

A PRACTICAL GUIDE ON THE USE OF BIOMASS BRIQUETTES AND IMPROVED DRUM KILN FOR SMALL-SCALE FISH SMOKERS



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PREFACE

Fish is an important source of food and income to many people in the developing world. In Lagos being a coastal community, a significant population depend wholly or partly on the fisheries sector, mostly small scale fisheries, for their livelihood.

Various traditional methods are being used to preserve and process fish for consumption and storage. These include smoking, drying, salting, frying and fermenting and various combinations of these. However, smoking is the most widely used method because practically all species of fish available in the can be smoked and it has been estimated that 70-80 percent of the domestic marine and freshwater catch is consumed in smoked form. Smoking prolongs shelf life, enhances flavour and increases utilisation in soups and sauces.

Several improved kilns have been introduced over the year to improve upon the demerits from the traditional kilns however using these kilns still had considerable disadvantages such as too different from what they are used to, very high cost among others. Also, charcoal was introduced to replace firewood as energy sources due to some safety issues associated with firewood accumulation, its uptake among fish smokers in the small-scale fisheries sector has been low due to strong biases and this has encouraged dependence on firewood. Recently, charcoal became very expensive apart from other demerits such as promotion of deforestation associated with its use.

This led ID_57 team members to seek alternative fuel energy and kiln. The improved drum kiln developed from this project has numerous advantages such as affordability, easy to use, made from 100 percent locally available materials, low energy source consumption and short smoking times among others. The team also came by briquette which eliminates deforestation, is environmentally friendly, waste to wealth and introduces clean energy.

This training manual therefore provides a guide on the use of the introduced kiln and alternative energy source. Simple tips on how to improve upon the current traditional practices were also illustrated for improved quality products, acceptability, storability among others. The manual was written with inputs from experienced fish smokers and briquette makers. This bottom –up approach helped to simplify and allow for ease of understanding among all small holder processors irrespective of their level of education.

CHECKLIST & TIPS OF GOOD PRACTICES IN FISH HANDLING, PRESERVATION & SMOKING

MATERIALS FOR FISH COLLECTION

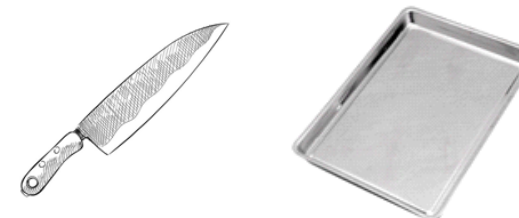
- The most important materials for collecting fish must be are easy to wash.
- Use plastic baskets, aluminum bowls with holes or aluminum baskets to pack your fish and allow water to flush out.



- Do not use the raffia/brown wooden baskets.

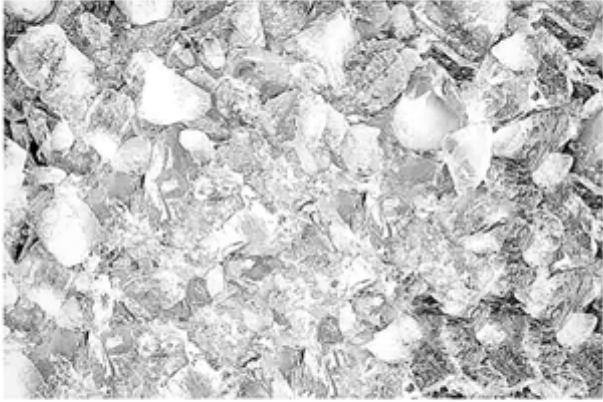


- Use stainless knives, trays and other utensils.



- Wash all utensils before and after use with clean sponges and water.

- Small ice cubes work better for freshly collected fish or you may break the big ice into smaller ones for better use.



- Get a record/log book to record all activities and weight of collected seafood or fish etc.



- Get a big or small weighing scale. However, use of digital weighing scale is recommended



- Handle fish and seafood with care to avoid bruises.
- Do not pack too many seafood or fish in a bag, basin or basket and avoid direct sunlight on the fish.

PERSONAL HYGIENE AND HYGIENIC PRACTICES

- Handlers must wash their hands before contact with fish.



- Wash your hands with soap and water after using the toilet, before handling food and after changing a child's diapers.



- Cut your fingernails and clean them regularly
- Do not use of nail hardener/paint during processing.



- Do not spit around while cooking or processing seafood.
- Avoid coughing, sneezing, touching your nose, hair, mouth, or eye when handling, preparing fish for processing.



- Always wear clean clothes and cap while handling or preparing food.



- Wash your clothes and aprons after the daily fish processing activity.
- Anybody who is sick should be excused from handling or processing fish.

SANITATION AND HYGIENE RULES FOR THE ENVIRONMENT

- Ensure a clean environment free from rubbish and dirt.
- The food processing site or kitchen must not be close to dumping sites and latrines or toilets.
- Provide improved sanitary facilities, toilets
- Use clean and enough water for washing utensils and fish preparation.
- Wash all utensils, dishes and tools with soap and clean water.



- Sanitize or wash and clean every surface or slab where fish or food items will be placed or processed
- Use thick net to keep away rodents and flies from coming closer to your fish or seafood.
- Provide sanitary waste bins with a tightly fitted cover.



- Throw wastes and spoilt fish away promptly.
- Ensure a clean and free-flowing drainage system to prevent building a place for flies.

PROCESSING FACILITY/LAYOUT

- Processing activities are carried out in a straight form i.e fish are moved from the measuring area to the gutting & washing area and then finally the smoking area.
- Raw materials and finished products should be kept apart in order to avoid the possibility of cross-contamination.
- "Wet" areas used for washing and doing other operations should be kept separate from "dry" areas such as those used for weighing, packaging and labelling.

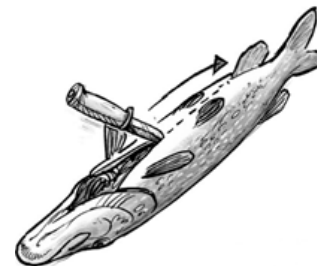
- Ensure that drainage is always away from the finished product and other clean areas. This allows you to carry out proper and effective cleaning and maintenance of equipment and tools.
- The smoking/ processing area should be thoroughly washed and cleaned before processing activities.

HANDLING, SORTING AND GRADING

- Place ice cubes/pieces on the freshly harvested fished seafood collected from the fishermen.



- Seafood should be graded and sorted by size and/or fish type after collection.
- Any live fish to be processed should be killed by appropriate method e.g. apply salt (100g for 20kg of fish) to weaken, demobilize and remove slime from the fish.
- Spoilt fish should not be mixed with those in good condition during sorting.
- Harvested seafood should not be stepped upon.
- Gutting should be done on the belly side from the gills to the vent and offal should be disposed properly.



- Fish or seafood should be measured and counted for proper record keeping.
- Remove viscera (the organs), gills, intestines, stomach contents, head and scales if applicable.
- Large fish can be cut into smaller pieces or folded as done with catfish.
- Wash with water and lime to remove slime. Do not use Alum!
- Season with table salt and other seasoning ingredients as desired (ginger, garlic, scent leaves, turmeric etc) prepared as a solution.
- Soak the fish or marinate in the seasoning solution (30 minutes)
- Drain or sieve for about 30 minutes and fold fish if desired. Then, arrange fish on the trays.
- Rub oil on the trays to prevent fish from sticking on the trays.
- The upper side of the fish is best facing down when arranged on the trays.

FISH SMOKING

- Wood for smoking should not be painted, treated with glue or any chemical preservatives. They should be stored away from the processing room and be inspected before use.



- Sudden smoke-drying leads to burning and case - hardening (hardened outer layer with the interior not cooked) in the fish.
- Smoking kiln should be made with stainless steel and enamel coated metal cookware that are very easy to clean and disinfect. They must not be harmful to handlers (joints and corners are to be smoothed)
- Smoking kilns are best having temperature gauge (in built ones that can measure temperature of up to 400°C).

- When fish are placed into the kiln, they should be exposed to moderate heat at the onset so they can dry gradually without burning
- Trays can be changed to get uniformly dried fish.
- Napkins used in holding trays should be kept clean at all times.



- Check and top up the fire wood, charcoal or other fuel at intervals, and also make sure that ashes from the coal pots do not deposit on the fish on the trays during this process
- If you get sweat due to heat, make efforts to clean your sweats often.
- Once fish is completely dried, the fish can then be placed on another set of trays, moved into a room, covered with nets to prevent flies and insects and then allowed to cool off at room temperature for some hours before packaging

PACKAGING AND LABELING

- Smoke-dried fish should be cleaned using neat brush.
- Smoke-dried fish should be weighed, sorted and graded according to their sizes in order to prevent breakage during handling
- It is advisable to package fish in air-tight materials to prevent oxidation from air getting into the fish thereby increasing the shelf life of the fish.
- When packaging fish in cartons or baskets, always guard the fish with clean newspapers to avoid breakage during handling and transportation.



- Do not blow air from your mouth into the packaging bag.
- Labels with the product and facility's information can then be glued on the packaging nylon



- Good labels should contain the brand name, logo, contact address, phone number, net weight and idea on shelf life at the minimum

BIOMASS BRIQUETTE PRODUCTION

Briquettes are fuels and they produce heat. They are made from wastes that are pressed for heating and cooking.

Briquetting involves the process of pressing together agricultural wastes or garbage into a product that is thicker than the original raw materials. Sometimes other materials such as binders are added to hold or stick together loose raw materials to produce briquettes. Examples of raw materials and binders used in briquette production are listed in Table 1.

The name given to any briquette depends on the raw materials of which it was made. For instance, common briquettes are charcoal briquettes, biomass briquettes and coal briquettes. The quality of briquettes is determined by so many factors including heat value, ash content, moisture (water) content, density and others. Because biomass briquettes are similar to firewood, coal and charcoal, they are therefore very good substitutes.

Table 1: A list of some locally available materials required for briquette production

Agricultural materials/ wastes	Common binders
Bamboo straw	Starch (usually cassava)
Sugar bagasse	Paraffin
Palm kernel husk or empty fruit bunch	Palm wax
Water hyacinth	Asphalt
Coconut shell	Plantain peel
Cassava starch	
Sawdust/ wood shavings	
Rice husks	
Forest wastes	
Corn cob	
Groundnut shell	
Wheat straw	
Corn stalk	
Bamboo	
Melon shell	



Sugar bagasse



Empty Fruit Bunch (EFB)



Coconut Shell.



Wood Shavings



Water hyacinth

Types of Briquette Procedures

Carbonized process: In this process, the raw materials are slightly burnt in a place where fresh air is controlled. This process is almost the same in making charcoal from piles of wood or trees. Once carbonized, a binding material is added and the materials are pressed together using a briquette press. The advantage of carbonized briquettes is that they are smokeless and this is why they are the best for household users and also recommended for smoking, baking and grilling.



Carbonized Bamboo



Carbonized EFB



Carbonized Coconut Shell Biochar

Non-carbonized process: This process does not need carbonizing the raw materials. The materials are simply prepared and pressed to produce briquettes. This is a simpler and cheaper process for a micro and small-scale enterprises than carbonizing but only suited to applications where smoke is not an issue.



Briquee Press



Mix of Carbonized and Non- Carbonized Briques

Advantages and Potentials of Biomass Briquettes

Briquettes are easy to handle, store and transport compared to raw agricultural residues and wastes.

The raw materials for various types of biomass briquettes are readily available locally. Burning carbonized briquettes is clean and smokeless and would reduce many health and environmental damage caused by traditional (firewood, charcoal) biomass energy. It will provide a cheap source of fuel for us at homes and which will be affordable by all Nigerians. Its use can also serve as a replacement in domestic and industrial cooking which could include baking, barbecue etc depending on consumers' needs. The procedure will solve disposal and pollution problems of agricultural wastes. It will reduce the quantity of firewood and allow more trees to live since it is a good substitute for firewood. It will generate employment opportunities and wealth for people in terms of briquette machine operations, supply of raw materials (i.e. coal and agro-residue, etc.), sales of briquettes to consumers.




DESCRIPTION, USE AND MAINTENANCE OF INSULATED DRUM KILN





This section offers simple, step-wise information with illustrations on how to use the insulated drum smoking kiln effectively. To get the most out of the kiln, it describes the parts and how to utilize the whole equipment. It also highlights good practices to produce good quality fish with minimum use of biomass fuel. The emphasis of this manual is on the small-scale, low-income actor in the value chain for fish smoking, and it is written in a simple language to facilitate its understanding and adoption.

The drum smoking kiln is a prototype built on existing technology in fish smoking such as the popular drum kiln. It is designed for the small-scale fish smokers to access improved fish smoking techniques, produce and market safe, high-quality food but can be scaled up in terms of number of fish trays and size which are measures of production capacity. The design is circular/barrel- shape along its whole length which comprises of the drying chamber and combustion chamber. It is double-walled and insulated. Within the combustion chamber is the charcoal/briquette pot above which lies the fat/oil collector. There are eight fish smoking trays arranged in the drying chamber and the top is covered with a lid bearing the chimney. The fish trays are made of wire-mesh, are semi-circular in shape and half size of the drying chamber. The insulated drum kiln is designed for the use biomass fuels such as charcoal and briquettes to minimize heat loss well as to cut smoke emissions and the amount of PAHs in smoked fish, and produce healthier smoked fish with increased nutritional benefits and shelf life.

A chimney that promotes heat retention and effective combustion of the biomass fuels is perched on top of the drum kiln, which is made up of a combustion chamber that contains charcoal or briquette pot. For improved fuel efficiency, the combustion chamber receives oxygen via air vents made of perforations at the base of the charcoal/briquette pot. The oil collector/tray is a part of the drum kiln. During smoking, this catches the fish oils and stops oil from dripping into the combustion chamber and charcoal/briquette pot. Another important component of the drum kiln are the fish trays; this is where the fish are arranged for smoking.

Table 2. PARTS OF THE IMPROVED DRUM KILN AND THEIR FUNCTIONS

Component	Pictures	Function
Chimney		This ensures heat retention It ensures efficient combustion of the smoking fuels
Charcoal/briquettes pot		This holds the smoking fuels
Oil collector/tray		This collects fish oils during smoking

Semi-Circular Fish trays		This is where fish are arranged
Chamber for the coal or briquettes pot		This receives the charcoal or briquettes pot
Air vents		This ensures proper ventilation and also serves as outlet for ash from the charcoal/ briquettes pot
Detachable double-wing doors with lock		These prevent pilferage, insect infestation, and attack by rodents.

STEP-BY-STEP USAGE OF THE DRUM KILN

STEP 1

Wash your hand and begin with fish preparation



STEP 2

Wash your fish with clean water



Lay them on the fish trays



STEP 3

Leave the fish for the water to drain out while preparing the fire



STEP 4

Before starting the fire, the clean fat collector should be installed



STEP 5

Set the briquette in the briquette pot. The quantity of the briquettes depends on the amount of fish, quality of the briquettes or the raw materials and amount of air to aid combustion. A proportion of 1kg -2 kg briquettes to 10kg fish is a good way to start and gradually build up to increase temperature



Set the fire by igniting the briquette



STEP 6

Push the lit briquette deep into the combustion chamber



STEP 7

Allow the briquettes to heat up, then set the tray with the fish into the kiln



STEP 8

Shut the kiln tightly to begin smoking



STEP 9

Check frequently and switch tray where necessary



STEP 10

After smoking, allow the fish to cool and package them neatly.



KILN MAINTENANCE

- Ensure the kiln is used in a steady level and in a clean location
- Always dispose off the ash (as soil replenisher or for the production of other energy source) from your energy source after use.
- Always clean the trays with good sponge and water after use and clean the kiln thoroughly once a week.
- Ensure you clean the oil collector too after every use.
- Do not use your kiln as a cupboard and keep the lid free of any object either in or not in use.
- Do a periodical evaluation of the kiln at a regular interval (quarterly or biannually)
- At a regular interval, check for any loose parts that if not screwed back can lead to breakdown of the kiln.

ABOUT THE PROJECT

The Project “Developing alternative energy source and kiln to improve traditional fish smoking in Lagos, Nigeria” is a part of the action launched to contribute to the improvement of traditional practices for safe fish products, sustainable livelihoods and ultimately food security in Nigeria and Africa. The project is exclusively funded by the International Development Research Centre (IDRC).

The Project ID_57 implemented activities within the framework of the Gendered Design in Science, Technology, Engineering, Arts and Mathematics (STEAM) in Low Medium Income Countries (LMIC) and achieved several outputs including a publication of a practical guide for small-scale fish processors on good practices, introduction and adoption of briquettes and use of improved drum kiln to smoke fish.

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