

# **STANDARD OPERATING PROCEDURES FOR BIOSECURITY IN AQUACULTURE VALUE CHAIN**

## Table of Contents

<b>1.0 STANDARD OPERATING PROCEDURES FOR INPUT SUPPLIERS .....</b>	<b>4</b>
<b>2.0 STANDARD OPERATING PROCEDURES FOR FEED MILLERS .....</b>	<b>5</b>
<b>2.1 Prevention of Entry and Spread of Pathogens and Vectors .....</b>	<b>5</b>
<b>2.2 Reception of Raw Materials.....</b>	<b>5</b>
<b>2.3 Laboratory for Quality Assurance and Proximate Analysis .....</b>	<b>6</b>
<b>2.4 Feed Production in Feed Factories.....</b>	<b>6</b>
<b>2.5 Packaging of Feeds.....</b>	<b>7</b>
<b>2.6 Record Keeping in Feed Mills.....</b>	<b>7</b>
<b>2.7 Storage in Feed Factories.....</b>	<b>7</b>
<b>3.0 STANDARD OPERATING PROCEDURES FOR HATCHERY OPERATORS AND BROODSTOCK MULTIPLIERS .....</b>	<b>9</b>
<b>3.1 Prevention of Entry and Spread of Pathogens and Vectors in the Hatchery .....</b>	<b>9</b>
<b>3.2 The Broodstock.....</b>	<b>10</b>
<b>3.3 The Fish Seed, Disease Prevention and Control.....</b>	<b>10</b>
<b>4.0 STANDARD OPERATING PROCEDURES FOR FISH FARMERS /OUTGROWERS .....</b>	<b>12</b>
<b>4.1 Prevention of diseases and pathogens in fish farms.....</b>	<b>12</b>
<b>4.2 Equipment and Personnel.....</b>	<b>12</b>
<b>4.3 Management.....</b>	<b>13</b>
<b>5.0 STANDARD OPERATING PROCEDURES FOR FISH PROCESSORS.....</b>	<b>15</b>
<b>5.1 Prevention of Entry and Spread of Pathogens and Vectors in Fish Processing Factory .....</b>	<b>15</b>
<b>5.2 Hygiene and Sanitary Conditions of Processing House/Factory Surrounding .....</b>	<b>16</b>
<b>5.3 Equipment and Personnel.....</b>	<b>17</b>
<b>5.4 Pre-smoking and Smoking Operations.....</b>	<b>18</b>

5.4. Freezing Operations .....	18
5.5 Packaging and Storage .....	19
5.6 Waste Management and Disposal .....	19
<b>6.0 STANDARD OPERATING PROCEDURES FOR MARKETERS .....</b>	<b>21</b>
6.1 On Farm .....	21
6.2 During Transportation .....	21
6.3 At Point of Sales .....	21
<b>7.0 STANDARD OPERATING PROCEDURES FOR TRANSPORTERS.....</b>	<b>23</b>
7.1 Vehicles.....	23
7.2 Equipment and Personnel.....	23
7.3 Quality Control During Transport .....	24
<b>8.0 WATER QUALITY ISSUES.....</b>	<b>25</b>

## 1.0 STANDARD OPERATING PROCEDURES (SOPs) FOR INPUT SUPPLIERS

Input suppliers are actors of the aquaculture value chain that provide goods and services such as feeds, raw materials, chemicals, fish nets, fish farm equipment, supplements, etc., to farmers and other actors in the value chain. The following are standard operating procedures for input suppliers to ensure prevention and control of diseases at potential entry points.

- A. Employ experienced managers capable of detecting and assuring the quality of inputs.
- B. Check labels to be sure that products (feeds, chemicals, hormones, supplements, etc.) have adequate shelf life.
- C. Buy goods from reputable suppliers and manufacturers.
- D. Maintain clean storage facilities by sweeping and disinfecting the office space, store, warehouse and environment daily. Use water and detergents/disinfectants to wipe floors and surfaces.
- E. Store feed items in cool and dry places, to avoid moisture absorption and spoilage.
- F. For feeds packaged in porous bags, store in dark, cool, and dry places, to avoid leaching of micronutrients and moisture absorption respectively.
- G. Place feed bags on pallets away from the wall and the ceiling.
- H. Ensure adequate airflow for ventilation in the store and warehouse.
- I. Fish feeds must not be stored for more than six months from the date of manufacture. Adhere to the first-in-first-out (FIFO) principle, i.e. older feeds must be sold out first.
- J. For safe handling, , wash hands with water and soap before and after handling inputs.
- K. Dispose wastes appropriately; waste from spilled raw materials, spilled finished products, dust bags must be dumped in designated dump sites approved by the local government authorities.

## 2.0 STANDARD OPERATING PROCEDURES (SOPs) FOR FEED MILLERS

Fish feed millers are aquaculture value-chain actors involved with the production of fish feed. The following are standard operating procedures for feed millers to ensure prevention and control of diseases at potential entry points.

### 2.1 Prevention of Entry and Spread of Pathogens and Vectors

- A. Build a biosecurity fence around the feed mill in addition to the perimeter fence to keep out intruders.
- B. Install appropriate mesh-sized galvanised or barbed wire to cover open spaces at the top wall of the fence of the feed mill house to deter entry of rodents and reptiles.
- C. Provide designated gates for human and vehicular traffic control.
- D. Provide foot disinfection dips at the entrance of the feed production section.
- E. Provide tyre disinfection system for all vehicles entering the feed mill facility.
- F. Provide cloakrooms for washing and clothe change for male and female workers.
- G. Train factory staff on Infection Prevention Control (IPC) such as hand hygiene, respiratory and cough hygiene, how to use personal protective equipment, safe management, and care of environment/equipment.
- H. Provide adequate water supply, toilets, cloakroom and handwashing facilities in the factory. Staff must be trained in the proper use of these facilities.

### 2.2 Reception of Raw Materials

- A. Ensure that ingredients are from safe sources, free from contamination and adulteration (know your supplier).
- B. Read labels to check for expiry dates on branded products to avoid the use of expired raw materials in feed production.
- C. Feed ingredients that are known to be regularly contaminated with aflatoxin (aflatoxin is a toxin naturally occurring in moulds such as *Aspergillus flavus*) should be inspected for evidence of mould and any that looks mouldy be properly discarded.
- D. Damaged grains should be avoided, as they are more prone to mycotoxin contamination.

- E. Inspect standard packages for damages and wetness and use inputs from damaged bags before others in undamaged ones.
- F. Look out for spills and wastage due to torn bags in the delivery truck and during offloading. Separate the spilled contents from the rest of the bags. They should be treated separately depending on the perceived level of contamination.

### 2.3 Laboratory for Quality Assurance and Proximate Analysis

- A. Raw materials and finished feed must be tested in the laboratory to ensure that all nutrients are balanced as formulated, to avoid disease emanating from nutritional deficiencies.
- B. Analyse microbial load of raw materials and the finished feeds to ensure supply of healthy feeds to farmers.
- C. Conduct laboratory analysis to detect the presence of aflatoxin in raw ingredients. The acceptable limit of aflatoxin in feeds for animals that will be eaten by humans should be less than 20 parts per billion (ppb).
- D. Discard raw materials that have aflatoxin levels above 20 parts per billion (ppb) in dump sites designated by the local government authority.
- E. All laboratory equipment used during quality assurance and proximate test must be disinfected and cleaned before and after use.

### 2.4 Feed Production in Feed Factories

- A. Implement Good Manufacturing Practices (GMP) which includes a factory design that ensures a smooth flow of processing activities from the reception of raw materials to the finished feeds, process validation, and good procedures.
- B. Machinery must be properly cleaned before and after every production cycle.
- C. Check the appearance of finished feeds for texture, colour and odour before bagging.
- D. Extractor fans must be used in the feed mill to reduce heat and humidity which are precursors for prolific growth of microbes. Dust collection bags must be installed on milling equipment to trap dust from powdered feed particles, to minimise contamination through dispersal of microbe laden dust particles.

- E. Ensure unidirectional flow of materials: raw materials enter at one end of the feed mill and come out in the opposite direction as product to avoid contamination from unprocessed feed ingredients; from raw material store to milling, mixing, packaging to feed store in one direction.

## 2.5 Packaging of Feeds

- A. Use new bags for all products every time (bags must not be reused) to avoid contamination.
- B. Feed must be properly dried and cooled before packaging to avoid contamination following condensation in the bags.
- C. The moisture content of packaged feed should not be more than 9%.
- D. Any mouldy or rancid feed must be promptly disposed of.

## 2.6 Record Keeping in Feed Mills

- A. Ensure to keep adequate and proper record of dates and times raw materials were received, processed, stored, date of manufacture of feed, the batch number, bag number and proximate composition or raw materials used and finished feed produced.
- B. Ensure feed samples analysed match claims on labels for proximate analysis
- C. Records such as Date and time of sales of feed, batch sold, destination of feed, etc., enhance traceability of raw materials, additives, finished feeds and sources of potential contamination (where applicable).
- D. Recall feed bags if associated with probable harmful effects on fish or consumers' health for analysis.

## 2.7 Storage in Feed Factories

- A. Allow adequate airflow for ventilation in the store or warehouse.
- B. Place feed bags on pallets away from the wall and the ceiling to ensure proper circulation of air and reduce heat.
- C. Utilisation of raw materials and sales of feed should follow a first-in-first-out (FIFO) basis.

- D. Store feed items in cool and dry places to prevent oxidative rancidity at high temperatures and mould formation at high moisture or humidity.
- E. Fish feeds should not be stored for more than 6 months from the date of manufacture.
- F. Keep the store/warehouse clean by sweeping and disinfecting on a regular basis.
- G. Store/warehouse should be located close to the farm entrance.

### 3.0 STANDARD OPERATING PROCEDURES (SOPs) FOR HATCHERY OPERATORS AND BROODSTOCK MULTIPLIERS

Fish hatchery operations involve the breeding, hatching and rearing of fish in a controlled environment to produce fish fry or fingerlings for stocking aquaculture farms, fisheries or natural water bodies. These operations typically include activities such as selecting broodstock (parent fish), hypophysation, stripping of eggs, collection of milt, fertilisation, incubation, hatching, separation of dead eggs and raising the resulting fish larvae until they reach a size suitable for stocking. The following are standard operating procedures for hatchery operators and broodstock multipliers to ensure prevention and control of diseases at potential entry points.

#### 3.1 Prevention of Entry, Spread of Pathogens and Vectors in the Hatchery

- A. Build a biosecurity fence around the hatchery, in addition to the perimeter fence to keep out intruders.
- B. Provide designated gates for human and vehicular traffic control.
- C. Access to the hatchery should be restricted and controlled.
- D. Coveralls (wears) should be provided for staff and visitors to prevent entry of pathogens into the hatchery.
- E. The hatchery must have foot dips located at the entrance. The breadth of the dip should be wider than the door, extending by 30 cm on both sides of the door and have a minimum length of 1 m.
- F. Overhead sprays and hand wash must be put in place for staff and visitors (where necessary) to clean and disinfect against pathogens.
- G. Do not allow visitors into the hatchery.
- H. Provide tyre disinfection system for all vehicles entering the hatchery premises.
- I. Provide cloakrooms for washing and clothe change for male and female hatchery workers.
- J. Train your factory staff on Infection Prevention Control (IPC) such as hand hygiene, respiratory and cough hygiene, how to use personal protective equipment, safe management, and care of environment/equipment.
- K. Provide adequate water supply in quantity and quality, toilet and bathroom , cloakroom, and handwashing facilities in the factory. Staff must be trained in the proper use of these facilities.

- L. Ensure regular water quality testing
- M. Ensure proper hatchery design and tank installation such that each tank can be isolated from the entire system whenever the need arises e.g., during treatment.
- N. Separate hatchery personnel and equipment from general farm use

### 3.2 The Broodstock

- A. Ensure broodstock is fully gravid with matured eggs
- B. Disinfect all broodstock with potassium permanganate before use for breeding to avoid transfer of pathogen from broodstock to eggs or fry.
- C. Ensure a salinity of 30-35 ppt for marine shrimp broodstock, for river prawns ensure a salinity of 0-5 ppt for the broodstock for proper osmoregulation.
- D. Quarantine all incoming broodstock and treat (where applicable) before introduction into the hatchery.
- E. Do not introduce any suspected diseased broodstock into the hatchery to prevent disease transfer.

### 3.3 The Fish Seed, Disease Prevention and Control

- A. Fish farm hatchery operators must observe good hatchery management practices such as hand washing.
- B. Ensure regular water quality testing
- C. Each tank must have clearly labelled siphoning hose, nets and bowls (each should have separate sets of equipment).
- D. All equipment should be washed, disinfected, properly rinsed and sun-dried before and after use.
- E. Thoroughly clean and disinfect facility between batches of fish seed produced.
- F. Ensure a proper reporting line in the event of a disease outbreak for prompt action to be taken.
- G. Use probiotics as prophylaxis instead of antibiotics and adhere to good farm hygiene to prevent antimicrobial resistance and emanation of diseases, respectively.
- H. Diseased fish (shellfish and finfish) must be isolated immediately.

- I. Only veterinarians and qualified personnel are authorised to administer and supervise the use of antibiotics, other medications, vaccines, and chemicals in the fish hatchery.
- J. Ensure proper record of antibiotics, chemicals, hormones, anaesthesia, etc., used in the hatchery.
- K. Keep and regularly update disease and treatment logbook. .
- L. Prevent escape of fish seeds with screens and catchment ponds to prevent spread of diseases to the wild.
- M. Treat effluent water and ensure a minimum of 5 mg/l of dissolved oxygen before discharge into open waters.
- N. Sort regularly.
- O. Ensure availability of correct feed for fish seed

## 4.0 STANDARD OPERATING PROCEDURES (SOPs) FOR FISH FARMERS/OUTGROWERS

Fish producers are actors in the aquaculture value chain involved in the cultivation, harvesting, and sale of fish. Producers can range from small-holder farmers to large-scale commercial aquaculture operations. The following are standard operating procedures for out growers to ensure prevention and control of diseases at potential entry points.

### 4.1 Prevention of Diseases and Pathogens in Fish Farms

- A. Site used for fishing farming should be approved by government authority
- B. Build a biosecurity fence around land-based fish farm to keep out intruders.
- C. Provide designated gates or access for traffic control.
- D. Coveralls (wears) should be provided for staff and visitors at the farm gate.
- E. Each tank/pond/cage should have separate equipment e.g. nets and bowls.
- F. Clean and disinfect boats before and after use in fish culture systems.
- G. Diseased fish should be immediately isolated from healthy fish stock.
- H. Implement monitoring and testing drug residues in aquaculture products before they are marketed or moved to different locations.
- I. Quarantine measures for new fish stock
- J. Strict adherence to regulations regarding use of drugs
- K. Observe withdrawal period for aquaculture drugs

### 4.2 Equipment and Personnel

- A. All equipment must be washed, disinfected, properly rinsed and sun-dried before and after use.
- B. Thoroughly clean and disinfect facility between batches of fish produced.
- C. Fish holding and cooling facilities must be in place before harvest.
- D. Only veterinarians and qualified personnel are authorised to administer and supervise the use of antibiotics, other medications, vaccines and chemicals on the farm.
- E. Keep out predators from fish rearing enclosures

### 4.3 Management

- A. Test water to ensure water quality parameters are optimum before use and adhere to daily monitoring of water at source and in ponds.
- B. Ensure procurement, storage and use of good quality feed with adequate shelf-life.
- C. Feed should be of adequate size for the gape-size of fish
  
- D. Do not overstock your ponds to avoid competition leading to stress and outbreak of disease:
  - a. Recommended stocking densities for intensive oyster production in netlon rafts should not exceed 500 spats per 0.05 m<sup>3</sup> cage/tray.
  - b. Recommended stocking densities for intensive catfish production in earthen ponds should not exceed 25-30 fish/m<sup>3</sup>.
  - c. Recommended stocking densities for intensive tilapia culture in cages should not exceed 50-80 fish/m<sup>3</sup>.
  - d. Recommended stocking densities in polyculture systems in earthen ponds should not exceed 2-5 fish/m<sup>3</sup> at a ratio of 1:4 catfish to tilapia.  
Note: the tilapia should be stocked a minimum of two months before the catfish juveniles.
- E. Feed your fish at the right time and frequency, with the right quality and quantity of feed. Observe the behaviour of fish during feeding.
- F. Scoop sluggish or slow-moving fish, which could be a sign of disease and isolate for further observation.
- G. There should be a proper reporting line in the event of a disease outbreak and prompt action taken to prevent spread.
- H. Proper record of antibiotics, other medications, chemicals, hormones, anaesthesia, etc., used in the grow-out operations must always be kept.
- I. Keep and regularly update disease and treatment logbook. .
- J. Record dates, time, number of fish, average weight of fish, stocking density and movement or transfer of fish within facilities.

- K. Screen ponds using 1- 2 cm mesh nets to prevent entry of potential disease carrying vectors such as wild fish, amphibians, reptiles, birds or mammals. Such screens also prevent diseased fish from escaping the culture facility.
- L. Fish ponds should be left inactive for 2-3 weeks before the next production cycle.
- M. Desilt ponds between batches.
- N. Collect and treat effluent water in a wastewater treatment pond. Ensure a minimum of 5 mg/l of dissolved oxygen before discharge into open waters.

## 5.0 STANDARD OPERATING PROCEDURES (SOPs) FOR FISH PROCESSORS

Fish processors are individuals or companies involved in the processing and preservation of fish products for distribution and sale. This can include activities such as filleting, smoking, freezing, canning or packaging of fish to make them suitable for consumption by consumers (FAO, 2011). Fish being a highly perishable food needs proper handling, processing, preservation and storage if it is to have a long shelf life and retain a desirable quality and nutritional value. The organoleptic changes (physical change) vis-à-vis appearance, odour, texture and taste that commences immediately (within 3 minutes) after harvesting make it mandatory for fish marketers/harvesters to initiate pre-processing immediately after harvesting. The following are standard operating procedures for processors to ensure prevention and control of diseases at potential entry points:

### 5.1 Prevention of Entry and Spread of Pathogens and Vectors in a Fish Processing Factory

- A. Build a fence around the processing factory to keep out intruders.
- B. Install appropriate mesh-sized galvanised or barbed wire to cover open spaces at the top wall of the fence and processing house to deter entry of rodents and reptiles.
- C. Provide designated gates for human and vehicular traffic control.
- D. Provide foot disinfection dips at the entrance of the fish processing section.
- E. Provide tyre disinfection system for all vehicles entering the processing facility.
- F. Install waterproof flooring which is easy to wash and disinfect and laid in such a way as to facilitate the drainage of water into a hygienic wastewater disposal system.
- G. Provide cloakrooms for washing and clothe change for male and female workers.
- H. Wash basins must be installed with materials for cleaning the hands and single use hand towels.
- I. Train your factory staff on Infection Prevention Control (IPC) such as hand hygiene, respiratory and cough hygiene, how to use personal protective equipment, safe management, and care of environment/ equipment.
- J. Provide adequate water supply, toilets (flush lavatories), cloakroom, and handwashing facilities in the factory. Staff must be trained on the proper use of these facilities.

- K. Farm/processing unit should have health facilities nearby.
- L. Workers should have knowledge of and observe Hazard Analysis and Critical Control Points (HACCP) principles.

## 5.2 Hygiene and Sanitary Conditions of Processing House/Factory Surrounding

- A. All processing factories must be routinely inspected by fish inspectors of the Federal Department of Fisheries and Aquaculture.
- B. Processing units should be located away from industrial and residential areas.
- C. The processing unit design should be "L", "U" or "I" – shaped.

Note: There should be unidirectional movement from raw materials to products.

- D. All processing units (reception, abattoir, kiln room, packaging room, storage area, etc.) must be in separate enclosures.
- E. Walls for housing facilities must be painted with gloss materials for easy cleaning/washing.
- F. There should be adequate ventilation and good working space.
- G. There must be a constant flow of potable water for cleaning and operational activities.
- H. The processing house must always be kept clean. The floors must be swept and mopped daily.
- I. All walls must be smooth for ease of cleaning.
- J. The doors must be closed always to prevent contaminants/insects from coming in.
- K. Windows, ceilings, dryers and pathways must be free from insects and dust.
- L. Carry out comprehensive cleaning exercises of smoking kilns/dryers immediately after every production.
- M. Cleaning exercises should be recorded in the cleaning cards provided.
- N. The surroundings must remain tidy, free of dirt and bushes and must be swept daily.
- O. Processing should be carried out in such a way as to avoid cross-contamination.
- P. All equipment and utensils such as bowls and knives, should be non-corrosive and disinfected before and after use.
- Q. Wash basins must be installed with materials for cleaning the hands and single use hand towels.

- R. All fish contact surfaces should be smooth, waterproof and easy to clean. Direct wooden surfaces are not allowed as they can harbour contaminants and pathogens.
- S. Processing facilities should have good drainage.
- T. Avoid the use of chemicals and pesticides as insect deterrents and preservatives.
- U. Storage for sales should follow a first-in-first-out basis.
- V. Processing areas should be equipped with first-aid boxes and fire extinguishers.
- W. Disinfectants made from chlorine must be available for cleaning.
- X. The premises should be fumigated at least twice a year.
- Y. The processing house should be cleaned every 3 days if not in use otherwise it should be done every day.
- Z. Ensure proper waste disposal

### 5.3 Equipment and Personnel

- A. Equipment such as weighing scales, knives, kiln racks, bowls, etc., must be made from materials that are not corrosive such as stainless steel or plastic.
- B. All staff must put on appropriate personal protective equipment (footwears, gloves, head cover, nose masks etc) when carrying out processing operations.
- C. Dedicate equipment to specific areas and/or purposes. Where avoidable, do not share processing equipment and where necessary, thoroughly wash and disinfect before use.
- D. Use appropriate equipment with the required specifications in fish processing, e.g. stainless-steel smoking kilns must be used instead of mild steel, and food grade packaging materials (e.g. plantain leaves) should be used in wrapping fish by barbecue processors instead of aluminium foils and polyethylene bags.
- E. Cleaning materials and chemicals must be adequately supplied and labelled to specific areas of use.
- F. All processing utensils must be washed thoroughly with warm water and soap, and dried before and after use.
- G. Clean utensils must be stored in locked up shelves to avoid contamination.
- H. Working clothes must be washed and kept separately from normal wears.
- I. All handlers must keep to good hygiene.
- J. No jewellery is allowed/worn during processing.
- K. All handlers must undergo a food handler's test twice a year.

- L. Men must be clean shaved; women without overgrown nails or nail polish and jewellery not allowed.

#### 5.4 Pre-smoking and Smoking Operations

- A. Properly de-gut and wash fish under running water.
- B. Wood for smoking should not be painted, treated with glue or any chemical preservatives. They should be stored away from the processing room and be inspected before use.
- C. Processing must be done within acceptable range of temperature over time, (80 – 100 °C for hot smoking for up to 3 hours, followed by 50-60°C for medium smoking till fish is dried).
- D. Fish products must be allowed to cool rapidly to room temperature.
- E. Smoking kiln should be made with materials easy to clean and disinfect.
- F. Smoking kiln should have time and temperature control devices.

#### 5.4. Freezing Operations

- A. Decayed or contaminated fish must be immediately sorted and separated from other fish before processing.
- B. Attention must be paid to all processing steps, adequate supervision and quality check should be in place at all steps. All smoked fish that require freezing must contain less than 10% moisture and all freezers must operate at sub-zero (- 20°C) temperatures.
- C. Apply HACCP, Good manufacturing Practices or quality control measures at each point of operation.
- D. Ice must be made from portable water.
- E. Sorted fish must be iced as quickly as possible.
- F. Icing must be done properly – Fish should be immersed completely in ice.
- G. Ice boxes must be disinfected and cleaned before and after use.
- H. Freezers and other cooling equipment must be in proper working condition at all times and be serviced by regular electricity.

## 5.5 Packaging and Storage

- A. Packaging must be carried out under satisfactory conditions of hygiene, such as improved ventilation, screened windows, smooth tables, insect-proof cabinets and dust-proof conditions.
- B. Food grade packaging bags must be used when packaging processed fish and must be properly sealed.
- C. Cold storage vans for fresh fish must be cleaned and disinfected before and after delivery.
- D. All packaging materials must be properly kept away from dust.
- E. Packaging material must be strong enough to protect the product.
- F. Racks or pallets must be used for stacking processed fish.
- G. Packed dried fish in cartons must be cushioned by proper laying to avoid breakages during transportation.
- H. All nutritional facts of fish products must be reflected on the packaged products label.
- I. The location and destination of products must be indicated on the package and recorded; manufacturing and expiry dates must be clearly stated on the label on the pack. Batch number, certificate/approval number, name and address of producer must be written on the label.
- J. Use clean and dry cartons (cardboard boxes) for secondary packaging of processed fish.
- K. Do not place cartons directly on the floor at storage, place them on shelves in racks or in cupboards.
- L. Make sure the smoked fish is very dry and cool before packaging.
- M. Always keep packed and unpacked fish in a cool and dry place.
- N. Check your storage every 2 weeks for any insects or damages.

## 5.6 Waste Management and Disposal

- A. Dispose fish waste away from the processing facility in dump sites designated by the local government authorities.
- B. Use covered, water-tight receptacles to prevent leakages, foul smell and pollution of waterways.
- C. Dispose of waste promptly and responsibly.
- D. Treat effluent water to deodorise and reduce contaminants before discharge.

E. Use biodegradable packaging materials and properly dispose of waste from the packaging material.

## 6.0 STANDARD OPERATING PROCEDURES (SOPs) FOR MARKETERS

Marketers are actors in the aquaculture value chain involved in connecting producers with different categories of middlemen and consumers by facilitating the distribution and sales of aquaculture products. There are different categories of marketers; agents/middlemen, wholesalers and retailers. Throughout this process, risks such as exposure to extreme temperatures, rough handling, packaging failures and use of chemicals may occur, necessitating proactive risk management strategies like best practices, personnel training and regulatory compliance to ensure safety and quality along the value chain. The following are SOPs for fish marketers to ensure prevention and control of diseases at potential entry points:

### 6.1 On Farm

- A. There must be designated collection points for marketers on the farm.
- B. Marketers must use the overhead sprays, foot disinfection dips before entering the designated collection points.
- C. Ensure the use of clean water and collection bowls/containers by marketers at collection points to prevent contamination.
- D. Ensure proper hand hygiene and handle or kill fish humanely.
- E. Equipment for harvesting, weighing and sorting fish must always be kept clean.

### 6.2 During Transport

- A. Avoid mixing fish from different farms in the same container for transport, storage and/or sales to prevent potential disease transfer.
- B. Train fish marketers on best practices on transportation of live/dry/smoked/frozen fish.

### 6.3 At Point of Sales

- A. Do not use antimicrobials and/or chemicals to prolong or preserve life/shelf-life of fish during sales.
- B. Ensure to have access to ice blocks and alternative power sources for refrigeration of fresh and unsold fish.

- C. Shops involved in sales of smoked /dried fish must have dehumidifiers and must be free from leakages, damp and access by rodents.
- D. Ensure clean contact surfaces and utensils.
- E. Maintain records of fish sources, harvest dates and handling practices.
- F. Package dried/smoked fish with water- and air proof materials.
- G. Label fish with relevant information for traceability.

## 7.0 STANDARD OPERATING PROCEDURES (SOPs) FOR TRANSPORTERS

Transporters are service providers in the aquaculture value chain involved with the movement of live aquatic organisms, aquaculture inputs, harvested and processed products to the market. The transport value chain involves activities aimed at ensuring efficient, safe and timely delivery of fish inputs and products while maintaining product quality and integrity from farm to fork. The following are standard operating procedures for transporters to ensure prevention and control of diseases at potential entry points:

### 7.1 Vehicles

- A. Vehicles must be in good working condition to avoid breakdown and delay in the delivery of input supplies, live and processed fish.
- B. Vehicles must be properly cleaned and sanitised before and after every delivery.
- C. Wastes removed from vehicles must be properly disposed of.
- D. Educate the transporters on the risks of contamination e.g. raw materials.
- E. Ensure vehicles used for transporting aquaculture supplies/products meet compliance requirements e.g. use of refrigerated trucks, insulated containers and coolers in trucks, cars, vans, trains.

### 7.2 Equipment and Personnel

- A. Educate transporters on the risk of pollution due to delays from non-compliance to regulatory requirements for transporting inputs/live fish/ aquaculture products.
- B. Vehicles must be provided with battery operated aerators, sealed oxygenated bags for live fish seed transport, etc.
- C. Transporters must practise Infection Prevention Control (IPC) such as hand hygiene, respiratory and cough hygiene, how to use personal protective equipment, safe management, and care of environment/equipment.
- D. Use clean packaging materials (where applicable) for all supplies/ products.
- E. Load/offload/deliver, inputs supplies/live fish/ aquaculture products separately to avoid cross-contamination.
- F. There should be adequate supervision of all the processes involved in transporting inputs/live fish/aquaculture products.

### 7.3 Quality Control During Transport

- A. Arrange for live fish to be transported early in the morning or late in the evening, to avoid high temperatures during transit.
- B. Avoid overstocking live fish seed in vats during transport. Fingerlings of catfish should not exceed 1,000/50 L jerrycan containing 20 L of water. Juveniles of catfish should not exceed 500/50 L jerrycan containing 20 L of water. Tilapia should not exceed 1,000 fingerlings per oxygen bag containing 15 L of water. These numbers are for distances not more than 400 km.
- C. Do not feed fish at least 24 hours before transportation to avoid contamination from faecal pollution.
- D. Acceptable doses of antifoaming (e.g. palm oil) and anti-stress agents (e.g. glucose or salt to prevent osmoregulatory stress during transport) must be used during transportation of live fish. This must be confirmed recorded and non-hazardous.
- E. Ensure to maintain recommended temperatures during transportation of live fish. For fingerlings, spats and post-larvae, 22°C - 26°C temperature is recommended, for broodstock 22°C-28° C is recommended. Place ice in a receptacle around the fish holding facility in the transport vehicle to prevent water from overheating during transportation.
- F. Dry aquaculture inputs must be transported in cool and dry containers/vessels, free from leakages, damp conditions and corrosion.
- G. De-humidifiers must be used in very humid weather conditions during transport.

