



# **Training Manual on Improved Fish Handling and Preservation Techniques**



**Funded by: The European Union**

**UNIDO Project on Enhanced Local Value Addition and  
Strengthening Value Chain, South Sudan**

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## FORWARD

South Sudan is blessed with inland aquatic ecosystem mainly the River Nile and its tributaries. This includes several lakes, floodplains, wetlands, creeks and small ponds , many of which are seasonal.

The fishery sector occupies a very important place in the socio-economic development of rural communities in the country. However, it only employs a limited number of the rural population estimated at 220,000 people, who are involved in fishing, processing, storage, transportation and marketing activities. Fish are preferably to be sold fresh but due to the absence of a cold chain and the remoteness of the fishing zones, an unknown but significant quantity of fish is smoked or sundried.

The majority of the rural fishing communities in the country belong to a marginalized stratum. They live in remote villages and fishing camps with very basic facility and in poor socio-economic conditions. The wealth of the rural fishing communities is measured in number of canoes possessed and bride prices are also paid in canoes rather than cattle.

The fisher-folk in South Sudan face numerous challenges during their daily fishing operation. The major challenges faced by the fisher-folk include a lack of knowledge and skills on fish handling and processing as well as unavailability of quality fishing gears. Due to absence of cold chain facilities, processing, storage, transportation and marketing are often done in very unhygienic conditions which contribute to high post-harvest losses along the fishery value chain.

The recent market assessment indicated that nearly 30% of post harvest losses along the fishery value chain take place during the transportation of fishery products from the remote fishing area to the urban centre. While remaining 70% of losses occur during the processing and marketing stage. The high post-harvest losses along the fishery value chain negatively contribute to the household's income of the fisher-folk as well as to the poverty of the rural fishing communities.

Currently, the fishery products supplied from the remote fishing villages and camps do not meet the demand of domestic consumption in the urban city. Hence, it is essential for the Department of Fisheries at the Ministry of Animal Resources and Fisheries to address issues related to production and post-harvest losses along fisheries value chain to allow the fisheries stakeholder to produce quality and safe fishery products for the domestic and international market.

The handbook titled "*Training Manual on Improved Fish Handling and Preservation Techniques*" is a technical document prepared by the United Nations Industrial Development Organization under the Zonal Effort for Agriculture Transformation - Bahr El Ghazal Effort for Agriculture Development (ZEAT-BEAD) Project with funding from the European Union.

The training manual aims to disseminate technical information related to the fish handling and preservation techniques in small-scale fisheries in order to improve technical know-how of the

fisher-folk, fish processors, fish transporters and other fisheries stakeholders to produce quality fishery products in compliance with safety standards.

The manual is intended as a guide to good environmental sanitation and personal hygiene practices for the small-scale fishery sector. The training manual will assist extension workers to educate the fisher-folk and other stakeholders in producing fishery products that are safe and of high quality. Fishery supply chain stakeholders especially fisher-folk, landing site operators, fish processors and fish transporters can use this manual in implementing good environmental sanitation and personal hygiene practices.

The training manual consists of eleven chapters. Chapter one covers overview of the fishery sector in South Sudan; chapter two is on health and sanitation; chapter three covers fishing boats and good hygiene practices; chapter four is related to fish spoilage; chapter five covers fish handling practices; chapter six is about fish processing practices; chapter seven is on fish preservation techniques; chapter eight covers fish oil; chapter nine covers fish transport, chapter ten covers fish markets and chapter eleven includes references.

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Special thanks are due to Mr. John S. Benansio, Fishery Expert from the University of Juba, South Sudan for developing this manual.

We hope and believe that this training manual will support extension officers in conducting practical training to the fisher-folk, fish processor, fish transport and fish traders on basic fish handling and preservation techniques in South Sudan. On the other hand, this training manual is also entitled to be a reference document to other non-governmental organization working in the field of fishery sector in South Sudan.

Juba Catering Services, South Sudan



## Definition and terms

**Cleaning:** means the removal of soil, food residues, dirt, grease and other objectionable matter.

**Cold storage:** refers to storage equipped with insulated walls to maintain fish in a frozen condition at a temperature of -18°C or less.

**Chemicals:** refers to any substance either natural or synthetic which can affect the live fish, its pathogens, water and equipment used for production or the land within the aquaculture establishment.

**Clean water:** refers to water from any source free from harmful microbiological contamination, substances and/or toxic plankton are not presented in such quantities as may affect the health quality of fish, shellfish and their products.

**Cross-contamination:** refers to the transfer of bacteria from contaminated food (usually raw) to ready-to-eat food by direct contact, drip or indirect contact using such as hand or poor personal hygiene practices.

**Disinfection:** refers to reduction of the number of micro-organisms in the environment, through chemical agent and /or physical methods, to a level that does not compromise food safety or suitability.

**Fishing boat:** refers to any water vehicle such as fiberglass boat or plank wooden canoe which is equipped with fishing gears for fishing

**Fishing camp:** refers to a location where fishers reside for extended periods of time during the fishing season.

**Fishing community:** refers to permanent locations where fisher-folks reside with their families.

**Fish landing site:** refers to structure constructed for the purpose of assembling fish products before onward transport to the urban fish market.

**Fishing crafts:** refers to the boats that have been used as fishing boats to catch fish in river, lakes and sea

**Fish Products:** refers to products exploited from nature, including fish and aquatic plants and processed products like dried fish, smoked fish, fish paste.

**Gutting:** refers to cleaning the fish by cutting along their mid ventral side and removal of their visceral organs.

**Good Hygiene Practice:** refers to procedure that must be undertaken and hygiene pest-refer to objectionable animal or insect include but not limited to bird, rodent, flies and larvae capable of direct or indirectly contaminating food.



**Hazard:** refers to biological, chemical or physical agent in or condition of food with the potential to cause an adverse health effect.

**Hygiene:** refers to the science of preserving health and involving all measure necessary to ensure the safety and wholesomeness of food (management of hygiene).

**Landing location:** refers to fishing camps and villages in remote areas where fish products are gathering before onward transport to the rural and urban fish market

**Potable water:** refers to fresh water fit for human consumption. Standard of portability should not be lower than those contained in the last edition of the “International standards for drinking water” World Health Organization.

**Raw Material:** refers to fresh or frozen fish, shellfish and their parts which may be utilized to produce fish and shellfish products intended for human consumption.

**Standard:** refers to the required way to produce or handle fish and what the final product should be like.

**Traceability:** refers to the processes of gathering information about what happens to fish at every stage of the distribution chain.

## **Acronyms and abbreviation**

BAED	Bahr el Ghazal Effort for Agricultural Development
CAMP	Comprehensive Agricultural Development Master Plan
FP	Fishery Products
GHP	Good Hygiene Practice
PHL	Post Harvest Losses
ToT	Training of Trainers
UNIDO	United Nations Industrial Development Organization
VCA	Value Chain Analysis
ZEAT	Zonal Effort for Agricultural Transformation

# Chapter One

## Fishery Sector in South Sudan

### 1.1. Introduction

South Sudan is endowed with vast inland waters having high fisheries potential. The Sudd is considered one of the largest wetland in the tropics covering an estimated area of  $57 \times 10^3 \text{ km}^2$  about 4.7% of the total area of south Sudan. The fishers were using small-scale rudimentary fishing gears and crafts both traditional and modern in performing their fishing practices in the remote camps. Fishery is of immense importance to the rural and agro-pastoralist communities residing along the river Nile. They depend on fisheries for their livelihood. In South Sudan fishery plays an important role, it's provide income and employment opportunities to the rural and agro-pastoralist communities. The role of fish in food security can be defined as a situation in which all households have both physical and economic access to adequate amounts of fish.

However, in South Sudan the fishery sector has been neglected due to several factors such as (a) lack of priority to support the development of fishery Sector, government placed highest priority on livestock health and improved rural livelihoods, while the fisheries agenda is given a medium to low priority; (b) lack of financial and human resources - limited financial resources by the government to accelerate the fisheries sector related activities to meet the objectives and mission statement of the directorate of fisheries may not be forthcoming compared with livestock health sector; (c) lack of information - there is no reliable data on the biological, social and economic aspects of a fishery sector to formulate policy and plan development strategies; (d) lack of National Fisheries Acts - South Sudan has no fisheries law of its own to guide management of fisheries resources (e) poor traditional practices - fishing has historically always been an activity to which the Nilotic communities turned into order to quickly rebuild lost assets after the loss of the cattle due to marriage, funerals or following an epizootic outbreak or cattle raiding; (f) high post-harvest losses – the recent post-harvest and market assessment revealed it nearly 30% fish losses occurs during the transportation of fishery products from the remote fishing area to the urban centre. On the other hand, 70% of fish losses occur at the marketing stage of the fishery products. Despite its importance to food security and livelihood to the rural population in the country, the fishery sector suffers from enormous post harvest losses. Because of these factors the contribution of fishery sector to poverty alleviation and improving food security and livelihood are not seen.

The inland water of South Sudan is one of the most productive zones in the world and is rich in diversity of fish species and other aquatic resources. There are more than 116 fish species are recorded along the River Nile of which 60 are said to be of commercial importance. The estimated total fish catch has been estimated at 100,000 to 300,000 tonnes/year according to the Ministry of Livestock and Fisheries Industry. Although, there is no reliable data on fisheries stock assessment of recent. However, fisheries manager and academician in the country argue that the country has significant unmanaged and under-utilized fisheries

resources that provide a valuable asset for supporting food security and livelihoods for its population. The economy of the country is predominantly agricultural with an estimated number of about 220,000 people depend directly primarily and secondary fisheries related activities mainly fishing, processors and fish trading activities. The per capita consumption in the country has been calculated at 17.36 kg/year.

The ecology of the inland waters in the country is open waters; the water has been disturbed especial in some parts of Sudd region. The inland water has disturbed due to human interference such oil exploitation and uses of other chemical that resulted to the pollution of the water. Fisheries managers and researcher nationwide believed that most of the vast inland water is virgin and untapped fisheries resources. For development of the small-scale fisheries sector in the country, there is a need for proper research studies and assessment to understand the present status of the fisheries is essential.

## Chapter Two

### Sanitation and Health

#### 2.1. Environmental Sanitation

The environmental sanitation refers to the control of the factors in human surrounding which cause or may cause adverse effects on human health. It is important for the fishing communities to keep their surrounding environment clean to promote health and prevent disease transmission by eliminating breeding places for insects and rodents as pests are disease vectors . Doing so will improve quality of life.

#### 2.2. Poor sanitation practices

Poor sanitation refers to the irresponsible behaviour and attitude practiced by the beneficiaries (fisher-folk, processors, transporters and fish traders) which lead to the risk of contamination in the workplace. Poor sanitation practices leads to high risk of diseases spread and health issues such as chronic diarrhea, intestinal worms, bilharzia, hepatitis and scabies. The below conditions are referred as poor sanitation practices:

- Latrine/toilets too close to the water source;
- Food served on the ground/dirty place;
- Human being and animal drinking water from the same source ;
- Uncovered pit latrine;
- Open rubbish;
- Animal roaming and defecating in the compound;
- Stagnant water;
- Landing of fish products on dirty place;
- Flies on food;
- Area full of litter or rubbish dump nearby

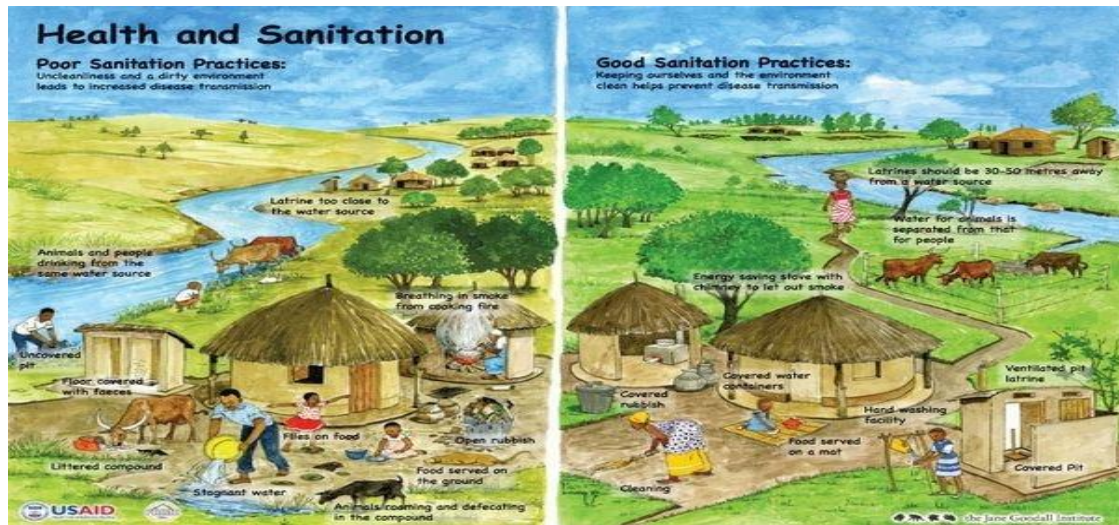


Figure 1: Shows poor and good sanitation practices in the rural area

(Source: USAID project on health and sanitation).

*By the end of training session, the trainee will be able to explain at least five disadvantages of poor environmental sanitation practices.*

### 2.3. Good sanitation practices

Good sanitation practices refer to the responsible behaviour and attitude applied by the beneficiaries (fisher-folk, processors, transporters and fish traders) to minimize the risk of contamination in the workplace. This means that beneficiaries have basic knowledge to promote good sanitation like using clean water, keeping fish disposal in closed container or controlling pests. The required conditions for good sanitation include the following:

- Toilets should be 30 to 50 meters away from water sources;
- Water source for animals is separated from the one for human use;
- Pit latrine shall be ventilated;
- Pit latrine shall be covered;
- Hand washing facilities must be available;
- Food is served on the plate;
- Water containers shall be covered;
- Rubbish shall be placed in covered containers;
- Compound must be kept clean;
- Landing of fish products on clean place

*By the end of training session, the trainee will be able to explain the importance of good environmental sanitation practices.*

#### **2.4. Personal hygiene**

Personal hygiene refers to good practices that are used by the beneficiaries (fisher-folk, processors, transporters and fish traders/retailers) to maintain health and preventing diseases especially through cleanliness. When we talk about personal hygiene, we mean maintenance of the health and healthy condition, simply because certain bacteria may remain active in our hands for longer time. Hence bacteria can spread to everything we touch. This is particularly dangerous in catering environment where germs can multiply easily on food.

#### **2.5. Poor hygiene practices**

Poor personal hygiene refers to irresponsible behavior and attitude on hygiene practices used by the beneficiaries (fisher-folk, processors, transporters and fish traders/retailers) in their workplace. The poor personal hygiene practices includes:

- Dirty clothing and hands are use to handle food;
- Uncover cut and wound ;
- Long dirty fingernails;
- Use of jewellery on hand and wrist which provide grounds for the germs;
- Coughing and sneezing over food;
- Handling food while sick with diarrhoea, vomitting or having skin infections;
- Fail to wash hands after going to the toilet ;
- Fail to wash hands after handling of pets such as dog and cat;
- Fail to wash hands before and regularly while handling and processing fish products;
- Poor hand washing practice: washing hands with dirty water, without soap.

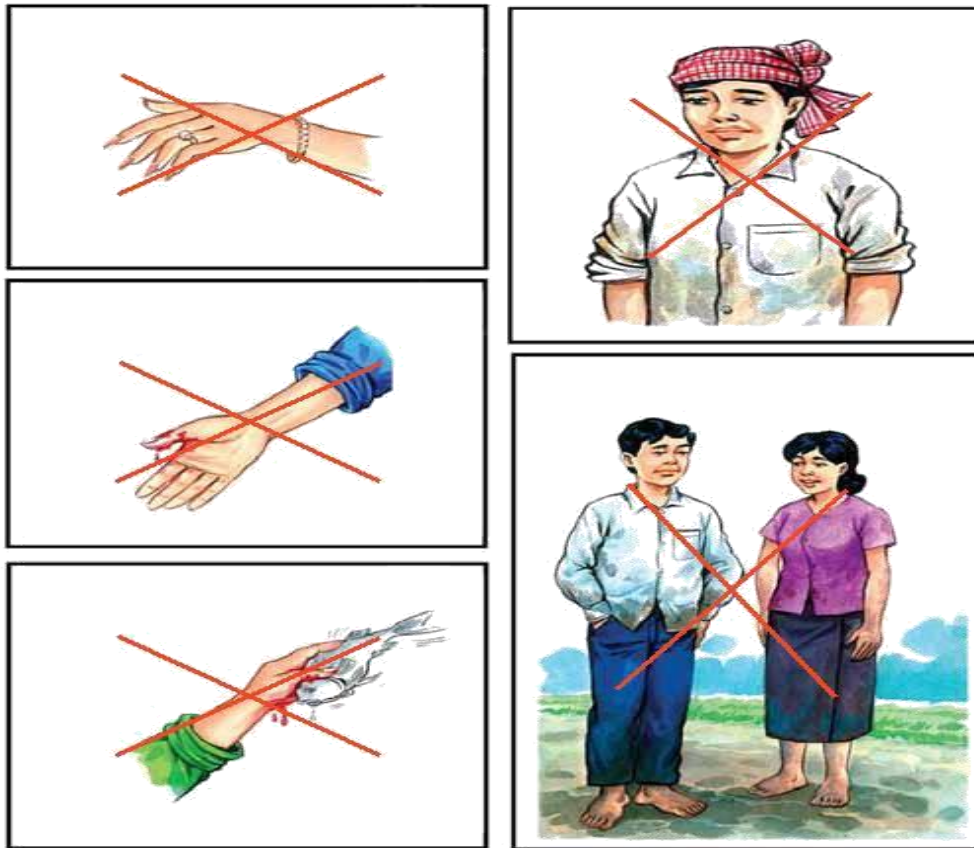


Figure 2: Poor personal hygiene practices

(Sources: Good hygiene practices for fishing boats and fish landing sites for small-scale fisheries).

*By the end of training session, the trainee will be able to correct at least five poor hygiene practices in his direct environment/ in a case example.*

## 2.6. Good hygiene practices

Good personal hygiene practices refers to responsible behavior and attitude on hygiene practices used by the beneficiaries (fisher-folks, processors, transporters and fish traders/retailers) in their workplace. The good personal hygiene practices includes:

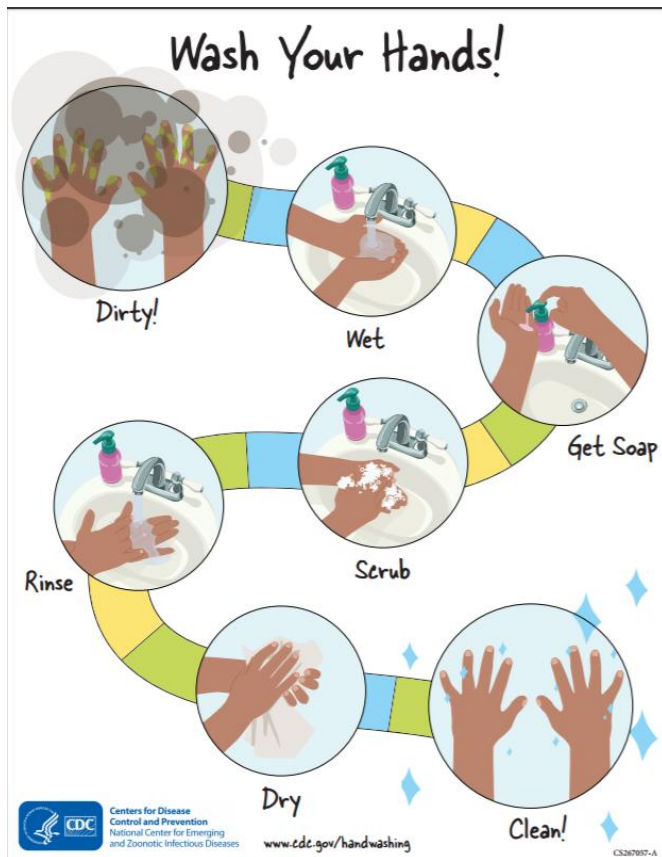
### When to wash your hand :

- Wash hands before preparing food.
- Wash hands before handling raw food such as fish, meat, eggs and poultry.
- Wash hand after handling raw food such as fish eggs, meat and poultry
- Wash hands after touching rubbish/ waste bins
- Wash hands after coughing or sneezing



- Wash hand after using toilets

### How to wash hands



### How to cater your food :

- Wear appropriate clothing when working in catering (ex: use head-gear/cap).
- Use clean clothing, and it should be changed when become dirty
- Use hand gloves
- Remove all jewellery before preparing food;
- Cover all cuts, burns and scores with water proof dressing.
- Avoid touching your ears, nose and teeth when working with food.
- Keep nails short and well structured,
- Never cough, spit, sneeze or smoke near food.
- Do not smoke in areas where food is prepared and stored.



Figure 3: shows good personal hygiene practices

(Sources: Good hygiene practices for fishing boats & fish landing sites for small-scale fisheries)

*By the end of training session, the trainee will be able to implement at least five good hygiene practices in his direct environment/ in a case example correcting wrong behavior.*

## Chapter Three

### Good Hygiene Practice for Fishing Boats

#### 3.1. Personal Hygiene Requirements

Personal hygiene practices and hygienic production processes are equally important to ensure that fish products are safe to eat. Fish products should be washed in clean water and remove any chemical or biological hazards that may be present. The concept of hygienic behavior consists of simple, hygienic actions that individual fishers and people who handle fish products can adopt. These principles apply both to the people who handle the catch and the equipment and surfaces that the fish products come into contact with. The basic hygiene concepts covered include:

- Personal hygiene rules for people handling the catch along the supply chain, from capture or harvest to consumption, including personal hygiene and dress codes;
- Production hygiene, which covers the things that come into contact with fish products. All these objects must be regularly cleaned to avoid contamination of the fish products.

Simple steps that can prevent pathogens from contaminating fish products include avoiding fishing in polluted waters, keeping the boat and fishing gear clean, observing good personal hygiene and keeping animals away from the boat. Keeping body clean and wearing clean clothing before starting work or fishing, washing hands with soap and clean water after going to the toilet, being aware of personal appearance and keeping fingernails and hair well trimmed are all examples of good personal hygiene. The following should not be permitted in areas where fish products are handled:

- Smoking;
- Spitting;
- Chewing or eating;
- Sneezing or coughing over the product;
- Wearing personal effects such as jewellery, watches, pins or other items that, if dislodged, may pose a threat to the safety.

#### 3.2. Fishing Boats Hygiene Requirements

Before leaving to the fishing ground, the boats/canoes should meet the following requirement

- Safety and efficiency of the fishing boat/canoe for operation
- Fisher-folk should maintain personal hygiene in the boat/canoe
- The boat and equipment should be thoroughly cleaned using clean water and approved detergent,
- The boat and equipment should be inspected for damage and necessary maintenance

carried out.

- Landing site water should not be used for cleaning, as this water will be polluted;
- Avoid animals into the fishing boat and using the boat for transport of products other than fish products because it increases the contamination risks;
- Fishing boats should be used for fishing only;
- Use tap water from the public water supply or clean well/borehole water that has been treated with chlorine to clean boats and equipment;
- Do Not use water that may be contaminated with sewage;
- Allow the fishing boat and equipment to sun dry.



Figure 4: Good and bad hygiene practices on the fishing boats

(Sources: Good hygiene practices for fishing boats and fish landing sites for small-scale fisheries)

### 3.3. Icing

Ice is defined as a cooling medium for fish. It has a great role in preserving its flavor. It is important to ice fish throughout the process of preparing fish. During the transport, the best way to store fish is to place it in cool boxes full of ice. The amount of ice required to cool fish depends on the insulation options, types of fish species, ambient temperatures and time of storage. Ice can be produced in different shapes; the most commonly utilized in fish preservation are flakes, plates, tubes and blocks. Ice must be manufactured either from fresh water of drinking quality i.e. potable water. Ice intended for preservation of fishery products in small-scale fisheries must be manufactured, handled, transported, stored and used in the most hygienic

manner possible in order not to expose the ice to any physical, chemical or biological contaminant. Storing fishery products in ice immediately after capture is the best way to maintain its quality and thus keep its value. Ice performs two jobs:

- It cools the fishery products to the temperature of melting ice (about 0°C);
- It keeps the fishery products cool for long periods.

Normally, for efficient cooling, one kg ice is needed for each kg of fish. The longer the storage time, or the larger the catch, the larger the quantity of ice will be required. It is important that some ice remains in contact with the fishery products at the end of the fishing trip.

Using ice correctly is simple. Ideally, flake ice should be used, but if only blocks are available then it has to be broken into small pieces. The reason is because large lumps can physically damage fishery products and cool the fish less efficiently than small pieces. It is recommended to use flake ice or mechanically crushed ice obtained from an approved supplier.

**How to arrange the ice:** Firstly a thick layer of ice (about 5 cm thick) should be placed at the bottom of the fish box. A single layer of fishery products is then placed on the ice. A layer of ice is placed on the first layer and the process is repeated until the box is full, finishing with a thick top layer of ice. The fish box should then be closed with a tightly fitting lid.

#### **3.4. Benefits of proper icing fish**

- Ice helps to prolong shelf life of fish product in a relatively simple way
- Ice helps to reduce the activity and reaction of enzymes in the guts and tissues that cause breakdown and changes its flavor and aroma.
- Ice helps to inhibit the growth of bacteria and microbes causing fish spoilage;
- Ice helps to keep surface of fish moist, this prevents fish from dehydration and weight loss
- Ice preserves the cold chain till it reaches the consumer.

#### **3.5. Effective fish icing**

- Use only good quality ice made of potable water, in well maintained ice plants;
- Always store ice in clean containers;
- Avoid large and sharp edged pieces of ice which can damage the fish;
- Ice the fish immediately after the harvest;
- Use at least 1kg of ice to preserve 1 kg of fish;
- Icing must be placed at the top and bottom of boxes and preferably mixed with the fish inside the box. This will cool the fish more rapidly;

- Ensure proper drainage of melted ice water from boxes



Figure 5: Good icing practices

(Sources: Good hygiene practices for fishing boats & fish landing sites for small-scale fisheries)



Figure 6: Bad icing practices

(Sources: Good hygiene practices for fishing boats & fish landing sites for small-scale fisheries)

### 3.6. Use of Ice in Small-Scale Fisheries

The flow diagram below illustrates step-by-step the actions to be undertaken by fishers. The personal and production hygiene rules and actions must also be followed during icing.



## **Ice Storage**

The ice storage container is filled with the required quantity of ice. The chosen type of ice will depend on the chilling method preferred by the fisher and the local availability of ice (Ice block should be avoided). The ice storage container should be insulated and have contact surfaces that are clean, smooth, easy to clean, durable, in good repair and made of non toxic, food grade materials.

## **Rinsing**

Using a bucket, clean the catch with large amounts of clean water to remove excess slime and blood.

## **Storage**

Carefully place the catch in the clean, dedicated container, taking extreme care not to physically damage the catch. It may be possible to use a partitioned container to store both fishery products and ice. Containers used for storing fishery products should have a drainage hole to allow melted water to escape (ensure evacuation of water is controlled, that it doesn't stay stagnant in storage area).

## **Chilling**

Chill the catch using ice as quickly as possible. For direct chilling put approximately 5 cm of ice at the bottom and place a layer of fishery products on top. Cover the catch with approximately 5 cm on top and 5 cm on the sides. Repeat for each layer of fish and ice. Make sure the catch, in the case of fin-fish, is stored in a straight position and is not bent. Check for ice melt at regularly at intervals. Replenish ice as necessary to compensate for ice melt and drain melted water as and when required.

## **Transport**

When returning from the fishing grounds to the landing site, check for ice melt and keep the ice uniformly distributed over the catch. If weather conditions are rough, take measures to prevent the catch from moving inside the container, to avoid damage.

## **Handling**

Treat the fish with utmost respect and care to avoid physical damage to the flesh, as the fishery products may have turned rigid due to the rigor mortis effect. It is recommended to use thermally insulated boxes which are fitted with lids to reduce the heat impact on the catch, and to shield the catch from contact with animals (insects, i.e. flies, rodents, other animals), dust and other potential contamination hazards. It is important that the inner lining of the box is made of food grade material.

*By the end of training session, the trainee will enable to correct icing practices in his direct environment/ in a case example. They should be able to expose difficulties faced to achieve good icing practices and define solutions.*

# Chapter Four

## Fish spoilage

### 4.1. Fish spoilage

Fish spoilage is referred to as a change in fish or fish product that renders it less acceptable, unacceptable or unsafe for human consumption. Fish spoilage is caused by the actions of enzymes and bacteria present in the guts of living fish. When fish dies the enzymes helps the bacteria in the digestive system to penetrate the belly wall, breaking down the flesh itself. The higher the temperature, the faster the deterioration; bacteria penetrate the fish reducing the quality of fish and the smell dramatically indicates fish deterioration.

### 4.2. Quality of fish product

The quality of the fish product affects the sale price.

High quality = High price

Poor quality = Poor price

Once the quality of the fish product is allowed to deteriorate it can never be regained. This means that everyone involved in the fishing business, from the fisherman at the point of capture, through the processor to the vendor at the point sale, must understand how to maintain quality in order to get the best possible price. There are four basic requirements for maintaining fish product quality.

- Thoroughly chill the fish product and keep it as cool as possible prior to processing or selling;
- Do not damage or crush the fish product;
- Keep the fish product clean;
- Work quickly.

### 4.3. Measuring quality of fish product

Quality can be measured by chemical or sensory methods. We are actually doing these ourselves when we look at a fish and decide how much we want to pay for it.

- **Chemical Testing:** We can use chemical analysis to measure the concentration of chemical produced during spoilage of fish product.



- **Sensory Evaluation:** We can quickly check quality by using (i) our eyes to look at the appearance of the fish product, (ii) our hands to feel the texture of the product, (iii) our noses to smell it and (iv) our tongues to taste it. The following table gives a numerical value for differing qualities of fresh fin-fish. It can be a useful tool in assessing quality. We simply describe what we see (appearance, colour), feel (texture), and smell.



Figure 7: Poor quality fish products with bad smell can make people ill  
(Sources: Community trainers manual on fish handling, quality and processing).

**Table 3: Quality evaluation of fresh fin fish using sensory evaluation**

Class	Gills	Eyes	Body appearance	Texture	Quality
5	<ul style="list-style-type: none"> <li>• Dark red colour</li> <li>• Some thin clear slime</li> <li>• Foul smell</li> </ul>	<ul style="list-style-type: none"> <li>▪ Bright, metallic</li> <li>▪ Clear pupils</li> <li>▪ Convex eyes</li> </ul>	<ul style="list-style-type: none"> <li>• Natural colour</li> <li>• Iridescent</li> <li>• Firm scales</li> <li>• Little/or no slime</li> </ul>	<ul style="list-style-type: none"> <li>▪ Firm before or in rigor</li> </ul>	<ul style="list-style-type: none"> <li>• Excellence</li> </ul>
4	<ul style="list-style-type: none"> <li>• Red colour</li> <li>• Some slime, but still thin and clear</li> <li>• No smell</li> </ul>	<ul style="list-style-type: none"> <li>▪ Bright metallic</li> <li>▪ Slightly cloudy pupils</li> <li>▪ Slightly convex eyes</li> </ul>	<ul style="list-style-type: none"> <li>• Natural colours</li> <li>• Firm scales</li> <li>• Some slime</li> </ul>	<ul style="list-style-type: none"> <li>▪ Firm</li> </ul>	<ul style="list-style-type: none"> <li>• Good</li> </ul>
3	<ul style="list-style-type: none"> <li>• Red –brown colour</li> <li>• Some thick slime</li> <li>• Beery/mousey/warm smell</li> </ul>	<ul style="list-style-type: none"> <li>▪ Dull</li> <li>▪ Pupils cloudy</li> <li>▪ Flat</li> <li>▪ Some blood</li> </ul>	<ul style="list-style-type: none"> <li>• Slight red colour</li> <li>• Scale loose</li> <li>• More thick slime</li> </ul>	<ul style="list-style-type: none"> <li>▪ Firm</li> </ul>	<ul style="list-style-type: none"> <li>• Average</li> </ul>
2	<ul style="list-style-type: none"> <li>• Brown colour</li> <li>• A lot of slime</li> <li>• Slight off smell</li> </ul>	<ul style="list-style-type: none"> <li>▪ Dull</li> <li>▪ Pupils cloudy</li> <li>▪ Slightly concave eyes</li> <li>▪ Bloody</li> </ul>	<ul style="list-style-type: none"> <li>• Red/yellow colour</li> <li>• Scales missing</li> <li>• Dry skin</li> <li>• A lot of slime</li> </ul>	<ul style="list-style-type: none"> <li>▪ Soft</li> </ul>	<ul style="list-style-type: none"> <li>• Poor</li> </ul>
1	<ul style="list-style-type: none"> <li>• Brown colour</li> <li>• A lot of slime</li> <li>• Bad/ammonia smell</li> </ul>	<ul style="list-style-type: none"> <li>▪ Dull</li> <li>▪ Pupils cloudy</li> <li>▪ Concave eyes</li> <li>▪ With blood</li> </ul>	<ul style="list-style-type: none"> <li>• Red/yellow colour</li> <li>• Few scales</li> <li>• Dry skin</li> <li>• A lot of thick yellow slime</li> </ul>	<ul style="list-style-type: none"> <li>▪ Very soft</li> <li>▪ Mark of finger left if pressed</li> </ul>	<ul style="list-style-type: none"> <li>• Very poor</li> </ul>

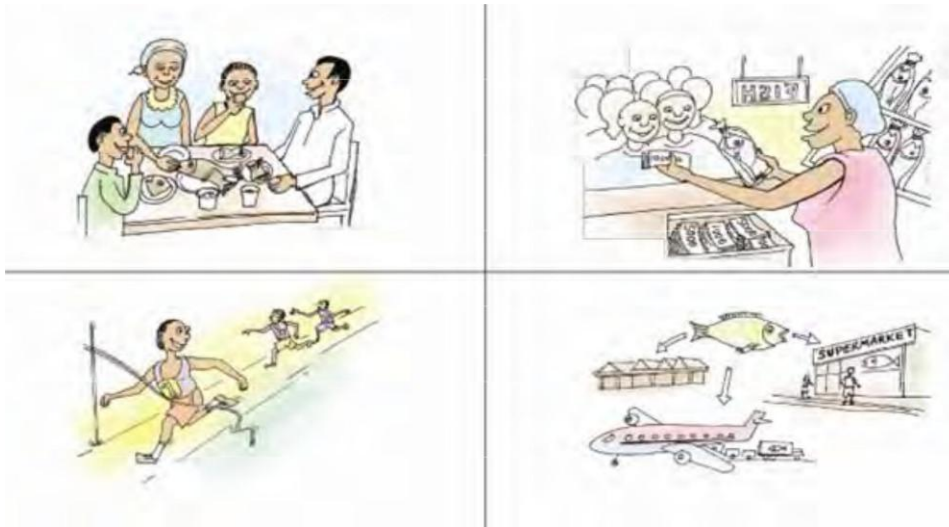


Figure 8: Good quality produce by the fisher-folk and fish processor which is tasty and good for our health makes; fisher-folk can make money fish products and fish that can be sold in different markets.

(Sources: Community trainers manual on fish handling, quality and processing).

*By the end of training session the trainee will be able to correct icing practices in his direct environment/ in a case example. They should be also able to expose their experiences regarding poor quality of product.*

## Chapter Five

### Fish Handling Practices

#### 5.1. Introduction

The primary objective of good fish handling techniques is to preserve the quality of fish. However, factors such as delay in handling the catch, poor control of fish temperature, poor standards of gutting are often deleterious on the quality of fish and results in reduction of shelf life and loss of weight.

#### 5.2. Fish handling after harvest

Maintaining the quality of fish begins with harvest and transport of the fish products. It is advisable for the fisher-folk to carefully handle their fish products on canoe/boat during transport. This will allow the fisher-folk to maintain high quality of the fish product. There are several factors affecting fish handling on canoe/boat, mostly the biological, chemical and physical factors that cause degradation of fish products.

The surfaces of dead fish are ideal growth habitats for bacteria contributing to the spoilage process. Hence, it is important for the fisher-folk to control the temperature of fish. Bacteria growth implicates chemical breakdown due to oxidative and enzymatic reactions leading to off odour; flavor and rancidity.

#### 5.3. Poor fish handling practices

Poor fish handling refers to inappropriate practices used by the fishermen while handling their fish products after harvest. Due to poor handling the fish get subjected to physical, chemical and biological hazard leading to increased microbial contamination, hastening the spoilage rate of fish. The poor fish handling practices includes the following:

- Fish placed on dirty surface;
- Inappropriate washing of fish in dirty water;
- Fish thrown/displayed on the ground;
- Beating fish with stick after harvest, or stepping on fish;
- Fish left to insect, birds and animal predation;
- Delay in gutting the fish after harvest;
- Use of dirty knives or other objects to remove the fish scale;
- Fish in contact with chemical substances such as fuel, oil;
- Use of colour additives in fish that may cause allergies;
- Use of dirty boxes, baskets and ices.



Figure 9: Poor fish handling practices being used by the fisher-folks and fish transporters (Sources: Benansio, 2016).

*By the end of training session, the trainee will enable to explain poor handling practices of fish on the canoes/boats.*

#### 5.4. Good fish handling practices

Good fish handling refers to the practices that are used by the fisher-folk after receiving their fish products at the fishing villages/camps and landing site. The fisher-folk wash their fish product to remove mud, sand and debris. In addition, the fisher-folk sorted/graded according to species or sizes, prior to fish processing. Hence fish processing will determine the quality of the final fish products. The recommended good practices of fish handling during processing are as follow:

- Control the temperature of the fish
- Avoid mishandling of fish
- Cool the fish as quick as possible by any convenient methods
- Fish caught at different time, have to be kept apart since they will be at different stage of spoilage
- Small fishes have to be kept separate from large fishes, as they tend to spoil more rapidly than the latter
- Soft-bellied fishes are to be kept separately, if the guts are being removed or the belly has burst, the body cavity has to be washed to remove any traces of the gut.
- The container used for the transportation of fish should be clean after every use.
- Fish handlers at every processing stage should learn about and adopt good hygiene practices.



Figure 10: Good and poor fish handling practice

(Sources: Good hygiene practices for fishing boats and fish landing sites for small-scale fisheries).

*By the end of training session, the trainee will enable to explain good handling practices of fish.*

## Chapter Six

### Fish Processing Practices

#### 6.1. Fish processing

Fish processing refers to a series of actions applied by the fisher-folk and other actors of the value chain to preserve their fish products from the time fish is caught until it reaches to the consumer. It is advisable for the fisher-folk and other beneficiaries to process their fish products in a proper place with good hygienic condition. In addition, they should avoid using sharp objects (other than appropriate knives) and poisonous substance. Prior to fish processing, fish are sorted/graded, washed and cleaned, then heads, tails, scales, fins, slimes are removed fish are then gutted and cut into steaks/pieces. Equipments and facilities used for processing fish should not get in contact with processed waste products. In addition, any waste products from fish processing areas/centre must be disposed in a friendly way that does not harm the environment neither aquatic ecosystem (water) nor terrestrial ecosystem (land). Fish waste should be kept and get rid of in a closed place that does not allow flies, rats and other pests to breed and be a nuisance. Finished products must be packaged and handled in a careful way to avoid contamination.

#### 6.2. Poor fish processing practices

Poor fish processing refers to insufficient knowledge and wrong practices used by the beneficiaries (fisher-folk and fish processors) in processing fish products after harvesting. Hence poor fish processing produces lower quality fish products. The below are the poor fish processing practices:

- Fish processing done at poor hygienic location;
- Fail to clean and wash fish prior to processing;
- Fail to quickly remove viscera and gills;
- Uses of inappropriate metals such as dirty knives, broken glass to process fish products;
- Fish processed with dirty utensil and equipment's;
- Fish waste products disposed around the processing workplace encouraging presence of flies and other insects;
- Use of chemicals such as pesticides or insecticides on the equipment during the final stage of fish processing.





Figure 11: Poor fish processing practices being used by the fisher-folks and fish processor in the remote fishing villages and camps along the river Nile and urban fish markets.

(Sources: Benansio, 2015; 2016).

*By the end of training session, the trainee will enable to explain poor fish processing practices.*

### 6.3. Good fish processing practices

Good fish processing practices refers to appropriate skills and knowledge being used by the (fisher-folk and fish processors) in processing fish products after harvesting. Hence good fish processing ensure a higher quality fish products. The required condition for good fish processing includes the followings:

- Fish that is processed should be fresh and in good condition;
- Fish should be washed in clean water thoroughly to remove blood, slime and scales;
- Fish are sorted/graded accordingly, large fish are separated from small fish;
- Fish processing should be done in a proper place where there is no chance for bacteria growth;
- Equipment and utensils used for fish processing should be kept clean in good condition;
- Waste fish products should be kept in a closed place that does not allow flies, rats and other pests to breed and be a nuisance;
- Any waste products from processing must be disposed of in way which does not harm the environment either the water or land;
- Finished products must be packaged and handled in a careful way to avoid contamination and so they remain safe to eat;
- Finished products are packaged and handled in a careful way;





Figure 12: Good fish processing practices being used by the fisher-folks and fish processor. (Sources: Community trainers manual on fish handling, quality and processing).

*By the end of training session, the trainee will enable to explain good fish processing practices.*

#### 6.4. Maintaining fish processing areas

Poor maintenance of fish processing areas refers to the state or condition that the premises and equipment used for fish processing are not kept in good condition. It may allow the entry of other sources of physical, microbiological and chemical contaminants such as dirty water, pests and dust. It can as well have health and safety implications for fisher-folk and fish processor. Specific procedures must be followed to minimize the risk of such hazards causing illness to consumers:

- The processing area should be closed: have a compound wall and gate to prevent the entry of wandering animals to the premises;
- Sweep and clean the processing area regularly to ensure that there is no rubbish lying around attracting flies, rats and other pests;
- Use clean equipment and utensils at the fish processing area;
- The processing area should have a separate washing facility for utensil ;
- Floor and walls of the peeling shed should be tiled to enable easy washing;
- The processing area should have a raised receiving area for the unloading of fish products;
- Make sure there are good toilet facilities and these are kept clean;
- Ensure that there are no trees or vegetation near the processing place as these are good places for insects and vermin to live;

*By the end of training session, the trainee will enable to explain about the maintaining of fish processing areas.*

### **6.5. Controlling disposal of fish waste**

If the fisher-folk process fish in large quantity and the fish scraps are deposited in an open place, this represents a high risk to the environment, public health and safety. Poor disposal of fish waste can produce bad odor and decrease levels of dissolved oxygen. The below are the guiding conditions to control fish waste:

**a. *Establish fish cleaning area*** and adopt the following techniques to dispose the waste:

- Ensure that fish waste and rubbish are disposed properly by keeping them in covered bins;
- Fish waste and rubbish shall be removed from processing area that are emptied and cleaned daily;
- Waste removing opening should have curtain/barrier to avoid entry of flies and insects.

**b. *Prohibited fish cleaning outside of the designed area.***

- Instruct fisher-folk, fish processor not to dispose fish scraps on the bank of the river and lakes.

**c. *Sign post directing people where and how to clean their fish***

### **6.6. Management of fish waste options**

Management of fish waste is essential because it will allow fish processors to extract the maximum practical benefits from the fishery products to generate the minimum amount of the waste. The below are the options to manage fish waste:

- Fish waste can be re-processed to produce oil and meal/flour;
- Fish waste can be used in production of silage; used as food for domestic animal/aquaculture;
- Fish waste can be used as fertilizer in land farming.



Figure 13: Poor management of fish waste practices by the fish processor in the Juba Custome market (Sources: Benansio, 2016).

*By the end of training session, the trainee will enable to explain how to control and dispose/manage fish waste.*

## Chapter Seven

### Fish Preservation Techniques

#### 7.1. Fish Preservation Techniques

Fish preservation techniques refer to a wide range of actions used by the fisher-folk and fish processors to preserve their fish products either through smoking, sun-drying, salting or wet salting . These techniques aim to prevent from spoilage, damages or destruction due to enzymes and bacteria action.

#### 7.2. Traditional fish smoking

This refers to the smoking techniques where fisher-folk often construct smoking oven with mud, bamboo or else. The construction is done in the ground through dugout. In this technique, fish is easily processed via means of smoke produced by the firewood placed in the smoking chamber. Hence, the produced smoked fish has a pleasant flavor, and at the same time it can be kept longer than fresh fish.

Despite these benefits, we should keep in mind that traditional fish smoking is an artisanal process that can't cope with large volumes of fish because of their low capacity and inefficient smoking process. Increasing the capacity could lead to high consumption of firewood and therefore contribute to forest depletion.

#### 7.3. Disadvantage of traditional techniques of fish smoking

- High consumption of firewood;
- Causes dark brown or black colour on the final product;
- Difficulty for the fisher-folk to handle wire mesh loaded with fish during the smoking;
- Low capacity;
- Loss of heat and smoke through the stoke hole and around the layers of fish, resulting in increasing need of fuel (wood);
- Damage caused by the sticks separating the layers of fish;
- Excessive handling of fish during smoking;
- Pieces of fish falling into the fire, especially if the wire mesh is damaged;
- Difficulty in controlling the heat.



Figure 14: Traditional fish smoking being used by the fisher-folks in Terekeka

(Sources: Manfred, 2009 and Benansio, 2016).

*By the end of training session, the trainee will enable to explain about the traditional fish smoking practices and its advantage and disadvantages.*

#### **7.4. Improved techniques of fish smoking**

This refers to the smoking techniques where fisher-folk often construct smoking oven with bricks or stones that can retain heat for continuous smoking of fish products. Improved fish smoking technique reduces firewood consumption, since enough heat and smoke is retained. Improved fish smoking practices eliminate nearly 90% of the challenges associated with the traditional fish smoking practices.

#### **7.5. Advantage of improved techniques for fish smoking**

- Efficient firewood use;
- Improved heat and smoke circulation;
- Reduction of smoking time;
- Increase of quantities that can be smoked at once;
- Use of trays reducing tediousness of the process;
- The trays form a chimney to trap the smoke and heat;
- Heat and smoke required during the smoking process can be regulated;
- Uniformly smoked product of better quality in terms of colour, shape and taste;
- Handling of the fish during the smoking process greatly reduced;
- The product acquires a higher market price.





Figure 15: Improve fish smoking being practice by women fish processor in Sernum cooperative society in Terekeka (Sources: Benansio, 2016).

*By the end of training session, the trainee will enable to explain about the improve techniques for fish smoking and it advantages.*

#### **7.6. Traditional techniques of sun-drying of fish**

The traditional technique for sun drying is the simplest and most primitive method of drying process. This method consists in spreading the fish on the ground, rocks, branches of trees or on the roof of houses as well as on roadsides. Traditional fish smoking practices are liable to contaminate the product with sand and micro-organisms. It also renders the fish prone to attacks by pets and other animals such as goats, sheep, pigs and rodents. Traditional sun drying often leads to quality loss due to oxidation, rancidity, spoilage and contamination.

#### **7.7. Disadvantage of traditional techniques of sun-drying of fish**

- Fishes are hanged on rope or branch of trees or raised racks;
- Fishes are touched from time to time while drying;
- Blowfly, beetle or mites and birds attack;
- Fish are exposed to rain;
- Use of pesticides;
- Protocol does not improve drying operation;
- Low social acceptance found;
- Not environmental friendly.



Figure 16: Traditional techniques for sun-drying of fish being practice by the fisher-folks in Lake Shambe (Sources: Manfred, 2009).

*By the end of training session, the trainee will enable to explain about traditional techniques for sun-drying fish and its disadvantages.*

### 7.8. Improved techniques of sun-drying of fish

This refers to sun-drying techniques where improved drying techniques and solar drier are used to achieve better fish products with high social acceptance. Solar driers are efficient in achieving higher drying temperatures and reduced humidity. They also increase drying rates, producing lower moisture content in the final product and highly improved quality.

Other improved sun-drying techniques such as ring tunnel or hanging box tunnel for organic dry fish are not liable to induce contamination with sand and micro-organisms. It does not render the fish prone to attack by pets and other animals such as goats, sheep, pigs and rodents. Improve sun drying produce high quality fish products.

### 7.9. Advantage of improved sun-drying of fish

- Low-cost, easy to construct and operate;
- Quick drying technique with premium quality product;
- No dust, insect or bacteria;
- No need to touch fish once hanged inside;
- No beetle, mites and blowfly attack;
- Protects from rain water if a polythene sheet is placed over during rain;
- No pesticides required;
- Protocol improved for drying operation;
- High social acceptance found;
- Environment friendly technology; organic products.



Figure 17: Improve techniques for sun-drying being practice by the fisher-folks  
(Sources: Anonymous).

*By the end of training session, the trainee will enable to explain about improve sun-drying techniques and its advantages.*



## Chapter Eight

### Fish Oil

#### 8.1. Fish oil

Preparing fish oil includes a set of techniques that are used to transform raw fish waste products into oil for human consumption. The reasons why human beings started utilizing fish waste products is because the waste products are rich in fat contents. The quantity of fat contents in fish depends on the size and types of fish species and the distribution of fat in parts of fish body. Fish oils contain the omega-3 fatty acids, *eicosapentaenoic acid* (EPA) and *docosahexaenoic acid* (DHA), precursors of certain *eicosanoids* that are known to reduce inflammation in the body. There are other uses than alimentary for the oil produced with fish wastes:

- As lubricant in the tanning and texture industries.
- In cosmetics and skin healing products
- In health products and traditional foods
- To coat the hulls of the wooden boat as preservative against fouling
- As fuel for street lamps
- To promote the healing of wounds, respiratory irritations and gastro-intestinal tracts.

#### 8.2. Preparation of fish oil

In general the oil is found in the flesh, head, frames, fins, tails, skin and guts of fish in varying quantity. Before oil can be extracted, several steps must be followed:

- Remove fish offal and internal organ using sharp knife
- Place the fish waste in clean cooking utensil/container
- Ensure that the quantity of the offal and internal organ does not exceed the quantity of water in the cooking utensil/container
- Boil/heat the fish offal and internal organ for 30-45 minutes to separate water from oil protein
- After boiling of the fish, separate fish bones and meat from the soup using fine mesh sieve
- Allow the soup to cool for 20-30 minutes. A layer of oil will be seen on the top of the soup
- Use a table spoon to scoop the oil from the soup

- Place oil in a cooking utensil to boil for a while to remove the remaining water content.
- Separate oil from liquid by fine mesh sieve which separates matter of varying densities
- The oil should be stored in a clean glass/container
- The concentrated leftover liquid (soup) should be boiled for about 90 minutes to remove water content to produce super saturated soup
- Allow the super saturated soup to cool for a period of one hour or more depending on the weather condition to form fish Jam.

### 8.3. Fish Oil Benefits

- a) **Cancer:** fish oil can help to prevent and slow down development of various cancers, including colon, prostate and breast.
- b) **Cardiovascular disease:** Omega-3 fatty acids from fish oil are associated with improved survival rates for heart attack and are helpful in plethora of cardiovascular system.
- c) **Diabetes:** Fish oil can help to reduce the risk of diabetics from developing cognitive deficit because it protects the hippocampus cells from being destroyed.
- d) **Eye disorder:** Fish oil has been shown to reverse age-related eye disorders like macular degeneration and cataracts.
- e) **Immune system function:** When the antioxidant *astaxantin* is combined with fish oil, the immune boosting power is increased.
- f) **Skin and hair:** One of the biggest reasons fish oil leads to healthier skin is definitely the fact that it can reduce inflammation.
- g) **Fertility and pregnancy:** *Docosahexaenoic* (DHA) and *Eicosapentaenoic* (EPA) play a key roles in sperm health and mobility, along with increasing female fertility and supporting nutritional needs for pregnant women and their unborn children;
- h) **Weight loss:** Adding fish oil to a current exercise program (and overall healthy lifestyle) looks like it can help decrease body fat as well as cardiovascular diseases risk.

# Chapter Nine

## Fish Transport

### 9.1. Introduction

Fish transport refers to a system or means of conveying fishery products from fishing villages/camps to the landing site and to the fish markets or established fish processing centres/areas. Transport can be done by means of vehicles of all kinds: cars, trucks, boats/canoes, motorcycle, bicycle or by foot. In South Sudan fish transport system is been categorized into two types: (a) daily fish collection and transport system (b) monthly fish transport system.

- a) The daily fish transport system is done by the fish retailers that travel on daily basis to collect both fresh and processed fish products to transport them to the urban markets.
- b) The monthly fish transport system is done by the fish traders (wholesale trader) who travel to the remote fishing villages and camps to collect both fresh and processed fish. In this system the organization is:
  - Two weeks in the fishing villages/camps collecting fish products;
  - One week for transporting fish products from the remote fishing villages/camps to the urban market.

### 9.2. Traditional fish transport

Traditional fish transport includes the use of local materials such as jerry can; basket and sisal sacks without ice. It also refers to the following means of transport: motorbikes, bicycles or by foot. The traditional fish transport offers several disadvantages to the fisheries stakeholders (fisher-folk, fish transporter) and this includes:

- Fish is exposed to high temperature during the transport
- Fish transporters fail to use ice and insulated boxes/containers
- Fish is subject to damage due to poor handling during the transport.
- Fisher-folk/fish transporters fail to wash/or clean the trucks/boats being used to transport fish.
- Trucks and boats used for fish transport are used to carry passengers and other goods as well.
- Fisher-folk and fish transporters does not record temperature of fish from landing site to the end of transport.



Figure 18: Poor fish transportation system used by the fisher-folk and fish transporter  
(Source: Benansio, 2015).

*By the end of training session, the trainee will enable to explain about disadvantage of traditional fish transport system.*

### 9.3. Improved fish transport

Improved fish transport refers to the appropriate use of equipment and facilities such as cool boxes, refrigerated/insulated trucks and boats loaded with ice to ensure preservation of fish during transport to the end consumers. Improved fish transport has several advantages to fisheries stakeholders (fisher-folk and fish transporter). Improvements include:

- Using trucks and boats certified by an authorized officer;
- Testing the temperature of the product before loading to determine whether more ice is needed;
- Careful handling of Fish to avoid damages;
- Ensuring the weight of ice is equal to the weight of fish being transported (1:1 ratio);
- Controlling the temperature of fish and protecting fish from contamination. These are the main factors to be controlled during transport;
- Washing trucks and boats used for fish transport with clean water and approved detergents;
- Never use dedicated trucks and boats to transport people or other goods;
- Recording the temperature of fresh fish products at the landing site and at the end of transport;
- Using trucks and boats with a storage compartment;
- Ensuring fish storage compartments are insulated and lined with strong, smooth, and easy to clean materials.

- Ensuring that storage is fitted with sealable doors to keep insulation during transport (keep temperature stable).
- Ensuring the cold storage area is independent from the engine.

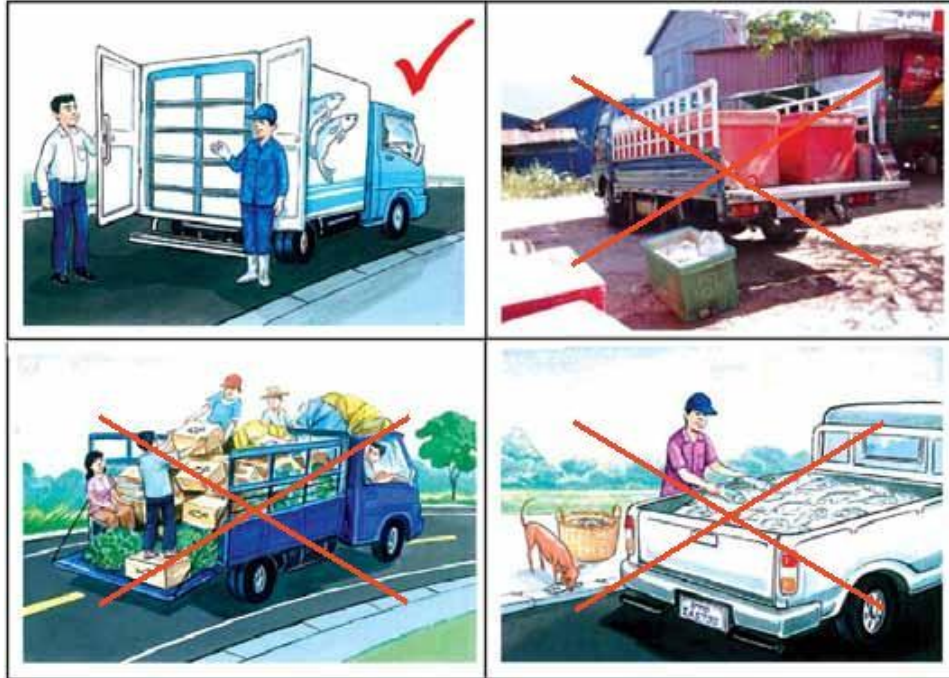


Figure 19: Good and poor fish transportation system being used by the fisher-folk and fish transporter

(Sources: Good hygiene practices for fishing boats and fish landing sites for small-scale fisheries).

*By the end of training session, the trainee will enable to explain advantages of improved fish transport systems.*

## Chapter Ten

### Fish Market

#### 10.1. Introduction

Fish market is defined as a place where all forms of fish products are exposed for marketing/sale by the fish traders and fish retailers. Fish markets play an important role in the economic development of fisheries stakeholders (fisher-folk, fish processors, fish transporters and distributor, fish traders and retailers). Fishery industry has an important role in food security and livelihoods, Fish are the source of animal protein to the majority of the rural community in the country.

#### 10.2. Management of fish market

- Fish stalls should be free from personal belongings, such as clothes, footwear, blankets, tobacco and other forms of contaminants;
- Fish stalls should be kept clean and sanitized at all times;
- The premises of the fish market should be kept clean and free of litter;
- The market should have sufficient light and be well ventilated;
- Equipment and facilities used for cutting and dressing of fish should be kept clean;
- The fish market should have sufficient potable water all the time;
- Water storage tanks, drums, etc. should be cleaned and covered;
- Waste water must be properly disposed of.



Figure 20: Good and poor fish marketing system being used by the fish traders

(Sources: Benansio, 2015; 2013).

### **10.3. Personal hygiene of fish seller at the market**

- Fish sellers should maintain personal hygiene and respect the environmental sanitation of workplace;
- Fish sellers are strictly advised to clean hands before handling and after handling fish.
- Fish sellers should wear clean clothes, gloves and gum boots while handling the fish;
- Fish seller should use hand gloves to avoid an extra barrier against germs while handling fish;
- Fish sellers are strongly advised to regularly change the gloves;
- Fish sellers are advise to get rid of soiled gloves, wash hands and putting new gloves on;
- Fish sellers suffering from contagious diseases, cuts and open wounds should not be allowed to work in the market;
- Smoking, spitting, chewing pan, eating, etc should be strictly avoided.

### **10.4. Good fish handling practices in the market**

- Fish sellers should clean fish and remove undesirable parts when necessary;
- Fresh fish for sale should be arranged on a first in, first out basis;
- Fish sellers should display their fish products on clean tables;
- Fish should be arranged with the bellies down to allow melting ice drains away from the fish, hence reducing the chances of spoilage;
- Fresh fish should be kept away from non edible products;
- Avoid to sale fresh fish in a room temperature without ice;
- Spoiled fish (soft body, sunken eyes, bad odor) should not be sold;
- Fish sold should be wrapped and packed in appropriate carrying bags;
- Fish seller should avoid using harmful and prohibited substances for treatment of fish like formalin;
- Fish sellers should use a storage space that is smooth and made of non-contaminating materials like bio-degradable plastic and stainless steel.

*By the end of training session, the trainee will enable to explain good fish handling practices in the market.*

## Chapter Eleven

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## About the Project

The Project “*Enhanced value addition and strengthening value chains in the Greater Bahr El Ghazal Region of South Sudan*” is a part of the global EU action launched in the Greater Bahr el Ghazal region with the objective to contribute to the improvement of food security and income of the population of South Sudan with focus on the small farmers of the Great Bahr el Ghazal region. Within the new program’s combined frame of the Zonal effort for agricultural transformation (ZEAT) and the Bahr el Ghazal Effort for Agricultural Development (BEAD), UNIDO, with the other partners FAO, GIZ and UNOPS have joined the many NGO’s engaged and already in the ground for SORUDEV and FSTP programs. The “Enhanced value addition and strengthening value chain” project is led by UNIDO for duration of 35 months starting from February 2015. The Project is exclusively funded by the EU for a global amount of two million Euros.

This project is to be conducted in full coordination with all partners of the EU action along with the concerned South Sudan National, State and local Public, Private and elected partner institutions. Main objectives of UNIDO action under the ZEAT-BEAD Project is to develop and implement value chain upgrading strategies and capacity building of actors operating in the identified value chains in the Greater Bahr El Ghazal region of South Sudan. UNIDO is focusing specifically on small scale producers and private business owners to create a sustainable and simple marketing network by developing and implementing upgraded value chain strategies. In addition, project is focusing on building capacity of different actors involved in the identified value chains. The commodities identified by UNIDO for upgrading value chains include sorghum, groundnut, rice, fish and leather (hide and skin). UNIDO has established four agro processing and training centers with basic facility for sorghum and groundnut processing and build capacity of farmers and other stakeholders on post harvest management, storage and marketing of agricultural produce. Two fish processing centers are being established in the Lake State and fisher-folk are being trained on improved fish handling and preservation techniques. The project is expected to achieve following outputs/results:

- Potential commodities identified and upgrading strategy for at least five value chains finalized;
- Five upgraded value chains strategies implemented;
- At least 800 actors performing in value chain capacitated and practicing technological and business tools for value addition enhancement;
- Four fully equipped micro agro-processing pilot centres established.

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