Training manual on EbA measures
PRESENTATION

This manual was designed as a support tool to train staff that offers technical assistance to small-scale farmers in the implementation of ecosystem-based adaptation (EbA) measures. Technical allies work with microfinance institutions in demonstration farms that allow, on the one hand, to show-case EbA solutions and, on the other, to offer financing for their implementation.

The fact sheets in the manual are aimed at the trainer in charge of sharing information with small-scale farmers on the EbA measures in these demonstration farms. The practical and didactic activities included are some ideas to “teach and learn by doing”. The objective is to have a work method to offer technical assistance that allows the greatest possible success in the implementation of the EbA measures. Certainly, successful experiences will also depend on access to financing and timely follow-up on some of the key points highlighted in the manual.

MEbA team
Learning objectives
a) Elements of conservation agriculture
b) Benefits for soil and water

Materials
a) Green manure and vegetable seeds and seedlings
b) Organic fertilizer
c) Straw bales
d) Tools
e) Hose for irrigation

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about conservation agriculture and its benefits?

Key messages
Conservation agriculture:
- Involves covering the soil, no tilling and crop rotation.
- Avoids soil and nutrient loss and maintains soil moisture.
- Is low cost and improves productivity with less work.

2. Training

a) Preparation of the land and planting (20 min)

Hands-on activity
With the help of the participants, prepare the soil and sow while explaining the steps for conservation agriculture.
- Do not till the earth; if necessary you can break up the top layers of soil using a pick or a chisel plough.
- Apply organic fertilizer to the land.
- Cover 100% of the surface with 5 to 10 cm of straw. You can also use harvest residues or green manure.
- Plant seeds and seedlings in rows. You can use tools for direct planting.
- Water the seeds or seedlings and the surrounding straw.

Cover the soil with straw or mulch to increase organic matter and maintain soil moisture.

Do not till the soil. You can use a chisel plough to break it up.
b) Green manure and crop rotation (20 min)

Didactic activity

Explain crop rotation while you show a green manure seed or plant.

- Crop rotation helps break the cycle of pests and restores soil fertility.
- Green manures are short cycle crops (2 to 4 months) that are planted between crop cycles, cut and left on the soil as mulch.
- They increase soil fertility and protect against erosion.
- You can also use other crops in rotation that do not use up the same nutrients from the soil.

There are specific tools for direct planting, such as this borer which has seeds on one side and fertilizer on the other.

When the soil is covered and not tilled a new layer of fertile soil is created.

c) Explaining the EbA measure (10 min)

Didactic activity

Show where each of the key points applies in the system so that it works correctly.

KEY POINT 1: Covering the earth stops rain or wind from eroding the soil and taking away its nutrients. Organic matter acts as a sponge that retains moisture in the soil for longer.

KEY POINT 2: Direct planting with no tilling avoids exposure of the soil to the air. This maintains its biological and chemical wealth and helps with the development of crops. It avoids erosion, conserves nutrients and maintains life in the soil.

KEY POINT 3: Crop rotation breaks the cycle of pests and weeds. When broken with green manure or legumes it also fixes nitrogen in the soil that will then be available for the crops.

The long term effect of the combination of these three points is a more fertile soil, richer in organic matter.

Crop residues make excellent mulch. It is important to leave them on the soil and not burn them.

¡TIP!

Conservation agriculture does not involve extra costs. On the contrary, you can achieve better yields with less work and fewer chemical inputs. However, when thinking about integrated productive systems a change in mentality is necessary. You can see the results of this system after just a few crop cycles.

QUESTIONS FOR PARTICIPANTS
1. What is the purpose of mulch?
2. What is the purpose of green manure and crop rotation?

ANSWERS
1. Mulch protects the soil from erosion by wind or water.
2. Green manure is used to improve soil fertility and is used as mulch when it reaches maturity.

Allocated time for questions and evaluation of the training

END OF ACTIVITIES
BEEKEEPING

Learning objectives
a) Assembly and parts of a hive
b) Materials and equipment necessary for beekeeping

Materials
a) Wooden hives with bees, one disassembled
b) Protective clothing and equipment

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about beekeeping and its benefits?

Key messages
Beekeeping helps to:
- Pollinate crops and wild flora (increasing productivity).
- Diversify income with the production of honey, wax, propolis, pollen and royal jelly.

2. Training
a) The hive (20 min)

Hands-on activity
Assemble a hive, demonstrating each component and its function.

- Support or stand: raises the floor of the hives, avoids accumulation of moisture.
- Bottom board: base that provides a platform for the entry and exit of bees from the hive.
- Brood super: a chamber containing removable frames where the bees build their comb to reproduce.
- Frames: where bees build their comb for broods or honey.
- Queen excluder: stops the queen from entering the brood chamber during the production of royal jelly or queen reproduction.
- Honey super: hive boxes that contain frames for the production of honey. There are between 1 and 3 supers per hive.
- Inner cover: controls ventilation and the temperature of the hive, there is usually a sliding board to regulate these two factors.
- Outer cover: removable cover that protects the hive and stops rainwater from getting inside.

The hive is detachable; for example, to get to the honey super and harvest honey you take off the outer and inner covers, blowing smoke into the hive.
b) Equipment (20 min)

**Hands-on activity**

Ask a volunteer to put on the protective clothing.

- Demonstrate the protective clothing: suit (white trousers and top), boots, helmet and veil, gloves.
- Show the participants the smoker and demonstrate how to use it.

![Smoker image](image)

A smoker is essential when working with bees. The smoke repels the bees and makes them sleepy while the producer works on the hive.

c) Explaining the EbA measure (10 min)

**Didactic activity**

Guided visit to an apiary to see the hives and their set-up while maintaining a safe distance.

**IMPORTANT:** participants should not approach the hives without protective clothing.

**KEY POINT 1:** The amount of hives you can have depends on the availability of flowers in the surrounding area. The normal ratio is between 20 and 30 hives per hectare. Bees have no problem finding food in the flowering and rainy seasons. In dry periods they should be fed with water, sugar and pollen.

**KEY POINT 2:** The apiaries should be placed in areas that are isolated from people and close to permanent water sources. In dry periods, there should be a water container inside the hive.

**KEY POINT 3:** The entrance and exit of the hives should not be directly facing predominant winds because this inhibits the activities of the bees.

**KEY POINT 4:** The hives should be placed horizontally, sloping slightly forward to facilitate the drainage of any water that accumulates in them.

![Hive image](image)

The bees deposit honey in the comb and seal it with wax. To extract the honey, remove the wax and put the frames in a centrifuge. After this you can filter the honey.

**¡TIP!**

Propolis is a natural antibiotic. To collect it, put a plastic sheet under the cover of the hive. To collect pollen, put a pollen trap at the entrance of the hive. To collect royal jelly, you must separate the brood super and honey super with an excluding mesh to stop the queen from getting through. Each of these products has a high nutritional and market value.

The protective clothing is white because bees cannot see this color and do not react to it as they do when they see bright colors. The smoke confuses the bees and stops them from becoming aggressive; however, excess smoke can put the bees into an aggressive state.

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**QUESTIONS FOR PARTICIPANTS**

1. What factor defines how many hives we can put in one place?

**ANSWERS**

1. The quantity of flowering plants in the area. The more flowering plants, the more hives you can have.

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**Allocated time for questions and evaluation of the training**

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**END OF ACTIVITIES**
BIODIGESTER

Learning objectives
a) Benefits of biodigesters
b) Functions of each component
c) Dilution and application of biofertilizer

Materials
a) Manure
b) Water
c) Buckets, cloth and backpack sprayer

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange

What does the group know about biodigesters and their benefits?

Key messages

A biodigester:
- Produces biogas as a source of energy.
- Produces organic fertilizer which is useful to restore degraded agricultural land.

The biodigester bag is made of PVC or polyethylene and is inflated with a compressor before the system is turned on.

2. Training

a) Elements and uses of the system (20 min)

Didactic activity

Demonstrate the components of the biodigester. Ask the participants to help you explain how it works.

- At the entrance there is a container made of cement or plastic. Here, the manure is diluted with water in a ratio of 1:4 until a homogeneous mixture is obtained.
- The bag or membrane is where digestion takes place and biogas is stored. It is made of PVC or high density polyethylene.
- You can collect the biofertilizer and store it for later use in the exit chamber and storage tank.
- The biogas management system includes security valves, a trap for hydrogen sulfide and a stove.

The entry chamber dilutes the manure and regulates its flow into the biodigester.
b) Dilution and application of biol (20 min)

**Participatory activity**

Prepare the biofertilizer with the help of the participants.

- Filter 2L of biofertilizer in a 20L bucket using a net to remove large particles.
- Add 10L of water to the bucket and mix well.
- Pour the mixture into the sprayer and finish filling it with water until it reaches 20L.
- The biol content for application should not surpass 10% (2L of biol in a 20L tank) otherwise it can damage crops.
- Using the sprayer, apply the biol to the stalks and on the backs of the leaves of the chosen plant and let it drip onto the soil.

c) Explaining the EbA measure (10 min)

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** Cow rumen or manure can be used to inoculate the system with anaerobic microorganisms.

**KEY POINT 2:** The biodigester works best at an ambient temperature of 20°C. If the average temperature falls below 15°C the biodigester should be put in a greenhouse.

**KEY POINT 3:** The stove should be adapted for use with methane gas and the biogas system should have security controls to avoid accidents or deficient operation.

**KEY POINT 4:** The retention time for manure to turn into biofertilizer is from 30 to 40 days, depending on the ambient temperature. The higher the temperature, the shorter the retention time.

The biogas outlet is airtight. There are two security valves in the system: one alleviates excess pressure and the other stops gas from returning. A trap for hydrogen sulfide is installed in front of the stove.

**¡TIP!**

Request support from qualified providers that use high quality material and provide user training to guarantee the system’s adequate dimensioning and proper functioning.

Savings in fertilizer and fuel make biodigesters a profitable option for farms with livestock or easy access to manure.

**QUESTIONS FOR PARTICIPANTS**

1. What fuels a biodigester?
2. What are the products of a biodigester?

**ANSWERS**

1. Diluted manure to the ratio of 1 part manure to 4 parts water.
2. Biofertilizer to apply in soils and biogas as fuel for cooking.

Allocated time for questions and evaluation of the training

END OF ACTIVITIES
Learning objectives
a) Benefits of solar dehydrators
b) Function of each of the components

Materials
a) Coffee or cocoa beans to begin drying
b) Dry beans for demonstration

1. Introduction to the EbA measure (10min)

Participatory knowledge exchange
What does the group know about solar dehydrators and their benefits?

Key messages
Conservation agriculture:

A solar dehydrator helps to:
- Improve the drying process of products like cocoa or coffee.
- Add value to fruit, meat or herbs to sell them as processed products.

Dehydrators have a heat collector and a greenhouse cover. The structure can be made of metal, wood, bamboo or other local materials.

2. Training
a) Elements and uses of the system (20 min)

Didactic activity
Demonstrate the components of the dehydrator. Ask the participants to help you explain how it works.

- Steel, aluminum, wood or bamboo structure.
- Solar panel. To receive the most sunlight possible, the panel should be inclined to the same gradient as the latitude of the location it is implemented in.
- Greenhouse plastic maintains heat in the drying chamber.
- Drying trays or beds.
- Outlet for hot and humid air (a wind-operated fan may be installed).

Beds or trays that allow for the flow of air are used for drying. In this case the trays have PVC netting.
b) Solar dehydrator in operation (20 min)

**Participatory activity**
Demonstrate the drying process, ask the participants to check how dry the beans are, as well as the temperature inside the dehydrator.

- To begin the drying process put fermented cocoa or coffee beans on the trays in layers 5 cm thick.
- Periodically turn the beans so that they dry uniformly.
- Choose some beans that have gone through the drying process and ask the participants to check if they are dry.
- The cocoa is dry when at 6% to 7% moisture. At this moisture level the beans are brown-colored, make a crackling sound when rubbed together and break easily.
- Coffee is dry at a moisture content of 12%. When you remove the husk, the bean has a green-grayish color.
- Ask a participant to check the temperature inside the dehydrator using an ambient thermometer and compare it to the temperature outside.

Using the trays, you can control the level of dryness of different varieties or qualities of the same crop or different products in the same space.

c) Explaining the EbA measure (10 min)

**Didactic activity**
Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** Humidity and temperature can be controlled by regulating the air flow. You should let in more or less air depending on the climatic conditions of the area. Low temperature and high humidity do not allow for good drying.

**KEY POINT 2:** In areas with heavy rain a solid cement floor is recommended to avoid the floor becoming damp with the rain and affecting the drying process.

For efficient drying there needs to be an air flow and a difference in the temperature of the air coming in and going out.

Dehydrators are a good alternative to improve the drying process of traditional crops like coffee and cocoa, and also to dehydrate fruit, herbs and meat. This way, you can sell a processed product instead of primary material and achieve a higher income.

**QUESTIONS FOR PARTICIPANTS**
1. How can you tell that a cocoa bean is properly dried?
2. How can you tell that a coffee bean is properly dried?

**ANSWERS**
1. The cocoa bean is brown colored and makes a crackling sound when rubbed. It should have a moisture content of between 6% to 7%.
2. The coffee bean is green-grayish colored when dry and it has 12% moisture.

**Allocated time for questions**
and evaluation of the training

**END OF ACTIVITIES**
Learning objectives

a) Benefits of ecotourism
b) Some of the main elements of an ecotourism project.

Materials

a) Established ecotourism project
b) Material to take notes and make a map (paper, pens, markers)
c) Mobile phone or cameras to take photos and short videos

1. Introduction to the EbA activity (10 min)

Participatory knowledge exchange

What does the group know about ecotourism and its benefits?

Key messages

Ecotourism helps to:
- Diversify producers’ income.
- Promote a culture of conservation among visitors.
- Conserve the biological and cultural diversity of natural areas and agroecosystems.

2. Training

a) Tour of the ecotourism area (20 min)

Hands-on activity

With the help of the participants go around an ecotourism project to identify its main elements.

- Ask participants to take photographs and make notes on the details of the tour.
- Walk around the areas of natural beauty, identifying conservation practices.
- Go to the productive areas taking note of practices for crop diversification, efficient water use, and nutrient, pest or soil management.
- Visit areas with infrastructure for visitors and ask participants to identify elements of bioconstruction, renewable energy, energy efficiency, water treatment and solid waste management.
- Finish the tour in the commercial area, taking note of whether there are local handicrafts and products, or products that have been made on site.

An ecotourism project requires infrastructure to receive visitors, good management of resources and waste, commercial strategies and above all attractive natural surroundings.

- If the project does not include some of the elements described above, ask participants where they think they should be and what practices or techniques they would apply.

In agrotourism farmers share their experience of sustainable production with visitors and offer their products for sale.
**b) Create a map of the area (20 min)**

**Hands-on activity**

Ask participants to draw a map with the main characteristics of the site.

- Draw out the area including easily recognisable elements.
- Add ecosystem services that the area offers (provision, regulation, support, cultural services).
- Add paths, points of natural beauty, productive areas, visitor infrastructure and commercial area.
- Include some of the following characteristics:
  - Fauna and flora.
  - Conservation practices: reforestation, soil restoration, sustainable forest management.
  - Sustainable production practices: organic fertilizers, mixed systems, efficient irrigation, terraces,
- conservation agriculture, greenhouses, nurseries.
- Ask participants what elements of sustainability, conditioning or design they would incorporate to improve the ecotourism project and where.

**c) Explaining the EbA activity (10 min)**

**Didactic activity**

Explain the key points for implementing ecotourism effectively.

**KEY POINT 1:** Before starting an ecotourism project it is advisable to have a business plan and a management plan. This way you guarantee the economic and environmental sustainability of the project. Both plans can be done in stages, including incremental project goals.

**KEY POINT 2:** The business and management plans should especially consider the carrying capacity of the project. This is determined by physical factors (e.g. accessibility of paths), ecological factors (e.g. seasonality of species or tolerance to the passage of people) and economic factors (e.g. number of rooms and wastewater treatment capacity).

**KEY POINT 3:** Staff training in customer service and sustainable management of natural resources provides coherence to the project. It is important that visitors learn by example to bring about a shift in consciousness.

**SIDE BOX:**

The use of local materials and eco-technology in visitor infrastructure provides coherence to the project.

**SIDE BOX:**

Signs are an essential element to guide visitors and give them information about local attractions, native species, adaptation measures, crops varieties, conservation areas, warnings and other key messages.

**TIP!**

Damage to the area can be prevented by implementing an ecological code of conduct for visitors and employees. It is also important to establish who is responsible for its enforcement.

**QUESTIONS FOR PARTICIPANTS**

1. What is the purpose of having signs on the paths?

**ANSWERS**

1. Inform visitors about the different areas of interest, species, crops, productive measures, warnings and other key messages.

Allocated time for questions and evaluation of the training

**END OF ACTIVITIES**
Learning objectives

a) Components of the hydroponic system
b) Benefits and operation of the system

Materials

a) Solar hydroponic system
b) Organic liquid fertilizer
c) Seedlings and substrate for planting

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange

What does the group know about solar hydroponics and its benefits?

Key messages

Solar hydroponics allows to:
- Obtain high yields in a reduced space
- Use less water than conventional cultivation methods.

2. Training

a) The system (20 min)

Didactic activity

Show the components of the system to participants and explain their function.

- Reservoir: constructed under the structure with a PVC membrane. It contains all the water in the system which circulates continuously. It is also recommended that you keep fish and aquatic plants here.
- Elevated tank: receives water from the pump and distributes it to the irrigation system.
- Pump and photovoltaic system: pumps water from the reservoir to the elevated tank with solar energy. The filter should be cleaned regularly.
- PVC pipes: seedlings are planted in pipes containing substrate.
- Irrigation system: each PVC pipe has a drip irrigation line. 3-4 hours of irrigation per day is recommended.
- Polytunnel: the system is covered in a polytunnel to maintain a constant temperature.
b) Fertilization (20 min)

*Participatory activity*

With the help of volunteers, plant seedlings in the substrate and add liquid fertilizer to the water in the reservoir.

- Distribute the seedlings among volunteers and ask them to plant them in the moist substrate of one or several PVC pipes.
- Insert the root of the plant in the substrate, leaving the leaves above the surface in order for them to have access to sunlight.
- Ask another volunteer to put the liquid fertilizer in the water in the reservoir. Turn on the irrigation system.
- The fertilizer dissolves in the water in the reservoir and begins to circulate in the system. It reaches the substrate via the irrigation system.
- The use of liquid humus (vermicompost leachate) is recommended. It should be well filtered to avoid blocking water circulation.

![Image of a greenhouse with pipes and solar panels]

Cut pipes are filled with substrate and a drip irrigation system is installed. The solar pump brings water from the storage tank to the elevated tank and the irrigation system is powered by gravity.

It is recommended that the whole system is produced and installed by a certified provider who can also train users on its use and maintenance.

When building the system yourself you can adapt it and use local materials.

![Image of a greenhouse with pipes and solar panels]

The hydroponic system recuperates the initial investment in a short time, with more efficient production in little space with little water. To maximize yields you should cultivate crops with high market value.

The system requires periodic maintenance.

![Image of a greenhouse with pipes and solar panels]

c) Explaining the EbA measure (10 min)

*Didactic activity*

Explain the key points while the system is working.

**KEY POINT 1:** The substrate supports the plants in the PVC pipes. For effective drainage, put down a layer of small-diameter gravel first, followed by a fine mesh and finally vermicompost or fertile soil.

**KEY POINT 2:** The plants are fed by organic liquid fertilizer which is added to the water in the reservoir, but also by other elements that can be incorporated into the system such as aquatic plants and fish in the reservoir.

**KEY POINT 3:** The pump constantly circulates water. It uses the energy provided by the solar panel. It can either be connected directly to the panel or via a battery.

**KEY POINT 4:** System maintenance involves checking that the irrigation system, pipes, connections, substrates and the pump are working properly. It is important to install filters for the pump and distribution system. The filters should be cleaned regularly. Liquid fertilizer should be filtered before it is added.

**QUESTIONS FOR PARTICIPANTS**

1. What are the elements of a solar powered hydroponic system?

**ANSWERS**

1. Pump and photovoltaic system, drip irrigation system, water reservoir, crops, PVC pipes with substrate, polytunnel or shade mesh.

Allocated time for questions and evaluation of the training

END OF ACTIVITIES
FAMILY ORCHARD

Learning objectives

a) Elements of a family orchard
b) The way to prepare double-digging beds
c) Benefits for family food security

Materials

a) Seeds for low stratum crops (lettuce, carrot, etc.)
b) Seeds for medium stratum crops (corn, quinoa, amaranth)
c) Seedlings for high stratum crops (preferred fruit trees or shrubs)
d) Organic fertilizer
e) Tools (spade, pitchfork)
f) Materials for marking double-dug beds (stakes, string)
g) Hose for irrigation

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange

What does the group know about a family orchard and its benefits?

Key messages

A family orchard:
- Provides varied food for the family.
- Takes advantage of available space using various plant strata.
- Generates income through the sale of vegetables and crops.

Double digging: dig a ditch the depth and width of the spade and then break up the soil in the ditch with a pitchfork.

Move the earth from the second ditch to the first, breaking up the soil below and repeating the process until you cover the whole area.

2. Training

a) Preparing the land (20 min)

Hands-on activity

With the help of participants, prepare the land, explaining each step.

Prepare the land with double-dug beds:
- Decide on an area of approximately 10 m² (e.g. 1.25 m x 8 m) and mark it out to avoid stepping on it and compacting the soil.
- Make a ditch the depth and width of a spade for the length of the area (e.g. 30 cm x 30 cm x 1.25 m). Put the excavated earth in buckets or near the marked area.
- Break up the soil at the bottom of the ditch without turning it by moving a pitchfork back and forth through it every 15 cm.

- Move behind the ditch and repeat the process, filling the previous ditch with the earth removed from the second. Break up the soil at the bottom of the second ditch.
- Repeat until you have covered the entire area (e.g. 8 m).
- It is recommended that you cover the beds with mulch.
**b) Planting at different strata (20 min)**

**Hands-on activity**

With the help of the participants, plant on three strata while you show the plants for each stratum and explain their role.

- The strata are organized to take advantage of light and space, including soil depth. The root depth is proportional to the height of the plant. You should organize the area in a way that the quantity of space, light and roots maximize plant development.
- The lower stratum is composed of vegetables (e.g., lettuce, radish, carrots). The medium stratum is made up of plants like corn or quinoa or crops that require additional support (e.g., tomato, beans). The upper stratum is composed of shrubs or trees (e.g., citrus fruits, vines). Show the plants for each stratum.

- Ask the participants to help plant the seeds and seedlings for the different strata: the lower plants on the outer edges of the beds and the medium ones at the center. This will allow them all access to sunlight.
- Ask the participants to plant the higher strata at the edges of the plot. Position them so that they block the wind or on the southern edge so as to avoid too much shade on the crops.

**c) Explaining the EbA measure (10 min)**

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** The size and location of the plot depends on the size of the family. It should be located close to the house so that it is easy to check and maintain.

**KEY POINT 2:** The kind of plants in the plot depends on the climate conditions of the area, the availability of water for irrigation and the dietary habits of the family.

Adjustments such as elevated beds can be made with local materials. Crops are for family consumption and the sale of surplus production.

The vegetable plot can be integrated into a productive farm, including small animals, a nursery, vegetables, medicinal plants, fruit trees and other elements to suit the needs of the family.

**¡TIP!**

A family orchard does not require much investment. It can be maintained by people in the home (women, children) and therefore it is important to place it close to the house and a secure water source. A drip irrigation system can be installed to facilitate care. The use of organic fertilizer and organic waste from the home, including manure from small animals, is recommended.

**QUESTIONS FOR PARTICIPANTS**

1. What are the benefits of double digging?
2. What is the reason for planting on various strata?

**ANSWERS**

1. It aerates and loosens compacted soil to help it absorb and retain water.
2. It takes advantage of sunlight and soil depth.

Allocated time for questions and evaluation of the training

**END OF ACTIVITIES**
GREENHOUSE

Learning objectives
a) The correct way of installing the greenhouse plastic cover
b) Benefits of greenhouses
c) Pest management in the greenhouse

Materials
a) Plastic sheeting
d) Yellow and blue plastic (1,5 m² each)

b) Wiggle wire
e) Molasses
c) Lock channel
f) Stakes
d) Yellow and blue plastic (1,5 m² each)
g) Brush
h) Nails

Learning objectives
a) The correct way of installing the greenhouse plastic cover
b) Benefits of greenhouses
c) Pest management in the greenhouse

Materials
a) Plastic sheeting
d) Yellow and blue plastic (1,5 m² each)

b) Wiggle wire
e) Molasses
c) Lock channel
f) Stakes
d) Yellow and blue plastic (1,5 m² each)
g) Brush
h) Nails

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about greenhouses and their benefits?

Key messages
Greenhouses help to:
- Increase yields through production in a controlled environment.
- Protect crops from heavy rain and strong wind.

To maintain optimal temperature for crops the greenhouse should have a good height and be well ventilated.

2. Training

a) Placing and attaching the plastic (20 min)

Hands-on activity
With the help of the participants, use the lock channel and wiggle wire to explain how to place and attach the plastic cover.

- Extend the plastic over the length of the greenhouse. Avoid ripping or making holes in it.
- Show participants the lock channel which should already be in place on the structure.
- Put the plastic into the lock channel followed by the wiggle wire. Attach the wire by sliding it from top to bottom.
- Pull the plastic tight avoiding creases or loose spots.
- Cut off the excess plastic with scissors.

The lock channel and wiggle wire help to pull the plastic tight without making any holes in it. This lengthens the lifetime of the material and maintains its function.
**Hands-on activity**

With the help of the participants, build traps for common pests.

- The blue traps are for thrips and the yellow traps are for aphids, whitefly, fruit flies, leaf miners and moths. The white traps attract mites.
- Cut one piece of yellow plastic and one piece of blue plastic by approximately 50 cm x 40 cm.
- Fix the plastic to two stakes with pins or nails so that they are smooth and push the stakes into the ground.
- You can make holes or cuts in the plastic to avoid damage from strong winds.
- Cover the plastic with molasses so that it is sticky and can trap the pests.

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** To make maximum use of sunlight, a greenhouse is normally positioned North to South with respect to its narrow edge, where the entrance is typically located. You should also pay attention to strong winds which could damage the structure.

**KEY POINT 2:** Tighten the plastic or anti-aphid netting with the lock channel and wiggle wire to avoid making holes in it and to avoid it getting damaged by the wind over time. Bury the bottom edge of the cover to avoid air or pests getting through.

**KEY POINT 3:** The effective management of water, soil, nutrients and pests is fundamental for sustainable greenhouse production. The use of organic fertilizer, efficient irrigation and traps for pests helps to increase productivity.

*The colored traps help control certain pests. They should be cleaned regularly and molasses or oil should be reapplied for them to keep working.*

*Management of water, soil, nutrients and pests inside the greenhouse is essential for sustainable production.*

*Windows with anti-aphid netting are recommended to regulate the temperature of the greenhouse without exposing it to pests. In addition to traps, you can use repellent plants and natural pesticides made with garlic, chili pepper and other herbs to control pests in the greenhouse.*

**QUESTIONS FOR PARTICIPANTS**

1. Why are nails not used to secure the plastic cover on greenhouses?
2. What are yellow and blue traps used for?

**ANSWERS**

1. Because the plastic deteriorates with wind and time.
2. To prevent pests such as whitefly, aphids or moths (yellow trap) or thrips (blue trap).

Allocated time for questions and evaluation of the training

**END OF ACTIVITIES**
VERMICOMPOSTING AND ORGANIC FERTILIZERS

Learning objectives
a) Elements of vermicomposting
b) Elements for making and applying “supermagro” fertilizer
c) Benefits of organic fertilizers

Materiales
a) Cow manure as source of N (65 kg)
b) Crop residues or straw as source of C (15 kg)
c) Earthworms (1 kg)
d) Mature vermicompost (15 kg)
e) Spades and pitchforks
f) Container with water trap
g) Ash (4 kg)
h) Milk or whey (2 l)
i) Molasses (2 l)

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about vermicomposting and its benefits?

Key messages
Vermicomposting helps to:
- Improve soil by restoring its capacity for absorbing and retaining moisture.
- Increase productivity by fertilizing the soil and reducing costs due to less reliance on chemical inputs.
- Diversify income if produced to sell.

2. Training
a) Adding the worms (20 min)

Hands-on activity
with the help of the participants, create a mixture for vermicompost production.
- The ingredients to start vermicomposting are sources of nitrogen (coffee pulp or manure), sources of carbon (harvest residues, straw, leaves) and mature vermicompost. Use the three ingredients in equal parts (15 kg in this case).
- With the help of the participants, put the three ingredients at the base of the composting bed and mix them with spades.
- For each 50 kg of the mixture, add approximately 1 kg of worms. Test moisture content by squeezing a handful of compost in your fist (it should form a ball that just about sticks together).
**b) Other fertilizers: “Supermagro” (20 min)**

**Hands-on activity**

With the help of the participants, prepare a mixture of “supermagro” in a 200-l container.

- Dissolve 50 kg of cow manure and 4 kg of ash or rock flour in 100 L of water in the 200-l container.
- Add 2 l of whey or milk and 2 l of molasses or sugarcane juice with water and mix.
- Hermetically seal the container and install an air lock. In a few minutes you will see bubbles in the bottle.
- Explain that in 20 to 30 days fermentation will be complete. In colder areas this can take between 60 to 90 days.

- The fertilizer will smell fruity and will be translucent and amber in color. If it is blue-purple and smells rotten there was a problem with the airlock.
- To apply, dilute 5 to 10 l of ferment with 100 l of water. You should filter the biofertilizer well before mixing.

![Diagram](Image)

*The production of “supermagro” is an anaerobic process (without air). The container should be hermetically closed and the air lock should be sealed with silicone.*

**c) Explaining the EbA measure (10 min)**

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** The dimensions of the composting beds depend on the quantity of organic waste generated by the farm or family.

**KEY POINT 2:** The process begins with a pile of the mixture at one end of the two production beds. As organic material is added, the pile spreads to the other end of the bed. As the worm compost matures it is left near the far end and the worms move to where the mixture is fresher. After about 21 days the compost will be mature and you can collect it.

**KEY POINT 3:** As it becomes moist the vermicompost mixture produces leachate (liquid that seeps out of the mixture). The system should have a chamber to collect the leachate which can be diluted with water and used as organic fertilizer on leaves.

**KEY POINT 4:** When producing “supermagro”, the container must be hermetically sealed. The air lock allows the gas generated in fermentation to escape while stopping air from getting inside. The gas trap should be sealed with silicone to guarantee that the system is anaerobic.

![Diagram](Image)

*Build the beds on a slight slope so that the leachate flows into the container. Dilute the leachate to a ratio of 1:20 and apply to leaves.*

**¡TIP!**

Keep the mature vermicompost somewhere dry to sell or apply later. It is recommended to apply compost before planting and during the cultivation period. It is cheaper to produce vermicompost than to buy it.

Once the supermagro is fully fermented and the container has been opened, you must use it within a few days before it goes bad. Dilute to 10% (1 part of “supermagro” for 10 parts of water) and apply to the soil during the crop growth period.

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**QUESTIONS FOR PARTICIPANTS**

1. How many days does it take to make vermicompost?
2. What is the purpose of the air lock in the process of making “supermagro”?**

**ANSWERS**

1. Vermicompost matures in approximately 21 days.
2. To allow gases produced by fermentation to escape but to stop air getting into the container as it could endanger the fermentation process.

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**Allocated time for questions and evaluation of the training**

**END OF ACTIVITIES**
# Rainwater Reservoir

## Learning objectives
a) Benefits  
b) Elements of the reservoir  
c) Importance of filters and overspill

## Materials
a) Sediment filters  
b) Reservoir exit valve  
c) PVC pipes for overspill

## 1. Introduction to the EbA measure (10 min)

### Participatory knowledge exchange
What does the group know about rainwater reservoirs and their benefits?

### Key messages
Reservoirs help to:
- Store water for use in dry periods.
- Increase productivity.
- Increase moisture in the surrounding area.

## 2. Training  
a) Main elements (20 min)

### Didactic activity
Explain the main elements required for the reservoir to work correctly.
- Reservoirs should have an impermeable layer. You can use a geomembrane, cement or compacted clay.
- Build the bottom on a slight slope to allow water to flow to the exit pipes.
- Build a simple filtration and sedimentation system before the entry canal or pipe.
- The exit has two pipes, one for cleaning and one for distribution.
- Put a pipe or overflow canal at the top of the reservoir to channel excess water to a drain.

- Digging of a reservoir and a ditch to support the geomembrane.

- Reservoir with geomembrane installed. Fill the ditch to hold the membrane in place once the reservoir is full.

- There are two exit pipes, one for cleaning and one for distribution with a filter to protect the irrigation system.
b) Distribution system (20 min)

**Didactic activity**

Demonstrate the distribution system and the elements that guarantee high-quality water for irrigation.

- Sedimentation tanks stop leaves, branches, rocks and other large objects that could damage the geomembrane or affect water quality from entering the reservoir.
- Filters are necessary to improve water quality so that it is appropriate for efficient irrigation.
- Place the reservoir in a high place so that the water in the distribution system is powered by gravity.
- The system should have a way to empty water from the reservoir to clean it or remove sediment.

In places where it is difficult to dig, you can build superficial reservoirs with a metallic structure and geomembrane.

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c) Explaining the EbA measure (10 min)

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** Calculate reservoir capacity based on the needs of irrigation, crops or livestock to provide productive systems with water for the entire dry season.

**KEY POINT 2:** Install a geomembrane cover or shade net, such as Raschel with a shade rate of 80%, to avoid the evaporation of stored water.

**KEY POINT 3:** Build the reservoir on unproductive, sloping land with a gradient of less than 30°.

Finished superficial reservoir. The water source should be higher than the tallest point of the reservoir.

**¡TIP!**

The reservoir needs maintenance every 6 months. Maintenance consists of emptying and removing mud and silt from the reservoir, checking all connections and cleaning filters. You should check and clean the irrigation system filters every week.

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**QUESTIONS FOR PARTICIPANTS**

1. Why is water filtered before it enters the reservoir?
2. What is the overflow or overspill channel for?

**ANSWERS**

1. To trap sediments brought by the rain that would make the reservoir water dirty.
2. For water to be able to escape if the maximum capacity of the reservoir is surpassed.

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**Allocated time for questions and evaluation of the training**

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**END OF ACTIVITIES**
EFFICIENT IRRIGATION

Learning objectives
a) Benefits of efficient irrigation
b) The importance of maintenance
c) Components of an efficient irrigation system

Materials
a) Uninstalled system components
b) Installed efficient irrigation system

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about efficient irrigation and its benefits?

Key messages
Efficient irrigation helps to:
- Water plants when they need it.
- Increase productivity.
- Fertilize plants with liquid fertilizers.

The water reservoir should fulfill the needs of the area that will be irrigated. It has valves and filters to control quality and quantity of water. It connects to the main pipe which supplies the distribution channels.

2. Training

a) Elements and uses of the system (20 min)

Didactic activity
Place the essential components of an efficient irrigation system in random order on the table. Ask the participants to help you put them into the correct order for installation, explaining their function.

- The system starts at the water reservoir.
- The gate valve lets water circulate throughout the system.
- The filter removes impurities in the water that could block or damage the irrigation system.
- The primary distribution pipe is buried and runs the whole width of the land that needs irrigating.
- The connectors or valves connect primary with secondary distribution.
- Secondary distribution has dispensers and runs the length of each bed that needs irrigating.

- The dispensers (drips, micro-sprinklers, mist sprayers) efficiently provide water to crops.
- PVC tubes, elbows and Ts are used for connections.

Bury primary pipes to protect them from damage.
b) Comparison with installed system (20 min)

Participatory activity

Ask the participants to observe an efficient irrigation system working and to compare it to a gravity-fed irrigation system.

- An efficient irrigation system uses much less water than a flooding or sprinkler system.
- All the water is used and stays on the land.
- The water has enough time to infiltrate into the soil without water-logging or causing erosion or run-off.
- Water passes through a filter before entering the distribution system. This avoids damage to the dispensers (drips, mist sprayers, micro-sprinklers).
- The pressure valves, installed after the gate valves, allow for air to escape the system so that it only contains water.

c) Explaining the EbA measure (10 min)

Didactic activity

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** System maintenance should be carried out at least once a month. It involves checking that the water in the reservoir is clean, checking that the drips or micro-sprayers have water flowing and checking the connections. The filters should be cleaned at least once a week.

**KEY POINT 2:** To avoid using pumps there should be a sufficient difference between the elevation of the storage tank and that of the distribution network. The system is based on water pressure, so the more pipes and distribution channels involved, the more height required.

The dispensers (micro-sprinklers, drips, mist sprayers) are low volume and high frequency. In other words, they provide a small amount of water constantly, giving the soil time to absorb each drop.

¡TIP!

You can carry out fertigation using biofertilizer or leachate from vermicomposting, as long as it is well filtered so as not to damage the dispensers.

QUESTIONS FOR PARTICIPANTS

1. What is the purpose of the filter and where is it placed?
2. How often should the system be checked and cleaned?

ANSWERS

1. It removes impurities from the water that could block the dispensers or damage the system. It is placed at the exit of the reservoir.
2. Once a month for all parts except the filter which should be cleaned at least once a week.

Allocated time for questions and evaluation of the training

END OF ACTIVITIES
AGROFORESTRY SYSTEMS

Learning objectives
a) Benefits of agroforestry
b) Functions of each stratum
c) Maintenance for each stratum

Materials
a) Agroforestry system in place

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange

What does the group know about agroforestry systems and their benefits?

Key messages

Agroforestry systems help to:
- Diversify income.
- Prevent impacts from extreme rain or wind.
- Conserve biodiversity, recycle nutrients and capture carbon.
- Generate a better microclimate for crops.

Agroforestry systems are very good at recycling nutrients. The trees generate better conditions for the crops and the soil.

2. Training

a) Elements and uses of the system (20 min)

Didactic activity

Show the participants the elements of the system.

- Plant trees from East to West, allowing light to reach lower strata.
- Use different types of plants that make use of all the different strata: timber species and fruit trees, edible shrubs, medicinal and pest-repellent herbs and annual crops.
- Select species according to their adaptability to the area and their nutritional demands on the soil.
- Maintenance (pruning, organic fertilizer, pest control).

Trees on higher strata get their nutrients from deep in the soil. When their leaves fall or are used in organic fertilizer their nutrients become available to plants lower down.
b) Strata and companion planting (20 min)

**Hands-on activity**

Ask the participants to identify the different strata in the agroforestry system, types of plants that make up each stratum and necessary maintenance activities.

- Higher stratum: timber species (mahogany, rubber, cedar), fruit trees (avocado, mamey) or forage (acacias). Maintenance consists of thinning, (removing trees for use as timber) and formative pruning to allow light to reach the lower levels (see the natural shade fact sheet).
- Medium level: fruit trees (banana, papaya, citrus, guava), vines (passionfruit, granadilla). Depending on the needs of the crop, annual maintenance consists of leaf fumigation, formative pruning, removing dry leaves and branches, clearing undergrowth and applying organic fertilizer.
- Lower level: annual grains (corn, rice, oats); semi-ligneous (tomato, pepper); tubers (potato, cassava, sweet potato, peanuts); vegetables (lettuce, onion, cabbage); cucurbits (cucumber, pumpkin, watermelon); aromatic herbs (marjoram, thyme, basil). Maintenance is based on an annual cropping plan and consists of carrying out crop rotation, companion planting, integrated pest management and the application of organic fertilizer.

c) Explaining the EbA measure (10 min)

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** The system is designed for constant production throughout the year and for companion planting to increase resistance to pests and disease.

**KEY POINT 2:** When planting timber species or fruit trees make sure that the diameter of the stalk is greater than 1.5 cm to increase the survival rate.

**KEY POINT 3:** Pruning is systematized and scheduled to control shade and maintain timber quality and the productivity of trees and herbaceous crops.

1. Timber tree
2. Fruit tree
3. Perennial shrub
4. Annual crop
5. Tuber
6. Creeper plant
7. Vine

**Different strata of an agroforestry system.**

You can also use leguminous species to prune and process them as green manure, incorporating them into the system to improve its productivity. The system should be considered as a medium and long-term investment (timber species and fruit trees) but also capable of annual and seasonal production, which is why a management plan is crucial.

**QUESTIONS FOR PARTICIPANTS**

1. What is the function of trees in an agroforestry system?

**ANSWERS**

1. They regulate temperature and maintain moisture in the soil, generating a microclimate that improves productivity. Trees can also be used for shade, timber or fixing nitrogen in the soil.

**Allocated time for questions and evaluation of the training**

**END OF ACTIVITIES**
1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange

What does the group know about silvopastoral systems and their benefits?

Key messages

Silvopastoral systems help to:
- Improve the availability and quality of feed for livestock.
- Recover eroded soil and strengthen local water cycles, conserving biodiversity.
- Diversify production by providing timber, firewood, forage and fruit, among other products, thereby increasing income.
- Generate a microclimate that protects the productive system from extreme climatic events.

Structure of a silvopastoral system

In a silvopastoral system each element contributes to the development of another: the trees provide forage and shade and the animals provide fertilizer for the pasture and trees.

2. Training

a) Components and uses of the system (20 min)

Theoretical activity

Invite participants to take a tour of the established silvopastoral system and ask them to help you explain the function of each element:

- **Soil**: provides nutrients and moisture for trees and grass to grow. Care must be taken so that it does not become compacted.
- **Pastures**: can be natural or improved. It is important to calculate the carrying capacity of the system and rotate the pastures so as not to deplete them and cause erosion.
- **Trees**: can use different kinds (timber, fruit, forage). They provide shade, feed the livestock, maintain moisture, prevent erosion and regenerate the soil.
- **Livestock**: provide nutrients for plants. It is the economic drive of the system.
- **Fences**: they can be live fences (with trees) or dead fences (with posts) with barbed or electric wire or shade. They separate the pastures and allow for the natural regeneration of pasture and plants.
- **Management plan**: by controlling the period of grazing and rest you avoid degradation of the pastures and increase the plant cover and organic matter on the soil.

Shade allows for longer grazing periods. Livestock can feed on forage at various levels in the fields or in stables with offcuts from pruning. It is therefore important to have diverse forage.
b) Levels and companion crops (20 min)

**Hands-on activity**

With the help of participants, carry out a transplant of nursery plants to establish or improve a silvopastoral system.

- Select healthy plants that are 30 cm tall or more, whose roots and stalks are not damaged and whose foliage is in good condition.
- The distribution of trees depends on the kind of system (e.g. scattered trees, living fences, grazing corridors).
- Clear at least 1 m around the area where each tree will be planted.
- Dig holes of 15 to 20 cm in width, a little deeper than the height of the bag around the plant.
- Fill them with some fertile soil and the plants without their bag. Make sure that plants are straight, in the centre of the hole and not too deeply buried.
- Fill the empty space around the plants with fertile soil or compost.
- Mulch the plants with straw, stubble or rice husks and water them.
- If there are already cattle in the system, protect the plants by surrounding them with wire or wood.

c) Explaining the EbA activity (10 min)

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** Shade management is important to increase the efficiency of the system. You can manage shade by pruning and thinning. You will use more or fewer trees depending on whether the principal focus is forestry or livestock.

**KEY POINT 2:** Diversification with fruit trees and other annual products helps to create a constant flow of income while the forest species and livestock grow.

**KEY POINT 3:** For good management, it is recommended that you begin grazing with beef cattle when the trees reach a height of 2 m or more. It is important to control weeds to facilitate the growth of pasture and trees.

Silvopastoral systems take advantage of different productive strata. Living fences can have many strata.

¡TIP!

Living fences can also act as windbreaks to avoid soil erosion on land with little plant cover. Living fences are a good way of encouraging an initial switch to a silvopastoral system and more sustainable livestock farming.

**QUESTIONS FOR PARTICIPANTS**

What is the purpose of the management plan in a silvopastoral system?

**ANSWERS**

To promote the natural regeneration of pasture and forage by rotating livestock in pastures according to their carrying capacity. This avoids the degradation of pastures and improves the cover of plants and organic matter on the soil.

Allocated time for questions and evaluation of the training

END OF ACTIVITIES
Learning objectives
a) Benefits of natural shade
b) Practices for efficient shading

Materiales
a) Saw for pruning
b) Protective clothing for pruning (helmet, gloves, protective glasses)

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about natural shade and its benefits?

Key messages
Natural shade helps to:
- Regulate temperature and humidity, creating a microclimate.
- Improve productivity.
- Diversify income.

Crops such as coffee and cocoa grow well in natural shade. The shade-providing species can be fruit trees, timber species or native species.

2. Training
a) Elements and uses of the system (20 min)

Didactic activity
Demonstrate the components of the system. Ask the participants to help you explain how it works.

- The shade-providing species to be selected may have various roles. They can be native species to house biodiversity; timber species to be cut down and sold once they reach maturity or species that produce fruit or forage.
- When planting trees, include extra space for the crop which will grow in the shade below so that it receives the right amount of light for its needs.
- Planned pruning regulates shade to let necessary light in for crops, pasture for livestock.

Pruning is an important part of the management plan. It regulates the light and shade necessary for crops or livestock.
b) Pruning (20 min)

**Hands-on activity**

Ask the participants to collaborate with the pruning demonstration.

- Prune low branches with clean, straight cuts.
- Avoid dead nodes which are the natural result of a lack of sunlight due to branches that are higher up.
- The ideal time to prune is before the rainy season so the plant regenerates with the thickening of the wood during this time.

Smoothly cut the branch, without splintering or breaking it. This prevents diseases from entering the plant.

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c) Explaining the EbA measure (10 min)

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** Calculate the distance between trees to allow enough light through for crops or cattle once the trees have reached maturity. You should also think about the space the shade crops will need when planting the trees.

**KEY POINT 2:** Pruning helps regulate the percentage of shade. Coffee needs a shade cover of 30% to 35%, not exceeding 45%. Shade coverage for livestock and pasture ranges from about 15% to 25%.

The distance between trees must allow the passage of light required by the crop.

The shade rate can vary depending on the time of year and species in question. For example, a coffee crop needs more light in rainy season and more shade in dry periods.

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**QUESTIONS FOR PARTICIPANTS**

1. What is the purpose of natural shade?

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**ANSWERS**

1. It regulates temperature and maintains moisture in the soil, generating a microclimate that improves the productivity of the crops or livestock in the shade. It improves the nutrient cycle. It can diversify income if the shade providing species have forest or productive value.

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**Allocated time for questions and evaluation of the training**

**END OF ACTIVITIES**
AGRICULTURAL TERRACES

Learning objectives
a) Benefits of agricultural terraces
b) Importance of a stone wall and drainage
c) Key points for building

Materials
a) Stones for the wall
b) Tools (hoe, pick, spade, wheelbarrow)
c) Leveling instruments (A frame)

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about agricultural terraces and their benefits?

Key messages
Terraces help to:
- Reduce erosion caused by intense rain.
- Absorb and retain moisture in the soil.
- Increase productivity on sloping land.

2. Training

a) Clearing and leveling the land (20 min)

Hands-on activity
Show how the terrace should look by pointing out to a finished terrace nearby. Ask participants to help clear and level approximately 2 linear meters of terrace.

- Remove weeds with picks and hoes.
- Level the earth so that water infiltrates rather than running off.
- Dig a drainage canal 50 cm deep next to the wall at the inside edge of each terrace.

Source: Adapted from PROMARENA (2006).

Build a drainage canal along the side of the wall with a 2% gradient. Build the walls perpendicular to the slope of the landscape. You can include protruding rocks to use as stairs.
b) Construction of the wall (20 min)

**Hands-on activity Cultiv**

Show what the stone walls are like on neighboring terraces. Ask the participants to build a wall for the 2 m previously worked on.

- Build the wall over the drainage canal or foundations by stacking rocks. Add wet earth on top of each row of rocks and compact it. The wall should be between 30 and 50 cm thick.
- If the wall is higher than 2 m tall, reinforce it with cement.
- Lay the larger rocks first, looking for smooth surfaces and being careful to fill gaps with smaller rocks and earth.

Build a drainage canal along the side of the wall with a 2% gradient. Build the walls perpendicular to the slope of the landscape. You can include protruding rocks to use as stairs.

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c) Explaining the EbA measure (10 min)

**Didactic activity**

Show where each of the key points applies in the system so that it works correctly.

**KEY POINT 1:** The terraces should follow the contours of the land. You can mark them out using an A frame or other leveling tool. Drainage at the inner edge of the terrace should have a 2% gradient to prevent the soil supporting the wall from becoming waterlogged, which could cause the wall to collapse.

**KEY POINT 2:** The walls sustaining upper terraces should be stable and built perpendicular to the slope to avoid collapse. Start with larger rocks then add smaller rocks and fill the gaps with compacted wet earth.

Agricultural Terraces, Peru.

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**¡TIP!**

Terraces require a large amount of labor; it is recommended to build them as a community.

An alternative activity may be to show the group how to draw contour lines in the terrain with the A frame.

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**QUESTIONS FOR PARTICIPANTS**

1. What is the purpose of the stone wall in terraces?
2. What is the purpose of the drainage below the wall?

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**ANSWERS**

1. To support the terraces and avoid them collapsing.
2. To drain the water below the wall so the soil does not give way and collapse.

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**Allocated time for questions and evaluation of the training**

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**END OF ACTIVITIES**
MIXED NURSERY

Learning objectives
a) Benefits of mixed nurseries
b) The importance of shade netting and maintaining moisture
c) The preparation of a seedbed

Materials
a) Pruning shears
b) Substrate for planting seedlings
c) Shade netting

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about mixed nurseries and their benefits?

Key messages
EMixed nurseries help to:
- Propagate vegetable species with market or ecological value.
- Diversify income.

The mixed nursery has various areas to meet the different needs of the plants.

2. Training
a) Propagation from cuttings (20 min)

Hands-on activity
With the help of the participants carry out propagation with cuttings.
- Some trees and shrubs are propagated with cuttings.
- Cut a piece of branch the thickness of a pencil and 20cm long. The branch should be neither very young nor very old.
- Take off the leaves and wrap the branch in wet newspaper to transport it.
- Put the cutting in substrate ensuring that you bury two or three nodes under the soil.
- It is recommended that you apply auxins to the nodes buried under the soil.
- Leave the cutting out of direct sunlight and keep the substrate damp.
- If the cutting starts to develop new leaves and branches, the propagation was successful.

Nursery for propagation of forest species from cuttings.
b) Preparation of a seedbed (20 min)

**Participatory activity**

With the help of the participants, prepare a seedbed, demonstrating the materials used.

- Prepare substrate with sand, organic fertilizer and fertile soil to the ratio of 1:1:1.
- Fill trays or seedbeds with the substrate.
- Water the trays or beds until they are saturated.
- If using cuttings, plant them ensuring that at least 2 nodes are buried in the substrate and 1 node is unburied.
- If using seeds, plant them at a depth of 2 times the diameter of the seed itself, opening holes with a stick.
- Cover the holes well with substrate.

A good quality substrate is necessary for good germination and propagation.

c) Explaining the EbA measure (10 min)

**Didactic activity**

Muestra en qué parte del vivero se sitúa cada uno de los puntos críticos para que funcione adecuadamente.

**KEY POINT 1:** The shade netting prevents direct sunlight on the newly propagated plants, ensuring that they stay hydrated and healthy. For the high Andes use a Raschel net with a shade rate of 50%, or 30% for lower areas.

**KEY POINT 2:** Integrated pest management reduces use of chemical pesticides. You can use a simple recipe of garlic, pepper, chili and vinegar that is fermented, diluted and applied as a spray. You should apply ecological pesticides every 15 to 20 days to avoid pests.

**KEY POINT 3:** The plants in the nursery should always have enough water, so you should either use an efficient irrigation system or hose to keep them well watered.

**KEY POINT 4:** Propagation is the most important element for the profitability of a mixed nursery. For it to be successful you must be knowledgeable about vegetative propagation (grafting, layering, cuttings) and seed propagation (germination).

Shade netting for propagated plants in the mixed nursery.

**¡TIP!**

he mixed nursery needs space to accommodate the successfully propagated plants in 0.5 l bags and to prepare them for use or sale.

The nursery can be a source of income or a long term business if you manage it well and cultivate species with market value.

QUESTIONS FOR PARTICIPANTS

1. What is the function of shade netting?
2. What is the function of integrated pest management?

ANSWERS

1. Shade netting avoids propagated plants from becoming dehydrated and dying from contact with direct sunlight.
2. To reduce the use of chemical pesticides and achieve a higher number of successful propagations.

Allocated time for questions and evaluation of the training

END OF ACTIVITIES
Learning objectives
a) Elements, functions and benefits of contour trenches.
b) Construction process

Materials
a) Tools (spades, picks, hoes)
b) Material for marking contours (A frame, stakes, string)
c) Perennial plants in 0.5 l bags adapted to the area

1. Introduction to the EbA measure (10 min)

Participatory knowledge exchange
What does the group know about contour trenches and their benefits?

Key messages
Contour trenches help to:
- Retain water runoff and avoid erosion.
- Infiltrate water for groundwater recharge.

2. Training
a) Marking out and digging (20 min)

Hands-on activity
With the help of the participants build a contour trench of about 5 m in length, following the contours of the land.

- Mark out the trench, following the contours of the land, with the help of an A-frame or similar tool.
- Following the contour lines, dig a trench of 0.5 m in width by 0.4 m in depth and 5 m in length.
- Make a berm on the lower side of the trench with the excavated earth to absorb retained water and avoid erosion.
- Dimensions vary according to the intensity of rain in the area and the infiltration capacity of the soil. The contour trenches can be as long as necessary, following the contours of the land.
- The distance between contour trenches depends on the gradient of the land. On a slope of 2% contour trenches are recommended at 40 m intervals. This distance is reduced for steeper landscapes.
b) Planting the berm (20 min)

Hands-on activity

With the help of the participants plant plants, shrubs or trees on the berm that are adapted to the local climate to improve soil retention.

- The distance between plants depends on their size.
- To retain soil in the berm, it is recommended to use perennial plants that do not require much maintenance, offer added value and have compact roots, for example: pineapple, aloe vera, agave or opuntia.

Perennial vegetation retains the soil and requires little maintenance.

c) Explaining the EbA measure (10 min)

Didactic activity

Show where each of the key points applies in the system so that it works correctly.

KEY POINT 1: Avoid building contour trenches on very steep slopes as the berm can collapse and cause more erosion. In this case it is better to plant vegetation that retains the soil.

KEY POINT 2: The bottom of the swale should be slightly sloped to allow for water circulation. The contour trenches can also be interrupted at intervals to create ditches that maintain water for longer.

KEY POINT 3: Plant perennial crops that take advantage of the infiltrated water and stabilize the berm. If possible, plant on two or three levels on the berm to cover the soil well and avoid erosion of any kind.

Infiltration and moisture retention. Channeling of excess water.

¡TIP!

Check the contour trenches before and after the rainy season to avoid erosion or overflow. Generally you will need to remove any material that has accumulated in the trenches, reducing their capacity.

This is a simple, low cost method to prevent erosion and the risk of landslides on slopes.

QUESTIONS FOR PARTICIPANTS

1. What is the function of the perennial plants on the berm?
2. What are the depth and width of the trench based on?

ANSWERS

1. To stabilize the berm, avoid erosion and take advantage of the water retained in the trench.
2. The dimensions of the trenches are based on rain in the area and the infiltration capacity of the soil.

Allocated time for questions and evaluation of the training

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