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WorldFish

Training Manual

Fish Value Addition and Business Training Manual for Women-Led Enterprises in Sindo, Homa Bay County

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Photo Credit: Dr Everlyne Okoth

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To learn more about CGIAR Scaling for Impact (S4I) program, please contact:

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About CGIAR Scaling for Impact (S4I) program

Scaling for Impact (S4I) is a CGIAR program (2025–2030) that tests, refines, and scales innovations in food, land, and water systems. It works to align those innovations with stakeholder needs to achieve transformative impact.

Website: https://www.cgiar.org/cgiar-research-porfolio-2025-2030/scaling-for-impact/

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PART 1: Processing and preservation of selected fishes through solar drying and smoking technologies

Chapter One

1.0 General Introduction

This is a simplified yet practical and all-inclusive information on value addition of selected fish products. It is designed for use in the processing, packaging and preservation of high quality, safe and nutritious solar dried and smoked fish products. Its sector part covers appropriate business information aspects to equip the learners and businesses owner participating in the training with sufficient practical skills and knowledge which they will need to apply in practice to make quality certifiable products; venture and compete favourably in the market space both locally and internationally.

This manual will serve as a valuable reference by entrepreneurs (Small and medium sized enterprises) in agro-processing and value addition in the fish value chain, especially trainers of trainers (TOTs) in the Fish on short course programs.

The Technical manual covers the areas of:

a) Fish Processing and Preservation on two technologies, namely:

   Solar drying of Omena (*silver cyprinid*) and Secondly Fish Smoking using a kiln smoking chamber.

b) Fish hygiene and safety handling measures

c) Good Manufacturing Practices (GMP)

d) Packaging and labelling requirements.

e) Step by Step Practical Processing Procedure of the Solar Dried **Omena** (*silver cyprinid*) and Smoked Products Tilapia or /and Mbuta).

1.1 Fish processing

Fish processing is the series of operations, from catching to final delivery, that prepares fish for consumption by cleaning, cutting, preserving (drying and Smoking), and packaging, using methods like freezing, drying, salting, or canning to prevent spoilage, extend shelf life, enhance flavour/texture, and create value-added products; create a variety to choose from, diversify markets etc. It's a vital part of the lake and seafood supply chain, ensuring safety, quality, and wider access to fish products, more so importantly consumers from the inland location who cannot do the fishing themselves.

Ensuring food safety along the fish value chain involves implementing measures at all the stages, from the time fish are caught or farmed to the final consumer. These measures focus on preventing foodborne illnesses and ensuring the quality of fish products.

1.2 Key food safety measures to be taken along the main fish value chain stages

1. Catch and Harvest:

- ✓ **Good on-board handling practices:**

This includes proper handling, storage, and chilling of fish on board vessels to prevent spoilage.

Food handlers' certificate must be renewed every 6 months.

Note: The businesses dealing with the fish suppliers will have to check out all these requirements with their suppliers

- ✓ **Maintaining the cold chain:**

Chilling fish rapidly and holding them at temperatures close to 0°C during transport, processing, and marketing is crucial to prevent bacterial growth.

2. Processing

HACCP (Hazard Analysis and Critical Control Points) systems:
Implementing HACCP-based systems helps identify and control potential hazards in fish processing, such as temperature control, hygiene practices, and proper storage.

Certified plants and establishments: -This applies to the trainees on board

Fish products should be processed in certified plants that meet minimal requirements for layout, design, construction, hygiene, and sanitation.

Proper sanitation:
Maintaining a clean and sanitized environment in processing facilities is vital to prevent contamination.

3. Storage and Transportation of the processed product

Maintaining the cold chain:
Ensuring that fish products are stored and transported at the correct temperature to prevent spoilage and maintain their quality.

Using appropriate packaging:
Proper packaging helps protect fish products from contamination during storage and transport, from the handlers, the vehicles and from the environment.

4. Distribution and Sales

Proper hygiene practices:
Food handlers should adhere to strict hygiene standards, including handwashing, personal protective equipment, and avoiding cross-contamination. All food handlers should possess valid food-handling certificates.

Regular inspections: Local food inspection authorities should conduct regular inspections of distribution and sales points to ensure compliance with hygiene and quality standards.

Consumer awareness:
Raising awareness among consumers about proper handling and storage of fish products can help reduce foodborne illnesses.

5. Regulations and Control

National food laws:
Regulatory authorities should implement and enforce national food laws that outline requirements for good handling practices and food safety.

International cooperation:
The EU, for example, delegates the control of food safety to Competent Authorities in each country exporting to the EU, ensuring that exporting farms, vessels, and processors meet equivalent standards.

6. Monitoring and Evaluation

- ✓ **Regular sampling and analysis:**

A hygiene and quality control plan should be in place to ensure regular sampling and analysis of the fish and the fish products.

- ✓ **Traceability:**

Direct partnerships with local food inspection authorities can help establish traceability throughout the value chain.

- ✓ **Food Safety Regulations:**

Ensuring compliance with national and international food safety regulations is essential.

7. Partnerships and Education

- ✓ **Collaboration:** Working with food inspection authorities, local communities, and stakeholders is crucial for implementing and enforcing food safety measures.
- ✓ **Awareness Campaigns:**

Raising awareness among fish farmers and consumers about food safety practices can help improve compliance.

- ✓ **Training:**

Providing training on food safety principles and practices to all involved in the value chain is important-like we are doing now.

1.3 Benefits of Consuming Fish as a Food Source by the Community

It is key, even as businesspeople, to appreciate the health benefits accrued from consuming fish and fish products for the well-being of our health and that of our clients.

Consuming fish and fish products offers numerous health benefits due to their rich nutritional profile, including high-quality protein, omega-3 fatty acids, and essential vitamins and minerals.

Key benefits include:

a. **Improved Cardiovascular Health:** Fish is widely recognised as a heart-healthy food. Omega-3 fatty acids (EPA and DHA) can help lower blood pressure, reduce triglyceride levels, and decrease the risk of stroke, heart attacks, and abnormal heart rhythms.

b. **Enhanced Brain Function:** Regular fish consumption is linked to better cognitive function and a slower rate of age-related mental decline. Omega-3s, particularly DHA, are crucial structural components of the brain and help protect against neurodegenerative diseases like Alzheimer's and dementia.

c. **Better Mental Health:** The nutrients in fish, including omega-3 fatty acids and vitamin D, may help prevent and treat depression and anxiety.

d. **Essential for Growth and Development:** For pregnant and breastfeeding women, adequate omega-3 intake is vital for the optimal brain, nerve, and vision development in their babies.

e. **Rich Source of Nutrients:** Fish is an excellent source of lean protein and is packed with vitamins and minerals the body needs but often cannot produce on its own. These include:

   a. **Vitamin D:** Helps with calcium absorption and bone health.

   b. **Vitamin B12:** Essential for healthy red blood cells and nerve function.

   c. **Iodine:** Crucial for proper thyroid function.

   d. **Minerals:** Includes selenium, zinc, iron, magnesium, and potassium.

f. **Anti-inflammatory Properties:** The anti-inflammatory effects of fish oil can help manage chronic inflammatory conditions such as rheumatoid arthritis and asthma, reducing joint stiffness and symptoms.

g. **Improved Vision:** Omega-3 fatty acids are a major structural component of the retina, and fish consumption is linked to a reduced risk of age-related macular degeneration.

h. **May Improve Sleep Quality:** Some studies suggest that fish consumption may lead to improved sleep quality, possibly due to its vitamin D content.

i. For optimal benefits, health authorities like the American Heart Association recommend that adults eat at least two servings of fish per week, including one serving of oily fish. Baked, grilled, or steamed fish are healthier choices than fried options.

1.4 Benefits of Fish Value Addition/Processing Through Hot Smoking and Solar Drying.

Fish processing has several advantages:

a. Provides convenience foods requiring little time for preparation. Dried and smoked fish products are pre-processed or precooked; thus, they will require little time to prepare before consumption

b. **Prevent Spoilage**.

Highly perishable fish need quick preservation.

They have low water activity due to drying either fully (M.C 5%) for the dried Omena and partially dried smoked fish (10-60% M.C for smoked fish (Minimized postharvest food losses and thus strengthens food security. The acceptable moisture content for smoked fish varies significantly depending on the desired product and intended shelf life, ranging from over 60% for moist products to less than 10% for dried versions.

Key Moisture Content Guidelines

The specific moisture content depends primarily on the type of smoking process and storage requirements:

a. **Hot-smoked fish (moist):** These products have a higher moisture content, generally **below 65%**. For safety, especially against bacteria like *Clostridium botulinum*, these fish also require a minimum of 3.5% water phase salt (WPS). They must typically be consumed within a short period (days) or stored under refrigeration.

b. **Smoked-dried fish (shelf-stable):** For long-term preservation and safe storage without refrigeration, the product must be dried more thoroughly. The widely accepted standard by the Codex Alimentarius Commission for smoke-dried fish is **10% or less** (or water activity of 0.75 or less) to control bacterial pathogens and fungal spoilage.

c. Removes toxins and makes fish safe to eat by deactivating spoilage and pathogenic microorganisms

d. Enables transportation of the delicate perishable fish across long distances, making it available to far-distance communities for either food or business purposes.

e. Provides the fish products throughout the year, both in low and high seasons (e.g. big fish have seasonally).

f. Improves preservation, easing marketing and distribution of these perishable fish products

g. Increases food consistency, since standard protocols are used its easy to duplicate the same quality of the dried and smoked products.

h. Processing allows for fish fortification (enrichment or addition of nutrients, flavourings, e.g. salt) with essential minerals and vitamins

i. Increases the variety of products; one raw material can be processed into various types of finished

j. Industrialisation and economic development (cottage, medium and large industries)

k. Wealth creation through job opportunities, self-employment and sale of the processed fish products at a better price than fresh fish.

1.5 Disadvantages of Food / Fish Processing

I. Fish processing (smoking and drying) can lower the nutritional value, especially heat-sensitive vitamins, and some can be lost through water leaching during washing and drippings as drying takes place.

II. The additives which may have little nutritive value, if not well apportioned, can be unhealthy, e.g. preservatives, too much salt can lead to high blood pressure

III. Chemical Hazards (Carcinogens)

When smoking is not well controlled (over-smoking can bring compound which are poisonous), smoked fish poses risks due to carcinogenic compounds, e.g. **Polycyclic Aromatic Hydrocarbons** **(**PAHs, heterocyclic amines **(HCAs)** from smoke; formed from burning wood, these include compounds like benzo(a)pyrene, linked to cancer.

IV. . Heavy Metals & Other Toxins: May also be present, depending on the fish's origin and processing.

V. Microbial & Parasitic Risks

Listeria monocytogenes: A significant risk in ready-to-eat cold-smoked fish, especially for pregnant women, the elderly, and immunocompromised individuals, potentially causing severe illness or death.

VI. Incomplete Microbial Kill: Smoke/heat might not eliminate all harmful microbes; spores can survive, requiring proper handling and cooking.

VII. Fish processing is a costly investigation that not everybody can afford. This is due to the investigation on equipment and capacity building, and training.

1.6 Mitigating the Challenges Identified

- **Cook Thoroughly:** Heat cold-smoked fish until steaming hot to kill *Listeria*.
- **Freeze First:** Freeze raw fish to kill parasites before cold smoking.
- **Moderate Consumption:** Limit intake to reduce exposure to PAHs and sodium.
- **Choose Wisely:** Be cautious with ready-to-eat smoked fish if in a high-risk group.
- Preservatives must generally be recognised as safe (GRAS)

1.7 Performance Parameters for Fish Processing

a. Hygiene and sanitation

b. Energy consumption

c. Wastes and their management

d. Labour usage and its efficiency – factory-trained personnel and automation requirements

e. Cleaning schedules

f. Maintaining the natural taste and aroma of products

1.8 Food Additives

These are chemical substances added to foods to serve a technological or quality function. They should be added to foods in small amounts for a specific purpose. They should be Generally Recognised as Safe (GRAS). In certain cases, food additives have been associated with health risks, e.g. cancer, digestive problems, neurological conditions, heart diseases, obesity, rapid heartbeat and more. The common food additives applicable in this training include:

i. Preservatives- Prevent spoilage due to fungi, bacteria or other microorganisms.

ii. Flavours – they give a particular taste or smell, and may be natural or artificial

1.9 Food Packaging

A package is anything in which food is wholly or partly placed or packed.

Food packaging is the enclosing of food that requires protection from tampering by physical, chemical or biological means. Functions of packaging include:

- Containment
- Protection – from external agents, mechanical damage and chemical degradation
- Communication – Identification of the food using a label, package shape

1.9.1 Packaging types

Is a marketing strategy, and it is mandatory and carefully thought.

Different products require different types of packaging material

1. Some products, e.g. dried ones, should be protected from moisture uptake and oxidative
2. Reactions that require air.
3. Loss of volatile compounds in some foods should be prevented; they give a specific flavour (fish and omega).
4. Handling methods require special packaging
5. Mechanical deformations of the package
6. Compatibility of the food product with the package
7. Legal considerations
8. Cost of packaging
9. Safety of the package when used in different products, e.g. chemical migration from some packages into food.
10. Compatibility with processing equipment (in case the packaging is automated), e.g. filling
11. Attractiveness (appropriateness of package)
12. Packaging should be convenient to the consumers, e.g. easy to open
13. Packaging is an important component of food processing
14. It is a value-adding step, particularly important for product handling and marketing.
15. It is a reflection of what is contained inside.

2.0 Food Labelling

Label means any **tag**, **brand**, **mark**, **pictorial** or other **descriptive matter**, written, printed, stencilled, marked, embossed or impressed on, or attached to include in, accompanying a container of food.

Labelling includes any **written, printed** or **graphic** matter that is present on a label, accompanies the food, or is displayed near the food, including that for the purpose of **promoting** its **sale** or **disposal**. Labelling is quite important in the food processing chain. All food products should be labelled. It is a **key marketing tool**. The label is the first point of contact between a consumer and the producer. It helps to **identify one product from another**, and to make a decision on which product to buy. The label should be **informative**, **attractive** and **eye-catching**. Unworthy labels give a **negative image** of the product. The type of label depends on the type of product, packaging container, individual preferences and availability of labels. Paper labels and self-adhesive labels are commonly used. The design of the label and the quality of the paper used are of key importance in promoting the product. The brand name or name of the company should stand out clearly. If pictures are used, they should be an accurate representation of the product or its main raw materials. Colours should be selected carefully as they may have a direct effect on people's perception of the product. In some countries, food producers can be prosecuted if their label is incorrectly designed. **It is important to involve the Bureau of Standards at an early stage of label design to ensure that the label meets all legal requirements.**

Food, Drugs and Chemical Substances Act, Chapter 254 – about labelling, "Any person who labels, packages, processes or advertises any food in a manner that is **FALSE**, **MISLEADING**, OR **DECEPTIVE** as regards its character, nature, value, quality, composition or safety – shall be guilty of an offence.

Purpose of label:

a. Gives information about the product

b. Advertises the product

c. Distinguishes the product from those of competitors

d. It is a legal requirement

Legal minimum requirements on a label:

a. Name of product

b. Name of manufacturer and address

c. Date marks:

   i. Date of manufacture and best before date (sell by date). The date of manufacture means the date on which the food becomes the product as described.

   ii. Sell-by-date means the last date of offer for sale to the consumer after which there remains a reasonable storage period in the home.

   iii. Date of minimum durability (Best before) means the date which signifies the end of the period under any stated storage conditions during which the product will remain fully marketable and will retain any specific qualities for which it claims to have. Beyond the date, the food may still be perfectly satisfactory.

   iv. Use-by-date. The recommenced last consumption date and expiration date. The date which signifies the end of the estimated period under any stated storage conditions, after which the product probably will not have the quality attributes normally expected by the consumers. After this date, the food should not be regarded as marketable.

d. List of ingredients (in descending order of weight); Net weight of product in the package

Additional information on a label (optional)

a. The brand name or brand logo.

b. Instructions for use of the product by consumers

c. Storage instructions and how to store after opening the package if necessary

d. Examples of recipes in which the product can be used.

e. A bar code unique to the product to facilitate marketing

Chapter Two

2.1 Quality and Safety of Fish / Food Products

To be in the business of processing any food products, one needs to know all the laws of processing, which ensure food safety. For the following reasons:

i. To protect the health of the consumers from poisonous foods.

ii. To protect the consumers from being cheated by the processors and distributors.

iii. To control the use of additives for the benefit of consumers' health.

iv. They promote the hygiene of the personnel and the factory for the processing.

The Standards promote fair and ensures safety to consumers.

The food processing industry includes a diverse mixture of food businesses, using different technologies and ranging from traditional cottage-style to small, medium, and large.

Irrespective of the specific nature of the food processing unit, the quality and safety of the food must be observed.

Good Hygienic Practices (GHPs) must be applied, which include the design and layout of the premises, provision of required facilities and programmers for cleaning and sanitation, pest control.

2.2 Hygiene and Sanitation in Fish Processing

Hygiene is the science of cleanliness in relation to health.

Sanitation is used together with hygiene, and this refers to the creation of hygienic conditions (clean).

Food hygiene, therefore, refers to all conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain, Production, transportation, processing, packaging and storage. Food may be rendered unsafe/unfit for human consumption at any stage in the food chain. Contamination may arise from:

a. **Physical substances**: Hair, soil, strings, etc.

b. **Chemical substances**: Detergents, reagents, pesticide residues, excess food additives, etc.

c. **Biological substances**: Micro-organisms, mainly bacteria, yeasts and moulds, insects, parasites, etc.

Food hygiene and sanitation are aimed at ensuring that all these contaminants are avoided/eliminated from the fish/food chain in question. Microbial contaminants pose the greatest threat to food, leading to food/ Fish spoilage and fish poisoning or a combination of the two.

2.3 Sources of Contaminants in Foods

2.3.1 People

This will be the main source of contaminants through poor personal hygiene and unacceptable habits during food processing. People may bring to the food physical contaminants like hair, nail polish, nails and microbial contaminants, especially bacteria.

2.3.2 Soils

Soil particles and other objects like glass pieces, metals and micro-organisms originate from the soil. Soil will also carry hazardous chemicals like heavy metals and pesticide residues. Some chemicals are absorbed by plants and deposited in organs consumed, e.g. fruits, vegetable leaves, etc.

2.3.3 Water

While water is vital in fish processing for use in various activities, it can also be a source of contaminants, e.g. micro-organisms, soluble heavy metals or agrochemicals, especially if the source is not protected.

Thus, water used in all the operations must be portable and safe to use.

2.3.4 Raw Fish/Materials

These include raw fish and any additives that we will use in smoking and treating the samples for solar drying.

All could be sources of micro-organisms or chemical contaminants, e.g. cyanogens from parasites in raw infected fish.

2.3.5 Processed Fish

When foods are adequately processed, packaged and stored, microbial contamination is minimal or absent.

However, there may be chemical contaminants from the processing apparatus and packaging containers if careful cleaning and selection of appropriate materials are not done. Inappropriate packaging of migration of chemical substances from inappropriate equipment. Chemical contaminants may arise from the use of excess additives.

The general principle of food hygiene is to prevent contamination and reduce microbial load at critical points in the production line. This is achieved by putting in place a good sanitation programme, such as:

I. Food production away from areas that pose a threat to food safety, i.e. avoid contaminated areas, e.g. crops should not be grown using sewage effluent, boreholes should be away from pit latrines.

II. Processing plants should be located away from obnoxious fumes, dust hazard areas. Construction should allow for self-drainage and adequate waste disposal.

III. Ensure adequate maintenance and sanitation.

IV. Adequate personal hygiene

2.4 Micro-Organisms and Food Hygiene

Micro-organisms – bacteria, yeast and moulds are associated with foods. Very few are useful, e.g. those used in fermentations or production of medicines; the majority are of concern because they cause food spoilage and poisoning. They therefore constitute the biggest concern in all foods.

There are many contributing factors:

a. Micro-organisms are found everywhere, on our bodies, in water, air, soil, on surfaces of animals, fruits and vegetables, etc.

b. Most are too small to be seen by the naked eyes and. they multiply at a very high rate, especially in warm environments, such that 1 hr can result in good milk becoming sour; it depends on the initial load.

c. Micro-organisms attack all types of exposed food and cause the following effects:

   i. Some hydrolysed proteins give putrid smells

   ii. Some hydrolysed fats give rancid smells

   iii. Some produce pigments resulting in discolouration.

   iv. Some grow in the food and are eaten together with the food, and produce toxins in the human body, causing food infections. Others produce toxins in the food, and when the poisoned food is consumed, food intoxication occurs.

2.5 Hand Washing Procedure

Hand washing may appear to be a basic procedure, but it is likely to pose a serious issue in hygiene.

The important thing to remember is that some serious diseases, including hepatitis A, meningitis, and infectious diarrhoea, can be easily prevented if people make a habit of washing their hands. Soap and hot water will quickly remove the danger. Ideally, it is essential to wash hands after coughing, sneezing, blowing nose, using the toilet, handling dirty surfaces, as well as during and after food preparation.

Good hand-washing procedure requires three things: soap, water and friction. The following need to be observed:

a. Remove jewels. Research has shown that these harbour a lot of micro-organisms both before and after washing. Jewels should be washed separately.

b. Use warm water (37-42^{0}C) or that which is comfortable to the hands.

c. Soap the hands: Wash with mild soap, preferably liquid. Liquid dispensers can also harbour a lot of micro-organisms; one must take care of them.

d. Take your time while washing: Once hands are lathered, time is critical. Vigorously rub your hands together. Cover all surfaces of the hands; front, side and back of hands and fingers; between fingers and under fingernails.

e. Rinse the hands thoroughly under running water; cold water is okay.

f. Use a clean, dry paper towel to close the water tap. Take a fresh paper to dry your hands or air - dry them. Cloth towels hold a lot of microbes from other users; please avoid them.

2.6 Regulations on Good Manufacturing Practices (GMP)

2.6.1 Personnel and Personal hygiene

These regulations are universal and applicable in all situations where food is prepared or stored. All persons (without any exception) coming in direct contact with food or food ingredients shall abide by them.

Personnel (Food Handlers) shall:

a. Maintain a high level of personal cleanliness and conform to hygiene practices to prevent contamination.

b. Wash their hands thoroughly with detergent/soap before starting work, after each absence from the workstation, and at any other time when hands become soiled or contaminated.

c. Remove all insecure jewellery and where food is manipulated by hand, e.g. juice extraction, dough handling or meat cutting, jewellery that cannot be sanitised should be removed.

d. Cover the hair with caps, hairnets or headbands to protect food from contamination. Hair could be heavily contaminated by micro-organisms, some of which are pathogenic.

e. Have no beards

f. Keep short and neat fingernails. No nail vanish/polish shall be used.

g. Desist from bad behaviour/mannerism such as unguarded coughs/sneezes, spitting, chewing or smoking in production areas.

h. Desist from touching hair or nose/throat areas where a host of microorganisms may be naturally found.

i. Take any other precaution necessary to prevent contamination of food with microorganisms, foreign substances or chemicals.

j. Ensure all surfaces coming into contact with food (knives, spoons, bench tops, equipment) are thoroughly cleaned before and after use.

k. Keep the production areas clean (i.e. floors, walls, windows)

2.6.2 Environmental Hygiene

a. To ensure environment damping sites are not near the food processing premises.

b. There should be no bushes around the premises.

c. The premises should be rat-proof.

d. The compound should be self-draining away from the food processing area.

e. The inside walls and floors of the processing building should be washable.

f. The floor should have a slight gradient to allow self-draining of wash water.

g. Tables (stainless steel/ hand plastic) and chopping boards must be washable.

h. Portable (Drinking) water shall be used always for processing and cleaning of working surfaces.

i. Rooms should be well ventilated to prevent condensation of moisture which may encourage microbial growth and eventual food contamination and poisoning.

    i. Lighting should be adequate; no dark corners that hides pests or dirt.

    ii. Thorough cleaning of equipment and utensils before and after use should be ensured.

    iii. Raw materials for processing must be sorted to remove rotten one) and cleaned before processing. This eliminates soil, residue chemicals, loose trash etc. NB: After every production session, it is the duty of the personnel to clean up the premises, equipment and utensils. All waste must be removed to the designated places, preferably far outside the building.

j. Waste bins should be covered to discourage animals like dogs/ cats and pests like rats / coach roaches that constitute a major source of contaminants.

Chapter Three

3.1 Processing of solar-dried *"omena"* using solar tent biomass drier (Appendix 1)

Step-by-Step Process, with SOPs spelt out:

1. Sort the fish: -

SOPs

- ✓ Grade for size and quality, separate the different sizes for a uniform dried product
- ✓ Check for the freshness of the Omena; Must be bright and have no Omena Aroma/smell.
- ✓ Remove any unwanted impurities, bycatch, or debris.
- ✓ Only the clean and safe fish should be processed.

2. Cleaning

SOPs

- ✓ Water used in the cleaning of the fish and indeed all the utensils, as well as the equipment, must be portable.
- ✓ The fish is washed thoroughly**.** Wash the fish multiple times using clean, fresh water to remove slime, dirt, and any adhering particles.
- ✓ For larger-scale processing, a chlorinated solution may be used for sanitisation.
- ✓ For the small-sized processing industries, the use of dilute vinegar water is acceptable.

Apply salt (optional): Small fish like Omena can be dried without salting. However, for flavour enhancement or extra preservation, you can briefly soak the fish in a 10% brine (salt) solution for about 15 minutes, then drain.

- ✓ Dry without salt too; another option is to mix salt and other spices to create variety, e.g., salt, sugar, chilli. Another option is to use spices commonly used in smoked beef and pork, like MSG, for better colour and flavour

3. Drain excess water:

SOPs

- ✓ After washing or brining, allow the excess water to drain off the fish, typically in a colander or on drip trays for 15-30 minutes.
- ✓ Make sure this is standardised for uniform products

4. Loading onto the dryer:

SOPs

- ✓ Spread the Omena evenly in **a single layer** on the mesh drying trays within the solar dryer chamber.
- ✓ Ensure there is enough space for air circulation between the fish.

5. Position the dryer:

SOPs

- ✓ Place the solar dryer in a location with maximum sun exposure throughout the day, away from shade.
- ✓ This ensures optimal heat collection and air flow.

6. Monitor the process:

- ✓ The solar dryer works by trapping heat and circulating hot, dry air to absorb moisture, which then exits through vents.
- ✓ The drying time will depend on the ambient weather conditions and the type of dryer used (passive vs. active).
- ✓ Key here is to monitor the temperatures, the time it takes to dry and to test if they are dry from time to time.

7. Turn occasionally (if necessary):

SOPs

- ✓ The fish will need to be turned over occasionally to ensure even drying, especially if the drying is not uniform.
- ✓ Drying time and temperature combination will depend on the weather of the place and the efficiency of the dryer. (Note: we will establish ours).
- ✓ More advanced solar tent dryers typically provide uniform drying.

8. Confirm dryness and store:

SOPs

- ✓ The Omena is fully dried when its moisture content is reduced to a safe level (around 10-14%). It is advisable for the project to acquire a moisture-determining gadget. This is for product consistency since the amount of final moisture content affects the shelf life and the quality of the end-product while in the market environment.

9. Packaging

SOPs

- ✓ Once completely dry and cooled, it's packed in good-quality, airtight pouches or containers to prevent moisture reabsorption.
- ✓ The package must protect the product against pests during storage.
- ✓ Due to the high protein and fats of the Omena, it's advisable to use non-transparent packages, especially for premium markets.
- ✓ The package must be safe, no reaction with the fish/to avoid chemical migration.
- ✓ As dictated by the client.

10. Storage

SOPs

- ✓ The finished product must be stored in a dry and cool place,
- ✓ Should not be exposed to sunlight,

11. Distribution

SOPs

Once the *Omena* is ready, it can be bought directly by the consumers from the factory sales point; therefore, the consumer does not need to take care of any safety measures. It could be distributed to other businesses as well as transported to long-distance markets.

The temperatures of the distribution channel need to be cool. The environment/vehicles are clean and safe. The handlers must desist from contaminating the products in transit.

It's advisable to have clear instructions for the transportation team for the control of safety and quality.

At the market outlets: It's advisable for the processor to liaise with its market for safe handling and storage of the product on the shelves, the condition of the shelves as far as quality is concerned, since if and when the product gets spoiled, it is returned to the processor.

3.2 Smoking of fish using a hot smoking kiln

Hot smoking fish involves brining for flavour/moisture, drying thoroughly, then exposing the fish to heated smoke in a preheated smoker (63-100°C) with wood chips/briquettes or charcoal for 4-8 hours, until flaky and an internal temp of 63°C is reached, ensuring smoke circulates, and the fish is cooked through.

The Procedure for Hot Smoking of Fish

Note: The preparation steps and SOPs reasoning behind each step is like the Omena drying process discussed in procedure clause 5.1.1

Step 1: Sorting and confirming the quality and freshness of the fish

A freshly harvested fish exhibits several distinct physical and sensory qualities that indicate its high quality and freshness. These characteristics are best evaluated using visual, tactile, and olfactory senses.

SOPs to perform and/or observe for freshness.

a. **Appearance and Eyes:** The fish's eyes should be **bright, clear, full, and often protruding** with a dark, metallic-sheen pupil and a transparent cornea. As fish lose freshness, their eyes become cloudy, pink, and sunken.

b. **Gills:** The gills are one of the most reliable indicators of freshness. They should be a **bright red or pink colour, moist, and free from loose or milky slime**, with a fresh, mild smell. Avoid fish with dull, grey, brown, or green gills.

c. **Odour:** A fresh fish should have a **mild, fresh, ocean or seaweed-like scent**, not a strong "fishy," sour, or ammonia-like odour.

d. **Flesh/Texture:** The flesh should be **firm, moist, and elastic**, springing back when gently pressed with a finger. An indentation that remains after pressing suggests the fish is older.

e. **Skin and Scales:** The skin should appear **bright, shiny, and iridescent**, with the characteristic colours and markings of its species. Scales should adhere tightly to the body and not be easily detached.

f. **Belly Cavity:** If the fish has been gutted, the belly cavity should be clean, with no discolouration, and the backbone should adhere firmly to the flesh.

g. Proper handling immediately after harvest, including prompt cleaning and chilling on ice, is crucial to maintaining these qualities and slowing the natural decomposition process.

Step-2: Fish preparation

1. Brining & Drying

- ✓ Clean & Fillet or Clean and Cut open, depending on the client's need
- ✓ Gut and clean fish thoroughly, leaving skin on and cutting fillets to similar sizes for even cooking, keeping them cool.
- ✓ Gut Clean and cut open for better drying, the slice is thin with a large surface area for drying

Make Brine: Dissolve salt and brown sugar (e.g., 3:1 sugar to salt ratio) in water.

- ✓ **Brine:** Submerge fish in the cooled brine for 1-3 hours (or overnight for thicker cuts) in the fridge.
- ✓ **Rinse & Dry:** Remove fish, rinse lightly, then pat completely dry with paper towels and let air-dry for a bit; this creates a pellicle for smoke adhesion.

Step 3: Preparing the Smoker

- ✓ **Preheat:** Set your smoker or grill (using indirect heat) to 63-100°C.
- ✓ **Add Wood:** Use soaked wood chips (apple, hickory) or chunks on the heat source, ensuring steady smoke.
- ✓ **Grease Racks:** Lightly oil your smoker racks or use a greased plank to prevent sticking.

Step 4: Smoking the Fish

- ✓ **Load Smoker:**
  - Place dry, seasoned fish on racks, ensuring space for smoke to circulate.
  - Or hung the fish with hooks or strings, spacing them well for even smoke circulation
- ✓ **Smoke:** Close the lid and smoke for 1-6 hours, depending on the thickness of the slices/fish.
- ✓ **Monitor closely**
  - Maintain consistent temperature & add more wood/briquettes/sawdust as needed.
  - Ensure a balance of heat and smoke; too much smoke can be poisonous

Step 5: Check product readiness:

SOP; Temperature

- ✓ Fish is done when it flakes easily with a fork and reaches an internal temperature of **63°C;** during smoking, the temperatures can vary from 60 to 90°C.

Step 6: Finish & Pack

- ✓ **Cool:** Remove the fish and let it cool slightly.
- ✓ **Package:** into the right package (Plastic polythene pouches, kaki pouched and plastic pallets).
  - The package should be moisture-proof for safe containment of the smoked and relatively dry fish; **Note:** The package can also be dictated by the end market Consumer.

Step 7: Storage

- ✓ **SOP:** Store in a dry, cool, and clean environment both at the factory and at the market outlet.

3.3 Quality & sensory evaluation of the solar-dried omena (*silver cyprinid*) & hot smoked fish

3.3.1 Sensory evaluation of the Solar-dried Omena (*silver cyprinid*)

The participants will evaluate the quality of the dried Omena guided by the listed quality characteristics; however, some qualities can only be determined in the food laboratory using specialised equipment.

For solar-dried Omena (*silver cyprinid*), check for good **appearance** (clean, less browning, uniform), pleasant **odour**, low **moisture content**, good **protein/fat levels**, minimal **dirt/sand**, and no signs of Mold, with superior quality often indicated by use of solar racks/dryers for better hygiene and sensory appeal than traditional methods.

3.3.2 The Key Qualities to Check out for

- ✓ **Appearance & Hygiene:**
  - **Cleanliness:** Look for Omena free from dirt, sand, or animal waste, a common issue with ground drying.
  - **Colour**: A good, appealing colour (less pronounced browning) indicates better drying, often from raised racks.
  - **Integrity:** Fish should be whole or in good pieces, not overly broken.
  - **No Mold/Fungus:** Check for any signs of fungal growth.
- ✓ **Sensory Attributes:**
  - **Odour:** Should have a fresh, pleasant smell, not a strong, off-putting fishy or rancid odour.
  - **Texture:** Firm but not rock-hard; the right moisture level prevents spoilage.
- ✓ **Moisture Content:**
  - Look for low moisture (around 15% or less), which is crucial for preventing Mold and preserving quality.
- ✓ **Nutritional Value:**
  - High-quality solar-dried Omena retains good protein, fat, and essential minerals (calcium, iron, zinc).
- ✓ **Drying Method:**
  - **Solar Rack Dried:** Often preferred for better hygiene and appeal than traditional ground drying.
  - **Solar Tunnel/Forced Convection:** Also provides excellent, controlled drying, enhancing quality.

3.3.3 What to Avoid

- **Ground-dried**: Prone to contamination, soil, dust and environmental contamination.
- **Damp Omena**: High moisture leads to spoilage due to the growth of microorganisms.
- **Strong, unpleasant smells**: indicate spoilage or poor handling.

In summary, if the Omena is clean, dry, good-smelling, and well-dried (not sun-baked or ground-dirty) then we have achieved the best quality of solar-dried Omena product.

3.4 Sensory evaluation of smoked fish

The participants will check for the listed key qualities of their end-smoked product.

- ✓ **Appearance**: The fish's surface should be **bright and glossy**, not dull. The colour will vary by species and the wood used for smoking (e.g., golden-brown for mackerel, rich orange pink for salmon), but it should be **uniform and appealing**.
- ✓ The fish selected for smoking must be fresh, not fish with any signs of Mold, extensive discolouration (like grey or green spots), or dried blood/gut remnants.
- ✓ **Texture**: Hot-smoked fish should have a **moist, tender, and flaky** texture, as it is reasonably cooked during the process. It should feel **firm and springy** to the touch, and the flesh should be fairly rigid, not soft, mushy, or sticky.
- ✓ **Aroma**: A high-quality product will have a **pleasant, balanced smoky aroma**. The smell should not be overpowering and should never have a strong, pungent, sour, or ammonia-like odour, which indicates spoilage.
- ✓ **Flavour**: The taste should be a harmonious blend of smokiness and the natural fish flavour. Avoid fish with objectionable rancid or bitter Flavors.

3.5 Product Profitability Assessment

The participants will be taken through an exercise to determine: -

- ✓ The cost of production of the two products.
- ✓ How to arrive at the selling price by adding a profit margin.

PART II: Gender Action Learning System (GALS) for Trainer-of-Trainers

Chapter One

1.0 Introduction to GALS

The Gender Action Learning System (GALS) is a participatory tool that helps women, men, and youth work together to improve their lives.

In this tool, drawings, symbols, and simple discussions are used to support households and groups to:

a. Identify their goals

b. Understand challenges

c. Plan how to overcome barriers

d. Work together fairly in farming, business, and household roles

GALS is included because:

a. Strong households work better as business partners

b. Fair sharing of work improves productivity

c. Women and men can jointly plan for food safety and value addition

d. Youth can participate more actively in business and community development

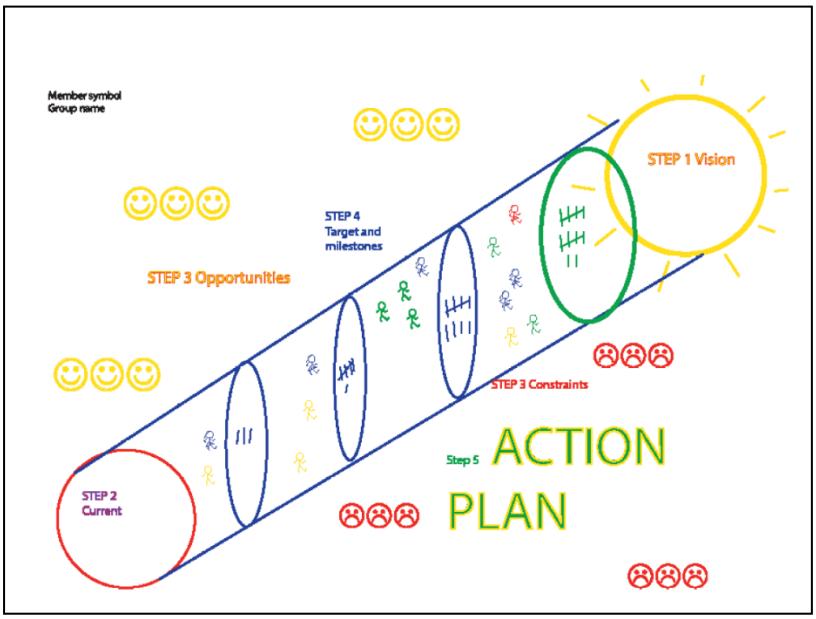
By using the GALS tool, it provides the foundation for ensuring effective and sustainable agribusiness practices.

1.1 Core GALS tools used in this training

This short manual focuses on ONE of the three basic GALS tools that support farmers and entrepreneurs to plan and grow their businesses fairly and sustainably.

The vision journey (vision road map)

The visioning approach (Source: Hivos)



This tool helps plan where you want to go and how to get there.

Steps to be followed:

1. Draw your current situation.
2. Draw your future vision (1–3 years). In our case, 1 year.
3. Identify opportunities that can help you reach your vision.
4. Identify challenges that may stop you.
5. Draw the steps needed to move from today to the future.
6. Plan who you need to work with and what resources you need.

Use this to plan improvements in food safety, fisheries value addition, and business models.

1.2 How to facilitate a GALS session (for TOTS)

1. **Create a safe and inclusive space**
   - Encourage participation from women, men, and youth.
   - All drawings are accepted and encouraged.
   - Ensure everyone has space to speak.
2. **Use easy language and visuals**
   - Draw large diagrams on flipcharts.
   - Allow participants to draw their own symbols.
   - Provide markers, crayons, and simple materials.
3. **Aim to be a facilitator and not a teacher**
   - Ask guiding questions.
   - Allow participants to work in pairs or small groups.
   - Celebrate creative ideas.

4. **Connect GALS to agribusiness topics**

Explain how GALS supports:

- Better planning for value addition (e.g., fish processing, hygiene improvements).
- Fair workload sharing to improve productivity.
- Household support for business start-up or scaling.
- Joint decision-making in investment and profit use.

5. **Support practical action plans**

At the end of each tool, participants should commit to:

- A clear action
- A timeline
- The support needed
- Who will follow up

PART III: Business Literacy and Development

Chapter One

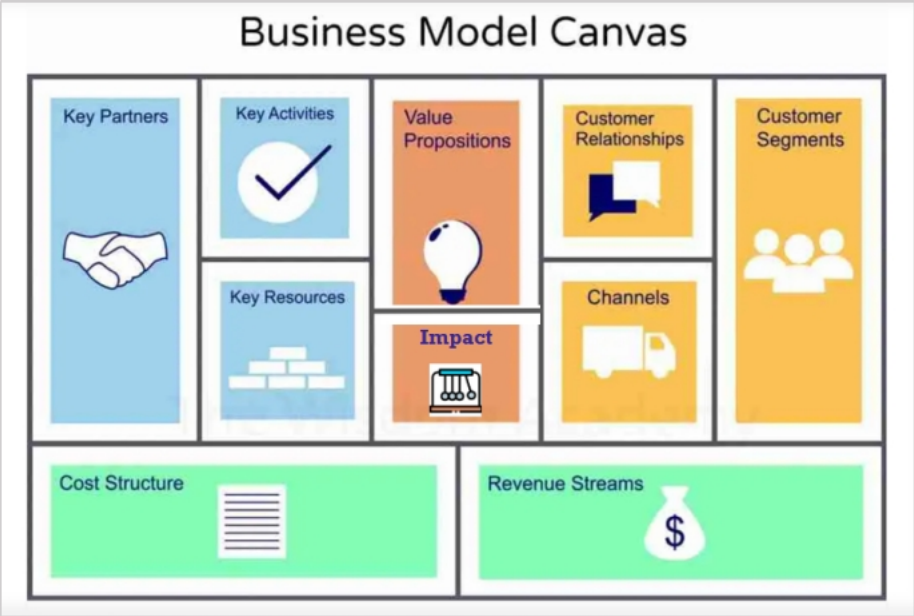
1.0 Introduction to enterprise development

Enterprise development is the process of planning for future growth by identifying new opportunities, forming partnerships, and adding value to a company. It involves understanding the target audience, market opportunities, and effective outreach channels to drive success. Essentially, it seeks to gradually boost profitability and establish long-lasting competitive advantages.

It not only drives revenue growth but also promotes innovation by stimulating the investigation of new concepts and solutions. Furthermore, good business growth can strengthen the enterprise's reputation and market position by positioning it as a leader in its field.

1.2 The business model canvas (BMC) tool

Business Model Canvas (BMC) is an enterprise expansion & strategic management tool used to visualise and develop a business model on a single page. It helps entrepreneurs to understand, communicate, and innovate their business approaches by breaking it down into nine key components. Each component reflects a vital aspect of the business, allowing users to explore how these elements interact and work together.



Source: The Wisdom Academy

Table 1.1: Key component of a BMC and the respective questions that a participant needs to answer when developing the BMC.

Key partners	Key activities	Value propositions	Customer relationships	Customer segment
Who are the key partners? **Who are the key suppliers?** **Which resources are acquiring from our partners?** **Which key activities do partners perform?**	What key activities do our value propositions require? Our contribution channels? Customer relationships? Revenue streams?	What value do we deliver to the customer? Which one of the customers' problems are we helping to solve? What bundles of products and services are we offering to each segment? Which customer needs are we satisfying? What is the minimum viable product?	How do we get, keep and grow customers? Which customer relationships have we established? How are they integrated with the rest of our business model? How costly are they?	For whom are we creating value? Who are the most important customers? What are the customer archetypes?
	Key resources What key resources do our value propositions require? Our distribution channels?		Channels Through which channels do our customer segments want to be reached? How do other companies reach them now? Which ones work best? Which ones are most cost efficient? How are integrating them with customer routines?	
Cost structure **What are the most important costs inherent to our business model?** **Which key resources are most expensive?** **Which key activities are**			Revenue streams For what value are our customers willing to pay? For what do they currently pay? What is the revenue model? What are the pricing tactics?	

most expensive?	

Exercise 1: Participants should develop the business canvas for their enterprises.

Chapter Two

2.1 Business Plan

Introduction
A business plan is a document that outlines a company's goals and the strategies to achieve them. It's valuable for both startups and established organisations.

2.2 How to develop a Business Plan

Below is a structured template that covers the key components necessary for developing a robust business plan.

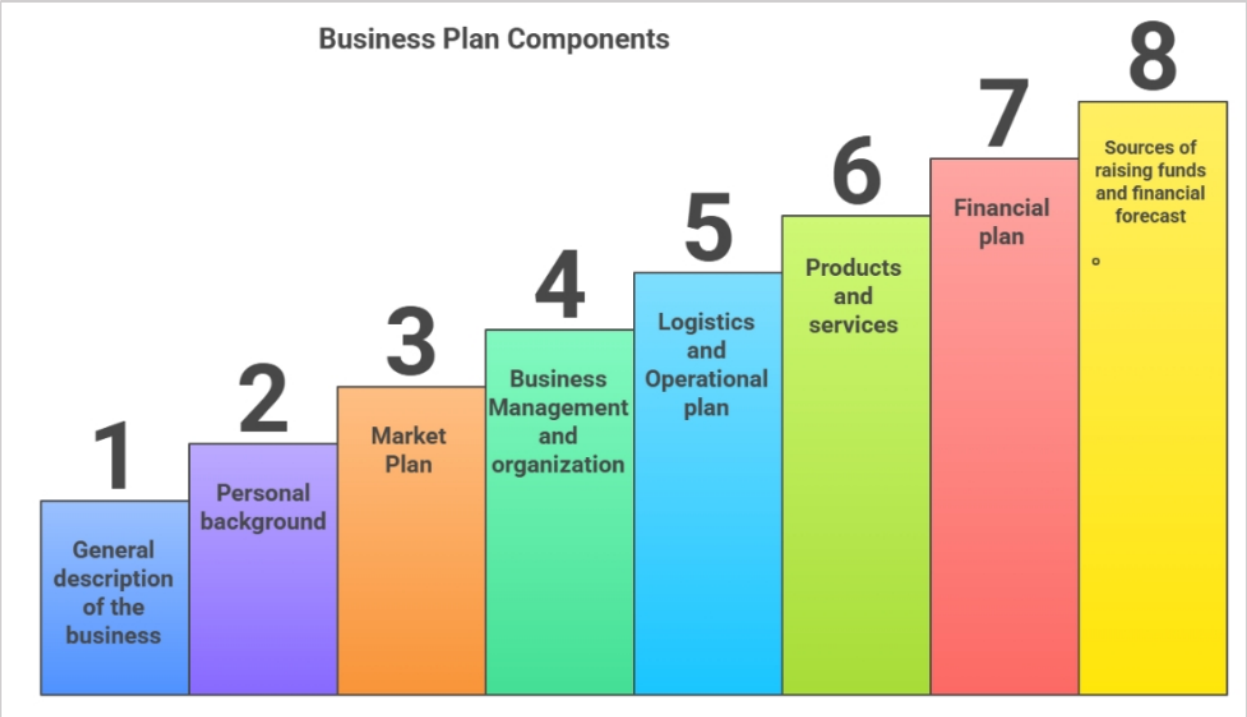


Table 1.2: Contents of a business plan

No.	Component	Description
1.	General description of the business	• Name of business, business location, and address • Nature of business activity • Type of business organization (partnership, new, or old) • Any further explanation summarizing why the business will be successful
2.	Personal background	• Name of business owner(s), promoter(s) • Educational, professional background & relevant experience in business activities
3.	Market Plan	Define how you will attract and retain customers: marketing channels, sales strategy and advertising and promotional plans. • Business market area and targeted customers/ customer groups • How you will be able to compete with existing products/services and how you compare competitors' (price, quality, appearance, performance) • Past, current, and future (projected) market demand for your product/service (if possible, in terms of volume/units per day/months) • Suppliers and supply terms and conditions • How you will be selling your produce (directly or through dealers).
4.	Business Management and organization	• Outline your business structure and management team, i.e., who are the main personnel/actors and their roles in the business • How will the business work be organized (e.g. working shifts, working times)
5.	Logistics and Operational plan	• Detail the day-to-day operations required to run your business, including production details such as development, technology requirement, equipment required technique, costs, inventory, etc.

		• Is there a need for further research and development? Who will do this? • How do you acquire your products? • What are the business hours? • Elaborate on the supply chain of your product/service • List, at minimum, the number of employees, the type of labour, and who does what tasks
6	Products and services	Describe what you are selling or the services you are offering: • Detailed description of products and services, unique selling proposition, pricing strategy and product lifecycle and future offerings.
7	Financial plan	Provide a detailed financial outlook for your business: Investments required, fixed assets/starting equipment (e.g., land, tools, machinery) • Preliminary expenses/pre-operative expenses (e.g. legal fees, licensing fees) • Start-up expenses (e.g., water, electricity connection, cleaning of premises, etc. • Working capital (raw materials, rent, water, transport, etc.
8	Sources of raising funds and financial forecast	• Total fund required for the business • Own contributions/investments • Family/friends' contributions/already secured loans, credits, etc. • Total funds available • Deficit/funding gap • Loan support required • Financial forecast: Projected income statement, Break-even analysis, and Cash flow projection

Exercise 2: The participants to develop a business plan for their enterprises

APPENDICES

Appendix-1: Solar tent drier

Appendix 2: Fresh fish vs Stale fish

Appendix – 3 Fresh gills

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