Training course packages targeting food operators on the adoption and management of the technological innovations

AQUACULTURE SYSTEMS

Seed Production Technologies for Labeo Victorianus (Ningu)

Website	foodland-africa.eu
Twitter	@FoodLANDafrica
Facebook	FoodLANDafrica
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1. FoodLAND technical innovation for local food supply chains: concepts and approaches

The FoodLAND project has the ambition to impact on a large number of supply chains and communities, hence the process of food operators' capacity development has to be tailored and as much participative as possible. Accordingly, one of the assumptions of FoodLAND is that sustainable and nutrition-responsive farming systems can be achieved basically by strengthening the capacity development, and specifically by **a)** empowering farmers and processors through the implementation of capacity building processes and concrete opportunities; **b)** creating or consolidating cooperation and shared knowledge to overcome the lack of coordination among food operators; **c)** addressing the inefficient use of resources; **d)** trying to address and build resiliency to the high vulnerability of food systems to climate change; **e)** enhancing the integration of supply chains by creating commercial and stakeholders' networks; **f)** improving the responsiveness of the production sector to the market demand.

To implement these elements of capacity development, FoodLAND proposed the adoption of specific innovations, among which the organizational ones, to create strong and responsive links between producers and encompassing all the intermediate actors along the food value chain, such as researchers, SMEs, NGOs, local and national authorities. In order to ease the creation of those links and guarantee the sustainability over time of the results, 14 Food Hubs will be created in 6 countries as part of the organizational innovations. Food Hubs are conceived as multi-actors centers of innovation where to develop or enhance the organizational and operational conditions enabling local food supply chains (D3.6).

Functional to the implementation of the Food Hubs and of the innovations, the training courses were designed – in form of capacity development activities – as a two-phase process. Firstly, a training session focused on general, preparatory

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topics was provided to farmers as described and reported in D3.5 ("Group Introductory Training", GIT). According to the project GA, GIT broad set of goals were: to enhance the knowledge of consumers' nutritional needs and market opportunities, and to boost the notions about climate change, sustainability, resilience, and food culture. Secondly, a specific training session were organized to provide food operators with practical information on the adoption and management of the innovations tested at lab / small scale level and to contribute to validating them at appropriate scale.

However, as the whole approach has been designed by FoodLAND to ensure the inclusion of the local actors from the first moment, both the training sessions were set up accordingly. Indeed, yet in the inception phase of the project, an assessment on participatory methods has been run and Participatory Learning and Action (PLA) approach has been eventually assessed as the best one to ensure the inclusion of multiple perspectives. The main purpose of PLA is to support people within communities to analyze their own situation, rather than have it analyzed by outsiders, and to ensure that any learning is then translated into action (Gosling and Edwards 2003). In addition, a gender-sensitive approach has been applied to the trainings that have been designed considering gender roles and power relations; they have provided equal opportunities to participate in the process by caring to times, venues and use of local languages.

The GITs have been conceived as the first step towards the innovation validation and aim at involving the producers, yet from the inception phase. They are just the first step in a sequence of 6, summed up in **Table 1**. After the GITs, where farmers and processors meet and share their vision and goals for the Food Hubs and exchange information about specific topics, the Food Hubs were created and the innovation tested (first in pre-test, then in pilot phase). The constant iteration between researchers and local actors is a key feature of the project: specifically, the practical trainings focused the single innovations (step 5) are aimed at validating the innovations at adequate scale and planned to trigger feedback loops of control and improvement involving developers and adopters.

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Table 1. Activities with farmers and food processors (SMEs) and participatory approach

Step	1	2	3	4	5	6
Task	T3.3	T3.3	T3.4	T4.1¸T4.5	T5.1¸T5.5	T5.1¸T5.5
Activity	Group introductory training	Food Hubs creation	Innovation undertaking	Innovation tests	Individual and group practical training	Innovation pilot and validation

2. FoodLAND practical training: aims and scope

According to the project bottom-up and participatory approaches, following the courses on introductory topics GIT organized in the early project phase (T3.3), and as component creating / strengthening the Food Hubs as local innovation centres, FoodLAND has organized a second set of training activities with food operators based on active learning methods and gender equality principle (Task 5.1-5.9). In this regard, specific mechanisms (being aware of the gender roles and power relations; providing equal opportunities to participate in the process by putting attention to the times, venues, use of local languages, etc.) will be lifted to ensure women's participation. These training packages are aimed at providing the local farmers and food processors with operational instructions on the adoption and management of the validated innovations.

This second set of training activities has been organised – triggering PLA approach – as individual and group practical (demonstration/capacity building) activities to be conducted in parallel to the implementation of the technological research (where relevant) and of the innovation pilots and validation. These technology-centred trainings aim at strengthening the participants' understanding of novel production and post-harvest techniques, innovative tools and systems (e.g., climate smart/precision agriculture, hydroponics, and integrated aquaculture), new technologies for primary and secondary processing, and supply chain management. Thus they aim at fostering knowledge and operational

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capacity to deploy, manage, and maintain the validated technological innovations – documented by the released guidelines D4.1 ÷ D4.11 (e.g., training pamphlets, user manuals, flow diagrams, and operational recommendations) and practice abstracts D6.5 – validated jointly at appropriate scale.

3. Second training packages on the adoption and management of the tested innovations: an overview

The second training course aimed at consolidating the food operators' knowledge and practical skills to adopt, manage and validate the project innovations and complement the related guidelines. Specifically, the realized training materials provide local farmers and food operators with a set of notions and concrete information on a series of innovative tools and systems as per the following **Table 2**. It is clear that both the contents and formats of the learning packages widely differ across technologies as well as Food Hubs (when the same type of innovation must be validated in different contexts). The diversity that emerges from the proposed solutions reflects the different needs highlighted by farmers and stakeholders as well as the conditions and opportunities characterizing the local communities. Nevertheless, in order to take into due account the existing heterogeneity inside the local communities, the developed learning materials have been let available on the project intranet so as to be used for further training initiatives across the network of Food Hubs.

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4. Second training packages on practical information on the adoption and management of the tested innovations

Aquaculture systems

Seed Production Technologies for Labeo Victorianus (Ningu)

Target group: Fish hatchery operators and potential seed producers of Labeo Victorianus, including women and youth

Aim Of Training: This training materials aim to provide trainees, hatchery operators, and seed producers with essential knowledge, skills and best practices, and technologies for seed production of Labeo Victorianus

Learning Outcomes:

Participants equipped with skills in captive spawning L. victorianus mainly use locally available materials.

Participants equipped with skills in L. victorianus larval nursing.

Areas of training

The importance and relevance of seed in Uganda's aquaculture industry

Spawning process

Larval nursing

Teaching & Learning Methods

Practical demonstrations, PowerPoint presentations, Open discussions/brainstorming, Question, and answer

Training materials description

This Module describes the practical aspects of L. Victorianus seed production. The Module emphasizes the need to help participants acquire relevant basic knowledge and skills to produce L. victorianus seed. The Module looks at the appropriate facilities and local materials required for seed production, the applicable practices, and protocols suitable for L. victorianus seed production.

Duration

40 hrs

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Overview

Aquaculture in Uganda has grown from 15,000 tonnes in 2,000 to an estimated 120,000 tonnes in 2018 (FAO, 2020), contributing nearly 20% of the total fish production in the country (FIP report, 2020-2025). However, this is insignificant compared to the required target of 1,000,000 tonnes by 2030 to meet the increasing demand for a cheap source of protein and more for foreign exchange earnings for a population of over 40 million (Fisheries and Aquaculture policy, 2018). Labeo victorianus is a food delicacy among many consumers, especially in central and eastern Uganda. The species is also favored as a bait for Nile perch fishery due to its high survival as live and bait on hooks (personal communication with the fishermen). Given this apparent demand, Labeo victorianus fetches US$2-4/kg. Rearing of this endangered fish species has the potential to alleviate fishing pressure and provide food fish and job opportunities to riparian communities.

Given that the captive culture of L. victorianus based on collecting seed from the wild is difficult and undependable since it's hard to identify spawning grounds and harvest eggs. Production of quality fish seed is critical to set off the sustainable culture of L. victorianus in captivity. The production of quality fish seed requires skills and knowledge of spawning and larval nursing procedures. Spawning protocols in captivity, including semi-artificial and artificial, have been developed. In addition, larval-feeding technologies that minimize mortalities are under development. These include the use of locally existing facilities and materials. Here we delineate the required protocols for the production of seed.

Best management practices of spawning and larval nursing

Broodstock selection

Broodstock can be sourced from the wild with the assistance of Aquaculture Research Development Centre (ARDC) in Kajjansi.

Females with bulging stomachs should be selected.

Mature females will produce eggs with the application of a gentle press. The eggs should be of uniform size and green color.

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Mature broodstocks of 1kg by weight can produce 200,000 to 300,000 eggs per spawn.

Select ready males that produce creamy milt with gentle pressure on the belly.

Select healthy broodfish without deformities and injuries.

Pre-induction conditioning

To limit stress among brooders, they should be rested for at least 6 hours before induction (Figure 1)

Broodstock should be kept in ponds or tanks with continually flowing clean water

Broodstock should be stocked at 1 kg per m^3

Figure 1. Resting of brooders in 500 l plastic tanks containing clean water before induction

Induction

Induce to ovulate by injecting the fish dorsal ventrally at a rate of 0.4 ml/kg for the females and 0.2 ml/kg for the males using Ovatide® or African catfish pituitary extracts at a rate of 1: 1 kg; donor to recipient ratio and half the dose for the male ones.

In semi-artificial spawning, keep the fish of both sex in fish ponds or tanks with water continuously flowing at a rate of 20 to 40 liters per minute for 8 to 10 hrs (Figure 2)

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Figure 2. Circular concrete tanks that can be used in semi-natural spawning of *L.victorianus*

Semi-natural spawning

Collection of fertilized eggs

The fertilized eggs will be produced after 8 to 10 hours. They will imbibe water and become semi-buoyant along the water column.

The eggs can then be collected using a scoop net of 0.5 mm mesh size or draining through harvest basins and net traps (Figure 3)

Figure 3. Harvesting of eggs from a net (0.5 mm) connected at the outlet pipe of a circular tank using a 0.5 mm scoop net

Artificial spawning

For artificial spawning, the males and females are kept in separate containers

Egg collection

Strip the females of eggs after 10 to 16 hours post induction into a dry container by gently pressing the belly towards the anal opening (Figure 4)

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Figure 4. Stripping of eggs in a dry container

Milt collection

strip the males of the milt into a bowl containing a physiological saline solution by gently pressing the belly towards the anal opening (Figure 5)

Figure 5. Stripping of milt into a bowl containing physiological saline solution

Egg fertilization

Add the milt solution into the bowl containing the eggs and mix by swirling for 2 to 4 minutes (Figure 6),
Add at least 1 to 2 liters of fresh water and further mix by swirling for at least 1 minute,

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Transfer the eggs to a 10-liter bucket filled with water and allow them to absorb water for 15-30 minutes.

Figure 6. Mixing eggs with milt to allow for fertilization

Egg incubation and hatching

Spread the eggs over trays made out of 0.5mm net material and wood frames and lay them in tanks filled with aerated clean water, preferably supplied by an underground well

Water temperature should be maintained at 26-28ºC

Larvae start emerging after 24-36 hours and go through the perforations of the trays to the bottom of the hatching/incubation container.

Remove the shell and dead eggs left behind on the tray immediately after most embryos have hatched.

Immediately remove the egg shells and dead eggs settled at the bottom of the hatching facility by siphoning to avoid build of ammonia in the system.

Replaced at least 50% of water in the hatching facility daily to maintain optimal water quality parameters (what are those optimum water quality parameters?)

Larval nursing

Start feeding the larvae 3-5 days after hatching to satiation with decapsulated/shell-free Artemia cysts (Figure 7) for 5 to 10 days.

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Figure 7. Commercial product of Decapusulated/shell-free Artemia cysts

Maintain the stocking rates between 10 to 20% by volume.
Nurse the hatchlings for 3 to 4 weeks using indoor facilities, preferably plastic tanks supplied with optimal quality water parameters (see table 1).
After 4 weeks, wean the hatchlings to dry feeds containing at least 40 crude proteins.
The fry are fed 10-15% of their body weight three times a day
Replace at least 50% of the water in the larval rearing facility every day to maintain optimal water quality parameters (table 1)

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Table 1. Water quality parameters and management during larval nursing

Parameters	Recommended values	Possible effects of poor H_2O quality	Control
Ammonia	<0.05 mg/l	Daily mortalities, poor feed acceptance	Avoid overfeeding and stocking Flush the system
Nitrite	<0.30 mg/l	Brown patches on the gills, known as blood disease, mortalities	Add sodium chloride, flush the system
PH	6.5-8.5	Poor feed response	Liming and use of bleaching powder
Temperature	25-28^{o}C	Low gonadal somatic index	Heating for indoor facilities

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