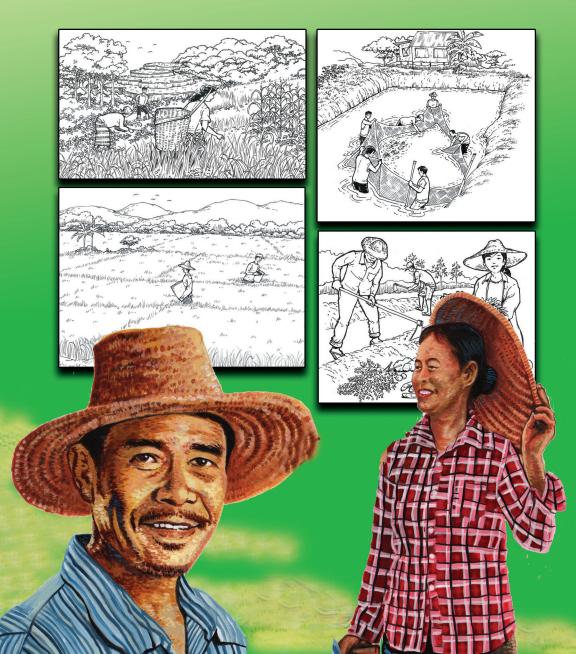
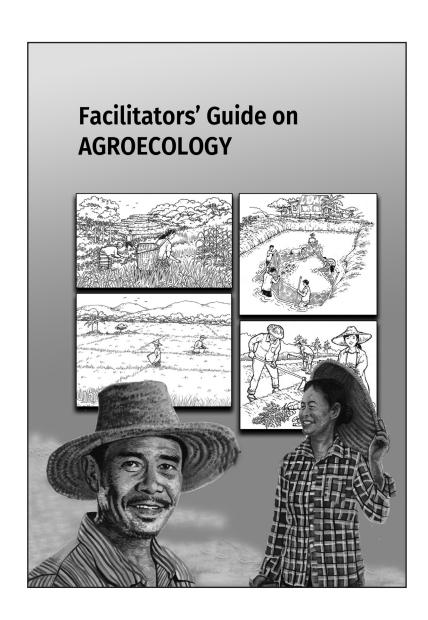




# Facilitators' Guide on AGROECOLOGY





#### Facilitators' Guide on Agroecology

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#### **PREFACE**

Agroecology has gained significant traction in recent years, driven by the urgent need for more sustainable agri-food systems. The alarming effects of the climate crisis, the continued decline of agricultural biodiversity—the very foundation of food security—and the unabated destruction of the environment have created profound challenges to food and nutrition security. In response, various agricultural approaches have emerged, often used interchangeably with agroecology, such as organic agriculture, green agriculture, permaculture, and natural farming. While these approaches are not identical to agroecology, they share a common objective: sustaining agricultural production while ensuring resilience and sustainability.

The pursuit of sustainable and resilient agri-food systems, and the pathways to achieving them, must be widely shared and promoted for global implementation. Only through collective action and knowledge exchange can true transformation in our agri-food systems be realized.

In this context, SEARICE has developed two complementary learning resources on agroecology. The **Field Manual on Agroecology** provides practical, easy-to-follow guidance on the technical aspects of agroecological practices—the "how-to's" that farmers and practitioners can directly apply in the field. To complement this, the **Facilitators' Guide on Agroecology** offers trainers and learning facilitators a set of participatory tools and learning exercises designed for adult learners. Together, these resources aim to strengthen the capacities of trainers and facilitators to effectively impart agroecological knowledge and skills in ways that are engaging, experiential, and rooted in farmers' lived realities.

The intention is for the Field Manual and the Facilitators' Guide to be used hand-in-hand, enabling trainers to design and conduct learning sessions that:

- build upon participants' own experiences,
- strengthen their analytical skills,
- foster learning through discovery and experiential learning, and
- enrich discussions through the exchange of knowledge among participants.

The Facilitators' Guide is organized to support this approach. Each topic includes exercises for skills development, opportunities for reflection, spaces for the sharing of experiences, and processing sessions that deepen understanding of key concepts. This structure ensures that learning is participatory, practical, and transformative.

Through this Guide, SEARICE hopes to support agroecology facilitators and trainers in becoming more effective catalysts of knowledge and skills development among farmers. Ultimately, this will contribute to encouraging more farmers to practice agroecology and to advancing the transformation of our agrifood systems toward sustainability, resilience, and equity.

#### **ACKNOWLEDGEMENTS**

SEARICE's long experience in building the capacity of farmers on seed conservation and management—guided by Farmer Field Schools (FFS) as the main learning approach—has strengthened our conviction that training adults, particularly farmers, must be participatory and experiential in order to be truly effective and empowering. These encounters have shown us that learning is most powerful when rooted in farmers' own experiences and shared collectively within their communities.

We are deeply grateful for the learnings we have gained with our partners in Asia, specifically in Bhutan, Lao PDR, the Philippines, Thailand, and Vietnam, through **the Biodiversity**Use and Conservation in Asia Program (BUCAP) and the Community Biodiversity Development and Conservation (CBDC)

Program. Together with our partners in these programs, we have explored various tools and methodologies over the years of implementation using FFS as a core learning strategy.

The insights we have gathered from implementing these programs over the past 20 years have been instrumental to the development of this Guide. This would not have been possible without the consistent support of **SwedBio**, whose assistance from CBDC to BUCAP, and up to the present, has enabled us to produce this manual.

Above all, we offer our heartfelt gratitude to our partners—farmers, local and national government agencies, and academic and research institutions across Bhutan, Lao PDR, the Philippines, Thailand, and Vietnam. Their collaboration, wisdom, and dedication have enriched this work in countless ways, and it is with them that we share the fruits of this journey.



# Module 1. WHAT IS AGROECOLOGY AND WHY WE NEED IT

Agroecology is an integrated approach that applies ecological and social concepts and principles to optimize interactions between plants, animals, humans and the environment, while it seeks to minimize the negative effects of certain human activities to ensure a sustainable and fair food system. Agroecological practices build synergies that support food production and food security, health and nutrition, and restore ecosystem services and biodiversity necessary for sustainable agriculture. Agroecology plays a key role in building the resilience of farming systems and in adapting to climate change.



## Exercise 1.1 What is agroecology? (Mind mapping)

At the end of the session, the participants shall be able to:

- define agroecology
- explain key concepts/principles of agroecology



Time: 1 hour

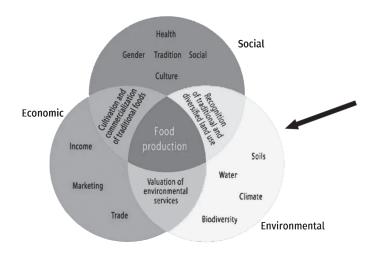
Materials/Preparation: newsprint or chart paper (5 sheets), pieces of half A-4 sized paper or meta cards (at least 3 pieces per participant), pens, markers, masking tape, diagram on the key aspects of agroecology (Figure 1a)

- 1. Warm up the group by getting a show of hands on who among the participants have been farming for more than 10 years. Ask them about the following:
  - their current inorganic NPK fertilizer use in rice production – and compare this with the amount they used 10 years ago



- why is there (or why is there no) change in the amount of fertilizer used
- what they think the continued use of NPK does to the soil and why.
- 2. Ask the big group if anyone has heard about agroecology. When participants start giving responses, get into the mind mapping exercise. Distribute the pieces of paper to everyone (some will most likely need two or more). Have them answer the question, "What comes to mind when you think about agroecology?"
- 3. Give about 10 minutes for the participants to gather their thoughts and ideas and for them to write these down on the pieces of paper (only one idea on each piece of paper). Then allow them another 5 minutes to tape these to the board or wall. (NB: This is a brainstorming activity so there is no right or wrong answer. Misconceptions can be clarified later; see Step 5 below.)
- 4. Take a mental note of the participants' ideas while they are posting their responses. After they are finished putting them up, quickly group the pieces of paper into three areas based on whether these are related to economic, environmental or social aspects without explaining why this is being done.
- 5. Walk participants through each aspect by asking them to explain or give examples of the ideas or concepts that they posted up. Clarify misconceptions and point out key concepts and principles of agroecology as these come up in the discussion.
- 6. Afterwards, put up the diagram on the key aspects of agroecology (Figure 1a). Explain that agroecology is a very broad field and that the session will only focus on the environmental aspects as indicated by the red arrow in the diagram. In particular, the discussion will revolve around practices rooted in traditional knowledge and local context,

and encourages the use of locally available resources and internal capacities to address food and nutrition security and human health.



Source: https://communityfoodforests.com/agroecology/

Figure 1a. Key aspects of agroecology

7. Emphasize that agroecology aims to restore the health of ecosystems. Refer to the example of NPK use in step 1 as appropriate. Summarize by re-stating that agroecology refers to the promotion of economically viable, environmentally-friendly and sustainable farming, with particular focus on food and nutrition security, and human health.



## Exercise 1.2 Why do we need agroecology? (Field walk)

At the end of the session, participants shall be able to:

- make an inventory of crop and animal production practices in the community
- identify which practices are sustainable/not sustainable
- propose changes that could be undertaken to make the practices more sustainable or agroecological

discuss challenges that may be encountered when adopting agroecological practices



Time: 3 - 3.5 hours

Materials/Preparation: Field observation guide for the field walk (Box 1a, at least 2 per group), newsprint or chart paper (at least 3 sheets per group), blank sheets of paper (15 sheets), pens, markers, masking tape

Several days before the session schedule, visit the village and discuss with local leaders about the plan to bring participants to the site to carry out a field walk for the exercise on agroecology. Explain the objectives of the exercise and the planned activity. Decide with them how to divide the village into quadrants using the main road as the point of reference. Request for at least one villager (farmer) to accompany each of the groups during the field walk.

- 1. Start by recalling the discussion in the previous session that although agroecology takes an integrated approach, this exercise will likewise only focus on the environmental aspect and agroecological practices to support the design and management of healthy agricultural and food systems.
- 2. Explain the objectives for this session.
- 3. Divide the participants into four groups; provide two copies of the observation guide to each group that they will use during the field walk (see Box 1a below). Go through the items quickly to ensure that the group task is clear to everyone. In addition to the information that they need to collect, they should also mark these practices as either "S" (sustainable), or "NS" (not sustainable). An hour for the walk should be sufficient.

In addition to the observation guide, provide each group an additional two or more sheets of paper for them to write their notes or observations.

4. Bring the participants to the main road and show them how you have divided the village into four sections; assign one group to cover each section. On their assigned area, the groups should collect information as outlined in the observation guide. Remind them to be back at the meeting place at the designated time, i.e., after one hour.

### Box 1a. Field walk observation guide: An inventory of the community's current farm production practices

- 1. Crop production practices (e.g., crops grown, method of soil preparation, planting/transplanting, fertilization, irrigation, crop protection, weeding, harvesting, etc.)
- 2. Livestock production practices (e.g., animals raised, types and sources of feeds, feeding systems, type of animal housing, water supply/water points, disease and health management, etc.)
- 3. Aquaculture (e.g., fish species raised, production practices and requirements such as source of feed, water supply, disease and health management, etc.)
- 4. Soil management practices (e.g., tillage, nutrient or fertilizer management, soil and water conservation practices, etc.)
- 5. Practices on recycling of farm "wastes" and byproducts to enhance crop production (e.g., types of farm wastes and how they are being used, on what crops, etc.)
- 6. Agroforestry or agrosilviculture- related practices (e.g., trees planted or cultivated, source of planting materials, care and management practices, pest and disease management, etc.)

NB: Indicate "S" (sustainable) or "NS" (not sustainable) on the farming practices as they may apply.



- 5. Once back in the meeting place, give an hour for the groups to process their findings from the field walk, with particular emphasis on items 1-6 in the field observation guide.
- 6. Allot 5-10 minutes of presentation per group. Ask other members of the group to add to what their representative just presented. Spend another 10 minutes for Q&A or clarifications after all the groups have presented. Keep the groups' notes for future reference.
- 7. To add more depth to the group presentations, probe for the participants' ideas on the following issues either as a big group (plenary) or via buzz groups (quick discussion + presentation) using the same groupings:
  - Why does the group consider some of the farm practices they marked "S" as such?
  - On the other hand, why do they consider the other farm practices they marked "NS" as such?
  - What changes can they propose to turn these NS practices into more sustainable or agroecological ones?
  - What challenges do they foresee in making farmers to adopt/adapt these changes?
  - Why is it important for farmers to work together in implementing agroecological practices? [Think about what will happen to farmers' fields at the foot of the hills (or lowlands) if farmers at the upper slopes or uplands continue cutting trees to expand land for cultivation.]
- 8. Highlight the major points raised in the presentations, then make a synthesis of the whole session/exercise.

#### **Module 2. UNDERSTANDING THE ECOSYSTEM**

In an ecosystem, everything – living organisms and non-living components alike – performs an ecological function, of which there are different levels. The first level is composed of **producers**: the plants that produce food for themselves and for other living things in the ecosystem. Next are the **consumers** which may be classified as primary, secondary, or tertiary level depending on whether they feed on plants, animals, or both. An equally important level, the **decomposers**, feed on organic matter to recycle nutrients in the system back into the soil. Everything in the ecosystem is linked together through nutrient cycles and energy flows.

The linear relationship between producers and consumers is known as the **food chain**. On the other hand, the interconnectedness of the food chains which shows the more complex relationships of the organisms is known as the **food web**. The food chain and the food web demonstrate the need to maintain the balance in the ecosystem – so that the ecosystem can function to ensure both the continued existence of living organisms and the stability of the environment.



#### Exercise 2.1 Ecological functions of organisms

At the end of the exercise, the participants shall be able to:

- identify the organisms found in a typical rice field ecosystem
- categorize the specimens/organisms according to their ecological functions in the ecosystem
- explain the function of the organisms found in the ecosystem



Time: 1 - 1.5 hours



Materials/Preparation: diagrams of blank ecosystem pyramid on newsprint or chart paper (Fig 1b, one per group), plastic bags (two per group, for specimens/organisms collected), alcohol, markers

Several days before the day of the session, visit the village and discuss with local leaders about the plan to bring participants to the site to carry out the exercise on ecosystem. The exercise will include collection of specimens of organisms from the **rice field**.

- You can also use the visit to make an inventory of organisms in the rice field to familiarize yourself with them, and be able to identify them by their common names (English, Tagalog, or local).
- To save on time during the group work, diagrams of the pyramid should already be drawn on the newsprints to be used by the participants. The pyramid is blank, except for the labels on the levels or functions of the organisms (see step 4). Alternatively, you could ask for several volunteers to draw the diagrams as an assignment in the previous session so that they come prepared for this session.

- Explain that this exercise is for the participants to be acquainted with all the organisms and their respective functions in a typical rice field ecosystem. They are to collect all types of plants and animals that they can see in the rice field, including those from the water and under the ground.
- 2. Divide the participants into small groups of four or five persons each. Provide two plastic bags for each group's animal and plant specimen collection. Remind them to return to the discussion site after 30-45 minutes.
- 3. Upon the groups' return to the meeting room, ask them to add alcohol to the plastic bags containing their animal specimens and gently shake them.

4. Post on the board/wall a copy of the blank ecological pyramid and explain briefly what it is, i.e., meaning and functions of producers, primary/secondary/tertiary consumers, and decomposers. Entertain questions for clarification but do not go into too much detail or give a lot of examples; part of the group exercise is for the participants to come up with their own answers.

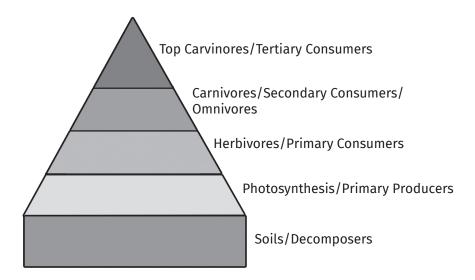


Figure 1b. The ecological pyramid

5. Lay the newsprints with the blank pyramid diagrams (that were previously prepared) on the tables/desks or floor. Leave enough space between them so that the participants can freely move about while working on the group activity. Instruct the groups to put their specimens in the appropriate levels of the pyramid as labeled. They may also write names of other organisms for the different levels as they see fit – specimens that they were not able to collect but would normally be found in the rice field, e.g., rats, snakes, etc. If unsure about the function of a certain organism, they may simply put this beside/outside the pyramid. When done, have the participants take a photo of their pyramid; they will need it for the next exercise.



- 6. (NB: The group outputs will be presented right on the tables (or floor) where the participants worked on them.) Have the participants stand around the group outputs so that each one will have a good view during the presentations. Instruct the presenters to identify their specimens using their common names, where they found them, and explain why they placed them in their respective levels.
- 7. Supplement the presentations with a few salient information that did not come up during the presentation and discussion, e.g., What observations can they make regarding the number of organisms in each level of the pyramid? Etc.
- 8. Get a few more comments from the floor, and summarize/ synthesize the session.

**NB:** Choose the "best" from among the outputs that you will use as a learning aid for the next session.



#### **Exercise 2.2 The food web**

At the end of the exercise, the participants shall be able to:

- draw a sample food chain and food web from a typical lowland rice field ecosystem
- explain the difference(s) between a food chain and a food web
- describe (or give example of) how food chains become interconnected and overlap to become food webs



Time: 1 - 1.5 hours



Materials/Preparation: "best" ecological pyramid from the previous exercise (chosen from among the outputs presented), illustrations of food chain and food web

(Figure 1c) on chart paper (step 2), newsprint or chart paper (2 sheets per group), markers, masking tape

- 1. Show the output (ecological pyramid) of the one group that you selected from the previous exercise to illustrate the sequence of transfer of matter and energy in the form of food from organism to organism (i.e., the food chain starting from the producer to consumers herbivores, omnivores, carnivores, and eventually to decomposers).
- 2. Then put up Figure 1c on the board. Point to the left side of the figure, which is a graphical depiction of a food chain. Explain that the food chain is a linear representation of "who-eats-what". However, the pattern of consumption in any ecosystem is a lot more complicated than a simple chain, as exemplified by the food web (right side of Figure 1c).

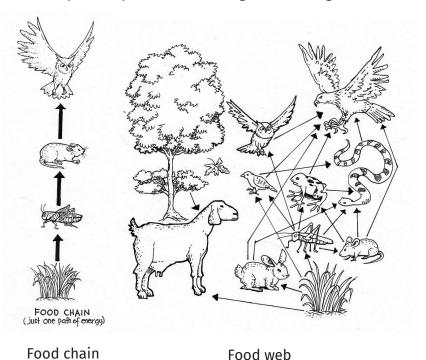


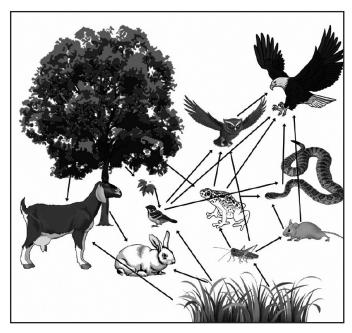
Figure 1c. The food chain and food web



- 3. Briefly discuss the following key ideas; draw attention to relevant elements or movements in the food chain or food web diagrams as appropriate:
  - Green plants are the only organisms that can derive energy directly from the sun.
  - Energy originally in the form of sunlight is transformed by the plant into sugars and starches through the process of photosynthesis. Animals (including humans) derive energy from eating food originating from plants. (You may do a quick check of the participants' recall of energy-giving or "GO" foods; underscore that – with the exception of fats from animals – all of these came from plants.)
  - Energy (and nutrients) are passed from one organism to the next in the food chain and the intertwined food web.
  - The energy consumed by animals from plants is ultimately exhausted, with decomposers using the last energy in breaking down organic matter so that it can be released back into the environment and used again in production.
  - While the flow of energy is unidirectional, the flow of nutrients is cyclical (nutrient cycling shall be the subject of the next exercise).
- 4. Using their respective ecological pyramids in the previous exercise as reference points, instruct the groups to work for 30-40 minutes on the following (the earlier groupings will be retained):
  - Draw a sample food chain starting from one organism (producer) in their pyramid.
  - In the second chart paper, prepare a food web they can start their diagram with the food chain that they earlier made above. Point out that several food chains will intertwine into a food web because most organisms consume more than one type of plant or animal, and one plant or animal is consumed by several organisms.

- 5. Allot 5-7 minutes for each group to present their outputs and have them leave their diagrams on the board or wall afterwards. Call attention to the interdependence and interconnection of organisms in a dynamic ecosystem, as exemplified by the food webs that they drew.
- 6. To conclude the session, underscore the importance of every organism in the ecosystem by asking the following questions:
  - What would happen to consumers if there are no producers?
  - How can insect pests become beneficial at low populations? Why are they important in the ecosystem?
  - What will happen if there are no organisms in the soil to decompose matter?

Allot about 10 minutes for discussions on responses to the questions above and for the conclusion.



Food web





### **Exercise 2.3 Nutrient movements/recycling**

The nutrient cycle is **nature's recycling system**. A nutrient cycle, also called ecological recycling, involves the movement and exchange of organic and inorganic matter back into the environment for the production of matter. All forms of **recycling** have feedback loops that use energy in the process of putting material resources back into use.

While the flow of energy in agroecosystems is unidirectional and energy cannot be recycled, nutrient recycling is cyclical and nutrients can be reused. Nutrients are continuously being recycled in the ecosystem. For example, plants – or the producers in an ecosystem take up organic and basic inorganic nutrients from the soil or atmosphere (e.g., water, oxygen, nitrogen, carbon) and release these back into the environment when they decompose.

At the end of the exercise, the participants shall be able to:

- define nutrient cycling/recycling
- enumerate the range of possible sources of nutrients in a home garden or farming system
- describe how to optimize the use of on-farm nutrient sources
- provide examples on how farmers can ensure that nutrients are cycled/recycled back to enrich the soil



Time: 1 - 1.5 hours

Materials/Preparation: video clips, laptop, LCD projector, screen (or white wall or light-colored sheet that can be placed against the wall), meta cards, chart paper, markers, masking tape (NB: If the training site is in a location where it is not possible to use these, then the facilitator should prepare the needed diagrams.)

Several days before the session, preview the video clips as part of preparing for the exercise and choose which one you feel most comfortable using. The third clip is very short, just a semi-animated diagram version depicting the same ideas as those in the second one; the said diagram can be simply copied on chart paper to give a brief summary of how nutrient cycling/recycling works.

- Ask participants if they have heard of the term nutrient cycling/recycling: What comes to mind if they hear the phrase? How would they define nutrient cycling/recycling?
- Show video clip(s).
   https://www.youtube.com/watch?v=NVhY4ssMtbI [Nutrient cycling, 00:03:12]
   https://www.youtube.com/watch?v=2lMdMa0bnQw [Explains (most of the) nutrient cycle, 00:04:46]
   https://www.youtube.com/watch?v=YXkaBaxiSAE [Nutrient cycle in the tropical rainforest, 00:01:01]
- 3. Highlight that nutrient cycling is the back- and- forth movement of nutrients between organisms and the physical environment in the ecosystem. The movement generally starts from a nutrient reservoir (e.g., air, soil) then to the producers, consumers, decomposers and back to the nutrient pool. The movement of nutrients is cyclic.
- 4. Distribute the meta cards. Ask the participants to refer to the videos they have just seen and their own experiences. Based on these, ask them to identify sources of nutrients or fertilizer that can be used in their home garden or farm and write these on the cards one idea, one card. Let participants post their cards on the board.
- 5. Form buzz groups of four to five persons (different from the previous groupings). Allot 20-30 minutes for the group work and ask them to do the following:

- Imagine a home garden or farm, what components it shall have, etc.
- Look at the ideas posted on the board, and think about how nutrients are made/manufactured (e.g., nitrogen from legumes, other minerals from other crops, manure and even vermicast from earthworms); how nutrients are consumed or stored, and how they move among organisms and the environment (e.g., atmosphere, soil, and water).
- Make a diagram on how they will make nutrient cycling work in their home garden or farm. Remind the group to include the home or household in the diagram if relevant or applicable.
- 6. Give 5 minutes for each group to present their diagrams. In addition to the Q and A that may arise from the presentations, ask the following to further enrich the discussion:
  - What would happen if decomposition did not occur? Supplement the responses by explaining that in agricultural systems, composting relies on natural ecosystem services (e.g., bacteria, insects, earthworms) for nutrient recycling. The rate of decomposition affects the availability of nutrients and how fast they are cycled back into the production of crops.
  - How do nutrients move in the ecosystem? Explain that during nutrient cycling, nutrients are not lost but may be stored in different form in the same system (used by the plants or animals) or move to another system (e.g., via soil erosion).
  - How can people or farmers ensure that nutrients are cycled/recycled back into the soil for use by plants/crops?
- 7. Summarize key points and recap highlights of the discussions.

# Module 3. BIODIVERSITY BASIC FOUNDATION OF AGROECOLOGY

Agricultural biodiversity or agrobiodiversity is broadly defined as the variety and variability of animals, plants and microorganisms that are used directly or indirectly for food and agriculture. A diversity of crops and animals in the farm is important for several reasons: ensuring the production of food, fiber, fodder and fuel; providing nutrition and livelihoods of communities; providing ecosystem services; and supporting adaptation to challenges in the environment like climate change. The crucial role of biodiversity calls for its conservation and management for agriculture to be sustainable and resilient.



# Exercise 3.1 Exploring agrobiodiversity<sup>1</sup> (Rapid survey)

At the end of the exercise, the participants shall be able to:

- define agrobiodiversity
- explain the benefits of agrobiodiversity
- identify locally available species and varieties of plants, animals, and other organisms and their uses
- review farmers' practices that positively and negatively affect biodiversity



Time: 2.5 - 3 hours



Materials/Preparation: newsprint or chart paper (at least two per group and a few extra sheets), markers, masking tape

Several days before the session, visit the village and discuss with local leaders about the plan to bring participants to the site to carry out a rapid survey on agrobiodiversity. With the help of

<sup>&</sup>lt;sup>1</sup> Adapted from Trees Outside Forests Module for RRI Phase 2 Training Manual



local leaders, identify five farms for the groups to visit and notify the respective farmers accordingly. These farms should differ on one basic characteristic: **level of (agro)biodiversity** – from one that is primarily growing one crop on one end, to one that is fully integrated on the other end (e.g., planted to cereal crops, vegetables, fruit and tree crops, plus raising some animals).

- Ask participants to recall the field walk in the previous session. Mention that the said session focused on crop and animal production practices and identifying practices that are sustainable/not sustainable, and challenges to adopting agroecological practices. Continue by getting the participants' ideas on agrobiodiversity. Write down all responses and, with the group, combine ideas to come up with a working definition of agrobiodiversity.
- 2. Explain that the focus of the current exercise will be to identify locally available variety of plants, animals, and other organisms and their uses, explain the benefits of agrobiodiversity, and identify farmers' practices that positively and negatively affect biodiversity. In addition, practices identified based on the previous session (field walk) will be reviewed.
- Form groups, then randomly assign them to their respective farms to visit. Give the groups about 1 hour to carry out a rapid survey of agrobiodiversity. Clarify the specific tasks for the survey:
  - Make a detailed list of crops being cultivated, trees and shrubs, wild plants and weeds, poultry and livestock, insects and other small animals, wild birds, aquatic animals and plants, living organisms in the soil, etc.
  - Indicate the uses or benefits for each species or organism. These may be in the form of products or goods (e.g., food, timber, honey, animal feed, etc.) or ecosystem services (e.g., pollination, soil fertility, pest management, etc.). N.B. The uses/benefits indicated in the given examples should NOT be supplied by the facilitator; let

- the participants come up with these via a quick Q and A or brainstorming session when the facilitator is clarifying the group tasks.
- In addition to collecting the above information, the groups should also note cultivation or production practices that they observe in the farm, (e.g., mulching, intercropping, feeding livestock with fodder grown onfarm, etc.). The group should also ask the owner of the farm about his/her production practices.
- 4. Participants return to the meeting place to process the information they collected; allot about 45-60 minutes for the activity. They may organize and summarize these using the suggested matrix below:

Table 3.1. Summary of survey on agrobiodiversity<sup>2</sup>

Species		Uses/Benefits		
(indicate or specify)	Quantity*	Products/ goods	Ecosystem services	Others (specify)
Cultivated crops				
Trees and shrubs				
Weeds and wild plants				
Poultry and livestock				
Insects/small animals				
Wild birds				
Aquatic animals and plants				
Life found in the soil				

<sup>\*</sup> Number if can be counted, area covered, etc. or any alternative way to indicate quantity

 $<sup>^{2}\,</sup>$  The exercise can be repeated after a year or at the end of the training



- 5. Groups present their outputs when everyone is ready. Ensure that the following issues are brought up during the Q and A and ensuing discussion:
  - a. Is there a difference in the level of (agro)biodiversity among the different farms? Which farm was the most biodiverse, second, third, etc. and least biodiverse? Why were they ranked accordingly? Mention that the level of biodiversity often reflects (or can be used to measure) the health of biological systems.
  - b. What specific farmers' practices positively (or negatively) affect biodiversity (e.g., growing only one type of crop or livestock, clearing/burning of natural vegetation)? In what way(s) do these practices affect biodiversity?
  - c. Compare the effects of production problems (e.g., diseases, pests,) and environmental extremes (prolonged hot or cold spells, floods or droughts, etc.) between monocultures (where single crops or animals are grown) and diverse systems (where a variety of crops or animals are grown together). Which farms are likely to support households better? Why? Mention, for example, that growing a variety of crops will ensure food and nutrition for the household even if some plant species are lost as a result of drought. Similarly, a variety of crops will ensure livelihoods even if yields from some plant species are reduced by pests or extreme weather events.
  - d. Beyond the households (farm families), how do other components of the (agro)ecosystem like animals and plants benefit from agrobiodiversity? Give examples (e.g., birds roost in the trees, shrubs provide organic matter for soil fertility, leguminous or nitrogen fixing trees provide fodder for animals, etc.).
  - e. How can the biodiversity in your assigned farm be increased/improved? Recall outputs of the field walk in the previous session: what current sustainable crop and animal production practices in the community did you observe that can be applied in your assigned farm?



#### MANAGING SOIL HEALTH AND NUTRITION

The soil is the top layer of the earth created from actions of the environment (climate and vegetation) and humans over time. Soil is an essential natural resource that sustains life on which about 95% of food is produced, directly or indirectly (FAO. 2015). It plays an important role in mitigating climate change, being one of the largest systems that can store carbon. Soils contribute to many important natural processes such as climate regulation, water and nutrient cycling, pest regulation, water purification or contaminant reduction, flood regulation, and serve as habitat for organisms that in turn perform a variety of functions. Unfortunately, while it takes about 100 years to form 1 cm layer of soil, degradation takes place very fast - about 30 football fields of soil are lost every minute - due to erosion, compaction, nutrient imbalance, acidification, water logging, salinization, and the like. If we continue to "manage" soil as we are currently doing it, there will be topsoil for only another 60 years. Guaranteeing food and healthy ecosystems for future generations will depend on how we manage our soils now.



# Exercise 2.1 Getting to know your soil (What is a soil system¹)

At the end of the exercise, the participants shall be able to:

- identify the principal factors (i.e., "elements" and "qualities") associated with a soil system
- explain how these "elements" and "qualities" are related to each other



Time: 1 - 1.5 hours

<sup>&</sup>lt;sup>1</sup> Adapted from FAO. 2000. Living soils: Training exercises for integrated soils management





Materials/Preparation: newsprint or chart paper (at least two per group and a few extra sheets), markers, masking tape, and other materials below to be prepared several days before the session:

- meta cards with the following labels: insects, worms, microbes, vermicast, sand, pebbles, small rocks, organic matter, dry leaves, azolla, water, nutrients, air/oxygen, plant roots; drainage, texture, structure, nutrient holding capacity, water holding capacity, porosity, consistency, stickiness, plasticity, coarseness, temperature, color, smell, etc.
- Figure 2.1a drawn on chart paper (step 2)

#### Steps:

1. Start the session with the following question to initiate discussion, "What is soil and what are the uses of soil?" When there are no more responses, add that soil is a medium for plant growth, a recycling system for nutrients and organic wastes, a habitat for soil organisms, (provides) an environment for organic and inorganic elements, etc. Soil also regulates water

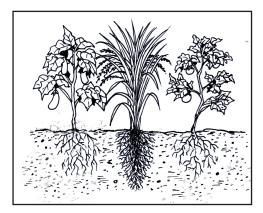


Figure 2.1a. Factors in the soil system

- quality, modifies atmospheric composition (e.g., absorbs carbon), and provides other ecosystem services.
- 2. Put up the chart paper with Figure 2.1a on the board. Briefly explain what the terms "elements" and "qualities" mean. Ask for or simply provide an example for each one as needed.
- 3. Ask for a participant, one at a time, to pick a meta card (previously prepared, stacked at random). Let each one read what is written on the card before posting it either under the

"elements" or "qualities" side of the illustration. Check that each card is placed correctly, e.g., "water" is put under "elements" and not under "qualities", etc.

- 4. When all the cards have been posted up, state that each element or quality is related another. The relationship he between could elements and qualities, elements. between between qualities. Ask for volunteers again, one at a time, to draw arrows to show direct and important relationships of one item to another and explain what the relationship is. Provide more explanation needed. Note: facilitate the exercise, the facilitator may start with drawing the first arrow and explaining what the relationship is.
- 5. When the participants have explained the relationships between the cards, ask which of the factors have the most number of connections (i.e., the highest number of arrows) and what this means.

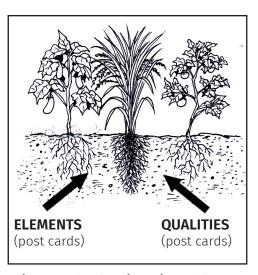
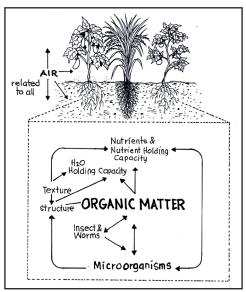


Figure 2.1b: Identification of key elements and qualities that affect the soil system



Source: Living soils: Training exercises for integrated soil management

Figure 2.1c. Relationships of key factors in the soil system



Summarize the activity by pointing out that theoretically, those that have the most number of arrows (or connections) are the most important factors. For instance, organic matter affects every other factor directly and indirectly and should appear with the most connections. The final output of the participants would look somewhat similar to Figure 2.1c.



### Exercise 2.2 Practical techniques for improving soil health and nutrition

At the end of the exercise, the participants shall be able to:

- name several techniques for soil improvement
- describe the process (how to) of at least one particular practice for soil improvement
- explain how a specific practice can improve soil health and nutrition
- discuss possible challenges or difficulties in applying a specific practice of soil improvement



Time: 2 - 2.5 hours



Materials/Preparation: newsprint or chart paper (at least two per group and a few extra sheets), markers, masking tape, and meta cards. Prior to the session, prepare meta cards labelled with the following techniques (with examples of specific practices) to improve soil health and nutrition:

- composting [e.g., open air, pit, in situ (deep bed, basket), vermicomposting, etc.]
- green manuring (e.g., cover cropping, use of nitrogen fixing trees)
- use of organic liquid fertilizers (e.g., fermented liquid nitrogen/liquid manure/manure tea, fermented plant or fruit juice, fish emulsion/fish amino acid)

- use of other soil amendments (e.g., animal manure, biochar, agricultural lime, wood ash, egg shells, spent coffee grounds)
- use of other techniques to help conserve and improve soil quality (e.g., minimum tillage, mulching, planting live fences or trees/grasses in boundary areas)

Fold the pieces of meta cards above and put these in a box. See step 3.

### Steps:

- 1. Start the session with the following question to initiate discussion: "Why is soil health important?" Write key words from their responses on the board or chart paper.
- 2. After exhausting responses, explain that the soil is the basis for agriculture and the foundation of the food system. Stress that a healthy soil provides the nutrients, water, and oxygen and the medium to grow healthy crops for the food of humans and animals. Mention that the quality of crops is greatly affected by the condition of the soil. Therefore, the soil has to be healthy in order for it to produce healthy and nutritious crops.
- 3. Form five groups and ask a representative from each group to pick one folded meta card from the box, and read aloud what was written on the card . Explain that each card represents a technique for improving the soil, along with examples of specific practices.
- 4. Instruct the groups to discuss what they know or have heard/read about the technique and specific practice that they picked; for instance if they got composting, they need to choose which among the four specific practices to discuss. Have them summarize their discussions in a table as shown below, to be written on chart paper. Give the groups 45 minutes for the task.

### Technique/specific practice (specify):

How the specific practice is done	How/in what ways the practice improves soil health and nutrition	Difficulties and possible challenges in applying the practice

- 5. Allot about 7-10 minutes for each group to report their outputs. Encourage contributions and questions from other groups.
- 6. Provide additional information as needed and write key words from the concepts below into the groups' respective matrices to enrich each group's report. Some key ideas to add to group presentations on the techniques are:
  - **Composting** is the process of speeding up the decomposition of organic matter by providing ideal condition for decomposers to do their work. This means that aside from the right amount and proportion of organic waste to be decomposed, sufficient air (oxygen) and moisture must be present.
  - **Green manuring** is the growing of plants that are later incorporated into the soil. Examples of the practice are the use of leguminous cover crops and planting of fast-growing nitrogen-fixing trees (NFTs). Legumes fix nitrogen from the atmosphere and store it in their root nodules, making nitrogen available to other crops. Cover crops also suppress weed growth, thereby reducing or eliminating costly weeding operations. Green manure crops can also serve as living mulch and windbreaks, and can help control soil erosion and nutrient leaching.
  - Organic liquid fertilizers are made from recycled plant products or animal manure. Beneficial microorganisms aid the fermentation process that breaks down the cells

of organic material, extracting valuable nutrients and enzymes. Such liquid fertilizers are ideal plant boosters because they can be absorbed more quickly and are fasteracting compared to their solid organic counterparts. They can be applied during critical stages of crop growth when they are most needed.

- Organic amendments come from biomass and/or living organisms. Soil amendments improve soil structure and texture, increase soil organic matter and nutrient content, as well as improve its water holding capacity. In effect, different soil amendments keep the soil alive, support plant growth and development, and sustain life.
- Key to environmental sustainability is soil conservation. Farmers can apply various other techniques to conserve soil (i.e., prevent soil degradation), increase soil organic matter, and improve soil structure thereby improving overall soil quality. These techniques include minimum tillage, mulching, and planting trees and forage grasses in boundary areas as live fences.
- 7. Summarize the exercise by emphasizing that the soil is a living system full of organisms. Mention that the soil is home to a multitude of living organisms which need to be fed and cared for, to enable them to decompose and process organic matter (OM) so that nutrients become available to plants. Soils have equally important and interacting chemical, physical and biological properties. The interaction of these properties determine the health of the soil.

Our mindset therefore should be to **feed the soil and keep it healthy,** instead of fertilizing the plant. As long as we keep the soil healthy and full of nutrients, it will in turn take care of our plants. A healthy soil is able to sustain agricultural productivity. Applying OM is important to provide the plants with essential nutrients for them to produce more, and to help them grow stronger (stronger roots, stems, leaves, etc.). Stronger plants are better able to withstand insect attacks, plant diseases, and environmental stresses.





# DIVERSE AND INTEGRATED CROPPING SYSTEMS

Applying agroecological principles in crop management requires understanding of the specific needs of the crops to be grown such as water, light, and nutrient requirements. This will guide farmers on how to plan their cropping system(s) and assemble the different crops together with the other farm components such as livestock, forestry and fisheries – ensuring spatial and temporal diversity, optimum use of resources, and high productivity without damaging the ecosystem.



## **Exercise 3.1 Crop diversity**

The overemphasis on increasing productivity rather than on a wholistic natural resource management approach has, among others, contributed to problems like loss of crop diversity, e.g., growing only one or few introduced crops or modern varieties. The loss of crop diversity brings about negative impacts at household, community, and even global levels. At the household level, for example, this could affect the kind of food – and nutrition – that could be made available to family members. At the community level, this could lead to crop susceptibility to pests and diseases and dependence on pesticide use. Farmers can choose combinations of crops suitable to their cropping systems to avoid the loss of diversity.

At the end of the exercise, the participants shall be able to:

- make an inventory of different crops grown, including other plants and trees in the community
- explain the importance of crop diversification
- draw a map showing the variety and arrangement of plants on a selected farm



Time: 3 hours



Materials/Preparation: Field survey guide (2 per group), chart paper (about 3 sheets per group), markers, masking tape

Several days before the session schedule, visit the village and discuss with local leaders about the plan to bring participants to the site to carry out a field survey for the exercise on crop diversity. Explain the objectives of the exercise and the planned activity. Identify with them five farms where the activity can be carried out and ask permission from the respective farmers. Request the farmers to accompany participants during the field survey as they will be interviewed as part of the exercise.

### Steps:

- 1. Explain that the participants will carry out a survey of the crops grown, plants, and trees in the community and discuss the importance of crop diversification.
- 2. Divide the participants into five groups and provide two copies of the survey guide to each group that they will use during the field walk (see Box 3.1 below). Go through the items quickly to ensure that the task is clear to everyone. Explain that the group should collect information using the survey guide and for them to make a rough sketch of the farm on their notebook to be drawn later on chart paper for presentation.

Each group will be accompanied by the respective owners of the farms to be visited. Remind them to be back at the meeting place at the designated time. About an hour for the walk should be sufficient.



## Box 3.1 Field survey guide: An inventory of the community's crop diversity

- a. What crops (and varieties) are being grown on the farm? Indicate if these are traditional (sourced locally or from other places) or introduced (including modern varieties and high yielding varieties). How did the owner select or decide what to grow?
- b. What other plants and trees are also seen growing on the farm? These may include those that already existed when the farm was established or that otherwise naturally or spontaneously grew afterwards. What reason(s) did the owner have for keeping these plants and trees?
- c. What produce do the crops, plants and trees provide? Which ones are primarily for home use/consumption or for the market?
- d. What other benefits (e.g., ecosystem services) do the crops, other plants, and trees provide?
- e. Make a rough sketch of the farm.
- 3. When back in the meeting place, give an hour for the groups to process their findings from the field (using the survey guide as outline) and have them write these down on chart paper for presentation. On another chart paper, the groups should sketch the map of the farm showing the location of the crops, plants, and trees they observed during the survey.
- 4. Give each group 10 minutes to present their outputs (answers to the field survey guide alongside the maps of the farm visited). Q and A may be done after each presentation or after all the groups have presented depending on the flow of discussion or time availability. (**Note:** Remember to collect the maps after the session for use in the next exercise.)

- 5. Synthesize the presentations, giving emphasis to the following key points:
  - Crop diversification entails growing of as many species and varieties of crops as possible at any given time. The more diverse the farm, the better.
  - Diversity helps better ensure household food, nutrition/ health, and livelihood/income security.
  - Increased crop diversity also helps improve the environment via the various ecosystem services that it can provide.



# Exercise 3.2 Nutrient and light requirements of crops

Different types of crops have different nutrient requirements that need to be met for them to properly grow and give the desired yield. Otherwise, poor soil nutrient management practices result not only in poor crop yields but also in further soil nutrient depletion. However, regardless of the quantity of nutrients they receive, plants will only achieve their maximum potential (i.e., yield) if they also receive enough (sun)light. Plants require enough light to grow and develop.

To optimize the use of a particular area, proper – sometimes closer – spacing should be practiced, taking into consideration the crops' nutrient and light requirements for optimum growth. Crop planning will contribute to improving soil health and fertility and should consider both the nutrient and light requirements of crops.

At the end of the session, participants shall be able to:

- explain how various types of crops have varying nutrient requirements
- discuss how various types of crops affect soil quality and nutrient availability

- explain how various types of crops have varying light requirements
- draw a suggested map of a sample farm showing various types, spacing, and arrangement of crops to optimize their use of light and soil nutrients



Time: 1.5 - 2 hours



Materials/Preparation: Maps drawn by the groups in Exercise 3.1, chart paper (about 5 sheets), markers, masking tape, diagrams of Fig 14 from p40 and Fig 15 from p43 of the field manual

### Steps:

- 1. Recall the various types of crops that the participants saw in the previous exercise as follows: staple or cereal crops, pulses or legumes, leafy vegetables, tuber or root crops, and fruit-bearing vegetables/crops/trees. Write these down on the board or chart paper. Ask for 2-3 examples for each type of crop and write these down as well.
  - Ask 2-3 participants on what they know about the difference in nutrient requirements according to the types of crops. Supplement their answers by mentioning that different crops require different types and quantities of soil nutrients, e.g., leafy crops are heavy consumers of nitrogen; tubers and root crops require more phosphorus; fruit-bearing crops need more of potassium; while legumes can in fact add nitrogen to the soil.
  - Cereal or grain crops are also known as heavy feeders, that is why planting legumes after rice or corn is a good practice to replenish the soil nutrients that have been used up - especially nitrogen.
- 2. Explain that the rooting depth of crops is also an important consideration with regard to their nutrient uptake. Shallowrooted crops will absorb nutrients from the top layer of the

soil while deeper rooted ones will utilize nutrients from the lower level(s) of the soil profile. Hence if different shallow-rooted crops are planted together, there will be competition for nutrients; the same is true if different deep-rooted crops are grown together. It is therefore crucial to mix crops of varying rooting depths. Show the diagram of crops of varying rooting depths to further clarify the idea (Fig 14 from p40 of field manual). This is important to consider in crop rotation, where shallow-rooted crops should be followed by deep-rooted crops (or vice versa), if possible, so as to optimize the use of soil nutrients in a given area.

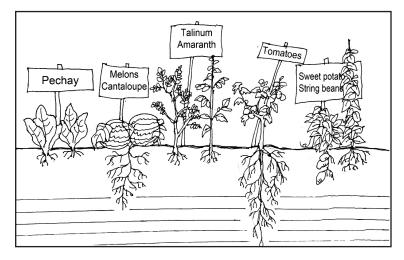


Figure 3a. Planting crops of varying root depths

3. Introduce the concept of light requirements of crops. Explain that different crops need varying amounts of light; they grow better and produce optimally if they receive their corresponding requirements for light. There are those that need full sunlight, others that can tolerate partial shade, and some that are shade-loving. Again, ask for examples of crops according to their difference in light requirements. Correct "wrong" answers and supplement the participants' responses with the following information:



- Sun-loving crops require at least 6 hours of sunlight; examples are corn and vegetables that fruit heavily like tomatoes, peppers, eggplants, etc. Vegetables of the cucurbit family such as squash, bitter gourd, and cucumbers are likewise sun-loving.
- Leafy vegetables like spinach and lettuce and root crops such as sweet potato and carrots can usually tolerate partial shade, i.e., at least 2 hours of full sunlight and then light shade (or filtered sunlight) for the rest of the day. Taro and ginger are quite tolerant to shade and can survive with just filtered sunlight.
- One can plant shade-tolerant or shade-loving plants under or near taller crops to protect them from sun damage. In multi-storied cropping, plants of different heights are purposely grown on the same piece of land. In this system, crops with different light requirements are planted in a layered or multi-storied pattern. Thus, various crops can be grown together in a limited space without them competing with each other for light. Post the diagram of an example of multi-story cropping system (Fig 15 from p43 of field manual).

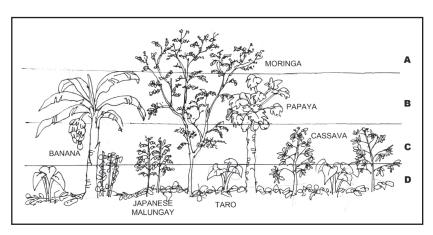


Figure 3b. Crop combinations in a multi-storied cropping system

- 4. Ask the participants to form the same groups as they had in the field survey on crop diversity. Distribute the maps of the farms to the respective groups that made them (in the previous exercise). Explain the tasks for the group work:
  - Quickly review their maps to remind themselves of what "their" farms looked like.
  - Discuss a "what if" scenario. If they could redesign the farm, what suggestions would they give for a better arrangement (placement) and spacing of the crops, plants and trees? What other crops and trees would they add or introduce?
  - Make a proposed design based on information on crop diversity and the more recent inputs and discussion on nutrient and light requirements of different crops (including the farm owners' own preferences). This could also include information on how crops affect soil quality and nutrient availability, and how they can optimize soil nutrient utilization, etc.
  - On a chart paper, draw a new design for the farm and be ready to explain the proposal during the presentation.

Allow 45 minutes to an hour for the group work above.

- 5. Have the presenters post both the "old" and proposed farm maps on the board before they present for the other participants to better understand or appreciate the farm improvements being proposed. Give 10 minutes for each group's presentation and another 5 minutes for comments or O and A.
- 6. Ask for 3-5 volunteers to briefly state one important information they have learned during the exercise. Supplement the discussions with additional information about the importance of crop planning in providing the nutrient and light requirements of crops. Highlight the major points raised during the presentations to synthesize the session.





## Exercise 3.3 The different cropping systems

At the end of the exercise, participants shall be able to:

- define cropping systems
- describe the basic features of different cropping systems
- explain advantages and disadvantages of different cropping systems
- identify (individual) actions to adopt or adapt for a more efficient cropping system



Time: 1 – 1.5 hours

Materials/Preparation: chart paper, markers, masking tape, labels of the different cropping systems: row cropping, alley cropping, relay cropping, crop rotation, multi-storied cropping; labels/names of farmers or panelists

Days (or a few weeks) before the session, ask assistance from village leaders in identifying farmers successfully practicing different cropping systems who could be invited as resource persons for the session. Invite one farmer each practicing any of the following cropping systems: intercropping (either row cropping, alley cropping, or relay cropping), crop rotation, multistoried cropping, etc. Provide them with the list of questions that they will be asked during the panel discussion (See Box 3.2 in Step 3).

Follow up with identified farmers to confirm their attendance in the training session. Ask them if they need help with preparing their presentations and provide assistance as appropriate.

### Prepare

### Steps:

 Ask the invited farmers to sit together in one area of the room where everyone can see them. Put up the label of the cropping system in front of the resource person who is representing it:

- row cropping
- alley cropping
- relay cropping
- crop rotation
- multi-storied cropping
- etc.
- 2. Introduce the resource persons and explain that they will be answering questions about the cropping system they are practicing.
- 3. Facilitate the panel discussion by asking the same set of questions, one question at a time to all panelists, who will be addressed in random order.

## Box 3.2. Guide questions for panel discussion on cropping systems

- a. Define/describe the cropping system you are practicing.
- b. Where or from whom did you learn about the cropping system you adopted/adapted? What did you consider in deciding on a cropping system to implement? How long have you been practicing the system?
- c. What are the advantages/benefits and disadvantages/drawbacks of the cropping system you are practicing?
- d. What challenges or difficulties did you encounter in practicing the system?
- e. How can you say that you have an efficient\* cropping system?

<sup>\*</sup> The efficiency of a cropping system is measured by the quantity of produce obtained per unit resource (land, labor, capital, farm inputs, etc.) used in a given time.

- 4. After the resource persons have answered each question, give time for participants to give their ideas or ask further questions.
- 5. End the session by asking the participants to answer the question: Based on what they learned from the discussion, what changes would they like to make to their cropping system to make it more efficient (define efficiency for the benefit of the participants, see Box 3.2)? Why? Give them 5 minutes to think about their answers then ask for 3 5 volunteers to share their thoughts. (**Note**: This is an individual exercise that participants should answer for themselves as it involves their own farms.)

As a final note, emphasize that the objective of any cropping system is efficient utilization of resources, stable production, and higher economic benefits. Cropping system refers to the kind and sequence of crops and the practices used to grow them on a given area over a period of time.



### PLANT HEALTH AND CROP PROTECTION

Disease pathogens, pests and accompanying species – such as predators, parasites, pollinators, competitors and decomposers – are naturally present in any farm with the latter performing a wide range of ecosystem functions. Intensified agricultural production has encouraged practices that break down the natural processes of pest and disease regulation. For instance, monocropping reduces crop resistance needed for managing plant diseases and many insect pests. Overuse and misuse of pesticides disrupt the balance of agroecosystems and have resulted in pest outbreaks by changing the dynamics of pest and natural enemy populations. An ecological approach to pest and disease management aims to build on natural pest management to balance pest populations while keeping losses to an acceptable minimum. This would also reduce health risks to farmers and damage to the environment.



# Exercise 4.1 Ecological balance: the first defense against pests and diseases (Interaction of ecosystem components<sup>1</sup>)

At the end of the exercise, the participants shall be able to

- enumerate components of the rice ecosystem
- demonstrate the interaction between components of the rice ecosystem
- explain the role of pests in the ecosystem
- describe what a balanced ecosystem is
- explain why ecological balance is the first defense against pests and diseases

Adapted from FAO Community Based Rice IPM Programme Development: A Facilitator's Guide.



Time: 1 – 1.5 hours



Materials/Preparation: chart paper, meta cards, markers, five sets of questions for group discussion

Several days before the session, visit the village and discuss with local leaders about the plan to bring participants to the site to carry out field observations for the exercise on ecological balance. Explain the objectives of the exercise and the planned activity. Identify with them five farms where the activity can be carried out, and ask permission from the respective farm owners.

### Steps:

- 1. Form five groups and clarify what the participants are going to do. Instruct the groups to go to the rice field for about 30 minutes and record **all kinds** of plants, insects, spiders and all sorts of living organisms that they see in the field. They will use the information to prepare the output for Step 2.
- 2. In groups, participants should write the names of all the organisms that they observed in the rice field on chart paper. Let them draw lines with arrow heads to represent interactions between certain organisms and discuss what the lines or interactions are. For example, a line with arrow heads on both ends between a certain insect (e.g., grasshopper) and a particular plant (e.g., rice) means that the grasshopper feeds on the rice plant and the rice plant provides food for the grasshopper. A line with an arrow head only from a weed to the rice plant means that the weed competes with the crop for nutrients (including water and sunlight) (See Figure 4 as an example.)

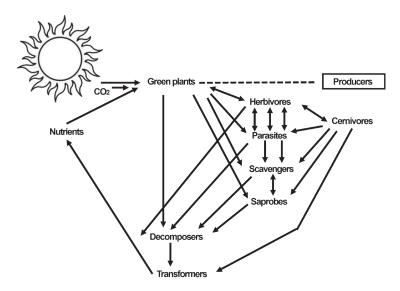


Figure 4. Interaction between components of the ecosystem

- 3. Ask a representative from each group to present their diagrams and explain the interactions between organisms in the rice ecosystem, i.e., the meaning of the lines and arrows that they drew between them. Relate the exercise to an earlier module on understanding different components of an ecosystem and how they interrelate, i.e., food chain and food web. Entertain several comments or questions as needed.
- 4. Ask a volunteer from each group to draw the set of questions for their group to discuss. Provide chart paper for them to write key points of their discussion. Allow 45 minutes for the groups to discuss and prepare for their presentation.
  - Group 1: Define "pest(s)". Give 5 examples of pests. Where do pests come from (or what conditions give rise to pest problems or pest infestation)? What is the role of pests in agroecosystems?
  - Group 2: What happens when all insect pests are killed by pesticides? What happens when all spiders or other natural enemies or predators are killed and a pest comes to the field? When (or at what point) does a particular animal or plant become a pest? Note that



- not all insects or animals in the field are pests; name at least three examples that are beneficial and why they are considered so.
- Group 3: Does all the pesticide applied in the field reach a target pest? If the answer is "yes", how can one ensure that this happens? If the answer is "no", where does the rest of the pesticide go? What are some general guidelines for the effective use of pesticides?
- Group 4: What happens when pesticide has been applied to the plant and it is very sunny? What happens when pesticide is applied to the crop and there is too much rain? What happens to diseases, pests and accompanying species (e.g., natural enemies) when there are no crops in the field?
- Group 5: What is a balanced ecosystem? Describe what a balanced ecosystem looks like. Why is ecological balance considered the first line of defense against pests and diseases?
- 5. Ask for another representative per group to share their discussions on their assigned questions. Again, allow for a number of comments or questions on the presentations. Add that aside from pesticides, fertilizers also determine the health and balance of the ecosystem. For instance, if there is too much rain and fertilizers (especially nitrogen) is applied, the plant will become "yummy" to insects. Too much rain also favors the development of certain diseases. On the other hand, if fertilizer has been applied and it is very sunny, the plant could be scorched or "burned".
  - Ecological imbalance occurs when a natural (e.g., drought or typhoon) or human-caused disturbance (e.g., use of inorganic pesticides or fertilizers) destroys the natural balance of the ecosystem.
- 6. Supplement the presentations by explaining that ecological balance is the natural tendency of plant and animal populations to neither decline to extinction nor increase

to indefinite density. A healthy (i.e., resilient) ecosystem is capable of returning to its balanced state or does not undergo extreme changes in its characteristics over time. In undisturbed ecosystems, a state of balance exists where each of the species achieves a certain status that becomes fixed for a period of time and is relatively resistant to change. A perfect example of such a naturally self-regulating ecosystem is an undisturbed forest.

Conclude the exercise by adding that a healthy or balanced agroecosystem fosters effective pest management. Natural biological processes that support production are protected, encouraged and enhanced; this is the first and most fundamental line of defense against pests and diseases.



# Exercise 4.2 The vicious cycle of chemical pest control

Natural enemies or beneficial organisms that help keep insect pests and some diseases from causing economic damage are usually more negatively impacted by pesticides than the pests themselves. Pests in fact may even develop resistance to pesticides, when the same type of pesticide is used repeatedly or for long periods. Furthermore, some pests pass on the resistance genes to their offspring as they rapidly multiply while natural enemy populations bounce back more slowly (or even disappear) when chemical pesticides are applied. Although chemical pest control usually demonstrates quick action and farmers often favor immediate results, such approach cannot solve the problem in a sustainable way.

At the end of the exercise, the participants shall be able to:

- explain the role of pests or hosts in the ecosystem
- describe the mode of action of different pesticides
- discuss how chemical pest control impacts ecological balance
- explain how ecological imbalance encourages more pesticide use



Time: 2 – 2.5 hours



Materials/Preparation: Nets to catch small insect pests (preferably brown planthoppers/BPH) and spiders and other natural enemies, small plastic bags for specimen collection (at least 5 per group), plastic cups (instant noodle size) or the bottom half of cut up 1.5 li soft drink bottles (2 cups per group), netting to cover the plastic cups, rubber bands to hold the netting in place, hand sprayers (minimum of 2 sprayers; groups can share), two kinds of pesticides, chart paper, markers, and masking tape

Several days before the session, select two of the most commonly used pesticides by farmers in the village. One of the pesticides should be preferably a contact pesticide and the other one, a systemic pesticide<sup>2</sup>. Calculate the concentration and dosage of the selected pesticides that the farmers typically use in the field. Label 5 cups with the name or brand of one and the other 5 with the name of the other pesticide.

### Steps:

- 1. Form 5 groups and explain the task they should carry out in the field. Distribute the plastic bags and nets to the small groups. Ask them to go to the field to collect insect pests (preferably brown planthoppers or BPH) and spiders (preferably the same kind) or other natural enemies. See to it that the participants understand what "natural enemies" are and several examples are given. They should make sure not to damage/injure the specimens. Allow about an hour for the activity.
- 2. Once the participants are back at the meeting place, distribute one of each of the cups pre-labeled "contact" and "systemic" (pesticide) to the groups. Explain that a contact pesticide kills its target when it comes into direct contact

<sup>&</sup>lt;sup>2</sup> Common examples of contact pesticides are permethrin and pyrethroids; for systemic pesticides, imidacloprid and thiamethoxam (N.B.: No attempt to promote certain brands is intended).

with and penetrates the pest's body. A systemic pesticide on the other hand kills when the target pest eats the plants (or plant parts) that have absorbed the poison. Instruct the groups to do the following:

- In each of the cups, put in the same number of insect pests and natural enemies, preferably BPH and spiders respectively, if there are enough of these. Cover the cups with the netting and keep the cover in place with rubber bands.
- Spray the cups with contact and systemic pesticides accordingly, as labelled.
- Watch the cups for changes in activity (or death) of the specimens – taking particular note if these are the insect pests or natural enemies. Record observations every 2-3 minutes for 30 minutes.
- 3. Ask for a group representative to report on the results of their observations. When all the groups have reported, ask participants the following questions:
  - Which ones ceased moving (or died) first the pests or the natural enemies? Why do you think this was so?
  - After 30 minutes, were there natural enemies still alive? Were there pests still alive? Would the situation be the same/similar, or different in the field?
  - What would happen if there was a big population of pests in the field and there were no natural enemies?
  - What would happen if the farmer kept using chemical pesticides to reduce the pest population in the field?
- 4. Conclude the exercise by explaining that the size of a pest population and the damage it inflicts will depend on the design and management of the agroecosystem. Natural enemies (e.g., parasitoids, pathogens, and predators) that provide natural biological control of pests need prey (or hosts) for their survival.

Insects (and diseases) become pests only when the damage they inflict causes yield reduction leading to economic injury or livelihood losses. The use of chemical pesticides causes ecological imbalance, which may result to an increase in pest populations, which in turn encourages more pesticide use. The only ecologically viable solutions are those that consider the root causes of insect or pest infestations and address the problems based on the rules of nature. (**Note:** Make sure that the term "economic injury level" is clearly defined and sufficiently understood.)



# Exercise 4.3 Ecological pest management and EPM practices

The basic guiding principle in ecological pest management (EPM) is that there is no such thing as a pest problem. If the ecological balance is not disturbed, then the appearance of a pest is not considered a problem but rather as a symptom of the problem. Once the symptoms show up, the causes (disruptive factors) should be identified and addressed to restore the ecological balance.

At the end of the exercise, the participants shall be able to:

- explain the basic principles of ecological pest management
- describe how each principle contributes to ecological pest management
- discuss methods that enhance the farming system's natural pest-fighting capability
- provide examples of how these methods/practices help in managing or controlling pests



Time: 1 - 1.5 hours



**Materials/Preparation:** chart paper, markers, and masking tape

Prior to the session, prepare A4 paper on which the three basic principles of EPM are written: CULTIVATING HEALTHY SOILS, GROWING HEALTHY PLANTS, and KNOWING THE PESTS

#### Steps:

- 1. Introduce the session by asking participants what ecological pest management is. After responses are exhausted, add that ecological pest management (EPM) helps strengthen the natural systems to support the natural processes in managing pests while enhancing agricultural production.
- 2. Explain that EPM puts emphasis on strengthening natural processes to enhance the agroecosystem's capacity to keep pest populations in check. One at a time, post on the board the pieces of A4 paper labelled with the three basic principles of EPM. Spend about 5 minutes to brainstorm with the big group about what each principle means and how it contributes to ecological pest management. (**Note**: There is no need to go into too much detail at this point; a more thorough discussion will be done in the small groups.)
- 3. Break the participants up into six small buzz groups. Assign two groups each to focus on one basic principle. Under the principle that they were assigned to discuss, the groups need to list techniques or practices that would support EPM and briefly explain how or why such a practice can help in managing or controlling pests. Give about 15 minutes for the buzz groups to discuss and to write down the results of their discussions on chart paper.
- 4. Allot about 5-7 minutes each for the groups to report on their discussions. Let the participants observe if the groups that worked on the same basic principles had similar (or different) outputs. Ask for a few volunteers to add to the list of techniques reported, then correct or supplement their responses as needed.



- 5. Introduce the concept of EPM methods. Define the terms and ask for 2-3 examples per method. You may use some of the examples below to stimulate participants to come up with their own, or to supplement their answers as appropriate:
  - Cultural method refers to the manipulation of the crop production system or cultural practices to reduce or eliminate pest populations (e.g., use of pest-resistant crop varieties; practice longer crop rotations to break insect/pest cycles).
  - **Mechanical or physical** method is the management and control of pests using physical means such as putting up of barriers (e.g., fence around the garden to keep goats or cows out; use of fine mesh nets to protect high value crops from insects). It also includes manual control or sometimes the use of tools where the pest is actually destroyed or eliminated (e.g., handweeding; picking of egg masses of Golden Apple Snail or golden *kuhol*).
  - Biological control or biocontrol is a method of managing pests such as insects, mites, weeds and plant diseases using other organisms. Biological control methods rely on predation, parasitism, herbivory, or other natural mechanisms and may or may not involve a farmer's active role (e.g., raising fish in the rice field to eat insect pests that fall into the water; growing plants with yellow flowers on rice bunds and between fields to attract natural enemies; use of dead frogs to attract rice bugs and burn them while they are on the bait).
- 6. Choose three of the outputs presented in step #4 (one each from the three basic principles) and ask the participants if a particular practice or technique is either cultural, mechanical/physical, or a biocontrol method as defined above.
- 7. Refer to Box 4.1 below to supplement information on the techniques or practices not mentioned by the participants.

## Box 4.1 Common techniques in the practice of ecological pest management

Soil management (cultivating healthy soils)

- Maintaining soil nutrient and pH levels to provide the best possible chemical, physical and biological habitat for crops and soil organisms;
- Practicing crop rotation to enhance soil microbial populations and break disease, insect, and weed cycles;
- Applying organic manures to help maintain balanced nutrient and pH levels; adding soil conditioners (biochar, coconut coir, sawdust, lime, vermiculite) and microbial inoculants (rhizobia, mycorrhiza, effective microorganisms/EM, indigenous microorganisms/ IMO) as supplements;
- Preventing or reducing soil compaction to improve soil structure and make nutrients more available; and
- Keeping soil covered either with crop residues or living plants

Crop management (growing healthy crops)

- Selection of pest resistant, local, or native varieties and well-adapted cultivars;
- Use of legume-based crop rotations to improve soil fertility and create favorable conditions for healthy plants, making them more pest- and disease-resistant;
- Use of cover crops such as green manure to reduce weed infestation and disease or pest attacks;
- Use of multiple cropping and agroforestry systems; and
- Use of crop spacing and patterns including tending practices to create conditions that are unfavorable to the pests

### Pest management (knowing the pests)

- Providing a favorable habitat to attract beneficial insects and other natural enemies;
- Managing plant density and structure so as to deter the onset of diseases;
- Cultivating for weed control based on knowledge of the critical competition period;
- Adopting intercropping (to "confuse" insect pests) and crop rotation (to break the pest cycle); growing pestrepellant plants; employing pest-trapping devices that use light, color, scents, and pheromones;
- Using of integrated pest management (IPM) strategies at various levels of integration;
- Using of synthetic agricultural chemicals to control pests only as a last resort.
- 8. Wrap up the session by mentioning that ecological pest management focuses on preventive (i.e., keeping pests from occurring) rather than reactive (i.e., acting in response to a pest situation that has occurred) approaches. A comprehensive knowledge of the ecosystem including the natural biological interactions that suppress pest populations is essential for ecological pest management.



## WATER CONSERVATION AND MANAGEMENT

The earth abounds with water, albeit only one percent of it is in the form that humans need to survive (i.e., liquid fresh water). The agriculture sector – the largest consumer of fresh water – has been and will continue to compete with the requirements of households and businesses (e.g., manufacturing). Conserving water will ensure that the supply is sufficient and safe for the present as well as for future generations. This will only be possible with sustainable use and management practices of this most precious resource.



## Exercise 5.1 The water cycle (Demonstration)

Water cycle is the continuous movement of water within the earth and the atmosphere. The cycle includes four basic processes:

1) the **evaporation** of water into vapor from water sources like oceans, soils, and ice; 2) **condensation** of water vapor in the air into droplets; 3) **precipitation** as water falls from clouds; and 4) **collection** of the water in places like oceans and the ground. The sun plays a key role in the process by heating up water in the earth. Human activity (e.g., deforestation and burning of fossil fuels) has contributed to the recent phenomenon of rapid global warming and has hugely disrupted the water cycle. The rates of evaporation and precipitation have increased, causing more floods and droughts to occur as well as a wide range of other weather- and climate-related issues and challenges.

At the end of the exercise, the participants shall be able to:

- explain the processes of evaporation and condensation
- explain how the water cycle works
- discuss how global warming has increased the frequency and severity of floods and droughts

- discuss issues and challenges resulting from changes in the water cycle (aside from more frequent and more severe floods and droughts)
- suggest practices to mitigate problems brought about by changes in the water cycle



Time: 2 - 2.5 hours

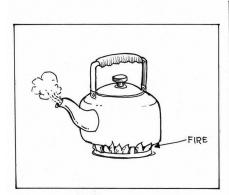


Materials/Preparation: Equipment for demonstration including a water kettle, butane or kerosene stove, water, ice cubes, colored plastic plate, small bowl, piece of cloth; chart paper (about 5 sheets), markers, masking tape. The following also need to be prepared on chart paper: guide questions for observation during the demonstration (step 3), illustration of the demonstration set-up (step 4), and simplified illustration of the water cycle (step 7).

### Steps:

- 1. Explain that the exercise seeks to explain the concept of the water cycle, and provide an opportunity for participants to discuss issues and challenges (e.g., flooding or drought) including other related problems resulting from changes in the water cycle. The session also aims to explore important practices to mitigate problems brought about by changes in the water cycle.
- 2. Initiate discussion by brainstorming about what participants know about the water cycle. Write their responses on the board. Remember that this is a brainstorming activity so there is no right or wrong answer; misconceptions can be clarified later.
- 3. Explain that participants will observe a demonstration on the water cycle. Post the guide questions on the board; these will cue the participants on what to observe during the demonstration. Allow for a minute or so for them to read the questions before starting the actual demo.

- What makes the water boil? What is coming out of the kettle? How does it look like?
- Where does the steam from the water kettle go? What happens to the steam?
- What do you see on (at the bottom of) the plastic plate placed above the steam? What happens when there is already a lot of water underneath the plastic plate?
- What do you see in the bowl that is placed below the plastic plate?
- What happens to the cloth spread under the bowl?
- 4. Set up the demonstration. It is important to have the set up on an elevated surface so that participants will clearly see the condensation happening on the bottom of the plate. Refer to Figure 5a for an idea of the demonstration set up.



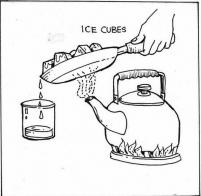


Figure 5a. Demonstration set-up

5. Put the stove on low setting. Set your stopwatch (or ask a participant to do so) to mark the time when the water starts to boil and keep the water boiling for another 10-15 minutes. Allot 5-10 minutes for participants to give their general observations.



- 6. Afterwards, explain what the water kettle, plate, bowl, and cloth were meant to represent. Then facilitate the discussion, focusing on the questions earlier posted in step 3.
- 7. Show Figure 5b on the water cycle and point out the parallels between the processes they observed during the demonstration and what really happens in nature.

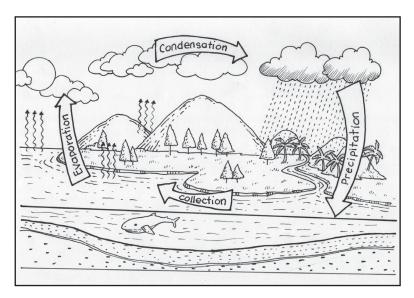


Figure 5b. The water cycle

If it did not come up in the discussion, add that water cycle is the continuous movement of water in different forms – on, above, and below the earth's surface. Summarize the process thus: 1) Water is lost as vapor when it evaporates from the earth (from the surfaces of water bodies, the soil, and ice; or from plants during transpiration); 2) The water vapor then forms clouds in the atmosphere; 3) Clouds build up until they become heavy and the water falls back to the earth as rain; and 4) Rainwater runs off the land into rivers, lakes, reservoirs, and oceans. Some of the water is absorbed by the soil and over time, it percolates into the groundwater.

Water that collects into water bodies or is absorbed into the soil eventually evaporates, returning to the atmosphere. And thus, the cycle starts again.

- 8. Facilitate further discussions by asking questions on scenarios like:
  - If **more** water evaporates into the atmosphere, what would this mean for water that comes down to earth? What is causing more water to accumulate in the atmosphere?
  - Can you compare the frequency of typhoons and floods between now or recently (e.g., past 5 years) versus 20-30 years ago? How about the severity of these typhoons and floods (recent vs "olden" times)? What about the frequency and severity of dry spells or droughts? What may be causing these extreme climatic or weather events?
  - What are the implications or effects do these occurrences have on your farming?
  - Are there actions that farmers can do to address the situation, i.e., practical or doable solutions at the farm or community level?
- 9. For the second demo, the same set up will be followed as in the first one. However, use a higher setting for the stove. Again, set the stop watch to mark the time when the water starts to boil, and keep the water boiling for another 10-15 minutes. anr. Allot 5-10 minutes for participants to describe their observations afterwards.
- 10. Explain that the second demo illustrates how global warming is speeding up the water cycle. Higher temperatures are increasing the rate of evaporation of water from the earth. This loss of water to the atmosphere means that the warmer air contains more moisture. Increased atmospheric moisture will result in changes such as more frequent cycles of floods and droughts, or more severe storms such as cyclones and hurricanes.
- 11. Highlight key points of the discussions and summarize the exercise.





### Exercise 5.2 Agricultural water management<sup>1</sup>

Agricultural water management (AWM) seeks to use water in a way that provides crops and animals the amount of water they need, enhances farm productivity, and conserves natural resources for the benefit of users. AWM is concerned not only about irrigation and drainage but also about improved utilization of rainfall, use of recycled water, soil and water conservation, and watershed management.

At the end of the exercise, the participants shall be able to:

- explain the value of rain(water)
- identify ways to make optimum use of the rainwater at the place where it falls
- describe efficient and sustainable AWM techniques or practices
- select AWM practices that they can apply in their own farms



Time: 2.5 - 3 hours

Materials/Preparation: chart paper, markers, masking tape

For Part 1: 1.5li soda bottles for putting soil samples in (cut-off lengthwise, 3 pcs); 1li soda bottles for catching water (3 pcs); 3 intact/undisturbed soil samples (approximately 6cm deep/thick, wide and long enough to fit into the cut-off bottle – see Figure 5c): 1 from a perennial grassland (with grass still attached), 1 from a crop field, and 1 from an open barren field; 15 bottle caps; 1 piece of wood to prop up bottles to simulate a slope, water, sprinkling can

For Part 2: 3 methods of AWM written on A4 paper (step 1) and in strips of paper for the draw lots (step 2), chart paper

<sup>&</sup>lt;sup>1</sup> Adapted from FAO. 2020. Soil health for paddy rice: a manual for farmer field school facilitators. Rome.

### Steps:

Part 1.

Inform the participants that the exercise will be in two parts.
 The first one will be a demonstration (on rainwater use, harvesting and storage) and the second part will be small group work.

Ask everyone to stand around the demonstration set up – already put together prior to the start of the session. Explain that what they have in front of them is a simplified representation of three samples of land on a slope, with the following characteristics: a) field with perennial cover such as napier grass (buntot pusa); b) field with standing crops or covered with crop residues + amendments to improve soil structure; and c) open, barren field, currently with no crops. Add that the bottle caps represent water harvesting and impounding facilities within the field, and the containers at the bottom of the "fields" represent the places where runoff collects or goes to (runoff is excess water that is not used by crops/plants or absorbed into the soil).

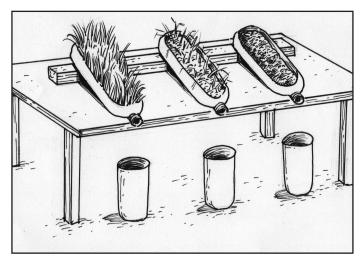


Figure 5c. Set-up for the demonstration on rainwater use, harvesting, and storage



**Note:** The set-up is a bit elaborate so it is best that it is already prepared prior to the session to save on time and so that the demo can start immediately.

- 2. Request for a volunteer to water the first "field" (Farm A) evenly using the sprinkling can; this will represent pouring rain. Record the starting time. Tell the participant to keep watering until water starts to drip to the container placed below the lower portion of the farm; also note the time when this happens. Continue doing this for at least one minute more after the water started to drip. Record the total volume of water used for the process by noting the original volume minus what is left in the watering can.
- 3. Ask for a second volunteer to do the same with Farm B, and another one with Farm C using the same volume of water for watering Farm A. As in the first "farm", the participant should keep watering until excess water drips again, continuing to do this for at least one more minute. Also note the starting times, the point when water started to drip to the collecting vessels, and the amount of water used in both farms B and C.
- 4. Process the exercise with the following questions:
  - How long did it take A, B, and C to get saturated (i.e., excess water started to drip)? What does this imply if the demonstration happened in actual fields?
  - What are your general observations about the excess water that dripped from A, B, and C?
  - How do those observations above translate if A, B, and C were actual fields?
- 5. Ask for 2-3 additional comments about the whole activity before providing your own inputs.
- 6. Explain that the water that the earth gets comes mainly from rain. It is rainwater that fills lakes and rivers, recharges empty spaces underground (aquifers) and provides for the water requirements of plants and animals, including humans.

However, rainwater is often wasted or underutilized. Several techniques can be practiced in farms to make more rainwater available to crops when most needed, which will be the subject for the second part of the session.

Mention that rainwater harvesting starts with managing surface water and preventing runoff. The less water runs off the soil surface, the more water sinks into the soil; plants can use this reserve water or moisture when needed. During strong rains however, only a part of the water infiltrates into the soil; most of it flows away as surface runoff, thus being wasted or lost for the use of crops. More importantly, runoff carries with it precious topsoil; this problem is even more serious in sloping areas or upland farms where soil erosion and even landslides usually occur.

#### Part 2.

 Start the second part of the exercise by mentioning that challenges confronting water management in agriculture include improving water use efficiency and ensuring the sustainability of our water resource. Mention that this part of the exercise will entail group work to discuss the methods of agricultural water management (AWM) and specific techniques or practices under each method.

Note that there are three main methods of AWM; post the A4 paper on the board labelled with the following: 1) improved rainwater harvesting and storage; 2) decreased evaporation; and 3) enhanced irrigation efficiency. Define or describe the methods and give at least an example each to distinguish one method from the other.

2. Depending on the number of participants, divide them into either three or six groups as in Exercise 4.3 (where two groups will discuss the same method) and ask for group representatives to draw lots (using the strips of paper labelled similarly as those in step 1 above). Clarify the tasks for the group work as follows:

- Name specific techniques or practices that can be done under the method.
- Briefly describe how each practice is done.
- Name the benefits/advantages and drawbacks/ disadvantages of each practice.
- Describe where or under what situation(s) the practice is suitable or appropriate.
- 3. Provide each of the groups with 2-3 sheets of chart paper for them to write on. They may organize the results of their discussion in the suggested matrix below (Table 5a). Allow 45 minutes to 1 hour for the group work.

Table 5a. AWM method: Improved rainwater harvesting and storage

Practice/ technique (name, description)	Benefits/ advantages	Drawbacks/ disadvantages	Situations where it is suitable or appropriate
1			
2			
3			
4			
5			

- 4. Give each group 5-7 minutes to present their outputs. When all the groups have finished presenting, allow for another 10-15 minutes for Q and A and additional comments or discussion on the presentations. Encourage contributions on other the water conservation practices/techniques that participants are familiar with that were not included in the group presentations.
- 5. Supplement the group presentations and the ensuing discussion by adding information that were not mentioned by the participants. Refer to Table 5b.

Table 5b. Efficient and sustainable AWM techniques/practices

Improved rainwater harvesting and storage	Decreased evaporation	Enhanced irrigation efficiency
<ul> <li>circular and semicircular bunds</li> <li>planting pits (e.g., zai holes)</li> <li>small farm reservoirs</li> <li>small water inpounding structures</li> <li>catchment strips</li> <li>contour ditches (contour trenches, infiltration ditches)</li> <li>contour ditches with live or stone barriers</li> <li>drainage and diversion ditches</li> <li>furrow dikes</li> <li>conservation bench terraces</li> <li>conservation tillage</li> </ul>	<ul> <li>mulching</li> <li>cover cropping</li> <li>application         of organic         materials</li> <li>multiple         cropping</li> <li>higher planting         densities         (triangular         planting, multistoried cropping)</li> </ul>	<ul> <li>matching crops and cropping systems with rainfall patterns</li> <li>adjustment in crop establishment practices</li> <li>supplementary irrigation</li> <li>drip irrigation</li> <li>gravity-fed irrigation</li> </ul>

- 6. Underscore that the specific techniques or practices can "cross" lines, and that the AWM methods are not mutually exclusive. For instance, contour ditches that are designed for improved rainwater harvesting and storage can at the same time be considered as a technique to decrease evaporation since such ditches or canals can also improve water infiltration.
- 7. Summarize the exercise by emphasizing that optimizing water use conserves one of nature's most valuable resources. Integrated practices must be employed to manage water insufficiencies, excesses (e.g., floods), or waste (e.g., overwatering, runoff). Sustainable agricultural water management will help ensure that current ecological, social and economic needs are met without compromising future needs of farming communities.





#### **POSTHARVEST HANDLING OF CROPS**

Postharvest handling, as the term implies, is the stage of crop production that immediately follows harvesting. This would include, among other steps, drying or cooling (depending on the crop), cleaning, sorting/grading, storage, and packing or readying produce for transport to the market. Postharvest handling contributes to how a produce is transformed into a form or condition for value addition, prolong its shelf-life or make it storable, and make it useable or edible – either for the household's consumption or for trade. To obtain high quality produce, postharvest handling must be done in a proper and timely manner. Careful observance of all stages of postharvest handling will determine the quality of the produce and minimize possible losses that could otherwise significantly affect the price farmers get for their produce.



### Exercise 6.1 Postharvest management

At the end of the exercise, the participants shall be able to:

- explain the importance of good postharvest management
- discuss the common causes of postharvest losses
- provide examples of damage sustained by produce from the different causes of postharvest losses
- propose measures to reduce cause-specific postharvest losses



Time: 1 – 1.5 hours



Materials/Preparation: chart paper, markers, masking tape, causes of postharvest losses printed on A4 paper (step 3)

Prior to the session, the facilitator should prepare pieces of A4 paper printed with the following causes (and definitions/descriptions) of postharvest losses:

- Metabolic. Fresh produce is "alive". It breathes, loses moisture, releases heat, can get "sick" and even "die". The natural process of respiration involves the breakdown of food reserves and the aging of these organs – thus leading to food losses.
- Developmental. These include sprouting, rooting, and seed germination – which all lead to deterioration in quality and nutritional value.
- Mechanical. Major losses are due to damage from rough handling, e.g., cuts and bruises on the produce. Use of inappropriate containers or overfilling them leads to compaction and increased mechanical damage.
- Diseases. Many pathogens and decay organisms can attack crops or produce, leading to damage and deterioration.
- Insects. Many insects can infest crops, especially before harvest. Larvae and insects that stay in the harvested produce can still continue to inflict physical damage.
- Temperature. High temperatures lead to significant deterioration, as exposure of produce to sun hastens wilting and decay.
- Relative humidity. Low relative humidity promotes water loss and shrivelling.
- Atmospheric composition. High oxygen content in the atmosphere increases respiration and ethylene production. Ethylene induces ripening, resulting to change in texture (softening), color (yellowing), and further deterioration of the produce.

#### Steps:

 Explain that the exercise seeks to explain the importance of good postharvest management, discuss the common causes of postharvest losses, and propose ways to reduce such losses.

- 2. Brainstorm with participants about their ideas or what they know about postharvest management and why good postharvest management is important. Write all responses on the board or chart paper.
  - When all responses are exhausted, summarize by defining postharvest management as the system of handling, storing and transporting agricultural commodities after harvest. Add that at the farm level, postharvest handling includes hauling, sorting/grading, weighing, packing, and loading for transport to the market. Good postharvest management is key to maintaining quality of produce, minimizing losses, and helping ensure that farmers get a premium price for them at the market.
- 3. Lay the stack of A4 paper face down on the table. The causes of postharvest losses are individually written on each one, along with their definition or description as follows: .
  - Metabolic. Fresh produce is "alive". It breathes, loses moisture, releases heat, can get "sick" and even "die". The natural process of respiration involves the breakdown of food reserves and the aging of these organs – thus leading to food losses.
  - Developmental. These include sprouting, rooting, and seed germination – which all lead to deterioration in quality and nutritional value.
  - Mechanical. Major losses are due to damage from rough handling, e.g., cuts and bruises on the produce. Use of inappropriate containers or overfilling them leads to compaction and increased mechanical damage.
  - Diseases. Many pathogens and decay organisms can attack crops or produce, leading to damage and deterioration.
  - Insects. Many insects can infest crops, especially before harvest. Larvae and insects that stay in the harvested produce can still continue to inflict physical damage.

- Temperature. High temperatures lead to significant deterioration, as exposure of produce to sun hastens wilting and decay.
- Relative humidity. Low relative humidity promotes water loss and shrivelling.
- Atmospheric composition. High oxygen content in the atmosphere increases respiration and ethylene production. Ethylene induces ripening, resulting to changes in texture (softening) and color (yellowing), and further deterioration of the produce.

Ask for one volunteer to pick one and to explain what it means in her/his own words and how it brings about postharvest loss. In addition, the participant should illustrate this with an example and suggest at least one measure to address the situation (i.e., reduce postharvest loss). Encourage other participants to add or share their ideas after the volunteer has finished.

- Do the same process (as in step 3) until all the other causes of postharvest losses and how to reduce them have been explained.
- 5. Summarize the session by highlighting that postharvest loss is one of the key concerns in agricultural production. Substantial **losses of up to 50%** have been recorded from the time produce is harvested until it is prepared for consumption id . These losses are expressed in quantity (measured in weight) and quality (measured in appearance, taste/flavor, texture, nutritional content, and economic value). Briefly explain what each of these losses mean. Stress that the quantity and quality of loss is affected by practices at all stages from the harvest of produce to food preparation tn . To reduce such losses, it is essential to encourage farmers, traders, transporters, and other actors to improve associated practices during and after harvest.





# **Exercise 6.2 Good harvesting practices**

Proper care in harvesting helps determine the quality of farm produce when it reaches the market. Oftentimes, farmers do not realize this and only see the problem after a few days when the produce starts to deteriorate. Proper timing and techniques and conditions of harvesting preserves yield and quality of produce.

At the end of the exercise, the participants shall be able to:

- discuss good practices for harvesting
- explain the indicators to determine the best time to harvest different types of produce



Time: 1 – 1.5 hours



Materials/Preparation: chart paper, A4 paper (3 pieces per group), markers, masking tape, one small empty glass bottle, maturity index chart for common local

produce (step 3)

Prior to the session, the facilitator should prepare the maturity index chart (see Table 6) on newsprint or chart paper. Include only those crops that are grown or commonly consumed in the locality so that the discussions will remain relevant.

#### Steps:

 Explain that the exercise seeks to exchange ideas on and discuss good harvesting practices. The first part of the session will employ a "spin the bottle" method to identify the participant who will complete and explain some statements on good harvesting practices. A checklist game will be used for the second part of the exercise. 2. Ask participants to stand in a circle. Spin the glass bottle in the middle of the circle. The person in whose direction the bottle is pointing to shall complete the statement and explain why she/he thinks this is a good practice. After the participant has explained his or her answer, provide additional explanation as needed.

Statement 1: It is better to harvest early in the day because... Explanation: Harvest early in the day when the air is cooler and the temperature in the field is still low to reduce internal crop temperatures or the product heat load by several degrees.

Statement 2: Harvesting during or just after the rain is not recommended because...

Explanation: Harvesting during or just after the rain is **not** recommended as wet condition (rainwater on the leaves or fruits) favors microbial growth and enhances tissue breakdown. Wet produce will also overheat when not sufficiently ventilated and could cause growth of molds, premature rotting, or germination. Harvesting produce that are still wet with dew is also not recommended for the same reasons mentioned.

Statement 3: Harvest produce with care because...

Explanation: Harvest produce with care to minimize physical injury and preserve quality. Use appropriate harvesting aids and tools to reduce labor cost, improve harvest efficiency, maintain produce quality, and speed up the harvesting process and field handling.

Statement 4: Product quality cannot be improved after harvest because...

Explanation: Product quality **cannot** be improved after harvest; it can only be maintained. It is therefore important to harvest at the right stage and size when the produce is at peak quality. Readiness of specific crops for harvest is commonly defined by maturity indices.

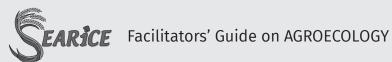
**Note:** The facilitator is encouraged to prepare more of such similar statements pertaining to good harvesting and postharvest practices based on what is relevant in the locality.

3. Prior to the session, the facilitator should prepare the maturity index chart (see Table 6) on newsprint or chart paper. Include only those crops that are grown or commonly consumed in the locality so that the discussions will remain relevant. Put up the maturity index table that was prepared prior to the session. Before putting up the chart paper, fold back the index column to hide its contents. Only the list of crops and the blank second column should be visible sn.

Table 6. Maturity indices for rice, vegetables, fruits, and root crops

Crop	Group answer	Index*
Rice		Grains are hard when bit into pieces, turning yellow/brown; about 80% of grains (in the field) have changed color from green to straw color
Root, bulb, and tul	er crops	
Radish and carrot		Large enough and crispy (over-mature if pithy); carrots also start to crack if harvested too late
Potato, onion, and garlic		Tops beginning to dry out and topple down
Yam (ube), taro/ gabi, and ginger		Large enough (over-mature if tough and fibrous); ginger leaves start to turn yellow or brown
Green onion		Leaves at their broadest and longest

Fruit vegetables	
Cowpea (paayap), yard-long bean(sitaw), snap bean (habichuelas), sweet pea (chicharo) and winged bean (sigarilyas, kalamismis)	Well-filled pods that snap readily
Lima bean (patani) and pigeon pea (kadyos)	Well-filled pods that are beginning to lose their greenness
Okra	Desirable size reached and the tips of which can be snapped readily
Snake gourd (Chinese okra) and sponge gourd (patola)	Desirable size reached and thumb nail can still penetrate flesh readily (over-mature if thumb nail cannot penetrate flesh readily)
Eggplant, bitter gourd (ampalaya), chayote (sayote), slicing cucumber	Desirable size reached but still tender (over-mature if color dulls or changes and seeds are tough)
Sweet corn	Milky sap oozes out when kernel is pricked
Tomato	Green color starts turning pink, seeds slipping out when fruit is cut
Sweet pepper (bell pepper)	Deep green color turning dull or red
Flower vegetables	
Cauliflower	Head or curd is compact (over-mature if flower cluster elongates and becomes loose)



Broccoli	Bud cluster compact (over- mature if loose)
Squash	Pick the male flowers (i.e., those with more hairs and thin base) while they are still buds or the petals have just newly opened. [Keep the female flowers for the fruit.]
Vegetable hummingbird (katuray)	Harvest flowers before they open entirely
Birch flower (himbabao or alukon)	Harvest when yellowish/ greenish-white male flowers are about 10 cm in length and female flowers are greenish globes with scales.
Leafy vegetables	
Lettuce	Big enough and before flowering
Cabbage	Head compact (over-mature if head cracks)
Celery	Big enough and before it becomes pithy
Fiddlehead fern (pako)	The terminal bud is still coiled and measuring about one inch in diameter
Bitter leaf (papait or sarsalida)	Ready for harvesting once it starts to flower or right before the flowering stage. (Cut the shoots 5-10 cm or even longer as long as the stems are soft enough to be cut with one's thumbnail.)
Jute mallow (saluyot)	Can be harvested in 30-40 days. (Weekly cut 20-30 cm of tender stems, or simply cut the young shoots.)

Malabar spinach (alugbati)	Ready for harvesting in 30-45 days. (Weekly cut 6-12 cm of tender stems or harvest tips and leaves.)
Fruits	
Muskmelon (melon)	Easily separated from vine with a slight twist, leaving a clean disc-shaped scar where the stem was attached
Honeydew melon (honeydew)	Change in fruit color from a slight greenish white to cream; aroma noticeable
Watermelon (pakwan)	Color of lower part turning creamy yellow, dull hollow sound when thumped
Avocado	Pick the largest (usually most mature) green fruit and put it in a paper bag or leave it on the table for a week or so. If the fruit softens, the rest of the fruits can be harvested

<sup>\*</sup>The third column is hidden from view until after all the groups have presented their outputs in step 5.

Adapted from Bautista, O.K. and Mabesa, R.C. (Eds). 1977. Vegetable production. University of the Philippines at Los Baños.

- 4. Participants work in small groups for this part of the exercise. Distribute about 3 pieces of A4 paper to each group. Assign groups to work on the crops but let them choose which ones they commonly grow or eat in their communities, as follows:
  - Group 1: root, bulb and tuber crops (specify 3-5 ); rice
  - Group 2: fruit vegetables (specify 3-5); rice
  - Group 3: flower vegetables (specify 3-5); rice
  - Group 4: leafy vegetables (specify 3-5); rice
  - Group 5: fruits (include those from trees, shrubs, or vines, specify 3-5); rice



The task of the groups is to discuss and write on A4 paper the correct time (i.e., their indicator/sign) when the crop is ready to be harvested – for each of the crops that they chose from the list. Additionally, **all groups** will also indicate the maturity index for rice. Allow about 15 minutes for the group task.

- 5. One at a time, ask a member from each group to read and post their answers on the second column and appropriate row on the chart paper. After all the groups are done, unfold and, show the third column on crop maturity indices.
- 6. Let the participants compare their answers with the correct indices and discuss only those that did not match. Ask concerned groups to explain why there was a difference. Likewise, let them compare their answers for the maturity indices for rice.
- 7. Summarize the exercise by emphasizing that producers should aim to harvest a good quality crop in good condition at the proper maturity, at the right time and using the right method, and by harvesting with care. The shelf life of the produce and its suitability for long-term storage is affected by the maturity of the crop at harvest. The quality of a produce that reaches the market and its selling price is affected by good harvesting (and postharvest) processes.



### Exercise 6.3 Proper postharvest handling

Postharvest handling is the stage immediately following harvest. Depending on the produce, this may include practices such as hauling, cooling, trimming, cleaning, sorting, grading, and packing or preparing the produce for transport to the market. In all these steps, farmers can take simple, no-cost (or low-cost) proper and appropriate measures to avoid damage to harvested produce and greatly minimize postharvest losses.

At the end of the exercise, the participants shall be able to:

- discuss proper postharvest handling practices
- describe examples of improper practices in postharvest handling
- explain consequences of improper postharvest handling practices



Time: 1 - 1.5 hours



Materials/Preparation: chart paper, markers, masking tape, images in Powerpoint (if a laptop and projector are available) or otherwise printed on A4 paper, see

Figures 6a-6f for steps 1-6

**Note:** Do not put captions on the images whether using slides or their printed version so as not to give away the answers for the activity.

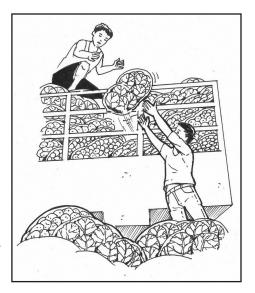
#### Steps:

- Explain that the exercise seeks to discuss examples of improper practices in postharvest handling and how these can be addressed or improved.
  - Flash the first slide (Figure 6a-1) on the screen and call on a representative from Group 1 to state her/his observation on the postharvest handling practice depicted (i.e., what is **wrong** about it) and how this can be improved. Alternatively if Powerpoint is not used, hand the printed image to Group 1 and have one member of the group do the same thing as previously described.



Figure 6a-1. Vegetables being tossed for loading onto a truck in La Trinidad, Benguet

Source: https://www. pressreader.com/philippines/ sunstar baguio/20200117/ 281496458235900



 Show the second slide or printed image (Figure 6a-2) and have another member of Group 1 identify what is wrong about the practice, and how it can be improved.

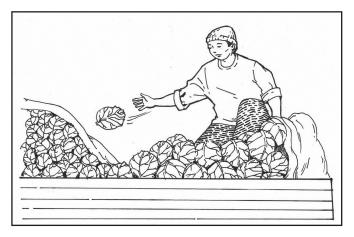


Figure 6a-2. Cabbages being tossed from a truck in La Trinidad, Benguet

Source: https://www.avianquests.com/2017/07/vegetable-porters-latrinidad-benguet.html?m=0

- Get 1-2 additional comments from the (same) group, as needed. Supplement the discussion by adding that it is important to avoid rough handling of produce because damaged produce tends to have a shorter shelf life, be more prone to disease and decay, and appeal less to consumers. Produce should be handled gently and no more than necessary. Avoid unnecessary wounding, bruising, crushing, or damage (from humans, equipment, or harvest containers).
- 2. Show the third and fourth slides (Figures 6b-1 and 6b2) and call on two representatives from Group 2 to state their observations on the postharvest handling practices being shown and how this can be addressed. Again, ask for additional inputs from the other members of the group.

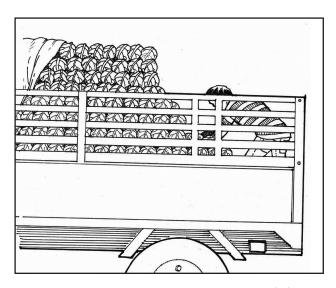


Figure 6b-1. Cabbages exposed to the sun, La Trinidad, Benguet

Source: https://www.avianquests.com/2017/07/vegetable-porters-la-trinidad-benguet.html?m=0



Figure 6b-2. Mangoes exposed to the sun, Ethiopia

- Stress the need to keep produce away from the sun, especially direct sunlight, by creating a makeshift shed or finding a shady spot to temporarily park or otherwise store them. This will prevent excessive water loss that could lead to wilting and shrivelling and other spoilage processes. Additionally, produce should be allowed to dissipate heat under shade before packing.
- 3. Repeat the same process for the fifth and sixth slides or prints (Figures 6c-1 and 6c-2), calling on two representatives from Group 3.

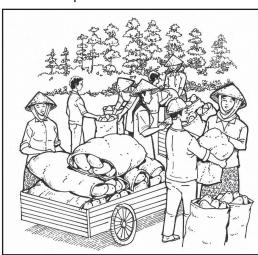


Figure 6c-1. Winter melons in recycled fertilizer bags at a buying point, Vietnam



Figure 6c-2. Washing vegetables in dirty or contaminated water\*

Explain that it is important to **avoid contamination** – **physical or chemical**. Faulty postharvest practices such as poor hygiene and use of dirty or contaminated wash water provide opportunities for contamination by toxin-producing and pathogenic microorganisms that can lead to spoilage. Contamination can also occur when using or recycling **unwashed** bags of fertilizer or animal feeds for packing vegetables or fruits. Appropriate ground cover or liner, or sorting table in the farm is important so that harvested produce is not in direct contact with the soil to avoid pathogens. Tools, equipment, and containers should likewise be clean. Damaged, decayed, or decay-prone produce should **never** be mixed with quality produce in a bulk or packed unit. Unit.

4. For Group 4, follow the same process as with the previous groups – using the seventh and eighth slides.

<sup>\*</sup>Note garbage on the bank of the pond and floating on the water





Figure 6d-1. Overfilled baskets in a buying point, La Trinidad, Benguet

Source: https://www.avianquests.com/2017/07/vegetable-porters-la-trinidad-benguet.html?m=0



Figure 6d-2. Mangoes bound for China packaged in bulging beer boxes, Myanmar

Add that proper packing protects the produce from damage during handling and transport. **Use appropriate packing and packaging systems (not overfilled, bulging containers).** Choose the right packing materials and methods depending on the type of produce, distance and mode of transport, and market destination, e.g., community market, supermarket, processing plant, etc.

5. For Group 5, follow the same process as with the previous groups by showing the ninth and tenth slide .

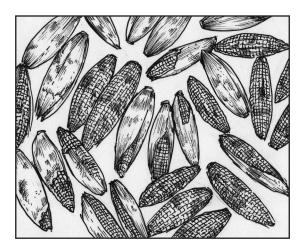
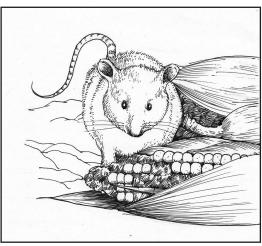


Figure 6e-1. Molds in corn from insufficient drying or water getting into the storage area or container

Figure 6e-2. Corn being eaten by rodents in the storage area

Source: https://www. juanmagsasaka. com/2020/12/cornproduction-guiderodent-management. html





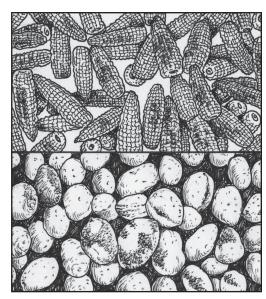
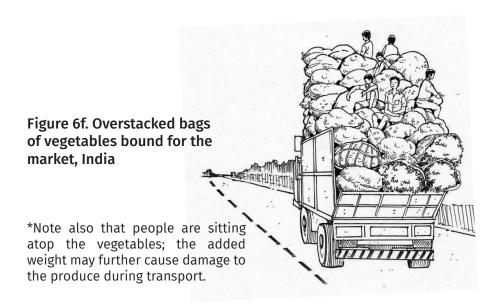


Figure 6e. Postharvest losses from storage

Supplement the points mentioned by the group. Add that during storage, the produce may over-ripen or can be damaged by mold, bacteria, disease, insects, or rodents. **Store produce properly (generally in a cool, dry place).** Proper storage aims to keep the quality of agricultural produce and prevent them from deteriorating for a specific period of time. In order to achieve this, farmers need to keep their produce in a place that can slow down respiration, moisture loss, and decay.

#### 6. Ask for a volunteer to take on the last slide.

Highlight the importance of **transporting produce appropriately**. The produce must be stacked in ways that minimize damage, then braced or secured. The use of an open air vehicle is preferable as it allows air to pass through the load and provides some cooling of the produce as the vehicle moves. Transporting produce during the night or early morning can reduce the heat load on the vehicle. Transition time between loading and unloading should also be as short as possible.



7. Conclude the session by stating that very high postharvest losses (reportedly up to 50%) is quite unfortunate, especially in developing countries where poverty, hunger, and malnutrition are prevalent. Proper harvesting practices and improvements in postharvest handling are key to keeping the quality of fresh produce; significantly reducing postharvest losses (and the resulting income losses to farmers); and ensuring that safe and more nutritious foods are made available to consumers.





### SEED CONSERVATION AND **MANAGEMENT**

practiced Smallholder farming households have conservation and management for a very long time. The practice has allowed them to continue growing a wide range of different crops and varieties suitable to their local conditions. The significant impact of numerous environmental stresses on agriculture highlights the importance of genetic diversity for crop resilience in order to reduce production risks and losses. Farming communities have long relied on the informal sector for traditional farmer-bred varieties and saved seeds of improved varieties. However, communities can also benefit from greater access to new varieties and quality seeds through stronger linkages with other community-based organizations and the formal sector.



### Exercise 7.1 Seed quality as a key determinant agricultural productivity

At the end of the exercise, the participants shall be able to:

- explain how seed quality determines agricultural productivity
- describe the qualities of a "good seed"



Time: 2 - 2.5 hours



Materials/Preparation: chart paper, markers, masking tape, 4 small plastic bowls, water, A4 paper for taking down observations, other materials prepared before the session (see below), 4 cards containing separate instructions for the group tasks (step 2), characteristics of good seeds written on chart paper (Box 7, step 5)

A few days prior to the session, go around the village and scout for a field near the meeting place that clearly shows a mixture of varieties. Make arrangements with the owner for participants to carry out observations in his farm during the session. Schedule the field visit to coincide with the dough stage of the rice crop. Dough stage is when the milky grain becomes a hard paste-like consistency.

Prepare several seed lots for the group work as follows: 1) two lots of poor quality seeds: one is a mixture of rice + other seeds, debris, inert matter; and another one containing seeds of poor health such as insect infestation and fungal + other disease infections; and 2) two lots of certified seeds (A and B).

About 4-5 days before the session, also pre-germinate 10 seeds each from a lot of certified seeds and a lot of poor-quality seeds. Follow the usual procedure using the paper towel method to germinate the seeds. Line the two kinds of seeds in two separate rows.

#### Steps:

- 1. Begin the session by mentioning that seed is a critical element which affects the performance and efficacy of other agricultural inputs. Seed contains the genetic information and is one of the least expensive but most important factors influencing a crop's yield potential, adaptation to environmental conditions, and resistance to insect pests and diseases. Explain that the exercise seeks to explain how seed quality determines agricultural productivity and to discuss the qualities of a "good seed".
- Divide participants into four groups whose respective tasks will help them understand the different standards of seed quality. Designate and provide the materials to the respective groups as follows:
  - Group 1- Genetic purity: field observation
  - Group 2 Physical or analytical purity: seed lot with the mixture of rice and other seeds, debris and inert matter; and lot A of certified seeds

- Group 3- Physiological quality: (pre-)germinated rice seeds
- Group 4- Health or sanitary quality: seed lot with a mixture of seeds with poor health (e.g., insect infestation and fungal and other disease infections), and lot B of certified seeds
- 3. Distribute the cards outlining the tasks to the respective groups. Allow the participants a few minutes to read the instructions. Explain or clarify the tasks as needed before the groups proceed with their respective assignments. Give 45 minutes for them to observe and write their outputs (i.e., results of their group tasks and observations) on chart paper, 2 pcs/group.

#### Group 1. Genetic purity

- Go to the rice field and observe the crop stand.
- Describe the plants in terms of height, maturity, color, and grain characteristics.
- Pay close attention to off-types or (rice) plants that distinctly differ in characteristics from the specific variety planted in the field.
- Compare the off-types with the "intended" variety in terms of physical characteristics as outlined above (second bullet point).

### Group 2. Physical or analytical purity

- Observe the cleanness of both the seed samples.
- From the poor-quality sample: separate the other seeds, debris, and inert matter from the rice seeds.
- Put water in two plastic bowls and put in the certified seeds and the poor-quality rice seeds.
- Observe what will happen.

#### Group 3. Physiological quality

- Observe (and note differences, if any) the color and grain characteristics between the two rows of germinated seeds, i.e., certified seeds vs. poor quality seeds.
- Compare (count) the number of germinated seeds per row.
- Describe/compare how the germinating seeds look like.

#### Group 4. Health or sanitary quality

- Describe the physical properties of the two seed lots, focusing on the physical properties and health of the samples.
- Put water in two plastic bowls and put in the certified seeds and the poor-quality seeds. Observe what will happen.

**Note:** Thirty (30) minutes into the exercise, alert the groups to start working on their outputs for presentation.

- 4. Allot about 5 minutes for each group to present their outputs and about 5-10 minutes for Q&A after all the groups have reported. Supplement with information as necessary, such as:
  - Genetic purity: The resulting plant should resemble its mother in all aspects. When fields have mixed varieties, the plants have different maturity periods. There are also differences in grain filling and moisture content at the time of harvest.
  - Physical or analytical purity: Seed is considered pure if it appears normal in terms of size, shape and general outward appearance. The quality of seed alone is known to account for at least 10-15% increase in productivity.
  - Physiological quality: This pertains to the ability of the seed to germinate which is in turn related to germination capacity, viability, vigor, and dormancy. Seeds high in vigor generally provide for quick establishment and uniform stands that give seedlings a head start against environmental stresses.



- Health or sanitary quality: The health status of seed or the absence of insect infestation and fungal and other disease infections contributes to greater potential of producing a good crop.
- 5. Do a quick 2-minute brainstorming by asking the participants, "Aside from the obvious physical attributes, what makes a 'good seed' good or desirable?"

Jot down all responses on the board. Then present the following list (Box 7a) and check against the participants' ideas. Discuss points that they did not raise.

#### Box 7a. What makes a good seed?

- A good seed grows into and produces something consumers want to eat in terms of nutritional quality, taste/flavor, aroma, texture, etc..
- A good seed not only produces good food, but also more good seeds that farmers can save, plant, and share.
- A good seed is one that farmers can afford and have access to.
- A good seed is ecofriendly. It works with nature, instead of against it (e.g., resistance to pests and diseases, adaptability/tolerance to other environmental stresses).
- A good seed has good or high yield potential, i.e., makes the most of the soil, water and light that are available in its environment.
- A good seed contains diverse traits that enable the crop to adapt and evolve with the changing environment.
- A good seed has potential traits that might not be immediately visible (or even useful), but they could come in handy down the line, especially with our changing climate.

- 6. Wrap up the session by highlighting key ideas that came up during the presentations and discussion.
- 7. Ask the participants to bring to the next session one (1) seed or planting material from **each** of the food crops which may include cereals, vegetables and even fruit trees that they grow in their field and home gardens or home lots.

**Note:** It is quite possible that seeds of some of the participants' crops are not currently available. They can therefore make an inventory and make a list of "everything" that they regularly grow in their farm and their home gardens/lots.



### Exercise 7.2 Seed conservation and management

At the end of the exercise, the participants shall be able to:

- explain the importance of genetic diversity in agricultural crops
- discuss the aim of seed\* conservation and management
- propose ideas on how farmers can be empowered to contribute to seed conservation and management



Time: 1 – 1.5 hours

Materials/Preparation: one seed or planting material each from the different crops grown by participants, commercial seeds of different crops (brought by the facilitator), small strips of paper, chart paper, markers, masking tape, objectives of seed conservation and management individually written on A4 paper (to be used in step 5) as follows:

- to conserve the processes of evolution and adaptation of crops to their environments
- to conserve diversity at different levels ecosystem, species, or within (intra) species
- to integrate farmers into a national plant genetic resources system

- to conserve ecosystem services critical to the functioning of the earth's life support system
- to improve the livelihood of resource-poor farmers by providing seeds that they can sell or cultivate as crops
- to maintain or increase farmers' access to and control over crop genetic resources

\*Note: "Seed" as it is used in this exercise also includes other planting materials such as seedlings, stem cuttings, bulbs, rhizomes, etc.

#### Steps:

- Explain that the exercise seeks to discuss the importance of genetic diversity in agricultural crops, discuss the aim of seed conservation and management, and come up with ideas on how farmers can be empowered to contribute to seed conservation and management.
- 2. Ask participants to form the same groups as they had in the previous exercise. Allow 30 minutes for the activities outlined below:
  - a. Let the members put together all the seeds and planting materials that they brought to the session. For the other crops for which they don't have seeds, let them write these individually on small strips of paper and include them in their pile.
  - b. Then mix in some of the commercial seeds of the different crops that you brought to each group's collection.
  - c. Instruct the groups to put seeds/planting materials of the same crops together, including the strips of paper with the names of crops written on them.
  - d. Within each crop, let them sort the seeds according to their characteristics (e.g., size, color, appearance, etc.).
  - e. Have them summarize their observations or findings on chart paper by indicating the kinds of crops, whether these are commercial or local (i.e., farmer-saved), and how many seeds/planting materials there are per kind.

- 3. Representatives from each group present their findings for 3-5 minutes. After all the groups have finished, ask which crop had the most number of seeds and possible reasons for this. After responses have been exhausted, mention that this indicates that there are more farmers in the group growing that particular crop.
- 4. Explain that farmers worldwide have been encouraged by seed companies (and often as part of government programs) to cultivate high-yielding modern cultivars at the expense of the more (bio)diverse traditional or indigenous crop varieties. This practice has resulted in significant erosion of the genetic diversity of agricultural crops. The increasing loss of crop biodiversity leads to the system's vulnerability to environmental stresses which include weather or climatic extremes, pests and diseases, etc.; as a consequence, it puts food and nutrition security at risk.
- 5. One at a time, post on the board or wall the objectives of seed conservation and management. Ask for a volunteer to explain each objective as it is posted. Provide additional information as necessary such as:
  - to conserve the processes of evolution and adaptation of crops to their environments:
     Smallholder farming households have practiced seed conservation for a very long time which has enabled them to continue growing a wide range of different varieties suitable to their local conditions.
  - to conserve diversity at different levels ecosystem, species, or within (intra) species:
    - The significant and often negative impact of climate and weather stresses on agricultural production can be reduced by conserving diversity at different levels. Diversity contributes to resilience to environmental changes and reduces production risks and losses.
  - to integrate farmers into a national plant genetic resources system:



Farming communities have long relied on the informal sector for traditional farmer-bred varieties and saved seeds of improved varieties. However, communities can also benefit from access to new varieties and quality seeds through stronger linkages with the formal sector.

- to conserve ecosystem services critical to the functioning of the earth's life support system: Seed conservation and management aims to address genetic erosion that puts food and nutrition security at risk (i.e., loss of agrobiodiversity increases vulnerability to environmental stresses such as pests and diseases, extreme weather or climatic events, etc.).
- to improve the livelihood of resource-poor farmers by providing seeds that they can sell or cultivate as crops:
   Seed conservation and management addresses farmers' limited access to locally adapted crop varieties that they can sell or cultivate.
- to maintain or increase farmers' access to and control over crop genetic resources:
   Seed conservation and management contributes to improving farmers' access to locally adapted varieties and lessen their dependence on commercial seed sources.
- 6. Brainstorm with the participants about what knowledge and skills do farmers need in order for them to contribute to seed conservation and management. Write down all ideas.
  - Stress that genetic diversity of crops can be increased by empowering farmers providing them access to varieties and equipping them with the knowledge and skills in undertaking varietal trials, selection, and breeding. They should also be encouraged to pursue and strengthen linkages with other farmers and institutions engaged in similar activities.
- 7. End the exercise by emphasizing that having access to a wide variety of crop seeds that are locally adapted is central to a community's ability to feed itself. Such diversity enables a community to withstand or survive and bounce back from pest infestations or extreme climate events that often result in total crop failure.



### Exercise 7.3 Seed production and handling

Seeds are the most efficient means of propagating crops. Seeds carry the genetic qualities of plants. They also transfer genetic improvements carried out by breeders. Seed quality significantly determines the potential yield of a crop. Farmers can breed high-quality seeds. However, this needs capacity building in seed production and handling techniques.

At the end of the exercise, the participants shall be able to:

- explain seed production and handling techniques
- discuss the importance of seed production and handling to the quality of seeds and to crop production



Time: 1 - 1.5 hours



Materials/Preparation: chart paper, markers, masking tape, two sets of cards for the exercise on seed production and handling (step 2)

Prior to the session, the facilitator should prepare two sets of cards on the steps of seed production and another two sets of cards on seed handling or processing as outlined in Table 7a. Each step should be written on a separate card.

#### Steps:

1. Introduce the topic by stating that in seed production, cultural management practices are more diligently applied to ensure the quality of the crops and their seeds. Adequate care is given from the acquisition of seeds up to and after harvest, adopting proper crop and seed management techniques. Explain that the exercise seeks to discuss steps in seed production and handling and their importance to the quality of seeds and to crop production.

#### Table 7a. Steps in seed production and handling

Seed production	Seed handling or processing
<ul> <li>Selecting varieties to be multiplied</li> <li>Selecting seed for planting</li> <li>Selecting the site where the seed will be grown</li> <li>Preparing the land or seedbed</li> <li>Planting the seed weeding</li> <li>Controlling diseases and insect pests</li> <li>Harvesting the seeds</li> </ul>	<ul> <li>Drying</li> <li>Cleaning</li> <li>Sorting</li> <li>Measuring moisture content</li> <li>Testing for germination</li> <li>Treatment</li> <li>storing</li> </ul>

- 2. Divide participants into four groups, i.e., two groups to work on the steps of seed production and two other groups to work on the steps of handling and processing. Groups will be given their set of cards for them to arrange in the correct order (make sure to shuffle the cards beforehand so that the steps are in random order), after which they have to tape them on chart paper. Allow 10 minutes for the activity.
  - Seed production steps: selecting varieties to be multiplied; selecting seed for planting; selecting the site where the seed will be grown; preparing the land or seedbed; planting the seed; weeding; controlling diseases and insect pests; harvesting the seeds
  - Seed handling and processing steps: drying; cleaning; sorting; measuring moisture content; testing for germination; treatment; storing
- 3. When all the groups are done, ask the two groups that worked on the steps in seed production to post up their outputs side by side on the board or wall.
- 4. Let the participants compare if the sequence of steps between the two groups are the same. If not, ask why there is a difference. Allow 5 minutes for discussion until the two concerned groups come to an agreement. Then walk everyone

through each step of the process to clarify misconceptions and explain further, if needed. For example:

- selecting varieties: Only one variety of high-quality seed should be grown in each field.
- selecting the site: A fertile field that conforms with isolation requirements should be chosen for seed production.
- planting: Intercropping or mixed cropping should not be done.
- controlling weeds, diseases, and insect pests: The crop should be kept free of weeds, insect pests, and diseases.
- harvesting: Only fully mature crops should be harvested and the seeds properly dried before storage. To check if anyone remembers what was taken up in a previous exercise on good harvesting practices, ask for a volunteer to explain the index of maturity for rice.
- 5. Bring up the concept of field isolation and rogueing or the removal of off-types. Ask for ideas from the participants about what these mean, why it is necessary to do them, and how they are done. Make sure that the following ideas are covered:
  - Isolation is the separation of a seed crop from all possible sources of contamination to prevent natural crosspollination from undesirable pollen (e.g., pollen from a different variety). Adequate isolation can be achieved through space (distance between crops) and/or time (separation through different periods of fertilization).
  - Plants with deviating characteristics (i.e., off-types) reduce the performance of the variety. These should be removed from the crop stand or field before pollen shed.
  - Field isolation and roguing help ensure genetic purity of the variety; this will help guarantee that the plants will develop distinctive, uniform, and stable verifiable characteristics.

Address additional issues before moving on to the other topic.



- 6. Ask the other two groups that worked on seed handling/ processing to post their outputs side by side on another part of the board or wall. Follow the same process as in step 4. Make sure that the following ideas are covered:
  - drying, cleaning, sorting: Sort, clean, dry, grade, and label the harvested seeds; remove debris, off-seed, and damaged seeds.
  - measuring moisture content: Seed needs to be dry to lengthen storage life and prevent insect infestation and mold growth.
  - testing for germination: Check for seed quality, percent germination, and purity.
  - treatment: Mix with dry ash, powdered seeds of black pepper or neem leaves. Or use extract of neem, peanut, castor bean or cotton (1 teaspoon oil/1 kg seed) to protect seeds from insects and fungi.
  - storing: Put the seed in a sealed container, which is placed in a cool, dry, and clean area.
- 7. Emphasize that farmers produce seed to have access to high quality planting material of their preferred varieties for the next growing period. Seed production (by farmers) also presents potential for gaining higher income either from getting better yields or from the sale of seeds.



## Exercise 7.4 Factors that affect seeds in storage

Seed storage aims to prolong the viability of the seed until planting time. Deterioration – especially physiological aging – largely depends on environmental conditions under which the seeds are stored and not the duration of storage per se. The intended period of seed storage depends on end-use of the seed; examples are supply for the next season, assurance against disaster, or to ensure supply of pure genotypes to replace contaminated seeds.

At the end of the exercise, the participants shall be able to:

- explain critical factors that affect seeds in storage
- describe basic features of good storage structures



Time: 1 - 1.5 hours



Materials/Preparation: chart paper, markers, masking tape, features of storage structures individually written on A4 paper (step 5), laboratory thermometer, moisture content (MC) meter, relative humidity (RH) meter (or photos of thermometer, MC meter, and RH meter if actual instruments are not available)

#### Steps:

- 1. Start the session by asking participants if they store seeds and if they do, what storage structures they use.
- 2. State that the exercise aims for participants to be able to explain critical factors that affect the quality of seeds in storage. It will also provide participants with the opportunity to describe basic features of good storage structures.
- 3. Ask one or two participants to explain the importance of seed storage, i.e., "Why do we need to store seeds?" In particular, emphasize that seed storage ensures the viability of the seed until planting time. Deterioration – especially physiological aging - largely depends on environmental conditions under which the seeds are stored and not on the duration of storage per se. Seed storage makes seeds available for use in the next season, serves as assurance against disaster(s), or ensures supply of pure genotypes to replace contaminated seeds.
- 4. Ask for volunteers to answer the following questions: Q1: Is high or low temperature better for seed storage? Why? Correct answer: Low

Key idea: The best temperature to store seeds for planting, including rice seeds, is 4 degrees Celsius. However, rice seeds are usually stored in temperatures ranging from 20-25 degrees C. Every 5-degree Celsius drop in temperature doubles the storage life of dry seed. Insects flourish at optimum temperature of 25-34 degrees C, while molds thrive between 15-30 degrees C.

A laboratory thermometer would come in handy to find out if stored seed is within the ideal temperature. Show the laboratory thermometer to the participants. This is usually attached to a wooden stick about a meter long and driven into the seed in the storage container.. If such an instrument is not available, a metal rod can be used in its stead. Insert the rod about 1m deep into the pile of seeds. Leave the rod in for about 30 minutes before pulling it out and then feel the temperature with the palm of the hand. Test at different points of the rod. Any point that feels warm to the touch indicates heating and possibility of seed spoilage.

**Q2:** Is high or low relative humidity (RH) better for seed storage? [You may ask someone to explain his/her understanding of RH, or simply explain what the term means.] Why?

Correct answer: Low

Key idea: Lower relative humidity is better. Optimum RH is between 40%-80%. High humidity can cause condensation and is conducive to the growth of mold and bacteria.

Show the hygrometer or RH meter. If such a device is not available, it is possible to determine the relative humidity by using the ice cube test. However, care must be taken that water does not spill on the grains. Put two or three ice cubes into a glass, while adding water and stirring until the ice cubes have completely melted. Set the glass of ice water next to the storage bin and wait for three to four minutes, then check the glass for condensation. If there is water (moisture) outside the glass, it means that the relative humidity level is high. If not, the humidity level is low.



Figure 7a. RH meter

**Q3:** Is high or low seed moisture content (MC) better for seed storage? Why?

Correct answer: Low

Key idea: Ideally, seeds must be dried to 11-14% moisture content. Every 1% reduction in seed moisture content doubles its storage life. Insects would find it hard to thrive below 9% MC (dry); on the other hand, molds would proliferate above 17% MC (moist).

Show the moisture content (MC) meter. Without the device, the hand test can be used to check the moisture of the seeds by their look and feel. Biting into the seed can also be done; one that breaks easily when bit into is considered dry.

Figure 7b. Moisture content meter



- SEARICE
  - 5. Divide participants into six groups and ask a representative from each one to pick one feature of storage structures written on A4 paper as follows:
    - protection from water or moisture
    - protection from contamination
    - protection from rodents or mice
    - protection from insects
    - protection from fungi
    - protection from fire

Allot 10 minutes for the groups to discuss why the feature that they picked is important and how it can be implemented especially in farmers' houses or in the community/village.

- 6. The groups report out on their discussions for 2-3 minutes each. Follow with a 10-minute Q&A when all of them have presented.
- 7. Ask 3-5 participants to name the different crops they plant for which they save seeds for their own use and quickly describe how they store them. [This is simply a "warm-up" for the next exercise where a more detailed discussion on the subject will be done.]
- 8. Wrap up the session by stating again that seed deterioration (especially physiological aging) largely depends on environmental conditions under which the seeds are stored and that proper seed storage aims to prolong the viability of the seed until planting time.



# Exercise 7.5 Storage containers and seed storage treatments

At the end of the exercise, the participants shall be able to:

- explain how different crops require different storage containers
- describe how different treatments or handling of seeds improve storage period



Time: 1 – 1.5 hours



Materials/Preparation: chart paper, markers, masking tape, copies of Table 7b printed on A4 paper for distribution as handout or reference material (step 5),

different types of grain storage (actual samples or photos)

#### Steps:

- 1. Refer to the quick discussion in the previous session about how the participants store the seeds that they save from their own crops. Ask them about all the crops (other than rice) that they cultivate. Jot responses down on the board. Prompt by mentioning a wide type of crops to come up with an exhaustive list, e.g., corn, vegetables (what kinds), tubers and root crops (what kinds). What about ginger, turmeric, onions, garlic, etc.?
- 2. Let them identify which ones on the list do or can they save the seed or planting material (not buy from agri-vet stores); check each one as it is mentioned.
- 3. Divide the group into six. Depending on the number of checked items in the previous step, assign a mix of crops for each group to work on, + rice for **all** the groups.
- 4. For every crop, ask them to specify the following information:
  - storage container that they use
  - how long the seed or planting material will keep (storage period)
  - any (special) treatment or handling that they practice, etc.

Allot 30-45 minutes for the groups to discuss and write their outputs on chart paper.

5. The groups report out on their discussions for 2-3 minutes each, followed by a 10-minute Q&A when all of them have presented.

6. Distribute the handout on examples of storage used for grains in smallholder households and give participants 5-10 minutes to read it. You can show slides or photos of the types of storage indicated in Table 7b or even actual samples if available (e.g., jute or sisal sacks, polythene or SuperGrain sacks, triple bags, etc.) Allow 10 minutes for additional comments, questions and discussions.

Table 7b. Examples of storage used for grains in smallholder households

Туре	Storage period	Weakness	Life span
Open weave sacks (jute, sisal, polypropylene)	0-6 months	If used >6 months, grain quality declines more rapidly than in other storage types	3 years
Improved mud silos	3-12 months	Shorter life than metal silo, very heavy so cannot be moved to new location, takes up fixed space in house or yard whether empty or full	5 years
Metal silos	3-12 months	Extra sealing required to make hermetic, then no access for 2 weeks	15 years
Polythene or SuperGrain bags (1 liner + sack)	3-12 months	Best for small quantities, susceptible to sharp objects and rodent attack.	2 years
Metal/plastic drums	3-12 months	Drum to be nearly full and no access for first 6 weeks of storage.	20 years

Triple bags (2 liners + sack)	3-12 months	Susceptible to sharp objects and rodent attack. No access for the first 6 weeks of storage.	3 years
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Source: Training Manual for Improving Grain Postharvest Handling and Storage



Figure 7.5a. Improved mud silos



Figure 7.5b. Metal silos



Figure 7.5c. Triple layer bags



Figure 7.5d. Steel, metal, and plastic bags





### Exercise 7.6 Community seed banks

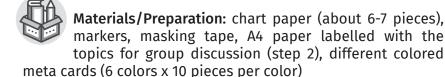
Seeds can be stored in farmers' fields (in situ) or in other sites (ex situ) like seed banks. Conserving seeds in farmers' fields allows species to be in their natural position in the food chain and in their own suitable environment. However, conserving seeds in other sites such as seed banks provides added security for long-term storage and the opportunity for species to be reintroduced in case these are lost in their natural environment.

At the end of the exercise, the participants shall be able to:

- generate ideas on the role of community seed banks (CSBs) in ensuring seed security
- explain how CSBs can help in conserving agricultural biodiversity along with the traditional knowledge in cultivating the crops (seeds)
- brainstorm on the functions and services of CSBs
- discuss how to manage CSBs
- explain the importance of household seed storage in relation to CSBs
- brainstorm on linkages essential to maintaining CSBs



Time: 1 - 1.5 hours



**Note:** Before starting the session, post up the labels (topics for group discussion) – with lettering big or legible enough for everyone to read from their seats – on six different areas of the meeting room.

#### Steps:

- Begin the session by asking what community seed banks (CSBs) are. When responses have been exhausted, explain that CSBs are collections of seeds that are administered by – as the term implies – communities. CSBs store seed collected from individuals, informal groups, and even nongovernment organizations that share seeds among themselves. The seeds are primarily obtained from farmers' own production, sometimes in partnership with research institutes and even with the formal or commercial seed sector (e.g., production of certified seeds).
- 2. State that the exercise aims to generate ideas on a host of issues, as indicated in the following labels previously posted around the room:
  - role of community seed banks in ensuring seed security
  - role of CSBs in conserving agricultural biodiversity and traditional knowledge
  - functions and services of CSBs
  - how to manage CSBs
  - the importance of household seed storage in relation to CSBs
  - linkages essential to maintaining CSBs
- 3. Divide the participants into six groups and assign to them their respective topics outlined in step 2. Provide each group with 10 pieces of meta cards. Each group should have a different color of cards, e.g., Group 1: white; Group 2: yellow, etc.).
- 4. Instruct the participants to brainstorm on the topic assigned to them and to write their ideas on their meta cards; emphasize the need for 1 idea: 1 card. The groups have 20 minutes for this task. Groups hold on to their cards until all the groups are done.

- 5. When the signal is given, ask the groups to quickly post their outputs on their respective areas of the room labelled accordingly. Allow about 5 minutes for each group to present. After all the groups have presented, devote 10-15 minutes for Q and A or discussion.
- 6. To wrap up the session, highlight key points such as:
  - In many developing countries, small farmers still source some 70%-80% of their seeds from those that were saved on-farm and often exchange these with their fellow farmers.
  - CSBs have three common underlying principles: 1) farmers require steady and reliable access to a wide variety of appropriate planting materials; 2) farmers are the stewards of agricultural biodiversity; and 3) optimal crop biodiversity requires sustainable use through onfarm conservation, e.g., the recovery and maintenance of crops with potential for being widely propagated, cultivated, and used.
  - The decision to set up a seed bank has to be based on a felt need of the communities;
  - Such seed banks should be managed by local farmers' groups that have clear goals and basic capacities in the conservation and sustainable use of seeds.
  - Household seed storage complements the seed bank and can serve as a back-up when materials stored there are damaged or have become non-viable for some reason.
  - Linkages among CSBs will strengthen solidarity, facilitate mutual learning, and generate support for seed conservation and use. Whenever possible, CSBs should also be linked to and supported by institutional or NGOmanaged seed banks that can provide access to more seed materials and serve as back-up to the accessions (seed collection) in the communities.



## LIVESTOCK PRODUCTION AND MANAGEMENT

Livestock provides food, income, transport as well as contributes to soil productivity, agricultural diversification, and sustainable agricultural production. Livestock plays a key role in the balance of agricultural systems wherein animals provide organic matter for the soil for plants to grow while plants produce food for animals. While traditional farming with the attendant use of high vielding breeds/cultivars often aims to maximize shortterm production of individual farm products, sustainable farming optimizes long- and short-term productivity and creates synergies between crop cultivation and livestock production. Ecological livestock production is adapted to the ecosystem by considering the needs of both the producer and the consumer. The livestock system uses local feed sources and create organic matter (e.g., through crop/livestock integration) for better management of nutrient flows and recycling of limited resources. Proper management of the plant-animal-soil systems will contribute to the overall health and productivity of livestock and consequently, the whole agroecosystem.



# Exercise 8.1 Integrating animal raising with crop production (BINGA game)

At the end of the exercise, the participants shall be able to discuss the importance of integrating animal raising with crop production



Time: 1 – 1.5 hours



Materials/Preparation: chart paper, markers, masking tape, small basket or box, 50 corn seeds, 5 BINGA cards printed on A4 paper (see Figure 8), small slips of paper walls labelled as follows:

individually labelled as follows:

- Livestock is an important food source.
- Livestock is a source of income.
- Livestock generates employment.
- Livestock is a source of energy (e.g., dung for fuel, biogas, draft power).
- Livestock is a source of fertilizer and soil conditioner.
- Livestock provides weed control.
- Livestock utilizes household, farm, and industrial byproducts and wastes (as feeds or feed ingredients).
- Livestock utilizes marginal lands (for pasture).
- Increasing local animal production saves foreign exchange (from meat and dairy imports).
- Livestock can be used as investment and as a means of savings.
- Livestock can provide other products and functions (horn, bones, hides and skins).

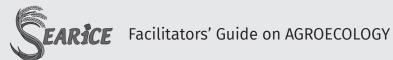
The labels above pertain to the roles of livestock in and their importance to food security and sustainable production. Fold and put them in the small box or basket before the session starts.

#### Steps:

- State that the exercise aims to discuss the importance of integrating animal raising with crop production. For the session, participants will play a game called BINGA, which is an adaptation of BINGO.
- 2. Form five groups and explain the mechanics before actually starting with the game. how the game works.
  - a. Each group will be given one BINGA card and 10 corn kernels.
  - b. The strips of paper inside the box (you may show one to the group) match the items on their cards. However, some of the items written on the cards do not have a match among those in the strips of paper.
  - c. As you pick one strip and read it aloud, the group that has the same item on their card should call out "YES!" and put one kernel of corn on the item.

- d. The facilitator validates (checks) the group's "claim" and asks for a representative to explain what the particular statement means.
- e. If another (or more than one group) has the same item on their card, a representative shall be likewise asked to add to the explanation of the first group.
- f. The first group to complete three boxes of the same color on their card wins, but the game continues until all the pieces of paper in the basket are drawn and the contents explained. The rest of the groups led by the facilitator give the winning team three cheers (i.e., hep-hep hooray!) as their reward. Or the facilitator may ask somebody from the participants to sing a song or tell a joke to be "dedicated" to the winning team.
- 3. Summarize the discussions by pointing out the importance of livestock in food security, and its use for other products other than food. In a system that integrates animal raising with crop production, crop residues and by-products serve as fodder or animal feed. Animal manure on the other hand is not considered a waste but serves as fertilizer or soil conditioner for the use of crops. The integration of cropping and livestock production allows for better management of nutrient flows and recycling of limited resources.

Direct role of livestock for food security	Livestock as a supplier of production inputs for sustainable agricultural development	Non-food attributes of livestock as a factor of sustainable agriculture
Livestock as an important food source	Livestock as a source of income	Increasing local animal production saves foreign exchange

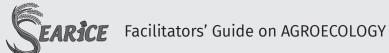


Livestock as a source of energy (dung for fuel, biogas, draught power)	Livestock can be used as investment and as a means of savings	Livestock utilizes household, farm, and industrial by- products and wastes (as feeds or feed ingredients)
Livestock can provide other products and functions (horn, bones, hides and skins)	Livestock utilizes marginal lands (for pasture)	Livestock generates employment

Direct role of livestock for food security	Livestock as a supplier of production inputs for sustainable agricultural development	Non-food attributes of livestock as a factor of sustainable agriculture
Livestock as an important food source	Livestock as a source of income	Increasing local animal production saves foreign exchange
Livestock as a source of energy (dung for fuel, biogas, draught power)	Livestock can be used as investment and as a means of savings	Livestock and weed control
Livestock can provide other products and functions (horn, bones, hides and skins)	Livestock as a source of fertilizer and soil conditioner	Livestock generates employment

### Chapter 8 Livestock Production and Management

Direct role of livestock for food security	Livestock as a supplier of production inputs for sustainable agricultural development	Non-food attributes of livestock as a factor of sustainable agriculture
Livestock as an important food source	Livestock as a source of income	Increasing local animal production saves foreign exchange
Livestock as a source of energy (dung for fuel, biogas, draught power)	Livestock can be used as investment and as a means of savings	Livestock and weed control
Livestock can provide other products and functions (horn, bones, hides and skins)	other products and functions (horn, bones, hides and marginal lands (for pasture)	



Direct role of livestock for food security	Livestock as a supplier of production inputs for sustainable agricultural development	Non-food attributes of livestock as a factor of sustainable agriculture
Livestock as an important food source	Livestock as a source of income	Increasing local animal production saves foreign exchange
Livestock utilizes household, farm, and industrial by-products and wastes (as feeds or feed ingredients)	Livestock can be used as investment and as a means of savings	Livestock and weed control
Livestock can provide other products and functions (horn, bones, hides and skins)	Livestock as a source of fertilizer and soil conditioner	Livestock generates employment

#### Card 5

Direct role of livestock for food security	Livestock as a supplier of production inputs for sustainable agricultural development	Non-food attributes of livestock as a factor of sustainable agriculture
Livestock as an important food source	Livestock as a source of income	Increasing local animal production saves foreign exchange
Livestock as a source of energy (dung for fuel, biogas, draught power)	Livestock can be used as investment and as a means of savings	Livestock utilizes marginal lands (for pasture)
Livestock can provide other products and functions (horn, bones, hides and skins)	Livestock as a source of fertilizer and soil conditioner	Livestock generates employment

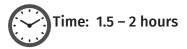
Figure 8. BINGA cards



## Exercise 8.2 Livestock care and management

At the end of the exercise, the participants shall be able to:

- define the different care and management practices needed for livestock
- discuss proper care and management practices depending on the kind of animals
- describe other care and management practices unique to particular animals and why these are needed.





Materials/Preparation: chart paper (2 sheets per group), printout of Table 8 on A4 paper (5 copies, step 3), markers, masking tape

Days before the session, invite the local veterinarian/livestock specialist or a successful livestock farmer to act as resource person on the topic **livestock care and management**. Brief the expert that he/she is not expected to give a lecture but rather to supplement ideas that arise from discussions of participants and provide useful and practical tips on the subject based on his/her expertise and experience.

#### Steps:

- 1. Start with the warm up questions: "Is there a difference between what you feed dairy cattle and beef cattle?" "Why do you need to give different kinds of feed to different kinds of livestock?" When responses have been exhausted, state that the exercise aims for participants to be able to describe proper care and management practices of livestock where feeds and feeding regimen is just one aspect. of them.
- 2. Divide the participants into five groups. For the first round of activity, assign one type of livestock to each group, for example:
  - Group 1: cow/cattle (dairy or beef, specify)
  - Group 2: buffalo (dairy or draft, specify)
  - Group 3: goat (dairy or slaughter, specify)
  - Group 4: chicken (broilers or layers, specify)
  - Group 5: pig (fattener or breeder/sow, specify)
- 3. Allot about 30 -45 minutes for the small group discussions on their current husbandry practices and the reason they practice such for the livestock assigned to them. The discussions should focus on the feeding, watering, security, housing, and disease or pest control practices that they employ. They can also add particular practices such as dehorning, hoof trimming, castration, "supak" method of

feeding beef cattle, etc. as appropriate. Groups should write down the results of their discussions in the second and third columns of their chart paper using the suggested format in Table 8 below. Let them leave the fourth column empty for the next part of the activity. Provide each group with a copy of the template.

Table 8. Care and management practices of livestock

Livestock: Example - Cow (dairy)	Why is it important	Current practice and why	Suggested improvements towards ecological livestock care and management
Feeding:			
Watering:			
Security:			
Housing:			
Disease or pest control:			
Others:			

4. Ask for a volunteer from each group to make a quick report (5-7 minutes) on their group output, i.e., information for columns 2 and 3 of the sample table. Welcome additional questions and comments. Supplement the discussion by stressing that efficient and sustainable livestock production relies on good basic animal care and management practices. It requires carefully selecting locally adapted animal species and breeds, using adequate locally sourced materials for feeding, providing good animal care and housing, and protecting the animals against parasites and diseases.



- 5. For the second round of the activity, instruct each group to pass their output to the group next to them, i.e., Group 1 will give its chart paper to Group 2; Group 2 will give its output to Group 3, etc. The "new" groups' task is to think about what improvements can be made towards ecological livestock management (for the output of the group that has been passed to them). These suggestions could be based on their own experiences or what they may have read or heard from other sources, to be written on the fourth column of the chart paper. Allow about 15 minutes for this activity.
- 6. The outputs will be reported out by group representatives from the second round. Allot about 3-5 minutes for each presentation and another 10 minutes for Q&A after all of them have finished reporting. Request the resource person to add, confirm, clarify, or correct points on the presentations and answer further questions from participants. You can also ask the expert to give additional inputs or advice, especially with regard to the fourth column in the matrix, "Suggested improvements..." especially on ethnoveterinary practices. (Recommended reading available at <a href="https://iirr.org/wp-content/uploads/2021/10/Ethnoveterinary-Medicine-in-Asia.pdf">https://iirr.org/wp-content/uploads/2021/10/Ethnoveterinary-Medicine-in-Asia.pdf</a>)
- 7. Highlight key points as needed, such as:
  - Sustainable livestock production is faced with challenges such as limited amount and inferior quality of locally available feeds especially during the dry season, pest and disease outbreaks, and unfavorable or inclement weather.
  - Successful livestock production depends on three basic requirements: proper selection of animals, appropriate feeding, and keeping the animals generally healthy.
  - Select animals appropriate to the farming system and the environment. Choose breeders depending on the animal species and the purpose for raising them.

- Good feed supply and feeding system are essential to successful livestock farming. Make the best use of locally available feed resources. Better yet, develop your own feed sources or fodder crop if possible or feasible.
- Livestock have different feed requirements based on their species, age, and purpose of production (e.g., for dairy, meat, eggs, draft, or as breeders). Raise healthy animals by preventing the introduction and spread of infections, providing good growing conditions, and implementing pest and disease control measures as needed.



Chapter 9

### **FISH REARING AND MANAGEMENT**

Aquaculture gives farmers the opportunity to produce fish and other marine organisms in different water environments. This process has many benefits but also has some drawbacks. Fish farming provides families a source of food and livelihood. It also protects marine fish species that are at risk of elimination from overfishing. On the other hand, fish farming can result in water contamination from fish waste materials, eliminate certain fish species by changing their natural habitats, or introduce diseases that could destroy surrounding wildlife. Proper management of local natural resources will support and ensure sustainable fish farming.



### Exercise 9.1 Sustainable fish farming

Learning objective: At the end of the exercise, the participants shall be able to:

- discuss practices that support sustainable fish farming
- discuss the importance of sustainable fish farming to family nutrition and food security



Time: 1 - 1.5 hours

Materials/Preparation: Newsprint or chart paper, pens, markers, masking tape, video on "5 ingredients to sustainable fish production" available on <a href="https://www.youtube.com/watch?v=LrntnLDTIR4">https://www.youtube.com/watch?v=LrntnLDTIR4</a>, computer for use in

showing the video

Prior to the session, the Facilitator should view the video to become familiar with it. Make arrangements for a computer to use during the session for showing the video.

#### STEPS:

- 1. Start the session by asking participants how many kilos of fish their family consumes in one week? How many kilos do the families of all participants consume in one week? In one month? In one year? Ask participants to imagine the families in the whole village and what the fish consumption of the village would look like in one year. Would this be sustainable for the next ten years?
- 2. State that the exercise aims to discuss practices that support sustainable fish farming and the importance of sustainable fish farming to family nutrition and food security. Explain that the participants will view a video on "5 ingredients to sustainable fish production". The video will take 3 minutes and 41 seconds only.
- 3. Assign one ingredient (i.e. principle) to each group without mentioning what the principle is. Just give the number of the ingredient:

Group 1: ingredient 1 Group 2: ingredient 2 Group 3: ingredient 3 Group 4: ingredient 4 Group 5: ingredient 5

- 4. After viewing the video, small groups discuss (a) what is the ingredient (i.e. principle) and what does it mean; (b) what practices are needed to support the principle and (c) how would these practices contribute to family nutrition and food security. Allow 15 minutes for small group discussions.
- 5. Groups report out on results of their discussions for 5 minutes followed by 2-3 minutes Q&A. After each group reports, supplement practices raised in the video that could have been missed by the groups.

Ingredient 1: Water, fertilizers, labor, energy should be used more efficiently (e.g. use fish feeds in a targeted manner; use only the amount of and kinds of fish seeds needed; manage the pond appropriately using the right tools and measures to avoid disease that are safe for humans and animals)

Ingredient 2: Land, water and biodiversity must be protected from degradation (e.g. carefully select the location of the fish pond to minimize external threat like climate threat; minimize escapes of farmed exotic species)

Ingredient 3: Foster resistance to shocks (e.g. build resilience to droughts, diseases, floods, etc. related to climate variability or climate change)

Ingredient 4: Use the fish pond in integration with other agricultural activities (e.g. use outflow water for agriculture irrigation and fertilization; combine fish farming with vegetable production; farm different fish together so that they can use the feeds more efficiently)

Ingredient 5: Governments should adopt policies that facilitate the application of the principles by fish farmers

- 5. Conclude by asking what is sustainable fish farming. Write down all ideas. These could include:
- requires only basic or simple technical know-how
- have zero or minimum negative impact on the environment
- allows for fast and low-cost fish production
- requires a minimum of intervention from farmer- fish raisers, who are engaged in other major activities
- can keep external inputs to a minimum
- should have a good potential to generate income

Summarize by mentioning that sustainable fish farming means:

More fish from the same pond while respecting the environment

- Raising fish for more years in the same pond without damaging the ecosystem
- More money

Add that productive and sustainable fish farming also requires a good fish breeding program or a reliable and reputable source of fingerlings, a feeding system, and fish and pond management systems.



### Exercise 9.2 Fish farm management

Learning objective: At the end of the exercise, the participants shall be able to discuss practices related to selecting fish to rear, feeding, managing fish health and harvesting and marketing fish



Time: 1.5 - 2 hours



Materials/Preparation: Newsprint or chart paper, pens, markers, masking tape

Prior to the session, the Facilitator should:

- Discuss with the village leaders and identify with them farmers successfully practicing fish rearing who could be invited as resource persons for the session; invite one farmer each raising one species of the following: tilapia, carp, catfish.
- Follow up with identified farmers to ensure their attendance in the training session.
- Prepare the list of questions to ask the resource persons (i.e. invited farmers) for the panel discussion (see section on below)
- Prepare labels of the fish species (i.e. tilapia, carp, catfish) to be used as name plates for the panelists

#### STEPS:

- 1. Explain that the exercise seeks to provide participants with information about possible species for stocking, the ratio to be maintained, appropriate size of fingerlings and suitable cropping pattern for their fish farm. The exercise will also provide information on feed material, quality requirement and feeding practices for optimum growth of fish species, managing fish health (e.g. diseases associated with fish rearing) and harvesting methods and marketing of fish.
- 2. Ask the invited farmers to sit together on one area of the room where everyone can see them. Put up the label of the fish species in front of the resource person who is representing it.
- 3. Introduce the resource persons and explain that they will be answering questions about their fish farming system.
- 4. Facilitate the panel discussion, asking one question at a time (i.e. the same question) to all panelists. After the resource persons have answered each question, give time for participants to give their ideas or ask further questions before supplementing the discussions. Below are suggested questions to ask the resource persons:

Q1: What factors do you consider in selecting the species to raise? Please give details about your practices on stocking, the ratio of fish to be maintained, appropriate size of fingerlings. If you raise fish with rice, please explain your cropping pattern. Based on the responses of the resource persons, add that the type of fish to farm depends on several factors such as environment, location, and the technical and financial capacity of the farmer. The key biological characteristics of the fish (growth rate, reproduction, size and age at maturity, feeding habits, hardiness and susceptibility to diseases) determine the suitability of a species for culture in the locality. The match between available fish feeds and the food preference of the selected fish species as well as the demand and market value also need to be considered.

Q2: What feed material do you use and why? Where do you source the feed and why? Please provide more information about your feeding practices. If you grow fish with rice, what additional feed becomes available to the fish?

Based on the responses of the resource persons, provide additional inputs, e.g. feed is a key component of fish production and therefore must be given priority. Feeds alone can constitute 70%-80% of production cost. Some farmers rely on the natural productivity of the environment or of the ponds/structures built for fish production. This means that food for the growing fish is provided by organisms that are naturally living or reproducing in the water. However, the farmer should be ready to provide additional feed if s/he wants the fish to attain their ideal weight gain, especially if they are primarily for sale.

Q3: What fish-associated diseases have you experienced and how did you handle the situation? Please tell us about other problems have you encountered in your fish farming. Who do you ask for advice if you encounter problems in fish farming? Based on the responses of the resource persons, mention that the main causes of disease in fishes are inadequate feeding, exposure to an extreme or toxic condition, and attack by pathogenic or disease-causing organisms. Nutritional diseases become more frequent as the cultivation system becomes more intensive and the fish are obtaining smaller proportions of their nutrients from natural food organisms. Pathogenic organisms will either attack externally (on the skin, gills or fins), or internally (in the blood, digestive tract, or the nervous system).

Q4: How do you harvest fish? How often? How much of the harvest do you sell and how much do you keep for own consumption? Based on the responses of the resource persons, mention that harvesting is catching fish either for home consumption or for sale. In order for the venture to be profitable, fish should be harvested at the correct time and using the appropriate method(s). Feeding is discontinued 24 hours prior to harvest; this is to lessen the "unfavorable" smell of the fish especially attributed to the feeds given. Partial or complete harvesting of the fish stock can be done.

Primary consideration in marketing is maintaining the quality of the fish, especially its freshness. One should ensure sufficient ice supply, clean containers, proper transport, etc.7 Clean water and adequate oxygenation, on the other hand, are critical if live fish are moved for marketing. The temperature difference between the transport water and the water from which the fish was harvested should be less than 10°F. Delivery schedules must be worked out carefully to minimize transportation time and quality loss

5. Highlight key points that came up during the discussions and summarize the exercise.



### Exercise 9.3 Establishing and maintaining fish

At the end of the exercise, the participants shall be able to:

- discuss considerations in establishing fish ponds
- discuss chores that should be carried out routinely to ensure continuous and sustained productivity

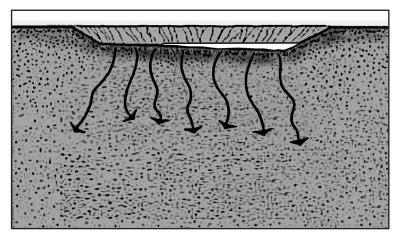


Time: 1 – 1.5 hours



**Materials/Preparation:** Newsprint or chart paper, pens, markers, masking tape.

Prior to the session, print out 5 copies each of:



**Figure 9.3a. Pond A**Source: https://www.fao.org/fishery/docs/CDrom/FAO\_Training/FAO\_Training/General/x6708e/x6708e06.htm

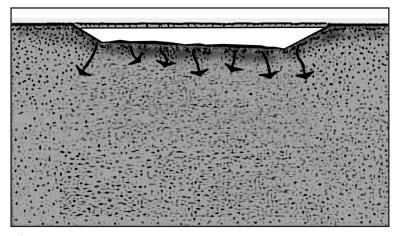


Figure 9.3b. Pond B
Source: https://www.fao.org/fishery/docs/CDrom/FAO\_Training/FAO\_Training/General/x6708e/x6708e06.htm

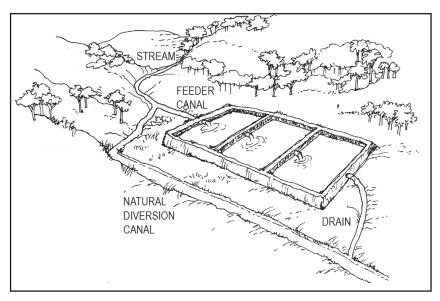


Figure 9.3c. Diversion ponds

#### STEPS:

- 1. Distribute one copy of Figure 9.3a: Pond A to each group. Start with a warm up question: What is wrong with the fish pond in the picture? (Answer: Porous soils at the surface or at a depth through which the pond bottom will be cut lose too much water.)
- 2. Distribute one copy of Figure 9.3b: Pond B to each group. Ask: What can you say about the fish pond in the picture? (Answer: Pond bottoms of fine-texture clay, silty clay or sandy clay soils lose little water.)
- 3. Each group should select one group member who is currently or ask for one volunteer who has intentions of farming fish to provide information on the items below. Other group members should also contribute their ideas. The group should indicate if the fish production is for household consumption only or to be sold. Discuss for about 15 minutes:

- the source of water used to fill the pond
- how water is/will be brought to the pond
- the type of soil available for building the pond
- the size, shape, and depth of the pond
- the slope of the pond bottom (for good drainage)
- the height, width, and slope of the dikes
- the type of drainage system that is being or will be used
- the layout (arrangement) of ponds used for different sizes of fish
- 4. Before the presentations, inform participants that they just discussed design considerations in establishing fish ponds. Allot 5-7 minutes for presentation of outputs and about 2-3 minutes for O&A.

Provide additional information, as needed such as that site selection for fish ponds should take into account the availability and quality of water, impermeability of the soil, and suitability of the topography. The slope should be shallow (not steep) and near the water source. The site should also be accessible for the farmer to have a daily control and supervision of the pond; preferably, it should be near the house to discourage poaching. A properly designed and constructed pond will be easily managed and will last longer, saving extra work and related expenses, and resulting in greater productivity.

- 5. Distribute one copy of Figure 9.3c: Diversion ponds to each group. Explain what diversion ponds are and that they are recommended for small-scale fish farming as they are generally inexpensive, have a low flood risk, and drain well. They are also easy to manage because the water supply is well controlled. This facilitates fertilizing the water, feeding and harvesting the fish, and preparing and drying the pond bottom.
- 6. Ask for three volunteers who are currently farming fish. Ask what chores they routinely carry out to ensure continuous and sustained productivity. List down all the responses on newsprint as they are mentioned. Supplement points that may have been missed, such as:

- Remove silt, mud, detritus and clay (from dike erosions, turbid water, organic fertilizer, rainwater run-off, etc.) from pond bottom to maintain its depth.
- Completely plow and expose pond bottom to sun and air for a few days or until the soil cracks.
- Clear the bottom of twigs, branches, leaves, dead fish, etc. and remove all predators that feed on fish (snakes, frogs).
- Smoothen the plowed and cleared area.
- Check any fences for damage. Repair holes which let in fisheating animals; clear weeds and unnecessary vegetation in and around the pond to keep pests and predators away.
- Check inlets, outlets, and screens for damage; remove clogs, or. replace them if necessary. Check the pond walls for cracks, leaks or weak points and repair them.
- Replant grass cover (re-grassing) on pond walls or mow, as needed.
- 7. End the session by emphasizing that fish farming is a viable enterprise that can help improve the socioeconomic conditions of farm households. It provides additional income and ensures families' access to a protein source for better food and nutrition security. Agroecological fish farming entails producing fish to high standards of animal welfare and environmental protection, with less environmental impacts and improved ecological resilience.



#### THE LOWLAND ECOSYSTEMS



## Exercise 10.1 Characteristics of lowland agroecosystems

At the end of the exercise, the participants shall be able to:

- describe characteristics of lowland ecosystems
- discuss the need to ensure that farming practices support the agroecosystem
- explain how supporting the agroecosystem can enhance the productivity of farms



Time: 1 – 1.5 hours



Materials/Preparation: Newsprint or chart paper, pens, markers, masking tape, illustration of a lowland agroecosystem on chart paper (see Figure 10.1a in step 2),

meta cards labelled with characteristics of lowland ecosystems (see step 3); graph of lowland rice yield trends on chart paper (see Figure 10.1b in step 4), blank meta cards

#### Steps:

- State that the exercise aims to describe characteristics of lowland ecosystems and the need to ensure that farming practices support the agroecosystem which in turn enhance the productivity of lowland farms.
- 2. Put up the illustration of the lowland agroecosystem on the board (Fig 10.1a). Mention that in the Philippines and in most of Southeast Asia, the lowlands are predominantly devoted to rice cultivation.

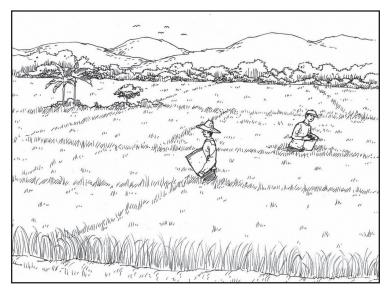


Figure 10.1a. Lowland agroecosystem

Ask participants what other (farm) components they would typically find in such an agroecosystem, e.g., "What other crops or animals would lowland farmers raise along with rice?" Write their answers beside the illustration. When answers are exhausted, read the components aloud, and name possible others that were not mentioned.

3. State that lowland agroecosystems like the one on the board have typical characteristics or features. Then post the meta cards so labelled with the said characteristics: alluvial plains; relatively flat areas; altitude no higher than 200 meters above sea level (masl); receive water draining from the uplands; may be rainfed or irrigated.

Call on volunteers to check on their understanding of the different characteristics and supplement their responses by adding the following information as needed:

 Lowland agroecosystems receive most of the water draining from the uplands, including the various particles

- and dissolved minerals. Because of this, lowlands have mostly rich soils capable of supporting varied (agro) ecosystems that produce food crops.
- Lowlands may either be rainfed or irrigated, with the latter being generally more productive due to the availability of water throughout the year.
- Lowland agroecosystems are typically associated with the significant but short-lived yield increases in rice production brought about by the Green Revolution (i.e., high external input production system which includes the use of high yielding varieties or HYVs, chemical fertilizers and pesticides) from the late '60s to the mid- '80s.
- 4. Walk participants through the example on rice yield trends in lowland agroecosystems in Figure 10.1b.

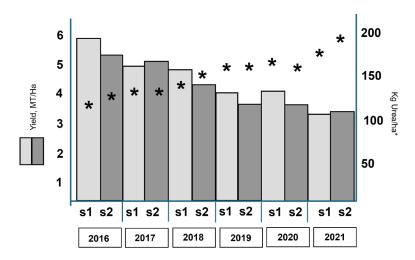


Figure 10.1b. Lowland rice yield trends

Explain that the bars indicate the yield/ha for 2 seasons (wet season and dry season crops) for six years and the asterisks indicate urea use during the said period. Ask what the graph implies with regard to trends in the use of synthetic nitrogen inputs vis-à-vis yields. Let participants share their own experiences.



5. Ask participants to name (other) negative effects resulting from excessive use of synthetic nitrogen. When responses are exhausted, mention that the practice accelerates the acidification of soil (farmers usually refer to it as the soil becoming "sour"). In general, overuse of chemical fertilizer(s) reduces organic matter and humus content of the soil, inhibits plant growth and beneficial organisms, and fosters the incidence of pests and diseases.

Add that although the heavy use of inorganic fertilizers and pesticides have led to significant yield increases, this has also caused many other unwanted side effects. Examples are increased pest and disease incidence, environmental degradation, decrease in nutrient cycling, and loss of biodiversity.

- 6. To wrap up the session, emphasize that:
  - Lowland agroecosystems are considered as the most productive and suitable for agricultural use.
  - Agroecological farming in the low lands employs ecological processes and methods to increase productivity, strengthen ecosystem services, and minimize negative environmental impacts.
  - Agroecological farming ensures and enhances productivity of lowland farms by encouraging farmers to intensify, diversify, and integrate their farming enterprises while adapting to climate change.



## Exercise 10.2 Systematizing crop intensification

At the end of the exercise, the participants shall be able to:

- discuss the concept of systematizing crop intensification
- describe principles and practices of system of rice intensification
- explain how such principles and practices contribute to increased productivity



Time: 2 - 2.5 hours



Materials/Preparation: Newsprint or chart paper, pens, markers, masking tape, seedlings from wet seedbed and drained seedbed (at least 25 of each kind), 10 small

plastic or paper bags, 10 clear plastic or glass containers, rulers with mm/cm markings (5 pcs) needed for measuring the length of the roots and height of the seedlings, Table 10.2a on chart paper (see step 3) and on A4 paper (5 copies), Table 10.2b on chart paper (see step 7) and on A4 paper (5 copies), meta cards labelled with SRI practices (see step 7).

Days prior to the session, discuss with the village leaders and identify with them one farmer who raises seedlings using the wet bed method and another farmer using the drained method. Know the farmers' schedules for raising their seedlings way in advance so you can schedule the session on SCI/SRI accordingly. The seedlings should be about a week old on the day of the session. Inform them that you will be needing at least 25 seedlings from each of them.

#### Steps:

- Explain that the exercise aims to describe the concept of systematizing crop intensification, discuss the principles of rice intensification, and explain how these can contribute to increased productivity.
- 2. Begin the session by introducing the concept of systematizing crop intensification (SCI), which takes into account agroecological principles that seek to make the most productive use of available natural resources in crop production. This is in contrast to the practice of using high yielding varieties (HYVs) and the attendant increased use of inorganic fertilizers and pesticides, improved irrigation facilities, and improved or mechanized farm implements. Mention that the system of rice intensification (SRI) is one

example of SCI – wherein the productivity and profitability of rice is substantially increased by more intensively managing the crop.

- 3. Form five groups and provide each one with the following materials: a) 5 rice seedlings from a wet seedbed; b) 5 seedlings from a drained seedbed; c) 2 plastic glasses with water; d) Table 10.2a in A4 paper. The two kinds of seedlings (a and b) should be separately placed in paper or plastic bags labelled accordingly to avoid mix-up. Explain the group tasks which should take about 45 minutes to an hour as follows:
  - Observe the seedlings and record the needed information on Table 10.2a provided to your group.
  - Note and compare how much soil is sticking to the roots in both kinds of seedlings. This can also be checked against the turbidity of the water in the step below.
  - Soak the seedlings in separate plastic glasses, swirling them gently to remove the soil from the roots.
  - Then change the water in both cups and float one seedling in each cup. Measure the diameter of the surface area that the roots cover. Likewise record the information on the table.

Table 10.2a. Comparison of seedlings from wet and drained seedbeds

Parameters	Wet seedbed	Drained seedbed
Amount of soil sticking to the roots (more? less?)		
Length of vertical roots (shortest-longest, in mm)		
Number of lateral roots (more? less?)		
Color of the roots		
Density of root hairs (more? less?)		

Number of leaves per seedling (average)	
Seedling height (shortest- longest, in mm )	
Color of the leaves	
Surface area covered around the roots when seedling is floating in water (more? less?)	

- 4. When the groups have finished with their observation and recording, put up Table 10.2a written on chart paper which is essentially the same table provided to the groups. Go through all the parameters, and write the results/observations from each group on the chart paper. Although clarificatory questions may be entertained, avoid any discussion at this point; the focus is to get the group observations and for everyone to see them.
- 5. Ask for volunteers (one from each group) about their **general observations** on what is written on the table/chart paper. Go through each item and facilitate discussion as needed.
- 6. Then ask WHY there are differences between the seedlings raised in wet and drained seedbeds, if any. After responses have been exhausted, point out that roots in water-saturated soils (anaerobic conditions from the wet seedbed) do not grow as well because the continuous saturation changes the (biochemical and physical) properties of the soil around the plant that is necessary for growth and survival.
- 7. Put up the newsprint with Table 10.2b Comparison of production practices between farmers' practice and SRI.
  - Get a show of hands on who among the participants are practicing or have heard about SRI and what they know about it. Inform them that you will need their help later in completing the practices under the SRI column.

### Table 10.2b. Comparison of production practices between farmers' practice and SRI

Practices	Farmers' practice (wet or anaerobic)	SRI (alternate wet and dry)	Rationale for SRI practices
Seedbed			
Seed rate/ha			
Seedling age at transplanting			
Distance between transplanted seedlings			
Number of seedlings/hill			
Soil condition			
Application of manure/compost			
Weed management			
Pest management			

Source: Adapted from https://www.aimspress.com/article/doi/10.3934/agrfood.2016.2.102?viewType=HTML

- Walk participants through each item and ask them for information on their current practices (non-SRI) until the column is completed.
- Do the same process for the SRI column. Get inputs from the participants first, and then post up the corresponding SRI practice (previously written on meta cards): dry raised seedbed with less seed rate (5-10 kg/ha); 8-12 days old; 5-20 kg/ha or less than 5 kg; 20x20 cm or wider; single seedling/hill; minimum water at vegetative period followed by alternate wetting and drying, 1-2 cm during

- grain filling and draining the paddy 2-3 weeks before harvest; enriching the soil with organic matter (could be more than 9 tons/ha); use of rotary weeder from 10 DAT for up to 4 times every 7-10 days; apply IPM with emphasis on plant environment management.
- To complete the exercise, provide the necessary information in the Rationale column. For example, the use of younger seedlings (i.e., only 2 small leaves) contributes to more tillering and better root growth potential, or the use of single seedlings per hill lessens root competition and encourages better root growth.
- 8. End the session by highlighting the central principles of SRI which include:
  - Reduced and controlled water application. Rice fields are kept moist rather than continuously saturated, minimizing anaerobic conditions; this improves root growth and supports the growth and diversity of aerobic soil organisms.
  - Reduced plant density. Seedlings are planted singly and spaced widely to permit root and canopy growth in order to keep all leaves photosynthetically active.
  - Early plant establishment. Seedlings are transplanted when young (less than 15 days old with just two leaves)
     quickly, shallowly, and carefully to avoid trauma to roots and minimize transplanting shock. This makes it easier and quicker for the seedlings to recover.
  - Enrichment with organic matter. OM improves soil structure, nutrient and water holding capacity, and favor soil microbial development. Cumulative OM additions make nutrients (including micronutrients) become more available to the rice plants.





## Exercise 10.3 Facilitating farm diversification and integration

At the end of the exercise, the participants shall be able to:

- explain the importance of agricultural diversification and integration
- discuss the benefits from integrating fish and/or duck raising in rice production
- describe good management practices for rearing fish and/or ducks in rice ecosystems



Time: 2.5 - 3 hours



Materials/Preparation: Newsprint or chart paper (about 10 sheets), pens, markers, masking tape, 5 strips of paper for drawing lots (see step 2); data collection forms Table

10.3a (5 copies), Table 10.3b (4 copies), and Table 10.3c (1 copy);

Several days before the session, visit the village and discuss with local leaders about the plan to bring participants to the site to interview some farmers and observe their farms. Explain the objectives of the exercise and the planned activity. Identify with them and request assistance to inform five farmers who will be interviewed. Preferably these should be farmer-owners who have been successful with their farming enterprises for several years already: integrated rice-fish farming (2 farmers); integrated rice-duck-fish farming (2 farmers); and rice farming only (1 farmer).

Follow up with the selected farmers a week or a few days before the session to ensure their availability for the scheduled field visit and interview.

#### Steps:

 Mention that the exercise seeks to explain the importance of agricultural diversification and integrated farming systems.
 It also aims to discuss the benefits from integrating fish and/ or ducks in rice production. Additionally, the exercise aims to describe good management practices for rearing fish and/or ducks in rice ecosystems.

- 2. Form five groups and explain that they will each visit a different farm and interview the respective farmer-owners.
  - Ask for volunteers to draw lots for their assignments as follows: integrated rice-fish farming (2 groups); integrated rice-duck-fish farming (2 groups); and rice farming only (1 group).
  - Distribute one copy of each of the data collection forms to the groups (Table 10.3a and Table 10.3b); note that the "rice farming only" group will use Table 10.3c instead of Table 10.3b.
  - Instruct participants to enter data only for either rice, rice-fish or rice-fish-duck, as relevant to their group.
  - Ask them to write details on input costs (marked with asterisks) on a separate sheet and place the total figures on the appropriate columns in Table 10.3a. Let them note that their interviewees may have a set of inputs different from what is written on the form – which is only for illustrative purposes.
  - Check if there are any items that are not clear and that need to be explained before the field visit.
  - Agree to meet up in the session area after 1.5 hours.

Table 10.3a. Economic benefits from rice and rice-fish and/or duck production (last season)

	Rice*	Fish**	Duck***
Area devoted for the component			
A. Yield (kg)			
B. Gross Income (pesos/ha)			
C. Input cost (pesos/ ha)			
D. Net Income (pesos/ ha) [B - C]			

### Enter data only for either rice, rice-fish or rice-fish-duck, as relevant to the group

- Seeds/seedlings; manure; fertilizer; irrigation; weed management; insect pest and disease management; labor (from land preparation to taking care of the field to harvesting), other inputs
- \*\* Fish stock; feed; water; disease management; labor (from pond preparation to taking care of the field to harvesting), other inputs
- \*\*\* Duck stock; feed; water; disease management; labor (from field preparation to taking care of the field to harvesting) other inputs

### Table 10.3b. Management practices for rice-fish/duck production

	Current practices
Pond/rice field preparation	<u> </u>
Pond and rice field fertilization	
Fish stocking (e.g. selection of stock, density, etc.)	
Duck stocking (e.g. selection of stock, density, etc.)	
Weed management	
Protection from predatory animals and competitors of fish	
Protection from predatory animals and competitors of duck	
Water management	
Feeding and supplemental feeding for fish	
Feeding and supplemental feeding for duck	
Harvesting	
Other inputs	

Table 10.3c. Management practices for rice production

	Current practices
Rice field preparation	
Rice field fertilization	
Weed management	
Insect pest and disease management	
Water management	
Harvesting	
Others	

- 3. The groups can process their field visit results and observations as soon as they are back in the session hall. They should write out their outputs (both on economic benefits and management practices) on chart paper for presentation. Allow for 30-45 minutes for this step. NB: It is quite likely that the five farmers do not have same-sized parcels of land. In addition to using the original "raw" figures (on their chart paper), the groups **may** choose to convert the values to "per hectare" for easier comparison (of yields, input costs, incomes) across the five farms.
- 4. Allot 7-10 minutes of presentation per group. After all the groups have finished reporting, allow for another 10-15 minutes for clarifications and quick Q&As. You may hold off lengthier discussions for the next step. Keep the chart paper posted up for reference in the succeeding discussion.
- 5. Direct the participants' attention to their outputs on the board. Ask them to compare the economic benefits from growing only rice, rice-fish, and rice-duck-fish combinations. Are there differences between the farms engaged in the

same enterprises (i.e., rice-fish and rice-fish-duck cultures)? Aside from economic benefits, are there other benefits or advantages of integrating fish (and/or duck) to the rice crop? To the fish (or ducks)? To the soil? To farmers and their households?

Add information that may not be mentioned like:

- Incorporating fish and/or duck in rice production discourages farmers from using pesticides that would otherwise harm the fish/ducks.
- It also encourages the application of other ecologically sound management practices (e.g., use of organic fertilizers) and improved agronomic practices (e.g., wider plant spacing and reduced seeding rates).
- Integrated agro-aqua production benefits from the reuse and recycling of nutrients (e.g., fish and ducks provide a natural source of fertilizer with their droppings) and shared use of water and land resources.
- With climate change, monoculture has resulted in higher risks from climatic variations while agricultural diversification has been proven as an effective strategy to promote resiliency to extreme climate and weather disturbances.
- 6. To end the session, emphasize that intensification is associated with increase in production of a given crop or product per unit of resources used, while diversification pertains to the generation of a wider variety of genetic, species, and enterprises within the farming system(s). Integration further amplifies the outcomes of intensification and diversification by ensuring that the outputs (including the wastes and by-products) of the diverse components of the system are being used as inputs in the other components.



#### THE UPLAND ECOSYSTEMS

Upland ecosystems provide important ecosystem goods and services such as conserving soils, sequestering carbon, recycling nutrients and water, providing habitats to animals, among others. Unfortunately, ecosystems in upland areas are also increasingly threatened by the expansion of agricultural areas and change in land use due to the growing human population. These changes have brought about negative consequences for both the uplands (e.g., soil erosion, reduced aquifer recharge) and the communities downstream (e.g., flooding, riverbank erosion). An ecosystems approach to upland ecosystem management will bring about productive, sustainable farming while conserving upland resources.



# Exercise 11.1 Characteristics of upland agroecosystems and establishing agroforestry systems

At the end of the exercise, the participants shall be able to:

- describe characteristics of upland ecosystems
- discuss the benefits from agroforestry systems
- describe different models of agroforestry systems



Time: 3 - 3.5 hours

Materials/Preparation: Newsprint or chart paper, markers, masking tape, Figure 11a drawn on chart paper and meta cards labelled with characteristics of upland ecosystems (step 2), inventory form on A4 paper (4 copies, step 6), blank meta cards



Several days before the session, visit the village and discuss with local leaders about the plan to bring participants for a field visit. Explain the objectives of the activity and select with them four farmers from upland ecosystems who will be interviewed and whose farms will be visited (step 4). Follow up with the selected farmers about the scheduled field visit to ensure that they will be available during the activity.

#### Steps:

- State that the exercise aims to describe characteristics of upland ecosystems and to discuss the benefits from agroforestry systems. It will also characterize the different agroforestry systems and for participants to know which one is appropriate for their particular situation.
- 2. Put up the illustration of an upland agroecosystem (Figure 11a). Ask participants to describe the characteristics of upland agroecosystems and write down their responses on newsprint. Then post up the meta cards prepared for the session if these were not mentioned, e.g., above flood level or alluvial plains; mountains and foothills; around 200-500 meters above sea level (masl); often highly eroded and acidic steep slopes dominated by persistent grasses; dependent on rainwater; unabated loss of biodiversity; high rates of soil erosion; low soil fertility.



Figure 11a. Upland agroecosystem

- 3. Initiate discussions about agroforestry by asking 3-5 volunteers about their definition of the term. Supplement their answers by mentioning that agroforestry systems are land management practices in which trees (and shrubs) are combined with the production of agricultural crops and/or livestock on the same area. Add that agroforestry can be practiced both in lowland or upland ecosystems, although it is more predominant in the latter which are usually marginally productive.
- 4. Divide the participants into four groups and assign them to the farmer/agroforestry system that they will observe as follows:
  - Farmer 1: practicing agrisilvicultural agroforestry (i.e., combination of crops and trees, such as alley cropping or home gardens)
  - Farmer 2: practicing silvipastoral systems (i.e., combination of trees and grazing of domesticated animals on pastures/rangelands, or on-farm)
  - Farmer 3: practicing agrosilvipastoral systems (i.e., integration of crops, trees, and animals (i.e., home gardens involving animals as well as scattered trees on croplands that are used for grazing after harvest)
  - Farmer 4: not practicing agroforestry
- 5. Inform the groups that as they conduct the field observation, they should discuss with the farmers to identify what types of crops, trees and animals are present in the farm. Likewise, they should also determine what products and ecosystem services or functions are provided by such elements in the farming system.
- 6. Distribute one copy of the inventory form to each group (Table 11a) where they will record the information they gathered in step 5 above. Note that a few examples were given in the table; you may quickly go through them with the participants. If the same examples exist in the farms that they visit, they may put in additional information (i.e., products, ecosystem services) as applicable.

Check if the group tasks are sufficiently clear before they go out to the field. About 1.5 hours should suffice for the activity.

### Table 11a. Inventory of trees, crops, and animals and their uses/functions in the agroecosystem

Trees, crops, animals present	Products	Ecosystem services
Coconuts	Food Fronds for wrapping native delicacies, "palaspas" Leaf midrib for broom, crafts, etc.	Wind breaker Host to birds
Corn	Food Feed for livestock	Wastes or by- products for mulch or compost
Cattle	Milk Meat	Manure for fertilizer

- 7. Upon their return to the meeting area, ask the groups to process their field visit results and observations. Give them about 30-45 minutes to write their outputs on chart paper for presentation following the format on the inventory form.
- 8. Allot 5-7 minutes of presentation per group and another 10-15 minutes for Q&A or clarifications after all the groups have presented. Keep the presentations posted up for reference.

- 9. Ask who among the participants practice agroforestry. If not, why not? After exhausting participants' answers, supplement with the following perceived reasons for why some farmers may not want to adopt the practice:
  - Trees will reduce productivity of the land.
  - AF may physically interfere with their farming operations.
  - Adding trees into the farm could result in the increase in pest species.
  - The area occupied by trees also represents an immediate loss from current production.

However, farmers must be encouraged to weigh certain short-term losses and perceived drawbacks against potential longer-term benefits that they may gain from increased soil fertility, reduced soil erosion, and other potential gains from agroforestry.

10. Summarize the session by underscoring that agroforestry systems are multifunctional; they can provide a wide range of economic, sociocultural, and ecological or environmental benefits. The three main components – crops, animals, and trees – can be combined in numerous spatial and temporal arrangements and for different functions based on the farmers' needs and preferences.



### Exercise 11.2 Sloping Agricultural Land Technology (SALT)

At the end of the exercise, the participants shall be able to:

- discuss agroecosystem management objectives
- identify technologies or practices corresponding to the agroecosystem management objectives
- describe the steps in establishing a SALT farm



Time: 1.5 - 2 hours

Materials/Preparation: Newsprint or chart paper, markers, masking tape, blank matrix on agroecosystem objectives and SALT practices on chart paper (Table 11a, step 2), list of questions for resource persons (step 3), Table 11b (printed on chart paper and reproduced as handout in A4, step 4), meta cards labelled with the steps in establishing a SALT farm, in random order (5 sets, step 7, steps on SALT establishment (printed on chart paper, step 8), Box 11 on Steps on establishing SALT farm (handout for participants, printed on A4 paper)

Several days prior to the session, discuss with the village leaders and identify with them two farmers successfully practicing Sloping Agricultural Land Technology (SALT, but preferably different "models") who could be invited as resource persons for the session. Provide the resource persons with the list of questions or points for discussion (step 3) so that they can articulate their answers in advance. Go through the list with them to ensure that each question is clear. In addition, explain that the exercise will also deal with the steps in establishing a SALT farm where the resource persons will share their own experiences.

#### Steps:

 State that the exercise aims to discuss agroecosystem management objectives and identify the range of SALT practices that correspond to those objectives. It will also describe the steps in establishing a SALT farm. Explain that the exercise will be divided into two parts to allow participants to delve deeper into technologies and practices for upland ecosystems.

Mention that sloping agricultural land technology (SALT) – developed by the Mindanao Baptist Rural Life Center (MBRLC) in the Southern Philippines – is a system of farming sloping lands whereby alleys of commercial and food crops are grown in between rows of perennial trees and leguminous shrubs that are planted along the contours. SALT promotes soil conservation along with food production that integrates

trees with crops and livestock. It was specifically designed as a viable alternative to the destructive traditional farming practices (swidden cultivation) of upland farmers.

#### Part 1

2. Ask the resource persons to sit together in front or in one area of the room where everyone can clearly see them. Introduce them and explain that they will be answering questions about Sloping Agricultural Land Technology (SALT). Before starting the interview, post up the blank matrix (Table 11a) on the board or wall and mention that the exercise will center around the said topic.

Table 11a. Agroecosystem management objectives and corresponding SALT practices (blank table)

Agroecosystem management objectives	SALT practices
Soil and water conservation	
Nutrient management	
Pest management	
Systems diversification	
Systems integration	

- 3. Facilitate the interview by asking the same questions below to both resource persons (RPs), onequestion at a time. As previously mentioned, provide the questions to the invited farmers way before the session so that they can be better prepared for the discussion. Direct the questions alternately to them, e.g., RP A then B, RP B then A, etc.
  - Before using SALT, what crops (and trees) did you grow and what animals did you raise? What farming practices did you implement on your sloping land?



- Why did you decide to adopt SALT? Where/how did you learn about the technology? How long have you been practicing SALT?
- Please outline the different SALT practices or techniques that you have adopted, with focus on the following aspects: a) soil and water conservation; b) soil nutrient management; c) pest management; d) systems diversification; and e) systems integration.
- Can you briefly describe the differences before and after adopting SALT? These may pertain to practices, results or outcomes, or characteristics of the farm itself.

As the resource persons mention the SALT practices they apply, write these up on the chart paper according to the agroecological management objective that they address. After the responses of the resource persons have been exhausted, draw out from the participants if they have anything to add to the practices already listed.

4. Then post up the completed version of the matrix (Table 11b below). Walk participants through the additional SALT practices, skipping those that were already mentioned by the resource persons (and participants). The table can also be reproduced on A4 paper for distribution to the participants later.

Table 11b. Agroecosystem management objectives and corresponding SALT practices

Agroecosystem management objectives	SALT practices
Soil and water conservation	a) establishing, cultivating, and planting contour lines; b) growing hedgerows, creating natural vegetative strips, piling rocks, stones, vegetative "trash", etc. in the contour lines; c) establishing check dams, contour and drainage canals; d) mulching with hedgerow trimmings and crop residues

Soil nutrient management	a) trimming nitrogen fixing trees and shrubs and incorporating them in the soil or using them as mulch; b) application of crop residues and other organic materials
Pest management	a) crop rotation, intercropping, companion planting; b) "push and pull" technique (growing plants that either attract or repel insects)
Systems diversification	a) intercropping, crop rotation; b) growing perennials and annuals in separate strips; c) growing live fence/trees in farm boundaries; growing nitrogen fixing trees as hedge rows; d) creating natural vegetative strips; e) growing fruit and timber trees; f) raising livestock
Systems integration	a) growing green manures (nitrogen fixing trees and shrubs) for soil quality improvement; b) growing forage and fodder for livestock; c) growing annual crops and using crop residues as feed and/or fertilizers; d) growing trees for food, fodder, timber and other wood products

5. The following additional questions may be asked in case these were not covered by the resource persons' answers: How has SALT addressed their land degradation issues? erosion? soil fertility? food security? Include economic benefits from practicing SALT and provide figures or estimates, if possible.

Explain that upland agroecosystems can be managed in ways that are sustainable. This can be done by ensuring that the choice of farm enterprises and land management practices are determined not only by the farm families' own needs and/or preferences, but also by the soil and climate conditions of the site. Farmers' socioeconomic constraints such as availability of labor, capital, and other production inputs should also be considered. Leave Table 11b on the wall; it will be used as a reference for the second part of the exercise.

#### Part 2

- 6. Recall that one of the objectives of this exercise is for the participants to be able to describe the steps in establishing a SALT farm.
- 7. Let the participants do a quick 7-10 minute exercise to outline the steps in establishing a SALT farm:
  - Distribute to the groups a set of meta cards labelled with the following: make an A-frame; locate the contour lines; cultivate the contour lines; plant seeds of nitrogen fixing trees; cultivate alternate strips; plant permanent crops; plant short-term crops; trim nitrogen fixing trees; practice crop rotation; build green terraces.
  - **N.B.** Make sure to mix up the cards so that they are not arranged in any particular order.
  - Instruct the groups to arrange the cards according to the "correct" steps or sequence in establishing a SALT farm.
  - Then ask them to tape their meta cards onto a chart paper and have them post it up on the board or wall.
  - Allow 1-2 minutes for everyone to observe their outputs (e.g., for similarities or differences in the sequence of steps); hold off on participants' comments for the next step.
- 8. Post up the chart with the steps in establishing a SALT farm (Table 11c).

Table 11c. Steps in establishing a SALT farm

Number	Step
1	Make an A-frame
2	Locate the contour lines
3	Cultivate the contour lines
4	Plant seeds of nitrogen-fixing trees in the contour lines

5	Cultivate alternate strips
6	Plant permanent crops
7	Plant short-term crops
8	Trim the nitrogen-fixing trees
9	Practice crop rotation
10	Build green terraces

If there is any group that came up with a different sequence, ask for someone from the group to explain the reason for their answer. Explain that the resource persons may or may not have practiced all the steps as outlined, and may have also followed a different sequence. Then go through each of the steps together, asking the resource persons to explain each one according to their own experience. Provide additional information, if needed, by referring to Box 11 below. Afterwards, distribute copies of the handout to the participants (Box 11 on A4 paper).

#### Box 11. Steps in establishing a SALT farm

- **1. Make an A-frame.** Nail or tie together three wooden or bamboo poles in the shape of a capital letter A. The base of the legs should be about 90 cm apart. Mount a level at the cross bar. (An A-frame is a simple device for laying out contour lines across the slope.)
- 2. Locate the contour lines. Locate the contour lines using the A-frame, starting from one side of the farm all the way to the other end. Mark with a stake each spot where the legs of the A-frame "land" as you go along. Make the next contour line above the first one going in the opposite direction, then the third one above the second, and so on. Space the contour lines 4-5 meters apart.



- **3. Cultivate the contour lines.** Plow and harrow 1m wide strips along the contour lines to prepare them for planting. Use the stakes/markers in step 2 as guide during plowing.
- **4. Plant seeds of nitrogen fixing trees.** Lay two furrows along each prepared contour line. Plant 2-3 seeds of the hedgerow species/hill (in double rows), with a distance of 12cm between hills.
- **5. Cultivate alternate strips.** Cultivate only alternate strips (i.e., 2, 4, 6 and so on) to minimize erosion, as unplowed strips can better hold the soil in place. (The space between rows of nitrogen-fixing trees on which the crops to be planted is called a strip or alley.)
- **6. Plant permanent crops.** Plant permanent crops every third strip. Plant tall crops at the bottom of the farm and put the short ones at the top. Permanent crops such as coffee, cacao, banana, and others of similar height may be planted at about the same time when the nitrogen fixing hedgerow species are sown in step 4.
- **7. Plant short-term crops.** Plant short and medium-term cash crops (e.g., corn, sweet potato, pineapple, ginger, taro, peanut) between strips of the permanent crops.
- **8. Trim the nitrogen fixing trees.** Every 30-45 days, prune the growing hedgerows to a height of 1.0-1.5m from the ground. Pile the cut leaves and twigs on the soil around the crops.
- **9. Practice crop rotation.** Plant legumes where cereals (e.g., corn and upland rice), tubers, and other crops were previously planted. Rotate crops every planting season; do not plant the same crop on the same area within the same year.
- **10. Build green terraces.** Pile organic materials such as straw, stalks, twigs, branches and leaves at the base of the rows of nitrogen fixing trees.

- 9. Draw participants' attention to Table 11b on the wall. Underscore that the steps in establishing a SALT farm and the practices therein address specific agroecosystem management objectives. For instance, steps 1-4 (and 8) correspond to the objective of conserving soil and water. Explain further that the steps are not mutually exclusive to particular objectives e.g., steps 4 and 8 are also meant to address soil and water conservation, soil nutrient management, and system diversification.
- 10. End the session by emphasizing that agroecological farming in the uplands requires cultural practices that can prevent soil erosion, improve soil fertility, conserve water, and maintain vegetative cover. They should also help ensure household food and nutrition security and generate income. At the same time, other interventions should address issues that are more acute in upland areas such as land tenure, product marketing, and access to financial and other basic services (e.g., development and extension programs). Such initiatives can be undertaken in partnership with other organizations which may include government or private/nongovernment agencies, universities, or research and development (R&D) institutions.





### AGROECOLOGY FOR SUSTAINABLE FOOD SYSTEMS

Agroecology is anchored on practices that are sustainable and environment-friendly; it restores and protects biodiversity and ecosystem services to ensure food production and food security. Agroecological systems that are more diversified are less vulnerable to environmental stresses such as pests and diseases, climate change, etc., thereby improving their adaptability and resiliency.



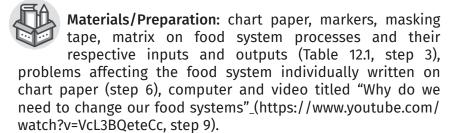
## Exercise 12.1 Understanding and transforming food systems

At the end of the exercise, the participants shall be able to:

- explain food system processes, inputs, and outputs
- discuss problems of current food systems
- propose changes needed to transform current food systems to minimize negative environmental impacts, sustain livelihoods, and produce sufficient and quality food



Time: 2 - 2.5 hours



#### Steps:

- State that the exercise aims to explain food system processes, inputs and outputs; discuss problems of current food systems; and propose changes to minimize their negative environmental impacts, sustain livelihoods, and produce sufficient and quality food.
- 2. To warm up the participants, ask what farmers do with their produce which can include crops, livestock, or fish. If they sell their produce, where and how do they sell them?
- 3. Post up the matrix shown below (Table 12.1). Mention that a food system comprises the activities, processes, and structures related to the production, processing, distribution, and consumption of food. Briefly explain the contents of the table.

Table 12.1. Food system processes and their respective inputs and outputs

Food system process	Inputs	Outputs
Production	knowledge and skills on how to raise crops and livestock; sun, soil, water, air, seeds, livestock; access to land, tools, farm equipment	Agriculutural production at farmer level which includes both crops and livestocks and by products
Processing	knowledge and skills in harvesting, packaging, storage, and processing; facilities and equipment	food ready for processing
Distribution	food ready for sale or distribution; sales outlets; marketing efforts	food ready for sale and distribution
Consumption	food that is ready to prepare; knowledge and skills in food preparation; cooking appliances	food ready for purchase and preparation food ready for consumption



- 4. Break the participants into five groups where they will discuss and give specific examples of the INPUTS under each process.
  - Assign a particular produce for each group to work on, e.g., vegetables (carrots), fruits (pineapples), root crops (cassava), chickens (layers), pigs, etc. Note: Choose examples that are usually grown or raised in the locality.
  - Underscore that under "processing", farmers can add value to their produce if they can practice simple or intermediate processing.
  - Provide markers and 2 sheets of chart paper per group for them to write their outputs for presentation.

Allot 30-45 minutes for the group work.

- 5. Give 5-7 minutes for each group to present. When all the groups have finished presenting, allow for 12-15 minutes for Q&A and additional discussion. If appropriate, mention that the group presentations mostly pertained to food systems processes at the local level. The processes will be quite different at the regional, national, and international levels due to the many other factors that may come into play.
- 6. Mention that several factors or problems have negatively affected our current food systems, e.g., a) climate change; b) environmental degradation; c) land conversion; d) lack of (or poor) postharvest infrastructure and facilities; e) shifting into less healthy diets; and the like.
  - Post the sheets of chart paper individually labelled with the problems affecting food systems as mentioned above.
  - Ask 2-3 participants to give examples or manifestations for each of the problems you just mentioned, e.g., What comes to mind when you hear the term climate change? How is it manifested? Etc. Write the participants' answers on the corresponding chart paper.

**Note:** Make this a quick brainstorming exercise; entertain comments and questions only after the last factor/problem has been covered to save on time.

- When done, let the participants scan their answers. Ask for clarifications if some of the items are vague or not specific enough. Add your own inputs as needed.
- 7. Form five groups (or participants may also opt to stay in their original groups) for them to discuss two aspects: a) how each problem affects our current food systems, and b) propose possible solutions to address them. Simply assign one issue for each group to work on. Give them the respective chart paper from the previous step (where you wrote their answers) and an extra sheet for them to write their group outputs. Allow about 20-30 minutes for this exercise.
- 8. Give 3-5 minutes for each group to report on the results of their discussion and another 10 minutes for Q&A and additional comments.
- 9. To supplement the group presentations, show the video "Why do we need to change our food systems"; the video runs for 3 minutes and 46 seconds. Afterwards, highlight the following ideas from the video presentation:

Our current food system is beset with several problems: a third of the world's population suffer from malnutrition (undernutrition and overnutrition, with their respective health implications); food composition is generally high in fat, sugar, salt, and meat (which negatively impact people's health and also the environment); as much as 1/3 of food goes to waste; natural resources are under pressure (water depletion, soil degradation, biodiversity loss, etc.), exacerbated by climate change.

The above problems can be addressed by: 1) adjusting/transforming the steps in our food system (e.g., production, processing, distribution, consumption) to ensure healthier food and reduce environmental impact; and 2) bring relevant stakeholders together (e.g., government agencies, private businesses, producers, consumers, etc.) to collectively act on how we can produce food sustainably and eat "differently".



10. To end the session, ask for several volunteers to comment on or give their opinions on the ideas presented in the video.



# Exercise 12.2 Creating agroecological food systems

At the end of the exercise, the participants shall be able to:

- exchange ideas on what agroecological food systems are
- assess individual capacity to apply agroecological principles in food systems
- identify needed support for the application of agroecological principles in food systems



Time: 2.5 – 3 hours

Materials/Preparation: Computer for showing the video on "Agroecology for sustainable food systems" (step 2), chart paper (4 sheets), markers, masking tape, matrix on agroecological principles on flip chart paper (Table 12.2, step 4), questions on how to apply agroecological principles to food systems on chart paper (step 5), food systems applications of agroecological principles written individually on A4 paper (step 6).

#### Steps:

- State that the exercise aims to exchange ideas on what agroecological food systems are, assess (the participants') individual capacity to apply them, and identify the support needed for applying agroecological principles in food systems.
- 2. To warm up the participants, show the video "Agroecology for sustainable food systems" on <a href="https://www.youtube.com/watch?v=OgJInRNyEDY">https://www.youtube.com/watch?v=OgJInRNyEDY</a> (03:30). Brainstorm on the concepts that were raised in the video. Write down all responses.

- 3. Underscore and briefly explain the three dimensions of agroecology: as a science, as a set of farming practices, and as a social movement.
  - Agroecology applies ecological science and concepts to the study, design, and management of sustainable food systems.
  - Agroecological farming practices are important in transforming food systems. Such practices are diverse but can be characterized by a generic set of principles, such as a preferential use of natural processes and a focus on local suitability, equity, and systems management.
  - As a social movement, it promotes rural development, food sovereignty, and other social dimensions that closely link farmers, consumers, governments, and all other actors in the food systems. It reconnects people to their food and producers to consumers – making healthy food available and accessible to all.
- 4. Explain that the application of agroecological principles helps in designing holistic farming systems according to local socio-economic and agroecological contexts. Post up Table 12.2 written on chart paper.

Table 12.2. Agroecological principles and their applications in food systems

Agroecological principles	Food systems applications	Individual assessment of capacity to apply	Support needed
Minimal external inputs		© ©	
Recycling of internal resources and minimizing losses		© ::	

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Contextualized farming	© ©
Resilience	© ©
Multi-functionality	© ©
Complexity and integration	© ©
Equitable	© ©
Nourishing	© ©

#### Legend:

- can confidently apply the principle
- (x) has concerns about and maybe unable to apply the principle
- 5. Then post the following questions (also written on chart paper) beside Table 12.2. Give a minute for the participants to read through them before proceeding to the next step.
  - a. How do you minimize external inputs?
  - b. How do you recycle internal resources and minimize losses and waste?
  - c. What does contextualized farming mean?
  - d. How do you make the food system resilient?
  - e. What is your idea of multifunctionality?
  - f. What does complexity and integration of a food system mean?

- g. What does an equitable food system mean?
- h. What do we mean by a nourishing food system?
- 6. Read aloud the first question (How do you minimize external inputs?), and ask 2-3 volunteers for their ideas or to give examples on how the concept can be put to use. Write down their responses on the space under column 2 of Table 12.2. Then post up the corresponding agroecological principle written on A4 paper beside the chart paper to summarize or supplement the participants' answers. Repeat this procedure until all the other questions are likewise answered.
  - a. use of local resources which enhance the environment; use of energy, human skills, capacities (internal inputs) in a food system that is in accordance with the natural and social environment
  - b. use and re-use of farm and household resources, byproducts, and wastes (e.g., food, water, and organic matter) in all the different levels of a food system, including minimizing losses of genetic resources
  - c. farming and food systems are developed in each context with and by the actors, who carry and constantly cocreate relevant knowledge
  - d. adaptive capacity, health and immunity in the food system at all levels (e.g., social and environmental; individuals and populations) in terms of ability to absorb shocks and disturbances over seasons and in times of change and challenges; this involves feedback loops of production and need for diverse food over seasons; diversification of enterprise and diverse genetic resources can enhance resilience
  - e. ability and capacity of the system to carry out multiple functions, often involving multiple actors and giving many different roles to each system element, as well as to the links between them
  - f. enhancing interaction and synergies in socioecological systems; building on resource efficiency at all levels of the food systems to meet the challenges of seasonality, storage, and production at scale



- g. emphasizing multi-actor involvement, the necessity of judicious use of human and other resources and mutuality within the system; valuing different capacities and knowledge types and no exploitation, as well as acting in ways that foster, nourish, and allow future generations to develop and prosper
- h. use of benign inputs and resources which nourish the soil, organisms, the environment, and ecosystems at all levels; supporting healthy diets in resource-efficient food systems, and understanding health as resilience
- 7. Drawthe participants' attention to the third column of the table and ask them based on their personal assessment about their individual capacity to apply each of the agroecological principles. Have a marker ready for this simple activity.
  - Ask them to raise their hands if they think they can confidently apply the principle of minimizing external inputs. Make a count of hands and note the number beside the happy face.
  - Do the same for those who have concerns about or feel unable to apply the principle; similarly note their number beside the sad face.
  - Repeat the above steps until done with the last principle.
- 8. Take a minute to look over the table together with the participants. Then ask for 2-3 volunteers to give their observations about the number of ① and ② faces and for their opinion or conclusion about the activity. Provide your own comments to supplement their observations.
- 9. Form 4 buzz groups to discuss the specific support they need to be able to apply the different agroecological principles (column 4 of the table). Assign 2 topics/principles at random for each group to tackle. Provide a chart paper and marking pen for each group to write their outputs. Give 10 minutes for the quick discussion, and 2 minutes per group for reporting. Note these down for possible follow up action. Supplement their ideas as needed.

10. Ask for 3-5 volunteers to explain important lessons they have learned from the session or what activities they found to be useful. Then provide a recap of the key concepts or ideas covered in the session.



### Exercise 12.3 Developing climate resiliency

At the end of the exercise, the participants shall be able to:

- describe how the climate has changed over three generations
- discuss how farming families have adapted to the changing agricultural environment
- explain the importance of developing climate resiliency



Time: 1.5 - 2 hours



Materials/Preparation: village map drawn on chart paper (step 2), chart paper (about 5 sheets), markers, masking tape, list of questions and topics for the

resource persons (step 3)

Days prior to the session, discuss with the village leaders and identify with them three farmers representing three generations/age groups, all of whom were born and have lived in or near the village from birth. The farmers could be in the age ranges of 35 years and below, 36-55 years, and 56 years-upward. The selected farmers will serve as resource persons for the training session. They will be provided in advance with the set of questions and topics that they will be asked to discuss. With their assistance, also prepare a village map on chart paper. Indicate in the map the location of houses and farms, grazing grounds, streams, hills, ponds, and other key landmarks of the village. As the day of the session draws near, follow up with the resource persons to confirm their attendance.

#### Steps:

- Start by stating that there is evidence to show that the climate has been changing for a very long time due to natural processes. However, the process has been accelerated and the impacts have become more frequent and severe in recent years as a result of human activities. Explain that the exercise seeks to discuss how the climate has changed over three generations and how farming families have adapted to the resultant changing agricultural environment over time. Additionally, the exercise seeks to discuss the importance of developing climate resiliency.
- 2. Put up the village map in front of the room where it is clearly visible to all the participants.
- 3. Let the resource persons sit in front of the room where everyone can see them. Facilitate discussions by asking them the following questions:
  - Where (in the map) are their homes and farms located?
  - Can you describe the water resources (e.g. streams or rivers, ponds, etc.) along with the grasslands, forests, or wooded areas in the village from 30 years ago, 20 years ago, 10 years ago? Are there areas in the village that were used differently over the years? What are the reasons, if any, for changes in their use?
  - What extreme weather events have affected the community in the past 10 years?
  - Have the incidents increased in frequency or become more severe?
  - What specific weather or climate-related threats to production have you experienced? Are the threats more severe, or occur more or most often in particular locations or types of fields?
  - What have you done to address the climate-related production problems your family has encountered? Name some resilient species and remedial practices used by farmers in your area to address these problems?
  - What would have happened if you continued doing (i.e., did not change or modify) what you were doing 30, 20, or 10 years ago?

Allow 10-15 minutes for entertaining comments or questions from the participants. Then add that climate change and variability, in combination with non-climate drivers such as land degradation, forest encroachment, and/or deforestation have altered ecosystem functions and agroecological systems.

Climate change and variability have likewise caused sea level rise or variation in the water regime, shifts in seasons, and increased the frequency and magnitude or severity of extreme weather events. Such changes have resulted in decline of agricultural productivity, species migration or displacement of ecosystems, worsening of the population's nutritional and health conditions, etc.

If farming communities do not do anything to address the problems brought about by climate change and variability, the resulting low production and productivity will greatly affect food availability.

- 5. Conclude the session by emphasizing the following:
  - Risks created by weather variability and extremes are addressed by ecological design and management of agroecosystems. (Cite examples that the resource persons have mentioned in the previous step.)
  - Agroecological practices emphasize the creation or development of production systems that are well adapted to the local landscape and climate.
  - Diversification and integration practices build soil health and spread risks throughout the growing season, reducing potential losses from any single extreme weather event. It also enhances ecosystem services that buffer production losses from weather-related disturbances.

Add other salient points that were covered in the session as needed.

#### **About the Publishers**



The Southeast Asia Regional Initiatives for Community Empowerment (SEARICE) is a regional non-government organization that promotes sustainable and resilient food systems through ecological agriculture with emphasis on the conservation and development of agricultural biodiversity; and advocates for policies that support, strengthen, and institutionalize community initiatives on sustainable and resilient food systems. It works in partnership with farming communities, local and national government units, civil society organizations, and academic and research institutions in Southeast Asia.

SEARICE is registered with the Philippines' Securities and Exchange Commission (SEC) as a non-stock and non-profit organization.

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SwedBio is a development programme that works to advance sustainable and equitable governance of biodiversity knowledge and policy. It is a knowledge interface at Stockholm Resilience Centre contributing to poverty alleviation, equity, sustainable livelihoods and social-ecological systems rich in biodiversity. SwedBio enables knowledge generation, dialogue and exchange between practitioners, policy makers and scientists for development and implementation of policies and methods at multiple scales.

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