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

AQUACULTURE SYSTEMS

Seed multiplication technologies for Barbus altianalis

Website	foodland-africa.eu
Twitter	@FoodLANDafrica
Facebook	FoodLANDafrica
LinkedIn	foodland-africa

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

Table of Contents

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

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

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

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.

FOODLAND has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

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

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

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.

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

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

Aquaculture systems

Seed multiplication technologies for Barbus altianalis

Target group: Food hub fish hatchery operators

Aim Of Training: The aim of this training material is to: provide trainees/hatchery operators with basic knowledge and skills of the best practices/technologies in order to improve seed production of Barbus altianalis

Learning Outcomes:

Participants will be able to spawn B. altianalis in captivity using improved spawning and nursing protocols

Areas of training

Overview: Providing the challenge at hand for solving inbreeding of B. altianalis

Spawning process

Nursing larvae and production of Moina for nursing the larvae

Teaching & Learning Methods:

Practical (hands on), power point presentations, excursion, discussions/brainstorming

Training materials Description

This material/module emphasises to the hatchery multiplies the need to use appropriate technologies to improve the survival of fingerlings during spawning and nursing. Challenges of seed production will be discussed during training in order for the hatchery producers to appreciate the effort on how best they could focus on overcoming them. The existing and the improved spawning and larvae nursing protocols will be discussed. They hygiene processes for improved biosecurity and safety during spawning and nursing aimed at reducing mortalities will be provided to trainees.

Assessment Methods:

Learners demonstrating what they have learned

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

Duration

6hrs; 2 hrs of class; 4 hrs of practical

Module Facilitator(s)

NARO staff

Overview/Introduction

The use of quality seed is significant for the production of table fish. Uganda currently needs more than 2.5 billion fingerlings to produce 1,000,000 metric tons of fish, according to the current government fisheries and aquaculture policy of 2018. There are currently only around 164 million seedlings, hence there is still a need to fill the enormous gap by ensuring more seed is produced for all fish farmers in the country to reach the government target.

Aquaculture in Uganda is primarily based on three fish species which include the African catfish, the Nile tilapia, and Mirror carp. However, there is an increasing demand for the native carps such as Barbus altianalis and Labeo victorianus which are being overexploited in the wild. These species, Kisinja (Barbus) and Ningu (Labeo), have been successfully domesticated. However, few hatcheries are producing seeds for other fish farmers to grow. Hatchery producers need to produce enough quality seed for our farmers.

There is evidence of insufficient protocols for producing sufficient fingerlings for distribution to farmers. There are still a lot of mortalities observed during spawning and nursing of the Kisinjja and Ningu larvae. Technologies have been focused on improving spawning and nursing protocols to ensure improved survival rates and hence, more seed/fingerlings are produced for our farmers.

Uganda's government and its development partners are currently supporting efforts to ensure that hatchery operators produce quality and sufficient fish seed for the farmers as well as promoting the distribution of these efforts to farmers throughout the country. There is a deliberate effort by the government to train and support hatchery operators to ensure the production of good fingerlings for the farmers.

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

Additionally, the quality and quantity of fish produced in the hatchery are synonymous with suitable hygiene protocols in the incubator. However, about 50% of fish death in hatcheries are linked to poor biosecurity and biosafety measures that hatchery operators or users do not observe. Therefore, the protocols or guidelines for hatchery operators must ensure that there is strict adherence to biosafety controls as well.

Biosecurity and biosafety procedures

Ensure that there is a feet bath with drugs (e.g. Potassium permanganate and iodine) disinfecting the feet before entry into the hatchery

Ensure that all hatchery items are disinfected (Potassium permanganate/salt) before and after use

Make sure all items are stored in a store separated from the hatchery

Ensure you are dressed in protective wear to reduce disease transfer incidences.

Sourcing and conditioning of broodstock for breeding

Seed producers should collect broodstock from certified broodstock producers. These have broodstock with optimal performance and ancestry. However, we find that there are not enough broodfish with hatchery operators or farmers. ARDC will provide or guide broodstock collection from the wild/or help build the stock from the wild for conditioning.

During conditioning, they are fed a balanced formulated feed (with a crude protein of 30-40 %). The fish are fed at a rate of 2-5% of their body weight. Feeding is done twice: in the morning (10.30) and in the afternoon (17.00).

Broodfish should be conditioned for two weeks to three months before use for spawning.

Well-conditioned females can produce 1,000-6,000 fry per individual fish (of 500-1000g) per spawn.

Protocol for breeding African catfish

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

Prepare a checklist of materials and requirements that you will need during spawning.

Check the worthiness of the hatching, nursery, and holding tanks aeration system, heating system, or power sources;

Clean and disinfect all contact points, including worktops, containers, hatching, and broodstock holding tanks.

Test the system at least a day before the beginning of the spawning.

Organize enough workforce depending on the scale of operation

Use natural (catfish pituitary) or artificial hormones to induce both the females and males to breed

The induced females are stocked in conditioning tanks; there are two approaches: a) put the fish in the riverine circular spawning system (e.g figure 1) with males and run water through the system for 12hrs until they begin hatching in this system, the eggs will be collected in the a net connected to the outlet and then transferred to the indoor incubation system; OR b) put the induced females in normal concrete tanks and ensure water is running through the tanks for 12hrs (for riverine fish the running water excites the females to begin releasing the eggs). Here the fish will be collected and striped to obtain the eggs for fertilization. Depending on the temperature, the fish will be ready to strip between 11-12hrs.

When the fish, in the concrete small rectangular tanks, are ready, they are stripped into a bowl and the eggs are mixed with the milt obtained from the males. Then water is added to facilitate fertilization.

After fertilization of the eggs, they are immediately transferred to the incubation unit.

Incubate for at least 48hrs. Then the fry will begin to emerge.

Feeding begins after six days with both live feed (Moina raised from ponds or tanks) with micro diets (45%-55% crude protein).

Ensure good water quality for the larvae; maintain a steady and clean water flow system

After three to four weeks, transfer the larvae to the outdoor nursing tanks

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

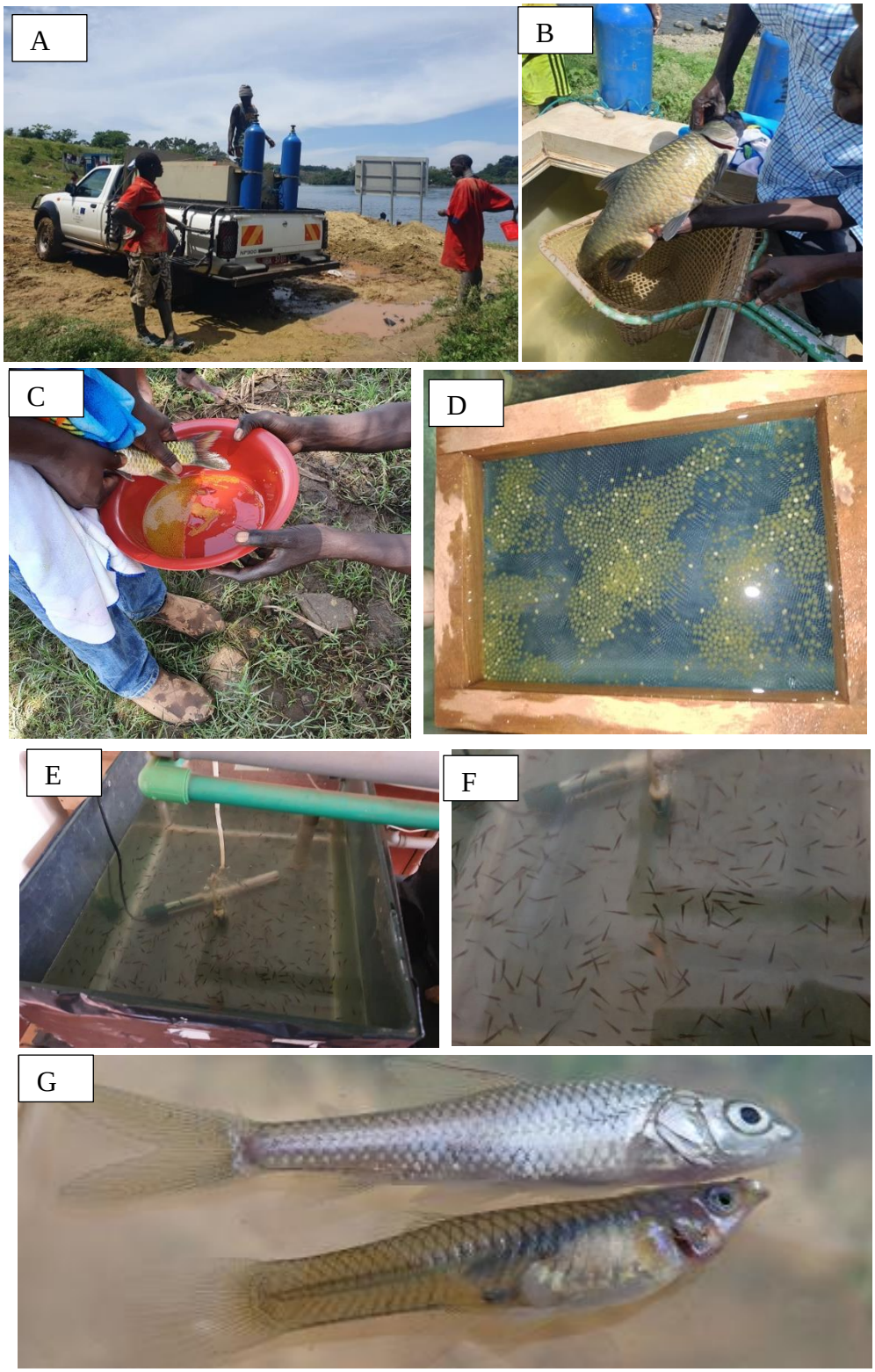

Figure 1: A,B) Loading live fish (Barbus altianalis) at the landing site; C) stripping; D) egg incubation; nursing larvae in aquarium; E) Fingerlings for stocking

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).

Bulking Moina for Nursing the larvae in the hatcheries

Prepare sufficient tanks and other equipment to use when you are going to nurse the larvae

Prepare at least two tanks (1000lt) and fill them with water

Collect manure to make the green water: collect 200gr/m^3 of chicken manure and 200g/m^3 sun flour cake and add them to the tanks filled with water.

Stir/mix well with water and leave the mixture in the tanks for at least four days. Keep stirring each day, in the morning and in the evening to facilitate the nutrients dissolve and mix well with water. Concentrate the green water cultures (microalgae-dominated by chlorella spp) from the ponds to produce approximately 9x10^6 cells/lt using 50µm planktonic net.

Introduce to each of the tanks at least 10lt and they will become green within 4-6 days. These tanks will be the source of green water used to feed the Moina.

Fill two other tanks (1000lt) with water and introduce green water obtained from the tanks with the manure.

When they are green enough, add Moina micrura concentrated from the lagoons or ponds. Little aeration may be needed to keep oxygen circulated.

About 20% of the water, must be replaced daily through the bottom of the tanks.

Keep replenishing the water in the Moina tanks with at least 5-10lt of green water from the manure tanks daily

The density of the Moina, increases from the 5th day until the 15th day when they reach their peak. When their density is about 100-120 Moina/ml, they are harvested to feed the Barbus/Labeo larvae in aquarium tanks.

Regular harvest of Moina is done to avoid saturation and crushing in the tanks.

The manure tanks should be complemented with manure every five days.

FOODLAND has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement (GA No 862802).