RSM2SNF
Research Supporting African MSMEs
To Provide Safe and Nutritious Food

TRAINING MANUAL

ON BASIC FOOD SAFETY AND HYGIENE PRACTICES FOR FISH AND FISH PRODUCTS

Source: RSM2SNF

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About RSM2SNF

The Research Supporting African MSMEs to Provide Safe and Nutritious Food (RSM2SNF) is a five-year project (2022–2026) sponsored by the Bill and Melinda Gates Foundation and implemented by Michigan State University (MSU) working with partners in Nigeria and Tanzania.

The project aims to respond to the observation that African agrifood systems are growing and transforming. This dynamism is driven by the many micro, small, and medium enterprises (MSMEs) that operate all along agrifood value chains. However, little research has thus far been focused on these relatively small businesses, even though they play an important role in the availability of affordable, safe, and nutritious foods in African markets.

RSM2SNF is carrying out research activities all along food supply chains. This includes the wholesale, logistics, processing, and retail segments of the value chains of several products, such as fish and tomato as well as farms. The goal of these research activities is to understand the midstream of these food value chains with a focus on MSMEs, and to inform policies and interventions to support MSMEs in providing safe and nutritious foods at affordable prices.

This manual presents training material on good hygiene and handling practices for fish products in Nigeria. It draws on an extensive review of the global literature on food safety as well as global and local recommended practices for fish handling from production to sale in traditional markets. The training material was developed as part of a co-creation activity with Rahama fish market, Ibadan, Oyo State to better understand fish processor handling practices in the state.

Training Objectives

1. To increase the awareness of traders about good hygiene practices during fish farming, transport, processing (e.g., smoking), and selling.
2. To enhance the technical skills of fish traders to meet food hygiene practices

Learning Outcomes

At the end of the training, participants should be able to:

- Know the different types of food safety hazards.
- Identify the possible sources of contamination of food.
- Understand the importance of food safety in handling fresh and processed fish.
- Apply basic hygiene practices to minimize contamination risks while handling, processing, and selling fresh and processed fish.
- Promote good agricultural and handling practices during production, processing, and distribution of fish.

Module 1: Introduction to Feed Safety and Hygiene

Introduction

- Consumers expect the food they eat to be safe, however people still fall ill from the food they eat.
- Safe and nutritious food is necessary for human survival and well-being.
- Food safety involves protecting food from anything that can cause harm or illness to the consumer.
- Food borne illnesses are caused by dangerous micro-organisms and/or toxic chemicals (e.g., bacteria, viruses, parasites, moulds, chemicals & metals)
- Food safety is a shared responsibility between governments, producers, traders, and consumers.
- Everybody has a role to play from farm to table to ensure that the food we consume is safe and will not cause any harm to our health.
- Farmers, processors, transporters, and traders of food must obey food hygiene rules to prevent food borne illnesses.
- Food businesses should know the hazards that may affect their products and the consequences of these hazards for consumer health and ensure that they are prevented.
- Good Hygiene Practices (GHPs) are the foundation of any effective control of hazards associated with food.
- Effective implementation of Good Agricultural Practice (GAP) & Good Hygienic Practice (GHP) should be sufficient to address food safety issues at the farm level, processing, and distribution.
- Food borne illness should be prevented because it is a burden to the healthcare system, It weakens the economy and national development efforts, as well as international trade.

Food Safety

- Food safety involves producing, handling, storing, and preparing food that is not contaminated hence preventing food borne illness.
- Safe food protects consumers from food borne illnesses, increases consumer confidence in the food supply system, improves the earnings of operators, encourages tourism, and enhances national and international food trade which boosts the economy of a nation.
- The current approach to food safety depends on the development of control measures and monitoring such measures.

Food Safety Hazards

The 3 types of food safety hazards are physical (objects), chemical (poisons) and biological (germs) hazards.
Examples of hazards include:

- Improper agricultural practices.
- Polluted environment (e.g., mercury, cadmium, nickel).
- Poor hygiene at any stage of the food chain (e.g., E. coli, Listeria, Campylobacter).
- Lack of preventive controls in food processing and preparation operations.
- Misuse of chemicals (e.g., pesticides, weed inhibitors, growth hormones).
- Use of banned dyes and flavours (e.g., Sudan red, tartrazine, azo dyes, butter yellow).

Possible Sources of Food Safety Hazards:

Physical Hazards

https://www.fao.org/fileadmin/templates/rap/files/meetings/2014/140623-haccp-03.pdf

Chemical Hazards

- Chemicals from non-food grade packaging in contact with food can also leach into food.
- Substances, such as heavy metals (e.g., lead, cadmium, zinc, cyanide) and refrigerants may be present in food due to pollution.
- Adding chemical (e.g. formaldehyde) for embalmment into fish, which is dangerous for human consumption.

Biological Hazards

- Biological hazards are harmful micro-organisms such as bacteria, viruses, algae, and certain toxic products they may produce.
- Not all micro-organisms are harmful. Bacteria in yogurt, yeast in bread, or certain molds in cheese form part of the food production and play an important role to impart characteristic flavours.
- Biological hazards are introduced into food primarily through:
  - contact with soil,
  - contaminated water,
  - incorrectly treated manure,
  - sewage,
  - air,
  - persons,
  - animals (farm animals, birds, and pests), and transport.

General Principles of Food Hygiene

- Food safety and suitability should be controlled using a science-based preventive approach such as a food hygiene system. GHPs, such as hand washing, clean clothes, clean environment, not keeping long fingernails nor cutting fingernails near food) ensure that food is produced and handled in an environment that minimizes the presence of contaminants (https://www.canr.msu.edu/resources/rsm2snf-practical-guide-to-support-increased-access-to-safe-fish-in-nigeria).
- Each fresh fish and processed fish farmer and processor should be aware of the hazards associated with fish during production, transport, and processing, and the hazards from the environment at which the fish is stored and handled.
- Food hygiene practices should be reviewed periodically and whenever there is a significant change that could impact the potential hazards and/or the control measures (e.g., new methods of farming, new methods of harvesting, new methods of processing, new equipment) associated with handling fish.

Handling Conditions from Production to the Market

- The structures for fish farming shod facilitate ample drainage.
- A good supply of clean water or potable water at adequate pressure should be in use. For example, pond water in Nigeria, should be treated to supply fish adequate oxygen and save them from intoxication and microbial infections.
- Vessels used for fish capturing should be kept clean.
- All surfaces in handling areas should be non-toxic, smooth, impervious to contaminated water/fluid and in sound condition to minimize the buildup of fish slime, blood, scales, and guts and to reduce the risk of physical and microbial contamination.
- Where appropriate, adequate facilities should be provided for the handling and washing of fish with an adequate supply of potable water or clean water.
- Adequate facilities should be provided for the washing and disinfecting equipment, where appropriate.
- Identify the source for clean water to avoid contamination.
- Where appropriate, containers for offal and waste material should be clearly identified, suitably constructed with a fitted cover and made of impervious material such as plastic, metals and cement.
- Separate and adequate facilities should be provided to prevent the contamination of fish and dry materials, such as packaging, by: – poisonous or harmful substances; – dry storage of materials, packaging, etc.; – offal and waste materials.
- Adequate hand washing and toilet facilities, isolated from the fish handling areas, should be available.
- The entry of birds, insects, or other pests, animals, and vermin, should be prevented, where appropriate.
- Individuals handling fish should avoid jewellry such as rings because they are made from metals and can thus be a source of physical, chemical, and microbiological contamination to the fish.
- Equipment, containers, and utensils coming into contact with fish should be designed to provide for adequate drainage and constructed to ensure that they can be adequately cleaned, disinfected, and maintained to avoid contamination.
- Equipment and utensils should be designed and constructed to minimize sharp inside corners and projections as well as tiny crevices or gaps to avoid dirt traps.
- A suitable and adequate supply of cleaning utensils and cleaning agents, approved by the official agency having jurisdiction, should be provided.

Personnel

- Personnel who come directly or indirectly into contact with fresh and processed fish should be instructed in food hygiene to a level appropriate to the operations they are to perform.
- All personnel (team leaders, full-time and part-time employees as well as seasonal workers) must be aware of their roles and responsibilities in protecting food from contamination or spoilage.
- All farmers, processors and traders must have practical knowledge of basic sanitation rules and hygiene measures related to the work they perform and the responsibilities they hold.
- Fish farmers, middlemen that transport fish to processors, should be well trained in the use of special cleaning tools and chemicals, and in methods of dismantling equipment for cleaning and they should be knowledgeable in terms of the significance of contamination and the hazards involved.
- There must be regular periodic training programmes.
- No person who is known to be suffering from, or who is a carrier of, any communicable disease or has an infected wound or open lesion should be engaged in preparation, handling, or transportation.
- Where necessary, adequate, and appropriate protective clothing, head coverings and footwear should be worn.
- All persons working in a fish facility should maintain a high degree of personal cleanliness and should take all necessary precautions to prevent contamination of fish.
- Hand washing should be carried out by all personnel working in a processing area:
  - at the start of fish or shellfish handling activities and upon re-entering a processing area.
  - immediately after using the toilet.

- The following should not be permitted in handling and processing areas:
  - smoking;
  - spitting;
  - chewing or eating;
  - sneezing or coughing over unprotected food;
  - the adornment by personal effects, such as jewellery, watches, pins, or other items that may pose a threat to the safety and suitability of the products.

Water Quality

When an establishment has its own supply of water or other water sources, and chlorine is used for the treatment of water that may come in direct contact with fish and fishery products, the residual content of chlorine should not exceed that of potable water. The use of higher concentrations of chlorine in water treatment, in the primary production-to-consumption food chain is subject to approval by the competent authority.

Transport & Storage Hygiene

Vehicles should be designed and constructed:

- Such that walls, floors and ceilings, where appropriate, are made of a suitable corrosion-resistant material with smooth, non-absorbent surfaces. Floors should be adequately drained.
- To provide the fish with protection against contamination, exposure to extreme temperatures and the drying effects of the sun or wind.
- Harvested fish should be transported to markets without undue delay.
- Whenever possible, use cold chains to transport and store fish (e.g., ice and cold temperature).

Module 2: Production and Safety of Food

Production of fish in the Pond

- High stocking densities should be discouraged to reduce risk of cross-infection of pathogens.
- Fish should not be fed with droppings directly from poultry without proper treatment.
- Domestic animals should not be allowed to move around fishponds.
- Aquaculture facilities should not be close to animal husbandry because of possible contamination by pathogens of fecal origin.
- Water used for fish farming should be clean and free from contaminants (e.g. treated water or clean water from a borehole).
- All equipment and utensils should be clean and regularly disinfected.
- Fish farms should not be in areas where they can be easily contaminated by chemical hazards (e.g. chemical manufacturing industries).
- Fishpond water should be changed regularly to maintain good quality and safety.

https://agricdemy.com/post/profitability-catfish-

https://www.youtube.com/watch?v=MbMaUSNv51Q

https://aqua4nations.com/fish-rearing/reasons-fish-farms-fail-in-nigeria/

https://www.proagrimedia.com/livestock/profitable-fishpond-farming-is-within-your-reach/

Module 3: Feed and Harvesting

- Feed should be used before the prescribed expiry date.
- Feed compounded by farmers should not contain toxic chemicals.
- Feed should be stored in a cool and dry environment to prevent mould growth.
- Fish silage, when used as feed, should be properly cooked.
- The surfaces for handling harvested fish (areas/tables) should be clean, non-toxic, and smooth (e.g., stainless steel or plastic) to reduce the risk of contamination.
- Harvesting should be rapid to minimize the time that the fish is exposed to high temperatures.
- Farmers should wash their hands before and after harvesting, using clean water and detergent.
- There should be adequate facilities for handling and washing of harvested fish with clean water.
- All equipment for harvesting and holding fish should be cleaned and disinfected regularly.
- Birds, insects, and pests should not be present in the harvesting environment.

Fish should be kept in clean containers

The blood should be removed from the fish.

Hands must be washed after each operation

https://www.creamy.no/Hand-hygiene-6456486.html

It is not allowed to enter the pond for harvesting.

https://catfishfarmenterprise.com/the-role-of-temperature-and-oxygen-in-catfish-farming/

Module 4: Fish Transportation

- Buckets/bowls for transportation of live fish should be easy to clean, free from contaminants and clean.
- Buckets/bowls should be made of non-corrosive materials that will not transmit toxic substances into the fish.
- Harvested fish should be transported to markets without undue delay.
- Fish should not be transported with other products that can contaminate fish.
- To minimize deterioration, the live fish should be kept in cool and clean water or processed early (ideally in the next 15 minutes after harvesting).
- Always maintain a cool temperature for the fish even when in the market.
- Do not store fish with other foods such as vegetables and meats.
- Fish should not be transported with animals in the same vehicle because they are potential sources of contamination.
- Transport vehicles should be checked before use for cleanliness, foreign objects and insect infestation.
- Keep vehicles/containers for transporting fresh fish or processed fish clean, in good repair and condition.
- Check vehicle for cleanliness, chemical spills, foreign objects, and pest infestation before loading.

Dirty environment for fish display

https://www.canr.msu.edu/fsg/projects/RSM2SNF%20Safe%20fish%20guide%2022-02 2023%20updated%202.pdf

Fish should not be bagged in dirty sacks.

https://www.youtube.com/watch?v=kc-QalwO0h8

Module 5: Market and Sales

- Killed fish should be processed immediately to prevent contamination by microorganisms.
- The quality of the fish should be monitored by looking at the gills to make sure that they are red and with no odor; eyes are clear and shiny; and the flesh springs back when pressed.
- The table/surface for processing should be covered with non-toxic material such as tiles or clean sacks (e.g., wash sacks with soap and rinse with hot water).
- The table/surface for processing fish should be cleaned regularly (e.g., daily and in-between different batches of fish being processed) and free of contamination.
- Always clean the table before and after each day's sales.
- Avoid selling your fish near toilets or refuse disposals.
- Wash your hands with soap for at least 20 seconds immediately after using the toilet and before and after each sale.
- The sales environment should be free from rodents and insects.
- Do not sweep around exposed processed fish.
- Clean your selling environment before and after each day's sales (e.g., sweep and remove any trash around your stall before bringing out the fish).

Fish should not be displayed on dirty table

The displayed table and environment is dirty

Module 6: Food Handling Practices

Personal Hygiene

- People are a common source of pathogenic bacteria.
- The best approach to avoid contamination is to prevent it.
- All employees working in direct contact with food, food contact surfaces and food packaging must conform to hygienic practices to protect food against contamination by microorganisms or unwanted material.
- Poor hygienic practices and careless handling behaviour can lead to product contamination.
- People cultivating fish and processing fish should be trained in personal hygiene practices.

Hand Washing

- All employees must wash their hands thoroughly:
- When they enter food handling areas.
- Before starting work.
- After handling contaminated materials.
- After breaks.
- After using toilet facilities.
- As often as is necessary to prevent product contamination.

Personnel

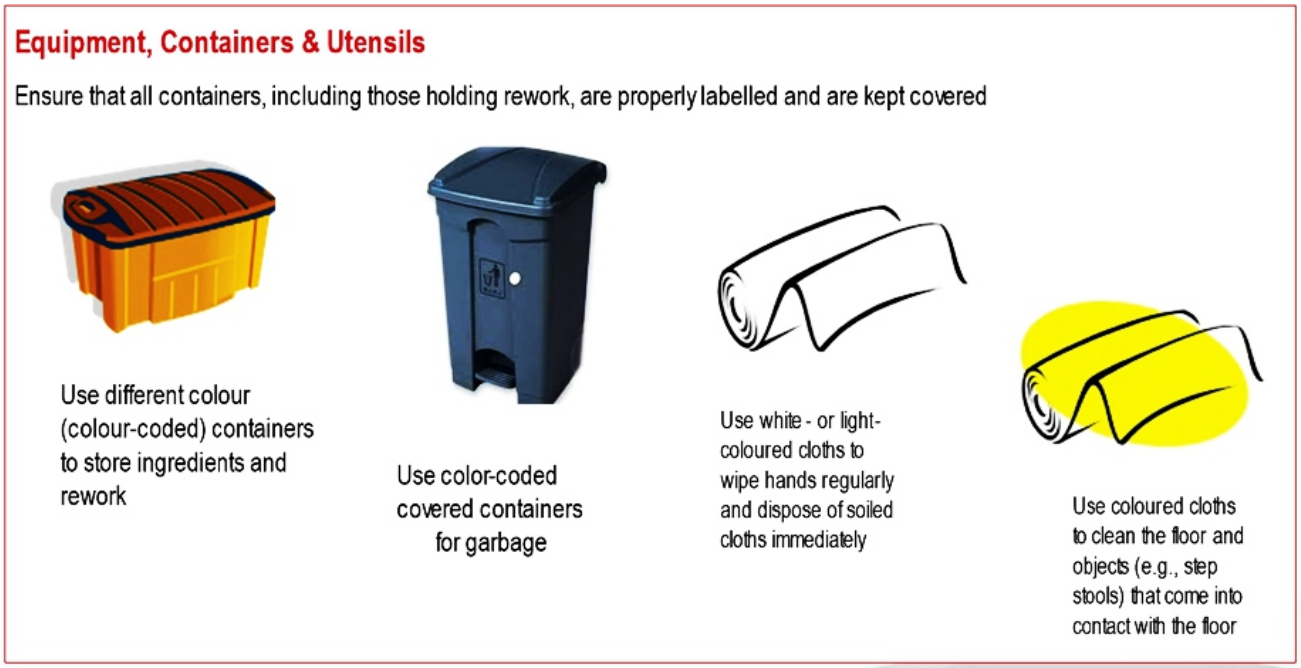
- Do not leave gloves, masks, etc. lying around while on break or at shift end.
- Crates boxes, containers or buckets used in your business must not be placed directly on the floor.
- Store brooms and dust pans at stations provided.
- Do not lean, sit, or step on produce surfaces.
- Do not handle ingredients or products with either cut or infected hand.

Produce

- Keep hand contact with ingredients and products to a minimum.
- Check ingredients for expiration dates to ensure that fresh ingredients are used.
- Always keep fresh fish in clean water and processed fish in a clean sealed plastic packaging material.

Packaging

- Packaging design & materials should provide adequate protection, prevent damage & accommodate proper labelling.
- Materials or glasses must be non-toxic.
- Primary packaging material must be food grade (safe for food as indicated on the packaging material).
- Reusable packaging should be durable, easy to clean and disinfect where necessary.



Sanitation

- Production equipment/utensils must be thoroughly cleaned and sanitized after use.
- Keep contact surfaces clean and free of contamination from tools, cords, cleaning utensils, machine parts, lubricants, and paper.
- Clean all spills promptly.
- Keep everything off the floor; keep the area clean and floors swept.
- Clean selling areas and stores regularly throughout the shift.
- Keep your immediate working area swept or dust mopped. Wipe or mop up spilled liquids promptly.
- Scrapers for molds and tabletops are not to be used on the floor.
- Leave your work area clean at the end of your shift.

Receiving & Storage

- Fish must be stored and handled under conditions to prevent deterioration.
- Ensure pallets and processed fish are kept at least 18" away from the walls and above the ground.
- Inspect torn storage bags and cartons and repair if appropriate.
- Brush off bags and boxes before opening them.
- Ensure stock rotation of processed fish, sell oldest stock first.

Module 7: Good Agricultural Practices

Farm Structure and Maintenance

- Farm and on-farm equipment and facilities must be well maintained, with proper equipment storage. Farm equipment should be disinfected.
- Farm structures should be checked regularly for damage or signs of weakness/instability to minimise risk of escapes.
- Farm should take appropriate measures to deter/prevent predator entry into fish culture areas.
- Farm, in particular, the packing area, must be cleaned regularly with planned cleaning schedules and procedures.

Farming and Packaging Practices

- Incoming fish stocks must be of good health and known origin i.e. from hatchery source.
- New fish stocks should be quarantined and separated from the other fish stocks.
- There must be proper documentation of fish stocks in the various netcages which must be labelled, and records MUST be kept of fish movement between netcages.

Feed Management

- Fish must be fed in a manner that avoids over-feeding and minimises water pollution.
- Feeding on dry, formulated pellet feeds is encouraged.
- Feeds must be properly stored to prevent spoilage/decomposition/ contamination.
- Expired or rancid fish feeds must not be used. Expiry dates of fish feed must be clearly stated on the storage containers/bags.
- Records of fish feed purchases (suppliers, dates, etc) must be kept. Records should include source of feed and material constituents of the feed.

Use of Chemotherapeutants (e.g. Antibiotics, drugs and chemicals)

- Application of antibiotics/drugs/chemicals must follow the recommendations as on the manufacturer's label or as directed according to a fish health specialist. Procedures and steps must be clearly documented.
- Antibiotics, drugs and chemicals must always be clearly labelled and stored in their original containers, securely. They must be stored at the appropriate temperature. Storage area must be isolated from packing areas and fish feeds to prevent contamination.
- All containers and unused portions of antibiotics, drugs and chemicals residues must be safely and properly disposed.
- Withdrawal periods of the respective antibiotics, drugs and chemicals prior to harvest must be strictly observed and recorded.

Module 8: Fish Smoking

Preparation

- Ensure the fish used for smoking is fresh (not smelling) and of high quality (i.e., eyes are clear and shiny; gills are red with no odor; flesh springs back when pressed). Remove scales, guts (optional), and other internal organs carefully to prevent contamination and dispose properly (see waste management section).

Cleaning

- Thoroughly clean all utensils, equipment (e.g., wash with soap and rinse with hot water) before and after use to prevent cross-contamination.
- Thoroughly clean the smoking area before bringing the fish out for display or sale.

Smoke Drying/Temperature Control

- Oven-smoking methods are highly recommended for proper drying. Once the fish is dried at the right temperature and right amount of time, it removes moisture, which inhibits microbial growth.
- Maintain consistent and appropriate smoking temperatures around 145°F (63°C) for at least 30 minutes. The kiln smoking methods often use high temperatures over a short period, which helps to kill or inhibit the growth of harmful microbes but only if it is smoked at the right temperature (145°F (63°C)) and length of time (at least 30 minutes).
- The smoke generated during traditional smoking not only imparts flavor but also helps preserve the fish by inhibiting microbial growth. Ensure the smoke is generated from clean, non-toxic sources such as hardwoods.

Monitoring

- There is need for regular monitor of the fish during the smoking process for any signs of spoilage, such as off odors, unusual colors, or sliminess. Discard any fish that appear spoiled following proper waste management procedures (see waste management section below).

Cleaning

- After smoking, the fish should be cleaned with clean materials (e.g., clean foam or white amala that will be changed frequently) to remove any contaminants.

Storage

- After smoking, store the fish in clean, sealed nylon and put in dry containers above the ground to prevent recontamination. The smoke-dried fish should not be placed directly on the floor. It should be kept in a plastic container/crates and pallets or put on elevated racks or tables.

Hygiene

- Maintain good personal hygiene practices throughout the smoking process to prevent the introduction of harmful microbes. This includes washing hands thoroughly before handling fish and wearing clean clothing.

Module 9: Waste Management

Waste Collection

- Drop all your waste in containers such as recycling bins or wheeled bins. Ideally, fish waste should be separated from other food waste.

Waste from Fish

- They should dry the fish waste (intestines etc.) at a uniform temperature, depending on moisture content, and store properly so that when milled they are all equally dry to avoid contamination.

Sorting of Generated Waste

- Generated waste should be sorted into recycling (plastic bottles, nylon) and biodegradable (organic materials).

Waste Storage

- There should be storage and bulking facilities in the market.
- There should be dedicated vehicles to offload the stored waste.

Composting

- There should be facilities for generated waste to produce compost for agricultural, municipal or consumer applications far from the market.

Recycling and Reuse

- The sorted waste can be processed into recyclable waste fractions into secondary raw materials.