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

AQUACULTURE SYSTEMS

Feed formulation

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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 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.

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 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.

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

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Introduction

Fish feed industry uses a variety of raw materials

- Almost any raw material can be included in fish feed formulas.
- The raw material should not contain any deleterious component.
- The raw material should be available in an industrialized scale
- Usually, the raw material should be dry
- The raw material can be stored in reasonable shelf life.
- The raw materials can be classified by their major contribution to the feed

Fish feed types

- Fish feed is the most significant cost in feed production. In some systems it can be more than 60% of total production costs.
- A diverse type of feeds are available in the market.
- The feeds are different in production method as well as in their physical and chemical properties.

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Factors affecting the feed type

- Fish species: herbivores, carnivores, bulk density
- Fish size (stage): decreasing protein level
- Availability of live feed in water: reduced protein, vitamins?
- Culture method: sinking / floating
- Water quantity and quality: consider lower quality feed in lower quality conditions
- Water temperature: feed density reducing with temperature

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Identified raw materials for the formulation of fish feeds within Kisumu

Protein sources	Carbohydrates	Oil Sources
Macrophytes	Wheat	Crude soy oil
Soy bean Meal	Maize	Sunflower oil
Lake shrimp	Cassava	
Blood meal	Sorghum	
Cotton seed meal	Rice Bran	
Sunflower meal		

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Culturing of Lemner and Azolla for fish feeds

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Chemical analysis of nutritional content of some of the identified raw materials

Feed ingredients	% CP	%EE	%Ash	%DM
Maize bran	12.35	3.41	6.22	89.90
Cotton Seed Meal	47.78	5.53	6.05	93.6
Soya Bean	42.30	5.60	5.30	88.0
Azolla pinata	22.25	2.45	25.50	91.78
Lemner Minor	41.7	15.6	16.2	90.2
Lake Shrimp	70.2	10	18.2	100
Rice Bran	11.80	11.30	9.70	88

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Factors to be considered in diet preparation

- Essential Nutrients Requirements
- Composition of Ingredients
- Digestibility and Nutrient Availability
- Dietary Interaction
- Mineral-mineral Interaction
- Micronutrient-macronutrient Interaction:
- Vitamin-mineral Interaction

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Fish feed production methods

There are two main industrialized pellets production methods :

- Press pelletizing i.e The raw materials mixture is heated to a temperature of 80–90^{0}C. Then pressed through perforated matrix to produce pellets of different size
- Extrusion i.e Raw materials are finely grinded, moistened and pre-cooked in a temperature of 90^{0}C. Dough enters the extruder barrel where it is pressed against a die to 40 ATM and temp of 120^{0}C.

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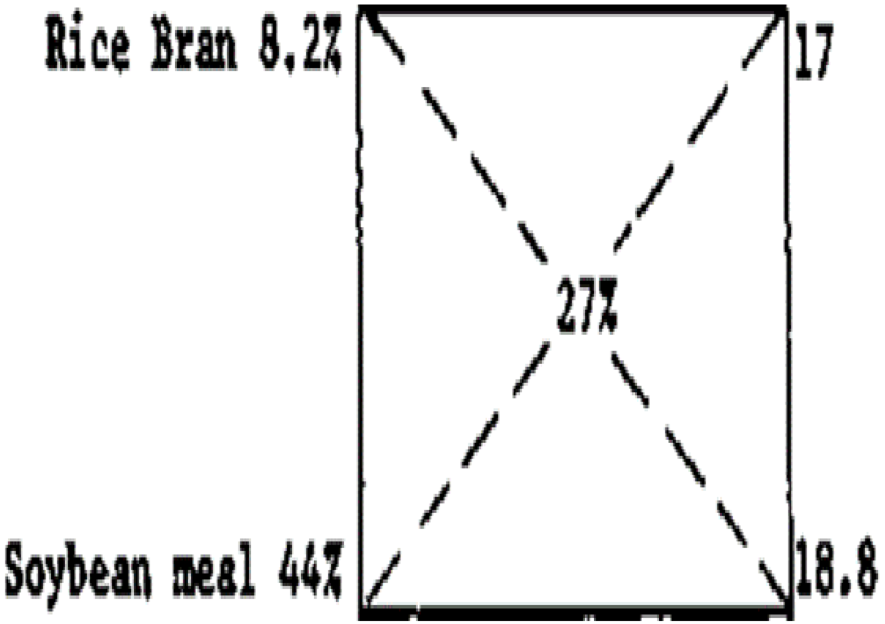
Fish feed formulation using pierson square method

For example, suppose rice bran and soybean meal were available as feedstuffs to prepare a diet for tilapia with 27% crude protein. A square is constructed, and the two feedstuffs are put on the two left corners along with the protein content of each. The desired protein level of the feed is placed in the middle of the square. Next, the protein level of the feed is subtracted from that of the feedstuffs, placing the answer in the opposite corner from the feedstuff. Ignore positive or negative signs.



To make the 27 percent crude protein carp feed, we must mix 17/35.8 of rice bran with 18.8/35.8 soybean meal.

Rice Bran 17/35.8 = 47.5%
Soybean meal 18.8/35.8 = 52.5%

So to make 100 kg of this feed we must mix 47.5 kg of rice bran with 52.5 kg of soybean meal.

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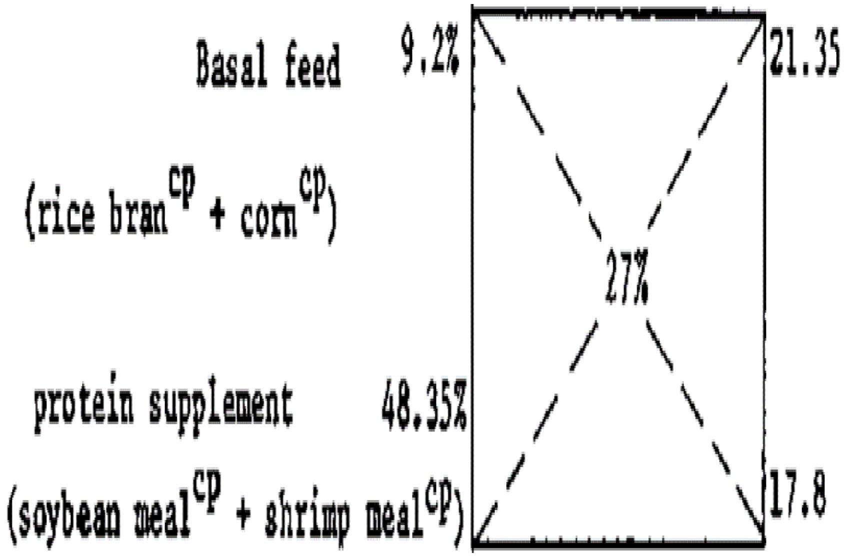
Fish Feed Formulation

If more than two feedstuffs are used in a feed, they may be grouped into basal feeds (CP < 20%) and protein supplements (CP > 20%), averaged within each group, and plugged into the square method. For example, suppose shrimp meal and corn were also available for the carp feed mentioned above. The crude protein levels of the shrimp meal (52.7 percent) and of corn (10.2 percent) are averaged with soybean meal and rice bran, respectively.



Feed = 21.35/39.15 = 54.53%
Protein supplement = 17.8/39.15 = 45.47%

Thus, to make 100 kg of this feed one would mix the following:

Rice bran	27.265 kg
Corn	27.265 kg
Soybean meal	22.735 kg
Shrimp meal	22.735 kg

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Formulation and mixing

- Formulation for fish feed should fulfill the nutritional requirements and be cost effective.
- Accurate dosing of raw materials according to formula.
- Mixing of raw material is critical; enough time should be spend on mixing to ensure complete mixing of all raw materials.

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Summary

- Most fish feeds in the world are in form of dry pellets.
- Mixing and grinding are important to product uniformity.
- Extruded feed has technical and nutritional advantages compared to feed produced by press pelletizing.
- Drying and cooling are important steps to avoid moulding, especially in tropical areas.
- Feeding frequency decreases as fish are growing
- Feed with the quantity that the fish are able to consume in a few minutes.
- Use a feeding table.
- Record mortality and daily feeding
- Do a monthly sampling to record the average weight of fish and calculate the quantity of feed to be given.

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