

*Technical
factsheet*

blue ventures
beyond conservation

Smoked fish production for reducing post-capture loss

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Technical factsheet

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Target products: Finfish

Objective: To provide the basics of fish smoking techniques so that those involved in fishing (technicians, fishermen, collectors) acquire this knowledge and are able to produce a quality product. At Blue Ventures' site of Mahajamba, smoking fish in a smokehouse is an activity that allows us to reduce post-capture losses and to improve the actors' standard of living.

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Blue Ventures

Founded in Madagascar in 2005, and today active in nine countries, Blue Ventures is a marine conservation organisation dedicated to rebuilding tropical fisheries with coastal communities.

We are committed to making conservation work for people, demonstrating powerful win-wins for marine biodiversity and coastal livelihoods. We have developed a responsive approach to conservation that takes into account the needs of the people that rely on the oceans the most to survive.

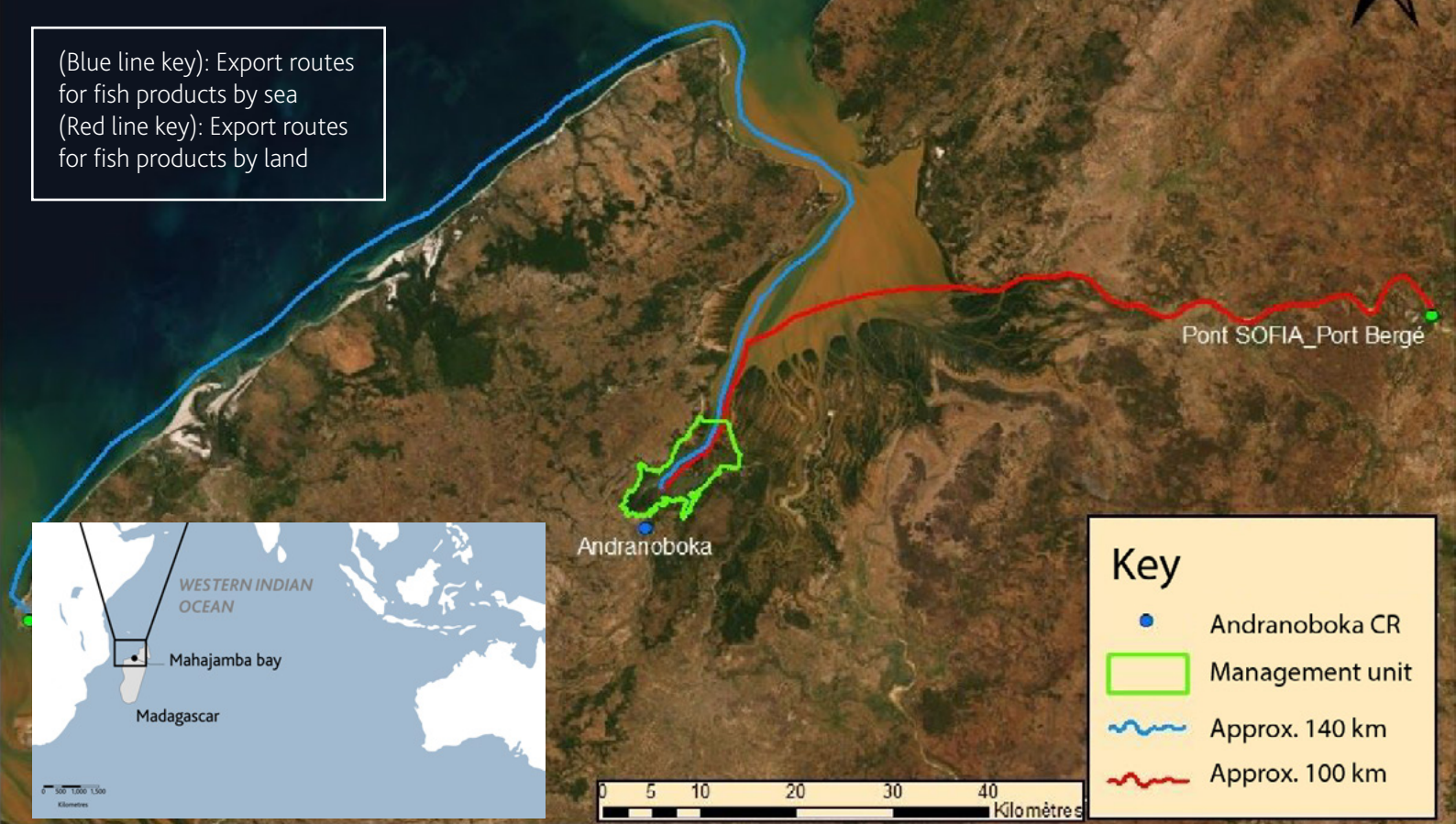
We are supporting coastal communities to tackle complex, interconnected challenges, to which there is no one-size-fits-all technical solution.

Our integrated health-environment approach combines the local management of marine areas with the strengthening and creation of income generating activities, and community health and education services.

Our vision: Empowered coastal communities managing their local coastal ecosystems in ways that enrich livelihoods and sustain healthy marine environments for generations to come.



(Blue line key): Export routes for fish products by sea
(Red line key): Export routes for fish products by land



Map showing the location of Blue Ventures' intervention zone in relation to the cities of Mahajanga and Port Bergé.

Context and issues

Located in Mahajamba Bay, Blue Ventures' intervention zone is **difficult to access** during the rainy season and the fishing communities are far from the urban centres of Port-Bergé and Majunga (see map above). This makes it difficult for collectors to travel from these towns and buy fresh fish from the communities in Mahajamba Bay; opportunities to sell fish are therefore uncertain.

According to a value chain study conducted in 2018-2019 by Blue Ventures (Zbigniew-Levrel), **more than 30% of the catches are lost** due to bad weather (little sunshine, a lot of rain, no space to dry the product). However, during the rainy season the catches are the most abundant. Therefore, the income from fishing does not therefore correspond to the fishing efforts made. This observation in the field led us to investigate how to reduce post-harvest losses.

The introduction of the technique of smoking fish on a smoking barrel (or hot smoking) seems to be a **promising solution**. With this technique, smoked fish can be stored for at least three weeks. They can even be re-smoked if necessary to extend this period up to an additional week, without impacting the quality of the products.

This document will be **updated** as data collection continues, in order to be able to evaluate the fish smoking activity in relation to its objectives: reduction of post-capture losses and improvement of the standard of living of the stakeholders.

The information presented here mainly reflects the context of fishing villages in Mahajamba Bay, but it can be adapted to **other contexts**.



Principles of fish smoking

Fish smoking involves burning wood and exposing fish to the smoke as a preservation technique. This is more accurately known as 'hot smoking'. Smoking has long been regarded as a food preservation technique. Today, however, smoking as practised by many fish smokers, with fish exposed for long hours close to a fire, has mostly a flavouring and colouring action. It gives fish a specific flavour and visual appearance.

Hot smoking is to be done **at the same time as cooking**, with the fish gradually rising in temperature to reach 60 to 70°C at the end of the cycle. The texture of hot smoked products is firmer than that of cold smoked products.

Cold smoking is done at a temperature between 20 and 40°C. In this case, the fish are not cooked, so they should be cooked afterwards.

Smoking is possible **for all types of finfish, except anchovies.**

In addition to its advantages in terms of preservation, the technique of hot smoking presented here is also an **alternative to braising accompanied by spraying with pesticides**, which can have disastrous consequences for the health of consumers and the environment. **Hot smoking also has the advantage of consuming much less wood fuel than traditional methods.**

Advantages of hot smoking

Reduction of wood consumption	50% less than traditional techniques
Preservation of the product	More than three weeks. Possibility of re-smoking if necessary to extend the preservation by one week, without altering the quality of the products.
Product quality	Firm flesh, good taste and golden colour

Technical sheet for a smoking barrel

Barrel	200 litres
Wire netting	3 m
Wire	7 metres of 6 mm diameter round iron bars; 3 metres of annealed wire
Manufacturing time	1 smoking barrel per day
Manufacturing cost	Approximately 120,000 Ariary (\approx 30 USD) according to the suppliers, labour included
Lifespan	At least 12 months, depending on maintenance and frequency of use
Loading capacity	30 kg/cooking
Cooking time	Depending on the size of the fish (20 cm = 2 hours, 30 cm = 3 hours). In all cases, turn the fish over every 20 or 30 minutes



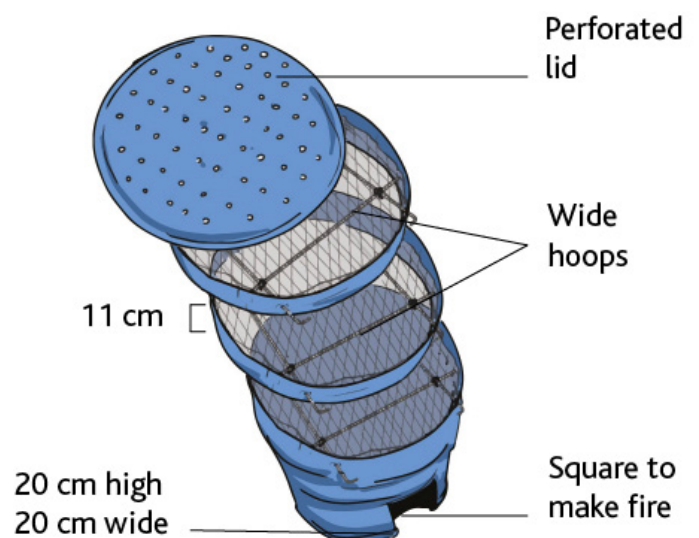
The process of making a smoking barrel in 5 steps

The manufacturing technique for a smoking barrel is easy to reproduce and does not require sophisticated equipment (i.e. no welding or electric saws). The necessary tools are: a hammer, a chisel and measuring equipment. This model can be reproduced after some basic training.

1. Marking out/cutting

With a hammer and chisel:

- Cut off and perforate the upper part of the barrel (to be used as a lid)
- Trace and cut out two 11 cm wide hoops at the top of the barrel
- Trace and cut out a 20 cm wide by 20 cm high square at the bottom of the barrel where the fire will be made



2. Placing the wires

- On the first level, place round iron bars (tied with annealed wires) to form a square inside the barrel; place a hoop over it
 - Place round iron bars (tied with annealed wires) again to form a square on the 2nd level; place the 2nd hoop on top
-



3. Positioning the wire netting

Install the wire netting inside each hoop. The hoop is 11 cm high and the wire netting is fixed 3 cm from the bottom of the hoop so that the fish can be placed on it. It is preferable to use a thick wire netting to make it heat resistant.



4. Final result

The lid can be placed on the barrel once the different parts are assembled.

5. Sterilization of new material

Let the smoking barrel smoke for 30 minutes before using it with fish, for health reasons.





Smoking process and technical recommendations

A. Smoking process preparation

1. Fish sorting

Smoking does not improve the quality of the fish. Poor quality fish will result in a smoked product that does not keep well, has a poor taste and breaks easily. Only good quality fish (with no signs of spoilage) will be preserved.

2. Keeping cool and evisceration

In the pirogue (boat), maintain the freshness of the fish: gut, rinse with sea water, store in a basket (*sobika*) or tub and protect against the sun (cloth/*soga*, seaweed or wet leaves).

After landing, keep the fish out of the sun.

It is very important to gut the fish. This is because the viscera are an ideal breeding ground for bacteria, which causes the products to spoil quickly, even after smoking.



3. Dehumidification of fish

Dry the fish in the shade for at least one to two minutes to drain the water off the skin before putting it in the smoking barrel.

This is essential for better preservation.

Dehumidifying the surface allows better smoke penetration and better colouring of the product.



4. Choice of wood

Organisations promoting the uptake of hot smoking techniques should identify sustainable sources of wood that are in line with local regulations. For example in Madagascar, it is illegal to cut mangrove wood. In the Blue Ventures intervention area, smoking is done with dead wood and Blue Ventures supports community-based mangrove management organisations' efforts to avoid illegal cutting (strengthening community patrols and planting alternative wood sources).

Different types of wood can be used. It is not possible to use resinous woods because they give an acidic flavour to the smoked product, and can generate greater formation of 3-4 benzopyrenes (carcinogenic polycyclic hydrocarbons). Resinous woods are woods that secrete resin (example: fir). Corn cobs and coconut shells can also be used.



B. During smoking process

1. Oil the wire netting



2. Place the fish on the netting and light the fire



3. Turn the fish over every 20 to 30 minutes



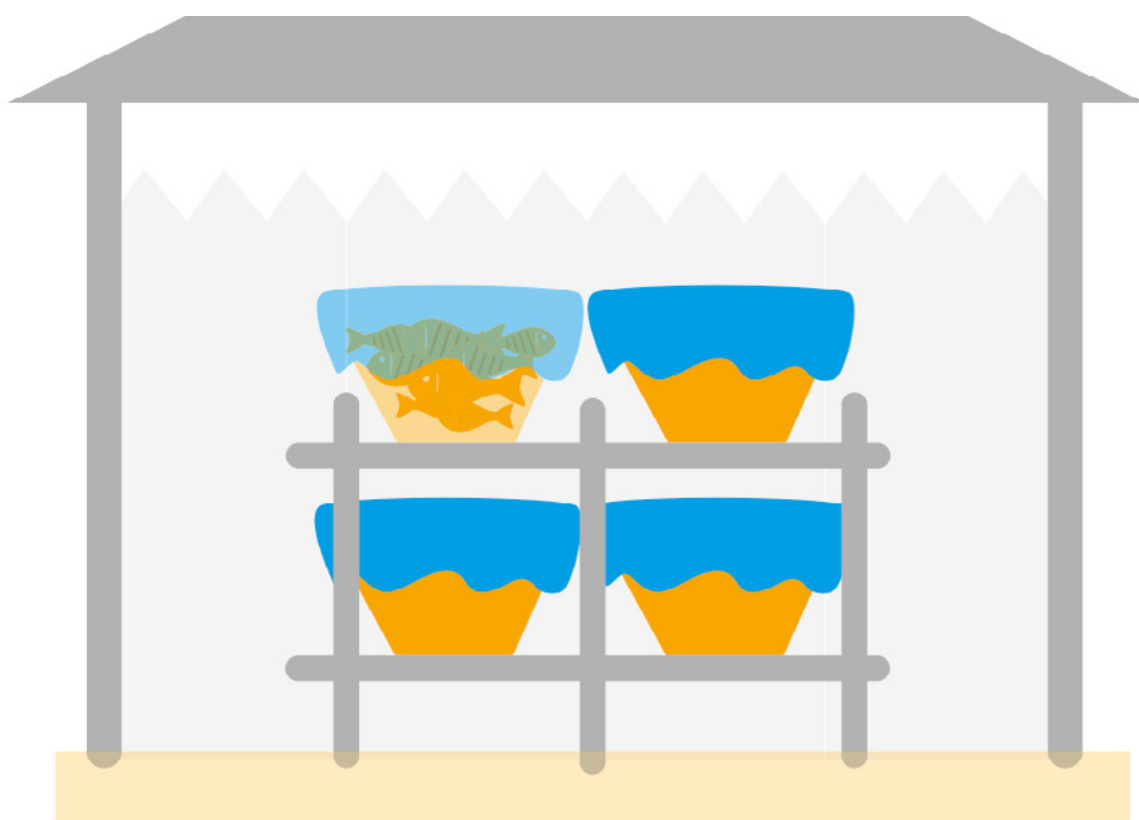
4. Cover during smoking



The visual indication that the burning temperature is correct is the change in colour of the fish's skin, which takes on a golden hue.

C. After the smoking process

1. **Dry the smoked fish** before putting them in the baskets (*sobika*). Do not wash them with water (risk of deterioration and mould).
2. **Store finished products**, preferably on shelves in a well-ventilated shed/hangar, protected from rain, insects, rats and other animals.



D. Re-smoking process

The re-smoking process consists of putting the finished products back on a smoking barrel for 30 minutes to one hour – the time needed for the smoke to be well distributed over the fish flesh. The wire netting must be well oiled to prevent the fish flesh from sticking to it.



Smoking barrel maintenance

The following actions can greatly improve the lifespan of smoking barrels:

- Remove debris and remnants of fish flesh from the wire netting after use;
- Wipe off oil stains and ash from the bottom of the barrel before and after use;
- Wipe the smoking barrel clean before each use (dust, etc.);
- Avoid smothering the fire inside the combustion chamber with water after use;
- Avoid permanently exposing the smoking barrel to rain;
- Keep the smoking barrel in a clean, dry place.

To preserve the wire netting, you need to:

- Monitor the height of the flame during smoking (treatment/preservation is carried out by the smoke and not by the flame that would “grill” the fish);
- Clean the wire netting regularly between uses.

This document has been developed based on **recent** findings and experiences with fishers. Some information will need to be supplemented as the situation on the ground evolves (e.g. lifespan of the smoking barrel, lifespan of the wire netting, etc.). These data will influence the final evaluation in terms of cost-benefit.

Tips for selling and consuming

Fish braised according to the traditional technique have been on the market for a long time. On the other hand, smoked fish with this improved technique is a new product, both at the community level and in the villages. This is why a **demonstration, tasting and awareness-raising session** on the availability and quality of the product is recommended at the points of sale. In the case of the Blue Ventures' intervention area, the sessions held in the local market raised many questions about the availability of products, the costs of acquiring materials, and the possibility of being trained in the technique of making the smoking barrel.

Sale

- Smoked fish intended for sale should be stored and displayed in a clean and easily washable plastic bowl/basket.
- It is important to cover the fish with a plastic mosquito net to protect the products from flies.
- Fresh and processed fish should not be sold on the same stands.

Consumption

- Smoked fish is a healthy (chemical-free), nutritious and tasty local product that is good for your health.
- Smoked fish can be eaten directly after smoking; its taste attracts many consumers.
- Smoked fish can also be cooked, for soups, starters or main courses.
- Before cooking, smoked fish should be washed and soaked in fresh, clean, cold water.



Smoked fish broth



Smoked fish pasta salad





Qualitative feedback collected to date

Fishers say that the technique presented here is very effective for smoking fish, and allows them to sell their products during the rainy season, which has never been possible before.

Consumers of the product say that it tastes very good and that they would consider buying it on a regular basis.

Appendix¹

Explanation of the effect of smoke on fish

From a physicochemical point of view, smoke is composed of liquid and solid particles suspended in a gaseous phase of variable composition. These volatile particles are absorbed at the surface of the fish and then migrate deep into the flesh. Penetration of the particles can take several days, depending on the fat and moisture content of the fish.

Smoke impacts:

- **Colour:** The colour of smoked fish ranges from golden yellow to dark brown. The opinions of fishermen are divided on the origin of this colouring. The colouring varies in line with the composition of the chemical elements in the wood but also to the fat content of the fish.
- **Aroma and taste:** The different types of wood used have a strong influence on the flavour. The aroma of the smoke is due to the chemical components called phenols. These are aromatic chemical compositions. They have important biological functions (biochemical defence against microbes).
- **Preservation:** Smoke has a bacteriostatic effect on the growth of microorganisms. However, in the case of hot smoking, it is mainly the temperature which is at the origin of the antibacterial action. It is important to stress that processors must also respect hygiene rules to prevent the growth of bacteria.
- **The combustion temperature:** The combustion temperature influences the composition of the smoke. A badly conducted combustion can lead to the formation of tars and carcinogenic molecules such as 3-4 benzopyrenes. The visual indication that the burning temperature is correct is the change in colour of the fish's skin, which takes on a golden hue.
- **Influence of the air:** Oxygen in the air is essential for wood combustion. Ventilation must be adapted to the humidity of the wood. The higher the ventilation, the greater the smoke penetration into the product.

¹[Aquimer's monitoring centre web page](#)
(in French)

A photograph of a bicycle wheel with a large catch of fish hanging from the handlebars. The fish are of various species, including snappers and sea breams, and are arranged in a dense pile. The background shows a rustic setting with a wooden fence and some foliage.

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