WEST AFRICA AGRICULTURAL PRODUCTIVITY PROGRAMME (WAAPP- NIGERIA)

TRAINING BROCHURE ON AQUACULTURE PRODUCTION AND POST HARVEST TECHNOLOGY

Prepared By

NATIONAL CENTRE OF SPECIALIZATION IN AQUACULTURE
FORWARD

The West Africa Agricultural Productivity Programme is a World Bank assisted agricultural productivity programme for ECOWAS member countries, aimed at increasing and improving sustainable agriculture while promoting sub-regional integration through technology generation and dissemination.

WAAPP-Nigeria’s mandate under component 2 is to become the centre of specialization in aquaculture. It is in the light of this that the Nigerian Institute of Oceanography and Marine Research (NIOMR), National Institute for Freshwater Fisheries Research (NIFFR) and the Nigerian Stored Products Research Institute (NSPRI) were selected as the National Centres of Specializations (NCoS), by reason of their various national research mandates.

This training brochure on Aquaculture Production and Post-harvest Technology is therefore produced with the view to build the capacity base of all stakeholders along the aquaculture value chain and ultimately resulting to improved and increased productivity.

This brochure covers wide range of vital topics that will be periodically reviewed and expanded to capture new findings that will unfold. It is hoped that the content of the modules will be beneficial to the targeted audience and beyond!

Prof. D. O. Chikwendu
National Project Coordinator
WAAPP-Nigeria
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Preface

This training brochure has been prepared for use by professionals in the sector that cut across stakeholders in public and private institutions, non-governmental organisations, civil society organisations, individuals and other developmental agencies that are responsible for shaping the enabling environment of the aquaculture value chains. Typically, the training programme is designed for:

- policy makers responsible for drafting strategic development policies and/or the implementation of these and particularly related to pro-poor, gender and smallholder inclusive development;
- development practitioners and managers of organisations responsible for drafting and/or executing market-driven development projects;
- staff of institutes of higher education and (applied) research, especially those involved in community outreach and/or research uptake;
- staff of local service providers, civil society organisations, community-based organisations and business associations;
- private farmers, prospective farmers, youth, business men and women and fish mongers.

The overall objective of this training programme is to enhance trainee’s capability to effectively contribute to the development of aquaculture sector. Specifically, the training programme is expected to provide all the guidance, resources, and support systems necessary to enable trainees to prepare themselves for effective service delivery either as fish farmers or change agents. In addition, the programme will assist the trainees develop greater self-awareness, identify their strengths and weaknesses, and prioritize their efforts to improve in areas most critical to their personal effectiveness.

This brochure is not intended to be a comprehensive, step-by-step guide to aquaculture training. Training is a dynamic process, constantly evolving, and always needs to be tailored to the unique circumstances of each trainee and or
organisation. This includes the needs of the trainees, the objectives of the aquaculture projects, and the personalities and styles of the training staff.

Participants’ cases are the starting point from which the programme departs. It builds on the participants’ own experiences and situations. A selection of these cases will be further analysed and elaborated throughout the course. In a learning by doing and step-by-step process, strategic action plans are developed to improve these situations. The resulting action plans are the ‘take-away-home’ outputs of the programmes.

The training uses interactive methods. Topics are dealt with in a combination of lectures, plenary and group work, study assignments and role plays. The programme includes field work at farm sites, and interaction with policy makers and researchers to discuss and refine strategies for aquaculture development. In order to ensure this training is relevant, current and applicable to industry standards at state, national and international levels, trainees undertake an intensive onsite work-based component. Trainees must undertake all activities associated with aquaculture, including the production of live feed for fish culture, the handling and culture of fish, the design and management of aquaculture systems, the transportation of live fish and fish products, value additions and the application of knowledge and practical skills for scientific research. The technical sessions described here are meant to serve as guidelines. They should be revised and adapted to the specific situations and logistical constraints of each training programme.

The brochure covers 23 courses, including aquaculture – pond construction and engineering; fish breeding and management, fish feed formulation and production; harvest techniques, preservation technologies, processing technologies, package and packaging materials, quality control systems, post-harvest handling of agricultural crops, value additions, to logistics and additives used in handling and processing, marketing etc.
About WAAPP

The West Africa Agricultural Productivity Programme (WAAPP) is a World Bank assisted Programme for members of the Economic Community of West African States (ECOWAS). One of the goals of the WAAPP is to encourage integrated development of agricultural research into the technology generation and dissemination (TGD) continuum throughout the sub-region. The project has four components namely:

1. Enabling conditions for sub-regional cooperation in technology generation, dissemination and adoption
2. National Centre of Specialization in Aquaculture
3. Funding of demand–driven technology generation and adoption
4. Project coordination, management, monitoring and evaluation

The objective of Component 2 of this project is to develop and release top-notch technologies in aquaculture for adoption in Nigeria and ECOWAS countries to increase productivity. This component is being carried out in collaboration with the following National Centres of Specializations (NCoS): the National Institute for Freshwater Fisheries Research (NIFFR), New Bussa; Nigerian Institute for Oceanography and Marine Research (NIOMR), Lagos and the Nigerian Stored Product Research Institute (NSPRI), Ilorin. WAAPP-Nigeria is expected to conduct training workshop to show-case the technologies that have been generated by the NCoS as well as sister research organizations within Nigeria, over the years, and in other ECOWAS countries.

It is in the light of above, that WAAPP-Nigeria is creating and developing this platform for researchers, stakeholders and policy-makers within the West African Sub-region to come together, examine what technologies are available and see how these and new ones could be transformed through research collaboration, partnership and dissemination of improved practices that will ensure the sector delivers expected and sustainable benefits to stakeholders.
i. Nigerian Institute for Oceanography and Marine Research (NIOMR)

The Nigerian Institute for Oceanography and Marine Research (NIOMR) was created by the Research Institutes Establishment Order (1975) with effect from 1st November, 1975. The headquarters of the Institute is located at the Bar Beach contiguous to the Atlantic Ocean, Lagos, Nigeria. The main research departments in the Institute are; (i) Aquaculture (ii) Fisheries Resources (iii) Fish Technology/Biotechnology (iv) Biological Oceanography (v) Physical/Chemical Oceanography (vi) Marine Geology/Geophysics. There are also four Services departments namely; (i) Finance and Supply (ii) Administration (iii) Technical Services and (iv) Information and Documentation.

MANDATE

NIOMR is charged with the responsibilities to conduct research into the resources and physical characteristics of the Nigerian territorial waters and the high seas beyond.

Specifics of the mandate include:

- Genetic improvement of marine and brackish water fisheries and other aquatic resources in Nigerian brackish and marine waters
- Abundance, distribution and other biological characteristics of fisheries and other aquatic resources in Nigerian brackish and marine waters.
- Improvement of brackish water aquaculture.
- Effective and sustainable management of fisheries resources through improved post-harvest preservation, utilization and storage using profitable technological processes.
- Physical characteristics of the Nigerian Territorial waters, the high seas beyond, topography of the sea bed, and deposits on or under the sea bed.
- Effects of pollution of Nigerian coastal waters and its prevention.
- Extension research and liaison services in areas of mandate.

### PROFILE OF SOME OF THE NIOMR RESOURCE PERSONS

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<th>Name</th>
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<tr>
<td>1</td>
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<td>Executive Director/CEO</td>
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</table>
II. Nigerian Stored Products Research Institute (NSPRI)

Nigerian Stored Products Research Institute (NSPRI) has its headquarters located at km 3 Asa Dam Road, Ilorin in Kwara State of Nigeria. The Institute has six outstations located in Ibadan, Kano, Lagos, Maiduguri, Port-Harcourt, and Sapele.

Nigerian Stored Products Research Institute is one of the Research Institutes under the supervision of Agricultural Research Council of Nigeria (ARCN) in the Federal Ministry of Agriculture and Natural Resources. The Institute was established in 1948 as West African Stored Products Research Unit (WASPRU) during the colonial era to assess the quality of exportable crops from Nigeria, Ghana, Sierra Leone and Gambia to United Kingdom. It became Nigerian Stored Products Research Institute after the independence in 1960.

Mandate

The Nigerian Stored Products Research Institute shall conduct Research into the post-harvest handling, identify problems of agricultural commodities and fabricate pilot scout post-harvest handling equipment. NSPRI shall disseminate results of research through appropriate Extension methods to improve competence and skills of farmers, industrialists, produce handlers and inspectors. It shall also in collaboration with other agencies, develop standards for marketing of agricultural commodities. The institute shall, in particular, conduct research into:

- Improvement and maintenance of quality of perishable crops including all roots and tuber crops, fruits and vegetables and other such crops.
- Improvement and maintenance of the quality of durable crops including cereal grain, pulses, oil seeds from the farm level to commercial level including export.
- Improvement and maintenance of the quality of tree crops including cocoa, kola, palm produce, coffee, cashew and shea nut.
- Designing, fabricating and developing postharvest equipment to the pilot plant stage. Specifically conduct studies into the improvement of food storage structures, primary processing equipment and food packaging.

- Improvement in the primary processing methods of livestock products including milk, meat, fish and related products and conduct research into packaging and proper storage of dried meat, fish and related products to maintain quality.

- Provide methods to improve the skill and build capacity building in postharvest technology through formal training of farmers, industrialists, food handlers, inspectors and extension workers in food preservation technique.

- Developing food standards to improve the quality of food commodities after harvest, which will aid in the marketing of produce in both local and export markets. Also conduct studies on the impact assessment of technologies and processes developed by the Institute.

- Provide advisory services on post-harvest food handling and preservation.

- Conduct special studies on stored products pests, pesticide formulation and mycotoxin survey.

- Create a database for published research findings and human resources directory in post-harvest science.

- Any other related matters as may be determined from time to time by the supervising ministries/agency.

The Institute has widened its research activities in the area of value addition and postharvest loss reduction that can match global standards. The Institute’s present efforts are to develop quality standards for the processing of agricultural products useful for small and medium scale enterprises in Nigeria. Efforts are also been made to develop effective packaging for agricultural products (especially fruits) that will enhance the marketability of the products locally and internationally. These will in long run create job and wealth for the farming populace in the country. Moreover, the Institute will intensify its efforts to disseminate the developed technologies to the end users through our extension and liaison services.
## PROFILE OF SOME OF THE NSPRI RESOURCE PERSONS

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<tr>
<td>1</td>
<td>Prof. Olufemi Peters</td>
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III. National Institute for Freshwater Fisheries Research (NIFFR)

National Institute for Freshwater Fisheries Research, New Bussa, was established in 1968 as "The Kainji Lake Research Project" by the Federal Government of Nigeria with assistance from the United Nations Development Programme (UNDP). At the initial stage, the mandate of the Institute was to carry out multidisciplinary activities on the Kainji and other man-made lakes in Nigeria in the following areas: - Fisheries, Wildlife, Agriculture, Limnology, Public Health, Sociology, Economics and Range Management with the objective of making the research results available for the development of the country. In 1987 the mandate changed to mono-commodity and research activities were centered to the present areas of Freshwater Fisheries and other Aquatic Resources.

Mandate
In 1987 the mandate changed to mono-commodity and research activities were centered in the following areas of Freshwater Fisheries and other Aquatic Resources such as:-

(a) genetic improvement of freshwater fishes and other aquatic resources in rivers and lakes (Natural and man-made);
(b) the abundance, distribution and other biological characteristic of freshwater fishes and other aquatic resources;
(c) hydrological behaviour of natural and man-made lakes;
(d) Limnology of surface and ground water around natural and man-made lakes;
(e) rational exploitation and utilization of freshwater aquatic resources;
(f) ecological and socio-economic effects of the development of man-made lakes;
(g) aquaculture.

The Institute shall also:

(i) carry out extension research liaison with Federal and State Ministries, primary producers, industries and other users of research results on matters of freshwater fisheries and other aquatic resources in collaboration with National Agricultural Extension Research and Liaison Services;

(j) provide technical and vocational training in Freshwater Fisheries and related fields leading to the award of National Diploma; and,

(k) provide laboratory and other technical services to fish farmers, industry and others concerned with freshwater fisheries problems.
# PROFILE OF SOME OF THE NIFFR RESOURCE PERSONS

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<td>1</td>
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Course I: SITE SELECTION, POND DESIGN AND CONSTRUCTION

Introduction

Participants will acquire theoretical knowledge and practical skills in site survey, designs and construction of various kinds of ponds. Participants are also expected to collect and analyze physico-chemical properties of soil and water from chosen sites. Development of recirculation aquaculture systems using local filter materials and calculation of water supply requirements to ponds are also an integral parts of the course.

Course Outline

- Introduction to fish pond construction
- Classification of fish ponds
- Soil sampling and analysis
- Soils and citing of fish ponds/farms
- The problem of acid sulphate soils
- Soil particle size analysis
- Fish pond site surveying
- Survey of sources of water for fish farming
- The problem of pH and iron content of water
- Water pumps for fish farming: selection and maintenance
- Socio-economic factors in site selection for fish farming
- Evaluation of site selection survey data
- Feasibility report writing in aquaculture engineering
- Design of concrete tanks and earthen ponds
- Construction of concrete and earthen ponds
- Design, construction and installation of recirculation aquaculture systems
- Design, construction and installation of flow-through system
- Maintenance and management of ponds, fish tanks and farm tools

Duration: 10 days

Course Fees: US$ 2000
Course II: FISH FINGERLING PRODUCTION AND HATCHERY MANAGEMENT

Introduction

The objective of this course is to equip participants with skills in the latest techniques for mass production of African catfish and all male tilapia fingerlings. Participants will learn how to develop brood-stock for production of healthy and fast growing fingerlings, hatchery management techniques, and bio-security measures for disease prevention and control.

Course outline

- Status of fish seed production in Nigeria
- Breeding of selected culturable fresh water fish of commercial importance (catfish, tilapia)
- Brood-stock management, feed requirements/fattening
- Fry rearing techniques
- Stripping and Incubation
- Water Quality Management
- Hatchery Management
- Production of live feed for rearing larvae
- Feeds formulation and production for fingerling production
- Production of artificial feeds for larval rearing
- Nursery pond preparation and management
- Hatchery tools and equipment: identification, uses and maintenance
- Prevention and control of hatchery fish diseases
- Site selection and construction of hatchery (Tilapia and catfish)
- Feasibility and economics of fingerling production
- Handling, packaging and transportation of live brood stock and fingerlings of catfish and tilapia
- Record keeping in fish hatchery.

Duration: 14 days
Course Fees: US$ 2000
Course III: INTRODUCTION TO
FISH GENETICS AND
BIOTECHNOLOGY

Introduction
Impact of human activities on the environment and its attendant degrading effect on natural water bodies resulting in insignificant fish harvest from the wild. Though aquaculture is globally practised, the demand of over 1 billion people who rely on fish as their main protein source has not been fully satisfied. In order to meet these demand, a high range of technologies of diverse sophistication are been employed across the nations. While many researchers and private corporations are pursuing the potential gains of molecular genetics and other highly technical approaches to the improvement of aquacultured species, the vast majorities of aquaculture producers throughout the world have little access to or interest in these approaches. This training therefore intends to expose farmers and other practitioners to the rudiments of aquaculture genetics and its practical applications to bring about the much desired impact in the sector.

The primary objective of this training is to provide basic training on the application of genetics and molecular approaches to solving day-to-day problems confronting fisheries and aquaculture development. At the end of the training, the participants are expected to utilize the knowledge acquired to solve the day today problems relating to fisheries and aquaculture such as:

- Higher growth rate
- Greater efficiency of food use
- Resistance to disease
- Tolerance to adverse environmental conditions
- Dressing percentage
- Others (species specific)
  - Catchability, age at maturation, fecundity

Course Outline

1. Introduction to Aquaculture genetics
2. Use of genetics in aquaculture
3. Fish seed Propagation Techniques
4. Control of Genetic Quality under Hatchery Conditions
5. Application of Genetics in Fisheries Management And Genetic Conservation
6. Genetic enhancement approaches in aquaculture:
   i. Traditional Approaches
      - Selection
      - Hybridization
      - Broodstock Management
   ii. Advanced approaches
      - Ploidy induction
      - Genogensis / Anderogensis
      - Genetic engineering

Duration: 7 days

Course Fees: US$ 2000
Course IV: PRACTICAL GENETICS
APPLICATION FOR
AQUACULTURE AND FISHERIES
MANAGEMENT

Introduction

Genetic improvement of fish and shellfish population is a key strategy for increasing efficient production in a sustainable manner. To facilitate genetic improvement, new knowledge of the genome and its interactions with environmental factors must therefore be acquired in a comprehensive framework pertaining to animal adaptation and wellbeing, reproductive efficiency, nutrient utilization and conversion to animal products and product quality. NCoS-NIOMR is therefore pleased to introduce this practical genetics application for aquaculture and fisheries management. The training is designed to further provide a basic understanding of the modern molecular techniques currently used in aquaculture research, primarily finfish aquaculture, such that trainees can develop and understanding of both the power and limitations of molecular biology.

The aim of this training is to provide a comprehensive practical tool for the generation and analysis of genetic data for subsequent application in aquatic resources management in relation to genetic stock identification in inland fisheries and aquaculture.

The practical based training will cover general background on genetics in relation to aquaculture and fisheries resource management, the techniques and relevant methods of data analysis that are commonly used to address questions relating to genetic resource characterization and population genetic analyses.

The training will be in two stand-alone parts:

Part 1: Conceptual basis of population genetic approaches. This will provide a basic foundation on genetics in general, and concepts of population genetics. Issues on the choices of molecular markers and project design will discuss.

Part 2: Laboratory protocols, data management and analysis. This is expected to provide step-by-step protocols of the most commonly used molecular genetic techniques utilized in population genetics and systematic studies. In addition, a brief discussion and explanation of how these data are managed and analyzed will be taught.

Course Outline

i. Material Basis of Heredity and Cytogenetic of Fish Reproduction
   - Introduction to Genetics. Variability and Evolution of Fish Karyotypes
   - Genetics of Sex Determination. Formation of Reproductive System and Sex Differentiation
   - Gametogenesis and Fertilization in Fish
   - Natural Glycogenesis and Hybridogenesis in Fish

ii. Inheritance of Quantitative Morphological Traits in Fish
   - Introduction to Mendelian Genetics and Inheritance of Color Traits in Fish
   - Inheritance of Scale Cover and Other Qualitative Morphological Traits in Fish

iii. Inheritance of Quantitative Traits in Fish
   - Inheritance of Quantitative Traits in Fish

iv. Biochemical and Molecular (DNA) Genetic markers
   - Protein Polymorphism and Its Application
   - Molecular (DNA) Markers and Their Application
v. Selective Breeding and Hybridization
   - Fish
   - Inbreeding and Methods of Its Reduction
   - Intra-species and Interspecies Hybridization

vi. Chromosome Set Manipulation and Sex Control in Aquaculture
   - Induced gynogenesis and androgenesis
   - Induced Polyploidy
   - Hormonal Sex Reversal and Genetic Sex Regulation

vii. Gene Engineering and Genomics
   - Gene engineering and Genomics
   - Fish Genomics

Duration: 14 days
Course Fees: US$2000
Course V: FISH FARM MANAGEMENT AND CULTURE SYSTEMS

Introduction

The objective of the training is to provide participants with theoretical and practical knowledge on day to day running of a fish farm, in order to maintain a healthy stock, attain high yields and commensurate profits in fish farming business. Participants would be taught how to prepare ponds for stocking and the management strategies for different pond types. This would include monitoring of physical, chemical and biological parameters of water quality. Calculation of stocking density and ratios in monoculture and polyculture systems would also be taught as well as management of various culture systems from extensive to hyper-intensive recirculation aquaculture systems and record keeping.

Course Outline

- Introduction to aquaculture production systems
- Identification and selection of culturable fish species
- Pond and tank preparation
- Water sources, supply, and water quality management
- Stocking density and ratio, growth monitoring
- Fish health monitoring and management
- Culture techniques
- Pest and predator management techniques
- Farm implements and maintenance
- Record keeping

Duration: 7 days

Course Fees: US$2000
Course VI: OYSTER FARMING

Introduction

Participants attending the oyster farming course would be taught how to rear oysters in open water bodies and in confined ponds. Collection and preparation of oyster spats for culture, selection of sites and methods for culture would be practically demonstrated. Participants would be taught various culture techniques including off and on bottom, rack on tray, long lines for grow out as well as ideal cultch materials for collection of spats. Calculation of stocking densities, management procedures, growth monitoring, record keeping would be practically taught.

Course Outline

- Introduction to oyster farming
- Biology of oysters
- Natural reproduction and artificial propagation
- Site selection
- Culture systems
- Spat collection and stocking
- Ideal cultch materials
- Feeding and growth monitoring
- Control of pests, predators and fouling organisms
- Harvesting and depuration
- Shucking techniques
- Preservation and processing
- Management of oyster farm
- Record keeping

Duration: 7 days

Course Fees: US$2000
Course VII: CAGE AND PEN CULTURE

Introduction

The use of cages and pens for fish culture is gaining attention in Nigeria. These enclosures installed preferably in natural water bodies utilize netting materials or other materials for housing the fish. Participants will be trained on criteria for site selection, construction, techniques, stocking, management and maintenance of the cages and pens.

Course Outline

- Site selection
- Types of cages and pens
- Construction techniques
- Management routine and special operation in cage/pen fish forums
- Economics of fish culture in cages and pens
- Harvesting techniques and marketing record keeping

Duration: 7 days
Course Fees: US$2000
Course VIII: FISH HEALTH MANAGEMENT AND DISEASE CONTROL

Introduction

Fish health management is a term used in aquaculture to describe management practices which are designed to prevent fish disease. Once fish get sick it can be difficult to salvage them. Successful fish health management begins with prevention of disease rather than treatment. This is accomplished through good water quality management, nutrition and sanitation. Without this foundation, it is impossible to prevent outbreaks of opportunistic diseases.

Participants taking this course would have the opportunity to get trained in fish disease diagnosis at the NCoS and be exposed to available husbandry practices to manage disease outbreaks and develop management programmes to prevent such. It is expected that at the end of the training, the support structures, practical measures and skills imparted on participants will hopefully contribute to the sustainable development of aquaculture in the sub-region.

Course Outline

- Introduction to fish health management
- Significance of fish disease to aquaculture
- Types of fish diseases and symptoms
- Principle of fish health management and disease control in Hatchery and grow-out system
- Therapy, husbandry and management of fish diseases
- Public health and risk considerations
- Analysis of pond water micro-flora and its effect on fish health

- Nutritional mediated diseases and control
- Principles and Practices of Quarantine
- Fish Borne Diseases

Duration: 7 days

Course Fees: US$2000
Course IX: ECONOMICS OF FISH PRODUCTION AND MARKETING

Introduction

Fish farming is, like most other types of farming, a risky business that requires special knowledge, skills, and careful considerations. Returns on aquaculture farming enterprises are influenced by risks and uncertainty, which are inherent to aquaculture production. The risks aquaculturist face include:

- establishment and management risks
- biological requirements of aquaculture species
- the physical environment in which the farm operates
- current and future markets.

It is important to understand the nature of risks facing each aquaculture species. For example, price, output, feed-conversion ratios and feed prices are parameters of risk that can vary on a regular basis.

This course explores important considerations that must be weighed when planning an aquaculture enterprise. The course will help the participants identify the production system, species and marketing strategy most appropriate to a given situation.

Course Outline

Production

- Production Economics
- Definition of terms
- Factors of Production
- Production techniques
- Cost of Production
- Farm management planning

- Risks in aquaculture
- Cash flow analysis
- Enterprise budget

Marketing

- Definition of terms
- Marketing structure and strategies
- Market conduct and performance

Financing Aquaculture

- Fund sourcing
- Portfolio risk
- Developing business plan

Duration: 7 days

Course Fees: US$2000
Course X: FISH FEED FORMULATION AND PRODUCTION

Introduction

Participants on the training programme would be taught how to formulate fish feeds using indigenous feedstuff for different species of fin and shellfish at various stages of development. Feed production based on calculations of cost-effective fish feeds would be hands-on at the feed mill. Participants would also be introduced to markets from where they can source feed stuff in commercial quantity. In addition, participants will acquire skills on basic maintenance of feed mill equipment, packaging of finished fish feeds and record keeping.

Course Outline

- Introduction to fish feed formulation and production
- Nutritional requirements of farmed fish
- Types of fish feed ingredients and nutrient composition
- Feed mill establishment: housing and equipment
- Fish Feed Formulation for different species
- Processing of feed ingredients
- Practical Floating Fish feed production
- Anti-nutritional factors in feedstuffs
- Fish feeding Best Practices
- Feed mill maintenance
- Safety Precautions
- Drying of Feed & Packaging
- Feeding practices
- Economics of feed production
- Record keeping

Duration: 7 days

Course Fees: US$2000
Course XI: FISH FEED PRODUCTION TECHNOLOGY

Introduction

Feeds and feeding constitute about 80% of the variable cost of fish production. This implies that, the more expensive a feed is, the lower the profit margin of the farmer. Fish being cultured in tanks except it is fed feeds that are qualitatively and quantitatively adequate will soon suffer from nutritional deficiencies. Not all feeds and feeding stuffs can meet the nutritional requirements of the cultured fish as most suffer from one inadequacy or the other. It will therefore be necessary to be knowledgeable in modern production techniques in developing feeds that will not only meet the nutrient requirement of the cultured fish at various stages of production but also be cost effective and economically sustainable.

The main objective is to develop the critical man-power in the production of modern aqua-feeds. At the end of the programme, participants should:

- be familiar with the machines and equipment for modern floating feeds.
- formulate, compound and extrude the feed to produce floating feeds.

Course Outline

- Introduction to aqua-feed technology
- Ingredients for fish feeds
- Common types of fish feeds
- Sinking
- Floating
- Feed additives
- Mycotoxin in aqua-feeds
- Fish feed formulation
- Machines used for aqua-feed production
- Compounding and packaging aqua-feeds

Duration: 7 days

Course Fees: US$2000
Course XII: FEED PRODUCTION TECHNOLOGY (II): EXTRUSION PROCESS

Introduction

Recent development in aqua-feed technology has led to the introduction of extrusion process to produce aqua-feeds that are better utilized. Extruded feeds have become popular amongst farmers because of its better utilization by the farmed fish. This will significantly reduce the culture period and an increased profit for the farmer. Recent report indicate that Nigeria imported European catfish feeds estimated at about USD38 million. NIOMR has an extruder machine and had been producing floating feeds for some years.

At the end of the training, participants are expected to be familiar with the extrusion processes and what determines the choice of the extruder.

Course Outline

- Introduction to extrusion technology
- Extruders and their application in aqua feeds
- Nutritional implication of extruded feeds
- Extruder handling and maintenance
- Cost benefit analysis of extruded feeds

Duration: 5 days

Course Fees: US$2000
Course XIII: FISH POST HARVEST TECHNOLOGY

Introduction

The objective of the course is to provide participants with the needed skills in value addition to forestall post-harvest losses and provide additional income to the farmer or processor. The course which is both theory and practical will cover fish handling, preservation, processing and packaging methods of different culturable fin and shellfish species.

Course Outline

- Introduction to fish post-harvest management
- Fish handling techniques
- Fish Processing and Preservation techniques
- Value addition techniques
- Aspects of fish spoilage (enzymatic, bacterial and oxidative)
- Fish transportation processes,
- HACCP and SOPs
- Marketing of fish and fish products

Duration: 5 days

Course Fees: US$2000

Course XIV: SMOKED FISH PROCESSING AND PACKAGING

Introduction

Smoked-drying as means of processing of fish and fishery products has a long tradition in the maritime and inland fishery states, the main objective being preservation of the catch for use over a longer period of time. The most obvious means of increasing supply of fish, even without increased landings is by improved processing and preservation to reduce postharvest losses of what is presently caught.

The present market trends reflect a rapidly growing demand for ready-to-cook/ready-to-serve convenience and value added fish and fishery products. However, the product should satisfy the quality criteria and the product specifications of the buyer and for this, training of technologists and managers of fish processing establishments is very essential.

The training covers theory and practical classes on handling and smoked fish processing; handling and processing of fish fillet; fish cracker; battering and breading technology; packaging and preservation; safety, quality and regulatory aspects for local and export markets.

Course Outline

- Smoked fish processing
  - Technological value and yield
  - Pre-process operation
  - Principles of smoking
  - Types of smoking process
  - Fuel wood used in seafood smoking
  - The smoking process
Issues of safety and Quality Control in smoked dried seafood
- Regulation on smoked fish
- Standards for smoked fish
- Heavy metals
- Histamine
- Smoke Poly aromatic hydrocarbons (PAHs)
- Microbiological Quality of smoked fish
- Quality Assurance HACCP

Packaging materials and methods
- Definitions and functions of packaging
- Packaging of smoked fish
- Vacuum packaging
- Modified atmosphere packaging
- Packaging requirements of EU Regulations
- Labeling

Export of smoked seafood
- Requirements of processing facilities
- Export potentials and markets
- Challenges and problems in the Export Trade of Seafood
- EU regulations
- Constraints to trade
- Suggested improvement

Value Added Products

Fish Filleting: processing and packaging
- Technological value and yield
- Preprocess operation
- Principles of fish filleting
- Filleting equipment
- Characteristics of fish fillet
- Development of products such as fish finger, fish steaks, fish cake, fish balls, breaded shrimp, fish cracker, etc.

Issues of safety and quality control in chilled and frozen fish products
- Regulation on chilled and frozen fish products
- Standards for chilled and frozen fish products
- Hygiene in fish processing plant
- Microbiological Quality of chilled and frozen fish products
- Quality assurance HACCP

Packaging materials and methods
- Definitions and functions of packaging
- IQF layered and shatter packs
- Vacuum packaging
- Modified atmosphere packaging
- Labeling

Export of chilled and frozen fish products
- Requirements of processing facilities
- Export potentials and markets
- Challenges and problems in the export trade of chilled and frozen fish products
- EU regulations
- Constraints to trade
- Suggested improvement

Duration: 10 days

Course Fees: US$2000
Course XV: FISH CANNING/RETORT POUCHING

Introduction

Fish canning/pouching is a method for industrial processing of raw fish and other edible aquatic products which, in a way, help to keep the final product suitable for consumption at ambient temperatures over a longer period of time than any other commercial fish processing would do.

The main subjects covered concern the fish canning principles, raw materials suitable for canned fish products, the major products, canning techniques in general. It also covers fish canning equipment, by-products, packaging and storage of canned products as well as process control in fish canning operations.

Course Outline

- Principles and objectives of fish canning/pouching
- Raw material
- Fish and Other Marine Foods
- Fish Handling
- Ingredients and Additives
- Packaging Materials
- Unit operations
- Raw Materials Handling
- Pre-treatment and Pre-cooking
- Sealing and Retorting
- Processing equipment / General canning and pouching equipment
- Process control in fish canning operations
- The Need for In-process Control
- The Hazard Analysis - Critical Control Point (HACCP) Concept
- Checking for Compliance with End Product Specifications
- Incubation Tests

Duration: 7 days
Course Fees: US$2000
Course XVI: FISH FOOD SAFETY EVALUATION AND QUALITY ASSURANCE

Introduction

This training programme is meant for the technologists and managers of seafood processing industry. The course includes basic principles of seafood quality assurance through organoleptic, microbial and chemical evaluation as well as basic plant design and process control, evaluation of food safety hazards etc. Besides, the course also covers basic systems of inspection in seafood processing plants, National and International standards (EU & USFDA) and principles of HACCP. The course includes both theoretical and practical classes of techniques and methodology of seafood quality assurance.

Course Outline

- Organoleptic evaluation of fish/shell fish
- Fundamentals of Microbiology
- Methods of identification and isolation of pathogens and indicator organisms
- Quality problems and management
- Requirements of importing countries
- Methods of evaluating fish freshness & quality
- Legislation on export inspection in Nigeria
- Systems of inspection

Duration: 7 days

Course Fees: US$2000

Course XVII: POST-HARVEST HANDLING OF AGRICULTURAL CROPS

Objectives of Training

The main objective of the training on Post harvest handling of agricultural crops is to enable the participants to acquire the requisite skill and knowledge in the principles and practice of appropriate handling of agricultural crops.

The specific objectives are:

i. To provide participants with the basic principle of post-harvest handling of crops
ii. To equip the participants with the principles of operation of the common post-harvest technologies used in handling of crops
iii. To equip the participants with basic skills for the operation and maintenance of post-harvest handling equipment.
iv. To expose participants to pest management and control in food storage.

Target audience:

i. Small scale entrepreneurs involved in handling of agricultural crops
ii. Produce handlers especially youths
iii. Extension agents
iv. Researchers and academics with desire to update their knowledge on post-harvest handling of crops
v. Farmers
vi. Food merchants
vii. Exporters
Outline

i. Economic prospect of post-harvest Activities.
ii. Harvesting, handling and storage of Cereals and Pulses.
iii. Harvesting, handling and storage of roots and tubers.
iv. Harvesting, handling and storage of fruits and vegetables.
v. Harvesting, handling and storage of Livestock and fisheries.
vi. Storage structures for Agricultural Products.
vii. Drying of Agricultural Products.
viii. Effective Packaging of Agricultural Products.
ix. Pest control measures in food storage

Duration: 3 days

Course Fee: US$3,000
Course XVIII: VALUE ADDITION TO ROOT AND TUBER CROPS

Objectives:

The main objective of the training on value addition on root and tuber crops is to enable the participants to understand the basic concept of primary processing and value addition to root and tuber crops in order to increase utilization, reduce post-harvest loss and increase income.

The specific objectives are:

i. To expose participants to the important factors guiding the availability, processing and utilization of root and tuber crops.

ii. To enable the participants understand the unit operations in primary processing of root and tuber crops.

iii. To expose the participants to various processing equipment, their operations and maintenance.

iv. To provide appropriate skills for marketing channel development and product branding.

v. To train and explain the importance of packaging in product storage, transportation and marketing.

Target audience:

i. Small scale entrepreneurs involved in handling of agricultural crops

ii. Small and medium scale processors

iii. Extension agents

iv. Researchers and academics with desire to update their knowledge on post-harvest handling of crops

v. Farmers

vi. Exporter

vii. Food merchants

Outline

i. Importance of roots and tubers in the food value chain.

ii. Products of roots and tubers into various products.

iii. Primary processing of roots and tubers into various products.

iv. Effective packaging Development for roots and tubers.

v. Equipment and its maintenance for roots and tubers processing plant.

vi. Developing effective marketing channel for products of roots and tubers.

Duration: 3 days

Course Fee: $3,000
Course XIX: VALUE ADDITION TO FRUITS AND VEGETABLES

Objectives of training

The main objective of this training is to provide participants with adequate knowledge and skill for effective utilization of fruits and vegetables in order to provide a sustainable approach to year round availability of common fruits and vegetables.

Specific objectives

i. To equip participants with basic knowledge of appropriate processing techniques used in producing quality dried fruits
ii. To expose the participants to various processing equipment, their operations and maintenance.
iii. To provide appropriate skills for marketing channel development and product branding

Target audience:

i. Small scale entrepreneurs involved in handling of fruits and vegetables
ii. Small and medium scale fruit processors
iii. Extension agents
iv. Researchers and academics with desire to update their knowledge on post-harvest handling of crops
v. Farmers
vi. Exporters

Outline

i. Importance of fruits and vegetables in the food chain
ii. Harvesting and packaging of fruits and vegetables for effective marketing
iii. Primary processing of fruits and vegetables through effective dehydration process
iv. Effective packaging development for fruits and vegetables.
v. Equipment development and maintenance for fruits and vegetables
vi. Developing effective market channel for fruits and vegetable products

Duration: 3 days

Course Fee: US$3,000
Course XX: VALUE ADDITION TO CEREALS AND PULSES

Objectives

The main objective of this training is to provide participants with requisite knowledge and skills for primary processing of cereals and pulses and also provide a sustainable market channels for the effective distribution of processed cereals and pulses products

The specific objectives are:

i. To provide adequate knowledge of the units operations involved in primary processing of cereals and pulses.

ii. To expose the participants to the various processing techniques

iii. To equip the participants with the basic knowledge of the operations and maintenance of primary processing equipment used for cereals and pulses.

iv. To provide appropriate skills for marketing channel development and product branding

Target audience:

i. Small scale entrepreneurs involved in handling of fruits and vegetables

ii. Small and medium scale processors

iii. Extension agents

iv. Researchers and academics with desire to update their knowledge on post-harvest handling of crops

v. Farmers

vi. Exporters

Outline

i. Importance of cereals and pulses in the value chain.

ii. Pests management in cereals and pulses.

iii. Storage structures for cereals and pulses.

iv. Primary processing of cereals and pulses into various products.

v. Effective packaging development for cereals and pulses products

vi. Development of effective market channel for cereals and pulses products

Duration: 3 days

Course Fee: US$3,000
Course XXI: VALUE ADDITION TO LIVESTOCK AND FISHERIES

Objectives

The main objective of this training is to provide participants with adequate knowledge and skills for the post-harvest handling of livestock and fisheries products for safe handling and processing for enhancement of live thorough adequate distribution of fish and meat products.

The specific objectives are;

i. To expose participants to the standard techniques of processing fish and animal products
ii. To provide basic knowledge on the operation and maintenance of processing equipment used for processing of fish and meat products.
iii. To provide appropriate skills for marketing channel development and product branding
iv. To train participants on packaging for storage, transportation and marketing

Target Audience

i. Small scale entrepreneurs involved in handling of fish, meat and their products
ii. Small and medium scale processors
iii. Managers of Eateries
iv. Extension agents
v. Researchers and academics with desire to update their knowledge on post-harvest handling of crops
vi. Farmers
vii. Exporters

Outline

i. Importance of Livestock and Fisheries in the value chain
ii. Post-harvest handling of livestock and fisheries products.
iii. Primary processing of livestock and fisheries products.
iv. Post-harvest equipment and maintenance for livestock and fisheries.
v. Effective packaging of livestock and fisheries products.
vi. Development of market channels for livestock and fishery products

Duration: 3 days

Course Fee: $3,000
Course XXII: TRAINING OF ARTISANS ON FABRICATION OF SOME POST-HARVEST EQUIPMENT

Objectives

The main objective of this training is to provide adequate manpower for production of appropriate technologies used in post-harvest handling of agricultural commodities through the provision of requisite knowledge and skill for fabrication of processing equipment.

The specific objectives are:

i. To expose participants to the standard approaches to equipment fabrication

ii. To provide participants with adequate knowledge of fabrication procedures.

iii. To provide participants with standard methods of fabricating attractive equipment at reasonable cost

Target audience

i. Fabricators

ii. Processors

iii. Workshop managers

iv. Technologist from academic and research institutes.

v. Entrepreneurs

Outline

i. Construction of multipurpose dryer

ii. Construction of smoking kiln.

iii. Construction of fish dryer.

iv. Construction of solar dryer for fish.

v. Construction of various packaging material

vi. Utilization of the constructed equipment

vii. Maintenance of the constructed equipment

Duration: 2 weeks

Course Fee: U$7,500
Course XXIII: TRAINING ON QUALITY REQUIREMENTS ON EXPORT CROPS

Objectives

The main objective of this training is to create awareness and equip participants with standard operating procedures for production of quality products that can meet international standards.

Target audience

i. Small scale entrepreneurs
ii. Small and medium scale processors
iii. Extension agents
iv. Researchers and academics with desire to update their knowledge on post-harvest handling of crops
v. Farmers
vi. Exporters

Course Outline

i. Quality standard for Cocoa, Cassava products, Yam, Processed Fish, Shea butter, Fruits and vegetables, Groundnut, Palm produce and Rubber
ii. Effective packaging for exportable crops
iii. Procedure for export of crops

Duration: 3 days

Course Fee: US$3,000
Further information

Application procedure:
Apply through the Project Coordination Office:
West Africa Agricultural productivity Programme (WAAPP)
2 Franca Afegbua Crescent, off Samuel Jereton Mariere Road
After Zone D, Apo Legislative Quarters, Abuja, Nigeria.

Log on to: www.waapp.gov.ng. or send an e-mail to: waappnpc@ymail.com

Participants will be granted a Certificate of attendance. Course programme might change to incorporate new insights

Fee includes all course related costs (materials, excursions, administration).