles in P. atlanticus, T. Fusca tus, C. Gasar, T. Guineensis, C. Latimanus from the Iddo area of the Lagos Lagoon were determined by ion pair chromatography using post-column derivatization (table 3). The toxin levels were recorded as ug/1000g flesh in shellfish. HPLC analysis showed only traces of PSP toxins in shellfish from the Lagos Lagoon. There are two possible reasons for the low toxin levels in shellfish from the Lagos Lagoon; either the shellfish samples may not have been harvested at the peak of algal bloom, or that tropical low altitude high temperature prevalent in Lagos area contributes to low toxin production.

Organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) levels were analysed for in Hemichromis faciatus and Tilapia guineensis from the Lagos Lagoon using chromatography with electron capture detector (ECD) (Table 4). All levels are based on wet weights and recovery was > 70%. All the levels were low. However the levels are higher in Hemichromis faciatus than Tilapia guineensis.

(a) Tidal and current pattern in Lagos coastal waters
(b) Sea temperature, salinity, conductivity and depth profiles.
(c) Nutrient status and (Particularly marine algal productivity
(d) Studies on pollution of coastal waters and in particular the Niger delta area

3 Collaboration with established laboratories eg Friedrich Schiller University Jena Germany who analysed the samples for Algal toxins and organochlorine pesticides

4. Exchange of data with International oceanographic data centers and co-operative linkage with centers for mutual benefits.

FUTURE PLANS:
1. Determination of the concentrations of heavy metals, OCPS, PCBs and Algal toxins in environmental samples.
2. Acquisition of Data (for which there has been consistent demand) on;
TABLE I.  Monthly means of salinity, surface water, air temperature, turbidity, pH and conductivity in Victoria beach January /December.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water Temp. °C</td>
<td>28.51</td>
<td>29.29</td>
<td>29.80</td>
<td>30.12</td>
<td>28.60</td>
<td>29.54</td>
<td>28.08</td>
<td>28.21</td>
<td>28.80</td>
<td>29.25</td>
<td>29.40</td>
<td>29.50</td>
</tr>
<tr>
<td>Turbidity (FTU)</td>
<td>2.18</td>
<td>1.57</td>
<td>1.00</td>
<td>1.00</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>8.0</td>
<td>3.0</td>
<td>3.40</td>
<td>2.0</td>
<td>2.40</td>
</tr>
<tr>
<td>Salinity °/00</td>
<td>29.95</td>
<td>31.71</td>
<td>33.30</td>
<td>33.72</td>
<td>32.72</td>
<td>33.13</td>
<td>31.33</td>
<td>32.35</td>
<td>33.86</td>
<td>32.80</td>
<td>30.86</td>
<td>30.96</td>
</tr>
<tr>
<td>pH</td>
<td>7.92</td>
<td>8.31</td>
<td>8.25</td>
<td>7.60</td>
<td>7.42</td>
<td>7.51</td>
<td>7.50</td>
<td>7.63</td>
<td>8.24</td>
<td>7.99</td>
<td>7.80</td>
<td>8.20</td>
</tr>
<tr>
<td>Conductivity μS/cm</td>
<td>46,028</td>
<td>48,393</td>
<td>49,805</td>
<td>51,147</td>
<td>49,706</td>
<td>55,220</td>
<td>46,423</td>
<td>48,323</td>
<td>52,000</td>
<td>50,486</td>
<td>48,000</td>
<td>48,150</td>
</tr>
</tbody>
</table>
TABLE 2:

Monthly means of Salinity, Surface water, air temperature, turbidity, pH and Conductivity in Lagos Habour
January/December 1999

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Temp °C</td>
<td>28.40</td>
<td>28.34</td>
<td>29.94</td>
<td>29.7</td>
<td>29.08</td>
<td>28.81</td>
<td>28.25</td>
<td>28.08</td>
<td>29.04</td>
<td>28.45</td>
<td>30.41</td>
<td>31.68</td>
</tr>
<tr>
<td>Surface Water Temperature °C</td>
<td>29.49</td>
<td>29.18</td>
<td>29.69</td>
<td>30.24</td>
<td>29.93</td>
<td>29.69</td>
<td>28.70</td>
<td>29.30</td>
<td>29.40</td>
<td>29.60</td>
<td>30.14</td>
<td>29.80</td>
</tr>
<tr>
<td>Turbidity (FTU)</td>
<td>2.20</td>
<td>1.70</td>
<td>4.65</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Salinity%</td>
<td>28.51</td>
<td>30.35</td>
<td>31.69</td>
<td>31.22</td>
<td>29.21</td>
<td>30.76</td>
<td>20.22</td>
<td>17.89</td>
<td>29.79</td>
<td>28.46</td>
<td>27.80</td>
<td>26.41</td>
</tr>
<tr>
<td>pH</td>
<td>7.80</td>
<td>8.39</td>
<td>8.48</td>
<td>7.50</td>
<td>7.33</td>
<td>7.01</td>
<td>7.33</td>
<td>7.88</td>
<td>7.80</td>
<td>7.34</td>
<td>7.41</td>
<td>7.86</td>
</tr>
<tr>
<td>Conductivity uS/cm</td>
<td>43,97</td>
<td>46,550</td>
<td>48,370</td>
<td>44,953</td>
<td>45,740</td>
<td>50,510</td>
<td>28,635</td>
<td>22,843</td>
<td>45,000</td>
<td>42,130</td>
<td>42,180</td>
<td>39,140</td>
</tr>
</tbody>
</table>

TABLE 3 Shellfish toxin profile from the Lagos Lagoon

<table>
<thead>
<tr>
<th>Sample</th>
<th>GTX4</th>
<th>dc GTX2</th>
<th>Dc GTX3</th>
<th>B-TOXIN</th>
<th>dc STX</th>
<th>C-TOXIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. atlanticus</td>
<td>-</td>
<td>Trace</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T. fuscatus</td>
<td>Trace</td>
<td>-</td>
<td>Trace</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. gasar</td>
<td>-</td>
<td>-</td>
<td>Trace</td>
<td>Trace</td>
<td>?</td>
<td>-</td>
</tr>
<tr>
<td>T. guineensis</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. latimanus</td>
<td>-</td>
<td>-</td>
<td>Trace</td>
<td>-</td>
<td>-</td>
<td>?</td>
</tr>
</tbody>
</table>
TABLE 4 Organochlorine levels in T. guineensis and H. faciatus from the Lagos Lagoon.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Tilapia guineensis</th>
<th>Parameter</th>
<th>Hemichromis Faciatus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Levels ug/kg</td>
<td></td>
<td>Levels ug/kg</td>
</tr>
<tr>
<td>Lindane</td>
<td>0.31</td>
<td>Lindane</td>
<td>0.59</td>
</tr>
<tr>
<td>PP’ DDT</td>
<td>0.94</td>
<td>PP’ DDT</td>
<td>2.20</td>
</tr>
<tr>
<td>PP’ DDD</td>
<td>1.29</td>
<td>PP’ DDD</td>
<td>4.98</td>
</tr>
<tr>
<td>PP’ DDE</td>
<td>0.75</td>
<td>PP’ DDE</td>
<td>3.43</td>
</tr>
<tr>
<td>PCB 153</td>
<td>0.11</td>
<td>PCB153</td>
<td>0.18</td>
</tr>
<tr>
<td>PCB 138</td>
<td>0.05</td>
<td>PCB 138</td>
<td>0.11</td>
</tr>
</tbody>
</table>
EXTENSION RESEARCH AND LIAISON SERVICES DIVISION

RESEARCH EXTENSION FARMERS INPUT LINKAGE SYSTEM (REFILS)

Research Team:

A. M. Ajana
O. A. Ayinla
O. A. Adeogun
E. A. Ajao

In the year 1999, Extension Research and Liaison Services became a full fledged Division. This became necessary in order to ease dissemination of research findings to end users. Three sections were created from the division. The sections include:

(I) Research Extension (TECHNOLOGY TRANSFER) Section;
(ii) Extension Research (EXTENSION METHODOLOGIES);
and
(iii) Liaison Services.

The activities carried out under REFILS during the year under review are presented below:

THEME: THEMATIC SURVEY

TASK:

Impact Assessment of Hybrid catfish in Nigeria.

Justification:

Research in agriculture is expected to face tough challenges in the near future. It has to meet the rising demand for food more importantly proteinous food, at declining prices. It must provide a catalyst for the evolution of rural economies. These and many more goals must be achieved with dwindling scarce public funds.

This study evaluates and quantifies the potential benefits produced by hybrid catfish improvements through Economic Surplus Approach (ESA). These benefits are contrasted to the corresponding cost of research and extension. Moreover, the equity implications of the technology are explicitly analyzed. Such an ex post evaluation is expected to bring an improvement of the cost-effectiveness of future research projects and their planning and provide assistance in decision-making at various phases of the technology.

The study is also of particular interest because of its explicit private-public interaction. An analysis of the Hybrid fish - the first of its kind in Nigeria can provide insight into future challenges in fisheries research.

Objective: This study attempts to examine the empirical evidence on whether public investment in Nigeria Hybrid catfish research has constituted socially profitable use of scarce public resources through ex post analysis.

Specifically, the study examines the following:
- the performance of the technology in quantitative and qualitative terms.
- Estimate the returns to research effort in returns of benefits accruing to society.

**Target:**
Fish Farmers, Researchers and Extensionists.

**Methodology:**
For empirical analyses of this nature and following the recommendation of Alston *et al* (1995) the use of Economic Surplus Approach (ESA) was adopted. The concept of ESA is based on three postulates. These postulates provide a conventional framework for applied welfare economics. The postulates include:
- that the competitive demand price for a given unit measures the value of that unit to the demander
- that the competitive supply price for a given unit measures the value of that unit to the supplier
- that when evaluating the net benefits or costs of a given action (project, programme, or policy) the costs and benefits accruing to each member of the relevant group(s) should be added without regarding individual to whom they accrue.

When these assumptions are valid, consumer benefits from consumption may be measured as the area beneath the ordinary demand curve, while net changes in consumer welfare may be measured using Marshallian consumer surplus. The magnitude of these surpluses represent the gains from research accruing over the years.

**a. Discounting the cost of research over time.**
Research benefits and costs are typically spread over many years, and the costs come first. In order to compare values in different years, it is necessary to take account of how time affects economic value. The most important indicator used to compare discounted costs and benefits is the “Internal Rate of Return (IRR)” or percentage interest rate at which the present value of the costs exactly equals the present value of the benefits.

If the IRR from the research project exceeds these rates, then, the research project was a good investment in the sense that doing it raised per - capita income relative to what it otherwise would have been.

A second type of indicator used for the project was the “Net Present Value (NPV)”, which is the amount by which total benefits exceeds total costs, when these are discounted at some specific interest rate. The interest rate chosen was the opportunity cost of the fund wasted.

We then calculate the internal rate of Returns (IRR) and Net Present Value (NPV) as economic summary indicators of the technology. Equation (1) and (2) show the underlying formula.

\[
0 = \sum_{i} \frac{B_t - C_t}{(1 - \text{IRR})^t} \quad (1)
\]

\[
\text{NPV} = \sum_{i} \frac{B_t - C_t}{(1 + R)^t} \quad (2)
\]
where \( r \) is the discount rate, and \( B_t \) and \( C_t \) is the stream of benefits and costs in year \( t \), respectively.

**Data for Analysis**

For *ex post* assessment, data requirement for the hybrid fish can be subdivided into two broad groups. First, fish market data is needed. This involves produced and consumed quantities, prices and price elasticities associated with supply and demand. On the producer side, the data must be disaggregated in accordance with the different farm groups. This market related data was taken from available literature and government agricultural statistical books.

Second, information on the technology itself and its implications for agricultural practice are needed. In order to get a better understanding of this framework, information was elicited from two main sources namely: The research scientist. It is aimed to compile more information about the hybrid catfish. This involved data on research and development (R & D) costs, a time pattern of the hybrid evolution, and information on potential net yield gain. The second data was farm survey. This focused on gathering insights into fish farming system. The semi-structured interviews concentrated on farmers' access to markets, sources of fingerlings, the input-output relations of hybrid fish production, and other specific problems associated with production. These data made it possible to realistically anticipate how the technology could change current production pattern and per unit cost figures. Another crucial variable obtained from this information is the technology adoption rate \( T \). Analytically, the study generated the following:

1. The proportional change in production, \( j \) due to the new technology as proportional to the total production ‘\( J \)’ is simply the absolute total increase in supply.

\[
 j = (\delta Y * T) = \frac{J}{Y} \frac{Q}{j} \]

Where, \( \delta Y \) = Yield difference between old and new technology
\( Y \) = Average yield; total production (Q) / total
\( T \) = Adoption rate; Acreage under new technology / total acreage.

2. Increased cost per unit of the inputs required to obtain production increase from new hybrid fish \( (I) \)

\[
 I = \frac{(\delta C * t)}{Y} \]

Where, \( \delta C \) is adoption cost per unit of area switched to new technology.
\( t \) = adoption rate.
\( Y \) = is the overall average yield for both old and new hybrid. Alternatively, in proportional terms we have,

\[
 \frac{l/p}{c} = \frac{(\delta c * t)/(Y * P)}{\delta c, t and y as previously defined.}

3. Net reduction is fish production costs induced by the new technology, combining the effects of increased productivity and adoption
cost (K). It is the difference between J and I parameters.

\[ K = \frac{J \times P}{E \times Q} - I \]

Where, J is the increased productivity
I is adoption costs
Q is total output of fish
E is elasticity of fish supply with respect to price \[ E = \left( \frac{I}{bs} \right) \times \frac{P}{Q} \]

In proportional term, we have,
\[ \frac{K}{P} = k = \frac{y \times p}{E \times Q \times p} - \frac{I}{p} = j/E - C \]

The elasticity of supply measures the aggregate supply response when the producer price increase or decrease by 1%. 

4. Obtaining the change in the equilibrium quantity due to the new technology.

\[ \Delta Q = \left( Q \times E \times e \times k \right) \left( E + e \right) \]

Where, e is the elasticity of demand. The elasticity of demand measures the aggregate response of consumers when the producer price increase or decreases by 1%.

5. Social gain from Hybrid fish research (SG) from the relevant parameters constructed in the previous steps.

\[ SG = \left( K \times P \times Q \right)^{-1/2} \left( k \times P \times \delta Q \right) \text{ for an Ex-post study.} \]

An Ex-post study is conducted after the adoption has taken place.

The formula can be reduced to:

\[ SG = KQ - \frac{1}{2} K \delta Q \]

Where, \( \delta Q = QeEk \)

All the parameters are as previously defined.

6. The net social gain (NSG) is, economic benefits to society after the additional costs of research and extension have been subtracted.

\[ NSG = \text{Social Gain less public cost (Research ® and Extension)}^{(E)} \]

\[ NSG = SG - R - E \]

The final calculation to determine returns to research adopted the NPV and IRR to deduce the flow of social benefits from research program.

RESULT:

SUMMARY MEASURES OF ECONOMIC EFFECTS.

It must be noted that agricultural research is an investment activity, comparison between the streams of social benefits and social costs is best expressed as a social rate of return. One of the most appealing methods of expressing this relationship and which is universally accepted is the internal rate of return. It is defined as the annual rate of interest that makes the discounted benefits equal to the discounted costs at a given point in time. In order words, it refers to the compound rate of interest that the investment is actually earning, and has the advantage of not relying on an external opportunity cost for investment funds. Thus, IRRs are in a reasonable dimension for long term technology projects (i.e. although the benefits only occur after
a considerable time lag behind the R&D investment, there is a sufficiency high return in the future to compensate for the opportunity cost of investments).

Benefits and costs of the hybrid catfish technology was measured over the whole 1998 period. The results showed that the Internal rates of return (IRR) from public investment in hybrid catfish research was 58 percent. The IRR from public investment in hybrid catfish is indeed high. Each Naira invested in hybrid catfish research produced an average annual return of 58 percent (or \(N\) 0.58 annually) from the date of initial investment. Although the result obtained indicates a highly successful programme, compared to 10 to 20 percent rate of return expected on most ordinary business investments and from those realised from other public investment (Krutilla; Rueber and Wonnacott, 1960). The high IRR can be attributable to marketing, high income and economic incentives provided to some of the farmers to encourage adoption of the hybrid catfish. Higher return could have been obtained if fund is budgeted for extension and technical assistance to small scale fish farmers who incidentally formed the bulk producers. It could be observed that no fund was allocated for the extension of the technology to beneficiaries. Presently, occasional training for supplies of private services and temporary cost-sharing programmes for farmers that contract private specialists are supporting the distribution of fish seeds. The lack of timely financial resource availability is one of the scant use technology among the smaller farmers. Myhre (1996) even includes limited access to credit as one of the main constraints for rural modernization.

Nonetheless, the benefits - cost figure demonstrates that this investment is not only justified from an equity point of view but would also considerably enhance efficiency. It should be noted that the cost side embraces the total cost of research and transfer (the cost items associated with the project but carried by different organisations outside the Institute are not considered). If only the national costs are included, the benefits - costs relationship would be even higher.

The Net Present Value (NPV) computation was for the same period. A discount rate of 21 percent is used being opportunity cost of capital. NPV figures is given in 1998 Naira. The NPV of \(N=953,799.89\) after deflating is obtained for the hybrid catfish.

Achievement:

The technology has the greatest potential to increase producers income. Although, the potential benefits is expected to differ among farm types due to the divergent potential per unit cost reduction and anticipated adoption rates. Agricultural research still hold great economic potentials for both food producers and consumers alike in Nigeria. The actual impacts of technological innovations are not
only a function of technological characteristics but also dependent on social and institutional support mechanisms. Hybrid catfish technology of this nature should not be confined to research and development only, but should include mechanism of diffusion and application. Information on socio-economic parameters are needed to identify and eliminate institutional bottlenecks.

NATIONAL FISHERIES EXTENSION WORKSHOP

THEME:

IMPROVEMENT OF THE EFFECTIVENESS OF FISHERIES EXTENSION IN NIGERIA

Research Team:

A. M. Ajana
O.A. Adeogun
T. Agbakoba.

Justification:
The demand for fish is increasing on the requirement for supplying the vital animal protein need of the teeming population. Various programmes have been outlined to develop the Nigerian fisheries industry with a view to make her self-sufficient in fish production and bridge the wide gap between supply and demand. Presently there are lots of fisheries technologies on the shelf waiting for commercialisation. In spite of these, there had been declining productivity from all sectors of the fisheries industry for the past three decades. One major constraint to fisheries development in Nigeria is ineffective fisheries extension delivery system for technology dissemination and utilization by end users.

It is therefore important to highlight fisheries extension in Nigeria for the past five decades, examining the practices and problems and recommending strategies for an effective fisheries extension delivery system for the next millennium.

Objective: To evaluate the role played by Fisheries Extension in fisheries development and formulate strategies for improvement.

Methodology: Participants for the one-day national workshop comprised of stakeholders in Agriculture and Fisheries Extension. These included fisheries experts from Federal Department of Fisheries, Fisheries Research Institutes, Fisheries Departments of the Universities, Federal Agricultural Coordinating Units (FACU), States' Agricultural Development Projects (ADPs), Fisheries Colleges, Non-Governmental Organisations (NGOs) and the Organised Private Sector (OPS).

Topics treated during the workshop included the following:

1. Overview of highlights and problems of fisheries extension research and transfer in Nigeria for the past two decades.
2. Policies, institutions and input agencies in Nigeria fisheries extension.

4. Information management, technology transfer and formulation of skills gap analysis.

5. Improving the appropriateness of Research and Effectiveness of Technology Transfer in Fisheries Sub-sector within REFILS.


7. Gender and Youth Perspective on effective fisheries extension methods.

8. Development and transfer of effective fisheries extension packages to farmers.


**Recommendations:**
The following recommendation were reached for the improvement of the effectiveness of fisheries extension in Nigeria.

1. **Capacity building.**
Fisheries extension delivery required for improved fish production should aim at the capacity building of the fisherfolks and fish farmers by mobilising the extension workers at all levels. Such strategies must take cognizance of the peculiarity of fisheries and the constraints impeding technology package development and transfer.

Strategies for significant impact on the fisheries component must address staff development, research, the programme execution, and technology demonstration.

2. **Determination of appropriate Fisheries Research Technologies**

Technologies that must be appropriate and sustainable in fisheries must have the following features:

i) Cost and catch efficient of durable gears;

ii) Simple, portable, easy to handle, adaptable and adoptable crafts, gears and kilns;

iii) Practicable gears and crafts maintenance and preservation methods;

iv) Availability, affordability, and suitability of recommended inputs;

v) For post-harvest handling, efficient, simple, and gender friendly kilns;

vi) Low cost, efficient models for ponds and associated infrastructures;

vii) Nutrient-rich feeds that are available, cheap, and compatible with farmer’s customs and agrarian practices;

viii) Fastness of growth of fish species for quick profit turnover;

ix) Simple technical features of management inputs; and

x) Availability of technical back-up.
5. **Adaptive Research**

Adaptive Research (Farm trials) are significant in linking Fisheries Research Institute technology packages with end users. Recognition should be given to the following.

i) Updating of field situation reports in capture fisheries, aquaculture and post harvest activities. Problems encountered in demonstration and dissemination of technology packages and the level of adoption should be noted and channeled back to research.

ii) Recommendations should be made to RIs on appropriate technology required by the farmers/fisheries based on field experience and feedback from extension through the VEAs.

iii) Post-adoption research to determine the impact of the technology on the fisheries /fish farmers should be carried out.

4. **Formation of community-based extension group**

Encourage community-level extension services in addition to funding fisheries research relevant to the community’s development efforts.

5. **Fisheries division of the Agricultural Department of the Local Governments** should be integrated into the research-extension network through active collaboration with relevant development agencies.

6. **Use of Media.**

Skillful use of communication and media facilities in extension work towards fisheries development and development of fishing communities should be encouraged e.g. establishment of community viewing centres or radio listening groups.

7. **Provision of Basic infrastructure**

Fisheries extension should not only focus on viability of fish stocks but it must also focus on: (i) the health and well-being of coastal communities; (ii) employment and social cohesion of coastal communities; (iii) the economic value of fisheries; (iv) fish as the primary source of protein for millions of people; and (v) fish as critical to the stability of the marine ecosystem or as a major component in the marine food chain.

8. **Data Bank**

Establishment of an Information Data (IDB) for fisheries sub-sector is necessary to serve as depository of research findings from Research Institutes, Universities and Polytechnics. Such an IDB accessible to Fisheries Extensionists will keep them well-informed on new technologies being generated and facilitate the transfer of such to fishers/fish farmers.

9. **Stock Conservation**

Precautionary approach to fisheries is recommended: This include:

   (i) constraining fishing pressures to levels which do not reduce fish stock biomass to levels that are substantially below the range of their natural fluctuation.
(ii) evaluating new fishing gears and techniques before being introduced; and
(iii) establishment of closed areas to protect the marine habitat.

MEDIA BROADCAST
During the period under review, thirty bush radios were distributed to fish farmers, fisherfolks and fish processors in adopted villages where the Institutes’ technologies had been adopted. The States involved are Lagos, Ogun, Delta and Ondo to enable them benefit from farm technology broadcast from the various extension agencies.

EXCURSION TO THE INSTITUTE
NIOMR during the year under review received two hundred and thirty five visitors comprising: ninety six Cadet/Naval Officers; one hundred and fifteen students from tertiary Institutions and one hundred and twenty students from secondary schools. The visitors were exposed to various research activities as well as On-shelf technologies of the Institute.
AFRICAN REGIONAL AQUACULTURE CENTRE, ALUU, PORTHARCOURT

INTEGRATED CULTURE UNIT

RESEARCHERS:

E. J. Ansa, R. M. Bashir
P. M. Edun, J. Y. Opara
P. K. Mokayi, D. N. Onunkwo

GENERAL INTRODUCTION:
Integrated fish farming system is an age long practise that has been well established in several Asian countries. The main aim of this system of fish farming is to ensure an ecologically balanced and waste free system that utilises all its available resources for the maximum production of fish and other 'secondary products' of agriculture such as crops, chicken, eggs, pork etc. at relatively reduced costs. In view of the above therefore, the Integrated Culture unit in ARAC embarked on two (2) projects in the year 1999.

PROJECT TITLE:
Integrated Culture Trial of African Catfishes (Clarias gariepinus and hybrid of C. gariepinus and Heterobranchus bidorsalis) cum poultry

Introduction

The project involved the vertical integration of poultry (egg-laying birds) with the African catfish (C. gariepinus and hybrid of C. gariepinus and H. bidorsalis). In this integration no extra cost was expended on feeding fish. Spilled feeds, water and chicken droppings from the poultry fell directly into the ponds through the wooden slats on the floor of the poultry cage.

Objective:
To determine the viability of fish cum poultry integration.

METHODOLOGY:
Stocking:

Two ponds no. 14 and no. 15 each having an area of 1500m² were stocked with 800 hybrid plus 2,000 C. gariepinus fingerlings and 2,500 C. gariepinus fingerlings respectively. Both ponds were stocked in July, 1999. Each pond having a poultry house built directly over it housed approximately 400 egg-laying birds at the onset of the project. Average initial weight of fish stocked was 4.25g and 0.33g with corresponding average total length of 8.28cm and 3.76cm for pond 14 and pond 15 respectively.

Feeding:
The laying birds were given commercial layer diets twice daily. The wooden slats on the poultry floor allowed for free passage of spilled feeds, chicken droppings and cracked eggs into the ponds. This was the main source of nutrients to fish in both ponds. However a bloom
of the duckweed, *Lemna* sp. In pond 15 which covered about 90% of the pond surface served as additional feeds for the catfishes.

**Sampling:**
Sampling was carried out on a monthly basis to determine the growth increase of fish in both ponds. Twenty (20) specimens each were obtained per pond for measurements. Morphometric measurements taken include weight, total and standard lengths. Water quality parameters for the period were also determined. These include dissolved oxygen, pH and temperature.

**Results and Discussion:**
Table 1 shows the growth pattern of fish from July 1999 to October 1999. In the first one month after stocking growth increases of 96.08% and 99.54% was observed for ponds 14 and 15 respectively. Although pond 15 was stocked with *C. gariepinus*, the growth rate appeared to be high and the fish were more uniform in size when compared to the faster growing hybrid in pond 14. The presence of the duckweed, *Lemna* may have been responsible for the improved performance of *C. gariepinus* in pond 15 as fish were usually observed grazing on this aquatic weed. The final weight gain of fish from ponds 14 and 15 was 99.14% and 99.94% with a corresponding mean size of 494g and 530g respectively. The size range at harvest of fish in pond 14 was between 400g and 4,130g (4.13kg). The fish specimen weighing 4.13kg had TL and SL of 77cm and 68cm respectively. All fishes were stocked simultaneously and were of the same size and age at stocking. The African catfishes have been reported to have cannibalistic tendencies which can lead to poor harvest under culture conditions. This innate problem can be solved in one or more of the following ways:

i) by partial cropping of the fish once in two months to separate large fast growing fish from the slow growers.

ii) by the increase in supply of feeds to the fish thereby reducing competition for available feeds. Allowing each individual fish to feed adequately will ensure uniform growth.

iii) by using genetically manipulated varieties of fish selected for uniform and fast growth.

**PROBLEMS AND CONSTRAINTS:**
Supply of water to the poultry house is required. A lot of time and energy was spent to fetch potable water and transport same to the poultry house for the birds.
Table 1: Growth Pattern of African Catfish Under Integrated Fish Cum Poultry System

<table>
<thead>
<tr>
<th></th>
<th>POND 14 (AREA = 1500M²)</th>
<th></th>
<th>POND 15 (AREA = 1500M²)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Mean Weight (g) ± S.D</td>
<td>% Weight gain</td>
<td>Yield (kg)</td>
<td>Mean Weight (g) ± S.D</td>
</tr>
<tr>
<td>July 1999</td>
<td>4.25g ± 3.92</td>
<td>-</td>
<td>0.33g ± 0.38</td>
<td>-</td>
</tr>
<tr>
<td>Aug 1999</td>
<td>107.5 ± 16.64</td>
<td>96.05 %</td>
<td>71.5g ± 6.00</td>
<td>99.54%</td>
</tr>
<tr>
<td>Sept 1999</td>
<td>232.5g ± 13.69</td>
<td>98.17 %</td>
<td>170g ± 9.56</td>
<td>97.50%</td>
</tr>
<tr>
<td>Oct 1999</td>
<td>494g ± 30.83</td>
<td>99.14 %</td>
<td>415kg</td>
<td>99.94%</td>
</tr>
</tbody>
</table>

PROJECT TITLE:
Cultivation of Crops on ARAC Integrated Farms

Introduction:
Population in the tropics has recorded a steady increase in the past decade, whereas increase in food production to satisfy this population growth has not been commensurate. Recognising that crop species and varieties adapted to the different vegetation zones will give better performance than those ill adapted to such localities, pineapple and plantain were planted in the last season.

Objective:
a) To experiment and obtain high crop yields and produce to sustain population increase.
b) To utilize organic manure produced by poultry and pigs.

Scope of Work:
a) Field preparation
b) Procurement of suckers from IITA, Onne
c) Planting, mulching and fertilisation of the crops

IMPLEMENTATION:
Procedure:
Fields were prepared using manual labour. Suckers were obtained from IITA, Onne. Plants were watered well just before planting, this took place immediately after field preparation. Plantain holes were prepared with a minimum size of about 30cm x 30cm, the recommended spacing within and between the row is 2.5m x 2.5m. For the pineapple, planting gap of 100cm x 100cm was used. Plant holes were mulched and manured using ARAC poultry and piggery waste according to recommended cultural practices in the area.

Result:
A high yield is expected at the end of the gestation period.
**Future Plan:**

Cultivation of Telfairia and Cassava will commence in the next planting season.

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**HATCHERY UNIT**

**RESEARCHERS:**

A. Uka, R. M. Bashir, S. O. Akog
B. S. Mnyanchie, M. M. Akinwale
J. N. Amadi

**PROJECT TITLE:**

Mass Production of Improved Cultivable Fish Fingerlings

**INTRODUCTION:**

Following an upsurge of interest in fish farming consequent upon increased awareness in Aquaculture, and less emphasis in capture fisheries as a result of escalated cost of fuelling and maintaining fishing vessels; there has been an increased demand for fish fingerlings of cultivable fish species. In order to meet up with the current high demand for fish fingerlings the unit research effort is channelled towards achieving steady supply of quality fish fingerlings all year round. The approach is to develop genetically sound brood stock lines through genetic selection and hybridization and to mass produce the improved strains as well as to develop improved fry and fingerlings rearing methods.

Low seed availability is associated with

- Inbreeding resulting from unguided breeding operations.
- General neglect and non recognition (for proper attention) of the critical periods (periods of increased mortality) of larvae and fry by most breeders.
- Menace of fry and fingerlings predators.

To improve on fish seed supply, detailed information on the factors hampering availability is imperative. The aim of the project therefore is to provide such information, as well as to give cue to their control options for better fingerling production.

**OBJECTIVES:**

i) To quantify the efficacy of different breeding programmes in ensuring genetic stability of breeding stocks and in checking genetic drift in production characters;
ii) To identify breeding options that will maintain wild genetic variance and good production character;
iii) To identify the period beyond which fry will perish subsequent to starvation even if food is provided; for further scientific understanding of the species and for improved fry management;
iv) To relate body size and time of attainment with period of increased mortality;

v) To identify development of certain organs that are associated with increased mortality; and

vi) To investigate the predatory role of certain aquatic faunas on fish fry, fingerlings and zooplankton which fish fry equally depend on.

JUSTIFICATION:
Unguided breeding exercise may lead to long-term exhaustion of genetic resources and production criteria they are aimed to protect. Therefore understanding the effectiveness of different breeding programmes in ensuring genetic stability of breeding stocks and in checking genetic drift production characters is imperative in brood stock development.

In course of development, fish larvae, fry and fingerlings meet with several challenges to survival culminating in increased mortality. Investigation of causative factors of such challenges at different stages of fish growth and the distinct periods of their expression is relevant for proper control measure; in effort to improve hatchery management technique.

SCOPE OF WORK:
Different culture strains from different rivers and farm locations in Nigeria are to be studied. Activities will include:

i) Characterization.

ii) Comparing different breeding programme.

iii) Monitoring development and challenges of survival at every stage of development.

iv) Determining fry and fingerlings predatory potential of different aquatic faunas.

TARGET:

i) To reveal the strength of different breeding programmes in enhancing production characters and in conserving genetic diversity.

ii) To distinguish distinct stages and sensitive periods in development of seeds of cultured species.

iii) To identify organs formation and extraneous factors associated with increased mortality and the specific periods of their expression in culturable species.

iv) To identify aquatic faunas that could prey on different stages of culture fish species and zooplanktons and to establish affordable predator control measures.

IMPLEMENTATION PROCEDURES
Cultivable species were sourced from different locations. Procured strains were characterized morphologically, Karyologically and serologically using standard methods.
in order to establish genetic distance between geographically separated species. Number of breeding programmes were carried out with genetically defined strains, in order to determine the breeding coefficients of each of the breeding programmes.

Seeds were multiplied from almost the breeding programmes, and adult fish being raised will be assessed for production character, breeding criteria and genetic soundness. Development and challenges to survival at various stages of growth are being monitored right from fertilization to sexual maturity.

**SUCCESS ACHIEVED**

Culturable species (*Heterobranchus bidorsalis* 18 females and 6 males, *Heterobranchus longifilis* 22 males and 55 females) were procured from River Niger and farm location in Port Harcourt respectively. 150 *Clarias gariepinus* from 3 farm locations (Osogbo 30, ARAC 60 and Lagos – Holland – 60) already characterized and partially selected for enhanced growth and size uniformity were provided for the research study. In addition, 120 number *Oreochromis niloticus*, 20 *Oreochromis aureus* and 120 *Sarotherodon galileaus* were selected from ARAC farm for the work.

All the specimens species procured were characterized morphologically, Karyologically and antigenetically. Breeding trials for realised heritability estimate in growth was carried out with *Clarias gariepinus* and *Heterobranchus* species for effective choice of selective programme.

Sensitive periods including period of pronounced size variation (table 1.0) and mortality effect of delayed extraneous feeding of *Clariids* fry were studied(table 2.0).

Hybridization among the cichlids for monosex male production was equally initiated with reciprocals of *Oreochromis niloticus*, *Oreochromis aureus* and *Sarotherodon galilaeus*.

Several predatory aquatic faunas were catalogued and are being monitored for their fry and fingerling predatory activities in nursery ponds.

**PROPOSALS FOR COMPLETION**

i) Continuation of comparative study of the efficiency of different breeding programmes in checking genetic drift in production characters.

ii) Determining critical stages including effect of delayed feeding in remaining aquaculture species.

iii) Further identification and control measures of fry and fingerlings predatory faunas in fish ponds.
Table 1.0 Daily Size Variation in population of *Clarias gariepinus* and *Heterobranchus longifilis* male x *Clarias gariepinus* female (Cg<sub>f</sub> HL<sub>m</sub>) fry

C.V(%) = Coefficient of Variation in percentage.

<table>
<thead>
<tr>
<th>Days</th>
<th>5</th>
<th>7</th>
<th>9</th>
<th>11</th>
<th>13</th>
<th>15</th>
<th>C.V(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cg&lt;sub&gt;f&lt;/sub&gt; HL&lt;sub&gt;m&lt;/sub&gt;</td>
<td>6.5</td>
<td>4.6</td>
<td>6.4</td>
<td>7.2</td>
<td>6.0</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.7</td>
<td>6.1</td>
<td>6.3</td>
<td>7.1</td>
<td>5.1</td>
<td>4.5</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.0 Mortality due to delayed feeding of *Clarias gariepinus* and *Clarias gariepinus* female x *Heterobranchus longifilis* male (Cg<sub>f</sub> HL<sub>m</sub>) hybrid fry

<table>
<thead>
<tr>
<th>Days of Starvation</th>
<th>3</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9% Survival During Starvation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Clarias gariepinus</em></td>
<td>100</td>
<td>100</td>
<td>92.5</td>
<td>92.5</td>
<td>82.5</td>
</tr>
<tr>
<td>*Cg&lt;sub&gt;f&lt;/sub&gt; HL&lt;sub&gt;m&lt;/sub&gt;</td>
<td>100</td>
<td>95</td>
<td>92.5</td>
<td>82.5</td>
<td>67.5</td>
</tr>
</tbody>
</table>
SAPELE RURAL EXPERIMENTAL FIELD STATION

RESEARCHER:
G.A. OLADOSU

INTRODUCTION
Towards the development and standardization of sustainable agricultural production systems based on result obtained from enterprise combination researches, the Nigerian Institute for Oceanography and Marine Research established a new station in the Sapele Local Government Council of Delta state.

The station took off on the 14th of May 1999 with eleven staff members redeployed from NIOMR headquarters, Lagos, and the African Regional Aquaculture Center (ARAC), Port Harcourt. Prior to this time, a 50ha swamp was acquired for the take-off of the Station at Okuovu II in the aforementioned LGA. However, due to the season of the year and the terrain of the acquired land, immediate take-off of the farming activities could not be ensured. To this end, another 50 ha farmland was further allocated to the station at the Dhegele communal farm, in response to the request made by the station to the Delta State Government, through the State Ministry of Agriculture.

A total of two hectares have since been cleared, and engaged in arable crop production, prior to the completion of the facilities for fish farming.

ACTIVITIES
ARABLE CROP PRODUCTION
A total of two (20 hectares of farmland were cleared, ploughed, harrowed and ridged for crop cultivation. Amongst crops cultivated are cowpea (0.8ha), ugu (0.2ha), Okra (0.6ha) and pineapple (0.1ha).

Pineapple suckers and Okra seeds were procured from the National Institute for Horticultural Research (NIHORT) Ibadan. Ugu and Cowpea seeds were procured locally. Presently, the cowpea and the Okra have started fruiting, while Ugu is also ready for harvest.

FISH PRODUCTION
A 0.02ha earthen pond and a 4ft² hatchery tank have been constructed for fish production. Impoundment of two facilities will be done as soon as a borehobe is constructed. The facilities, which are intended for fingerling production will be enlarged as fund is made available. With the completion of these facilities and the imminent provision of a borehole, fish production is expected to commence soonest.

STAFF TRAINING AND TEMPORARY APPOINTMENT
Three staff members were trained in snail farming at the Rubber Research Institute of Nigeria (RRIN), between July and August 1999. In November, two study visits were also made to the International Institute for Tropical Agriculture (IITA), Ibadan, to acquire information on farmland
preparation and development, as well as farm planning.

OFFICE ACCOMMODATION
Office accommodation was secured within the Nigerian Stored Product Research Institute (NSPRI), complex at Sapele. Slight renovation and partitioning was carried out, while the joinery section of NIOMR’s Technical Services Division made the furniture. A direct telephone line was also acquired to ease communication with the headquarters.

COMMUNITY RELATIONS
Relationship with all communities associated with acquired farmlands is cordial. Community members were involved in farm activities ranging from weeding and planting to pond construction. The station also enjoys the confidence of the Local Government Council and the monarch of Okpe Kingdom.

Constraints
A) Lack of water for irrigating the arable corps and for the impoundment of the newly constructed fish pond and hatchery tank constitutes a major problem. Some of the crops actually suffered sunburn due to lack of water. Obviously, fish production could not commence as well.

B) Survey of the acquired farmland is yet to be carried out. A proper farm development can only be achieved with a survey map.

C) Inadequate funding has made development very slow.

RECOMMENDATIONS
A) Adequate funding is required to ensure rapid development.
B) Survey of the acquired farmlands should be carried out as soon as affordable, even if it will be done in phases.
C) Provision of water source for the farm is very important, as this will enhance productivity.
INFORMATION AND DOCUMENTATION

HEAD: T.O. SOYANWO

INTRODUCTION

The library services unit was upgraded to a full Division with the new name INFORMATION AND DOCUMENTATION DIVISION during the year under review when a documentation section was established. The two sections which make up the Division are Library services and Documentation and Publications Unit.

Since the inception, the division continued to contribute to the development of the Institute by improving on its services.

LIBRARY SERVICES

Library Collection

Acquisition by direct purchase was limited due to inadequate funding, but materials were received from exchange partners, International organisations – IOC, ICLARM, UNESCO, UNDP, UNIDO, FAO, IDAF, IMO, WHO, OAU, sister Research institutes – National Agricultural Research Institutes and Science and Technology Research Institutes as well publications from officers who went on training or exchange programmes. These – materials had been useful additions to NIOMR collections.

LIBRARY EQUIPMENT

Ten units (10) of reading carrels were added to the function as well as soft cushion chairs (60 for browsing, a dailies rack for newspaper, a low coffee table for the browsing area of the library as well as a computer and its accessories from NARP. Some computer soft-ware were also acquired.

CURRENT AWARENESS

The division participated in the mini-exhibitions set up for important personalities to the Institute.

STATISTICAL DATA

A) Total Holdings

<table>
<thead>
<tr>
<th>TITLES</th>
<th>VOLUMES</th>
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<tr>
<td>Books</td>
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<td>Journals</td>
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<td>Reports</td>
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<tr>
<td>Dissertation</td>
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<td>Compact Disk (CD)</td>
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B) Loans (Books)

<table>
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<tr>
<td>To staff</td>
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<tr>
<td>To others</td>
<td>NIL</td>
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<td>From other libraries</td>
<td>NIL</td>
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</tbody>
</table>

C) Loans (Journals)

<table>
<thead>
<tr>
<th>TITLES</th>
<th>VOLUMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>To staff</td>
<td>520</td>
</tr>
</tbody>
</table>

D) Total Number of users 7969

CONCLUSION
The year had been an encouraging one and the Division, although new had been able to contribute the growth of the Institute. With the Documentation Unit in place, most of the Institutes publications are now done in house and this had saved the Institute a lot money. Late night closing and a shift arrangement were introduced in the Library to preparatory to Internet connectivity being arranged.

DOCUMENTATION UNIT

J. O. OYEGOKE, M. KALU

INTRODUCTION

The Documentation and Publications Unit was established in 1998 under the Library, which was later renamed Information and Documentation Division. Basically Documentation Unit is to handle designs of prints for the Institute.

The Documentation Unit became fully functional in January 1999 when a clone computer and a HP commercial printer were procured to actually start its maiden production of 1995 annual report. The unit still has a lot of teething problems; Hopefully, it will eventually overcome them as time goes by and the equipment for production are procured.

HIGHLIGHT OF MAJOR ACTIVITIES

Production

- During the report year (1999) the Unit typed, designed, printed, collated and stitched the 1995 and 1996 annual reports which were long overdue and held up by a bill for =N=0.6M each.
- Designed and printed personalized season cards for the Institute
- Designed and printed labels for the tuna fish cannery;
- Designed and printed the GEF/UNEP/FAO report on Regional workshop on reduction of the Impact of Tropical Shrimp Fisheries on Living marine Resources and their environment.
- Designed Adverts for NIOMR's 12 week practical Aquaculture training programme
- Designed the certificates for training programmes.
- Design and printing of book marks for staff
- Designed and printed posters for exhibition and a lot more as directed.
TECHNICAL SERVICES

INTRODUCTION:
Technical Services is charged with the responsibilities of:

i. Maintenance and upkeep of the Institute’s physical assets and direct labour execution of minor works projects and

ii. Provision of engineering services to research in the form of engineering studies and designs, prototype fabrication and trial demonstration of equipment in fisheries, marine technology and oceanography.

The human resources of the section include 2 Engineers, 1 Technologist, 3 Technicians and 20 Tradesmen in ten trades and technical skills operating in two workshop complexes within the Lagos headquarters.

Major among the assets base of the Institute are the only Research vessel, a pole and line Tuna boat MV “SARKIN BAKA”, office and residential buildings, 5 diesel-electric generators (25 – 310) KVA generating capacities, 2 cold rooms, one water production system, fish processing pilot plant equipment, audio and visual communication equipment, science laboratory equipment and engineering workshop equipment. 1999 saw many desk top personal computers added to the Institute’s list of assets.

MAJOR WORKS PROGRAMMES EXECUTED IN 1999:
The first phase of the turn-around refurbishment of MV “Sarkin Baka” was over 95% completed by March 1999. She was still mooring at the dockyard, awaiting further release of funds to get into the second phase of repairs at the close of the year.

The NARP bore hole project was commissioned early in the year for operation. The teething problems diagnosed in its operation were dealt with during the year. The bore hole was in a perfect operating condition at the close of the year. However, a lot still needed to be done on the water treatment plant and the main treated water tank for a trouble-free potable water delivery in the Institute.

In conjunction with the Federal Ministry of Works, the Institute's Consultants and a few firms of Architects, the problems with the Jetty slabs were thoroughly re-examined and studied in-depth. Alternative solutions were proffered in many new designs. All the new designs were reviewed during the year and the Consultants were mandated to complete tender documents awaiting availability of funds to complete the award of the contract. The same went for roofing of block ‘B’, painting of the Technical Services Block and completion of junior staff Quarters at Badore.

In addition to the above, the acquisition of NITEL telephone line for Library Internet Services was initiated during the year and the
Carpentry and the Metal Fabrication units were the busiest units during the year accomplishing numerous construction works including furniture works for the newly established out-station of NIOMR in Sapele and burglary proofing of windows and doors.

CONSULTANCY ACTIVITIES AND PROJECTS WITH OTHER BODIES:

- Work on the NIOMR/SPDC Jeddo project really started in November 1999. Except for disturbances by Community Youths towards the end of the year, which had since been resolved, work progressed satisfactorily into the new year.
- The Forcados-Yokri Integrated Plant also of SPDC witnessed a demonstration of the Jeddo Equipment prototype, became interested and started negotiating another project with NIOMR to be based in Forcados. Negotiations had reached an advanced stage by the close of the year.
- ARCT Dakar released funds for the “Agro-Food Enterprises in West Africa” project during the year. Funds were yet to be disbursed at the close of the year.
- NIOMR opened up Communication with the Bayelsa State Government on introducing the Magbon-Alade Fish Smoke-drying Equipment to Entrepreneurs in that State. Proposals were submitted during the year for training and supply of Fish Drying Kilns to that state.
ADMINISTRATION DIVISION

ADMINISTRATIVE SECRETARY,

Changes in personnel and records at the Institute in 1999 are shown in Tabular forms below.

Twenty three Junior officers appointments were confirmed, and four women changed names because of marriage. Four births were recorded and six officers were upgraded.

TEMPORARY APPOINTMENT

<table>
<thead>
<tr>
<th>S/NO</th>
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<td>Edeki A.</td>
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**CHANGE OF NAME**

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**BIRTH**

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**UPGRADED**

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## CONFIRMATION OF APPOINTMENT 1999 JUNIOR STAFF

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<tr>
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<td>1.</td>
<td>E. I. Uka</td>
<td>Per. Asst. III</td>
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<td>2.</td>
<td>Mrs. V. O. Arowolo</td>
<td>Accounting Asst. I</td>
<td>03</td>
<td>Finance &amp; Supply</td>
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<td>K. S. Ologun</td>
<td>Craftsman</td>
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