

**Fishing Training Manual:**

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Frontcover photo: A picture of Fish Farming. (Photocredit: APDC)

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## URBAN FISH FARMING

**Aim:** To provide youths with sufficient knowledge and information on fish farming and to allow them to understand catfish farming in an urban settlement.

## MODULE 1. INTRODUCTION TO CATFISH PRODUCTION

### LEARNING OBJECTIVE

At the end of this course, participants will be able to:

1. Define aquaculture and fish farming.
2. Differentiate between aquaculture and fish farming.
3. Identify the factors for selecting site for fish pond construction.
4. Identify different types of ponds and steps involved in pond construction.
5. Highlight the management practice in the pond and water quality parameters affecting fish farming.

### 1.0 INTRODUCTION AND DEFINITIONS

- i. **Aquaculture** refers to the breeding, rearing and harvesting of plant and animals in all types of water environments including ponds, river, lakes and the ocean and enclosed water bodies such as ponds, tanks, cages, pens, dams and aquaria.
- ii. **Fish farming** is the principal form of aquaculture which involves raising fish commercially in tanks and pond usually for food. Fish farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being

cultivated. Fish farming is a proven and profitable venture, provided there is sufficient information.

Fish farming is the fastest growing food producing sector. It has received a lot of attention in recent years and the industry is witnessing more influx of people into it than any other livestock industry. It provides a range of opportunities for individuals irrespective of their discipline and background.

Total annual fish production (capture fisheries and aquaculture) in Nigeria is about 1,000,000 tonnes. Aquaculture accounts for about 310,000 tonnes.

### **1.1 WHY FISH FARMING**

There are many reasons for farming fish.

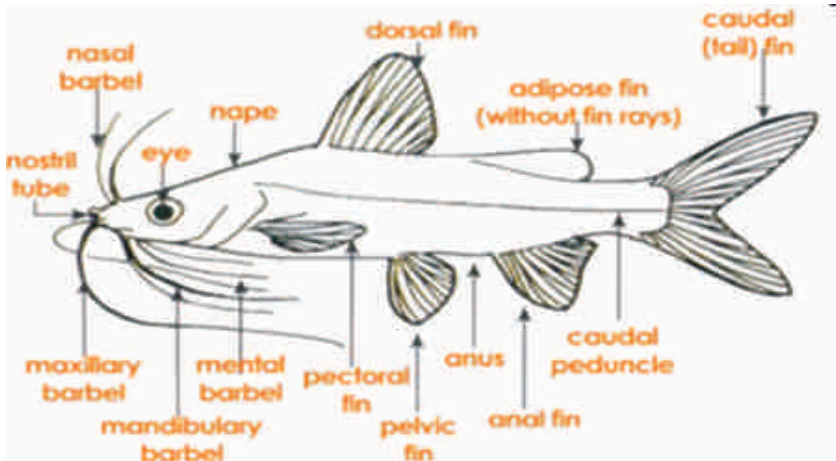
1. Cheaper and more reliable method of getting fish for the growing world population
2. Food and nutrition
3. Demand for low fat food
4. To reduce over-fishing
5. Source of income and employment
6. For use in animal feed
7. Ornamental purposes



## 1.2 CULTURABLE FISH SPECIES IN NIGERIA

Common name	Scientific name	Local name
North African catfish	<i>Clarias gariepinus</i>	Aro, Tarwada
African catfish	<i>Heterobranchus</i> spp.	Azuu isii, Ramboshi
Tilapia	<i>Oreochromis niloticus</i>	Epia
African Knife fish, Aba	<i>Gymnarchus niloticus</i>	Asa, Aba, Dan sarki
African Bonytongue	<i>Heterotis niloticus</i>	Aika
Common carp	<i>Cyprinus carpio</i>	

## 1.3 LABELLED DIAGRAM OF AN AFRICAN CATFISH



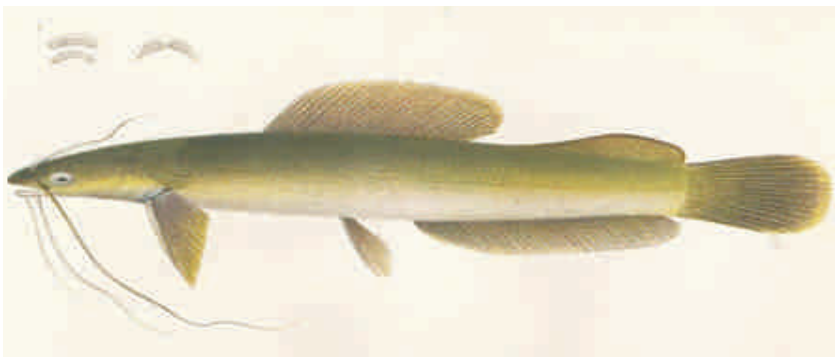
## 1.4 THE COMMONLY FARMED AFRICAN CATFISHES IN NIGERIA

The African catfishes, especially *Clarias gariepinus* are the most commonly farmed species in Nigeria. They constitute over 80 % of the total farmed fish in Nigeria.

***Clarias gariepinus***: has a flat head and an eel-like shape. They are without scales. They have extremely long dorsal fins (nearly reaching or reaching the caudal fin).



***Heterobranchus* spp**: an oval and has a rectangular dorsum (upper side of the catfish), the snout is round and the eyes are lateral, with half lateral fin



***Heteroclarias***: This is an hybrid of *Clarias gariepinus* and *Heterobranchus*



### 1.5 ADVANTAGES OF FARMING CATFISH (*Clarias gariepinus*)

In Nigeria, catfish remains the most cultured and most profitable in fish farming. Some of the advantages of rearing catfish include;

- Reach table size within a short period
- Accept artificial/supplementary fish feed
- High food conversion ratio
- Disease resistance/tolerance
- Regular source of fish seed and fish feed.
- Survive artificial/harsh environment.
- Highly acceptable
- Command a good market price.

### 1.6 PICTURES OF TILAPIA AND THE AFRICAN KNIFE FISH





## 2.0 GENERAL CONSIDERATION IN SITE SELECTION FOR AQUACULTURE

The selection of a suitable site for aquaculture is important to the success of a fish farm. The species to be cultured and the technology to be used determine site selection. The following are factors to consider in deciding the location of a fish farm.

- Land availability
- Good water sources
- Good soil characteristics
- Labour/equipment availability
- Topography
- Accessibility
- Vegetation density/cover
- Expertise
- Proximity and size of market
- Safety
- Availability of farm inputs

## 2.1 TYPES OF POND

1. **Earthen pond:** are usually V-shaped, dug-out or excavated mini water dam where fishes can be raised from juvenile to table size. It is sometimes referred to as 'stagnant' water body but it is actually not because there is seepage of water from the ground through the pond bottom and it can be drained through 'monk' or by pumping.



## 2. Concrete pond



## 3. Movable plastic tanks



## 2.2 STEPS INVOLVED IN CONCRETE POND CONSTRUCTION

- Clearing of proposed site
- Setting out which involves pegging and lining with the rope
- Topsoil stripping to form strong basement
- Surface blinding with concrete mixture (sharp sand, cement & gravel/ granite at ratio 3:1:6)
- Block laying and stuffing of holes with concrete mixture
- Placement of water inlet and outlet pipes

## 2.3 STEPS INVOLVED IN INSTALLING PLASTIC AND COLLAPSIBLE TANKS

- The tank is usually ready made or constructed by fabricators given specific requirements like size.
- Installation of constructed tanks will be done by plumbers who align units to the farms' water system (plumbing)

## **2.4 PREPARATION OF AN EARTHEN POND FOR STOCKING**

- Prepare the pond bottom using lime
- Let in water into the pond.
- Fertilize the pond with inorganic / organic fertilizer.
- Select and stock good quality fish.
- Carry out daily necessary routine management of the pond.

## **2.5 PREPARATION OF A CONCRETE POND FOR STOCKING**

- Wash the pond thoroughly.
- Flush with water.
- Fill the pond with water.
- Put dry grasses into the pond filled with water.
- Leave for two weeks.
- Drain and wash the pond.
- Refill with water and leave for one week.
- Drain and fill with water the third time.
- Fertilize using organic or inorganic until water turns light green in colour
- Stock the pond

## **2.6 PREPARATION OF COLLAPSABLE AND PLASTIC POND FOR STOCKING**

- After installation, expose the pond to sunlight
- Impound with water for few days and check for leakages by marking the initial and final volume of water
- Drain the water and wash the pond and rinse with salt water
- Put fresh water and stock

## **2.7 FACTORS TO CONSIDER IN SELECTING FISH BREED**

- Hardy and easy to manage
- Resistant to disease and parasite infections
- Fast growing fish
- High market value
- High feed conversion rate
- High survival rate
- Acceptability to locality

## **2.8 STOCKING MANAGEMENT**

- Leave the bag of juveniles in the pond for 5mins without opening it, so the water temperature in the juvenile bag will gradually adjust to that of the pond.
- Make a solution of 4% salt with pond water.
- Transfer juvenile into salt solution.
- Leave juvenile in the solution for 2mins.
- Drain out solution.
- Release juveniles into pond.
- Take out the empty bag

## **2.9 ROUTINE MANAGEMENT AND STOCKING TECHNIQUES**

- Salting
- Filling pond with water
- Stocking
- Feeding
- Flushing
- Grading/sorting
- Weeding
- Test Cropping



### 3.0 FEEDS AND FEEDING SYSTEM

Fish feed is one very important aspect in fish farming. In fish farming, feed represents about 70% - 80% of the production cost so a well-balanced diet is important to achieve good growth and high profit margin.

The amount of feed fed depends on size and nutritional need of the fish. It should be ensured that feed contains balanced proportions of protein, carbohydrate, fats, vitamins and mineral salts.

Fish do best when fed right quality and quantity at fixed time and position and must be fed at a particular time interval daily and at a particular spot. Feed should be given gradually to avoid food wastage and water pollution.

#### 3.1 TYPES OF FEED

- i. **Natural Food:** i.e. Planktons (zoo, phyto), they are produced through pond fertilization using organic manure (cow, pig and poultry droppings) and inorganic fertilizers such as NPK, Urea and SP. Other natural foods include maggot, insects and earthworm
- ii. **Artificial Feeds:** artificial feeds are compounded feeds. They could be in mesh, crumbles or pellets (sinking or floating).

#### 3.2 FEED GRADES

- 2mm
- 3mm
- 4mm
- 6mm
- 9mm



#### **4.0 WATER SOURCES AND QUALITY MANAGEMENT**

Well and Springs, Ground water, Streams, rivers, and lakes  
Water is the medium in which fish lives; thus, water quality management is about the most important aspect of management practices in fish farming. This is because fish cannot survive without water.

#### **4.1 DISSOLVED OXYGEN (DO):**

The DO content of pond depends on water temperature, quantity of organic matter present and population of submerged aquatic vegetation.

Weight of fish that can be produced in a pond is limited by the ability of that pond to provide adequate oxygen. Dissolved Oxygen in pond water is needed to;

- I. Keep the fish alive
- II. Enable fish to metabolize their food and grow
- III. Break nitrogenous wastes

**1. CAUSES OF LOW OXYGEN IN WATER**

- Decay of left over feed.
- Reduced oxygen production by photosynthesis due to cloud cover.
- Lack of agitation from wind.

**2. SIGNS OF LOW DISSOLVE OXYGEN**

- Air bubbles on surface of pond water in the morning.
- Fish will come to surface of the water seeking higher oxygen levels from water in contact with the atmosphere.
- Fish suffering from low oxygen will usually not eat and appear to be “drinking” the surface water.

**3. EFFECT OF LOW DISSOLVED OXYGEN**

- Slow digestive and absorption rate
- Slow conversion rate
- Low appetite
- Trigger bacterial infections
- Mortality



**A FISH WITH BACTERIAL INFECTION**

#### 4. CORRECTING LOW DISSOLVED OXYGEN IN TANKS

- Reduce water in pond and refill with fresh water containing higher oxygen level.
- Stop feeding for some days and observe fish behaviour, start feeding again when dissolved oxygen has been corrected
- If problem persists, reduce feeding rate.

#### 4.2 FISH PREDATOR

Common fish predators that should be prevented from causing fish losses in ponds include

- Water snake
- Turtles
- Alligators
- Crocodiles

But in an urban farm predators mentioned above may not be valid.

#### 4.3 CONTROL OF PREDATOR

- Ensure regular cleaning of pond side.
- Fence the pond site and screen the top.

**Hunt predators by using trap net.**



## 5.0 STOCKING

This is the process of introducing desired fish seeds into a prepared fish pond.

The fish seed could be either fingerlings or juveniles from a reputable source.

The stocking rate/density is determined by the space available, management practices e.g. feed, water quality etc. as well as, the feeding habits of the fish.

## 5.1 SORTING/GRADING

- Sorting means stocking of the same size of fish together while the shooters are removed. This practice reduces cannibalism and also reduces competition amongst the fish where the big fish would eat first leaving little or nothing for the smaller ones.



**SCOOP NET**

## 5.3 HARVESTING TIPS

- Harvesting is conveniently done by drag netting (useful for small ponds) or by draining the pond.
- Feeding is stopped a day before the date of harvesting.
- Harvesting is done during cool morning hours as per the demand of market.



#### **5.4 DISEASES IN FISH POND**

Disease can be defined as any alteration of the body or one of its organs so as to disturb normal physiological function. Many agents are responsible for the abnormality often observed in fish. These parasites include Bacteria, Fungi, viruses, and other pathogens.



#### **FISH WITH BACTERIAL INFECTION**

#### **5.5 CAUSES OF DISEASES**

- Exposure to poor conditions e.g.  
(a) Overcrowding, (b) starvation
- Poor quality feed/ over feeding,
- Stressful condition e.g. rough handling,
- Low dissolved oxygen
- High temperature

### **5.6 SIGNS IN DISEASED/INFECTED FISH**

- Refusal of fish to feed due to loss of appetite,
- Crowding of fish at the water surface particularly near water inlet,
- Abnormal activities such as whirling, twisting or lack of activity,
- Abnormal colouration and erosion of the scale and skin,
- Rubbing of body against surface,

### **5.7 SOLUTION**

Prevention is the best control measure to overcome fish disease outbreak.

- Stock only healthy fish from reliable hatcheries,
- Feed fish only with balanced diet that will meet their nutrient requirement,
- Avoid over stocking, and
- Ensure good quality water at all times.
- Good farm hygiene should be maintained at all time.
- However, some health problems still occur in cultured fish species. These health problems or disease outbreak could be approached in two ways, viz:
- Prophylactic (Preventive approach) and Curative
- A fisheries expert should be consulted for proper diagnosis and medication

### **5.8 POST HARVEST HANDLING**

Catfish is known to survive outside the aquatic area for about 3-4 hours. However, the fish must be harvested only if there is a customer who has earlier requested for fish.

### **5.9 COMMERCIALIZATION**

The market for catfish is wide, ranging from the wholesaler to the final consumers. The catfish is expected to attain

maturity at 6-7 months. It can be sold to either the wholesaler (open market), retail (hotels, restaurant) or the final consumer (household).

## 6.0 CATFISH PRODUCTION

### 6.1 ESTIMATED CAPITAL EXPENDITURE FOR OPERATING ONE COLLAPSIBLE TANK

1 Collapsible tank of 10ft diameter @ N150, 000	150,000
Netting of collapsible tanks using fishing nets	5,000
Plumbing (2" backnut, pipe, air valve, labour etc)	5,000
Transportation	2,000
<b>Subtotal</b>	<b>162,000</b>

### 6.2 ESTIMATED RECURRENT EXPENDITURE

700 Juvenile <i>Clarias gariepinus</i> @ N30	21,000
47 bags of Extruded feed @ N6, 500	305,500
Drugs	1,000
<b>Subtotal</b>	<b>327,500</b>

### 6.3. ESTIMATED REVENUE

Maturity period	4 - 5months
Average weight at harvest	1kg
Mortality	5%
Estimated harvestable numbers of fish per batch	665
Harvested Fish in Kg	665kg
Current market price of <i>Clarias</i>	N800/kg
Expected Revenue	N532, 000

Estimated Profit = Revenue - Recurrent expenditure  
 = N532, 000 - N327, 500

**Profit = N204, 500**



## **MODULE 2: FISH PROCESSING AND VALUE ADDITION**

### **1.0 INTRODUCTION**

Fish is one of the proteins that need careful handling. This is because fish spoils easily after capture due to the high tropical temperature which accelerates the activities of bacteria, enzymes and chemicals oxidation of fat in the fish. Due to poor handling about 30-50% of fish harvested are wasted in Nigeria which is estimated to be 10 to 12 million tons per year. These losses could be minimized by the application of proper handling, processing and preservation techniques.

- Post-harvest fish loss refers to fish that is either discarded or sold at a relatively low price because of quality deterioration.
- It also means that less fish is available to consumer and whom are supplied low quality fish and fish product
- The preservation of fish such as salting, drying, freezing, smoking is geared to reduce the fish post-harvest losses by limiting bacterial activities between harvest and human consumption.
- Technologies for fish preservation is to encourage at different stages of handling such that whatsoever surplus that are not taken up for immediate consumption in the fresh form can be processed for increased shelf life and thereby preventing spoilage,

- glut and loss of income to the farmer.
- Preservation of fish does not just increase its shelf life, the taste differs and also make the fish to be used in different way which might not have been possible
- In its fresh form such as in stew or sauce. Drying is one of the oldest methods, through sun drying or applying fire.

### **1.1 DIFFERENT METHODS OF FISH PRESERVATION**

- BRINE-SALTING
- CORNING
- DRYING
- SMOKING
- CANNING
- COLD STORAGE

### **1.2 WHY FISH PROCESSING, PACKAGING, STORAGE AND MARKETING?**

- Post harvest activities based on value addition.
- Consistent good profit and growth for the Operator/ Entrepreneur.
- Fish is available all year round in preferred taste to the consumer.
- Available aquaculture fish/packaging materials to guarantee full capacity utilization.
- Generate marketing activities.

### **1.3 PROCESSING, SMOKING, COOLING AND PACKAGING**





## A FLOW CHART OF SMOKING FISH

### 1.4 CONSUMABLES

- Processing materials - Salt, Ginger, Scent leaves, Charcoal, kerosene.
- Packaging materials-Labels, DIOTHENES, Cartons, Sellotape, Gum
- Cleaning- Chemicals / soaps.
- Towels

### 2.0 DIFFERENT SOURCE OF HEAT FOR FISH COOKING

The heat source in fish smoking determines the intensity of dryness experienced in the smoked fish. The taste of the fish differs depending on the source of heat, the following listed below are the most used material for smoking fish;

- Firewood; Please note that firewood and sawdust (as in briquette) is to be avoided because the two generate a lot of smoke which contain high PAH (Polycyclic Aromatic hydrocarbon) that is very toxic to human health.
- Charcoal
- Cooking Gas
- Briquette

## **2.1 GUTTING**

Gutting is the removal of the intestines of the fish. Gutting should be carried out on fish no matter what method of preservation is going to be applied. Gutting and washing of fish helps to prevent bacterial attack before and during processing, preservation and storage.

## **2.2 WASHING**

Washing is the act of using solvent (preferably water) to remove dirt or debris of any size from an object. The intent is to make the product dirt/debris free. Some raw materials undergo this process to be considered as finished products e.g. fresh vegetables and fruits. The importance of washing cannot be over emphasized. Washing helps to reduce the presence of physical, chemical and biological contaminants.

## **2.3 DRYING**

This is the most important process in value addition. Drying involves the gradual removal of water from a product as a result of heat. Drying could be done naturally or artificially. Natural drying involves the use of sunlight, which is common in rural areas where cassava pallets or yam pallet and other crops are dried. This method is cheap but the end product might not be good quality as drying in open space invites rodents, animals and also dirt causing health issues. Artificial drying involves the use of alternative source of heat apart from sunlight. The heat systematically extracts moisture from the product until a desired result is attained. There are many types of smoking kilns, each of which is adapted to suit local conditions. However, every kiln has two major compartments,

- The smoke generator
- The smoking chamber

## 2.4 DIAGRAM OF A SMOKING KLLIN AND SMOKING CHAMBER



## 2.5 MAINTENANCE OF SMOKING KLIN

Frequent cleaning and maintenance of smoking klin can guarantee normal performance and longer life span.

- Test run before first use.
- Ensure the smoking chamber cools before closing doors after use.
- Grease the trays to prevent sticking during usage.
- When the fish are properly smoked withdraws the source of heat, unload and allow cooling.
- Always clean the smoking cabinet immediately after use with soapy water.
- When inspecting the fish being smoked, avoid peeping into the cabinet immediately it is opened.
- Use hand gloves or protective materials when removing the hot trays.
- Maintain a high level of hygiene at all times.

## 2.6 HYGIENE ISSUES

- Personal hygiene and dressing
- Environmental cleaning and drainage
- Management of waste (solids & effluents)
- Sanitation of Factory and equipment (daily, weekly and periodic)
- Sourcing of the right and mixing of cleaning materials.
- Health hazards / Medicals and periodic test
- Fumigation

## 2.7 FISH SPOILAGE/DAMAGE

Common causes of losses are microbial decay due to bacterial, moulds and insect infections expressed from

- Poor pre-drying hygiene
- Uncoordinated drying stage
- Post drying stage infections
- Fragmentation due to poor handling/ delivery

## 2.8 PREVENTION

- Be confident of the quality and freshness of fish to be processed.
- Dry to a low moisture content-15% or less to inhibit bacterial growth and mold.
- The total time and the proportion spent at each stages will be depend on the species, size and fat content of the fish and the kind of product intended.

## 3.0 COST BENEFIT OF SMOKE DRIED CATFISH

### A. Estimated Cost

- |  |          |
|--|----------|
| • 1 <sup>1</sup> / <sub>2</sub> bags of charcoal @ N 3,000 per bag | N4,500   |
| • 200kg of Live Catfish @ N 700 per kg                             | N140,000 |

• Vegetable Oil	N500
• Table salt and other seasoning	N500
• Packaging Nylon (not brand)	N2,500
• Lighter, Soap etc.	N1,000
• Transportation	N10,000
• Workmanship	N20,000
<b>Total</b>	<b>N179,000</b>

**B. Projected Revenue**

• 1kg of packaged smoked dried catfish	N 4,000
• 50kg of packaged smoked dried catfish	N 200,000

**C. Projected Profit**

Projected Revenue - Cost Estimate= Projected Profit  
**N 200,000 - N 179,000 = N 21,000**

If the processing cycle is 12 days in a month (3 days in a week)

• <b>In a week</b>	<b>N 21,000 x 3= N 63,000</b>
• <b>In a month</b>	<b>N 63,000 x 4 = N 252,000</b>

**3.1 CONCLUSION**

Fish processing, packaging and marketing is the future of this country

- Provides quality nutrients
- An opportunity for potential investors
- An added value window for wealth creation for fish cropping operators in the country.