



Minimum Viable Product (MVP) Documentation

Hatchery built of concrete

Living Lab USTM



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1. Overview

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1.1. Abstract

The aquaculture sector in the region around Franceville, Gabon (Haut-Ogooué), is underdeveloped despite a clear market potential for aquaculture products. The INCiTiS FOOD Project, represented by its Living Lab at the University of Science and Technology of Masuku (USTM), has set itself the goal of contributing in its own way to the revival of the fish farming sector by helping to produce one of the major inputs: fry. The chosen approach is to set up an **above-ground concrete hatchery with a water recirculation system**. The system comprises four incubation tanks, two mini filtration tanks, one settling tank and a sump.

1.2. Photos



Figure 1: Concrete fish tanks for fry and fingerlings (left); external view of the hatchery (right)



Figure 2: Male and female *Clarias* candidates for reproduction



Figure 3: Incubation of fertilized eggs

1.3. Motivation and challenges overcome

One of the core technologies of the INCiTiS-Food projects is aquaponics, a production system where recirculating aquaculture is combined with hydroculture to create a circular, resource efficient and sustainable production system. When setting out to create an aquaponic prototype at USTM LL, the team quickly realized that aquaculture in and around Franceville is underdeveloped despite clear market pull. The main reason for this is the scarcity of high-quality fry, very young fishes, which are an essential input for the production chain. This observation is corroborated by the FAO which reports that national aquaculture output has averaged only about 45 tons per year over the last decade, and identifies as principal constraints the lack of quality inputs, specifically good-strain fry (alevins) and quality feeds (FAO, 2023). Instead of creating more demand for fry by developing and promoting aquaponic setups, the USTM team decided to tackle the root cause and to create a hatchery for African catfish.

The MVP is represented as infrastructure that involves tanks and hatcheries designed and adapted to protect eggs and larvae in order to increase their survival rate. Technical monitoring such as feeding, oxygenation and health management protocols were put in place to ensure the healthy growth of the fry. The team opted for a sustainable approach by selecting commercial high-performance broodstock that guarantees better growth performance and reduces pressure on wild stocks.

1.4. Feedback process

At first, the LL team assumed that feed was the only factor discouraging people from getting involved in fish farming. After numerous discussions with a number of active farmers and those who had been forced to stop, it became clear that feed is certainly a problem, but it is not the most crucial one. The real problem, according to fish farmers, is the lack of fry producers. This situation is exacerbated by the fact that, despite purchasing fry in Libreville, huge losses are incurred during transport. Ultimately, this makes their product less competitive on the market.

The idea of developing the MVP was conceived by setting up infrastructure that involves designing tanks and hatcheries adapted to protect eggs and larvae in order to increase their survival rate. Technical monitoring such as feeding, oxygenation and health management protocols were put in place to ensure the healthy growth of the fry. We opted for a sustainable approach by selecting high-performance broodstock that guarantee better growth performance and reduce pressure on wild stocks.

2. Implementation

2.1. MVP Design

The structural choices that influenced the construction and operation of the fish farm: a fish farm with a production capacity of 20,000 fry per production cycle. The aquaculture system is supplied with water and is designed as circular recirculating aquaculture system (RAS). The building itself is half concrete and half wood. The system consists of four hatching tanks, each with a capacity of 0.4 cubic meter, two biofilters, a 0.3 cubic meter settling tank, and a sump. The idea behind setting up such a structure is to solve the problem of the shortage of Clarias fry. Several fish farms have been forced to close because it was very difficult to obtain fry. They were forced to buy them more than 700 km from their farms, with transport losses exceeding 50%. By setting up a hatchery within their reach, we hope to motivate them and, above all, revive fish farming in our region.

2.2. Operations

USTM team followed the steps recommended by literature and reproduction experts in the animal production department of the University:

1. Selection of breeding stock: Males and females were selected based on their weight to ensure they were sexually mature. The animals weighed between 700g and 1000g.
2. Preparation of females: After selecting females that met the above criteria, a hormone was administered to the females to induce final maturation and ovulation of the eggs. The female was then placed in an individual tank to allow maturation, which can take about 8 hours.



Figure 4: injection of the hormone into a female

3. Collection of gametes: After the 8-hour wait, the eggs are mature and are extracted by applying pressure to the female's abdomen (often by massaging her or collecting them manually in a container).



Figure 5: Extraction of oocytes from females by abdominal pressure

Next, the testicles are removed from one of the males and the milt from the testicles is sprinkled onto the collected oocytes.

The eggs and milt containing the sperm are mixed, and fertilization takes place at this point. The result is eggs that will be incubated.



Figure 6: Excised testes from a male African catfish (*Clarias gariepinus*), collected for use in the in vitro fertilization of fish eggs.



Figure 7: Mixing of the milt with the extracted oocytes

4. Incubation and hatching: The fertilized eggs are placed in incubators under controlled conditions (pH, temperature, clean water). Hatching takes place after 24 to 72 hours, depending on the temperature. After this time, larvae should begin to appear.

2.3. Bill of materials & Required Tools

Table 1. Bill of materials

Article	Quantity *	Unit price FCFA	Total FCFA
PVC pipe	12m	1000	12 000
PVC tees and elbows	13	2500	32 500
15 cm concrete block	240	500	120 000
Cement bags of 50KG	5	6500	32 500
Sandbags	20	3000	60 000
plywood sheets	10	6000	60 000
Wooden slats	20	3000	60 000
Nails	4kg	2000	80 000
Electrical cables and plugs	10m	4000	12 000

Table 2. Required tools

Item	Quantity	Unit cost	Total cost
Pump	1	30 000	30 000
Thermostat	5	20 000	100 000
Water heater	1	40 000	40 000
Synthetic hormones	2	15 000	30 000

3. Economics

3.1. Business model

A targeted public intervention can unlock the “no fry → no farms → no fry demand” trap, but it should be carefully designed. In Gabon, the FAO and government have already identified lack of quality alevins (fry) and feeds as principal constraints to aquaculture, with national output stuck around 45 t/yr despite strong market demand (~35 kg/capita) and explicit project focus on Haut-Ogooué (Franceville’s province) to improve access to quality seeds and feeds (FAO, 2023). Local reporting also flags the practical bottlenecks of moving alevins and other inputs, even as demand remains robust. This evidence of a coordination failure along the value chain (Gabon Environnement, 2023).

Global and African evidence supports temporary, catalytic public action on seed supply. FAO reviews highlight that access to quality seed is a prerequisite for aquaculture take-off and a frequent binding constraint in Sub-Saharan Africa; experience cautions against large, centralized government hatcheries displacing private operators, and favors models that build quality broodstock, seed standards, and decentralized supply (FAO Aquaculture Newsletter, 2005).

A small, self-built and operated hatchery in a living lab context, augmented with capacity building activities, perfectly implements this recommended decentralized approach outlined above.

4. Future improvements

4.1. SWOT analysis



Figure 8: SWOT – USTM LL – Catfish

hatchery

4.2. Optimization

Improving water quality:

- automated pH monitoring with alarms,
- temperature regulation with thermostat,
- sterilization of tools and materials

4.3. Threat mitigation

- Spark curiosity among the population, starting with the lower grades (primary, middle and high school).
- Maximize marketing and outreach for our activities by holding seminars and open days.
- Combat inbreeding by using animals taken from their natural environment.

5. Appendices

5.1. Additional Photographs/Documentation

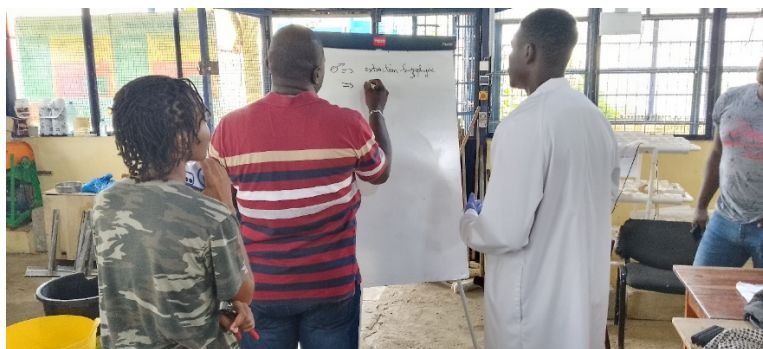


Figure 9: Explanation of the reproduction protocol to students who will be performing the procedure



Figure 10: Taking body measurements of animals before gonad extraction



Figure 11: Fertilization of fish eggs

5.2. Additional Notes

The first attempts at breeding were unsuccessful. The LL team inferred that the temperatures were too low and decided to augment the setup with a dedicated water heater with thermostat temperature regulation to maintain the water temperature at the recommended level. This augmentation was successful. Subsequent breeding attempts yielded the sought after fry.

5.3. References

FAO (2023). Gabon: FAO supports commercial aquaculture; constraints include lack of quality alevins/feeds; project targets Haut-Ogooué; demand ~35 kg/capita. <https://www.fao.org/gabon/actualites/detail-events/en/c/1634707/>

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