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

AQUACULTURE SYSTEMS

Integrated aquaculture

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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

Aquaculture systems

Integrated aquaculture

INTRODUCTION

1. What is the integration of fish/animal culture?

Integrated Aquaculture is a farming system which links together two or more normally separate production enterprises. In this system livestock, crop, fish and tree farms are combined and become subsystems of a whole farming system (Figure 1).

The combination of one or more enterprises when carefully chosen, planned and executed gives a greater dividend than a single enterprise, especially for smallholder farmers.

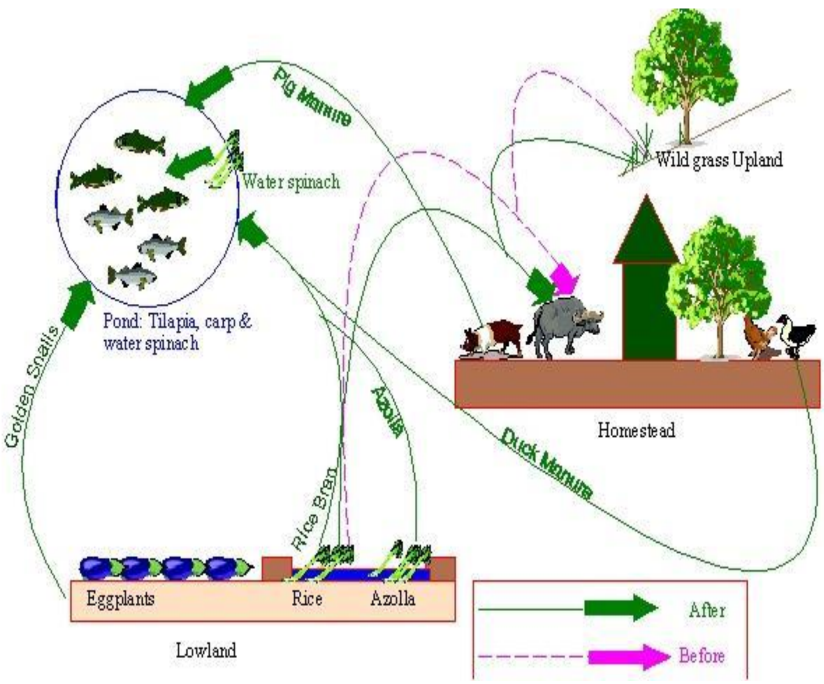
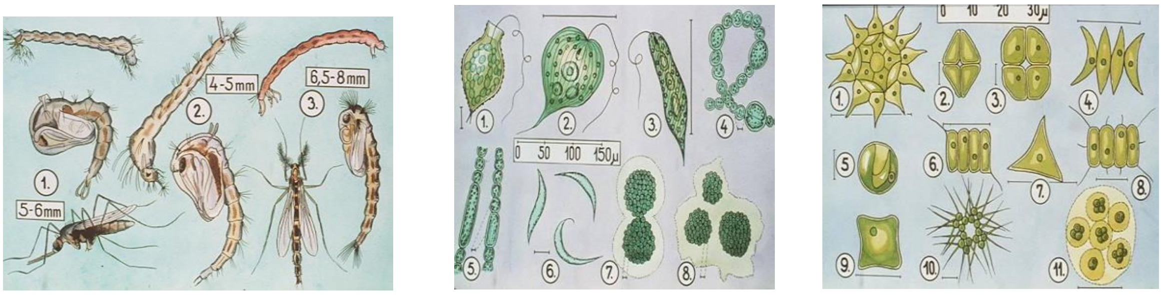


Figure 1. Demonstrate activities and the linkage between resource systems with and without integration, Philippines, after Lightfoot et al., 1993

For example, chicken farming can be combined with Nile tilapia culture and vegetable production, with manure from the chicken house used to fertilize the fish pond and wastewater from the fish pond (which contains uneaten, fish faeces, and excretes) used as a source of nutrients for vegetable production. Vegetables can also be utilized as ingredients in feed formulation, and plant waste can be turned into compost, which can then be used as fertilizer in fish ponds.

When manure is used as fertilizer, it promotes natural food, by enhancing phytoplankton and zooplankton (Figures 3&4) growth at the food web base, eventually culminating in fish and other aquaculture species.
Natural food comprises animal (zooplankton) and plants (algae) (Figure 2).



A B C

Figure 2. A–C Shows types of natural food available in an integrated fertilized pond. (A) zooplankton, (B) Green phytoplankton and (C) Diatoms-phytoplankton (source: Internet)

Importance of fish, animal and vegetable integration
Diversification in livelihoods, which means: Combining fishing with other food producing activities to generate more income. For example, crop or livestock and farming, small-scale business or waged employment, amongst other options.

Recycle nutrients between different production components or result in additional food production with little or no additional effort or investment.

Fish farming and agriculture can be complementary activities: fish ponds provide water for irrigation or conversely water stored for irrigation can support fish; and nutrients produced on the farm, including crop wastes and animal manures, can be utilized as fish food.

When fish ponds are emptied for cleaning, the silt can be a rich source of nutrients that can be used to increase soil fertility for vegetable production.

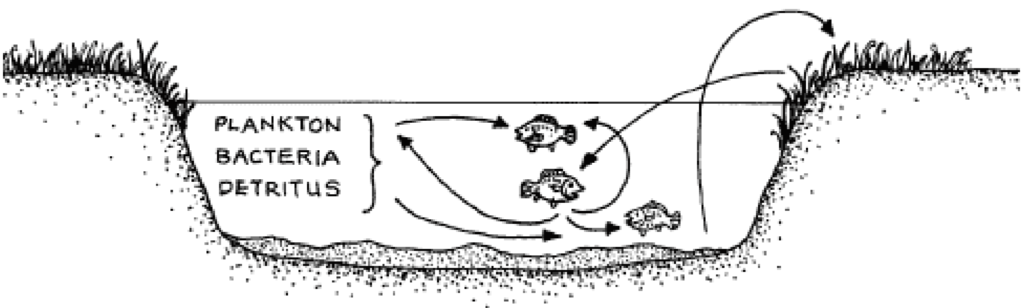


Fig. 3: Available natural food in an integration pond system

Promotes stability in production/ spread of risk and uncertainty; because it produces more than one product.

Sustainable resource management; Wastes of one enterprise become inputs to another and, thus, optimize the use of resources and lessen pollution (Conservation of the environment)

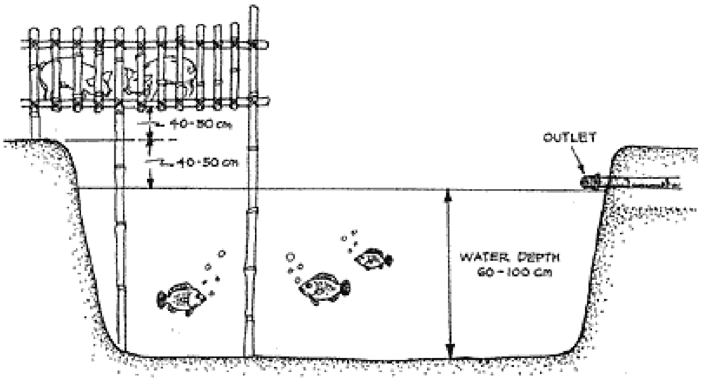


Figure 4. Pig and Fish pond with the animal housing above the pond. Manure drops directly into the pond.

Types of manure that can be used for integration system**:**

Cow dung manure
Advantages:
Bulk easily available

Disadvantages:
Contain a lot of fibre,
Which means that a lot of oxygen is required for decomposition

Chicken/ Ducks Manure

Advantages:
Less fibre, hence good source of nutrients

Pig Manure

Advantages:
Less fibre, hence good source of nutrients

2. Types of integration

i) Animal housing and pond (example pig and fish): The raising of pig can fruitfully be combined with fish culture by construction of an animal housing unit on the pond embankment (Figure 5) or over the pond (Figure 7) in a way that the wastes are directly drained into the pond. Housing should be built in such a way that rubbish collection is simplified.

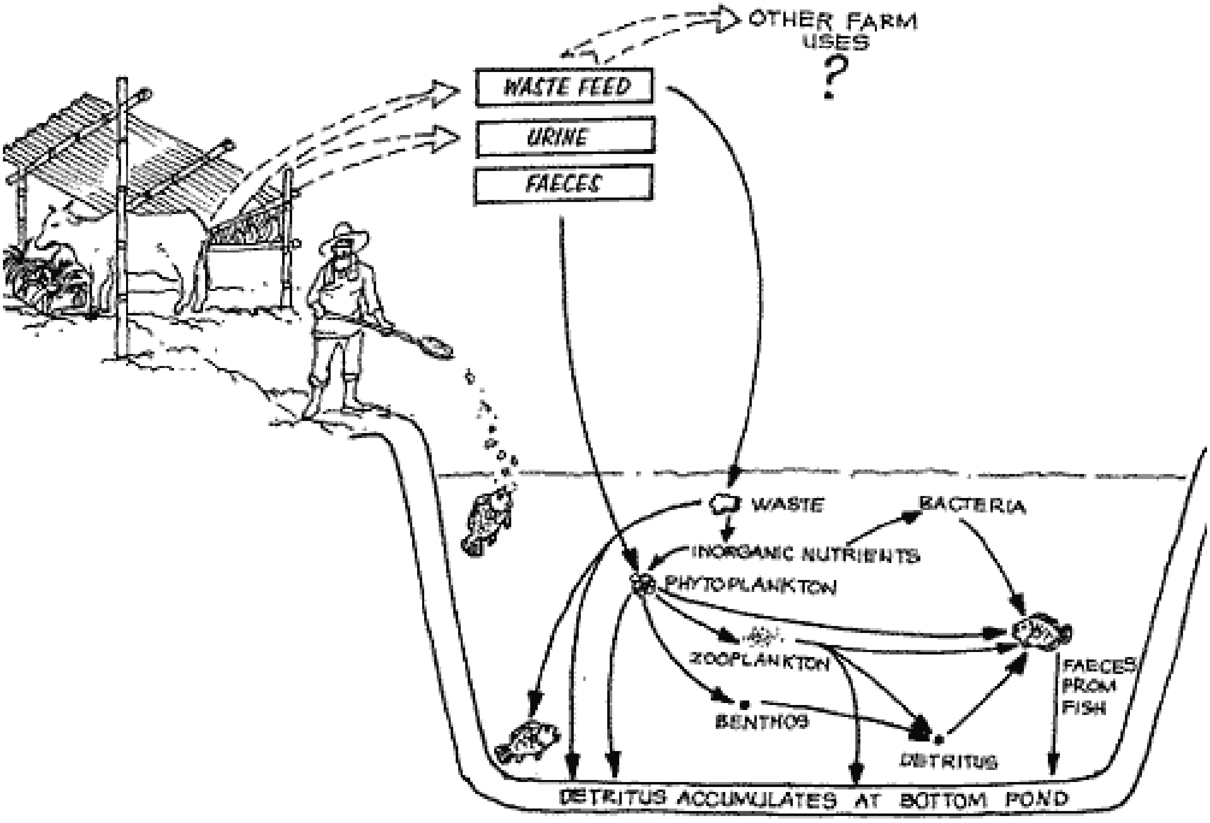
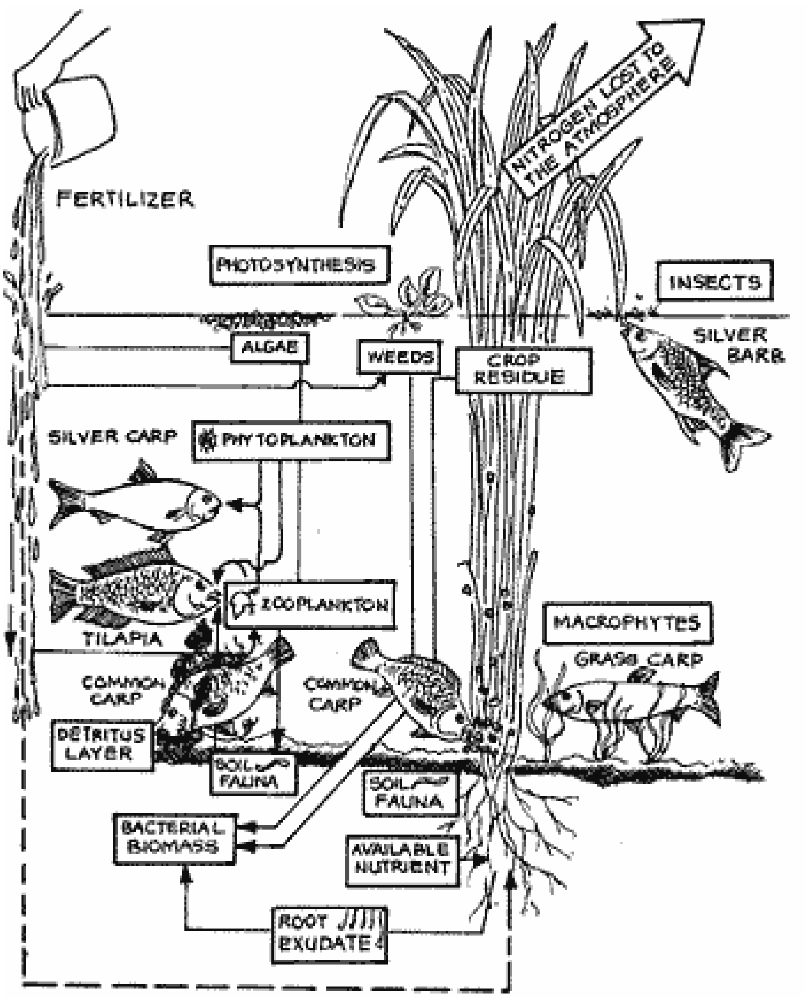


Figure 5. Cow and fish culture with the animal housing located on the embankment or dyke: Manure is transferred from the animal barn into the pond

ii). Animal housing besides the fish pond (example cow and fish).

iii) Fish, rice and animal besides the fish pond (Figure 6).



Fertilizer

Organic: available also to fish, plankton, algae, soil, fauna and bacteria

Organic matter: available only to rice crops, macrophytes / algae/ weeds, phytoplanktons and bacteria

Fig. 6: Rice and Fish culture in a polyculture system, where fish feed differently based on their feeding habit to avoid competition for space and food (Source FAO Training manual)

iv) Fish, animal housing and vegetable integration (Figure 7).

Fig. 7: Fish, animal housing and vegetable integration (Source fishconsultance.org)

3. How to assess the water quality and apply manure:

Check water transparent using Secchi Disc. Secchi Disk Is an instrument used to measure water turbidity. The Disk is attached to a rope and then lowered until you can no longer see the design (Figure 8). The distance to the surface from the disk below is then measured and the level of natural productivity is assessed (Table 1).
From table 1, it can be understood that fertilization should be done when water transparent is above 45 cm and should stop if less than 20 cm.

Table 1: Shows the depth and interpretation of secchi disk reading for management

Secchi Disk Depth (cm)	**Interpretation (explanation)**
0 - 20	Too much suspended solids stop fertilization (water exchange required), Stop feeding
20 - 30	A lot of algae, stop fertilization
30 - 45	This is the right depth and right water transparent
45 - 60	Few algae and suspended solids, fertilization is required
More than 60	Too transparent add fertilizers

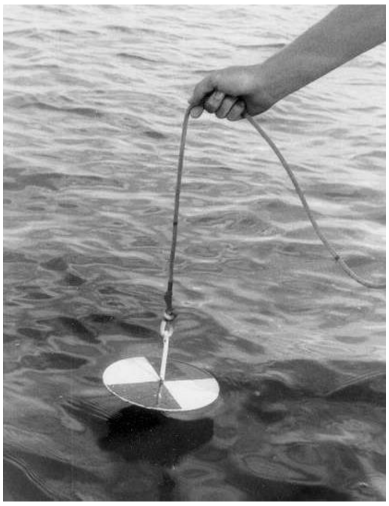



Fig. 8: Secchi Disk for measuring pond water turbidity

4. Feeding strategies under the integrated Agri-Aquaculture

As feed is very costly, it is important to adopt a strategy to reduce feeding costs. Supplementary feeding in integrated aquaculture systems can be reduced. Research shows that when fish were fed 50% of the required amount of feed in combination with weekly manure application, the yield was higher than when animal manure was used alone, or feeding alone (Figure 9).

NOTE: Therefore, farmers are advised to integrate pond farming system with animal keeping to improve natural food production and reduce feeding costs.

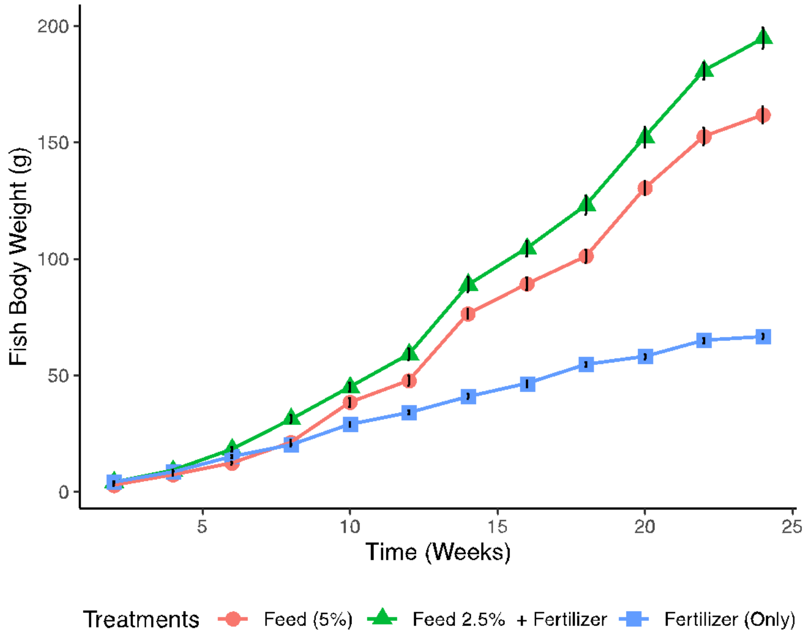


Figure 9. Fish yield when feed only was used (100 %), combination of feed (50%) plus fertilization and fertilization alone (Shabani et al. 2020).

5. Practical Session

Visit two different fish farmers with fish ponds and conduct water quality assessment (DO, Temperature, pH and conductivity using a DO miter) and turbidity (using secchi disk)

Fertilization of fish pond using chicken manure

Assess economic benefit of integration and non-integrated systems.