



Food and Agriculture  
Organization of the  
United Nations

# Post-harvest management and hygienic seafood processing for small-scale fisheries in Bogale





# **Post-harvest management and hygienic seafood processing for small-scale fisheries in Bogale**

**by**

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**Food and Agriculture Organization of the United Nations  
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## Introduction

Post-harvest management and hygienic seafood processing for small-scale fisheries in Bogale training manual is a comprehensive guide designed to enhance the knowledge and skills of small-scale fisheries (SSF) households in sustainable seafood handling, processing, and management practices. Tailored to the unique needs of Bogale's SSF sector, this manual provides actionable insights to minimize post-harvest losses, improve seafood quality, and ensure food safety while promoting sustainable practices.

The manual is divided into four modules. The first, post-harvest management for small-scale fisheries, explores the causes of post-harvest losses and introduces strategies to reduce waste and improve operational efficiency along the supply chain. The second module, seafood preservation and processing technology, provides practical guidance on preservation methods including chilling and freezing, alongside techniques for producing dried and fermented seafood products. Clear process flow diagrams and detailed process description ensure participants maintain product quality and safety.

The third module, understanding basic food safety and key preventive measures, focuses on food safety awareness, detailing the four primary food safety hazards and their preventive measures. This knowledge empowers participants to ensure both safe seafood production and healthier daily practices. The final module, good hygiene practices (GHP), emphasizes the importance of basic hygiene standards in seafood processing. Participants learn to implement GHP in line with local and international standards, enabling them to achieve certifications and expand market opportunities.

This manual equips SSF households in Bogale with the essential tools to optimize seafood handling and processing practices, enhance product safety and quality, and support sustainable livelihoods within the fisheries sector.

# Module 1. Post-harvest management

## Supply chain vs value chain

### Supply Chain

The supply chain includes all links from the **point of production (point of catch or farm site in the case of aquaculture) to the end-user or final consumer**. The supply chain for fish and fishery products can involve many people between the fisher or fish farmer and the final consumer.

### Value Chain

A value chain is a supply chain where at **every stage value is added** as the product moves from production or the landing site to consumption. The product gains value, for example, through processing or packaging.

Figure 1. Fish supply chain



Source: FishAdapt mobile app, fishadapt project, post-harvest management module, [www.fishadapt.org](http://www.fishadapt.org)

Value chains are concerned with what **the market will pay for a good or service offered for sale**. The main objectives of value chain management are to maximize profit and long-term sustainability.

### **Importance of post-harvest management**

Post-harvest fisheries encompass all activities occurring from the moment fish is harvested or landed until it reaches the consumer. This critical phase integrates multiple dimensions, including cultural, environmental, economic, institutional, social, technical, and marketing aspects of the supply chain.

The primary objectives of post-harvest activities are to maintain product quality, extend shelf life, and enhance value. By addressing these goals, post-harvest processes ensure that seafood products meet market demands and consumer expectations while minimizing losses and optimizing resource utilization. This comprehensive approach highlights the significance of post-harvest fisheries in sustaining the seafood industry's economic viability and ensuring the availability of high-quality, safe products for consumption.

**Figure 2. Benefits of efficient post-harvest management**



**Source:** Author's own elaboration.

## Causes of post-harvest losses

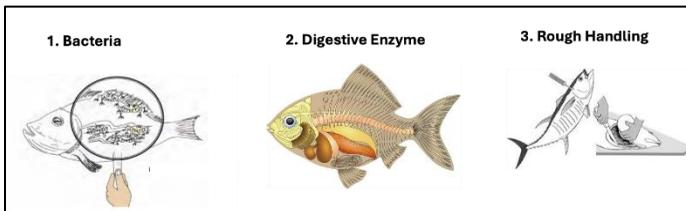
Post-harvest losses in fish and shrimp can be attributed to several factors, including microbial activity, enzymatic processes, and improper handling. These factors contribute to quality deterioration, reducing the market value and usability of the products.

1. **Bacterial spoilage:** Bacteria, particularly spoilage microorganisms, begin to attack and break down the fish after it is harvested. This process causes the tissue to soften and emit an

unpleasant odor, significantly reducing the product's quality and safety.

2. **Digestive enzymes:** Digestive enzymes, naturally present in fish and shrimp, play a vital role in sustaining their life. However, once the fish dies, these enzymes start to break down the tissues, leading to soft or mushy textures and altering the taste of the product.
3. **Improper handling:** rough handling practices, such as throwing, dropping, or stepping on fish, can cause physical damage, including bruising and softening of the fish. Such damage not only compromises the texture and appearance but also makes the product more susceptible to spoilage. Fish and shrimp that are damaged are often deemed low-quality, resulting in reduced market prices.

**Figure 3. Causes of post-harvest loss**



Source: Ward, A. & Benyen, Y. 2012. Fish handling, quality and processing: training and community trainers manual. SmartFish Working Papers N. 005 - SmartFish Working Papers N. 001. FAO/IOC.

## Post-harvest losses in the supply chain

Activity/Site	Types of post-harvest losses
<p data-bbox="204 456 370 517"><b>Aquaculture site</b></p> 	<p data-bbox="454 323 900 491"><b>Physical loss from disease or oxygen deprivation:</b> High mortality rates from diseases or low oxygen levels cause significant physical loss.</p> <p data-bbox="454 504 900 671"><b>Restricted aquaculture production capacity:</b> Inadequate space and infrastructure hinder efficient harvesting, contributing to post-harvest losses.</p> <p data-bbox="454 684 908 882"><b>Resource scarcity due to climate change and biodiversity loss:</b> Environmental challenges, such as climate change and the depletion of biodiversity, can lead to reduced availability of essential resources.</p>
<p data-bbox="204 970 393 999"><b>During fishing</b></p> 	<p data-bbox="454 898 837 994"><b>Spoilage:</b> Poor handling and storage can lead to rotting and quality loss.</p> <p data-bbox="454 1007 908 1102"><b>Extended gear Use:</b> Leaving nets or traps in water too long causes spoilage.</p> <p data-bbox="454 1115 852 1211"><b>Improper harvesting:</b> Rough handling or poor equipment damages fish, leading to waste.</p> <p data-bbox="454 1224 889 1319"><b>Harmful practices:</b> Using poisons compromises fish quality and safety.</p>

Activity/Site	Types of post-harvest losses
<p data-bbox="206 368 359 432"><b>Storing fish onboard</b></p> 	<p data-bbox="452 252 871 352"><b>Quality loss from prolonged transportation:</b> Extended transit times degrade fish quality.</p> <p data-bbox="452 395 882 496"><b>Damage from floor Storage:</b> Storing fish on the floor leads to physical and quality deterioration.</p> <p data-bbox="452 539 922 639"><b>Insufficient cleaning and cooling:</b> Failure to properly wash and chill fish compromises quality.</p> <p data-bbox="452 683 911 783"><b>Poor hygiene practices:</b> Unsanitary conditions during storage increase contamination risks.</p>
<p data-bbox="206 794 396 858"><b>Offloading the catch</b></p> 	<p data-bbox="452 794 911 927"><b>Quality loss from delays:</b> Prolonged bargaining and offloading in high temperatures accelerate spoilage.</p> <p data-bbox="452 970 908 1070"><b>Hygiene issues:</b> Poor sanitary practices during offloading increase contamination risks.</p>
<p data-bbox="239 1125 393 1157"><b>Fish selling</b></p> 	<p data-bbox="452 1125 908 1225"><b>Insufficient ice supply:</b> Insufficient ice supply leads to a decline in quality and safety.</p> <p data-bbox="452 1246 908 1378"><b>Contamination:</b> Environmental and soil contamination, particularly from surfaces near the ground, further compromises fish quality.</p>

Activity/Site	Types of post-harvest losses
	<p><b>Poor hygiene:</b> inadequate hygiene practices contribute to a reduction in quantity and safety.</p>
<p><b>Processing and packaging</b></p> 	<p><b>Quality loss:</b> Spoilage from delayed processing and quality deterioration resulting from unhygienic processing conditions and poor hygiene practices.</p> <p><b>Insufficient ice supply:</b> Quality of water and ice used, along with insufficient ice supply, results in deterioration of fish quality.</p> <p><b>Loss in organoleptic properties:</b> degradation of organoleptic properties caused by prolonged processing times, inadequate ice supply.</p>
<p><b>Storage</b></p> 	<p><b>Quality loss:</b> Growth of mold, spoilage, fish dump due to inadequate ice</p> <p><b>Physical damage:</b> Overloading and poor handling, incorrect storage practices, discoloration of fish</p> <p><b>Poor hygiene:</b> Poor hygiene practices, rodents, pests result in post-harvest losses</p>
<p><b>Distribution</b></p>	<p><b>Quality loss:</b> improper packaging, inadequate ice, exposed to high temperature results in quality loss.</p>

Activity/Site	Types of post-harvest losses
	<p><b>Physical loss:</b> Damage of fish during transportation due to improper storage practices</p> <p><b>Low price:</b> Supplying the market at the wrong time results in low price, especially peak season</p>

## Preventive measures

To mitigate post-harvest losses across the supply chain, **several preventive measures** can be implemented at key stages, including the following: on the boat, at the landing site, during processing and packing, and while selling at the market.

**Figure 4. Preventive measures on the boat**

							
Use proper gear and fishing methods	Adapt to changing weather conditions, seasons, distance from shore (commute time) to prevent fish from becoming spoiled once it is out of the water.	Use good sanitary practices. For example, wash hands	Do not let fish sit at the bottom of the boat where it can be stepped on or sloshed in fuel from the outboard motor.	Bleed fish if possible and place in cold brine solution (saltwater with non-contaminated ice). Do not store or wash with contaminated water (e.g. shore water).	remove heads, gills or guts when possible.	Store in clean container with lid and ice.	If possible, keep alive.

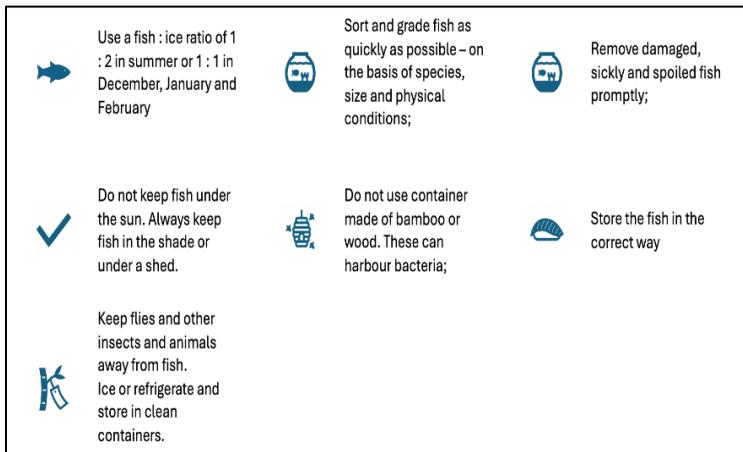
**Source:** Author's own elaboration.

**Figure 5. Preventive measures at the landing site**



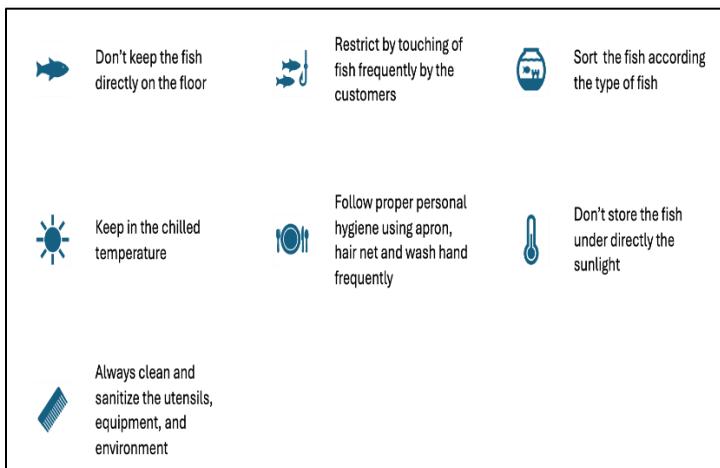
**Source:** Author's own elaboration.

**Figure 6. Preventive measures at processing and packing**



**Source:** Author's own elaboration.

**Figure 7. Preventive measure at selling**



**Source:** Author's own elaboration.

## Module 2. Seafood preservation and processing technology

### Seafood preservation (Icing)

#### Importance and Use of Ice in Fish Chilling

Ice is recognized as the most effective medium for cooling fish, owing to its distinctive properties. First, its high cooling capacity allows for substantial temperature reduction relative to its weight or volume, making it an efficient choice for chilling. Furthermore,

ice is safe, affordable, and easy to use; it is non-toxic, cost-effective, and straightforward to handle, which enhances its practicality in various settings.

Additionally, ice provides efficient cooling by ensuring rapid temperature reduction through direct contact with the fish. This method is crucial for maintaining the quality of the fish, as it keeps the fish cold, moist, and glossy, thereby preserving its fresh appearance. Finally, ice plays a vital role in preventing dehydration; unlike refrigeration methods that do not utilize ice, the application of ice effectively prevents fish from drying out, ensuring that the product remains appealing and marketable.

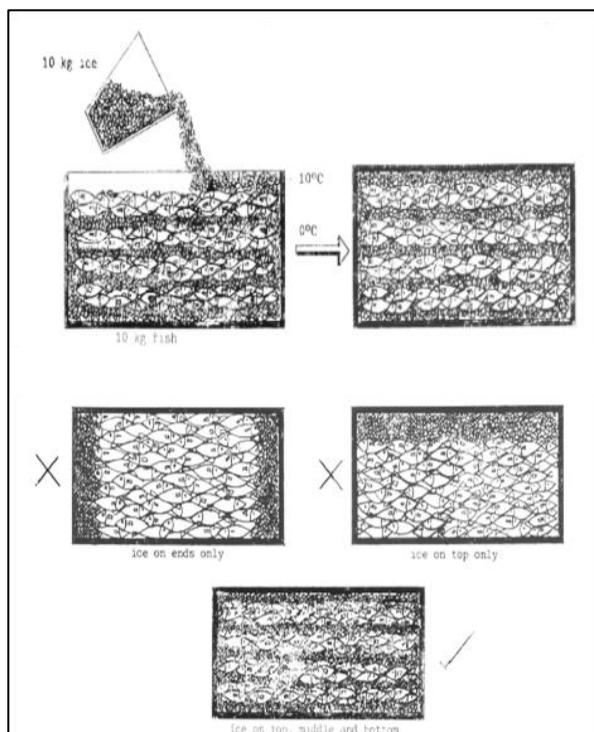
### **Key steps for handling and chilling fish**

**Step 1. Washing:** Immediately after harvest, fish should be thoroughly washed with clean water to remove mud, debris, and any foreign material.

**Step 2. Pre-chilling:** Fish should be pre-chilled by placing it in a 1:1 ice-to-fish ratio to quickly cool it to 0 °C (32 °F). Small ice pieces ensure good contact with the fish. In some cases, fish are chilled in tanks at 0 °C. Studies suggest that chilling to 4 °C (39 °F) immediately after harvest is equally effective for short transport, with no significant temperature change during air transport.

**Step 3. Packing:** After pre-chilling, fish are packed in suitable containers with sufficient ice, using the 1:1 ice-to-fish ratio for long-distance transport. Ice should be layered at the bottom, between fish layers, and on top to keep the temperature close to 0 °C until delivery.

**Figure 8. Correct way of fish preservation (chilling)**



**Source: FAO, Fish Handling Methodology**

## Key steps for handling and chilling of shrimp

**Step 1. Sorting:** After harvesting, shrimps should be sorted by type and species.

**Step 2. Washing:** Shrimps should be washed in clean water to remove sediment and iced immediately to avoid damage from sun and wind exposure.

**Step 3. Pre-chilling:** Quickly pre-chill the shrimps to 0 °C (32 °F) and maintain this temperature until they reach the market.

**Step 4. Packing:** Pack shrimps in shallow layers with finely crushed ice for close contact, ensuring rapid cooling while minimizing pressure damage. Avoid overfilling containers to ensure proper chilling.

## Key points for handling and transporting crab

**Rapid deterioration:** Crabs spoil faster than most fish after death, so it is best to keep them alive until processing to preserve quality.

**Careful handling:** Live crabs must be handled gently to reduce stress and prevent high mortality rates.

### **Transport methods for crabs are as follows.**

- Live crabs should be kept in clean bags, wet sacks, or boxes to avoid suffocation from mud or slime.
- Packing crabs with fresh seaweed during transport helps keep them alive.
- Lightweight plastic boxes are a safe and cost-effective option for transporting live crabs.

### **Seafood preservation (Freezing)**

Freezing is a preservation technique that involves lowering the temperature of food products, including seafood, to below their freezing point, typically around -18 °C (0 °F) or lower. During this process, the water content within the fish transitions from a liquid to a solid state, forming ice crystals. This change in state effectively halts the growth of microorganisms and enzymatic reactions that can lead to spoilage.

#### **Key steps of freezing**

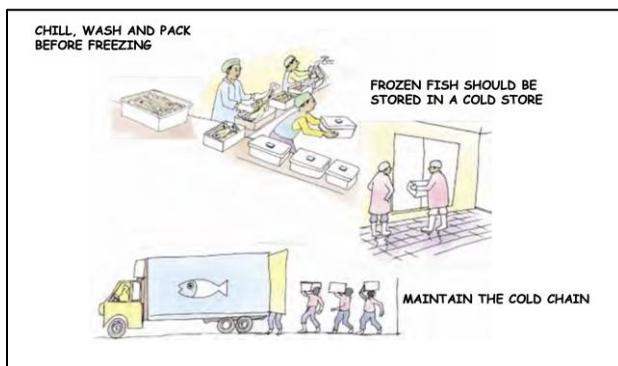
**Step 1. Pre-treatment:** Prior to freezing, it is essential to subject the fish to a thorough **pre-treatment** process. This involves **cleaning and washing** the fish to remove any impurities, followed by **chilling** during processing to slow down enzymatic reactions. Additionally, **blanching may** be employed

using chemical, boiling water, or steaming methods to inactivate enzymes and preserve texture and flavor.

**Step 2. Freezing:** The **freezing** process itself can be achieved through either **slow freezing** or **rapid freezing**, depending on the specific product requirements. The chosen method will influence the formation of ice crystals and the subsequent quality of the frozen fish.

**Step 3. Frozen storage:** Finally, the frozen fish must be **stored** at a temperature of **-18 °C or lower** to maintain both quality and safety. This ensures that the growth of microorganisms is inhibited, and the fish remains in a stable condition until it is thawed and consumed.

**Figure 9. Seafood preservation (Freezing Process)**



Source: Ward, A. & Benyen, Y. 2012. *Fish handling, quality and processing: training and community trainers manual*. SmartFish Working Papers N. 005 - SmartFish Working Papers N. 001. FAO/IOC.

## Seafood processing technology (drying)

Drying involves the controlled removal of moisture from fish (or other food products) using heat, air, or both, to inhibit the growth of microorganisms, thereby extending shelf life and preserving nutritional value. This process reduces water content, preventing microbial growth and spoilage, and allows for long-term storage without refrigeration particularly valuable in areas with limited cold storage. Dried fish products have a significantly longer shelf life than fresh fish, facilitating easier storage, transport, and marketability, especially for small-scale fisheries. The drying process also enhances food safety by reducing the risk of foodborne illnesses and retains essential nutrients, such as proteins, vitamins, and minerals. Additionally, it improves flavor and texture, creating a popular product with a unique taste. Dried fish can be marketed as a premium product, offering high value due to its portability and convenience for consumers, thus broadening its market appeal.

### Three processing steps of dry fish products

#### **Step 1. Preparation of fish**

The preparation of fish involves several key considerations, including the selection of the fish,

choice of ingredients, and proper handling to ensure quality drying. The following steps should be followed:

- Select the appropriate type of fish for drying (avoid oily fish, as it is unsuitable for this process) and choose ingredients, with salt being essential for preservation.
- Ensure that all equipment, utensils, and the environment are properly cleaned to maintain hygiene standards.
- Cut the fish into uniform thickness and size to ensure even drying throughout the process.
- Place the fish evenly on clean trays or containers, ensuring a consistent distribution for uniform drying.

## **Step 2. Drying of fish**

The drying process can vary depending on the product, weather conditions, and the drying technology used. Common drying methods include sun-drying, solar-drying, smoking (in the rainy season), and hot air drying (using electricity). The drying process should adhere to the following guidelines:

- Dry the fish in a clean, enclosed environment to avoid contamination from the surrounding environment, people, and equipment.
- Solar-drying is an effective method as it provides higher temperatures, better productivity, and reduced contamination risks.
- Smoking should be employed during the rainy season when sun-drying is not feasible.
- Clean all utensils and accessories thoroughly before and after use.
- Maintain personal hygiene throughout the drying process.
- Dry the fish until the moisture content reaches less than 15 percent to ensure proper preservation.

### **Step 3. Packaging and storage of fish**

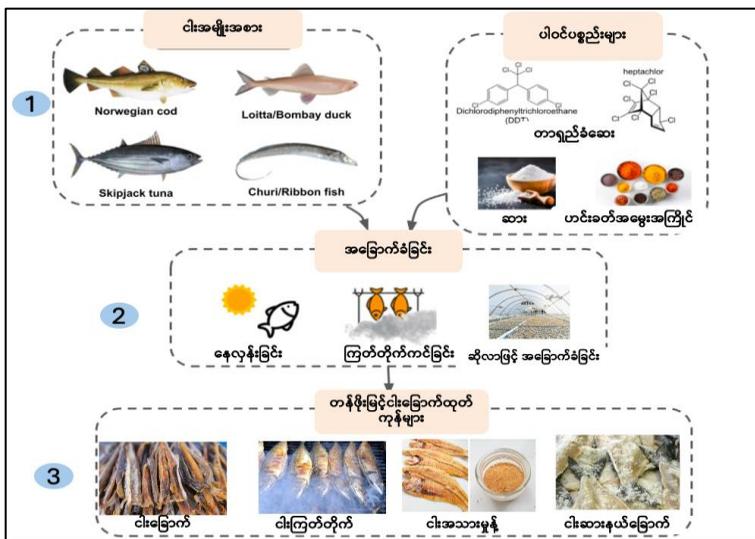
The packaging and storage of dried fish are crucial to maintaining quality and preventing contamination. Depending on the type of dried product, the packaging should be chosen accordingly. The following steps are recommended:

- Use clean, closed containers or bags to protect the product from external contamination and moisture absorption.

- Store the dried fish in a cool, dry place to maintain its quality and prevent moisture from re-entering the product.
- Label the products according to the labeling requirements specified in Module 4 to ensure proper identification and compliance.

By following these steps, the fish will be properly prepared, dried, packaged, and stored, ensuring a safe and high-quality product for consumers.

Figure 10. Three processing steps of dry fish products

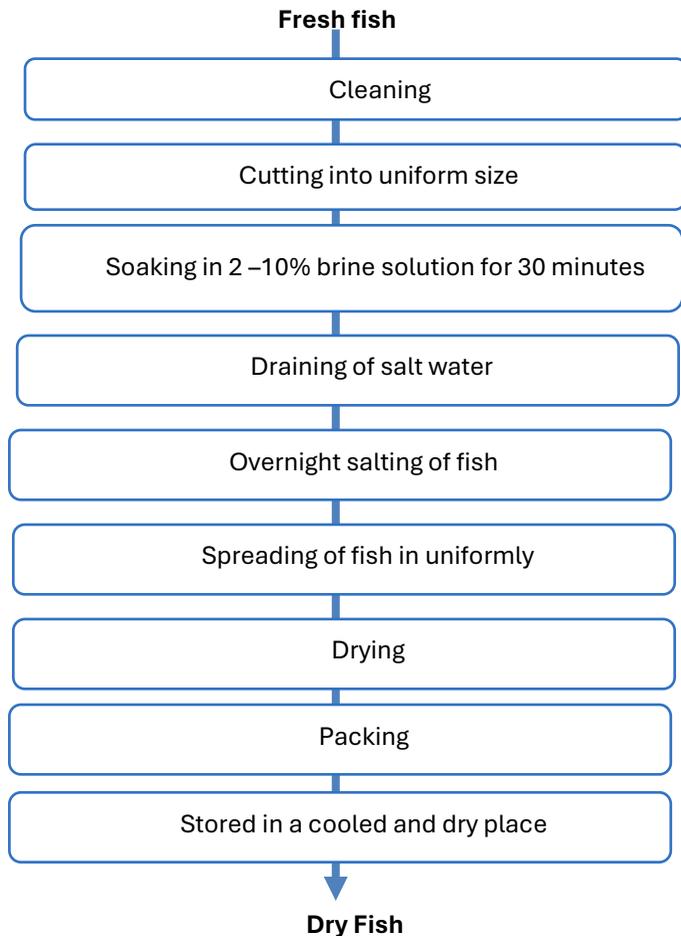


Source: Fitri, N.; Chan, et al. 2022 A Comprehensive Review on the Processing of Dried Fish and the Associated Chemical and Nutritional Changes. *Foods* 2022, 11, 2938.

## Dry fish production

Dried fish products have long been a staple in Myanmar's food culture, significantly contributing to both local diets and the economy. Due to the country's abundant freshwater and marine resources, fish drying has evolved as a traditional preservation method, especially in rural areas where refrigeration is scarce. Dried fish, a key source of protein, is used in a variety of dishes and forms an essential part of many traditional Burmese recipes. The drying methods, including sun-drying, solar-drying, and smoking, effectively extend the shelf life of fish, facilitating easier storage and transportation. Over time, dried fish has become an important value-added product, supported the livelihoods of local communities and expanded market opportunities, both within Myanmar and internationally. Final product yield is 30 percent.

## Process flow diagram



Source: Author's own elaboration.

## Processing steps

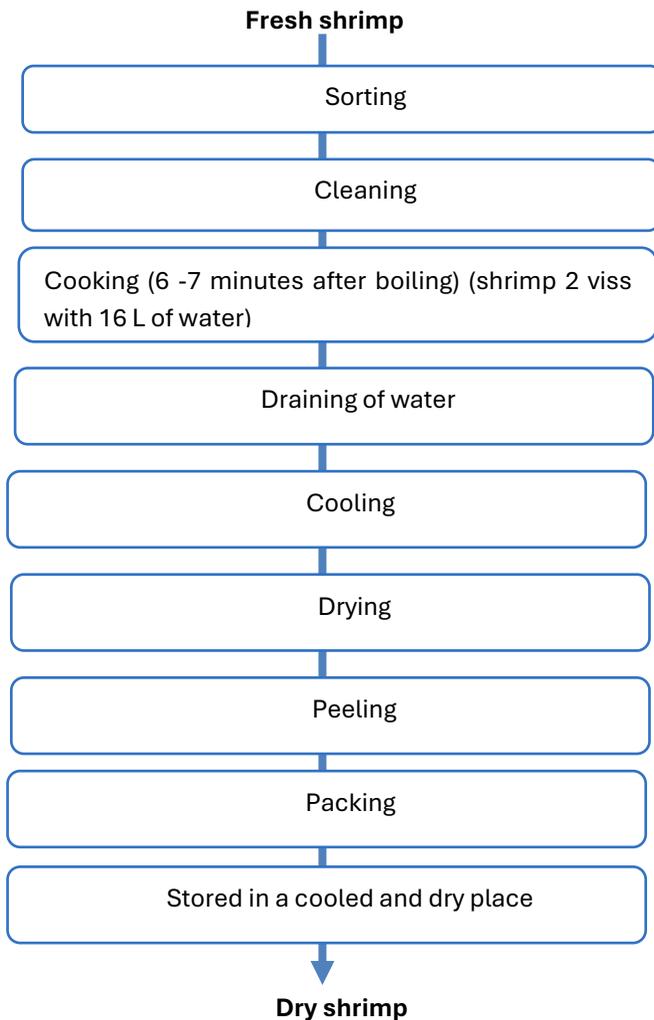
<b>Sr</b>	<b>Process step</b>	<b>Description</b>
1	Selection of fish	Begin by selecting high-quality fish, as this significantly impacts the quality of the final product. It is advisable to choose less oily fish to produce dried fish, as oily varieties take longer to dry and are more prone to rancidity.
2	Cleaning	Small, fresh fish should be thoroughly washed with clean water. For larger fish, preparation should be tailored to meet market demand.
3	Cutting	The fish must be cut into uniform sizes and thicknesses to ensure even drying.
4	Soaking	The cut fish should be soaked in a 2 – 10 percent salt solution for approximately 30 minutes. This process helps to extract moisture from the fish and replace it with salt.
5	Drainage	After soaking, remove the fish from the saltwater and place them in a container for dewatering
6	Salting	Following dewatering in a basket, cover the fish with a clean cloth

Sr	Process step	Description
		and apply weight on top. This step allows excess liquid and salty water to be removed overnight.
7	Spreading	The fish are spread in a uniform way on clean trays over the drying shelf in a clean environment. If the market demand calls for less salty dried fish, it is essential to rinse the fish with clean water and filter again to achieve the desired salt content.
8	Drying	Continue the drying process until the moisture content of the fish is less than 15 percent.
9	Packing	Once adequately dried, the fish should be packaged in clear plastic bags or containers to protect against contamination and moisture absorption.
10	Storage	Store the dried fish in a cool, dry environment to maintain its quality and prolong shelf life. Conduct frequent inspections of the product to ensure its quality and safety throughout the storage period.

## Dry shrimp production

Dried shrimp is a staple ingredient in Burmese cuisine, valued for its intensified umami flavor and slight saltiness achieved through sun-drying small shrimp after boiling. It is widely used in soups, salads, curries, and condiments, playing a vital role in Myanmar's culinary culture. Coastal regions such as the Ayeyarwady Delta, Rakhine State, and Tanintharyi Region are major producers, leveraging their proximity to the sea. The quality of dried shrimp is heavily influenced by processing methods, handling, and hygiene practices throughout production. Poor practices not only lower the market value and income for producers but also pose potential health risks to consumers. This underscores the need for improved standards and guidance for producers, buyers, and stakeholders in the industry.

## Process flow diagram



**Source:** Author's own elaboration.

Sr	Process step	Description
1	Selection of shrimp	The production of high-quality dried shrimp begins with selecting premium shrimp, as this is crucial to achieving a superior final product.
2	Sorting	Proper sorting by type and size is essential to ensure uniformity during processing; uneven sizes can compromise the overall quality. If uneven size were cooked or processed, the quality will not be good.
3	Cleaning	Cleaning must be done to remove debris and foreign matter.
4	Cooking	Cooking is a critical step that significantly influences the quality of the dried shrimp. The process involves boiling water before adding shrimp, with a recommended ratio of 2 viss (approximately 3 kg) of shrimp to 16 liters of water, cooked for 6–7 minutes. Properly cooked shrimp are pink, curled, firm to the touch, and opaque inside.
5	Drainage	The cooked shrimp are transferred to the container with good

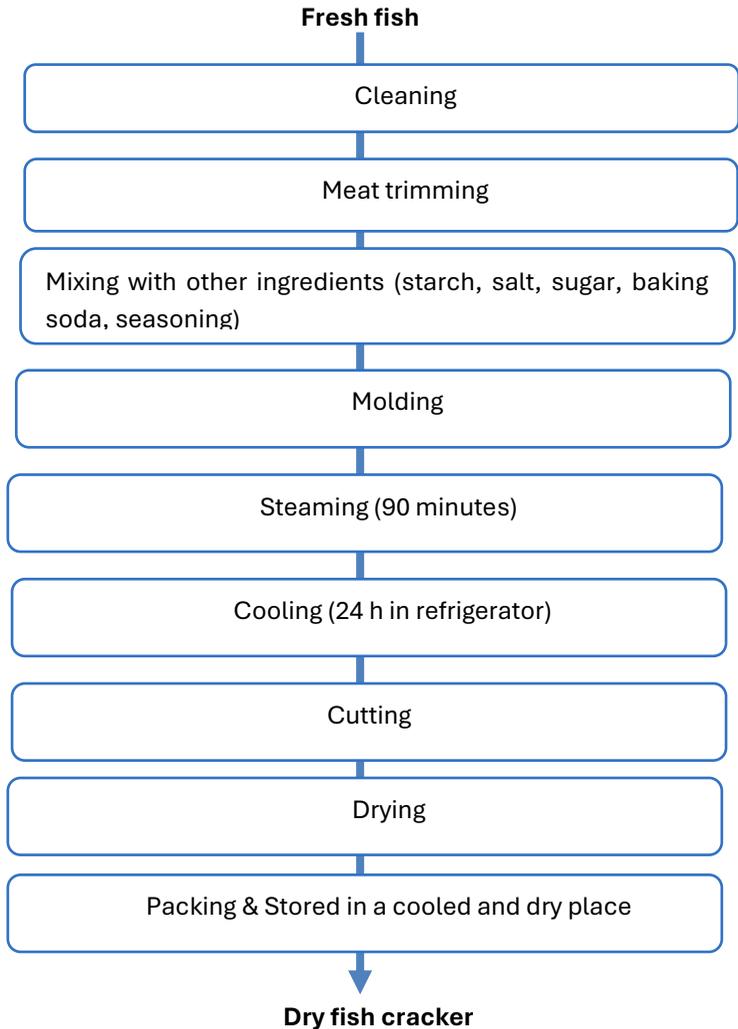
Sr	Process step	Description
		ventilation to remove excess water from shrimp.
6	Cooling	Before drying, they are allowed to cool naturally or with the aid of a fan to ensure even cooling.
7	Drying	After cooling, the shrimps were spread on a clean tray in a clean environment. Continue the drying process until the moisture content of the shrimp is less than 30 percent.
8	Peeling	The removal of shrimp heads and shells should be performed carefully, either manually, mechanically, or with a net, to prevent breakage while maintaining hygienic standards. Shrimp are then graded and sorted by size to ensure uniformity and quality.
9	Packing	The dried shrimp should be packaged in clear, airtight plastic bags or containers to protect them from contamination and moisture absorption.
10	Storage	Store the dried shrimp in a cool, dry environment to maintain its quality and prolong shelf life. Conduct frequent inspections of the product to ensure its quality

Sr	Process step	Description
		and safety throughout the storage period.

## Dry fish cracker production

Dry fish crackers are a popular value-added fish product in Myanmar, offering a unique way to utilize fish while enhancing its market potential. They are particularly significant in Myanmar as they add economic value to lower-grade or excess fish that might otherwise go to waste, supporting livelihoods in coastal and fishing communities. As a culturally beloved snack, dry fish crackers also contribute to the diversification of fish products, catering to both local and export markets, and promoting sustainable utilization of aquatic resources.

## Process flow diagram



Source: Author's own elaboration.

Sr	Process step	Description
1	Selection of fish	The selection of fish is crucial to ensuring the quality of the final dry cracker product. Fish with minimal bones are preferred for cracker production to enhance processing and product texture.
2	Cleaning	Cleaning must be done to remove debris and foreign matter.
3	Meat Trimming	The fish meat should be carefully trimmed to ensure it is free from bones, as any remaining bones can negatively affect the quality of the final product.
4	Mixing with other ingredients	<p><b>Recipe</b></p> <p>Fish meat - 0.5 kg</p> <p>Starch - 0.5 kg</p> <p>Salt - 1 %</p> <p>Sugar - 1 %</p> <p>Baking soda - 0.1 %</p> <p>Seasoning, if prefer</p> <p>Water as necessary</p> <p>Mix all ingredients as per recipe until it forms uniform dough.</p> <p>In addition to fish crackers, other types of crackers, such as shrimp crackers and pumpkin crackers, can be produced using a similar process. In these variations, the</p>

		primary ingredient, fish, is substituted with shrimp or steamed pumpkin, while the remaining steps remain consistent.
5	Molding	Combine all ingredients according to the recipe and mix thoroughly until a uniform dough is formed. Shape the dough into cylindrical or round forms, ensuring uniformity in size and shape to allow for even cooking
6	Steaming	All the dough shall be cooked by steaming for 90 minutes until fully gelatinized. The steaming time may be adjusted based on the dough's size and shape.
7	Cooling	After steaming, the dough should first be cooled to room temperature. Once cooled, it should be stored in a refrigerator or icebox overnight to harden, making it easier to slice the next day.
8	Cutting	The hardened dough is then cut into uniform slices, either manually or using a cutting machine.

9	Drying	The slices are dried under sunlight or in a solar dryer until their moisture content is reduced to less than 10 percent.
10	Packing & Storage	Once dried, the crackers should be stored in airtight containers or plastic bags to prevent moisture absorption. For optimal quality, store the dried crackers in a cool, dry environment to maintain their quality and extend shelf life. Regular inspections should be conducted during storage to ensure the product remains safe and of high quality.

## Seafood processing technology (fermentation)

Fermentation is one of food preservation technology since long-time ago. It involves the use of microorganisms and ingredients as sources of fermentation to transform raw materials into value-added products, improving their nutritional, sensory, and shelf-life characteristics. In our country, Myanmar, fermented fish products hold significant cultural, economic, and nutritional importance, serving as a staple and condiment in traditional diets. Popular items like *ngapi* (fermented fish paste)

and *pazun ngapi* (shrimp paste), *yaycho ngapi* (Nga pyi yay cho), and *nga chin* (Fermented fish) are integral to Myanmar's cuisine, providing a rich source of protein, essential nutrients, and unique flavors.

**Figure 11. Fermentation process**



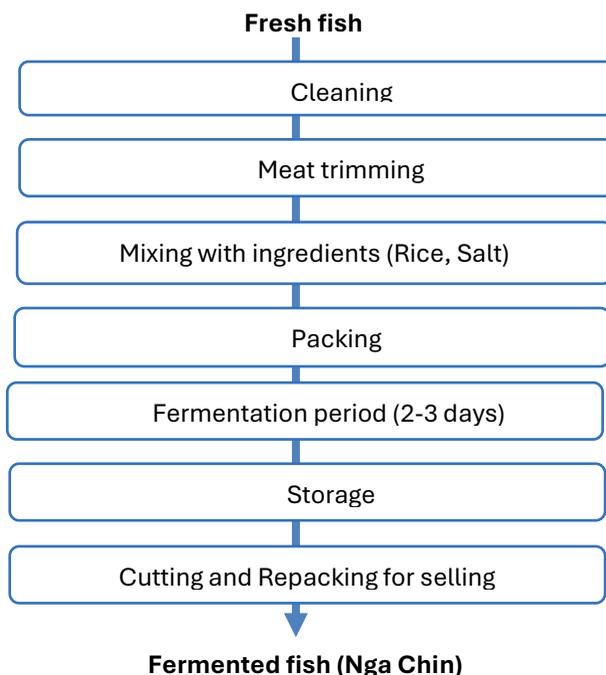
Source: Author's own elaboration.

## Fermented fish production

Nga-chin, a traditional fermented fish product, is a staple in the country's diverse culinary landscape. It undergoes a natural fermentation process that

enhances its flavor, texture, and shelf life. Known for its distinct tangy and savory taste, nga-chin is widely used as a seasoning or side dish in various regional cuisines. It is often paired with rice, vegetables, or chili to create simple yet flavorful meals, and is a common ingredient in ethnic and rural diets.

### Process flow diagram



Source: Author's own elaboration.

Sr	Process step	Description
1	Selection of fish	The selection of fish is crucial to ensuring the quality of the final dry fermented fish.
2	Cleaning	Cleaning must be done to remove debris and foreign matter.
3	Meat Trimming	The fish meat should be carefully trimmed to ensure it is free from bones, as any remaining bones can negatively affect the quality of the final product. For small fish, no need meat trimming step.
4	Mixing with other ingredients	<p><b>Recipe</b></p> <p>Fish meat - 1.0 kg  Rice. - 0.3 kg  Salt - 4-7 %  Seasoning, if prefer</p> <p>Crush the rice and mix with fish and meat until it is uniform.</p>
5	Packing	The fish mixture is packed in banana leaves or a plastic container for fermentation. If a plastic container is used, excess water may accumulate, requiring daily dewatering by inverting the container.

6	Fermentation & storage	The packed fish is then stored at room temperature for two to three days.
7	Repacking and selling	After this period, the product is ready for consumption. Based on consumer preferences, it may be repackaged for commercial sale.

## Module 3. Understanding food safety and key preventive measures

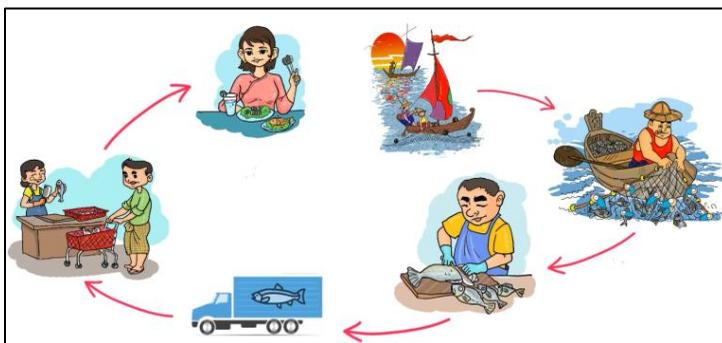
### Importance of food safety

Foodborne illnesses affect 1 in 10 people globally each year, causing 420 000 deaths and significantly impacting vulnerable groups such as children, the elderly, and those with weakened immune systems. These illnesses result from consuming contaminated food or water containing harmful pathogens, toxins, or chemicals, leading to substantial health and economic consequences, including healthcare costs and productivity losses.

**Food safety** is about making sure that food is **safe to consume, and will not cause illness, harm, or death to the consumer** when it is prepared and/or eaten according to its intended use. Food safety is

about, producing, processing, storing, and handling food in a manner that prevents infections or diseases and retains nutrients for a healthy diet. By making food safe to consume, food safety becomes everyone's responsibility, safeguarding lives and well-being.

**\*Food safety is everyone's responsibility\***



Source: FishAdapt mobile app, fishadapt project, post-harvest management module, [www.fishadapt.org](http://www.fishadapt.org)

## Four types of hazards

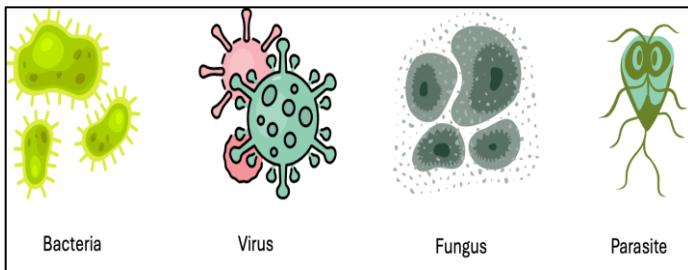
**Hazard** is defined as a biological, chemical, or physical agent in food, or a condition of food, that has the potential to cause adverse health effects. (Codex Alimentarius).

1. Biological hazard
2. Chemical hazard
3. Physical hazard
4. Allergen

**1. Biological hazard:** Biological hazards in food refer to microorganisms such as bacteria, viruses, parasites, and fungi that can contaminate food and cause spoilage or foodborne illnesses. These hazards pose significant risks to human health if not properly managed.

The type of food determines the specific pathogens that may be present; however, common pathogens frequently associated with foodborne illnesses include ***Staphylococcus aureus***, ***Listeria monocytogenes***, ***Escherichia coli***, ***Salmonella***, and ***Bacillus cereus***, among others.

**Figure 12. Biological hazard in food**



**Source:** Author's own elaboration.

**2. Chemical hazard:** Chemical hazards in fish are harmful substances that may arise from natural processes, environmental contamination, or human activities. These hazards can pose health risks when contaminated fish are consumed. Common chemical hazards include naturally occurring histamine in certain fish species, mercury, pesticide residues, and antibiotic residues, which may enter the fish either intentionally or unintentionally through environmental exposure.

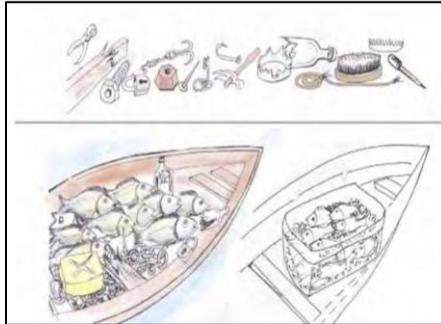
**Figure 13. Chemical hazard in fish**



**Source:** Author's own elaboration.

**3. Physical hazard:** Physical hazard refers to presence of foreign objects in food that can cause adverse health effects for consumers. Foreign matter includes pieces of glass, metal, stone, etc.

**Figure 14. Physical hazard in fish**



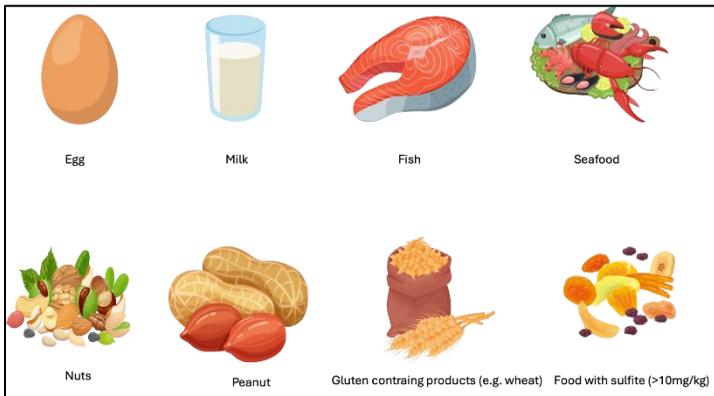
Source: Ward, A. & Benyen, Y. 2012. *Fish handling, quality and processing: training and community trainers manual*. SmartFish Working Papers N. 005 - SmartFish Working Papers N. 001. FAO/IOC.

**4. Allergen:** Allergen hazards in food refer to substances that can trigger adverse immune responses in sensitive individuals, ranging from mild discomfort to life-threatening anaphylaxis. These reactions occur when the immune system identifies certain proteins in food as harmful, even though they are safe for most people. Managing allergen hazards is critical in food production, processing, and labeling to protect consumers and comply with food safety regulations. The following is 8 groups of allergens according to Food Labelling order of prepacked food, Myanmar FDA (2022).

1. Egg
2. Milk and milk containing products

3. Peanuts
4. Tree nuts
5. Seafood
6. Fish
7. Gluten containing food
8. Food with sulfites (> 10 mg/kg)

**Figure 15. Allergen ingredients in food**



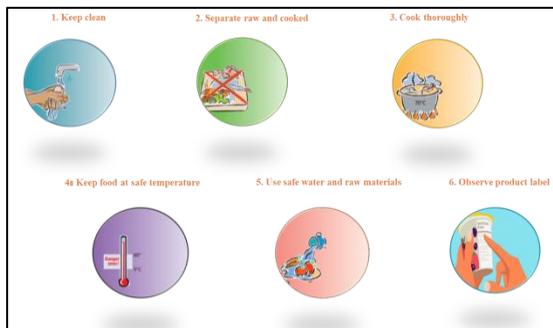
**Source:** Author's own elaboration.

## Key preventive measures

1. **Keep clean:** Ensure proper cleaning of hands, utensils, and kitchen surfaces to prevent foodborne illnesses.
2. **Separate raw and cooked food:** To prevent cross-contamination, keep raw and cooked foods separate during preparation, storage, and when using utensils.

3. **Cook thoroughly:** Cooking food to the appropriate temperature, at 70 °C or higher, kills harmful microorganisms. Always ensure food is thoroughly cooked and reheated to the correct temperature.
4. **Keep food at safe temperature:** Avoid the "Temperature Danger Zone" (5 °C to 60 °C) by refrigerating perishable foods below 5 °C or reheating them to above 63 °C.
5. **Use safe water and raw materials:** Ensure food safety by using clean water, selecting high-quality raw materials, and thoroughly washing fruits and vegetables before consumption.
6. **Observe product label:** Always verify product expiration dates, ingredient lists (particularly allergens), and storage instructions to ensure the safety and quality of the product.

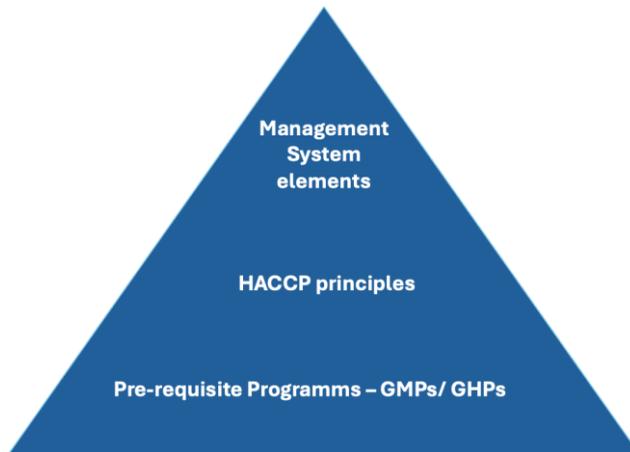
**Figure 16. Key preventive measures**



**Source: Author's own elaboration.**

## Module 4: Good hygiene practices

Basic conditions and activities that are necessary **to maintain a hygienic environment** throughout the food chain suitable for the production, handling and provision of safe food.



*Source: Author's own elaboration.*

It provides the fundamental measures and conditions applied to any step within the food chain to provide safe and suitable food. Basic component of GHP includes

1. Primary production
2. Design of facility and equipment
3. Maintenance and cleaning
4. Pest control
5. Waste management

6. Personal hygiene and employee facility
7. Control of operation, Traceability
8. Product information and consumers awareness
9. Transportation
10. Training and competency

## Primary production

The primary production area (fishing site) or aquaculture farm shall meet the following minimum requirements:

- Harvesting shall be conducted in a manner that prevents contamination and reduces the risk of cross-contamination to the products.
- Caught fish shall be handled with care to avoid damage.
- Measures shall be taken to prevent cross-contamination during transportation.
- Fish shall be kept on ice and transported as quickly as possible.
- Hygiene of fishing accessories, vessels, and transportation vessels shall be maintained throughout the entire fishing process.
- Personal hygiene shall be followed in entire processing to ensure safety of the products.

## Design of facility and equipment

### Location of production facility:

The production facility shall be situated away from:

- Environmentally polluted areas.
- Locations that generate unpleasant odors, waste, or chemical and biological emissions.
- Areas prone to pest infestations.
- Locations where industrial waste cannot be effectively managed.
- The facility should implement appropriate measures to protect against potential contamination.

### Facility design:

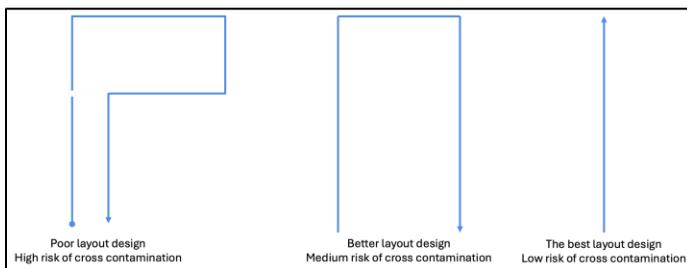
- The facility layout shall follow a **one-direction flow** to minimize processing time and reduce the risk of cross-contamination.
- It shall be fully enclosed to prevent pest and insect entry.
- Floors shall be easy to clean and designed for proper drainage.
- Walls and ceiling shall be smooth and easy to clean.
- Adequate ventilation and sufficient lighting should be provided.

- to ensure operational efficiency and prevent cross-contamination.

### **Equipment and utensils:**

- Equipment should be made from non-corrosive materials. All equipments shall be in hygiene design.
- Food grade materials shall be used. Wood should be avoided as it may harbor mold growth.
- All equipment must be well-maintained and kept in good condition and used for its intended purpose.
- The design of equipment should facilitate easy cleaning and prevent contamination.

**Figure 17. Layout of food production facility**



**Source: Author's own elaboration.**

## Maintenance and cleaning

Establishments and equipment must be kept in proper condition to:

- Support effective cleaning and disinfection procedures.
- Operate as intended.
- Prevent food contamination from sources such as pests, metal fragments, flaking plaster, debris, chemicals, wood, plastic, glass, and paper.

### **Cleaning Programme**

Cleaning should effectively remove food residues and dirt, which could serve as contamination sources, including allergens.

Equipment should be cleaned and sanitized by designated personnel after each daily operation, with the supervisor overseeing the process on a daily basis.

The cleaning procedure for cutting tools and accessories should include the following steps:

1. Remove the debris
2. Rinse with water thoroughly
3. Apply soap

4. Rinse with water.
5. Sanitize with boiling water or chlorine or sanitizer.
6. Apply air dry.
7. Visual inspection by supervisor.
8. Verification of cleaning programme by be performed by swab test.

## **Pest control**

To ensure effective pest management, the following four steps shall be carried out

1. Prevent access: Prevent pests from entering the facility by maintaining the premises in good condition and sealing any potential points of entry, ensuring that all items are properly covered.
2. Deny harborage and infestation: Clean all potential pest harborage sites, both inside and outside the facility. Ensure that waste does not accumulate anywhere within the premises.
3. Monitor and detect: Establish a monitoring schedule to assess pest activity, either by internal staff or through a third-party service, to ensure the pest management programme's effectiveness.

4. Control of pest infestation: In the event of a pest infestation, a qualified individual must promptly address the issue by identifying the root cause and implementing preventive measures to avoid recurrence.

## **Waste management**

An effective waste management system shall:

- Prevent the accumulation of waste.
- Ensure proper segregation of waste according to its type.
- Dispose of waste in covered, labeled bins specifically designated for food operations.
- Clearly identify designated areas for waste bins.
- Manage waste by converting it into value-added products, such as animal feed, fish amino acids, or natural fertilizers.

## **Personal hygiene and employee facility**

Staffs who are working in food production facility

- Shall be in good health and not suffer from communicable diseases.
- Shall be aware of personal hygiene.

- Be sure to wear the prescribed personal hygiene equipment before entering the workplace. (apron, hood, mask, shoes)
- Do not apply artificial nails, and jewelry which may be threat to the safety and suitability of food
- Wash hand systematically according to hand washing procedure and wash hands whatever touch contaminated sources.
- Refrain the following behavior which could result in contamination of food, for example
  - Smoking or vaping, spitting, chewing, eating or drinking
  - Touching the mouth, nose or other places of possible contamination, sneezing or coughing over unprotected food.

Figure 18. Hand-washing poster



Source: Ministry of Health, Myanmar

## Control of operation

- Select fresh, high-quality raw materials to ensure the production of safe and suitable final products for consumers.
- Use good quality fish and avoid storing fish at room temperature for extended periods.
- Do not handle fish directly on the floor and always wash fish with clean water.
- Fish should be chilled to the correct temperature and facilities should be improved to ensure safe and high-quality fish.
- Use clean, potable water throughout the food processing stages.

- Raw materials must be systematically separated, and the FIFO (First In, First Out) method should be applied.
- Only food-grade stainless steel utensils should be used in food processing.
- A detailed process flow should be established for each product to ensure consistency and safety.
- Identify and implement quality control measures, such as controlling time and temperature, throughout the processing.
- All packaging materials and containers must be food-grade
- Food safety practices must be strictly followed by all operators and processors to prevent microbiological contamination, chemical contamination, physical contamination, and allergen contact.
- Product/process description, raw materials description, and intended use shall be identified.

## **Product information and consumer awareness**

Appropriate information about food must ensure that:

- Sufficient and accessible details are provided to the next food business operator (FBO) in the supply chain or to consumers, enabling them to handle, store, process, prepare, and display the product safely and correctly.
- Consumers can easily identify allergens present in the food.
- The lot or batch can be readily identified and, if necessary, removed or recalled.

All products must be traceable, clearly labeled with a lot number, and include the following details on the product label:

1. Name of the food.
2. List of ingredients, including allergen information.
3. Net weight, quantity, and drained weight (if applicable).
4. Name and address of the manufacturer or distributor.
5. Country of origin.
6. Lot identification.
7. Date marking (e.g. "best before" or "use by" date).
8. Instructions for use.
9. Nutritional information

Consumer education programmes should promote awareness of general food hygiene, emphasizing the importance of understanding product labels and instructions for safe food handling.

## Traceability system

Traceability refers to the capability to track and access critical information at every stage of the food supply chain, including supplier sourcing, raw material preparation, storage, and distribution. A robust **food traceability system** records each step from farm to fork, ensuring transparency and accountability.

The traceability system benefits both producers and consumers by:

- Enabling the efficient removal or recall of products when necessary.
- Enhancing consumer and customer trust in the safety and quality of food products.
- Trace \*One-step-Forwarded and One-step Backward\*

Accurate records and documentation are fundamental to traceability, allowing for the referencing of product-related information to identify root causes and implement corrective actions effectively.



fish from physical damage and minimize quality loss during transit. Packaging should also prevent cross-contamination and exposure to external contaminants.

- **Temperature control:** Transport fish using insulated ice boxes or temperature-controlled systems to maintain optimal storage conditions and prevent spoilage.
- **Timely delivery:** Minimize delays during transportation to preserve the freshness and quality of the fish, ensuring it reaches its destination promptly and in safe condition.

## Training and competency

Providing effective training is crucial for fostering a strong food safety culture and ensuring the successful implementation of safe practices in the workplace. To achieve this, organizations should:

- Conduct awareness training for all new employees upon onboarding.
- Provide annual refresher training to reinforce key food safety principles.
- Distribute informational materials, such as pamphlets, to enhance understanding.

- Organize monthly knowledge-sharing sessions to promote continuous learning and improvement.

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