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

SMART STORAGE SYSTEMS

Empowering Agriculture: A Step-by-Step Guide to Assemble Your Charcoal Cooling Blanket

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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

Empowering Agriculture: A Step-by-Step Guide to Assemble Your Charcoal Cooling Blanket

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The Charcoal Cooling Blanket is a net zero energy solution that through evaporative cooling improves the storability of fresh fruit and vegetables. The blanket results as being user-friendly, cheap to manufacture and biodegradable. The solution was tested in Uganda where over 70% of population is engaged in agricultural activities. The nation boasts over three and a half million family farms, with a significant portion of its smallholder farmers ranking among the most economically disadvantaged individuals globally (FAO, 2023).

High levels of food losses are prevalent among smallholder farmers, primarily attributed to the absence of cold storage facilities (Ricciardi et al., 2018). Consequently, fruits and vegetables are typically stored solely in natural shade, where elevated external temperatures and low humidity contribute to hastened aging and wilting. The charcoal cooling like evaporative coolers in general, can lower the air temperature in the cooler by 3-10 ºC and increase the relative humidity inside to 70 -100% (Defraeye et al., 2022). Though unlike general evaporative coolers, the CCB can reach more easily off-grid farmers due to its scalability and locally sourced material for its production.

In this guide it is possible to find the material and the procedure to assemble a charcoal cooling blanket of 3,5m in length and 0,6m in height (Fig.1).

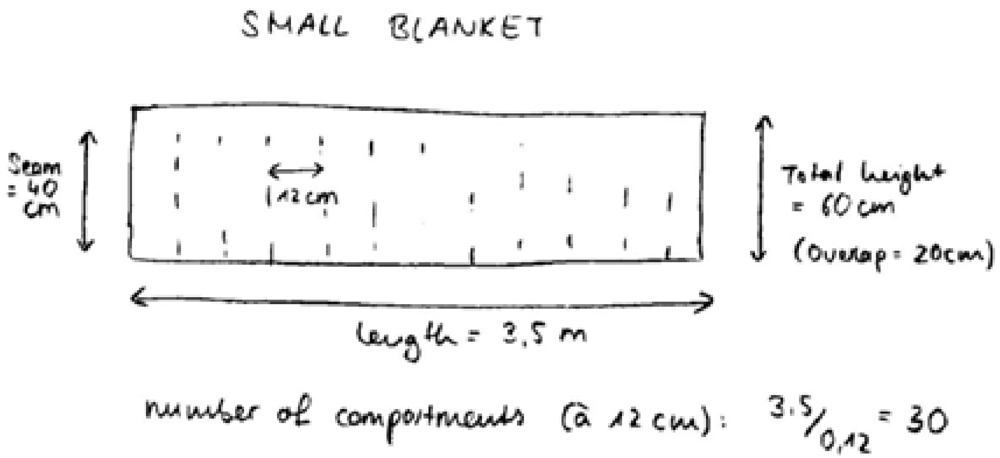

Figure 1. Drawing of a small charcoal cooling blanket with specifications regarding length, height, number and size of compartments.

Material

- 4X1m of Burlap/Jute or 4 Sisal bags
- Sewing needle and thick thread (200m)
- Markers

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- 1 Ruler or measuring tape
- Scissors or knife
- 12kg of Charcoal broken in medium sized pieces
- 1 plastic crate (0.6 x 0.4 x 0.3m max size)
- 1 rubber band (the same used by boda-boda drivers)
- 5 halved bricks
- Dried leaf cover or any other cover that guarantees insulation

Assembling procedure:

1. The material chosen for the blanket is measured with a tape and then using a ruler and a marker the sewing line are drawn (Fig.2). The dotted lines represent the borders of the compartments of the blanket.

Figure 2. A bag of sisal was laid on the ground to be measured and marked to afterwards sew the compartments.

2. Using a sewing needle and a thread, the dotted line were sewed to create the compartments (Fig.3).

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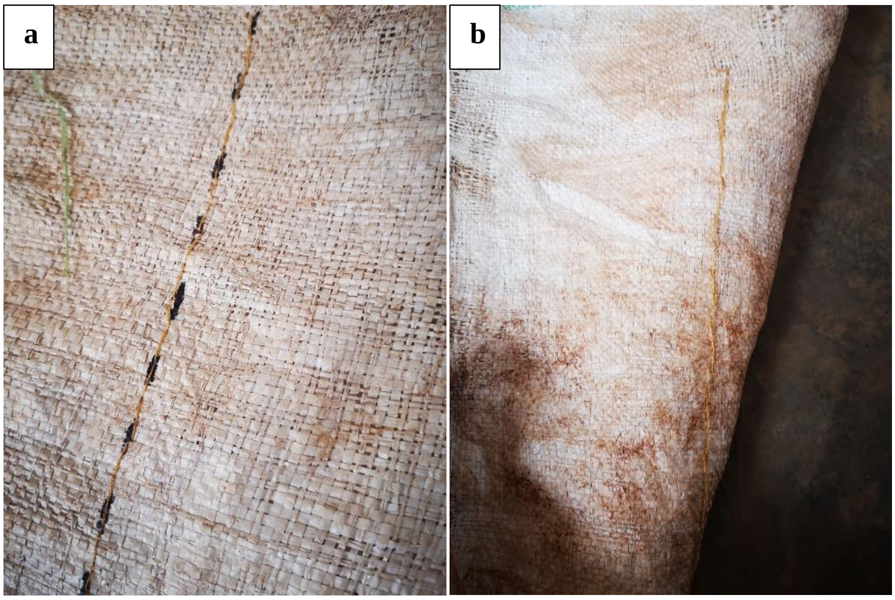

Figure 3. Picture (a) shows the sewing line in yellow on one side of the sisal bag. Picture (b) shows the sewing line in yellow on the opposite side.

3. The same procedure has to be repeated on 4 sisal bags then sewed together or along the 4m burlap sheet. Once all the compartments are formed, it is possible fill them with pieces of charcoal (12kg) (Fig.4).

Figure 4. Picture (a) shows the process of filling the burlap blanket by hand. Picture (b) shows the finished charcoal cooling blanket made with sisal bags.

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4. The Charcoal Cooling Blanket is then wrapped around the plastic crate that contains the fresh produce. Four halved bricks are placed on the side of the crate and another one below the crate. The aim is to create air spaces between the blanket and the crate and the blanket and the ground to improve air movement and consequently the cooling.

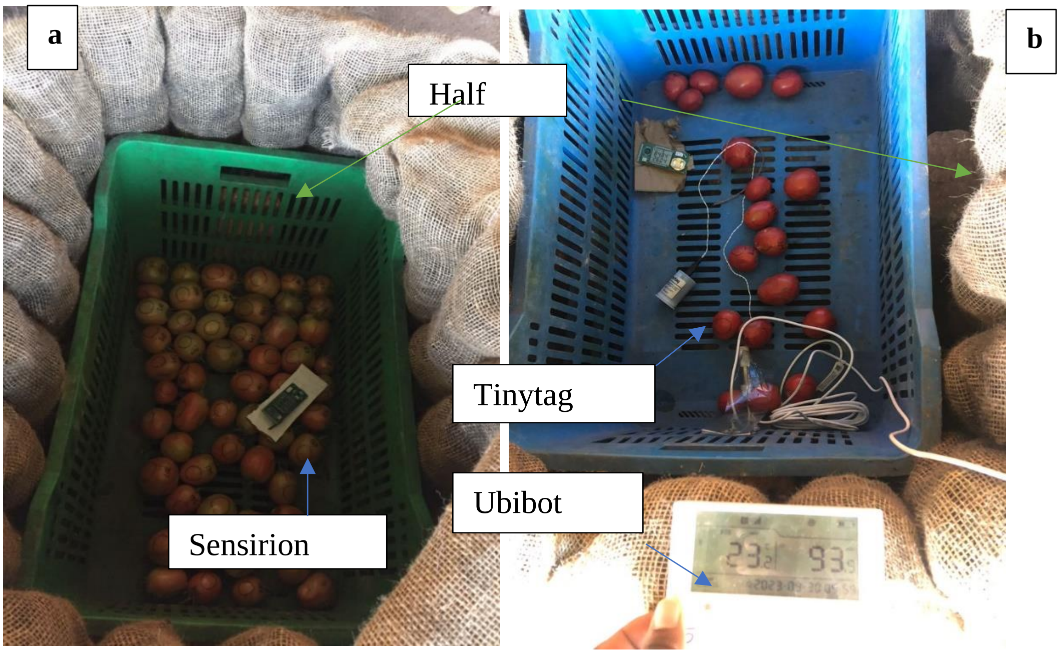

Figure 5. Pictures (a) and (b) show an example of how the plastic crate containing fresh tomatoes is wrapped within the CCB. The label and black arrows indicate two visible halved bricks. One halved brick per side was positioned though only these two are visible in the pictures.

5. Once the blanket is wrapped around the crate, a black rubber band is tied around it to guarantee adherence. Then a cover made of dried leaves was applied on top to insulate the system (Fig.6).

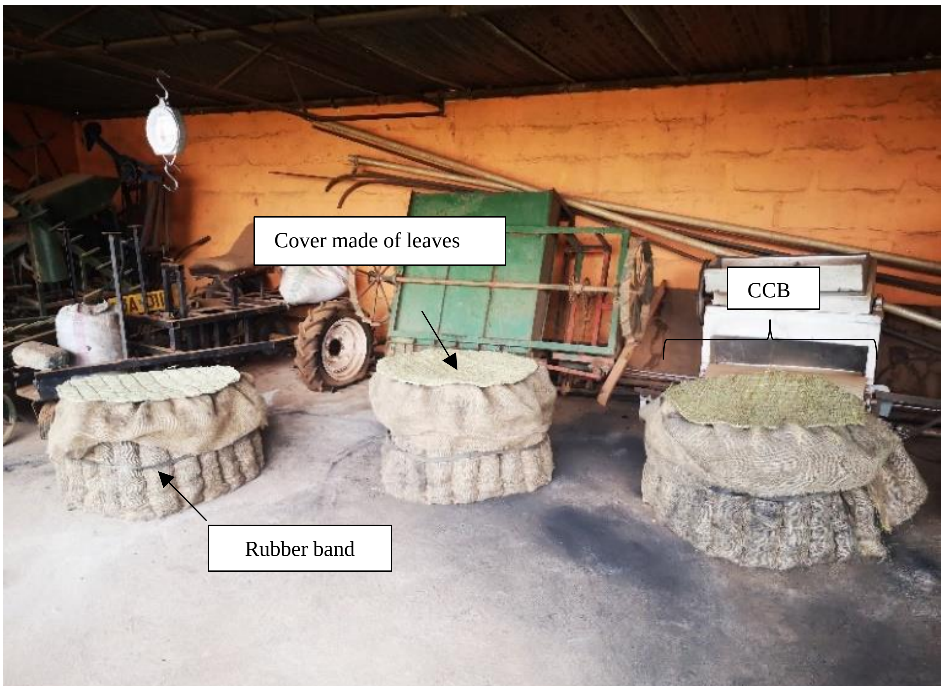

Figure 6. Three finished blankets tested at Makerere University. It is visible the rubber strap tied around and the leaf cover on top.

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6. In order to monitor the cooling performance of the blanket it is possible to insert hygrothermal sensors inside and outside the blanket to gather and compare temperature and relative humidity data. In the study conducted by Agroscope, three sensors were employed (Fig.5a,5b):
   - Sensirion sensors -> Bluetooth hygrothermal sensor (SHT4X SMART GADGET, Sensirion AG, Stäfa, Switzerland)
   - Tinytag sensors -> product's core temperature, temperature data logger with probes (Tinytag Talk 2 - TK-4023, West Sussex, United Kingdom)
   - Ubibot sensors -> IoT Wi-fi hygrothermal sensors equipped with probes (UbiBot WS1 Pro, Hong Kong)
7. In order to initiate the cooling action of the blanket, it is necessary to pour water on top of the charcoal though it is important to avoid wetting of the fresh produce to avoid molding inside the blanket (Fig.7). A watering can or a plastic bottle can be used to pour the water and the amount can range from 3-5L depending on the dryness of the climate. During the Ugandan wet season, 3L were applied on one blanket, 2/3 times a week in the early morning.

Figure 7. The picture represents the event of watering the blanket using a watering can. 3L were applied going around all the area of the CCB.

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The blanket was tested also for transport to simulate a cold supply chain from the field to the market. The assembling of the blanket followed the before mentioned procedure, in addition it was mounted on top of a boda-boda and transported to the local market (Fig.8a). The use of the blanket extended the selling of tomatoes of two days leading to an increase in the income of the market lady, owner of the stand (Fig.8b).

Figure 8. Picture (a) shows how the cooling blanket mounted on a boda-boda. Picture (b) shows the positioning of the blanket at a market stand in Kabanyolo, Uganda.

Reference List

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