GENDER TRANSFORMATIVE AGROECOLOGY

Training Module for **Farmland** Ecosystem in Kenya

JUNE 2025

ACKNOWLEDGEMENTS

The development of this training module was commissioned by GROOTS Kenya under the Rural Women Cultivating Change (RWCC) project, implemented in collaboration with Seed Change, HIVOS, and Seed Savers Network with financial support from Global Affairs Canada. The process of developing this resource was shaped by the dedication, expertise, and collaboration of a diverse team of technical professionals, grassroots leaders, and community members.

First, we wish to acknowledge the invaluable contribution of the grassroots women champions from Laikipia and Kitui counties, whose involvement was central to the consultative and participatory nature of the module. From the outset, these women leaders were deeply engaged in every phase, from organizing and participating in field visits to collecting community-level data that informed the content, to validating the draft versions and offering rich, contextual feedback. Their leadership ensured the module was responsive to real grassroots needs. We are grateful to the many farmers, women leaders, and community members who generously contributed their time, knowledge, and lived experiences during focus group discussions and training needs assessments. Their perspectives brought life to the module and ensured that it remained grounded in local realities and aspirations.

Second, we acknowledge the support of the Ward Agricultural Extension Officers who facilitated key aspects of the process, including data collection, community mobilization, and piloting of the draft modules. In Kitui County, we acknowledge support from Zombe Mwitika, Voo Kyamatu, Ikanga Kyatune, Ikutha, and Kivou Wards, and Igwamiti, Marmanet, Mugogodo West, Segera, and Nanyuki Wards in Laikipia County. Their collaboration bridged institutional knowledge with grassroots insights, enhancing the credibility and usability of the training content.

Third, we wish to acknowledge the invaluable contribution of a core team of experts and gender specialists whose technical input and passion were instrumental in bringing this module to life. Dr. Josiah Mwangi Ateka, Dr. Annah Indeche, and Dr. Forah Mokua Obebo provided critical academic guidance. They were supported by Ms. Mercyline Njeri and Ms. Ellyjoy Kithure Masila, a renowned Gender Equality and Social Inclusion expert, whose insights ensured that the module was inclusive and grounded in feminist practice.

Finally, we acknowledge the leadership and technical coordination from the GROOTS Kenya Secretariat . We are deeply grateful to Doris Munyingi, Dennis Njung'e, Eunice W. Mwangi, and Rachel Kagoiya, who played pivotal roles in facilitating research, validating content, and aligning the module with the needs of rural women. Their stewardship provided both strategic direction and practical support during each stage of development. We also take this opportunity to recognize Ms. Fridah Githuku, the former Executive Director of GROOTS Kenya, whose vision and foundational leadership laid the groundwork for this important work.

This training resource is a product of a collaborative effort, merging academic rigor, community knowledge, and the shared commitment to transforming agriculture through inclusive and gender-just systems. It stands as a testament to the power of participatory development and the unwavering leadership of rural women in shaping their futures.

ABBREVIATIONS AND ACRONYMS

FAO	Food and Agriculture Organization of the United Nations
GBV	Gender Based Violence
HPLE	High-Level Panel of Experts
GROOTS	Grassroots Organizations Operating Together in Sisterhood (GROOTS) - Kenya
KEPHIS	Kenya Plant Health Inspectorate Service
RWCC	Rural Women Cultivating Change
SWOT	Strengths Weaknesses Opportunities and Threats
VAWG	Violence against women and Girls
SDG	Sustainable Development Goals

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1.0 INTRODUCTION

1.1 Background

The current food and farming systems require a fundamental transformation in response to the serious environmental, health, and socio-economic challenges. The food provisioning challenges, which span the entire food system, right from production to consumption, are likely to remain a significant barrier to sustainable food systems, if they are unaddressed. These challenges are made worse by issues of land degradation and climate hazards, which result from the high-input, resource-intensive production systems which have caused soil depletion and high levels of greenhouse gas emissions (Republic of Kenya, 2017). There are vast areas in Kenya with agricultural potential, but crop and livestock production is constrained by unreliable weather and limited water resources. Agroecology is therefore seen as a pathway to addressing the challenges of climate change and conservation issues while ensuring the sustainability of productive agricultural systems.

Agroecology is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. Agroecological approaches use natural processes to optimize the interactions between plants, animals, humans and the environment while taking into consideration local and scientific knowledge and the social aspects that advocate for a sustainable and fair food system. Moreover, agroecology as a pathway to achieving the Sustainable Development in line with The Constitution of Kenya (2010) which recognizes grants the right to adequate food and a clean and healthy environment to all citizens (Article 42 and 43).

> ***Agroecology*** *is one of the internationally recognized approaches for addressing many of the challenges facing food systems in a manner that is eco-friendly, resilient, and just. Agroecological approaches favor the use of natural processes, improving the use of inputs available at the farm level, promoting circularity (such as recycling) with minimal negative impacts on the environment, and addresses social inequalities. The approach puts emphasis on participatory process, combining local and scientific knowledge and focusses on the interactions between plants, animals, humans and the environment.*

In order for agroecology to achieve its aims of social and ecological wellbeing, women and other historically marginalized stakeholders must be empowered to play a leading role in the change . The importance of gender and social considerations is not limited to patently social aspects of the agroecological agenda, but bears relevance in every dimension of agroecology. Yet, issues related to gender have commanded relatively little attention in the agroecological literature. This training module has described principles of agroecology through a feminist lens to demonstrate the ways in which human dimensions and power dynamics are interrelated in every principle. Through this analysis, we demonstrate that a feminist approach is instrumental to establish a gender transformative agroecology for farmland ecosystem in Kenya.

This training manual has been developed to build smallholder farmers' capacity to respond to some of the constraints. The preparation of the manual was commissioned by GROOTS Kenya and HIVOS in collaboration with Seed Savers Network. The project intends to equip smallholder farmers with the capacity to be resilient to climatic change for improved livelihoods. It intends to equip farmers under the RWCC project with knowledge to transform and promote livelihoods through agriculture and other natural resource related fields.

1.2 Learning outcomes and objective

Smallholder farmers, especially women, face different challenges which include environmental degradation, climate change and food insecurity as well as the triple burden of malnutrition. Other include;

- Low productivity – associated with poor soil health, poor agricultural practices, deteriorating ecological status of the environment and climate change, among others.
- Loss of biodiversity loss.
- Limited access to and ownership of productive resources,
- Unpaid care work,
- Increased incidences of pests and diseases,
- Shortage of water for domestic and agricultural use
- Limited access to input and output markets.

The purpose of this module is to build the capacity of farmers (women, men and youth) and other food system stakeholders to respond to their current and emerging challenges in the context of climate change whilst addressing gender-released issues to enhance access to productive resources, declining crop productivity and high levels of food insecurity and malnutrition.

1.3 Who is this module for?

The module will be used by agroecology champions under the RWCC project and, government extension staff to engage farmers and communities to transform and promote livelihoods through agriculture and other natural resource-related activities. The materials can be also used outside the project by interested stakeholders.

The module was developed to serve as a tool for effective farmer trainings in agroecology and has been compiled in an easy-to-use format for trainers (TOTs) and farmers who intend to apply the agroecology principles and practices in their farms.

The manual is designed to be flexible so that facilitators can tailor the delivery through simulations with colleagues but also enriching it with their own experiences to make it more applicable to meet the needs of different groups or organizations. It also contains clear training guidelines on how to facilitate the various sessions.

1.4 Training approach and methodology

The delivery of the training materials will employ a participatory and adult learner-centred approach. The module facilitators should create a learning environment where the participants' beliefs, skills, and knowledge are respected. The participants and facilitators should work together to generate collective understanding on issues, problems, solutions and opportunities. Each session has a series of facilitator-led inputs, and participant-led tasks and outputs. The design and implementation will take the following approach:

- Participants will be accorded the opportunity to engage with the material at a practical level and transfer what they have learnt to their own farms, enterprises or households.
- Participatory group activities and discussions will support the development of critical thinking, open mindedness, activism and social mobilization.
- Lecture-based teaching is avoided and the number of power-point presentations is minimal.

Instead, facilitators should use visual aids, group activities and demonstrations that are easily understandable and applicable in real-world settings of the participants.
- Reference materials and handouts for each session that recap the main messages for participants' easy reference should be provided.

The users of the manual (trainers) will find group activities in the manual that will help them to allow for interactive training sessions with the participants. The trainers will put in place reasonable accommodations during implementation to ensure full engagement of all participants, regardless of their individual circumstances. Some key accommodations might include:

- **Language and communication Needs:** Providing translation or interpretation services for farmers who speak different languages or dialects.
- **Physical accessibility:** Ensuring the venue is accessible to people with disabilities (e.g., ramps for wheelchairs, accessible toilets).
- **Organizing transportation** if the venue is far from participants' homes
- **Cultural sensitivity** by tailoring training content to reflect local customs, beliefs, and agricultural and livestock practices.
- Providing **gender-sensitive** accommodation (e.g., separate spaces or times for women if cultural norms require it)
- **Flexible scheduling** of sessions to minimise interruptions of the farmers' routines.

By considering these accommodations, participatory training can become more inclusive, ensuring that all participants have the opportunity to benefit regardless of their personal circumstances.

1.5 Materials and equipment

The equipment and resource needs will depend on the context (how the manual is implemented) and scope of the training programme. The following resource materials and learning aids could be provided:

- Audio visual equipment – such as a laptop and projector
- Field plots for demos and excursions
- A board or a wall where the works and training works will be pinned during training
- Flip chart stands sufficient to the number of possible groups
- A digital camera – for taking pictures and short videos
- Paper; Small pieces of blank paper/cards, note pads, post it notes,
- Tapes: Sticky tape, blu-tack, sticky stuff or masking tape
- Marker pens, and pens
- scissors, worksheets / handouts / exercises, as set on the programme

1.6 Organization of the agroecology module for farmland ecosystems

This training manual consists of nine (9) modules organised in 24 sessions. It envisaged that these meetings are bi-monthly (every two weeks). The module covers topics prioritised through a training needs assessment among women smallholder farmers in the target counties.

Training Module for farmland landscape

S/No	Module	Session	
1	Key concepts and agroecological transition	1	Introduction to agroecology
2	Women's leadership and male involvement	2	Agency in Food Systems
		3	Gender Transformative Leadership and Communication
		4	Participation and Governance
3	Water Management and Conservation	5	Water harvesting practices
		6	Water testing and treatment
		7	Water management and conservation
4	Soil health and fertility management	8	Soil fertility management
		9	Integrated nutrient management
		10	Production and use of organic inputs
5	Seed diversity and security	11	Seed diversity
		12	Seed security
6	Integrated crop farming	13	Agroecological Cropping systems
		14	Integrated Farming systems
		15	Natural Pest and Disease Management
		16	Production and Use of biocontrol/biopesticides
		17	Post-harvest activities and value addition
7	Farmer field experimentation	18	On farm experimentation and participatory field trials
8	Nature positive practices	19	Agroforestry
		20	Enterprise Diversity
		21	Growing Indigenous Fruits in farmlands for Women empowerment
9	Markets	22	Understanding marketing and markets for agroecology products
		23	Creating strategic markets for agroecology products and inputs
		24	Planning and developing viable agroecology enterprises

Each module will be delivered in structured sessions (2-5) covering an outline of the learning objectives and outcomes, the delivery plan (logic of design and flow of session), and the reference materials.

1.7 Preparing for the training

The effective delivery of the training requires good planning. Facilitators may use the following tips during their preparation

- Identify the expectations of the learners before starting the training and identify specific training needs of the participants. Here, the facilitator will ask the participants to explain their expectations from the training. The facilitator should write down the key points on a flip chart or white board in order to revisit the same at the end of the training (whether the training has met those expectations).
- Identify and source the training materials and resources to be used before the start of sessions.
- Prepare to use diverse and suitable training delivery methods, e.g., group activities, fun-facts, games, and icebreakers. Some of the group activities are set out in the respective modules.
- Be conversant about potential gender and cultural perceptions that may impact the training.

- The trainer and participants can develop ground rules to guide the sessions. This may include: asking the participants what general behaviour he or she expects to experience (e.g., switching off the mobile during training; coming to the training on time; leaving the training before completion; non-involvement on side discussions during the training delivery, etc.). In order to run the training smoothly and effectively, the trainer will list all suggestions on a flip chart and post the stationary where they are easily visible throughout the training.

1.8 Obtaining feedback during training and evaluation

It is also encouraged that facilitators conduct a pre- and post-evaluation of the training. The pre-evaluation assessment is conducted at the beginning of the training to the learners` prior knowledge, skills, and understanding of the subject matter. The post-evaluation is conducted at the end of the training session to assess the effectiveness of the training, gauge participants' learning outcomes, and gather feedback for improvement. Apart from the pre and post training evaluations, the facilitators are encouraged to create an interactive feedback loop during training to capture real-time input from participants. This allows for immediate adjustments, ensuring the training remains responsive to learners' needs and can be continuously improved throughout the session. By carefully designing both evaluations, facilitators can identify areas of success and opportunities for improvement, ultimately enhancing the quality of future training sessions.

Agroecology training, Nairobi

MODULE 1: KEY CONCEPTS AND AGROECOLOGICAL TRANSITION

The current food and farming systems require a fundamental transformation in response to the escalating environmental, health, and socio-economic challenges. The food provisioning challenges, which span the entire food system, right from production to consumption include; low productivity, limited access to and ownership of productive resources, unpaid care work, increased incidences of pests and diseases, shortage of water for domestic and agricultural use and, limited access to input and output markets.

Agroecology is one of the approaches that has gained significant recognition as one of pathways for addressing the food systems challenges in a holistic manner.

> *Agroecological approaches favor the use of natural processes, improving the use of inputs available at the farm level, promoting circularity (such as recycling) with minimal negative impacts on the environment, and addresses social inequalities. The approach puts emphasis on participatory process, combining local and scientific knowledge and focusses on the interactions between plants, animals, humans and the environment.*

The module is designed to introduce participants to key concepts in the agroecological transition. By embracing agroecology, farmers can not only contribute to environmental sustainability but also enhance the social and economic well-being of rural communities, paving the way for a more just and resilient food system.

Agroecology is a pathway to achieving the Sustainable Development in line with The Constitution of Kenya (2010) which recognizes grants the right to adequate food and a clean and healthy environment to all citizens (Article 42 and 43).

SESSION 1: INTRODUCTION TO AGROECOLOGY

CONTEXT

This session aims at enhancing the understanding of the farmers on agroecology: agroecology principles, feminist agroecology principles and its application in the farming and livelihood activities.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session, participants will recognize the importance of adopting the agroecological approach as a pathway for improving;

- Farming practices and crop and livestock productivity
- Livelihoods and sustainability of incomes
- Conserving and protecting the environment
- Adaptive capacity and resilience to climate change

Key terms: Agroecology, food systems, feminism and food system transformation

Training materials and resources: Stationery, model farm visits, demonstrations, and visual materials (pictures and videos)

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting

Activity	Description	Resources
1	Welcome the participants to the training and briefly highlight the objectives of the training/session. Then ask prompting questions to enable the facilitator engage farmers in identifying the obstacles they face in their agri-food systems. ▪ What are some of challenges you face in your farming practices today? ▪ What difficulties do farmers in your area encounter when it comes to accessing quality seeds, fertilizers, or other inputs ▪ Describe the key shifts in consumer dietary preferences and probe how the trends vary by gender, age, wealth categories, religion etc ▪ Identify how shifts in diets or food habits are influencing their agricultural practices and health of the community members The responses to the questions, will help the facilitator explain why transformation of the food system is important for socioeconomic development at the local and national economy. Agroecology presents an opportunity to address many of the food system challenges (Refer to the reference materials).	15 minutes
2	**Introduction to Agroecology** The activity can begin by playing a short video to help participants recognize the role of agroecology in addressing most of the food systems challenges. The video will help participants understand how agroecology can address the various challenges in food systems **(e.g., climate change, soil degradation, food insecurity, and biodiversity loss).** https://www.youtube.com/watch?v=vqbA3EW5sLQ The facilitator can play a short, engaging video (e.g., 5-10 minutes) that highlights: ▪ The key principles of agroecology (e.g., biodiversity, soil health, water conservation). ▪ How agroecology helps create sustainable and resilient food systems. ▪ Success stories or real-world examples where agroecology has improved food security or farmer livelihoods. **Video Resources**: Many organizations in the agroecology space, such as FAO have free resources or videos that can be used for this purpose. After the video, the facilitator should allow the viewers to share their thoughts about the video before explaining it. The facilitator can then provide a brief explanation of the main points covered in the video, helping participants connect the concepts to their own experiences. **Agroecology's Role**: Explain how agroecology offers a holistic approach to food systems that focuses on sustainability, resilience, and equity. Emphasize its potential to address these challenges by fostering local, diverse, and adaptive farming systems.	25 minutes

<table>
<tr><th>Activity</th><th>Description</th><th>Resources</th></tr>
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Agroecology principles

Organize the participants into groups, and ask them participate in World Café Activity. The World Café is a structured conversation method that fosters collaborative dialogue and creative thinking among participants, typically in a group or community setting. It encourages the exchange of ideas on a specific topic or question in a relaxed, café-style environment.

The World Café is a structured conversation method that fosters collaborative dialogue and creative thinking among participants, typically in a group or community setting. It encourages the exchange of ideas on a specific topic or question in a relaxed, café-style environment.

- An example of how to set it up is outlined below. The activity is to encourage deep, collaborative discussions on key agroecology principles, where participants can reflect on how these principles are applicable to their own experiences and practices.
- **Preparation**: Arrange the space with about **5 tables** (the number will depend on the number of participants and the number of principles the facilitator may wish to focus on). Each table should have a flip chart with one principle clearly written at the top. Each table will have markers or coloured pens for participants to write and draw on the flip chart.
- The facilitator should introduce the activity and explain the purpose of the activity—to explore the principles of agroecology (**Diversity, synergies, resilience**) and feminist agroecology principles (**Gender equality, social justice, solidarity etc**)- reflecting on their relevance to participants' lives, and build on each other's ideas.
- **World Café Process**: the process may take the following format
  - Session 1: Groups start at their assigned table, discussing the first principle.
  - Prompt: "Do you see this principle showing up in your life or practice? In what ways?"

	Principle	Flip Chart Prompts
1	Diversity in Agroecology	How does diversity play a role in your farming practices
2	Resilience of Agroecological Systems	"In what ways have you seen resilience in your food systems?"
3	Gender Equality in Agroecology (Feminist Principles)	"What sustainable practices have you adopted, and how do they rely on local knowledge?"

  - Participants write down responses, questions, or insights on the flip chart.
  - **Rotation**: After 20 minutes, participants rotate to the next table. One person stays behind as the host.
  - **Session 2, 3, 4, etc.**: Groups continue the discussion for each subsequent principle, spending **10 minutes** at each table, and building on the notes or insights already

Because of the principles, are many the facilitator can utilise some documented **agroecology case studies.**

</td><td>35 minutes</td></tr>
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Activity	Description	Resources
	In this activity, the facilitator should organize the participants into groups ask the members to read a short case study that embodies some of the principles being explored in the training. Each group will be assigned the task of identifying different principles within the case. Afterward, each group will share their findings, explaining where the principles appeared in the story. Other groups will have the opportunity to add to the discussion, point out any overlooked elements, or respectfully challenge any points they believe were misunderstood. Facilitators will create space for debate and personal opinions before stepping in to clarify any points at the end if necessary. This approach encourages deeper engagement with the material and helps participants internalize the principles, as stories are easier to remember than lists. By analysing the case together, participants will not only learn the principles but also gain a practical understanding of how they apply in real-world scenarios After the presentation, the facilitator can provide an overview summarizing the principles asking the participants to refer to the handouts for additional information.	
4	**Understanding feminism** To demonstrate the meaning of feminism the facilitator can lead a role play activity designed to help participants reflect on traditional gender roles within their communities. The activity should help participants examine and challenge traditional gender roles and expectations in their society. By having them step into the shoes of the opposite gender and engage in **role-play**, it encourages a deeper understanding of the dynamics that shape societal expectations. Here's how the session could be structured: ▪ **D**ivide Participants into Two Groups (A and B) ▪ **Group A:** Takes on the traditional roles typically associated with men (e.g., farming, working outside the home, making financial decisions). ▪ **Group B**: Takes on the traditional roles usually associated with women (e.g., caregiving, household chores, looking after children). ▪ Encourage each group to act out their assigned roles as realistically as possible, using the space and resources available. Remind participants to not laugh or make fun of others as they participate in the role play. The purpose is to think critically about these roles, not to trivialize them. ▪ After the first round, swap the roles so that Group A now performs traditionally female roles, and Group B performs traditionally male roles. ▪ Debrief discussion: After each role-play, engage the entire group in a guided discussion based on the following questions: ▪ What do you think about this situation? This question prompts participants to think critically about the roles they are acting out. What do they find surprising or challenging? Do they notice anything that feels unfair or unbalanced? ▪ How did you feel when you were watching the role play, and why? This helps participants become more aware of their emotional responses to the roles. Did they feel uncomfortable, proud, or perhaps frustrated by certain aspects? This question encourages empathy and emotional reflection. ▪ What do our feelings show about how we see the roles of men and women in society? This question allows participants to explore how their emotions are shaped by cultural norm	20 minutes

Activity	Description	Resources
	▪ If the role play were the other way around, would you have felt differently? This is an opportunity to challenge participants' assumptions. Would they have felt more or less comfortable if the roles were reversed? This question helps people understand how gender roles can shape behavior and expectations differently depending on societal conditioning. After the role play, the facilitator should; provide a clear explanation of the activity's purpose: to encourage reflection on gender equality and the impact of traditional roles. He/she should emphasize the importance of creating a safe and respectful environment during the activity and draw the attention of the participants to the definitions in the reference section.	
5	**Feminist agroecology principles** The facilitator to lead the discussion on feminist agroecology principles. This should involve the use of the case studies and the World Café process as highlighted in step 4 above to enable them connect the principles with their real live situation or experiences.	15 minutes
6	**Wrap up** Question and answer session to address the questions. This activity should allow wrap up, to address any lingering questions, and any key takeaways from the session.	10 minutes

REFERENCE MATERIAL FOR INTRODUCTION TO AGROECOLOGY

Feminism: Feminism refers to a broad movement and lens which seeks to examine and uproot the underlying causes of inequality and disempowerment—not just for women but for all marginalized people—by challenging patriarchal and colonial power structures. A feminist agroecology which values the equitable contributions of all stakeholders leads to a more creative, versa tile, and successfully transformative movement.

Agroecology: Agroecology is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. Agroecological approaches use natural processes to optimize the interactions between plants, animals, humans and the environment while taking into consideration local and scientific knowledge and the social aspects that advocate for a sustainable and fair food system.

Why is Agroecology Important?

Kenya's food production system—including agriculture, livestock, forestry, and fishing, is characterized by low and declining productivity associated with;

- Poor soil health,
- Poor agricultural practices,
- Impacts of climate change on food systems
- Deteriorating ecological status of the environment and climate change.
- A trend towards monoculture which reduces agricultural biodiversity.
- Reliance on external inputs, which increases the vulnerability of farmers while also reducing returns from their farming practices.
- Improper and increased use of pesticides and other agro-chemicals which increases residual levels that are harmful to humans.
- While markets for conventional inputs like hybrid seed, fertilizer and pesticides are well developed, those for organic and biological inputs are still nascent

Moving towards greater use of organic inputs has been found to enhance and preserve the environment. Beyond production, agricultural and food markets are characterized by;

- Poor aggregation arrangements and inefficient distribution systems.
- Inefficient supply chains,
- limited access and availability of traditional foods due to cultural shifts and change focus in favor of production for the market
- Shifts in consumption preferences in favor of foods that are considered unhealthy
- Discriminatory social norms and economic barriers for marginalized groups.

Why the Food System?

A food system gathers all the elements (environment, people, inputs, processes, infrastructure, policies, laws and institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes (HPLE, 2017) (Figure 1.1).

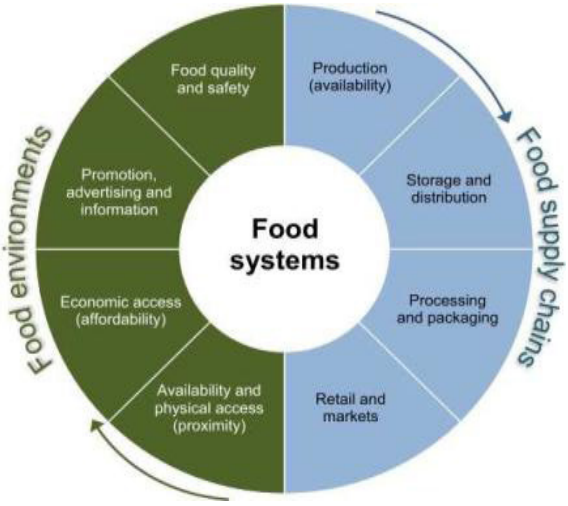


Figure 1.1: Simplified diagram for the food system

Figure 1.2: Pillars of a sustainable food system

(Source: HPLE, 2017)

When food systems are sustainable, they play a vital role in nourishing humanity, supporting well-being, and sustaining livelihoods. However, they face many challenges across its components including production, distribution, consumption of food, and food waste and recovery.

Agroecology presents an opportunity to address many of the challenges facing our **food system** in a manner that is eco-friendly, resilient, and just. Agroecological approaches favor the use of natural processes, improving the use of inputs available at the farm level, and promoting closed cycles with minimal negative externalities. Agroecology is inspired, by 13 agroecological principles which are organized around the three pillars of sustainable food system as shown in Figure 1.2.

The 13 principles of agroecology are presented in Table 1.1. sustaining livelihoods. However, they face many challenges across its components including production, distribution. The 13 principles of agroecology were developed by the Food and Agriculture Organization (FAO) of the United Nations, based on a combination of scientific research, fieldwork, and the contributions of various experts in the field of agroecology.

The 13 principles aim to guide farmers, policymakers, and practitioners in applying agroecological approaches to food systems and farming. They focus on the ecological, social, and economic aspects of agriculture and emphasize the need for a holistic approach to food production, processing, distribution and consumption as well as waste management.

Table 1.1: Agroecology Principles

Improve resource efficiency	Strengthen resilience	Secure social equity/responsibility
1. Recycling Preferentially use local renewable resources and close, as far as possible, resource cycles of nutrients and biomass.	**6. Synergy** Enhance positive ecological interaction, synergy, integration, and complementarity among the element of agroecosystems (plants, animals, tree, soil, water)	**10. Fairness** Support dignified and robust livelihoods for all the actors engaged in food systems, especially small-scale food producers, based on fair trade, fair employment, and fair treatment of intellectual.
2. Input reduction Reduce or eliminate dependency on external inputs	**7. Economic diversification** Diversify on farm incomes by ensuring small scale farmers have greater financial independence and value addition opportunities while enabling them to respond to demand from consumers.	**11. Connectivity** Ensure proximity and confidence between producers and consumers through promotion of fair and short distribution networks and by re-embedding food systems into local economies.
3. Soil health Secure and enhance soil health and functioning for improved plant growth, particularly by managing organic matter and by enhancing soil	**8. Co-creation of knowledge** Enhance co-creation and horizontal sharing of knowledge, including local and scientific innovation, especially through farmer-to-farmer exchange.	**12. Land and resource governance** Recognize and support the needs and interests of family farmers, smallholders, and peasant food producers as sustainable managers and guardians of natural and genetic resources.
4. Animal health Ensure animal health and welfare	**9. Social values and diets** Build food systems based on the culture, identity, tradition, social and gender equity of local communities that provide healthy, diversified, seasonally, and culturally appropriate diets.	**13. Participation** Encourage social organization and greater participation in decision-making by food producers and consumers to support decentralized governance and local adaptive management of agricultural and food systems.
5. Biodiversity Maintain and enhance diversity of species, functional diversity and genetic resources and maintain biodiversity in the agroecosystem over time and space at field, farm and land scape scales		

Source: HPLE, 2019

Feminist Agroecology Principles

Despite the agroecology movement's emphasis on social equity in agriculture, issues related to gender and other intersectional inequalities have not received adequate attention. A feminist agroecology focuses on redressing unequal gender relations as well as other intersecting relations of marginalization such as race, class, caste, disability and ethnic identity.

Gender equality is central to transformation. A feminist agroecology which values the equitable contributions of all stakeholders leads to a more creative, versa tile, and successfully transformative movement. As Lopes and Jomalinis (p. 17) observe, women's disempowerment directly hinders agroecological imperatives, as "male dominance commonly manifests itself as an impediment to the advancement of agroecology transition by hindering women's free expression, their creative development and, finally, restricting their contribution to the productive unit".

As the HLPE (2019) principles demonstrate, agroecology is not only about lowering agrichemical inputs and increasing sustainability; it is about self-determination and reclaiming control of one's own food, land, and body—a right that has been stripped from the majority of producers by a productionist and profit-driven industrial agricultural paradigm. As agroecology inherently encompasses a normative commitment to redressing unequal power dynamics in the food system, agroecological approaches cannot be discussed without addressing the power imbalances based on gender and other axes of marginalization that embed food systems and their actors and stakeholders (Seibert, 2019). Agroecology that lives up to its name centers food sovereignty as well as the more mainstream goal of food security, taking social relations based on gender, socioeconomic status, Indigenous identities, and their intersections into account.

Rather than flattening women's experience in food systems as one of unilateral victimhood and exploitation, or positioning women as environmental saviours, an intersectional analysis recognizes that their experiences are complex, dynamic, heterogenous, and shifting feminist agroecology which values the equitable contributions of all genders leads to a more creative, versatile, and transformative movement (Zaremba et al., 2022). As part of supporting feminist agroecology, RWCC has established some feminist agroecology principles (Table 1.2);

Table 1.2: Feminist agroecology principles

	Principle	Description
1	Valuing women's knowledge, skills, and innovation	▪ Recognize and value women's knowledge, skills, practices, and priorities in the production, utilization, and marketing of food, and support their research and innovation in agroecology practices
2	Facilitating an enabling environment for gender equity	▪ Focus on the structural changes (legal frameworks, government structures, organizational aspects of institutions) needed. It's policy, interventions, but also how these interventions are designed/developed (the role of women, and specifically connected to agroecology), and recognizing the role of women in programming - development programs and policy processes. ▪ Lead to gender transformative outcomes, such as the increased role of women in decision making and changes in the way men recognize and take on reproductive work.
3	Supporting women's leadership and movement building	▪ Support women's organizing, leadership, advocacy and grassroots movement building for agroecology.

	Principle	Description
4	Securing access and control over resources and services	▪ Secure access to and control over productive resources and services for women farmers bringing necessary structural and policy changes.
5	Supporting the right to embrace agroecology	▪ Women farmers have the right to embrace agroecological production systems and practices that: ▪ Address their needs within the household and community, ▪ Reflect their cultural heritage and traditions, ▪ Challenge the inequities and negative impacts of the conventional agricultural research and development model, and contribute to socio-ecological resilience

Source: RWCC

Taking a feminist approach to agroecological transformation also means understanding and addressing the myriad ways in which gender intersects with, influences, and is impacted by all aspects of food systems, as power relations underpin food systems in their entirety, not just their patently social dimensions.

MODULE 2: WOMEN LEADERSHIP AND MALE INVOLVEMENT

This module has three (3) sessions; 1) Gender Social Norms and Agency of Women in Food Systems, 2) Gender Transformative Leadership and communication, and 3) Participation of women in governance of food systems. It is intended to assist participants to overcome the numerous challenges and impediments that they may face in leadership and decision-making positions. The sessions provide guidelines and resource materials for designing effective leadership strategies through training, knowledge and experience sharing.

SESSION 2: GENDER ROLES AND SOCIAL NORMS IN FOOD SYSTEMS

CONTEXT

Gender Roles and Social Norms

Social and cultural norms shape and reinforce ways in which women and men can participate in, access, and benefit from opportunities i.e., norms can hinder women's ability to access or adopt new agricultural products. Women face social, cultural and institutional barriers to access and adopt agricultural technologies, information and services. Access to resources and empowerment can be linked to nutrition outcomes and children's educational outcomes. Women who own land have greater influence in household decision making regarding agricultural or productive decisions. Women's voices are critical in integrating their preferences into agricultural solutions, including technology design and implementation.

This training will focus on positive gender social norms to promote women's participation, leadership and decision making. The role of men in food systems; How the role differs from women; How can men and women work in harmony for improved food systems.

Women's Agency: Decision-making and Leadership

Positive nutrition, livelihood, well-being and resilience outcomes occur when women are more involved and have greater influence in household decision-making. Women's empowerment, including women's participation in community leadership, is associated with higher agricultural productivity; and women from more food-secure households are more likely to participate in community leadership roles. Women who own land have greater influence in household decision making regarding agricultural or productive decisions. Women's voices are critical in integrating their preferences into agricultural solutions, including technology design and implementation.

Strategies for empowering women economically to give women greater autonomy in securing livelihoods, including through self-employment, collective income-generating arrangements within households and communities, formal employment and entrepreneurship. Promoting the agency of women in agriculture, food production, and decision-making processes ensures equity in food systems. Economic empowerment and gender-based violence (GBV) are closely linked. Economically and market activity, have shown some of the best-evaluated outcomes in terms of reducing participating women 's future experience of violence. This session is designed to equip the participants with a better understanding of leadership, participation and governance of the agri-food systems for improved livelihoods.

LEARNING OBJECTIVES AND OUTCOMES

At the end of this session, participants should be able to:

(i) Explain women's gender positive social norms in food systems

(ii) Interpret the concept of time agency in agri-food systems

(iii) Analyze pathways through which decision-making and economic empowerment improves the food system and livelihoods.

Key Terms: Agency, Violence Against Women (VAW), equity, decision making, economic empowerment, gender-based violence, food systems

Training Materials/Resources: The training materials and requirements include; Stationary; Markers; Training manual/booklets

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the session;

Activity	Description	Duration
1	Welcome the participants, and share with them the objectives of the meeting. Make sure that all participants have their handbooks with them and share the objectives of the session.	10 minutes
2	Write the word 'Power' "agency", "decision-making", and "economic empowerment" on the flip chart, and ask the participants to state what they understand by these terms. Take note of the key words in their statements, and define the terms and allow them to give examples. After the discussions, explain the terms using examples and refer the participants to the handout for detailed information.	20 minutes
3	Ask the participants to differentiate between the following terms with examples ▪ Gender-based violence ▪ Violence against women (VAW) Ask the participants to create a short play to demonstrate their understanding of the two concepts.	20 minutes
4	Explain the Women Empowerment Assessment Index (WEAI) based on the five domains of empowerment and their indicators Ask the participants to state what would make someone to be termed as "empowered". Explain to the participants using examples.	40 minutes
5	Conclude the training and explain to the participants what they will be dealing with in the next session.	10 mins

REFERENCE MATERIAL FOR GENDER SOCIAL NORMS AND AGENCY OF WOMEN IN FOOD SYSTEMS

Violence Against Women and Girls (VAWG)

Violence against women and Girls (VAWG) is any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life - The UN Declaration on the Elimination of Violence against Women Proclaimed by General Assembly resolution 48/104 of 20 December 1993.

Gender-based violence and violence against women is a violation of human rights and a form of discrimination against women. This includes acts resulting in 'physical, sexual, psychological or economic harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life - The Istanbul Convention (Council of Europe, Convention on preventing and combating violence against women and **domestic violence**).

VAWG is the manifestation of the historically unequal power relations between men and women in private and public life. It is characterized by the use and abuse of power and control over women, and it is a form of discrimination that seriously violates and impairs the enjoyment by women and girls of all human rights and fundamental freedoms. VAW can happen in different contexts, including the family, the community and the State.

Gender Based Violence (GBV)

Gender-based violence is violence directed against a person because of their gender. Both women and men experience gender-based violence but the majority of victims are women and girls. Many forms of violence against women are rooted in power inequalities between women and men- The European Institute for Gender Equality-EIGE.

Types of Gender based violence

Information Sheet on types of GBV

Types of GBV can be categorized broadly:

- Physical violence,
- Psychological/ emotional violence,
- Sexual violence
- Economic violence.

Physical violence: -

Slapping, beating with or without an object, punching, kicking, bitting, pinching, Burning, threatening with a weapon, attempts to strangle or murder, locking a person in or preventing them from going out, and abandonment.

Psychological/Emotional violence: -

Verbal abuse, picking on children, abducting children, controlling outings and relationships, imposing specific behaviour, despising, undermining the value of a person, denigrating a person, bullying, keeping somebody in the background, refusing to speak, threatening with death, use of emotional blackmail, insulting, debasing.

Sexual violence

Denotes any act, attempt or assault of a sexual nature that affects the victim emotionally, physically or psychologically as a manifestation of unequal power relations between men and women, resulting in the domination of women by men. While sexual abuse manifests mostly against women, there are also cases of unwanted sexual activity against boys and men. The Sexual Offences Act No. 3 of 2006 (Rev. 2007) defines and describes sexual assault as any person who unlawfully penetrates the genital organs of another person.

- Rape and marital rape. Marital rape involves taking conjugal rights over spouse forcefully. Marital rape was removed from the Sexual Offenses Bill (2006)
- Child sexual abuse
- Defilement
- Incest
- Sodomy/anal rape
- Attempted rape or attempted forced sodomy/anal rape
- Forced prostitution (also referred to as sexual exploitation)
- Sexual harassment

As part of sexual violence, child sexual abuse includes:

- Actual or attempted penetrative sexual intercourse with a child
- Non-penetrative sexual activity
- Inappropriate touching of a child's sexual parts
- Oral sex with a child
- Displaying or exposing genitals to a child
- The exploitative use of a child in prostitution
- The use of a child in, or exposure of a child to, pornography
- Sexual relations with a child (any person under 18 years of age)
- Sexual violence as a weapon of war and torture

Economic violence

Economic violence refers to actions such as preventing someone from having access to resources, refusing to meet the fundamental needs (food, drink, clothing, shelter, etc.) of a family member (wife, child, father, mother, grandfather or grandmother) or of the whole family.

- Discrimination and/or denial of opportunities, services: Exclusion, denial of access to education, health assistance or remunerated employment; denial of property rights
- Social exclusion/ ostracism based on sexual orientation: Denial of access to services, social benefits or exercise and enjoyment of civil, social, economic, cultural and political rights, imposition of criminal penalties, discriminatory practices or physical and psychological harm and tolerance of discriminatory practices, public or private hostility to homosexuals, transsexuals or transvestites
- Obstructive legislative practice: Denial of access to exercise and enjoy civil, social, economic, cultural and political rights, mainly to women

Gender based violence

GBV involves not only direct force, but also threats, intimidation and coercion. Even the threat of violence can have a devastating impact on people's lives and the choices and decisions they make. It manifests in forms that include sexual harassment and abuse, physical violence, trafficking in women and children for prostitution, verbal abuse, restrictions in freedom of movement, withholding of funds,

female infanticide, incest, child prostitution, rape, partner violence, psychological abuse, **harmful traditional practices**: - such as

- forced marriage
- Female Genital Mutilation/Cutting (FGM/C),
- contraception imposed on women by constraints or force,
- forced sterilization or abortions,
- selective abortion of female fetuses,
- female infanticide,
- sex trade and prostitution,

Intimate partner violence (IPV) is the most common form of violence, because it involves people that are often together or meet often due to love or marriage relationships, hence such survivors of IPV tend not to report the violence and chose to suffer in silence for the sake of the family and children.

Possible Perpetrators of GBV

▪ husbands	▪ Extended family	▪ Boyfriends
▪ Fathers	▪ Police	▪ Boys
▪ Mothers	▪ Chiefs	

This list is not exhaustive as everyone is a potential perpetrator or survivor of GBV. No single group can exclusively be said to be a perpetrator group. Every member of a community has a responsibility in GBV prevention and response.

Special note

In times of conflict, the perpetrators may include military people, rebels, etc

Key Aspects of Agency in Food Systems:

1) **Decision-Making Power**

Decision making power is the ability to participate in decisions about what food to produce, how to produce it, and how resources and benefits are distributed within the food system. This involves the;

(i) Decision-making power over agricultural production;

(ii) Access to and decision-making power over productive resources; and

(iii) Control over use of income.

Ensuring people have the resources, knowledge, and infrastructure needed to make informed decisions, such as access to land, water, technology, education, and markets. The ownership, use, and accumulation of physical and human capital play a role in determining productive capacity. In turn, productive capacity affects food security directly when households consume from their own production.

Women have subordinate roles and are marginalized from autonomous decision-making and control of resources in most spaces. At the household level, men generally are considered the primary breadwinners and they wield in decision-making authority, set priorities, and determine the distribution of resources. In general, women are not able to make independent spending decisions and even sometimes have to get permission from their husbands to take their children or themselves to a health clinic for treatment. Despite women working to earn household income, they are perceived to be financially dependent on men who control the household spending decisions, preventing women from acting independently. Adolescent girls have the least power and rights within the household and society because of their young age and gender bias and are subject to unfair treatment as a result.

Although women's rate of leadership has improved over the past decade, barriers to entry in the political realm are significant. Women who do accede to elected and appointed office face limits on their ability to influence decisions and often are subject to harassment and gender-based political violence. Men still dominate public leadership roles and elected offices, despite efforts to legislate quotas and promote women's political leadership. Backlash and violence against women who seek public leadership roles demonstrate the challenges in breaking norms around women's roles.

There are prevalent normative expectations in various contexts about the allocation of time that men and women should have. Women are restricted by traditional gender roles to performing unpaid domestic and caregiving duties, while men are seen as the household providers. Time use, or how people use their time, is thought to be a significant indicator of inequality. Time use is considered an important metric of inequity. However, growing evidence suggests that time-use agency – the individual's confidence and ability to make strategic decisions and choose how they allocate their time – is equally salient.

2) **Economic Empowerment**

As a key source of rural income, empowerment in agriculture indirectly improves food security Gender, access to agricultural resources and food security in Kenya indirectly through the income as a result of increased productivity. Empowerment in agriculture also influences labour allocation (Kassie et al., 2020). Adoption of effective and more efficient ways of production as a result of empowerment is likely to lead to labor-saving where the freed labour could be engaged in off-farm and non-agricultural activities. This has the potential to further increase households' incomes and in turn expenditures on food items. Of particular interest is the role of women in agriculture and intra-household decision-making and resource allocation.

Women in majority of the societies play an essential role in selection, acquisition, preparation, and allocation of food among households, and are observed to have higher spending on food relative to men within households. This highlights the crucial importance of empowering women in agriculture, which in turn influences intra-household allocations of food and ultimately household's food security outcomes.

The WEAI is a composite comprehensive and standardized measurement tool that directly captures women's empowerment and inclusion levels in the agricultural sector (Malapit et al., 2014). Whereas the WEAI was initially developed to evaluate women's empowerment, it can be used more generally to measure women's and men's empowerment and assess the state of gender parity in agriculture (Alkire et al., 2013). WEAI assesses five domains of empowerment: (i) production; (ii) resources; (iii) income; (iv) leadership; and (v) time (Table 2.1):

Table 2.1: Indicators for Measuring Agricultural Decision-Making and Empowerment

Domain	Indicator	Definition of Indicator
Production	Input in productive decisions	Sole or joint input into making decisions about food crop farming, cash crop farming, livestock raising, and fish culture.
	Autonomy in production	Autonomy/ability to act on what one values in regard to agricultural production (e.g., inputs to buy, crops to grow, when to take produce to market). Reflects intrinsic decision motivation.
Resources	Ownership of assets	Sole or joint ownership of major agricultural assets (e.g., land, livestock, fishponds, machinery, equipment).
	Purchase, sale, or transfer of assets	Participation in decisions to buy, sell, or transfer household assets.
	Access to and decisions about credit	Access to and participation in decisions about agricultural credit.
Income	Control over use of income	Input into decisions about the income generated, conditional on participation in activities.
Leadership	Group membership	Active membership in economic/social groups (e.g., agricultural marketing, credit, water user groups).
	Speaking in public	Comfort in public speaking (e.g., participating in public decision-making about infrastructure like wells, roads).
Time	Workload	Allocation of time to productive and domestic tasks; less than or equal to 10.5 hours of combined work per day.
	Leisure	Satisfaction with time available for leisure activities.

Source: Adapted from Alkire et al. (2013) and Sraboni et al. (2014)

A man or woman is defined as **empowered** if he or she has adequate achievements in four of the five domains or has achieved 'adequacy' in 80 per cent or more of the weighted indicators (Alkire et al., 2013; Sraboni et al., 2014). However, adequacy can be explored over a range of achievements. For example, one might assess of individuals who have achieved adequacy in less than 40 per cent if this is considered to be the most disempowered group (Alkire et al., 2013).

Respecting and empowering diverse cultural food practices and traditions, ensuring that all groups—especially marginalized populations—can influence food systems according to their values. Autonomy in choosing diets, farming practices, or livelihoods without undue pressure or systemic barriers helps in shaping policies or influencing market conditions.

SESSION 3: GENDER TRANSFORMATIVE LEADERSHIP AND COMMUNICATION

CONTEXT

Women's leadership, like women's participation or women's power, does not need to signify men's loss of leadership, participation, or power. True leadership leads to greater choices for everyone.

Most of us live in communities that are hierarchically organized and command-oriented. The locus of command may be at home, community, work place, business, the political arena. The structure of command nurtures and is nurtured by a culture of obedience that at once sustains and camouflages a pecking order by producing a system of authority.

The role of authority is to legitimize command relations by creating consent. In the absence of authority, everyone in the command relationship becomes a potential aggressor. This cannot be the ideal relationship we seek. Rather, we look to a different kind of society where men and women turn to one another not as objects in social functions, where one commands and the other obeys, but as genuine communicating beings.

LEARNING OBJECTIVES AND OUTCOMES

By the end of this session, the participant should be able to:

(i) Explain what is a leader and the effective leadership skills.

(ii) Describe what gender transformative leadership type.

(iii) Identify key aspects of gender transformative communication. and explain the key principles of gender communication.

Key Terms: Leader, leadership skills, transformative leadership, gender, transformative communication etc.

Training materials and resources: Stationery; markers; training manual/booklets

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the session;

Activity	Description	Duration
1	Welcome the participants, and share with them the objectives of the meeting. Make sure that all participants have their handbooks with them, the objectives of the session.	10 minutes
2	Write the word "leader", and "leadership skills", on the board, and ask the participants to state what they understand by these terms. Take note of the key words in their statements, and define the terms with examples. After the discussions, allow the participants to give examples to demonstrate their understanding of the terms.	20 minutes

3	Ask the participants to explain what they understand by the following; ▪ Gender transformational leadership ▪ Ask the participants to state what is the importance of women participation in leadership. After their responses, explain the terms using examples and ask them to give examples of each. For detailed information, ask the participants to refer to the handouts.	30 minutes
4	Ask the participants to explain what they understand by the following; Gender transformative communication. Explain to the participants what the principles of gender transformative communication and ask participants to give examples.	20 minutes
5	Conclude the training and explain to the participants what they will be dealing with in the next session.	10 minutes

REFERENCE MATERIAL FOR GENDER TRANSFORMATIVE LEADERSHIP AND COMMUNICATION

Who is a Leader?

A leader influences and guides other people to accomplish/achieve a goal using specific skills and attributes that facilitate to leading others (Myles Munroe, 1993).

Leadership Competencies/Skills

In order to succeed, leaders need to have specific skills and competencies in securing and maintaining their positions. Women leaders need to grasp these skills and competencies in order to be effective in their work and become more competent in representing the needs of team members, constituents and other stakeholders (Table 2.2). Leadership skills enable women to compete favorably with men in an environment that is influenced by patriarchal norms and values, which reinforce gender biases, discrimination and stereotypes.

Table 2.2: Skills of an Effective Leader

Competency/Skill	Application
Effective Communication Channels	▪ Makes use of the available communication channels to speak to audiences
Good Public Speaker or Presenter	▪ Engages and captivates the audience ▪ Uses appropriate and culturally sensitive body language ▪ Thinks positively ▪ Controls emotions and grabs the attention of the audience ▪ Maintains eye contact ▪ Researches, plans speech appropriately ▪ Someone who is confident

Active Listener	▪ Captures what is communicated and provides feed back in time ▪ Respects other people's views ▪ Does not interrupt others while they talk ▪ Shows approval
Delegates Power and Responsibilities	▪ Supports followers to exploit their potential by giving them the opportunity to lead ▪ Shares the work burden ▪ Mentors' future leaders
Good Advocate and Lobbyist	▪ Defends the rights of his/her followers and is inclusive ▪ Promotes equitable sharing of resources
Decision Maker	▪ Takes decisions and stands by them

What Leadership Is Not

One way to begin a discussion on leadership is to state what it is not. Let us begin with the obvious. Most of us would agree that leadership is not the same as the capacity to employ force or coercion. It is possible to force people to do what we want them to do by threatening them with some kind of deprivation or punishment. A father threatens to punish his son because the son has failed in one of his classes or neglected his chores around the house. A superior in the office threatens to withhold an employee's bonus unless the latter improves her performance. We may feel that these types of actions are negative reactions to circumstances that need not have occurred if leadership had been exercised. The father, for example, might not have needed to punish his son or the superior his subordinate if effective communication had been used to reach a better understanding.

a) Gender Transformative Leadership

Leadership is the ability of an individual to influence, motivate, and enable others to contribute towards the effectiveness and success of the organizations of which they are members. **Transformational leadership** consists of four factors—charisma, inspirational motivation, intellectual stimulation, and individualized consideration. Gender transformative leadership seeks to cultivate individuals, including decision-makers, who empower themselves and their organizations "to pay close attention to gender power structures and discriminatory practices—both formal and informal—in order to advance gender equity in their organizations" as well as in the communities and constituencies they serve. Transformative leadership in the context of gender equality is considered to entail two inter-connected dimensions. This entails increasing the number of women leaders to achieve the goal of equality in number between the sexes in leadership positions and in political representation. The second is the element of transforming the dominant political and other values, processes and institutions themselves to achieve different ways of perceiving and using power.

Promoting women's leadership and decision-making is a core component of UN Women's efforts across its thematic areas: promoting women's economic empowerment, addressing violence against women and girls, advancing the women, peace and security (WPS) agenda, and ensuring legal and policy commitments on gender equality are implemented and monitored. Transformative leadership has been recognized as a vital key to advance gender equality and women's empowerment.

Specifically, transformational leaders inspire followers to go beyond their personal goals in order to serve a collective interest. Leaders who scored higher on the communal factor tend to be more considerate and

benevolent towards their followers and highlight the importance of collective goals, which is in line with the characteristics of transformational leaders.

The Importance of Women in Leadership

Research studies revealed that women could be as competent as men in organizational management can, and can be more competent in some areas, such as conflict handling.

The reasons why women should have an equal share leadership and decision making is so that they:

- Actualize the principles of democracy and fairness
- Effectively and efficiently design appropriate and sustainable products, in the form of goods or services, for all of its members
- Systematically make use of the distinctive competence of women for the benefit of organizations and the country. Women should enjoy the same right with men in being considered for leadership positions.

b) Gender transformative communication

Gender transformative communication aims to change behaviour, attitudes and beliefs about gender, and to challenge power imbalances. It counters discriminatory gender norms through images, language or evidence. It does more than just make people gender aware: It fosters real transformation. Gender transformative communication goes beyond superficial modifications and aims to transform the space where knowledge is produced, thereby creating new narratives around who gets to tell the story and how.

Why is Gender Transformative Communication Useful?

Communication is one of the oldest ways in which behaviour can be influenced, from written advice in religious texts and sermons, to verbal advice from elders. Mass media communications such as broadcast news, radio and newspapers have also been widely used to inform people as well as affect change in their behaviour. Unlike the methods of the past, internet-based communication through social media or news websites has become personal, direct and frequent. Digital communication both allows many causes to engage with their audience, and opens a range of options for people to engage in social change. Hence, adopting gender transformative communication can promote the cause of an organization and catalyse change in gender relations in turn influencing privilege.

Key Principles Underpinning Gender Transformative Communication

- **Making gender visible:** The aim of gender transformative communication is to intentionally include women and gender issues in the agroecological discussion, especially in those that might seem non-gender specific. Including women and gender aspects helps understand how planning, policies and programmes affects or ignores those individuals.
- **Attention to intersecting identities:** Such communication should not only acknowledge gender, but also different identities like class, religion, ethnicity, and race privileges or disadvantages. This includes considering the related needs, challenges, norms and roles, while avoiding stereotypes and subordinations and instead fostering sensitivity and equal representation.
- **Actively resisting stereotype messaging and changing existing narratives:** Communication that aims to challenge and reverse any discrimination that is based on gender inequality is one of the main principles of gender transformative communication. Using critical and creative thinking to question traditional narratives is key to sparking lasting change.

SESSION 4: PARTICIPATION AND GOVERNANCE IN FOOD SYSTEMS

CONTEXT

Gender inclusive participation and governance in food systems refers to the recognition and incorporation of gender perspectives in decision-making, resource allocation, and leadership within food systems. It focuses on addressing gender inequalities and ensuring that women and marginalized genders have equitable opportunities to contribute to and benefit from food systems. Participation and governance involve individuals and communities in policy-making, local governance, and global dialogues about food security, sustainability, and climate resilience. In this regard, this session will provide the participants with the capacity to understand what constitutes participation in the agri-food systems and the governance strategies that enhance the access to productive resources for improved livelihood.

LEARNING OBJECTIVES AND OUTCOMES

(i) Explain the keys aspects of women's participation in agri-food systems

(ii) Describe the key concepts in governance and the role of women in food systems.

(iii) Classify the differentiate gender roles of men and women in the food system.

Key words: Governance, participation, food system, food systems

Training Materials and resources: Stationary; Markers, Training manual/booklets

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the session;

Activity	Description	Duration
1	Welcome the participants, and share with them the objectives of the meeting. Make sure that all participants have their handbooks with them and the objectives of the session.	10 minutes
2	Write the word "participation", and "governance", on the board, and ask the participants to state what they understand by these terms. Take note of the key words in their statements, and define the terms and allow participants to share examples.	15 minutes
3	Male involvement in agri-food systems Ask the participants to state ways in which men are involved in the agri-food systems? ▪ The role of men in food systems? ▪ How the role differs from women? ▪ How can men and women work in harmony for improved food systems?	15 minutes

Activity	Description	Duration
4	Explain to the participants the key aspects of gender inclusive participation in agri-food systems. ▪ Inclusive Decision-Making ▪ Knowledge Co-creation ▪ Capacity-Building Organize the participants into groups, allocate each aspect to one group, and ask them to give examples on each key aspect, and write their responses on the board. Let each group present and ask the rest of the participants to provide their inputs. After their responses, ask for and address any questions. For detailed information, ask the participants to refer to the handouts.	20 minutes
5	Explain gender governance in food systems using the following concepts using examples that resonate with the participants; ▪ Equitable Representation: Ensuring that governance bodies include women and other marginalized genders. Setting gender quotas in agricultural committees, cooperatives, and policy-making platforms. ▪ Policy Advocacy: Promoting policies that address gender disparities, such as land tenure rights, access to credit, and social protections for women farmers. ▪ Supportive Frameworks: Developing legal and institutional frameworks that promote gender equity, such as the enforcement of anti-discrimination laws. Have a question-and-answer session for the participants to provide any clarifications where necessary. For detailed information, refer the participants to the handout.	20 minutes
6	Conclude the training and explain to the participants what they will be dealing with in the next session.	10 minutes

REFERENCE MATERIAL FOR PARTICIPATION AND GOVERNANCE

Gender Dynamics in Food Systems

a) **Women's Roles in Food Systems**: Women contribute significantly to food production, processing, and distribution, particularly in small-scale farming, yet they often face systemic barriers. Women are often primary caregivers and food preparers, making their role in ensuring household food security crucial.

B) Challenges Women Face:

- **Limited access to land, credit, and agricultural inputs.** Gender inequalities in employment and access to productive resources have an important influence on the participation of women in the agri-food systems. When women farmers lack access to financial services, their ability to invest in modern technologies to raise their productivity is limited.
- **Disproportionate workloads due to unpaid domestic labor and caregiving responsibilities**. The inequalities in outcomes and participation in the labor market is a result of women carrying a larger burden of unpaid caregiving and household duties. Women have a higher burden on their time (on average spend 3 hours more a day on domestic and unpaid care work than men) (UN Women, 2017). Similarly, the burden of childcare and reproductive work is associated with lower

productivity of female farmers compared with that of males (FAO, 2023). Unpaid care can intersect with market participation through impacts on time, mobility and agency.

- **Underrepresentation in decision-making and governance structures at local, national, and international levels**. Access to resources remains a problem for females hoping to enter politics. Many women who are elected hail from wealthy backgrounds or have made money through successful careers. Family wealth and connections to party leaders and machinery are also important forms of access to resources to support women's access to politics. But limited control of and ownership of assets and resources limits access to a large proportion of Kenyan women to positions of influence, or opportunities for political careers. Although the Constitution supports the bequeathing of land to daughters, informal norms make this difficult to implement over the short term. Even with the new rights the Constitution affords women, some women interviewed admitted that they did not challenge the allocation of family land to their brothers. Land and property continue to be a key source of financing for male candidates.

Gender Inclusive Participation in Food Systems

Participation ensures that women and marginalized genders have a voice in shaping food systems policies and practices.

Key Aspects of Gender Inclusive Participation in Agri-Food Systems

- **Inclusive Decision-Making:** Ensuring women are actively involved in decisions about resource use, crop choices, and farming techniques. Encouraging participation in farmer cooperatives, community planning, and policy forums. Women's economic empowerment requires adequate participation of women in decision-making processes and consultation mechanisms to give voice to their interests and priorities. Yet, women traders are often not well represented either in formal consultation mechanisms, such as national trade facilitation bodies, or professional associations.
- **Knowledge Co-Creation:** Recognizing and integrating women's traditional knowledge in agriculture, biodiversity conservation, and food preparation. There is need to enhance co-creation and horizontal sharing of knowledge, including local and scientific innovation, especially through farmer-to-farmer exchange.
- **Capacity-Building:** Providing women with education, training, and leadership skills to enhance their participation in food systems. Interventions to strengthen women's full participation, leadership and equal representation in agri-food systems and other decision-making processes are important. Trainings should be done in locations close to homesteads which may better suit women farmers and time schedules that do not conflict with domestic and other chores. Also, consider focus groups or specific working groups which offer more informal access to participation to the agri-food systems, that is better adapted to the levels of education of women traders.

Male involvement in agrifood systems is crucial for promoting equitable, sustainable, and efficient food systems. While women often play significant roles in food production and security, men frequently dominate resource ownership, decision-making, and leadership in agrifood systems. Actively engaging men as key point persons in advancing equity, sustainability, and shared responsibilities can enhance the overall resilience of food systems.

Examples of Gender Inclusive Participation:

- Women's farmer groups advocating for access to agricultural resources.
- Participatory research projects focusing on gender-sensitive agroecological practices.
- Training programs that support women in adopting new farming technologies.

Gender Responsive Governance in Food Systems

Governance involves creating policies, institutions, and systems that address gender disparities and promote equitable resource distribution and decision-making. They include;

- **Equitable Representation:** Ensuring that governance bodies include women and other marginalized genders. Setting gender quotas in agricultural committees, cooperatives, and policy-making platforms. Women's economic empowerment is closely linked to their participation in political decision-making processes and consultation mechanisms, where they can voice their interests and priorities. However, women farmers are often underrepresented in formal consultation mechanisms. This could be improved through creating networking and benchmarking opportunities for learning.
- **Policy Advocacy:** Promoting policies that address gender disparities, such as land tenure rights, access to credit, and social protections for women farmers. This should focus on equal access, use and decision making on the key productive resources for improved agricultural production and livelihoods.
- **Supportive Frameworks:** Developing legal and institutional frameworks that promote gender equity, such as the enforcement of anti-discrimination laws. There are existing policies and strategies in place i.e. the National Agroecology Strategy which offer guideline, which needs to be leveraged to support women farmers for improved livelihoods.

MODULE 3: WATER MANAGEMENT AND CONSERVATION

Water is important for agricultural and livestock production, and its shortage negatively affects crop yields and food availability. Poor water management worsens the problem, reducing both water quality and availability. Climate change worsens the issue of water shortage, impacting soil health and the overall well-being. Agroecology enhances water efficiency through innovative management practices and sustainable inputs. Water harvesting, conservation and management is one key agroecological strategy to address water scarcity and support sustainable agriculture. The module covers three key aspects:

1) Water harvesting,
2) Water testing and treatment, and
3) Water management and conservation.

SESSION 5: WATER HARVESTING PRACTICES IN FARMLAND ECOSYSTEMS

CONTEXT

Water harvesting reduces farmers' reliance on irrigation and improves water availability for consistent crop and livestock production. In Kenya, rain-fed agriculture is limited by unpredictable weather and scarce water resources, while traditional water sources are under pressure. Proper water harvesting and management minimize losses from runoff and evapotranspiration, promoting sustainable water use. This training session equips smallholder farmers with agroecological practices to enhance soil water retention and utilize water from unproductive areas.

LESSON OBJECTIVES AND EXPECTED OUTCOMES

This session aims to equip small scale farmers with knowledge on different types of water harvesting methods for agricultural and domestic use. By the end of the session, the participants will be able to;

(i) Identify and explain the types of water harvesting methods in their community
(ii) Apply different water harvesting techniques in their farm

Key Terms: Water harvesting, water testing, water treatment, water conservation etc

Training resources and materials: stationary, Markers; Demonstration farm and; Training manual/booklets

DELIVERY PLAN

To ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting.

Activity	Description	Resources
1	Welcome the participants to the training. Let them introduce themselves to each other and explain the objectives of the session. Discuss with the participants learning outcomes - they should be able to identify and explain the types of water harvesting methods, their advantages, disadvantages and the requirements for construction.	20 minutes

Activity	Description	Resources
2	Write the words "**Water**" and "**Water Harvesting**", on the board and ask the participants to explain what they understand by these terms. Take note of the key words in their statements. Explain the definitions using examples that resonates with the participants as follows; ▪ Water – as a component of an agroecosystem - is essential for agriculture as it represents one of the limiting production factors in many parts of the world. ▪ Water harvesting - Water harvesting comprises of all the activities where water is collected, stored and utilized. It includes harvesting rainfall directly, as well as floodwater harvesting.	20 minutes
3	Inform the participants that they will spend some time discussing the uses of water on their farms, and the most common water harvesting methods they know and use. The discussions will be guided by the following questions; ▪ What are the main uses of water on the farm? ▪ What are the methods used for collecting and storing water for agricultural use on the farms? To help the participants understand better the water harvesting methods, explain to them what water harvesting methods are i.e. rain water harvesting takes the form of i) Roof catchment, and ii) Water Pans and Ponds. Explain the differences between the two approaches, and clarify any questions asked.	20 minutes
4	Organize the participants in three groups, and ask them to choose a secretary and a chairperson for their groups. Allocate each group a water harvesting technique (roof catchment, water pans and, water ponds). Ask the group members to discuss and answer the following questions based on the allocated techniques and write their answers on the board. ▪ Which farmers are undertaking which technique? What are the advantages and disadvantages of each method mentioned? ▪ What are the suitable construction materials and area to construct a water pan/water pond that is accessible to women, children and persons with disability? (materials, size/measurements, typology etc) ▪ What is their opinion on the sustainability of the mentioned approaches/ methods?	30 minutes
5	Facilitate a discussion to ensure the participants have a deeper understanding of what each method of water harvesting entails, in terms of the materials required for construction, measurements, typology, and their advantages, disadvantages. Refer the participants to the handout for more information the water harvesting techniques. If possible, do demonstration of some of the methods in one of the participants' homesteads where some of these methods have been practised	30 minutes

REFERENCE MATERIAL FOR WATER HARVESTING PRACTISES IN FARMLAND ECOSYSTEMS

Water is essential for agriculture as it represents one of the limiting production factors in many parts of the world. Water has a number of important uses (Figure 3.1):

Transporting nutrients to the soil and plants | Cooling the plants | Water for irrigation and livestocks | Used for drinking and domestic use

Efficient water harvesting supports soil health, nutrient transport, temperature regulation, and food security while also having significant social and gender implications.

- Women and men use water differently, with women focusing on domestic, health, and sanitation needs, while men prioritize agriculture and livestock.
- Integrating gender considerations in water management is essential for effective resource allocation.
- Water scarcity unequally affects women, increasing their burden of collection and limiting economic, educational, and social participation.
- Women play a crucial role in both irrigated and rain-fed agriculture, yet they face challenges due to decreasing water availability.
- Providing technical training for women in water management, irrigation, and rainwater harvesting can enhance agricultural sustainability.

Water Harvesting Techniques

Water harvesting is crucial for farmlands, where erratic rainfall and prolonged dry spells threaten agricultural productivity. Farmers in the region use various techniques, including rooftop rainwater harvesting, farm ponds, and sand dams, to store water for irrigation and livestock. Some farms benefit from river-fed irrigation, but water scarcity still necessitates efficient harvesting and storage solutions. Smallholder farmers rely on water harvesting to improve soil moisture retention, ensuring sustainable crop production and pasture growth for livestock.

Rainwater harvesting is the collection of rainfall runoff from various sources such as roofs, the ground surface, water sources or other surfaces and its storage in structures such as tanks, dams, to provide water for domestic use, livestock, commercial purposes or irrigation. The term also includes flood water harvesting as well as water stored within the soil profile as "green water" using approaches such as Zai pits. Rainwater storage provides water at home or close to households. It reduces the burden, especially on women and girls, of fetching water from long distances. In some cases, rainwater provides better quality water thereby improving health.

There are many ways of harvesting water and storing rainwater in various structures as "blue water", meaning water that can be retrieved in its liquid form and used for various uses, including agriculture using techniques such as water ponds. Rainwater harvesting and storage systems are categorized according to water storage methods, and the purpose with which the water is used for. Based on the storage methods, three broad categories of rainwater storage facilities are:

- Surface tanks or above-ground tanks; e.g use of plastic or concrete tanks
- Sub-surface tanks or underground tanks; e.g use of underground plastic or concrete tanks
- Dammed reservoirs and ponds; e.g dams and ponds
- Rivers and directed into water ponds/dams

The water storage facilities constitute the most expensive component of a rain water harvesting system, determining the extent of the direct use of rainwater. For example, surface tanks account for up to 90% of the costs of roof rain water harvesting systems. It is therefore necessary to pay due attention to the selection/design and construction of reservoirs, always keeping in mind cost aspects along with other considerations.

Based on type of storage structure, several classifications exist and sub-categories. Generally, the most commonly used structures for storage of harvested rainwater include the following:

- Farm ponds – Farmers in dig farm ponds lined with plastic sheets to collect and store rainwater for irrigation during dry spells.
- Roof rainwater Harvesting – Households install gutters and storage tanks to collect rooftop rainwater, ensuring a steady supply for household and small-scale farming needs.
- Water pans – Large-scale farmers construct water pans to store surface runoff, providing water for livestock and irrigation.
- Rock catchments – Farmers use natural rock formations to channel rainwater into reservoirs, ensuring a reliable water supply for dry seasons.

The harvesting techniques can be generally categorised into;

a) Roof Catchment

A roof becomes a catchment when it is used for harvesting rainwater. Roofs are the most common types of catchments used for harvesting rainfall. Rainwater harvesting from impervious roof made of corrugated iron sheets corrugated plastic and clay tiles is a popular method for providing portable water directly from rainfall (Figure 2.2). The system provides water at home, is affordable, easy to practice regardless of physical or climatic conditions and can be designed to suit different conditions (available finances, roof area, family size, rainfall or roof area).

Roof water harvesting is particularly attractive where the main alternatives are surface water sources are unavailable, and groundwater (such as wells) is either difficult to secure or has been rendered unusable by fluoride or salinity. Also, where management of shared point sources has proved unsuitable and delivery of water is a particular burden on household members or where householders are prepared to invest in water convenience.

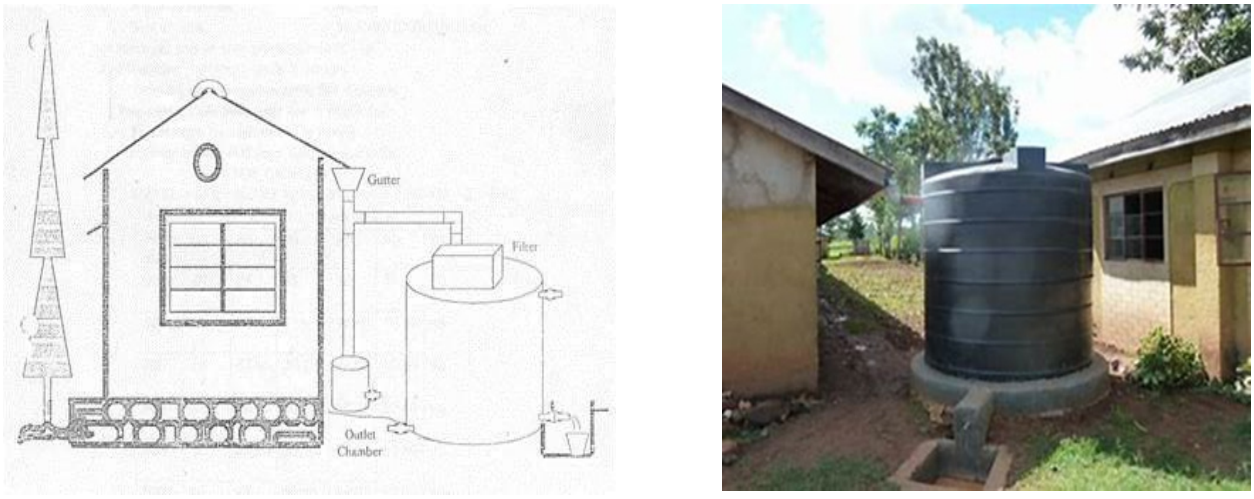


Figure 3.2: Components of Roof Catchment, and a roof water harvesting structure whereby rain is collected from two sides of the roof and directed through gutters to the plastic raised tank

Advantages of roof catchment

Roof catchments have some advantages over ground catchments.

- When buildings with impervious roofs are already in place, the catchment area is effectively available free of charge.
- They are relatively clean and thus provide safer water
- Surface tanks are relatively smaller, they are affordable for household water harvesting
- They normally supply water at the point of consumption, while the water from other catchments needs to be transported or piped.
- Water can be extracted easily through a tap just at the base of the tank. Placing it on a stand or base elevates the tank, so that the water can be piped by gravity to where it is required.
- Construction of such water tanks makes use of locally available materials and local artisans, thus creating employment.
- The storage provided by a tank provides households with security against short-term failure of alternative water sources.
- Since the structure is family owned, maintenance is usually very good and no water conflicts occur.
- Certain tank types such as plastic or canvas are portable, and can be transported to remote areas where they are fixed at site.

Disadvantages of roof catchment

Despite its advantages, roof water harvesting has a number of limitations including:

- It may be inadequate as a stand-alone water supply solution unless in the most water-stressed situations.
- The tank capacity necessary to bridge a long dry season would be large and this can be prohibitively expensive.
- Surface tanks are relatively expensive when compared with subsurface storage tanks;
- They require space in the home compound, and this may be a problem in urban areas;
- Water quality still requires some treatment especially to remove biological pathogens.

b) Water Pans and Ponds

Digging ponds and pans are small reservoirs, about 1m to 3m deep, usually dug of-stream with raised and compacted banks all around. They are constructed to collect and store runoff water from various surfaces including from hillsides, roads, rocky areas and open farmland. The difference is that pans receive their water wholly from surface runoff, while ponds are constructed where there is some ground water contribution or a high-water table. The capacity of pans and ponds can range from 500 to 5,000 m3. Structures whose reservoir capacity is less than 500 m3 are called tanks, while those exceeding 5,000 m3 are called dams. Pans and ponds are generally built close to settlements, and are located on grazing lands rather than farmlands, since the latter is more valuable and the former more compact.

Water Pans: A pan is a small reservoir created by digging open ground, to collect and store surface runoff from uncultivated grounds, from hillsides, roads, rocky areas and open rangelands. Pans rely wholly on surface runoff and do not receive ground water contribution. Construction of a water pan needs a flat and level location that is easily accessible to the farm. Farmers are required to dig a hole that is two meters deep, 40m by 18m to accommodate the water pan and provide a stable foundation. The pan itself is made of a polythene-like material that can last for an average of eight years before it is worn out. A pan can be made square, rectangular or hemi-spherical in shape. The hemispherical shape is preferred as it accords better hydraulic efficiency. The main limitation with water pans includes; relatively small capacities; high siltation rates; loss of water through seepage and, high evaporation losses. Otherwise, pans can be excavated almost anywhere and lined with various materials. They are popular for livestock watering in dry areas having few watercourses. Pans are particularly useful for runoff harvesting from home compounds where the houses are grass thatched or other traditional dwellings.

Water pans with plant buffers to avoid contamination

Water Ponds: Ponds, like pans, are also excavated depressions (1 m-3 m deep), and holding at least over 100 m3 but less than 5,000 m3 of water. However, ponds are constructed in areas where some ground-water recharge is possible, mostly due to high water table. Ponds are also excavated in perennial swamps and streambeds to increase the volume of water storage and improve inflows from outlying areas. Since they get recharged naturally, they have few seepage problems and are preferred to pans.

Farm ponds for fish farming and water harvesting with plant buffers to avoid siltation and other contamination

Advantages of water pans and ponds

- They can hold relatively large volumes of rainwater compared to surface tanks.
- The storage structure is easy to construct and use
- Pans can be used to collect runoff from home compound, where houses are grass-thatched
- They can provide water for domestic/livestock use and for crop irrigation
- Pans can be sited almost anywhere if lined to control seepage.

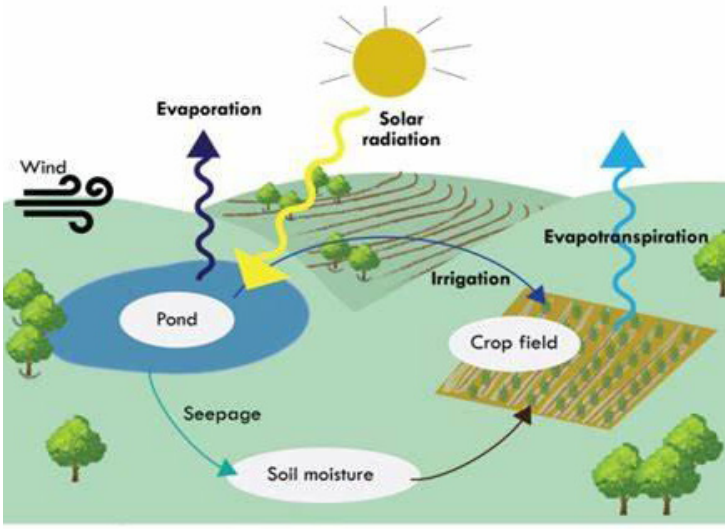


Figure 3.3: Diagram showing importance of water harvesting ponds on the farm

Disadvantages of ponds

- Water from pans/ponds is liable to pollution and contamination
- Evaporation losses are also problems owing to the fact that the reservoirs are built on natural ground and that they are mostly too wide to provide cover.
- For community water supplies, they have relatively small capacities compared to earth dams.
- They can also suffer high siltation rates

c) Zai pits

Zai pits (also known as planting pits) are a traditional water-harvesting technique used to improve soil moisture, increase crop yields, and rehabilitate degraded land.

Zai pits for water harvesting

Advantages of Zai Pits

- Enhances water retention – Captures and stores rainwater, reducing runoff and increasing soil moisture for crops.
- Improves soil fertility – Organic matter (manure/compost) enriches the soil with nutrients, promoting better plant growth.
- Reduces soil erosion and land degradation – Prevents topsoil loss by slowing water movement, making it effective for land restoration.
- Increases crop yields – Provides higher yields even in drought conditions due to improved water and nutrient availability.
- Climate resilience – Helps farmers adapt to climate change by enhancing productivity in dryland farming.
- Low-cost and easy to implement – Requires simple tools and local materials, making it affordable for smallholder farmers.
- Weed and pest control – Concentrated planting in the pits reduces weed spread and some pest infestations.

Disadvantages of Zai Pits

- Labor intensive – Digging the pits requires a lot of manual work, especially for large farms.
- Time consuming – Preparing Zai pits before the rainy season takes more time compared to conventional planting.
- Limited to small-Scale farming – Not easily scalable to large commercial farms without mechanization.
- Requires maintenance – The pits need regular maintenance (clearing silt, adding organic matter) to remain effective.
- Competition for organic matter – Requires manure or compost, which may not always be available in adequate amounts for all farmers.
- Not suitable for all soil types – Works best in sandy or loamy soils; heavy clay soils can retain too much water, leading to waterlogging.
- Initial training required – Farmers need training on proper pit spacing, size, and organic matter application to maximize benefits.

SESSION 6: WATER TESTING AND TREATMENT

CONTEXT

Agroecological water testing ensures that water used for irrigation, livestock, and domestic purposes is safe and sustainable. It assesses key parameters such as pH, salinity, turbidity, microbial contamination, and nutrient levels, which impact crop productivity and ecosystem health. Poor water quality can lead to nutrient deficiencies, toxicities, and plant stress, affecting agricultural yields. Contaminated irrigation water can degrade soil structure and disrupt microbial activity, reducing soil fertility. Unsafe water can pollute household supplies, increasing the risk of waterborne diseases.

LESSON OBJECTIVES AND EXPECTED OUTCOMES

This session provides guidelines for conducting water quality assessments, covering sampling methods, testing procedures, result interpretation, and best practices for maintaining water safety. It equips the participants with the practical skills to monitor and manage water resources sustainably. By the end of the session, the participants will be able to;

(i) Define key parameters for water testing

(ii) Describe the procedure for water testing

(iii) Conduct water testing and treatment in the households

(iv) Apply different measures for protecting water quality

Key Terms: Water testing, water treatment, water conservation etc

Training materials and resources: Stationary, Markers, Demonstration farm, Training manual/booklets

DELIVERY PLAN FOR WATER TESTING AND TREATMENT

To ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting.

Activity	Description	Duration
1	Welcome the participants to the training. Let them introduce themselves to each other, and explain the objectives of the training/meeting; By the end of the meeting, the participants should be able to understand the water testing procedure, treatment methods and the agroecological practices that ensures the quality of water is maintained. As an ice breaker, show the farmers a picture of water is contaminated and let them discuss the potential effects of the contaminated on their health, health of animals and crops	15 minutes
2	Write the words "**Water testing**" and "**Water Treatment**", on the board and ask the participants to explain what they understand by these terms. Explain the definitions using examples that resonates with the participants as follows; ▪ Water testing - Water testing in agroecology is essential for assessing the quality and suitability of water for agricultural use, ensuring it supports crop growth, livestock health, and ecosystem sustainability. It involves checking the quality of the water based on several parameters including hardness, alkalinity and pH.	30 minutes

Activity	Description	Duration
	▪ Water treatment – Water treatment is the process of improving the quality of water for farm and domestic use. It involves the removal of contaminants and undesirable components from water.	
3	In an open discussion, ask the participants to state their responses for the following; What causes water contamination from their agricultural activities? How can they identify contaminated water? ▪ What are the parameters of testing the water quality? ▪ What are the methods of water treatment? ▪ How can these be improved to meet the daily needs of a household? ▪ Is the clean water accessible to women, children and persons with disability? Explain to the participants what contaminated water contains (i.e. bacteria, heavy metals etc). Elaborate on the water testing parameters (Physical, biological and chemical), and the procedure i.e. the spots of collecting water for a lab testing, and ask the respondents to refer to the handout.	30 minutes
4	Organize the participants into 3 groups and ask them to discuss the agroecological practices/methods that can be used to protect the water quality for the water harvesting techniques discussed in the first session, and write their discussions on the board. After the discussion, elaborate more on how to ensure the quality of water for the different water harvesting techniques and refer the participants to the handout for further information.	15 minutes

REFERENCE MATERIAL FOR WATER TESTING AND TREATMENT

Water Testing

Water testing in agroecology is essential for assessing the quality and suitability of water for agricultural use, ensuring it supports crop growth, livestock health, and ecosystem sustainability. It involves checking the quality of the water based on several parameters including hardness, alkalinity and pH.

While rainwater quality will not always match the required drinking water standards when compared with most unprotected, traditional water sources rainwater from well-maintained roof catchments usually represents a considerable improvement and is generally safe to drink without treatment. The parameters of water testing are;

a) Physical; - colour, taste, odour and solids

b) Biological; - Bacteria and algae

c) Chemical; - water pH, dissolved minerals e.g calcium and magnesium.

It's important to take into consideration the following;

Box 3.1: Considerations for water testing in farmlands

- Rainwater from ground catchment systems is not recommended for drinking unless first boiled or treated.
- Except in heavily urbanized and industrialized areas, atmospheric rainwater is pure and any contamination would usually occur after contact with the catchment.
- The chemical and physical quality of stored rainwater is normally high. Care should be taken to avoid any possible sources of lead or other heavy metals e.g. from lead-based roof paints.
- A degree of contamination of roof rainwater runoff is inevitable, but this will not generally be a problem if the gutters and storage tanks are properly maintained and regularly cleaned
- Reports of disease outbreaks linked to roof water sources are rare. A few cases of gastrointestinal illness linked to large quantities of bird or animal droppings on the roof have been reported and appropriate measures should be taken to reduce any risks.

For water testing, the following procedure is undertaken (Box 3.2)

Box 3.2: Sample water testing procedure

1) Choose places where water is used, like ponds, wells, or streams.
2) Use clean bottles, gloves for sampling and label bottles with the location and date.
3) For surface water: Take water below the surface (not floating debris).
4) For wells: Pump some water out first, then collect fresh water.
5) You can use kits to check for alkalinity or acidity of the water.
6) Send your samples to a lab for detailed tests, like: chemicals (nitrates, salts), bacteria (like E. coli), and heavy metals (lead, arsenic).
7) Compare the results with safe water standards for crops, animals, or drinking provided by NEMA.
8) Clean or treat water if needed (filtering, removing pollutants).

Water Testing in a water pond

Water Treatment

Water treatment is the process of improving the quality of water for farm and domestic use. It involves the removal of contaminants and undesirable components from water. Primary treatment involves the removal of large amounts of solids and organics from water, through sieving. Further treatment through boiling exposure to sunlight or ultraviolet radiation and chlorination can be undertaken if there are concerns over the water quality.

Measures for Protecting Water Quality

a) **Buffer Strips**: Strips of vegetation along water ponds/pans to filter runoff and prevent contamination. There are different buffer strips
   - **Riparian Buffer Strip**: A linear band of permanent vegetation adjacent to an aquatic ecosystem intended to maintain or improve water quality by trapping and removing various nonpoint source pollutants from both overland and shallow subsurface flow.
   - **Riparian Corridor** is a strip of vegetation that connects two or more larger patches of vegetation.
   - **Contour buffer strips**: strips of vegetation alternated with wider cultivated strips that are farmed on the contour.
   - **Filter strips**: areas of grass or other permanent vegetation used to reduce sediment, organics, nutrients, pesticides, and other contaminants in runoff and to maintain and/or improve water quality.

b) **Integrated Pest Management (IPM)**: Reducing pesticide use to protect water from agricultural pollution.

c) **Use of Organic Fertilizers**: Avoiding chemical leaching into water sources i.e. biofertilizers, animal manure, compost manure and municipal waste.

Buffer Strips

IPM

Organic fertilizers

SESSION 7: WATER MANAGEMENT AND CONSERVATION

CONTEXT

Meeting food security and nutrition requires sustainable agricultural practices and policies that allow improved soil quality and water retention capacity. Agroecology provides such sustainable practices to food security and nutrition as it allows producing more foods with few waters while achieving better nutrition. Agroecology provides many ways in which one can better manage water in agriculture and these practices are not exclusive one of the other.

LEARNING OBJECTIVES AND OUTCOMES

This session aims at equipping the participants with skills and knowledge on agroecological practices that ensures water management and conservation, for improved production, hence enhanced livelihoods. By the end of the meeting, the participants should be able to;

(i) Appreciate the importance of water managing and conservation in their farms

(ii) Describe different strategies to manage water in their community

(iii) Apply different water management strategies in the community

Key Terms: Water management, water conservation

Training Materials/Resources: Whiteboard/Flip chart, markers, projector/computer (optional for slides), handouts with key concepts and visuals.

DELIVERY PLAN FOR WATER MANAGEMENT AND CONSERVATION

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Duration
1	Welcome the participants to the training. Let them introduce themselves to each other, and explain the objectives of the session	10 minutes
2	Write the words **"Water management"** and **"Water conservation"** on the board and ask the participants to state what these words mean to them. Take note of the key statements in their responses, define the words to them as follows; ▪ Water Management- Water management in agroecology refers to sustainable use of on-farm water resources by managing harvested water and the soil-water system through the optimized use of water sources ▪ Water Conservation- Methods to maintain soil health and reduce water loss for long-term productivity.	20 minutes
3	Organize the participants in two groups, and ask them to discuss the following; ▪ What are the agroecological practices that ensure Water is well managed on the farm? ▪ What are the agroecological practices that ensure water is conserved on the farm?	30 minutes

Activity	Description	Duration
	Let the participants write their answers on the board, and select one person to present their discussions. After the discussions, elaborate on the agroecological practices that ensures water management and conservation, and ask the participants to refer to the handouts for more information.	
4	Identify and visit a farm where a water pan/pond has been constructed. As the participants to identify the features of the water pan/pond, and determine whether they meet the requirements. ▪ Demonstrate the sites of water collection for testing purposes in the water pans/ponds. Carry out a water testing exercise i.e. check the colour of the water, odour, and solids. Carry out a primary water treatment method (i.e. using a clean piece of cloth to sieve water collected in the water pan/pond). ▪ On the demonstration farm, identify the agroecological practices used to ensure water management and conservation.	60 minutes

REFERENCE MATERIAL FOR WATER MANAGEMENT AND CONSERVATION

a) Water Management

Water management in agroecology refers to sustainable use of on-farm water resources by managing harvested water and the soil-water system through the optimized use of water sources: rainfall water and irrigation as well as through the reduction of water losses.

Rainwater management systems can be classified by regime as follows:

- Occasional — Rainwater is stored in small containers for only a few days. Suitable where rainfall is regular—very few days without rain—and where there is a reliable alternative water source nearby.
- Intermittent—Used in situations with one long rainy season when all water demands are met by rainwater. However, during the dry season, water is collected from wells, springs and streams.
- Partial—In normal seasons, rain is used directly or water is drawn from other source such as wells, springs and streams.
- Full—Rainwater provides water for all purposes throughout normal seasons. Usually, there is no alternative source of water. In these cases, the available water should be well managed and enough stored to bridge the dry period.

Sustainable agricultural and land management practices that improve soil moisture retention are summarized in the following picture (FAO, 2015).

Figure 3.4: Sustainable agricultural and land management practices that improve soil moisture retention

Source: FAO, 2015. International Year of Soil. Infographic "Soils store and filter water"

b) Managing water harvested in water pans and ponds

Figure 3.5 illustrates strategies to manage water in ponds effectively to keep them full for a longer period. It is divided into three main approaches, with subcategories detailing specific actions:

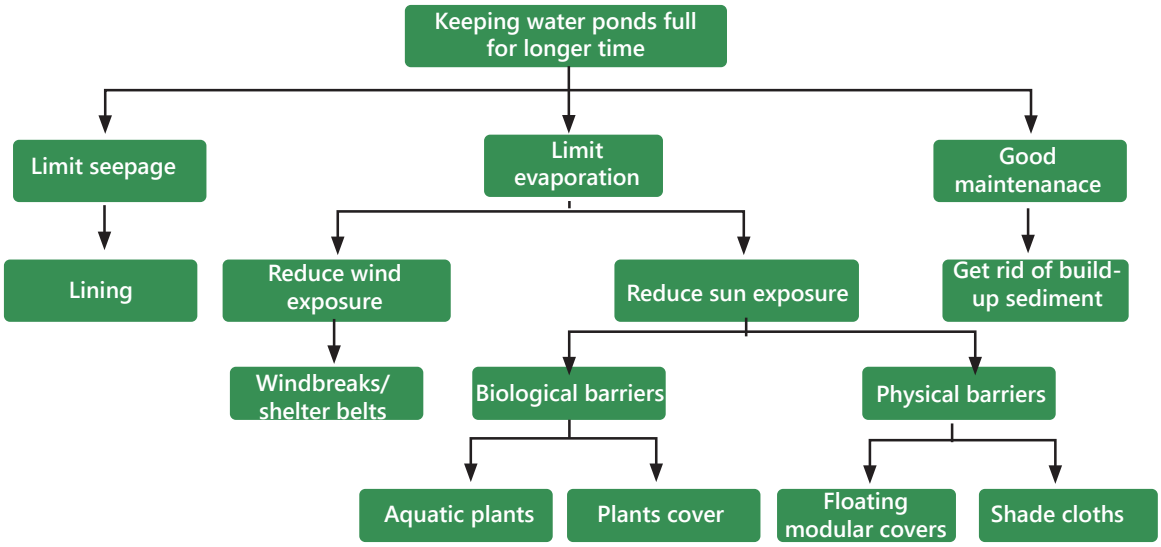


Figure 3.5: Strategies to manage water in ponds/pans

1) Limit Seepage:
   - Apply a lining to the pond to prevent water from seeping into the soil, reducing water loss.
2) Limit Evaporation:
   - Reduce wind exposure by using windbreaks or shelterbelts (e.g., trees or shrubs) around the pond to block winds that increase evaporation.
   - Reduce sun exposure by:
     ~ Biological barriers: Planting vegetation in or around the pond to provide shade and cover.

- ~ Physical barriers: Using floating modular covers or artificial structures to reduce direct sun exposure.

3) Maintenance of Water Pans and Ponds:
   - Regularly remove built-up sediment to maintain depth and reduce water capacity loss due to siltation.
   - Clean the pond periodically to ensure efficient water storage.
4) Efficient Water Management:
   - Use precision irrigation methods like drip irrigation to minimize water wastage.
   - Implement automated greenhouses for better control and prudent management of water resources.

c) Water Conservation

Different water conservation practises can be applied in small-holder context;

Zai Pits and Mulching: A Zai pit is a water harvesting technique that involves digging holes into the ground and filling them with organic matter like compost, mulch and manure. Once the hole is filled, farmers plant vegetable seeds like onion, kale and spinach, in the centre and cover it with a layer of soil or mulch. In dry areas like Kitui County where rainfall is scarce, Zai pits is a simple and affordable solution that can help smallholder farmers to thrive in the face of climate change. Covering the soil with organic or inorganic materials to retain moisture and reduce evaporation.

Pits for water harvesting

They can help boost crop harvests by providing plants with access to water and protecting young seedlings from the harsh sun by retaining moisture. And the pits also help reduce soil erosion by trapping rain water and preventing it from running off.

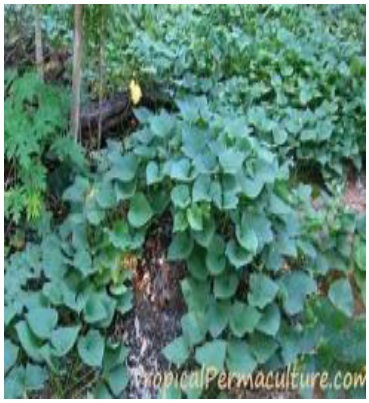
Cover Crops: Planting crops to protect the soil, enhance its structure, and maintain moisture. Cover crops have a range of benefits including soil health, weed and pest control, increasing biodiversity, fodder for livestock and pollinators and, climate-smart regenerative agriculture.

Agroforestry: Integrating trees into agricultural systems to reduce water loss, improve microclimate, and enhance infiltration. Agroforestry systems can reduce soil erosion caused by water, and prevent the runoff of sediment and pollutants, whilst keeping soil nutrients on land.

Zero tillage or Minimum tillage: Zero tillage is a process where the crop seed will be sown through drillers without prior land preparation or disturbing the soil. Zero tillage can reduce the cost of cultivation as well as reduce soil erosion, crop duration and irrigation requirement.

Agroforestry

Minimum Tillage



Cover Cropping

MODULE 4: SOIL HEALTH AND FERTILITY MANAGEMENT

Soil health and fertility management are fundamental to sustainable agriculture. By maintaining healthy soil ecosystems and using targeted fertility practices, farmers can ensure productive, resilient, and environmentally friendly farming systems. These practices help reduce dependence on external inputs, lower costs, and improve long-term agricultural sustainability.

Women farmers already use fewer inputs than men due to limited access to extension services, credit, income, and technologies, this module aims to capture the interest of women by showcasing how to use low-input farming methods. Reduced time spent and increased benefits for women by applying natural soil health and fertility management practices that ensure the soil remains fertile, resilient, and capable of supporting plant growth while minimizing environmental degradation.

This module therefore discusses three aspects of improving the status of soil for production namely: Soil fertility management, integrated nutrient management and production and use of organic inputs.

SESSION 8: SOIL FERTILITY MANAGEMENT

CONTEXT

While synthetic fertilizers can enhance crop yields in the short term, excessive use can lead to soil degradation over time, affecting its structure and nutrient balance. Continuous application of nitrogen-rich fertilizers can disrupt the natural microbial communities in the soil, reducing soil fertility in the long run. Practices such as mono cropping and over-reliance on chemical fertilizers can degrade soil quality, leading to reduced agricultural productivity.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to:

(i) Explain the importance of a healthy and fertile soil for agricultural production.

(ii) Apply key natural methods and practices for improving soil health and fertility

Key terms: Soil, Soil health, Soil fertility

Training aids and materials: Stationary, model farm visits, demonstrations, on farm practicums

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Duration
1	Welcome the participants, and share with them the objectives of the meeting. Make sure that all participants have their handbooks with them so that they can refer to the objectives	15 minutes

Activity	Description	Duration
2	Ask the participants to share their understanding of the following: ▪ What is soil? ▪ What are the components of soil? ▪ How can you tell a soil is healthy? ▪ How can you tell a soil is fertile? Conclude this discussion by affirming all the correct explanations given by the participants, adding aspects of the definitions they may have missed out and refer them to the handout for further understanding of the terms.	30 minutes
3.	Now that the participants understand soil, soil health and soil fertility, introduce the concept of soil fertility management. Refer them to the handout for objectives of soil fertility management. Guide a short discussion on which of the objectives resonates best with their soils.	20 minutes
4.	Facilitate a session on Key natural soil fertility management Practices referring participants to the handout. Draw their attention to the group activity in the handout. Allow them to decide how best to handle the activity and present.	40 minutes
5.	Conclude the meeting by telling participants that in the next meeting they will discuss integrated nutrient management which will be a fields trip	15 minutes

REFERENCE MATERIAL FOR SOIL FERTILITY MANAGEMENT

Soil Fertility Management

Soil is a natural resource made up of minerals, organic matter, water, air, and living organisms. It serves as a medium for plant growth, a habitat for many organisms, and a vital component of Earth's ecosystems. Soil forms over long periods through the breakdown of rocks (weathering) and the accumulation of organic material.

Soil has different components including; (i) minerals- sand, silt, and clay particles derived from rocks; (ii) organic matter- decomposed plant and animal residues (humus); (iii) water-moisture held between particles; (iv) air-Spaces between particles that allow oxygen and carbon dioxide exchange and (v) microorganisms- Bacteria, fungi, and other organisms that aid in nutrient cycling.

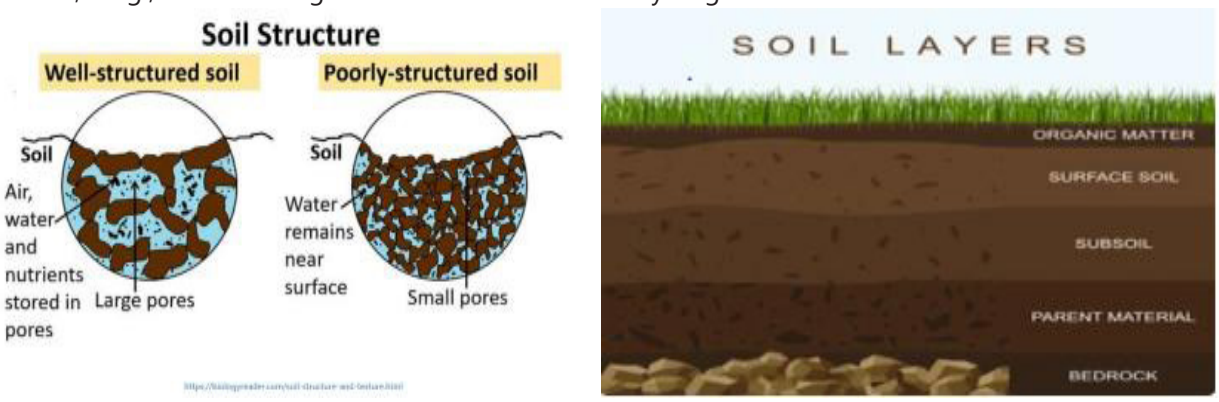


Figure 4.1: Soil structure

What is Soil Health?

Soil health refers to the soil's ability to sustain plant and animal productivity, maintain or enhance water and air quality and support biological diversity and ecosystem functions.

Indicators of soil health:

(i) **Physical Properties**: This is the arrangement of soil particles (sand, silt, clay) into aggregates. Good structure improves water infiltration, root growth, and nutrient retention. It ensures minimal erosion and compaction.

(ii) **Chemical Properties**: Balanced levels of essential nutrients (e.g., nitrogen, phosphorus, potassium); appropriate pH for plant growth (typically 6–7.5 for most crops) and low levels of harmful salts or toxic elements.

(iii) **Biological Properties**: High microbial activity and the diversity of microorganisms, fungi, earthworms, and other soil organisms that help break down organic material, fix nitrogen, and control pests and diseases; and proper organic matter content.

What is Soil Fertility?

Soil fertility refers to the soil's capacity to provide plants with essential nutrients in sufficient quantities and proper proportions for optimal growth.

Essential Nutrients:

(i) Macronutrients: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulfur (S).

(ii) Micronutrients: Zinc (Zn), Iron (Fe), Copper (Cu), Manganese (Mn), Boron (B), Molybdenum (Mo), Chlorine (Cl).

Each crop has its nutrient requirements. This helps to classify plants as either heavy or light feeders.

Objectives of Soil Fertility Management

1) Enhance Nutrient Availability: Ensure the soil has sufficient nutrients for crops throughout the growing season.
2) Maintain Soil Health: Improve soil structure, water-holding capacity, and microbial activity.
3) Prevent Nutrient Loss: Minimize nutrient leaching, erosion, and volatilization.
4) Sustain Productivity: Support long-term agricultural sustainability while minimizing environmental impact.

Key Natural Soil Health and Fertility Management Practices

Soil health and fertility are closely interconnected. Both concepts involve practices aimed at improving soil structure, nutrient content, biological activity, and overall ecosystem function. Making soil fertile naturally is therefore all about nurturing the soil's biological processes and building up organic matter. By using a

combination of sustainable practices, you can improve the soil's fertility over time. We discuss some of these practices for improved soil health and fertility.

1) **Nutrient Management**: Ensure the availability of macronutrients (N, P, K) and micronutrients (Fe, Zn, Cu, etc.), test soil to determine nutrient deficiencies and apply biofertilizers accordingly and use organic (e.g., manure, biofertilizers) to avoid nutrient imbalances and environmental harm.

2) **Enhancing Organic Matter**: This is adding organic matter like compost, manure, leaf litter, or crop residues to the soil improves its structure, water retention, and nutrient availability. For composting, create a compost pile or bin with kitchen scraps, plant material, and manure. Over time, microbes break down these materials into rich humus. For manure, well-aged animal manure (e.g., from cows, chickens, goats) is a great organic fertilizer and ensure it is well-composted to prevent burning plants and spreading pathogens. Lastly, you can use green Manure by growing cover crops like legumes (peas, beans) or other plants specifically for the purpose of incorporating them back into the soil as green manure.

3) **Crop Rotation and Diversification**: This involves rotating crops to break pest and disease cycles and improve soil fertility. It also entails nitrogen-fixing legumes (e.g., beans, peas) to replenish soil nitrogen.

   A well-planned crop rotation program maximizes soil fertility, minimizes pest and disease buildup, and ensures sustainable yields. Tropical agriculture typically involves staple crops like maize, legumes, root crops, and vegetables. The crop rotation plan should be sustainable taking into account crops grown by both men and women (Table 4.1).

Table 4.1: Indicative crop rotation plan

	Season 1 Nitrogen-Depleting Crop (Cereal Grain)	Season 2 Nitrogen-Fixing Crop (Legume)	Season 3 Root Crop or Tuber	Season 4 Vegetable or Leafy Crop
Crops	Maize, Sorghum, Millet.	Cowpeas, Pigeon Peas, Beans, Groundnuts	Sweet Potatoes Cassava Yams Arrowroot.	Leafy Greens (Spinach, Amaranth), Cabbage, Tomatoes, Peppers
Best practice	Use organic mulches to conserve moisture and apply compost or manure to boost nutrients.	Incorporate crop residues back into the soil and allow fallen leaves to decompose, adding organic matter.	Avoid over-harvesting by alternating harvest timings and apply mulch to protect soil from erosion.	Plant companion crops (e.g., basil with tomatoes) to deter pests and use organic fertilizers like compost teas

   Optional: Cover Crop Season (Green Manure). If there's a gap between main crops, plant cover crops to restore fertility. They suppress weeds, add biomass, and protect the soil from erosion. Example Cover Crops: Velvet Bean (Mucuna pruriens), Sunn Hemp (Crotalaria juncea), Lablab (Lablab purpureus)

4) **Utilizing biofertilizers like**: Rhizobium bacteria can fix nitrogen in the root nodules of legumes; Mycorrhizal fungi - Enhance phosphorus uptake by increasing root surface area; Azospirillum and Azotobacter -Improve nitrogen availability in non-legume crops. These reduce dependence on chemical fertilizers and improve long-term soil fertility.

5) **Conservation Tillage**: Reduce soil disturbance to maintain structure, prevent erosion, and enhance microbial activity.

6) **Mulching**: Cover the soil with organic materials (straw, leaves, or wood chips) to conserve moisture, regulate temperature, and suppress weeds.
7) **Natural Fertilizers**: Use natural amendments like bone meal (phosphorus), blood meal (nitrogen), and rock phosphate.
8) **Cover Cropping**: Grow cover crops to prevent erosion, suppress weeds, and add organic matter.
9) **Soil Erosion Control**: Techniques such as contour farming, terracing, and the use of vegetative buffer strips prevent the loss of topsoil, which is nutrient-rich especially on slopes; Preventing erosion ensures that organic matter and essential nutrients remain available for plant growth and lastly avoid overgrazing by livestock.
10) **Vermicomposting (Worm Composting)**: Uses earthworms to decompose organic waste into nutrient-rich humus (worm castings) that can be added to the soil to improve fertility. You can set up a vermiculture system (a worm bin) with organic waste (e.g., vegetable scraps, coffee grounds) and red wiggler worms. The resulting worm castings can be used to fertilize soil naturally.
11) **Use Biochar**: This is a form of charcoal that is produced by heating organic material in a low-oxygen environment (pyrolysis). It improves soil structure and fertility by increasing water retention, providing habitat for beneficial microbes, and enhancing nutrient absorption. It not only boosts agricultural productivity but also contributes to carbon sequestration, making it an excellent tool for sustainable farming. Biochar is mixed into the soil, ideally in combination with compost or organic matter, to enhance soil fertility and microbial activity.

Biochar ready for soil application

12) **Use of Local Microorganisms (Effective Microorganisms or EM)**: These are beneficial microbes that can be applied to the soil to enhance nutrient cycling, improve plant health, and restore soil biodiversity. Farmers can purchase or prepare EM solutions (often containing lactic acid bacteria, yeast, and photosynthetic bacteria) and apply them to the soil.
13) **Irrigation and Water Management**: Apply water efficiently to prevent salinization and waterlogging; Use mulches to conserve soil moisture and reduce evaporation.
14) **Soil pH Management**: Add lime to raise soil pH or sulfur to lower it as needed, based on soil test results.
15) **Promoting Soil Biology**: Encourage biodiversity by reducing chemical inputs that harm beneficial organisms; Avoid overuse of pesticides and herbicides to protect microbial and faunal life.

Group Activity: *Let participants discuss the soil health and fertility management practices the have been using on their farms citing benefits, challenges and possible solutions*

SESSION 9: INTEGRATED NUTRIENT MANAGEMENT

CONTEXT

Integrated Nutrient Management (INM) is an approach to managing soil fertility that combines multiple sources of nutrients, such as organic materials, biological inputs, and mineral fertilizers, to optimize nutrient availability for crops while maintaining or improving soil health and minimizing environmental impact. The goal is to achieve sustainable and balanced nutrient cycling to support long-term agricultural productivity. It is an approach that can be adopted for transitioning from conventional to agroecological farming.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to:

(i) Understand key natural methods/practices for improving soil health and fertility

(ii) Develop a plan of integrating natural soil fertility practices into their existing farming systems

Key terms: Natural soil fertility practices

Training aids and materials: Stationery, model farm visits, demonstrations, on farm practicals.

Participants will be expected to gather different organic materials for preparing soil fertility enhancing inputs and do a practical.

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Duration
1	Welcome the participants, and share with them the objectives of the meeting. Make sure that all participants have their handbooks with them so that they can refer to the objectives	15 minutes
2	Participants to be introduced to the ▪ Concept of integrated nutrient management (INM), ▪ Principles of INM ▪ Key strategies as highlighted in the handout. Participants to visit an organic farm and learn the practical ways in which to manage their farms using agroecology strategies	30 minutes
3.	Now that the participants understand soil, soil health and soil fertility, introduce the concept of soil fertility management. Refer them to the handout for objectives of soil fertility management. Guide a short discussion on which of the objectives resonates best with their soils.	30 minutes
4.	Facilitate a session on Key natural soil fertility management Practices referring participants to the handout. Draw their attention to the group activity in the handout. Allow them to decide how best to handle the activity and present.	30 minutes
5.	Conclude the session by asking the participants to ensure they have assembled all the materials required for preparing organic inputs as shown in the handout ready for the next meeting.	15 minutes

REFERENCE MATERIAL FOR INTEGRATED NUTRIENT MANAGEMENT

Principles of Integrated Nutrient Management

There are different principles for integrated nutrient management;

1) **Diversity of Nutrient Sources**: Use a mix of organic, biological, and inorganic inputs. Balanced use prevents depletion of nutrient from different sources thus ensuring Sustainable Soil Fertility.
2) **Site-Specific Management**: Tailor practices to the local soil, climate, crop, and farming system. This approach optimizes input use, enhances productivity, and promotes sustainability by accounting for spatial variability in soil properties, crop needs, and environmental factors. Some key issues include;
   - **Crop Requirements:** Identify the nutrient demands of specific crops or crop rotations. Consider crop growth stages and the timing of nutrient uptake (e.g., nitrogen is critical during early vegetative growth).
   - **Climatic Conditions:** Rainfall: Impacts nutrient leaching and water availability; Temperature: Influences microbial activity, nutrient cycling, and plant uptake; Humidity: affects evapotranspiration and soil moisture retention
   - **Topography and Landscape:** Slope and Elevation: Steeper slopes are prone to erosion and nutrient runoff, requiring erosion control measures.
   - **Drainage:** Ensure proper drainage in low-lying areas to prevent waterlogging and nutrient loss.
   - **Decision Support Tools:** These tools help interpret data for informed decision-making
   - **Farmer Field Books:** Manual records for tracking crop performance, soil conditions, and organic inputs.
   - **Local Knowledge and Indigenous Practices:** Use traditional knowledge and observation-based tools for soil assessment.
   - **Participatory GIS (Geographic Information Systems):** Community-driven mapping tools to manage local soil resources effectively. E.g. Soil Grids by ISRIC (World Soil Information), OpenStreetMap (OSM) with Agriculture Extensions, Participatory 3D Modeling (P3DM), Land PKS (Land Potential Knowledge System) and water Soil Mapping Tool among others.
3) **Efficient Nutrient Use**: Minimize nutrient losses through leaching, runoff, and volatilization. It also involves maximizing the uptake and utilization of nutrients by crops while minimizing losses to the environment.
4) **Sustainability**: Maintain soil fertility and ecosystem health over the long term.

Key Strategies for Achieving Efficient Nutrient Use

The key strategies for efficient nutrient use include;

1) **Follow the 4Rs of Nutrient Management**

   The 4R framework ensures nutrients are applied correctly to maximize efficiency:

   - Right Source: Use appropriate organic inputs that match crop needs (e.g. compost for organic matter).
   - Right Rate: Apply nutrients based on soil tests, crop requirements, and growth stage, avoiding over- or under-application.
   - Right Time: Time nutrient applications to match crop uptake patterns (e.g., nitrogen during early vegetative growth).

- Right Place: Place nutrients where roots can access them, such as banding fertilizers near the root zone or using foliar sprays.

2) **Conduct Regular Soil Testing**
   - **Soil Analysis:** Test for macronutrients (N, P, K), micronutrients (Zn, Fe, Mn), pH, and organic matter. For this to be successful, proper soil sampling must be done. Soil sampling is the process of taking a small quantity of soil from the field to act as a representative sample of the soil in that particular field. Soil is sampled in order to be tested for soil nutrients and soil pH. Analysis of the samples gives the farmer information about fertility status of the soil in order to; optimize crop production, aid in the diagnosis of plant culture problems, improves the nutritional balance of the soil, saves money and conserve energy and protect the environment.

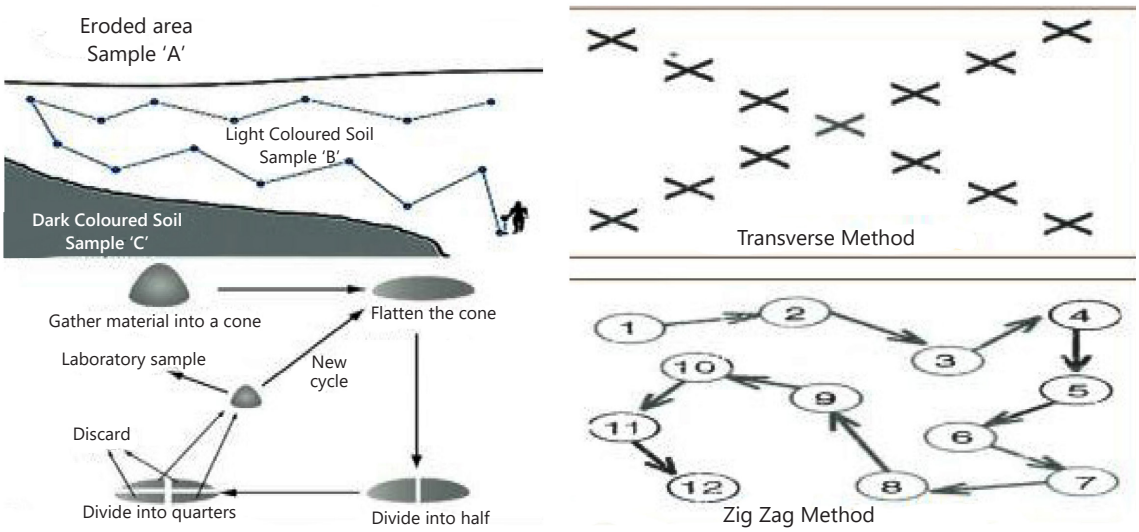


Figure 4.2: Sample areas with different properties and sampling zigzag pattern and (b) method of coning and quartering for reducing sample size

   - **Site-Specific Fertilization:** Tailor nutrient applications based on the variability within a field for optimal results.

3) **Use Organic Amendments and Residues** such as compost and Manure to add organic matter to improve soil structure, water retention, and nutrient cycling; leave residues in the field to decompose and release nutrients and you could use biochar to enhance nutrient retention and reduces leaching losses.

4) **Incorporate Biological Inputs** such as Biofertilizers, Mycorrhizal Fungi, Green Manures and Cover Crops

5) **Adopt Precision Agriculture Practices**
   - Variable Rate Application (VRA): Use GPS-guided systems to apply nutrients based on real-time field data.
   - Remote Sensing and Drones: Monitor crop health and detect nutrient deficiencies to target interventions.
   - Soil Moisture Sensors: Optimize irrigation to prevent nutrient leaching due to overwatering.

6) **Implement Conservation Practices** such as Conservation Tillage, Contour Farming and Terracing, and Buffer Strips and Riparian Zones to filter runoff and trap nutrients.

7) **Monitor Plant Health and Nutrient Uptake**
   - Visual Diagnosis: Identify nutrient deficiencies through symptoms such as yellowing (N deficiency) or purpling (P deficiency).

Box 4.1: General tips for visual diagnosis of plant health

- Older Leaves Affected First: Nitrogen, phosphorus, potassium, magnesium.
- Younger Leaves Affected First: Calcium, sulfur, iron, zinc, boron.
- Interveinal Chlorosis: Magnesium, iron, manganese.
- Necrosis or Browning: Potassium, calcium, copper.
- Yield Monitoring: Use data from previous harvests to refine nutrient management plans.

SESSION 10: PRODUCTION AND USE OF ORGANIC INPUTS

CONTEXT

Organic inputs improve soil fertility, enhance plant growth, and promote sustainable farming by using natural materials such as compost, manure, biofertilizers, and botanical extracts. These inputs are eco-friendly alternatives to synthetic fertilizers and pesticides. High input farming can be more labor intensive and can increase drudgery, which has disproportionate impacts on women, who are tasked with time-consuming agricultural activities, such as manual weeding. This is of particular concern as women already face longer workdays and a more severe time deficit than men in general, given their often-invisible household reproductive and care work. This session will ensure that women gain knowledge and skills on healthy, fertile soil which will lead to better plant growth, reduced time and money spent on chemical fertilizers and labour, and a more resilient farming system overall.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to:

(i) Prepare and apply organic inputs to their selected crop enterprises.

(ii) Reduce use of non-organic inputs into their enterprises

Key terms: organic inputs, locally available materials

Training aids and materials: Stationery, model farm visits, demonstrations, on farm practical.

Participants will be expected to gather different organic materials for preparing production and use of organic inputs.

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Duration
1.	Ask the participants to discuss the field visit and what it is they gained most from the visit in relation to managing their soils for optimum crop production.	15 mins

Activity	Description	Duration
2.	Introduce the topic on production and use of organic inputs as follows: ▪ production and use of organic inputs. ▪ Identify locally available materials for production of organic inputs ▪ Prepare the organic inputs ▪ How to use the organic inputs Proceed for on farm practical and allow the participants to divide themselves in Four (4) groups so that each group prepares two (2) organic inputs as shown in the handout. Once this has been done, supervise the activity ensuring the steps are being followed correctly.	60 mins
3.	The participants to then select a crop and use the inputs and give results at the end of the course. Weekly data and evidence will be expected.	45 mins

REFERENCE MATERIAL FOR PRODUCTION AND USE OF ORGANIC INPUTS

Production and Use of Organic Inputs

Organic inputs improve soil fertility, enhance plant growth, and promote sustainable farming by using natural materials such as compost, manure, biofertilizers, and botanical extracts. These inputs are eco-friendly alternatives to synthetic fertilizers and pesticides.

1) **Compost Preparation and Use**

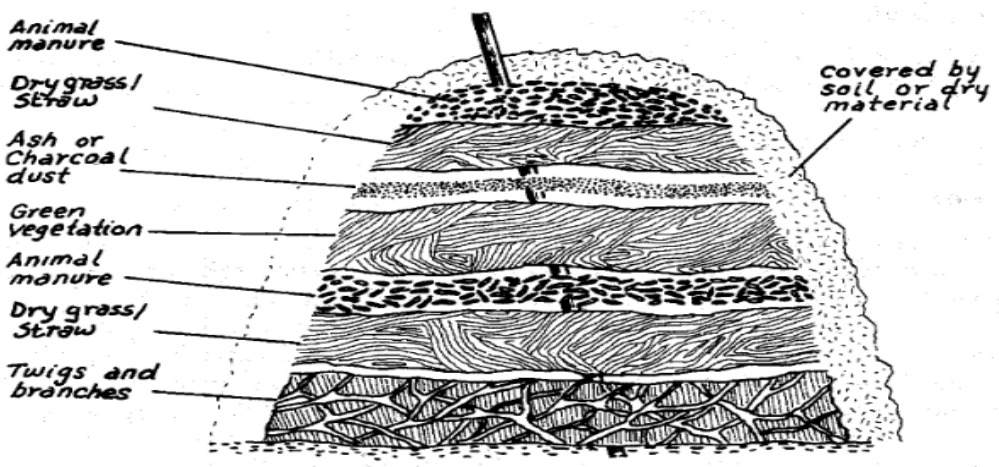
Compost is decomposed organic matter made from crop residues, kitchen waste, animal manure, and other biodegradable materials.

Box 4.2: Preparation steps for compost

1) Materials Needed: Green materials (nitrogen-rich, e.g., kitchen waste, green leaves) and brown materials (carbon-rich, e.g., dry leaves, straw).
2) Layering: Alternate layers of green and brown materials.
3) Moisture Control: Keep the pile moist (like a wrung-out sponge) by watering periodically.
4) Check progress of composting regularly using a stick inserted in the centre of
5) the heap. When the stick is whitish apply water and when warm decomposition is taking place. However, when it is cold turn the compost heap.
6) Aeration: Turn the pile every 2–3 weeks to provide oxygen for microbes.
7) Maturation: Compost is ready in 2–4 months when it is dark, crumbly, and earthy-smelling.

Use in agriculture

- Apply as a soil amendment.
- Mix compost into the topsoil before planting to improve nutrient availability and water retention.



How to layer the materials for compost making

Source: https://statistics.kilimo.go.ke/files/bookpage/KARI_Use_of_Organic_and_anorganic_fertilizers_MaizeVegetables_finger_millet_kenya_.pdf

2) **Vermicompost Preparation and Use**

Vermicompost is compost produced with the help of earthworms, which accelerate decomposition and enrich the material.

Box 4.3: Preparation steps for Vermicompost

1) Materials Needed: Organic waste (vegetable scraps, manure), bedding material (straw, paper), and earthworms (e.g., *Eisenia fetida*).
2) Setup: Prepare a bin with drainage holes and bedding material.
3) Feeding: Add organic waste in thin layers.
4) Maintenance: Keep moist but not waterlogged, and avoid adding meat or oily substances.
5) Harvest: In 2–3 months, collect the vermicompost after earthworms move to fresh waste.

Use in Agriculture:

- Apply vermicompost at 1–2 tons per acre to improve soil structure and microbial activity.
- Use it as a potting mix for nursery seedlings

3) **Manure Preparation and Use**

Farmyard Manure (FYM) and Green Manure are rich in nutrients and improve soil organic matter.

Box 4.4: Preparation steps for Vermicompost Preparation and Use

Preparation of FYM:

1) Materials Needed: Cattle dung, urine, bedding material (straw).
2) Composting: Pile the materials in layers, keeping it moist.
3) Maturation: Allow decomposition for 3–6 months.

Green Manure Preparation:

4) Select Crops: Grow nitrogen-fixing crops like Sunn Hemp, Mucuna, or Sesbania.
5) Incorporation: Plow the crop into the soil when it reaches flowering stage.

Use in Agriculture:

- Apply FYM at least 100 wheelbarrows of 50kg each per acre.
- Use green manure crops as part of a rotation to enhance nitrogen content.

4) **Biofertilizer Preparation and Use**

Biofertilizers contain beneficial microbes that enhance nutrient availability (e.g., nitrogen-fixing, phosphorus-solubilizing).

Types and Preparation:

1) Nitrogen Fixers: Rhizobium for legumes, Azospirillum for cereals.
2) Phosphate Solubilizers: Pseudomonas and Bacillus species.
3) Potash Mobilizers: Frateuria aurantia.

Use in Agriculture:

- Seed Treatment: Coat seeds with biofertilizer slurry before sowing.
- Soil Application: Mix biofertilizer with compost and apply near the root zone.

These can be sourced from companies e.g KOPPERT and REAL IPM

5) **Compost tea**

Compost Tea provides a quick nutrient boost.

Preparation Steps:

- Mix compost with water (1:5 ratio) in a bucket.
- Aerate the mixture for 24–48 hours.

Use in Agriculture:

- Foliar Spray: Dilute with water (1:10) and spray on leaves for quick nutrient absorption.
- Soil Drench: Apply directly to the root zone to improve microbial activity.

6) **Plant Teas for Fertilization**

Plant teas are organic liquid fertilizers made by steeping plant materials in water to extract nutrients and beneficial compounds. These teas provide plants with essential nutrients, boost soil health, and repel pests. They are widely used in agroecological and organic farming systems.

Materials Needed

1) Fresh or dried plant materials (e.g., comfrey, nettles, garlic).
2) Water (preferably rainwater or non-chlorinated water).
3) Container for steeping (plastic or non-metallic).
4) Stirring stick.
5) Optional additives: Molasses (to enhance microbial activity) and Wood ash (for added potassium)

Box 4.5: General Steps to Prepare Plant Teas

1) Gather Plant Materials chosen based on their nutrient properties.
2) Chop or Crush Plant Materials into small pieces to release more nutrients during steeping.
3) Fill a container halfway with the plant material and add water to fully submerge the plants, leaving some space for fermentation.
4) Mix in 1-2 tablespoons of molasses per 4L of water to boost microbial activity and wood ash for extra potassium.
5) Steep and Ferment by covering the container loosely to allow gases to escape. Then place in a shaded area and let it steep for 7-14 days. Stir daily to aerate and promote even fermentation.
6) After fermentation, strain the liquid through a sieve or cloth to remove solids. Compost the leftover plant material or use it as mulch.
7) Dilute before use with water at a ratio of 1:5 to 1:10, depending on plant sensitivity.

Examples of Plant Teas for improved plant growth

Plant Teas	Description	How to Use
Nettle Tea (Nitrogen-Rich)	▪ Ingredients: Stinging nettle leaves. ▪ Benefits: Promotes leafy growth and improves chlorophyll production.	Dilute 1:10 and apply as a foliar spray or soil drench
Comfrey Tea (Potassium-Rich)	▪ Ingredients: Comfrey leaves. ▪ Benefits: Enhances flowering, fruiting, and root development.	Dilute 1:5 and apply to flowering plants or fruit trees
Weed Tea (General Fertilizer)	▪ Ingredients: Common weeds like blackjack, Mexican marigold, wandering jew etc ▪ Benefits: Recycles nutrients and improves soil microbial activity.	Dilute 1:10 and apply to the soil
Seaweed Tea	▪ Ingredients: Fresh or dried seaweed. ▪ Benefits: Provides trace minerals, hormones, and growth stimulants.	Dilute 1:5 and apply as a foliar spray or root drench

Application of Plant Teas

1) Foliar Spray: Spray diluted tea onto leaves to provide immediate nutrients.
2) Soil Drench: Pour around the base of plants to feed roots and enrich the soil.
3) Compost Activator: Use undiluted tea to accelerate composting processes.

Precautions

1) Avoid Over-Fermentation: Over-steeping can lead to anaerobic conditions, resulting in foul odors and harmful compounds.
2) Dilution: Always dilute before applying to prevent nutrient burn.
3) Test on Plants: Test on a small area before wide application to ensure plant compatibility.
4) Storage: Use fresh or within a week, as plant teas lose potency over time.

7) **Tithonia plant tea preparation and use**

Tithonia, also known as Mexican sunflower (Tithonia diversifolia), is a fast-growing, nutrient-rich plant that is commonly used in agroecological farming systems. It is known for its high nitrogen content and ability to improve soil fertility. Tithonia can be used as a plant tea to enhance plant growth, improve soil health, and promote microbial activity in the soil and Some compounds in Tithonia have mild insect-repellent properties, which can help reduce pest pressures.

How to Prepare Tithonia Plant Tea

Ingredients:

- Fresh Tithonia leaves (preferably from young plants).
- Water.
- Optional: Molasses (to boost microbial activity) or wood ash (for added potassium).

Box 4.6: Steps to Make Tithonia Tea

1) Collect fresh, healthy Tithonia leaves. If possible, use young leaves as they tend to have the highest nutrient content.
2) Chop the leaves into smaller pieces to help release more nutrients during the steeping process. You can also crush or
3) Place the chopped leaves into a container (plastic or non-metallic). Fill it halfway with the Tithonia leaves.
4) Pour water over the leaves until they are completely submerged. Use around 1 part of leaves to 3-5 parts of water, depending on the concentration you prefer.
5) Optional Additives: Molasses: Add 1-2 tablespoons per gallon (3.7 liters) of water to enhance microbial activity. Wood Ash: Add a small amount (about a handful per 10 liters of water) for extra potassium if desired.

Box 4.6: Steps to Make Tithonia Tea

6) Ferment the mixture by covering the container loosely to allow gases to escape and place the container in a shaded area.
7) Let the mixture steep for 7-14 days, stirring daily to keep the fermentation process active.
8) After fermentation, strain the liquid to remove the solid plant material. The tea should be dark and nutrient-rich.
9) Dilute before Uue with water, typically at a ratio of 1:5 (1 part Tithonia tea to 5 parts water), depending on plant sensitivity. For young or delicate plants, dilute further.

How to Use Tithonia Plant Tea

1) Soil Drench: Pour the diluted tea around the base of plants to provide nutrients directly to the roots and improve soil fertility. This is especially effective for plants in need of a nitrogen boost.
2) Foliar Spray: Spray the diluted Tithonia tea on plant leaves, especially for leafy vegetables and plants that require rapid vegetative growth. Apply in the early morning or late afternoon to avoid leaf burn.
3) Compost Activator: Use undiluted Tithonia tea to help accelerate the decomposition of compost and enrich the microbial diversity in compost piles.
4) Pest Control (Mild): Tithonia has some pest-repellent properties due to compounds like saponins. Applying the tea may help deter pests, though it is not as strong as other insecticidal plants like neem.

Precautions

1) Dilution: Always dilute the tea before use to prevent nutrient overload or potential plant burn due to the high nitrogen content.
2) Odor: As with many plant teas, the fermentation process may create strong odors, so it's best to prepare it in a well-ventilated area or outdoors.
3) Application Timing: Apply during cooler parts of the day (morning or evening) to prevent rapid evaporation or leaf damage.
4) Test First: Before using on all plants, test the tea on a few plants to ensure it does not cause diverse reactions.
5) Storage: Use fresh or within a week, as plant teas lose potency over time.

8) **Liquid Manure from Rabbit Urine**

Rabbit urine is an excellent source of nutrients like nitrogen, potassium, and phosphorus, making it a potent organic fertilizer for plants. Proper preparation ensures it is safe, effective, and easy to use

without causing harm to plants or the environment.

Materials Needed

1) Fresh rabbit urine (collected from rabbit pens or litter trays).
2) Water.
3) Fermentation container (plastic or non-metallic container with a lid).
4) Optional additives:
   - Molasses (to enhance microbial activity during fermentation).
   - Wood ash (for additional potassium).

Steps to Prepare Liquid Manure from Rabbit Urine

1) Collect Rabbit Urine
   - Use trays or containers beneath rabbit pens to collect urine.
   - Filter or strain the urine to remove solid impurities, like feces or bedding materials.
2) Mix the Ingredients
   - In a container, combine the rabbit urine with water at a ratio of 1:2 (1 part urine to 2 parts water) for fermentation.
   - Add optional materials:
   ~ Molasses: Add 1-2 tablespoons per liter of liquid to promote beneficial microbial activity.
   ~ Wood Ash: Add a handful per 10 liters to increase potassium content.
3) Ferment the Mixture
   - Stir the mixture thoroughly and cover the container loosely to allow gases (like ammonia) to escape during fermentation.
   - Place the container in a shaded area and let it ferment for 1-2 weeks.
   - Stir the mixture daily to aerate and ensure uniform fermentation.
4) Dilute Before Application
   - Once fermentation is complete, dilute the liquid manure with water at a ratio of 1:10 (1part fermented rabbit urine to 10 parts water) before applying it to plants.

How to Use Rabbit Urine Liquid Manure

1) Foliar Spray
   - Fill a sprayer with the diluted liquid manure.
   - Spray directly onto plant leaves, focusing on the undersides where nutrient absorption is most effective.
2) Soil Drench
   - Pour the diluted mixture around the base of plants to enrich the soil and feed plant roots.

3) Compost Activator
   - Add undiluted rabbit urine to compost piles to accelerate decomposition and enhance nutrient content.

Nutrient Content of Rabbit Urine

- Nitrogen (N): Promotes leafy and vegetative growth.
- Phosphorus (P): Enhances root development and flowering.
- Potassium (K): Improves disease resistance and overall plant health.
- Contains trace elements like calcium, magnesium, and sulfur.

Precautions

1) Always dilute fermented rabbit urine to prevent plant burn due to its high nitrogen content.
2) Apply in the early morning or late afternoon to avoid nutrient loss through evaporation.
3) Ferment in a sealed or covered container to minimize odors.
4) Excessive application can lead to nutrient imbalances or contamination of water sources.

Stakeholder's training on compost manure

MODULE 5: SEED DIVERSITY AND SECURITY

In practice, farmers need require a better understanding of seeds types, how to manage the seeds, storage and saving the seed to ensure availability for planting. This section of the module contributes this need by focusing on two aspects; (i) seed diversity, and (ii) seed security.

SESSION 11: SEED DIVERSITY

CONTEXT

Seed is the first link in the food chain, and smallholder farmers rely on farmer-to-farmer seed exchange and storage for production, biodiversity, and food security. Promoting agroecology transition requires prudent seed management systems, such as farm-saved seeds and community seed banks. Protecting traditional seed knowledge and farmers' rights to save, use, exchange, and sell seeds is essential. Incorporating seed governance with a focus on farmer-managed seed systems strengthens sustainable agriculture. This training module equips smallholder farmers with practical knowledge on seed selection, breeding, quality, harvesting, packaging, and bulking.

MODULE LEARNING OBJECTIVES AND EXPECTED OUTCOMES

By the end of the session the participants will be able to:

(i) Describe the different concepts in seed management

(ii) Integrate seed saving practice in their production systems

(iii) Analyse factors affecting seed security

Key Terms: Seed diversity, seed saving, seed storage, farmer managed seed systems, certified seeds

Teaching aids and materials: Stationary, Markers, Demonstration farm; seed savers/banks, Samples of different types of seed and glass bottles to demonstrate proper seed storage and; Training manual/booklets

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Duration
1	Welcome the participants to the training. Give then a chance to introduce themselves to each other, and explain the objectives of the training/meeting. Thereafter, introduce the main objectives of the training.	10 minutes
2	**Group discussion** The discussion aims to encourage participants to examine the advantages and disadvantages of seed management;	30 minutes

	Instructions 1) Form small groups of 4-5 people and assign each group a common vegetable seed in their area. 2) Instruct each group to discuss the importance of seed and where they normally obtain seed. 3) Let them discuss how whether they face any challenges in production, availability, and accessing seeds and how they overcome the challenges. Invite the groups to present their findings.	
3	Ask the participants to mention different types of seeds used in the production of crops specific to the area. In a discussion, ask the participants to form groups of 4-5 individuals, and discuss the following; ▪ What are some of the features of healthy seeds? ▪ What are some of the measures taken to ensure proper drying, and storage of the seeds? ▪ What are the methods used to prepare and store the seeds? ▪ What is the difference between certified and uncertified seeds in their own understanding? ▪ Do they know any policies/regulations in place guiding the seed systems in Kenya or at the county level? **Role play:** Trainer – Leads the discussion. Farmer A (Experienced Farmer) – Shares knowledge about certified and uncertified seeds. Farmer B (New Farmer) – Has little knowledge and asks questions. Farmer C (Traditional farmer) – Prefers indigenous methods and expresses doubts about certification. Agricultural officer – Provides official guidance on regulations and best practices. Farmer A: Healthy seeds should be clean, free from pests, have high germination rates, and be adapted to our climate. Farmer B: How do I ensure my seeds are stored properly? Farmer C: In my family, we dry seeds under the sun, then store them in gourds or sacks with ash to keep pests away.	60 minutes

	Agricultural officer: That's a good traditional method, but certified seeds are stored in controlled conditions to maintain quality. We also recommend airtight containers or treated storage bags to prevent pest infestation. *(Let the discussion to continue exhaustively)* Allow the group to present their findings, and allow the rest of the participants to critique their findings, and propose the best way forward.	
4	Identify a farm within the area where seed production, storage and saving are being done for the demonstration. Allow the farmers to demonstrate how they prepare the seeds in readiness for storage, and guide them on the best practices.	120 minutes

REFERENCE MATERIAL FOR SEED DIVERSITY

Introduction to Seed Management

Seed may be any plant part used for further propagation or multiplication. Seed management ensures that existing seed systems conserve, manage, and regenerate diverse species and varieties and can ensure the flow of quality seed for production. That way, seed systems are not commodified and farmers have free and adequate access to conservation contributing to regenerating the environment as well as supporting rural communities. Seed is important for several reasons;

- Seed is the foundation of production and poor-quality seed leads to poor harvest or yield.
- Seed is one of the most important inputs and often covers a major cost in the production process.
- Seed carry a specific genetic potential and any loss of genetic potential impacts negatively on the resilience of crops.
- Seed combined with the appropriate agri-inputs and food agricultural practices can help to exploit the genetic potential of the seed.
- Seed is living matter and can deteriorate in value if not properly handled and stored.

Seed systems management offer several significant benefits, which contribute to agricultural sustainability and resilience. They include;

- Agricultural biodiversity by maintaining and using a wide variety of crop species and landraces. This diversity includes traditional varieties that may not be commercially viable but are well adapted to local conditions. Preserving this genetic diversity helps ensure a resilient food supply and protection against pests, diseases, and changing environmental.
- Cost-effective for farmers compared to purchasing seeds from commercial sources. Farmers save money by reusing seeds from their own harvests and exchanging seeds with other farmers, reducing their dependency on expensive, externally sourced seeds. This financial saving can be significant.
- Improves seed access, particularly in remote or underserved areas where formal seed distribution systems are either lacking or unreliable. Farmers can access a variety of seeds that are better suited to their specific agro ecological conditions. This localized system ensures that seeds are readily available when needed, enhancing timely planting and productivity.
- Empowers farmers by giving them control over their seed resources. Seed sovereignty means that farmers can save, use, exchange, and sell seeds freely, without being restricted by patents or

proprietary seed laws. This autonomy supports traditional farming practices and allows farmers to maintain their agri biodiversity.

Key Components of Seed Management

Seed Selection and Preservation

- **Selection**: Farmers choose seeds from their best-performing crops based on desired traits such as yield, resistance to pests and diseases, and adaptability to local conditions.
- **Preservation**: Selected seeds are carefully preserved using traditional methods to maintain their viability. This might include drying, storage in cool, dry places, and the use of natural preservatives.

Seed Exchange and Sharing

- **Exchange**: Farmers often exchange seeds with one another to diversify their seed stock and introduce new gene c material. This can occur within communities or between different regions.
- **Sharing**: Seeds are also shared during community gatherings, festivals, and through local seed banks, ensuring that all farmers have access to quality seeds

Local Seed Banks

- **Community Seed Banks**: These are established to store and manage a variety of seeds for communal use. They act as a reservoir of genetic diversity and provide seeds during planting seasons or a er crop failures.
- **Farmer-Owned Seed Banks**: Farmers also establish their personal seed banks where they save seeds awaiting the next planting season

Figure 5.1: Components of seed management

Types of Seed

In seed management, it's important to distinguish between different types of seed and the implications thereof: The types include;

1) Open-pollinated variety (OPV) - A heterogeneous variety of a cross-pollinated crop that is allowed to inter-pollinate freely during seed production. This variety seed is one in which pollination is carried out from either the same (parent) plant. OPVs are more resilient and resulting crop is affordable and available to smallholder farmers.
2) Self-pollinated crops seed - Those plants that pollinate themselves by accepting pollen from within their own flower before it open.
3) Hybrid variety - A hybrid seed is created by crossing two unique parents. Crossing involves taking the pollen from the male and transferring it to the female.
   - They are produced through a controlled cross pollination of one variety of a class of plant with the pollen of another genetically different variety of that class. Often the seed shows "hybrid vigor" – where the plants come out stronger than their parents.
   - However, the resulting seed cannot be replanted in the following year. Upon saving and replanting, these plants will not give the best characteristics. By implication, since hybrid seed is mostly commercialized, it locks in smallholder farmers into dependence compromising their seed sovereignty.
   - The seeds are in most cases not adaptable to the local climate conditions affecting crop resilience.

4) Improved (modern) varieties – These are seed varieties which have been bred for specific traits such as high yields, resistant to pest and diseases, tolerant to drought or other stresses. These can be OPVs or Hybrids. Improved OPVs can be certified or not.

5) Improved varieties are not only higher-yielding but are also more resistant to the climatic stresses typical of the region, such as erratic rainfall and prolonged dry spells. Cost effective measures such farmer-led seed selection is encouraged.

Seed selection

To identify the plants from which to source seeds from, farmers need to note the first plants, which sprout after planting. The plants are then marked, for example, by tying the stems with a colour. The key factors for selection are;

- Genetic purity –refers to the percentage of contamination by seeds or genetic material of other varieties or species. The genetic characteristic of a particular cultivar variety should be high yielding and disease or pest resistance
- Analytical purity- The proportion of pure seed in a seed lot should be selected as much as possible
- Seed viability and germination capacity - Seed viability refers to the capacity of a seed to germinate and produce a normal seedling. Good quality seed should have a germination rate of at least 90%.
- Seed vigour-Seed vigor is the ability of seeds to germinate and establish healthy seedlings under variable field conditions
- Seed size – Seed size is a trait of the plants that directly affect seed germination and seedling recruitment. Often, larger seeds have higher germination percentage and produce more vigorous seedlings
- Seed health – This is the extent to which seed is free from or carries pests and diseases. Healthier seeds have a higher germination rate and vigor (how well the plants grow)
- Seed moisture-Seed moisture affects seed longevity, processing and attack of pathogens. Seeds with moisture content of 14% or less can be stored for few weeks, while seeds with a moisture content of 5-10% can be stored in the long term.
- Seed longevity-Refers to how length of time from maturation to the loss of seed viability in dry storage. Seeds with longevity are more preferred.

Seed saving and storage

- Seed-saving: Selecting and storing seeds from the best plants for planting in the next season to ensure suitable and adapted varieties.
- Minimizes chemical use: Reduces dependence on artificial fertilizers and agrochemicals by preserving resilient seed varieties.

- Seed storage: Involves preserving seeds under controlled environmental conditions to maintain viability, germination, and vigor from harvest to planting.
- Misconception about storage: Storage is often wrongly assumed to require complex and costly structures, whereas simple, effective methods can suffice.
- Importance of proper seed storage: Ensures seeds remain in good physical and physiological condition until planting.
- Key principles of seed storage Include:
  - ~ Maintaining low moisture content to prevent fungal growth.
  - ~ Storing seeds in cool and dry conditions to preserve viability.
  - ~ Using airtight containers to protect seeds from pests and humidity.
  - ~ Regularly monitoring stored seeds to check for spoilage or loss of germination capacity.

Requirements for storage;

- Seed storage conditions should be dry and cool.
- Ensure proper storage pest control
- Proper sanitation in seed stores / banks
- Ensure seed has safe moisture limits
- Seed longevity is improved by storing seeds in low temperature and low moisture content

Key considerations;

- Storage methods: Seeds can be stored in glass bottles, sealed containers, aluminum or plastic cans, and laminated paper bags.
- Airtight storage & preservation: Seeds should be kept in airtight containers and preserved using natural methods like adding ash or diatomaceous earth dust.
- Accountability in storage: Farmers can hold each other accountable throughout the storage period, either through individual seed banks or jointly managed storage systems.
- Women's involvement: Women should be fully involved in setting up seed banks and, where possible, have equitable ownership of them.
- Documenting traditional knowledge: Indigenous seed varieties should be researched and documented to preserve traditional knowledge and support conservation efforts.

Practical Activity

1) What are some traditional methods you use to preserve and store seeds, and how effective have they been in maintaining seed quality?
2) How can natural preservatives like ash help in seed storage, and what other locally available materials can be used?
3) What challenges do you face in seed storage, and what strategies can be implemented to improve seed longevity and quality in your community?


Farmer showing seed storage bottles; Courtesy, PELUM Kenya, 2024

The storage period can be divided into five stages: (i) Harvest maturity; (ii) Drying and threshing; (iii); Processing; (iv) Distribution and marketing; (v)On-farm storage (FAO, 2018)1;

1) The period from physiological maturity to harvestable maturity is the first segment of the storage period. Seeds are physiologically mature when they reach maximum dry weight on the plant.
   - At physiological maturity, dehydration of the seed has begun, but is not yet complete; it continues until the moisture content of the seed and fruit decreases to a level that permits effective and efficient harvest and threshing, i.e. harvest maturity.
   - Any delay in harvesting after the seed reaches harvest maturity prolongs the first segment of the storage period, and often results in deterioration of quality.
   - The moisture content is the amount of water in the seed and is usually expressed as a percentage on a "wet basis" (wb), calculated as follows:

$$\frac{\text{Weight of moisture}}{\text{Weight of wet sample}} \quad X \quad 100$$

Occasionally, "dry basis" (db) moisture content is given and it is important to know which has been used. For example, if 100 kg of moist grain is dried and loses 20 kg of water, the moisture content is;

$$\frac{20 \times 100}{100} = 20\% \text{ (wb)} \qquad \text{or} \qquad \frac{20 \times 100}{100} \times 100 = 25\% \text{ (db)}$$

Grain is normally harvested at moisture content of 18–25% (wb).

- However, a range of factors – stage of crop maturity, season, weather pattern and drying facilities – influence the moisture content, which can therefore be substantially higher or lower.
- Hand-held electric moisture meters are used at field level to obtain a rapid reading of grain moisture content. They measure the grain's electrical properties, which are closely related to moisture content and give quite accurate results within the range of 13–16% moisture content.

1 FAO. 2018. Seeds toolkit - Module 6: Seed storage. Rome, 112 pp.

2) The second segment of the storage period is from harvest to the beginning of seed processing. When seed is in the combine, the grain wagon, in bulk storage or the drying bins, it is in storage; its quality is affected by the same factors conditioning seed quality during the later stages of storage (packaged seed or distribution and marketing).
3) The third segment of the storage period is from the onset of seed processing through to packaging.
4) Once the seed is in its packaged form, the storage period covers distribution and marketing, including storage in warehouses and at retail points.
5) Finally, seed is stored on the user's farm before and during planting. The seed quality – mainly germination and vigor – can be significantly affected during any of these five stages.
    - It is therefore essential to follow sound principles of seed storage and to handle seeds properly; best practices apply also to seed held at transit points during transportation by cart, lorry, rail, air or any other means.

Certification level

The listed types of seed can be certified or uncertified;

- Certified seed - Seed of a prescribed standard of quality, produced under a controlled multiplication scheme, either from basic seed or from a previous generation of certified seed. The seed is normally sourced from formal seed shops.
- Uncertified seed is part of commercial produce, saved for sowing/planting purposes. Often, routine seed testing is not done and processes are manual and sometimes prone to diseases.
- As majority of seed is uncertified, establishing farmer-based system is important for ensuring quality of seed. For example, quality declared seed (QDS) is an alternative system for seed quality assurance, developed for countries with limited resources.
- The QDS system is a seed-producer implemented system for production of seed that meets at least a minimum standard of quality but does involve formal seed inspection by the authorities.
- In Kenya, QDS is allowed for vegetative propagated materials (VPG). In the absence of an elaborate quality seed management, farmers and farmer groups can establish their own ways for ensuring that they use quality seed.

Seed regulation

In Kenya, the Seeds and Plant Varieties Act regulates the production of all seed varieties and planting materials.

The law requires that all seed producers and distributors must be registered, certified and have specific licenses to operate in the country.

The Kenya Plant Health Inspectorate Service (KEPHIS) oversees the implementation of the Act, through seed testing, certification and enforcement of the regulations. KEPHIS has licensed a number of seed actors – some who pushed for the creation of the law – who have the financial and technological muscles to produce seeds, therefore, keeping the sector in the hands of a few.

SESSION 12: SEED SECURITY

CONTEXT

In the recent past, there has been increased formalization and commercialization of seed, raising concerns about seed sovereignty in developing countries. Particularly, access to formal seed limit what farmers can do with their own seed varieties and also leads to loss of control and accessibility of local seed resources.

MODULE LEARNING OBJECTIVES AND EXPECTED OUTCOMES

By the end of the session the participants will be able to:

(i) Appreciate the key elements of seed security

(ii) Integrate seed saving practices in their production systems

Key terms: seed quality, seed viability, seed access

Training materials: Stationary, Markers; Demonstration farm; seed savers; Samples of different types of seeds for assessing the quality and viability; Training manual/booklets

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Duration
Welcome	Welcome the participants to the training. Let them introduce themselves to each other, and explain the objectives of the training/meeting, and introduce the main objectives of the training.	15 minutes
Activity	**Group Discussion** Ask the participants to mention different types of seeds used in the production of crops specific to the area. In a discussion, ask the participants to form groups of 4-5 individuals, and discuss the following; ▪ How can they describe seed security, and what measures are in place to ensure they are seed secure? ▪ What does seed quality means to the farmers? How do they ensure good quality for their seeds? ▪ What are the means used to access seeds during the planting? What are the systems in place to ensure ease of access to the seeds? ▪ What are some of the challenges encountered in accessing the seeds and how have they been addressing it? ▪ What does seed viability mean to them? What measures are in place to ensure seed viability is ensured as they undertake the seed saving and storage?	60 minutes

	Role play: Farmer B: I am worried about this planting season. Last time, I bought seeds, but they didn't germinate well. How do we ensure we have good seeds? Farmer A: That is a big problem. Seed security means we should always have access to high-quality seeds that are affordable and available when we need them. Farmer C: I save my seeds from previous harvests. My grandparents did the same. But last year, my maize didn't grow well. Maybe my storage method wasn't good enough. Agricultural officer: Provide guidance… *(Let the discussion to continue exhaustively)* Allow the group to present their findings, and allow the rest of the participants to critique their findings, and propose the best way forward.	
Farm visit	Identify a farm within the area where seed production, storage and saving are being done for the demonstration. Allow the farmers to demonstrate how check on the seed quality and viability and guide them on the best practices.	120 minutes

REFERENCE MATERIAL FOR SEED SECURITY

Elements of Seed Security

Seed security ensures that farmers have reliable access to quality seeds that are available, affordable, and suitable for their local conditions. It is essential for food security, agricultural resilience, and sustainability. Seed security is built on four key pillars:

a) Seed availability

Local and national availability: Seeds must be accessible locally, regionally, or nationally, especially during crises like droughts or floods.

Importance of seed availability: Ensures farmers have sufficient, high-quality seeds when needed, relying on efficient production, distribution, and storage systems.

Formal and informal systems: Both certified seed companies (formal) and farmer-saved seeds, community seed banks (informal) contribute to seed availability.

Challenges and solutions: High costs, poor infrastructure, and climate change limit access, while solutions include strengthening local production, improving distribution, and investing in climate-resilient varieties.

Farmer participation: Women and men farmers can save and exchange seeds, participate in local seed banks, learn improved storage techniques, join cooperatives, and advocate for inclusion in seed distribution initiatives.

b) Seed access

Access to seed is not uniform across farmers. The following aspects affect seed security;

- Higher income households manage fewer diverse crop systems since they are more commercialized and focus on cash crops. At the same time, these households grow local crops for food consumption.
- Improved and hybrid varieties are commonly used by higher income farmers while local uncertified varieties are used by lower income farmers. This leads to differences in production and productivity. Lower income farmers find more difficult to obtain improved varieties leading food insecurity and stagnated incomes.
- Higher income households have higher control over and access to seed. Lower income farmers on the other hand have limited stock and more constrained specially if the seed costs are high during the planting season. In the face of seed scarcity, the lower income households are only able to buy to poor quality seed and/or exchange of their labour for seed.
- Women have a lower access to seed for a number of reasons;
  - ~ Seed systems tend to prioritize higher-value cash crops dominated by men, excluding seed for women-dominated enterprises.
  - ~ Women also lower access to and control over essential resources to purchase seed.
  - ~ Women often have inadequate information and knowledge about seeds, and limitations to their mobility and social networks often shut them out of formal information channels, such as extension services.
  - ~ Training opportunities are often limited by household norms and roles. This restricts women's abilities to use new seed technologies effectively, and when combined with barriers access to money, women only afford lower quality seed.

c) Seed quality

Types of seeds and longevity: Seed storability depends on its type—as sensitivity to drying and temperature affects longevity.

Natural lifespan of seeds: Some crops (e.g., onion, soybean, groundnut) have short-lived seeds, while others (e.g., cereals and grain legumes) store longer.

Storage maintains, not enhances, quality: Storage cannot improve seed quality, except in cases where dormancy is broken in hard seeds to enable germination.

Impact of initial quality: Seeds with high initial quality (germination and vigor) are more resistant to unfavorable storage conditions and last longer.

Risk of deterioration: Once deterioration begins, it progresses rapidly, making it essential to store only high-quality seeds and reject low-quality ones for future planting.

d) Seed viability

Seeds with high initial viability maintain their quality for longer than seeds with low viability. The dry and cool conditions prevailing in certain locations during seed maturation and harvest mean that freshly harvested seeds reaching very high viability and germination capacity levels. This high initial viability can be key for the successful and sustainable supply of high-quality seed. Test for germination right after harvest to determine which seed lots have high viability (good candidates for storing) and which have low viability (higher risk in storage). The quality of any seed decreases with time and deterioration is inevitable. The survival curve for dry seeds stored under favourable environmental conditions is divided into three distinct parts:

1) The seed is vigorous and the decline in life functions proceeds slowly. Germination (viability) remains unchanged for a period during storage until this stage ends at a survival level of 90–75%.
2) Deterioration and decline in germination proceed very rapidly to a survival level of 25–10%.
3) Deterioration slows again and continues gradually until all seeds are dead.

e) Importance of seed security

The importance of attaining food security is as follows;

- It supports the food production and nutrition of the farmers.
- It enhances climate resilience and biodiversity amongst the farmers.
- It strengthens the farmers' autonomy and livelihoods.
- It prevents dependency on low-quality or counterfeit seeds.

Therefore, in supporting seed security, there must deliberate efforts to support women and vulnerable households to increase access to seed. This may include;

- Recognizing the user needs and preferences of women and men and devising appropriate delivery channels for each.
- Using targeted and accessible channels, such as video, mobile seed shops or promotions in local markets to provide information, for both women and men
- Making quality seed affordable and within the reach of women, tackling any negative outcomes and trade-offs. .
- Enhance the knowledge and skills of women, while reinforcing access to supporting and complementary resources, inputs and services.
- Adapting training and other support to meet the specific needs of women—and their families in terms of location and timing.
- Involving women and men equally in making decisions on seed systems especially community seed banks.

Seed bank

MODULE 6: INTEGRATED CROP PRODUCTION

Crop production is the process of growing crops for food, fibre, or other agricultural products. Women take up the more time-consuming and labour- intensive tasks of crop and livestock production. The types of agricultural activities taken up by women include: sowing, nursery management, transplanting, weeding, irrigation, fertilizer application, plant protection, harvesting, winnowing, storing among others. Integrated crop production requires technical knowledge and careful planning to ensure all components work synergistically. It has the benefits of providing women farmers with multiple income streams, thus protecting them from financial risks caused by crop failure or market price fluctuations. Integrated farming systems produce diverse food items, including grains, vegetables, meat, eggs, milk, and fish, for better nutrition and reduce waste by reusing by-products across different farm enterprises.

Recycling is central to the concept of a circular economy, in which no external inputs are needed and no waste is created, as all resources are recycled in a closed loop. In several important ways, women in particular stand to benefit from closing this loop. In a treadmill system with high input costs, women and marginalized people are frequently shut out of markets due to barriers to entry and lack of access to extension and credit services.

The aim of this training module is to equip participants with knowledge in integrated farming methods, natural pest and disease management, production and use of biopesticides and lastly techniques to naturally store and prepare value added products, hence, enhanced food security.

SESSION 13: AGROECOLOGICAL CROPPING SYSTEMS

CONTEXT

A key principle of agroecology is the diversification of the farming system through practices such as mixed cropping, intercropping, agroforestry, and livestock integration. These practices amplify the positive effects of biodiversity on productivity through better use of sunlight, water, and soil resources, and the enhanced regulation of pest populations. Crop diversification schemes are multi-functional as their adoption usually means favorable changes in various components of the farming systems at the same time, activating key processes such as recycling, biological control, antagonism(interaction between organisms where one organism benefits at the expense of another) , and allelopathy(biological process in which plants are able to prevent other plants from growing near them due to the release of toxic substances)., which are essential for agroecosystem sustainability and productivity. of crop and livestock production

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session, the participants will be able to:

(i) Identify the different agroecological cropping systems

(ii) Select and implement appropriate cropping systems that meet their needs and protect the environment

Key terms: mixed cropping, intercropping, crop diversification

Training material and resources: Stationery, model farm visits, demonstrations, on farm practical.

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Resources
1	Welcome participants to the session. Start by asking them to name the crops which they grow including. (i) Vegetables, (ii) Fruits, (iii)Cereals, (iv) Legumes. Then ask the participants to rank the crops in terms of most important according to gender.	15 minutes
2	Discuss agroecological cropping systems. Refer to handout (i) Allow the participants to identify cropping systems they use in their farms to grow the crops mentioned in step 1. (ii) Ask which cropping systems work best for the participants? (iii) What indicators do they use to judge the functionality of a cropping system?	20 minutes
3	Facilitate a Practical activity on how to prepare different types of beds- Double dug, raised, sunken and vertical garden. Participants to be divided into groups for this exercise.	45 minutes
4	Conclude this session by asking the participants to volunteer (1 from each group) to give a summary of the main points learnt. Allow the two to agree who presents which points.	20 minutes
5	Inform participants that the next meeting will be a field trip to learn about integrated farming. Refer them to the handout so that they have an idea before the field trip.	10 minutes

REFERENCE MATERIAL FOR AGROECOLOGICAL CROPPING SYSTEMS

Introduction to Crop Production

For successful crop production, other than plant nutrition, pest and disease control, water management, other important practices include:

1) **Selection of crop varieties**: Choose appropriate crop varieties that are well-suited to local climatic, soil, and market conditions is essential for success. Select varieties resistant to pests, diseases, and environmental stress and those that are high-yielding varieties that meet the market demand (e.g., disease-resistant varieties in the case of rice or maize).

2) **Proper land preparation**: Land preparation involves preparing the soil for planting to ensure a favorable environment for seed germination and root growth. Small seeded crops require a fine tilth while large seeded crops may require minimum tillage. Plants may be raised in beds.

Types of beds include:

- Double dug- The bed remains active for replanting for 2-3 years, or 6-8 planting cycles. Then it should be re-dug.
- Raised beds- for areas that received a lot of rainfall.
- Sunken bed- for dry land areas.

- Vertical gardens- help **maximize limited garden space**. Farmers can get as innovative as they may by using all sorts of locally available materials such as sacks, wood, dam liners, broken plastic containers, old jeans, pvc pipes etc.

3) **Crop establishment and planting**: Proper planting is critical for optimal crop growth. Consider planting depth, spacing, timing and whether you plant directly or transplant.

4) **Harvesting and post-harvest handling**: Timely harvesting ensures the crop is collected at its peak quality and yield. Harvest crops when they have reached optimal maturity. Handle harvested crops properly to prevent bruising, spoilage, or contamination and use appropriate techniques (e.g., cool storage, drying, or packaging) to maintain quality and prevent loss.

5) **Climate adaptation**: Climate change poses a challenge to crop production, and adapting to changing conditions is crucial for future food security. Adopt Climate-smart agriculture practices, such as drought-resistant crop varieties, efficient water use, and diversifying crops and monitoring weather patterns and adjusting planting and harvesting schedules accordingly. Indigenous knowledge for prediction of weather is critical.

6) **Economic and market considerations**: Economic viability is essential to ensure that crop production is profitable and meets both domestic and market demand. Key practices include diversifying crops to spread economic risk, market research to understand consumer demands and pricing, and post-harvest value addition, such as processing or packaging, to increase the value of crops.

Agroecological Cropping Systems

1) **Intercropping systems**: Intercropping involves growing two or more crops together in the same field to optimize space and resource use. Types of Intercropping:
   - Row intercropping: planting crops in alternating rows (e.g., maize with beans).
   - Relay intercropping: planting a second crop before the first is harvested (e.g., maize followed by legumes).
   - Mixed intercropping: random mixing of different crops (e.g., cereals with leafy greens).

   Examples of intercropping systems:

   - Maize and legume (e.g., Beans): Maize provides shade, while legumes fix nitrogen.
   - Sorghum and Cowpea: Sorghum serves as a windbreak, while cowpea improves soil fertility.

2) **Agroforestry systems**: Agroforestry integrates trees, crops, and sometimes livestock in the same system to enhance biodiversity and soil fertility.

   Examples of Agroforestry Systems:

   - Alley cropping: planting crops between rows of nitrogen-fixing trees (e.g., Gliricidia, Leucaena).
   - Silvipasture: combining trees with pasture for livestock grazing.
   - Home gardens: Diverse cropping systems with trees, vegetables, fruits, and medicinal plants.

3) **Polyculture systems**: polyculture involves cultivating multiple crop species simultaneously to replicate the diversity of natural ecosystems. Examples include:
   - Three Sisters (Maize, Beans, Squash): Beans climb the maize, squash covers the ground to retain moisture.
   - Vegetable Polyculture: Growing leafy greens, root crops, and herbs together in small

4) **Permaculture Systems**: permaculture designs are based on perennial plants, integrated with annual crops, to create self-sustaining ecosystems.

Key Elements:

- Zones and layers: planting in layers (trees, shrubs, ground cover) to mimic natural ecosystems.

Perennials and annuals: integrating trees, perennial crops, and annual vegetables.5.

5) **Conservation Agriculture Systems**: Conservation agriculture focuses on minimal soil disturbance, permanent soil cover, and diversified crop rotation.

Key Practices:

- No-Till Farming: Avoid ploughing to preserve soil structure.
- Permanent Mulch Cover: Use organic mulch to cover soil.
- Diverse Crop Rotations: Rotate diverse crops to maintain soil health.

SESSION 14: INTEGRATED FARMING SYSTEMS

CONTEXT

Integrated Farming is an agricultural approach that combines different types of farming activities—such as crop cultivation, livestock rearing, aquaculture, and agroforestry—on the same farm to maximize resource efficiency, minimize waste, and increase farm productivity and sustainability. The system integrates various components of agriculture so that the outputs of one component serve as inputs for another, creating a circular and interconnected system. For instance, livestock manure can be used as fertilizer for crops, crop residues can feed animals, and water from aquaculture can irrigate fields.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to:

(i) Select and integrate different cropping systems to increase farm productivity

Key terms: Cropping systems, livestock rearing, aquaculture and agroforestry, integration

Training aids and materials: Stationery, model farm visits, demonstrations, on farm practical.

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Resources
1.	Welcome participants and recap on meeting 1 on agroecological cropping systems.	10 minutes
2.	Now introduce: ▪ The concept of integrated farming ▪ Principles of integrated farming ▪ Components of integrated farming- ▪ Refer to the reference material	20 minutes

3.	Field trip to a model farm to expose the participants to different types of integrated farming systems. Ask the farmers to first identify the different types of integrated farming systems and guide them afterwards.	120 minutes

REFERENCE MATERIAL FOR INTEGRATED FARMING

Key Principles of Integrated Farming

(i) Resource efficiency: Reuses and recycles farm resources to reduce waste and external input costs. It aims to achieve "zero waste" farming.

(ii) Diversity and complementarity: Incorporates multiple farm enterprises to reduce risks and enhance productivity. It ensures that components complement one another for mutual benefits.

(iii) Sustainability: Promotes environmentally friendly practices, such as organic fertilizers, natural pest control, and efficient water management.

(iv) Economic stability: Diversification of farm activities reduces dependency on a single source of income, making the farm more resilient to market fluctuations.

(v) Self-sufficiency: Focuses on creating a self-contained system where the farm produces most of its own inputs.

Components of an Integrated Farming System

(i) Crops: staple crops, vegetables, and fruits can be grown in rotation or intercropping systems to optimize land use.

(ii) Livestock: poultry, cattle, goats, or pigs provide meat, milk, eggs, and manure for fertilization.

(iii) Aquaculture: fish farming can be integrated with crops, where nutrient-rich water from fish tanks irrigates crops, and crop residues feed the fish.

(iv) Agroforestry: planting trees and shrubs alongside crops and livestock for timber, fruit, shade, and windbreaks.

(v) Composting: organic waste, including animal manure and crop residues, is turned into compost for soil enrichment.

(vi) Renewable energy: biogas from animal waste or solar power can provide energy for farm operations.

Examples of Integrated Farming Systems

1) **Livestock-Crop-Agroforestry System**

- Components: Livestock (e.g., cattle or goats), crops (e.g., maize or vegetables), and trees (e.g., fruit trees or timber species).
- Integration:
  - ~ Trees provide shade, windbreaks, and additional income from fruits or timber.

- ~ Livestock graze under the trees, eating crop residues or grasses while providing manure that is composted to fertilize crops.
- ~ Crops are grown in rotation to maintain soil health and diversity.

- Benefits:
  - ~ Diversifies income streams through livestock, crops, and forestry products.
  - ~ Improves soil quality through organic matter and nitrogen fixation (if nitrogen-fixing trees are used).
  - ~ Promotes biodiversity and enhances resilience to environmental stresses.

2) **Aquaponics with Poultry**

- Components: Fish farming, hydroponic vegetable production, and poultry.
- Integration:
  - ~ Fish are raised in tanks where their waste-rich water is used to fertilize hydroponic vegetables.
  - ~ Plants filter and purify the water, which is then recirculated to the fish tanks.
  - ~ Poultry is reared nearby, and their manure is composted to grow additional crops or produce biogas for energy.
- Benefits:
  - ~ Maximizes resource efficiency with minimal water use.
  - ~ Produces multiple outputs: fish, vegetables, poultry meat or eggs.
  - ~ Reduces the environmental footprint by recycling nutrients and minimizing waste.

SESSION 15: NATURAL PEST AND DISEASE MANAGEMENT

CONTEXT

Natural Pest and Disease Management (NPDM) is an ecologically-based approach to controlling pests and diseases in agricultural systems. It ensures environmental protection by reducing reliance on synthetic chemicals, preventing soil, water, and air pollution. This leads to economic sustainability as costs associated with chemical inputs are decreased. Through biodiversity conservation, healthy ecosystems are encouraged with robust predator-prey relationships. Consequently, resilient systems are built, which are more resistant to future pest and disease outbreaks. Ultimately, food safety is assured as healthier crops free from chemical residues are produced. Major challenge however is inadequate knowledge about NPDM techniques.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to:

(i) Identify common pests and diseases affecting their crops;

(ii) Carry out IPM strategies in their farms.

Key terms: Pests, Diseases, natural management

Training aids and materials: Stationary, model farm visits, demonstrations, on farm practical.

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Resources
1.	Recap on field trip on integrated farming systems and introduce some of the challenges especially pests, diseases and weeds. Probe the participants to find out; 1) if they regard these as challenges in crop production. 2) Are there differences in perception across gender? 3) How do they deal with these challenges? 4) What do they consider most in selecting a remedy for pests, diseases and weeds?	20 minutes
2.	Now discuss: 1) What is Natural Pest and Disease Management (NPDM)? 2) Why should NPDM be considered in pest and disease management? 3) What are the common pests on participants' farms? 4) What are the common diseases on participants' farms? 5) What are the common weeds on participants' farms? Introduce the participants to the practicals and proceed.	20 minutes
3.	Practical 1: Session to identify pests, diseases on different crops	60 minutes
4.	Practical 2: Integrated Pest Management Practical 3: Push-Pull strategy for pest and weed management	90 minutes

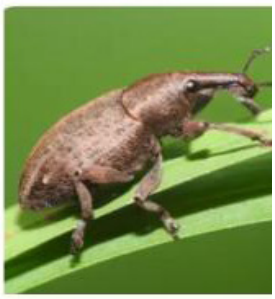
REFERENCE MATERIAL ON NATURAL PEST AND DISEASE MANAGEMENT (NPDM)

Common Pests in the Tropics

ids (different colors)

Whiteflies

Leaf miner



Weevil

Common Diseases in the Tropics

: blight in Tomatoes (Phytophthora infestans)

Wilting in tomatoes caused by bacteria Wilt (Ralsto solanacearum)

Powdery Mildew in Cucurbits

Black Sigatoka (Mycosphaerella fijiensis) in Banana

Cassava Mosaic virus

Maize Streak Virus

Group Activity

Let participants discuss common pests and diseases that attack their crops and how they deal with the problem in a sustainable way.

Integrated Pest Management

Integrated Pest Management (IPM) is a sustainable and holistic approach to managing pests in agricultural systems. It combines various control strategies to minimize pest damage while reducing the reliance on chemical pesticides. The goal of IPM is to maintain pest populations at levels that do not cause economic damage to crops, while also minimizing risks to human health, beneficial organisms, and the environment. Through effective monitoring and strategic interventions, farmers can manage pests in a way that preserves both their crops and the environment.

IPM can be implemented using methods that support these principles. Here are some of the approaches farmers can adopt:

1) Promote biodiversity to enhance natural pest control: Some practices include intercropping, agroforestry and diversified planting.
2) Use of biological control such as beneficial insects and predators, microbial control and nematodes to control soil-borne pests such as root-eating grubs.
3) Cultural controls: Crop rotation, trap cropping, and mulching can be helpful.
4) Physical and Mechanical Controls such as erecting Barriers and Screens, hand-picking and traps and growing companion plants that naturally repel pests or attract beneficial insects.
5) Minimal use of chemical controls: Do targeted application of pesticides and / or botanical Pesticides like neem oil, garlic spray, or insecticidal soap, which are less toxic to humans and beneficial organisms.
6) Monitoring and regular assessment by pest scouting and use of traps to monitor pest populations and assess whether they exceed the economic threshold.
7) Farmer education and knowledge sharing by organizing training and workshops and encouraging collaborative approaches by working with local communities, agricultural cooperatives, and extension services to share experiences and strategies for pest management.

Push-Pull Strategy for Pest and Weed Management

The push-pull strategy is an innovative, ecological pest and weed management system designed to protect crops by using natural plant interactions. It involves "pushing" pests away from the main crop using repellent plants and "pulling" them toward trap plants that attract pests. This method is particularly effective in managing pests like stem borers and striga weeds in cereal crops, especially maize and sorghum.

Key components of push-pull:

1) **Push plants (Repellent Plants)**: These are planted around or between the main crops to repel pests by emitting chemicals or masking the main crop's scent. Example: Desmodium (silverleaf desmodium or greenleaf desmodium) is often used to repel pests like stem borers and suppress parasitic weeds like Striga.
2) **Pull plants (Attractant Plants)**: These are planted on the edges of the field to attract pests away from the main crop. Example: Napier grass (Pennisetum purpureum) or Sudan grass attracts pests such as stem borers, which lay their eggs on these plants instead of the main crop.

SESSION 16: PRODUCTION AND USE OF BIOCONTROL/BIOPESTICIDES

CONTEXT

Natural pesticides are eco-friendly alternatives to synthetic chemicals. They are made from readily available, non-toxic materials that effectively control pests while minimizing harm to beneficial organisms, humans, and the environment. Synthetic chemicals, apart from being harmful to the environment are expensive and inaccessible to rural women.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to: Demonstrate their abilities to use biopesticides for the control of plant pests and diseases.

Key terms: Pests, Diseases, natural management

Training aids and materials : Stationary, model farm visits, demonstrations, on farm practicals, field

DELIVERY PLAN

This session will be delivered through facilitation of practicals on farm with the participants.

Activity	Description	Resources
1.	With the participants, go through the protocols for Production of bio control agents/bio pesticides. Allow the participants to form gender balanced groups and prepare the bio pesticides with supervision from the facilitator. Refer to handout	180 minutes
2.	Conclude the session and ask the participants to apply the prepared biopesticides on their crops and record results.	10 minutes

REFERENCE MATERIAL ON PRODUCTION OF BIO CONTROL AGENTS/BIO PESTICIDES

Natural pesticides are eco-friendly alternatives to synthetic chemicals. They are made from readily available, non-toxic materials that effectively control pests while minimizing harm to beneficial organisms, humans, and the environment. When preparing biopesticides, farmers are encouraged to scale up ensuring they keep the recommended ratios which vary from one formulation to another. Participants to be keen.

How to Make and Use Natural Pesticides

1) **Neem Oil Spray**: Neem oil is derived from the neem tree (Azadirachta indica) and contains azadirachtin, a natural insecticide that disrupts the life cycle of pests.

   Ingredients: 2 tablespoons neem oil, 1 teaspoon mild liquid soap (biodegradable) and 1 liter water

   Preparation: Mix the neem oil and liquid soap in water and stir thoroughly to emulsify the oil.

   Application: Spray on plants in the early morning or late afternoon. Apply once every 7–10 days or after heavy rain.

   Effective Against: Aphids, whiteflies, caterpillars, and spider mites.

2) **Garlic and Chili Spray**: Garlic and chili contain sulfur compounds and capsaicin, which repel many insects and pests.

   Ingredients: 5 cloves of garlic, 2–3 hot chilies (or 1 teaspoon chili powder), 1 tablespoon vegetable oil, 1 liter water and 1 teaspoon liquid soap.

   Preparation: Blend garlic and chilies with water into a smooth paste, add the mixture to 1 liter of water and stir in the oil and soap. Let it steep for 24 hours and strain.

   Application: Spray directly on plants and soil. Reapply every 5–7 days.

   Effective Against: Aphids, ants, beetles, and caterpillars.

3) **Soap Spray**

A simple soap spray suffocates soft-bodied insects by disrupting their cell membranes.

Ingredients: 2 tablespoons liquid soap (natural or biodegradable), 1 liter water

Preparation: Mix the soap into water thoroughly.

Application: Spray directly on affected areas, especially on the underside of leaves. Use every 3–5 days until pests are controlled.

Effective Against: Aphids, mealybugs, whiteflies, and spider mites.

4) **Tobacco Spray (Nicotine-Based)**

Nicotine is a natural insecticide, but it must be used with caution as it is toxic.

Ingredients: 1 cup dried tobacco leaves or cigarette butts, 1 liter water, 1 tablespoon liquid soap

Preparation: Soak the tobacco in water for 24 hours. Strain the liquid and add liquid soap.

Application: Spray on plants, avoiding edible parts within two weeks of harvest.

Effective Against: Caterpillars, aphids, and thrips.

Caution: Avoid using on solanaceous crops (tomatoes, peppers) as they are sensitive to nicotine.

5) **Onion and Mint Spray**

Onion and mint repel pests with their strong odors.

Ingredients: 1 onion, a handful of fresh mint leaves and 1 liter water

Preparation: Blend onion and mint with water into a smooth mixture. Strain and dilute with an additional liter of water.

Application: Spray on plants and soil to deter pests.

Effective Against: Beetles, aphids, and caterpillars.

6) **Baking Soda and Oil Spray (Fungicide)**

Baking soda can prevent fungal diseases like powdery mildew.

Ingredients: 1 tablespoon baking soda, 1 tablespoon vegetable oil, 1 liter water

Preparation: Mix all ingredients thoroughly.

Application: Spray on affected leaves weekly or after rain.

Effective Against: Powdery mildew, black spot, and rust.

7) **Citrus Oil Spray**

Citrus oils are effective against ants and aphids due to their limonene content.

Ingredients: Peels from 2–3 citrus fruits (e.g., oranges or lemons), 1 liter water and 1 tablespoon liquid soap

Preparation: Boil the peels in water for 10 minutes. Cool, strain, and add liquid soap.

Application: Spray on pests and entry points of ants.

Effective Against: Ants, aphids, and fleas.

8) **Salt Spray**

One of the best and most natural ways to make pesticides at home is salt spray. It helps deter pests, it will also help increase nutrition absorption like magnesium and help plants take up vital nutrients like phosphorus and sulphur.

Preparation: Add some salt in water and stir the solution well.

Application: Add it into a spray bottle and sprinkle on the plants. You can also sprinkle salt around the base of your plants, reapplying every week.

9) **Eucalyptus Oil** : The strong smell of eucalyptus oil deters insects and bugs. Spray some oil on plants and see the results. Use it regularly.

10) **Spider plant (Saget)**: Burn the whole plant, mix the ashes with water and spray on vegetables against aphids

11) **Marigold**: Mexican marigold is a common weed in Kenya, spray against aphids, caterpillars and flies.

12) **Tomato**: Some insects do not like the smell of tomato plants. Pruning of healthy tomatoes can be scattered on the mulch in cabbage bed, cabbage worm and cabbage butterfly do not like to lay their eggs where there is tomato plants.

13) **Woodash**: The alkaline nature of ash irritates cutworms

14) **Milk**: Used as a natural fungicide, especially in organic gardening, to combat fungal diseases like powdery mildew, black spot and downy mildew on cucumbers, squash, roses, and grapevines. Its effectiveness lies in its composition and the reactions it triggers on plant surfaces when exposed to sunlight. To prepare, mix milk with water in a 1:9 (milk: water) ratio. Some use higher concentrations (up to 1:1), but 10% milk is often sufficient. Spray the mixture on affected plants' leaves, ensuring good coverage on both upper and lower surfaces. Apply once a week or after rain for ongoing protection. Both fresh and powdered milk can be used. Skim milk is often preferred to reduce odors and fat residue.

Limitations: Milk can smell unpleasant if over-applied or left to spoil. It works best for mild infections and as a preventive measure rather than curing advanced fungal outbreaks. Its efficacy increases with sunlight exposure, so should be applied on sunny days.

Tips for Using Natural Pesticides:

1) Test First: Spray a small area of the plant to ensure it doesn't cause damage.
2) Timely Application: Apply in the early morning or late afternoon to avoid harming beneficial insects like bees.
3) Consistency: Regular reapplication may be necessary for effective control.
4) Storage: Prepare small batches as natural pesticides degrade quickly.

NB: Facilitator to visit *https://infonet-biovision.org/natural-pest-control/biopesticides-kenya#3* to get more biopesticides in Kenya that can be recommended to farmers. Dosage is always indicated on the package

Producing Biocontrol Agents

Biocontrol agents are beneficial organisms (microbial or macrobiotic) used to control pests by predation, parasitism, or competition.

1) **Microbial Biocontrol Agents**

These include bacteria, fungi, and viruses that suppress pests and diseases.

- Examples:
  - ~ Bacillus thuringiensis (Bt): Bacterial spores that produce toxins to control caterpillars, mosquitoes, and beetles.
  - ~ Trichoderma spp.: A fungus that combats soil-borne fungal pathogens like Fusarium and Phytophthora.
  - ~ Beauveria bassiana: An entomopathogenic fungus that infects and kills pests like aphids, whiteflies, and weevils.
- Production Process:
  - ~ Isolation: Collect the microorganism from soil or infected hosts (e.g., isolate Trichoderma from decayed wood or soil).
  - ~ Culturing: Grow the microorganism in a laboratory using specific growth media (e.g., nutrient-rich agar plates for fungi or broth for bacteria).
  - ~ Mass Multiplication: Scale up production in liquid or solid fermentation tanks.
  - ~ Formulation: Prepare formulations by mixing the microorganism with carriers (e.g., talc powder or liquid suspensions).
  - ~ Packaging: Pack in sealed containers, ensuring proper shelf life and storage.

2) **Macrobiotic Biocontrol Agents**

These include insects, mites, or other organisms that prey on or parasitize pests.

- Examples:
  - ~ Trichogramma spp.: Parasitic wasps that lay eggs inside pest eggs, controlling pests like moths and caterpillars.
  - ~ Ladybird Beetles: Predators that feed on aphids, whiteflies, and scale insects.
  - ~ Nematodes: Parasitic nematodes (e.g., Heterorhabditis spp.) that attack soil-dwelling insect larvae.
- Production Process:
  - ~ Collection: Collect beneficial insects or organisms from natural habitats.
  - ~ Rearing: Rear them in controlled environments, providing their natural food source or target pest.
  - ~ Field Release: Distribute the reared agents directly in pest-infested areas.

At home level it may not be very easy to produce bio control agents. Several companies in Kenya specialize in producing biocontrol agents to promote sustainable agriculture. Some notable ones include: Real IPM: Based in Thika, Dudutech (Bioline AgroSciences Africa and Novo Science

Facilitator to visit this website to get more biopesticides in Kenya that can be recommended *https://infonet-biovision.org/natural-pest-control/biopesticides-kenya#3*

SESSION 17: POST-HARVEST ACTIVITIES AND VALUE ADDITION

CONTEXT

In agroecological systems, post-harvest activities and value addition play a crucial role in ensuring sustainability, improving food security, and enhancing farmers' livelihoods. These activities go beyond merely harvesting the crops to include the proper handling, processing, storage, and marketing of agricultural products. By integrating these practices, agroecological systems contribute to environmental health, social equity, and economic viability.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to:

(i) Identify key post-harvest activities to ensure quality and reduce losses

(ii) Prepare some value-added products on farm using harvested produce

Key terms: Post harvest, value addition

Training aids and materials: Stationary, model farm visits, demonstrations, on farm practicals and locally available materials as identified by the facilitator.

DELIVERY PLAN

This session will be delivered through facilitation of practicals on farm with the participants.

Activity	Description	Resources
1.	Welcome participants to the session. Introduce the main topic (i) Post-harvest activities such as harvesting, cleaning, drying, sorting, grading and storage (ii) value addition on produce such as canning, drying	20 minutes
2.	Practical on how to make some simple On-farm storage facilities using locally available materials. Refer to handout	60 minutes
3.	Practical on how to add value to farm produce to increase shelf life. Refer to handout	90 minutes

REFERENCE MATERIALS ON POST-HARVEST ACTIVITIES IN AGROECOLOGY

Post-harvest activities involve the processes that occur after the harvest of crops, aimed at preserving the quality of the produce, reducing losses, and enhancing its nutritional and market value. These activities are essential for both food security and economic sustainability in agroecological systems. Key Post-Harvest Activities include:

1) **Harvesting**: Harvesting at the right time ensures maximum quality and quantity of produce. In agroecology, methods such as selective harvesting and minimal handling help maintain soil health and prevent crop degradation.

2) **Cleaning and sorting**: Cleaning and sorting crops to remove dirt, damaged, or diseased produce reduces post-harvest losses and improves the quality of the final product. This process also ensures that only the best quality produce reaches the market.
3) **Drying**: Drying is essential for crops like grains, beans, and fruits to prevent spoilage and extend shelf life. In agroecology, natural drying methods such as sun-drying or using solar dryers are encouraged, reducing the need for energy-intensive technologies.
4) **Storage**: Proper storage is crucial to prevent spoilage and pests. Agroecological systems often use traditional storage techniques such as root cellars, clay pots, or hermetic storage bags, which are eco-friendly alternatives to chemical-based preservatives.
5) **Additionally, on-farm storage techniques that maintain the quality of crops for longer periods help farmers avoid selling crops at low prices when supply exceeds demand. Examples of these techniques include**

On-Farm Storage Techniques

These are critical in agroecological systems to preserve harvested crops, reduce spoilage, and ensure food security. These techniques often rely on low-cost, locally available materials and sustainable practices. Here are some examples of effective on-farm storage techniques:

1) Root cellars: These are underground storage spaces that utilize the earth's natural insulation to maintain cool and stable temperatures, ideal for storing root vegetables like potatoes, carrots, beets, and onions. The temperature in root cellars remains consistent year-round, helping to preserve produce by preventing spoilage due to heat or frost. Ventilation is key to avoid excess humidity. They can be built with stone, brick, or wood and covered with soil for insulation.

Root cellar

Food inside a root cellar

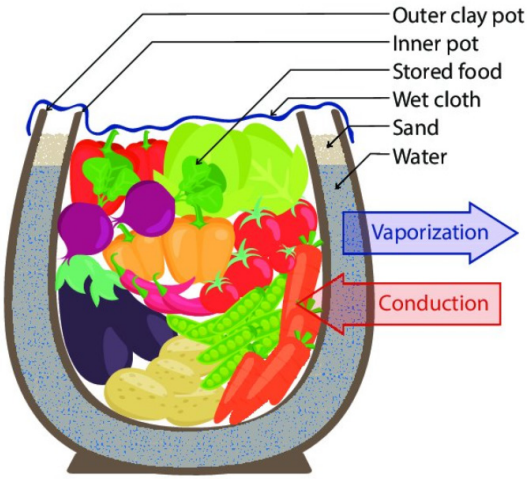
2) Grain silos and bins: Simple grain silos or bins are used to store cereal crops like wheat, rice, maize, and other grains after harvest. The grains are stored in airtight containers to prevent moisture buildup, pest infestations, and spoilage. For larger-scale storage, silos can be used, while smaller farmers might use metal or wooden bins. They are built using metal, wood, or woven baskets for smaller quantities. Modern silos often come with aeration systems to regulate moisture levels. Best for rice, maize, millet, lentils, and beans.
3) Hanging storage (for Tubers and Bulbs) : Tubers like garlic, onions, and certain root vegetables can be stored by hanging them in mesh bags or strings. Hanging the crops helps with air circulation,

which prevents mold growth and reduces moisture retention, ensuring the crops stay dry and fresh. They are made from mesh bags, twine, or string, often hung in shaded, dry, and ventilated areas. Best for storing onions, garlic, shallots, and similar bulbous crops.

4) Hermetic Storage Bags (PICS Bags): PICS (Purdue Improved Crop Storage) bags are airtight bags designed for storing dry crops vulnerable to pest damage and spoilage. The bags create an anaerobic environment that prevents the growth of insects and mold. They are especially useful for smallholder farmers to store grains without the need for chemicals. The bags are made of durable plastic that is sealed to prevent air exchange.
5) Solar dryers: Use the sun's energy to dry crops like fruits, herbs, and vegetables. They are simple, low-cost devices that protect produce from direct sunlight and contamination by pests. Solar dryers are typically designed as covered racks or enclosed chambers that allow air circulation while protecting produce from rain, dust, and pests. The drying process reduces moisture, which prevents mold and rot. They are made of wood, plastic, or metal frames with transparent roofing (such as clear plastic or glass) to trap heat.
6) Cold storage (Refrigeration or Ice Storage) : Cold storage involves keeping perishable crops like fruits, vegetables, and dairy at low temperatures to prolong shelf life. Cold storage systems can be as simple as a refrigerator, but larger-scale storage can involve insulated rooms or cool boxes, especially for dairy products, eggs, and fresh vegetables. They are insulated rooms or refrigeration units, sometimes powered by solar energy for sustainability.
7) Canning and bottling: This involves preserving food by sealing it in jars or cans to prevent spoilage and extend shelf life. Canning requires heating the food to kill bacteria, followed by sealing the food in air-tight containers. Once sealed, the jars are stored in a cool, dark place. The jars can be made of glass jars, metal lids, canning pots, or pressure cookers. Vegetables, fruits, jams, sauces, and pickles are best stored in such jars.
8) Smokehouses or drying Racks (for Meat and Fish): Traditional smokehouses and drying racks are used for storing and preserving meat and fish through smoking or air-drying processes. Meat and fish are hung or placed on racks in a smokehouse where they are exposed to low heat and smoke, which acts as a preservative. Alternatively, the produce can be air-dried in open or semi-closed spaces. Smokehouses are often made of wood, while drying racks can be constructed with bamboo or metal. Best For: Fish, meat, and other animal products.

9) Pit storage (for Root Crops and Vegetables): Pit storage involves burying crops in the ground to protect them from weather extremes, pests, and diseases. A shallow pit is dug, lined with straw or leaves, and then crops like sweet potatoes or carrots are placed in the pit. The crops are then covered with soil and often lined with more organic material for insulation. They are made of soil, straw, leaves, or other organic material to maintain humidity and temperature. Best For: Root crops, such as potatoes, sweet potatoes, carrots, and beets.

10) Clay Pot Storage (Zeer Pot or Evaporative Cooler): This is an ancient, low-cost cooling technique that utilizes the evaporation of water from porous clay pots to cool the interior and extend the freshness of perishable items. Two clay pots are placed one inside the other, with wet sand or water between them. As the water evaporates, it cools the inner pot and preserves the contents. Best for vegetables, fruits, and other perishable food items in small quantities. See image below.



Source: Arene et al 2018 https://www.researchgate.net/publication/323301501_Heat_transfer_and_evaporative_cooling_in_the_function_of_pot-in-pot_coolers

11) Processing and Packaging: Processing crops into value-added products like jams, sauces, dried fruit, or flour adds value to the product and extends its shelf life. Agroecological systems promote small-scale, low-energy processing techniques that reduce waste and retain the nutritional value of the products. Sustainable packaging, such as biodegradable or reusable materials, is encouraged to minimize environmental impact.

VALUE ADDITION IN AGROECOLOGY

Value addition in agroecological systems refers to the process of transforming raw agricultural products into products that have higher economic value. This can involve physical, chemical, or biological processes that enhance the product's quality, shelf life, and market appeal.

Benefits of Value Addition in Agroecological Systems:

- Economic empowerment: Farmers can increase their income by processing raw products and accessing niche markets for organic, locally-produced goods.
- Reduced waste: By adding value to surplus or low-grade products, agroecological systems reduce food waste and maximize resource use.
- Improved food security: Value-added products provide farmers with a more stable income, enabling them to invest in better farming practices and improve community food security.

- Preservation of cultural heritage: Traditional food processing methods often align with agroecological practices and help preserve local food systems and culinary traditions.

Methods of Value Addition:

1) Processing Techniques:
   - Fermentation: Used for products like yogurt, kefir, or fermented vegetables. This method enhances the nutritional profile of foods and increases shelf life.
   - Canning and bottling: Fresh fruits, vegetables, and herbs can be preserved by canning or bottling, making them available throughout the year.
   - Drying and dehydrating: Techniques like sun-drying or using solar-powered dehydrators to process fruits, vegetables, and herbs.
   - Grinding and milling: Processing grains into flour, rice, or even animal feed.
   - Extraction: Extracting oils, juices, or essences from crops such as olives, coconut, or herbs.
2) Product Diversification:
   - Agroecological systems encourage diversification of products to reduce the dependency on a single crop and provide additional income streams. For example:
     ~ Transforming excess vegetables into canned or pickled products.
     ~ Processing fruits into jams, jellies, or juices.
     ~ Converting herbs into medicinal teas or essential oils.
3) Local and Niche Markets:
   - Agroecology promotes selling directly to consumers through farmers' markets, local shops, or through community-supported agriculture (CSA) models. This helps farmers gain a higher return on investment by cutting out intermediaries.
   - Emphasis on organic and locally-produced products helps create a unique selling point that appeals to consumers willing to pay a premium for sustainably produced goods.

Group Activity

Participants to be engaged in preparation of value-added products at home such as Fermented Cabbage (Kimchi), yoghurt, jam, natural juices, healthy pastries.

MODULE 7: FARMER FIELD EXPERIMENTATION

Training farmers to conduct their own field experiments is an effective strategy to enhance agricultural practices and empower them to make informed, data-driven decisions. By equipping farmers with the skills and knowledge to assess local conditions, they can independently test new techniques, crop varieties, and inputs, leading to improved yields and efficiency. To ensure the success and acceptance of such training, it is essential to use tools, materials, and concepts that are familiar to their daily experiences. This approach not only accelerates learning and understanding but also facilitates a smoother transition to experimental practices. These experiments should be accompanied by proper data analysis, monitoring, and evaluation to assess their impact and determine their usefulness to the farmers in the community. In summary, training farmers in field experimentation and individualized trials plays a critical role in agroecology. It empowers farmers with the knowledge to develop, validate, and implement practices that are tailored to their unique conditions, fostering sustainable and resilient agricultural systems.

SESSION 18: ON FARM EXPERIMENTATION AND PARTICIPATORY FIELD TRIALS

CONTEXT

The training on on-farm experiments is a vital component of our ongoing efforts to build evidence around agroecological practices that can enhance food and nutrition security in an environmentally sustainable and socially inclusive manner. By conducting participatory trials, we aim to empower farmers to take an active role in evaluating and adopting sustainable farming practices that are suited to their local conditions.

MODULE LEARNING OBJECTIVES AND EXPECTED OUTCOMES

The objective of the session is to build capacity of farmers to design and implement on-farm field experimentation and trials for agroecological practices

(i) Understand the key principles of participatory on-farm experiments and develop the skills to design, plan, and implement experiments that compare conventional and agroecological practices on their own farms.

(ii) Assess the biophysical performance of agroecological practices (including crop establishment, soil health, and plant health) in comparison to conventional farming practices in real farming conditions.

Key Terms: On-farm field experiments, participatory farm trials and data analysis ant methods

TEACHING AIDS AND MATERIALS

The training materials and requirements include; Stationary Markers Demonstration farm, Samples of trees/shrubs, Training manual/booklets, Sample crop data sheets (for tracking observations), handouts with key principles of on-farm experimentation (e.g., experiment design, treatment definition, data collection), a whiteboard or flipchart to illustrate experiment design, example of an agroecological practice vs. conventional practice (e.g., organic vs. chemical fertilizer use), Simple statistical tools for analysis (e.g., mean, variance, and comparison of treatment outcomes), Measuring tools (e.g., rulers, weight scales for yield, thermometer for temperature, etc.)

DELIVERY PLAN

The training will take the form of field demonstration, field trips, and farmers given the chance to showcase their knowledge and skills (peer learning).

Activity	Description	Duration
Welcome	Welcome the participants to the training. Let them introduce themselves to each other, and explain the objectives of the training/meeting. By the end of the meeting, the participants should have good understanding of the key principles of participatory on-farm experiments and develop the skills to design, plan, and implement experiments that compare conventional and agroecological practices on their own farms	15 minutes
Rationale of on-farm experimentation	The trainer to engage farmers in discussing the importance of of on-farm experimentation.	15 minutes
Design	This activity will guide farmers through the process of designing an on-farm experiment to compare two farming practices: conventional and agroecological. Farmers will work in small groups to discuss and plan their experiment, including selecting crops, defining treatments, and understanding the steps involved in conducting the trial. They will then share their plans with the larger group and receive feedback.	30 minutes
Documentation and data analysis	Data Analysis: Techniques for analysing collected data and drawing conclusions about the effectiveness of the farming practices tested.	30 minutes
Actual implementation	**Plot Setup for Full Crop Cycle:** Each group will plan to establish two plots on a sample farm: one for the conventional practice and the other for the agroecological practice. Discuss the importance of marking plots clearly and maintaining consistency across all farms to allow for meaningful comparisons. Plan the duration of the trial (e.g., 3 to 6 months depending on crop cycle) and outline when and how to collect data at regular intervals (e.g., weekly or monthly). Establishing Baseline Data: Emphasize the importance of collecting baseline data before planting (e.g., initial soil quality or current pest levels) for comparison purposes at the end of the crop cycle.	Full crop cycle
Facilitator's Summary	**The step will help** summarize key points and answer any remaining questions. The facilitator will recap. The steps in setting up an on-farm experiment. ▪ The importance of consistent data collection and analysis. ▪ How to apply the results from these trials to make informed decisions about farming practices. ▪ Address any final questions and encourage farmers to start implementing the experiments on their farms, using the full crop cycle for the trial.	10 minutes

1) **Importance of training farmers on conducting their on-farm experiments**

- **Better decision-making practices:** conducting field trials helps farmers make informed choices by showing what works best. They are able to understand cause and effect; how changes, like adjusting fertilizer or planting density, directly impact yields, pests, or soil health. This propels them to making better choices for the next farming season to improve yields and quality of crops.

- **Supporting agroecological research:** farmer led experiments provide valuable real-world insights that support broader agricultural research. When farmers test and refine techniques on their own, they help validate scientific findings in real conditions.
- **Empowering farmers and communities:** Training farmers to experiment boosts their confidence and encourages collaboration. Farmers feel empowered to solve problems on their own, without always relying on external inputs or advice. They can also share their findings with others, fostering a culture of collaboration and spreading effective practices.
- **Creating farmer focused knowledge:** every farm is different, with their own unique soils, challenges, and in different climatic regions. Field experiments will help farmers find and adapt practices that suit their specific conditions, to boost yields and prevent food loss at the farm level.

2) **Design of participatory farm trials Comparison of plots with different practices**

- Choose a crop: Farmers select a crop relevant to their needs (e.g., kale, pumpkin leaves, amaranth).
- Define treatments: Each group defines two treatment methods:
- Conventional practices (e.g., chemical fertilizers, monoculture).
- Agroecological practices (e.g., organic fertilizers, intercropping, mulching).
- Determine variables: Identify the key variables to measure, such as:
  - ~ Crop yield (e.g., number of fruits/vegetables harvested, weight).
  - ~ Soil health (e.g., soil texture, color, or organic matter content).
  - ~ Plant health (e.g., plant height, pest damage, leaf color).
  - ~ The abundance of pests in each plot and how different practices influence pest populations (e.g., use of natural pest control vs. chemical inputs).
  - ~ Plant vigour and costs of practices
  - ~ Marketability of produce
  - ~ the visual appeal of the produce
  - ~ Taste and flavour: assess the organoleptic qualities (taste, texture, aroma) of the produce.
- Plan Data Collection: Decide how often to measure the variables, what instruments to use (e.g., rulers for plant height, scales for weight), and how to record the data.

Farmers can compare the performance of plots where different agricultural practices are employed. For example, they might compare one plot where agroecological methods were applied with another where conventional farming techniques were applied. Some of the key aspects to observe and record could include:

Using pictures – farmers can take pictures on what is on the trial plots at different stages of the trial and use if for reference.

MODULE 8: NATURE POSITIVE PRACTICES

Our food systems are at risk. The way we produce, distribute and consume food is not sustainable and cannot sufficiently meet the needs of our growing population. Our production depends on substantial application of chemical fertilizers and pesticides which leads to loss of biodiversity, deforestation, less water availability, poor soil health and high greenhouse gas (GHG) emissions. Poor agricultural and livestock practices is leading to degradation of land, soil and water resources. In addition, drought and floods are leading to food insecurity, loss of income and low resilience of households to withstand shocks. To address some of these challenges, nature-positive practices (NPP) are those that are regenerative, and do not deplete or destroy natural resources. NPP has three pillars; protect, manage and restore.

Protect	Manage	Restore
▪ Protecting natural habitats and giving land back to nature ▪ Reducing land use change, especially the loss of forests and trees in the landscape through farming	▪ Sustainable use of natural resources (soil, water and forests ▪ Promote circular economy, in which production, consumption and the use of all residues are integrated and balanced	▪ Actions that rebuild natural ecosystems in order to restore soil health, enhance biodiversity, and ecosystem services. ▪ Rehabilitating of agricultural productivity

This module covers three important elements of NPP namely; agroforestry, diversity and, growing indigenous fruits in farmlands for women empowerment

SESSION 19: AGROFORESTRY

CONTEXT

Agroforestry is the deliberate growing of trees and shrubs crops alongside agricultural crops and livestock to the mutual benefit of both. Good agroforestry practices can help farmers to diversify products and farm income, improve soil and water quality; and reduce erosion, non-point source pollution and damage due to flooding. It can also enhance land and aquatic habitats for fish and wildlife and improve biodiversity while sustaining resources for future generations (sustainability). This training module provides smallholders' farmers with knowledge on the practise of agroforestry in including types of agroforestry systems, selection of trees and shrubs and plant management for better ecosystem conservation.

LEARNING OBJECTIVES AND EXPECTED OUTCOMES

By the end of the session the participants will be able to:

(i) Compare and contrast the different types of agroforestry systems being practised

(ii) Identify trees and shrubs for suitable for agroforestry

(iii) Integrate agroforestry in their current production systems

Key Terms: Agroforestry, Indigenous and Exotic trees, agro forestry plant methods

Teaching aids and materials: The training materials and requirements include; Stationary; Markers; Demonstration farm; Samples of trees / shrubs; Training manual/booklets.

DELIVERY PLAN

The training will take the form of field demonstration, field trips, and farmers given the chance to showcase their knowledge and skills (peer learning).

Activity	Description	Duration
1.	Welcome the participants to the training. Let them introduce themselves to each other and explain the objectives of the training/meeting.	15 minutes
2.	The trainer to engage farmers in discussing the importance of agroforestry within their farms and community. Through pictures, videos and field observation, farmers observe the various agro forestry practices.	20 minutes
3.	The trainer to expose learners to various agro forestry systems through observation, pictorial illustration and photos	30 minutes
4.	The trainer introduces farmers to the characteristics of agro-forestry trees. Ask farmers what characteristics they would consider important for their selection.	15 minutes
5.	Let farmers brainstorm of the various agro forestry trees they know, in their local language. Let them divide it into exotic or indigenous. They would highlight which trees they considered for their livelihoods. Let the trainer guide which trees may be planted in their farms.	30 minutes
6.	The trainer to ask how they practise their agroforestry including plant density, spacing and pattern. Introduce the various plant methods and what they might choose in their farm	15 minutes

REFERENCE MATERIAL FOR AGROFORESTRY

Role of Agroforestry

Agroforestry has high potential for simultaneously protecting and stabilizing the ecosystems improving income of the population. Some of the important functions of agroforestry include;

- **Improving soil quality:** Sediment eroded from fields and construction sites carries unwanted pesticides and excess nutrients into ditches, streams, and water supply reservoirs. Trees and shrubs create stable areas that reduce or eliminate wind and water soil erosion. Old roots, flowers and other matter decompose and add organic matter to the soil.
- **Arresting land degradation:** Agroforestry approaches are available for restoring and increasing land productivity. Agroforestry systems can increase soil productivity, control erosion and regulate water availability in degraded or less-productive lands.
- **Nitrogen fixation:** Micro-organisms (bacteria and fungi) in certain trees and shrubs fix nitrogen from the atmosphere into a form crop can use in the soil. Equally, nitrogen fixing trees e.g. Calliandra calothyrsus and Mimosa tree (Albizia julibrissin) have the capacity to yield high nitrogen.
- **Livelihood and employment opportunities:** Agroforestry services and products provide opportunities for employment generation in rural areas. Food products (fruits, nuts, edible leaves);

animal fodder and non-food materials (sap, resins, tannins, insecticides and medicinal compounds) increase incomes for the population.

- **Biofuel and bioenergy:** Biofuels are renewable, coming from biological raw materials and has proven to be good substitute for oil therefore addressing environmental degradation,
- **Water conservation:** Trees increase soil water retention through organic matter which acts like a sponge thus increasing the soils ability to adsorb and retain water.
- **Ecosystem services:** Agroforestry systems can provide a wide range of ecosystem services. An ecosystem service is any positive benefit that wildlife or ecosystems provide to people. Some of the services include, pollination, carbon cycling, regulating, increased water quality and biological pest control. Agroforestry systems can help restore ecosystems contributing to biodiversity conservation and climate-change adaptation and mitigation.
- **Wind breaks:** Trees act as windbreaks reducing the rates of evaporation caused by high temperature and dry winds and hence helping improve crop performance.

Overall, agroforestry is beneficial conserving our environment and helping us sustainably benefit from nature.

Common Agroforestry Systems in Kenya

Agroforestry requires allocation of land and careful selection of trees and shrubs. The trees should be those that have multiple benefits including good (fruits, nuts, edible leaves); animal fodder; inedible materials (sap, resins, tannins, insecticides and medicinal compounds); fuel; shade and; nutrient cycling and improved soil fertility. There are different agroforestry systems and land-use (Table 8.1)

Table 8.1: Common agroforestry systems in Kenya

	System	Definition	Suitable zone
1	Agri-Silviculture	Growing of agricultural crops as a primary component with the secondary component of trees on the same land	Farmland
2	Agri-Horticulture	Growing of agricultural crops and fruit trees on the same land. Fruit tree species like lemon (Citrus limon), mango (Mangifera indica), and ber (Ziziphus Mauritania) can be successfully planted in agricultural fields and on degraded and low fertile lands	Farmland
3	Alley Cropping	Growing of agricultural crops in the alley formed between the hedgerows of leguminous nitrogen-fixing tree species. This system is one of the effective measures for soil and water conservation in hilly landscapes	Farmland
4	Silvi-pastoral system	Raising grasses trees or shrubs on rangelands or pastures for reclaiming eroded and degraded lands while sustainability providing feed for animals	Rangeland
5	Agrosilvopastoral systems	This system combines trees plus crops plus pasture and animals and includes home gardens involving animals, multipurpose woody hedgerows, apiculture with trees and aqua forestry	Farmland/ Transitional/ Rangeland

The choice of the system depends on the farming system the farmers are in. Farmers in farmland will be under Agri-Silviculture, Agri-Horticulture, Alley Cropping while those in rangelands might engage in silvi-pastoral system and Agrosilvopastoral systems

Characteristics of Trees for Agro Forestry Development

A producer must choose the type of trees and plants they want to have in their system. The following characteristics are important when selecting trees for agro forestry

- Marketable and profitable; The products from the trees or shrubs e.g. fruit, nuts or wood can generate income
- Compatible with the companion crops or forage: The trees should not negatively the growth of the companion crops.
- High quality: Fast growing trees are desired so that they are profitable
- Suited for the environment: The trees should be well suited for the climatic conditions, soil type and altitude

Types of Agro Forestry Trees

Types of agro forestry trees are suited to different agroecological zones. The listed species could perform well, across diverse agro-ecological zones (Table 8.2)

Table 8.2: Common agroforestry trees used in Kenya

Species	Ecology	Management System	Remarks
Grevillea robusta	Found in Ecozones with altitude of 0 - 3000 m.	Plantation, hedge planting, Agroforestry	Important tree in the Kenyan highlands
Sesbania sesban (Egyptian riverhemp)	Tree can survive waterlogging and fixes nitrogen. Ecozones of 350- 1,900 m	agroforestry (mixed farming system), conservation	The species harbors root knot nematodes.
Croton megalocarpus (Mukinduri)	Found in Ecozones 1000 - 2000 m above sea level and is well adapted to highland soils	mixed farming systems, woodlots, boundaries and, agroforestry systems	Seed has high oil (30%) and protein content (50%).
Cordia abyssinica / Cordia africana (Muringa)	A large forest tree of moist warm areas, woodland and bush. common in pasture land between 1,200 and 2,000 m.	Plantation, mixed woodlots, amenity, agroforestry	Found in cropland where it is managed to reduce shade
Markhamia lutea (Zusiala)	A tropical African tree common in the lake basin and highland areas, to 2,000 m.	Plantation/ amenity/ agroforestry systems	The species is widely used in western Kenya. The wood is fairly termite resistant.
Markhamia lutea (Siala)	1400m: Red loam to clay loamy soil	Plantation/ amenity agroforestry systems	Short (15 - 30 yrs)
Calliandra calothyrsus	0 - 1400	Agroforestry system	Short
Acacia tortilis	Wide spread in lowland arid and semiarid areas of kenya. Often stands along rivers, 0-1,650 m. Rainfall 150-900 mm.	Mixed enrichment/ agroforestry	The tree is limited to desert areas. Its pods are popular feed for livestock

Species	Ecology	Management System	Remarks
Melia volkensii (Mkau)	A valuable tree in the dry bushland or woodland and drier wooded grasslands. Altitude ranges from 400 to 1,650 m	Mixed/ agroforestry systems	Makes good timber, resistant to attack by borers.

Source: KEFRI/Biovision

Grevillea robusta

Source: KEFRI

Croton megalocarpus

Source: Growtech nurseries

Melia volkensii

Source: Better Globe Media

Types of Agro Forestry Fruit Trees

In the face of sustainable use of land and water resources to produce food, its recommended that fruit trees be included in agroforestry. The fruit trees can either be indigenous or exotic. Table shows some of the indigenous trees/ shrubs can be integrated into agroforestry.

Table 8.3: Examples of indigenous fruit trees/ shrubs

Scientific name	Local name	Description
Adansonia digitata L (Baobab)	Mbuyu (Swahili);Muramba (Embu, Meru); Muamba Mauyu (Kamba);	The fruit contains a white, acidic-tasting, nutritious pulp that can be eaten raw and used to make drinks
Annona senegalensis Pers. (Wild custard apple)	Makulo, Matimoko (Embu); Kitomoko/ Matomoko (Kamba); Mtomoko mwitu/Mbokwe/ Mtonkwe/ Mkonokono (Swahili);	Ripe, yellow fruit is very sweet and edible with acidic taste and aroma of pineapple.
Balanites aegyptiaca (L.) Delile (Desert date)	Lowei, Lowa (Ilchamus);Mulului/ Kilului (Kamba), Mjunju/ Mchunju (Swahili), Kiwowa (Taita); Lungoswa (Taveta) Ng'oswo/Ngosyek/Ngoswa (Tugen)	A drupe; oblong, up to 4 cm long; both ends round; green, turns pale yellow when ripe; hard, pointed seed inside surrounded by yellow/brown, bittersweet flesh.
Tamarindus indica L. (Tamarind).	Ukwaju/Msisi (Swahili); Arwe/Aryek (Tugen); Muthithi (Embu, Mbeere, Meru, Tharaka);	The edible fruit pulp is sour, has a very acidic taste and can be eaten raw; it is popularly used to flavor food

Source: See Dharani et. al (2022) https://www.cifor-icraf.org/publications/downloads/Publications/PDFS/B23017.pdf

Most of the available indigenous trees are resilient and suited to local conditions especially under rangeland systems. Farmers can identify their local fruit trees and adapt accordingly. Agroecology promotes use of indigenous knowledge to conserve resilient fruit trees.

Group Activity

Ask the participants to name some of indigenous fruit trees and shrubs they know. Let the list the ones they grow in their farm and the benefits they see out of these trees. Let them discuss how they can start growing these trees and how peer to per learning can work among them

Exotic fruit trees are critical for both food production and commercialization. Across farmland and rangeland systems, a number of fruit trees can be grown (Table 8.4)

Examples of exotic fruit

Scientific name	Local name	Description
Annona squamosa L. (Custard apple)	Mtopetope/Mtomoko (Swahili);	The fruit is edible; its creamy white pulp is very sweet with pleasant flavour that tastes like custard
Carica papaya L. (Papaya, Pawpaw)	Mpapai (Swahili)	Ripe papaya is a key dessert fruit that is available all year-round
Mangifera indica L. (Mango)	Maembe/Muembe (Kamba); Mwiembe (Kikuyu); Mwembe (Swahili)	It is the most abundant and widespread fruit tree growing in Kenya from sea level to 1800 m
Persea americana Mill (Avocado)	Ikoloviu (Kamba); Mukorobea/ Maguna ngui (Kikuyu	Avocado is a common fruit used in fruit salads, green salads and desserts

Among exotic fruits, avocado is increasingly becoming important for biodiversity conservation and incomes. Farmers engaged in avocado can ern high incomes compared to other fruit trees. Table 8.4 provides the list of fruit trees that may be cultivated in farmlands

Table 8.4: Selection of fruit tree species suitable for the highlands of Kenya (altitude >1500m)

Exotic species for highlands		Indigenous species for highlands	
Scientific name	**English name**	**Scientific name**	**English name**
Annona cherimola	Cherimoya	*Annona senegalensis*	Wild custard apple
Carica papaya	Pawpaw	*Balanites aegyptiaca*	Desert date
Casimiroa edulis	White sapote	*Myrianthus holstii*	Giant yellow mulberry
Cyphomandra betacea	Tree tomato	*Pappea capensis*	Jacket plum
Eriobotrya japonica	Loquat	*Phoenix reclinata*	African wild date palm
Malus domestica	Apple	*Syzygium guineense*	Guinea water berry
Passiflora edulis	Passion fruit	*Vangueria madagascariensis*	Wild medlar
Persea americana	Avocado	*Vitex doniana*	Black plum
Prunus domestica	Plum	*Ximenia americana*	Wild plum
Prunus persica	Peach		
Psidium guajava	Guava		
Syzygium cumini	Jambolan		

Source: See Dharani et. al (2022) https://www.cifor-icraf.org/publications/downloads/Publications/PDFS/B23017.pdf

Agro Forestry Plant Methods

Distribution of the trees and plants can take different forms depending on the land size and objective of components can vary in space and time. Plant components can be mixed in different densities and have a separate long/short cropping/fallow cycle. There are five main methods of planting.

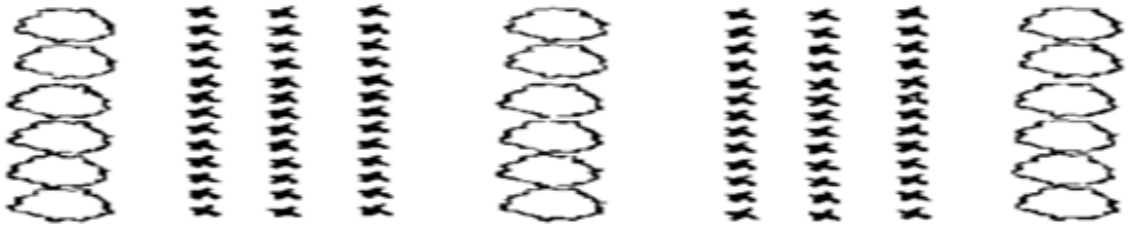


Figure 8.1: Alternative strips or alley cropping Source: B.T. Kang, IITA (1996)

Figure 8.2: Random mixture of plant components B.T. Kang, IITA (1996)

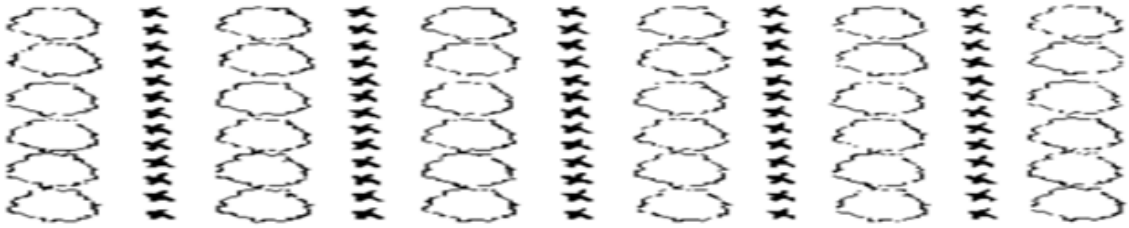


Figure 8.3: Alternative rows of plant components B.T. Kang, IITA (1996)

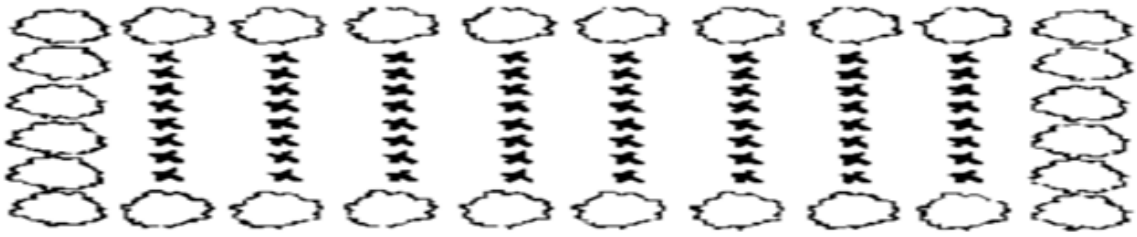


Figure 8.4: Alternative strips rows of plant components B.T. Kang, IITA (1996)

Farmers can engage in various planting methods, alternative strips or alley cropping, random mixture of plant components, alternative rows of plant components and alternative strips rows of plant components. Farmers can choose alley cropping where they grow food crops between hedgerows of shrubs and trees, especially leguminous species. The arrangement of the components is uniform (not mixed), consisting of strips with different widths. Farmers can also plant dispersed trees on cropland. There are different spacing patterns and densities of placement depending on the type of tree chosen and of crop grown. Farmers can also grow trees, shrubs, vines and herbaceous plants in or around the homesteads, aiming mostly food production for household consumption. In more systematic agroforestry, they can have alternative rows of plant components in the land. This is especially critical when combining forestry crops and agricultural crops during the first years of establishment of the forestry plantation.

SESSION 20: ENTERPRISE DIVERSITY

CONTEXT

Diversity is an important part of agriculture, and a core principle of agroecology. It includes biological, cultural, and social aspects to build a sustainable and resilient food system. In agroecology, diversity can be seen in different farming methods, the use of various knowledge systems, and attention to social issues like gender. By making diversity a key part of nature-friendly practices, we can support sustainable food production and make agriculture more resilient to environmental and economic challenges.

LEARNING OBJECTIVES AND EXPECTED OUTCOMES

By the end of the session, the participants will be able to:

(i) Describe diversity as an important aspect of agroecology

(ii) Classify the different ways to include diversity in agroecology

Key terms: Diversity, biodiversity, food security

Teaching aids and materials: The training materials and requirements include; Stationary; Markers; Demonstration farm; Samples of trees / shrubs; Training manual/booklets.

DELIVERY PLAN

The training will take the form of field demonstration, field trips, and farmers given the chance to showcase their knowledge and skills (peer learning).

Activity	Description	Duration
1	Welcome the participants to the training. Let them introduce themselves to each other, and explain the objectives of the training/meeting.	10 minutes
2	Write the words "**Diversity**" and "**Biodiversity**", on the board and ask the participants to explain what they understand by these terms. Take note of the key words in their statements. After the discussions, ask the participants to refer to their handouts for the definitions of the terms and define to them the words as follows;	10 minutes

Activity	Description	Duration
	Diversity Biodiversity Inform the participants that they will spend some time discussing different biodiversity practices. The discussion will be guided by the following questions; ▪ What are the common biodiversity practices? ▪ What is their importance in agroecology? Divide the participants into 3 groups and assign them a biodiversity practice. Ask them to discuss examples of the listed biodiversity practices and answer the following questions based on the allocated techniques, and write their answers on the board. ▪ What are some common examples of the biodiversity techniques? ▪ What is their importance? Refer to the reference material to assist in facilitating the discussion.	10 minutes 25 minutes
3	Write the words **"Food security"** on the board and ask the participants to state what these words mean to them. Take note of the key statements in their responses, ask them to refer to the handouts and define the words to them as follows; Food security Divide the participants into two groups and ask them to discuss importance of diversity and biodiversity in improving the food security. Write their answers on the board and refer to the reference material to facilitate discussion.	10 minutes 10 minutes
4	**Field Visit:** ▪ Visit a farm where various biodiversity practices are implemented and ask the participants to identify those practices. ▪ Demonstrate on how to set up the kitchen garden techniques.	45 minutes

REFERENCE MATERIAL FOR ENTERPRISE DIVERSITY

Diversity and Biodiversity

Diversity refers to having a mix of different plants, animals, and farming methods on the same farm. For example, growing different crops together or raising various types of livestock helps create balance and reduce risks, like pests or crop failure. Biodiversity is about all the living things in a farm system, including crops, animals, insects, and soil organisms, and how they interact. Increasing biodiversity on a farm brings many benefits for production, income, nutrition, and the environment. By carefully choosing and managing different crops, animals, and plants, agroecological farming supports important natural processes like pollination and improving soil health, which are essential for productive farming and increasing yields.

Figure 8.5: Examples of biodiversity practices

Polyculture

Polyculture, also known as intercropping, involves cultivating multiple crop species in the same area simultaneously. This practice offers several benefits to farmers and the environment, including;

- **Improved soil health:** different crops contribute to the soil in unique ways, such as fixing nitrogen or adding organic matter, keeping the soil fertile. An example is growing beans with maize, beans help to fix nitrogen in the soil.
- **Pest and disease control:** growing diverse crops helps break pest and disease cycles, reducing the need for chemical pesticides.
- **Increased Yields:** mixed crops often use space, sunlight, and nutrients more efficiently, leading to better overall productivity.
- **Resilience to weather changes:** if one crop fails due to drought or disease, others may survive, reducing the risk of total loss in the far

Crop Rotation

This is a technique where different crops are grown in a sequence on the same land. It also means that the succeeding crop belongs to a different family than the previous one. This practice helps prevent the depletion of specific soil nutrients, disrupts pest and disease cycles, and enhances soil structure and fertility. Other advantages of crop rotation include;

- **Manages weeds:** growing crops with different growth patterns and timing can suppress weeds naturally, reducing the need for herbicides.
- **Promotes biodiversity:** rotating crops encourages a more diverse range of soil organisms, insects, and plants, creating a healthier ecosystem within the farm.

An example of crop rotation would be growing beans in a portion of land that was previously used for tomatoes, then growing another crop such as wheat for another extended period of time, before growing beans in the same portion of land. This can vary between seasons in a year.

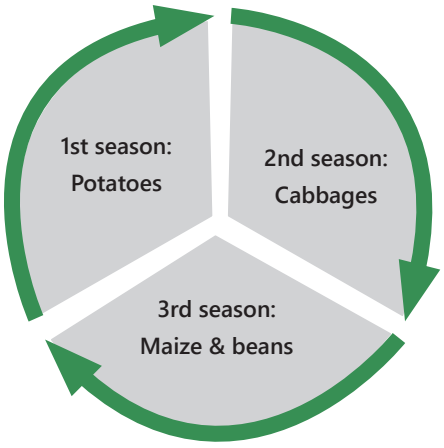


Figure 8.6: Crop rotation idea

Another example of crop rotation is planting various crops in separate sections of a parcel of land that has been divided into different plots. This is explained in the image below;

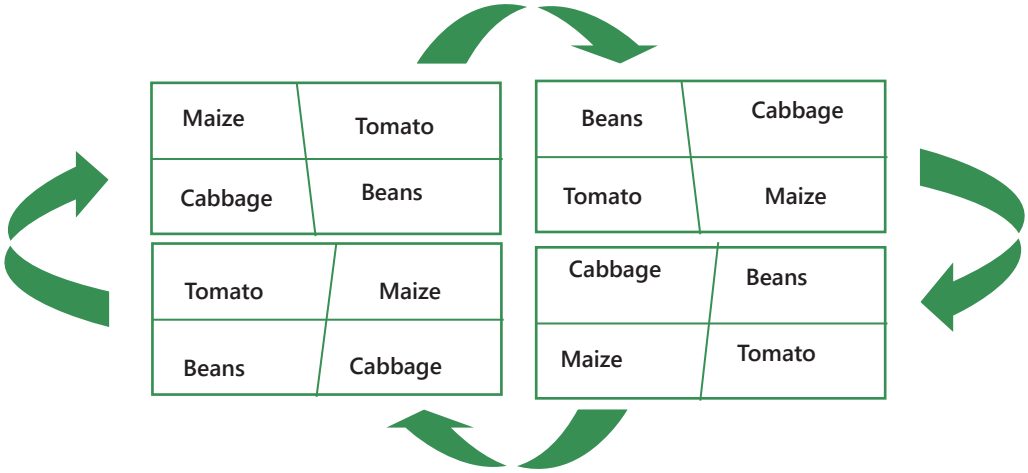


Figure 8.7: Crop rotation suggestion for a parcel of land divided into different plots. Source: ICIPE

Mixed Farming

Mixed farming, integrates crop cultivation with livestock rearing. This system creates a relationship where animal manure is used to fertilize the crops, improving soil health and boosting agricultural yields, thus having enough to provide the animals and also for the family to eat. The following are some of the advantages of practicing mixed farming;

- **Reduced risk:** if one activity fails due to weather or pests, the other can still provide income and food, offering stability.
- **Diverse income sources:** farmers can earn from both crops and livestock, reducing financial dependence on one product.
- **Natural pest and weed control:** animals can help manage weeds by grazing, and their presence may ward off some pests.

Kitchen Gardening

For small-scale farmers or individuals with limited farming space, kitchen gardens provide a solution for producing fresh vegetables daily. These gardens often include crops such as kale, spinach, tomatoes, and onions grown together. Kitchen gardening offers a practical, low-cost, and sustainable way for households to boost food availability and improve dietary diversity. Some of the benefits of a kitchen garden include;

- **Fresh produce:** allows the household access to fresh fruits and vegetables.
- **Addressing malnutrition:** common vegetables grown in kitchen gardening are green leafy vegetables which contain important nutrients such as iron and calcium which are important in fighting malnutrition.
- **Promotion of culture:** promotes growth and consumption of fruits and vegetables that are distinct to their culture ensuring cultural heritage is preserved.
- **Environment sustainability:** kitchen gardening supports use of organic methods of farming such as using compost as fertilizer and use of biopesticides such as ash, thus reducing use of synthetic fertilizers and pesticides that can leave residues on food that are harmful to our health. It also prevents land degradation.

Examples of Kitchen Gardening Techniques

Illustration of various kitchen garden methods,

Use of old tires to grow vegetables

Use of sacks for vegetable production

Food Security

Food security refers to a situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Diversity in agroecology plays a key role in improving food security. By growing different types of crops together, farms become more resilient to pests and diseases, reducing the chances of losing harvests. This ensures that households have enough food to eat. Kitchen gardens provide families with a steady supply of vegetables like spinach, kale, and tomatoes throughout the year. These vegetables are rich in important nutrients like iron and calcium, which improve family health and help fight malnutrition. Diversifying crops can also provide extra income for small-scale farmers. By selling part of their harvest, they can earn money to buy other foods or essential items for their families. This not only improves their economic situation but also ensures a diversified diet at home.

SESSION 21: GROWING INDIGENOUS FRUITS IN FARMLANDS FOR WOMEN EMPOWERMENT

CONTEXT

Fruit cultivation can enhance food security, improve nutrition, generate income and offer environmental benefits such as enhancing biodiversity, preventing soil erosion, and improving microclimate. Indigenous fruits are well-adapted to local environments, require minimal inputs, and are highly nutritious. Indigenous fruit farming offers a powerful tool for women empowerment, fostering resilience, income generation, and community development. Once established, fruit trees require less labor compared to annual crops, therefore women can manage orchards with less effort, especially with proper training and tools. Drought resistant fruit trees provide a sustainable food source and income even in dry seasons. Fruit growing reduces dependence on seasonal crops, providing year-round income. By equipping women with the skills and resources needed, they can become champions of sustainable agriculture in Kenya. This guide provides step-by-step instructions for women farmers to establish and maintain productive fruit trees on their farmlands.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to:

(i) Establish and maintain diverse indigenous and underutilized fruit trees on their farmlands

(ii) Construct a simple fruit orchard in their farmlands

Key terms: Fruits, indigenous, underutilized, farmland

Materials and resources: Stationary, model farm visits, demonstrations, practicals

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting

Step	Description	Resources
1	Welcome the participants to the training and provide brief highlight about the objectives of the training/session. Allow the participants to enumerate why Indigenous fruit farming offers a powerful tool for women empowerment. At the plenary lead the participants to name some of the fruits that they are growing on their farms and whether they are indigenous or exotic species. Draw the attention of the participants to some recommended indigenous fruits that they could consider growing to foster resilience, food nutrition, income generation, and community development.	15 minutes
2	Facilitate a session on fruit growing emphasizing the following: ▪ Site selection ▪ Propagation and planting ▪ Watering ▪ Weeding, ▪ Pruning and training ▪ Fertilization ▪ Pest and disease management ▪ Harvesting and post-harvest management ▪ Marketing and selling indigenous fruits ▪ Advocacy for fruit growing ▪ Sustainability In groups, allow the participants to select a fruit tree and then discuss all the above topics ready for a practical session	30 minutes
3	Facilitate a practical session to focus on: ▪ Propagation techniques- Grafting, budding, air layering, seed extraction ▪ Site selection and hole digging (Correct dimensions and fertilization)	60 minutes
4	Conclude the session/ feedback	10 minutes

REFERENCE MATERIAL FOR GROWING INDIGENOUS FRUITS ON FARMLANDS FOR WOMEN EMPOWERMENT

Indigenous fruits are well-adapted to local environments, require minimal inputs, and are highly nutritious

Seed Propagation

This is the simplest and most common method, especially for species with viable seeds. Seeds are collected from mature fruits, cleaned, and planted directly in the nursery or field. Examples:

- Baobab (Adansonia digitata): Seeds are extracted, soaked in hot water to break dormancy, and sown in a nursery bed. Since baobab takes long to grow, it`s sustainable over a long period of time
- Tamarind (Tamarindus indica): Seeds are scarified (scratched or nicked) before planting to enhance germination.

Advantages: Simple, cost-effective and suitable for large-scale propagation.

Limitations: Takes long to start fruiting and the fruit quality may vary.

Vegetative Propagation

This method involves using parts of a tree (such as cuttings, grafts, or suckers) to grow new plants. It ensures the offspring retains the parent tree's characteristics unlike using seeds.

a) Cuttings

Cuttings are sections of stems, branches, or roots that are planted to produce new plants.

Examples: Wild loquat (Uapaca kirkiana): Stem cuttings and Guava (Psidium guajava): Root and shoot cuttings can be used for rapid propagation.

b) Grafting and Budding

This technique involves attaching a scion (a shoot or bud from a desirable tree) onto a rootstock of a compatible species.

Examples: Marula tree (Sclerocarya birrea): Grafting ensures quicker fruiting and better fruit quality. African plum (Parinari curatellifolia): Budding is used to propagate improved varieties.

Advantages: Preserves desirable traits like fruit quality and disease resistance and shortens the time to fruiting compared to seed propagation.

Limitations: Requires skill and precision and may have lower success rates without proper conditions.

There are many grafting techniques that a farmer may use but whip grafting is easiest as shown below.

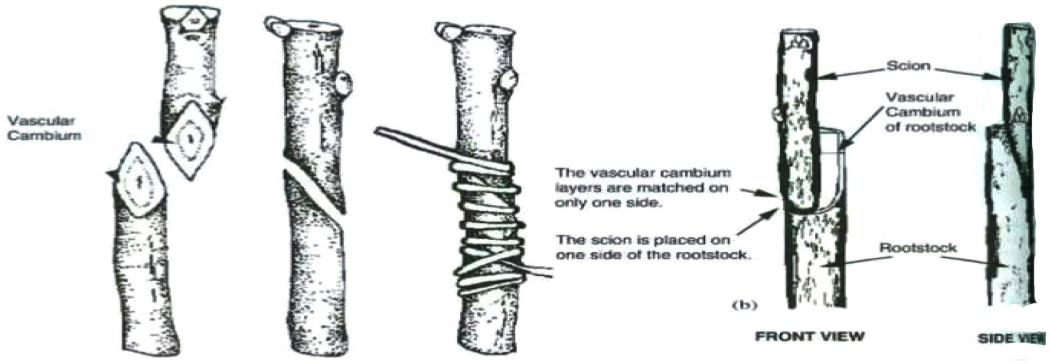


Figure 8.8: Whip grafting, Source: www.slideshare

Facilitator can mention the other grafting techniques such as cleft, approach, topworking and veneer. The aim is to let the farmers understand the principle and the materials they need for grafting.

c) Air Layering also known as marcotting

In this method, cut through the bark of the tree all the way round. Remove several leaves around the wound. Pack area with finely chopped dry grass mixed with loamy soil. Cover moss with polyethylene plastic and tie each end. Check to make sure moss remains moist until roots form. After roots are visible inside the bag, the rooted stem can be cut from the mother plant and potted. Examples: Fig trees (Ficus spp.): Air layering is used for species with thick branches. Kei apple (Dovyalis caffra): Air layering enhances survival rates.

Advantages: No need for a separate nursery and produces mature plants quickly.

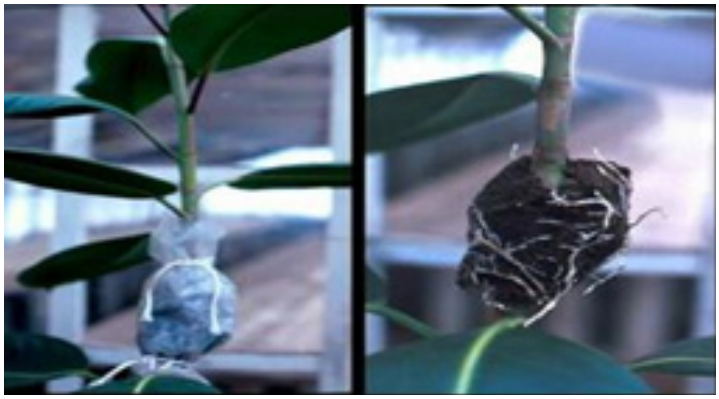


Fig 8.9: Air layering in Ficus spp.

d) Wildlings collection

Young seedlings (wildlings) growing naturally under parent trees are transplanted to nurseries for nurturing before planting in the field. Examples: African cherry (Prunus africana): Wildlings are collected to boost afforestation efforts. Shea butter tree (Vitellaria paradoxa): Naturally occurring seedlings are transplanted to plantations. Other examples include Guava and loquats.

Advantages: Simple and cost-effective and utilizes naturally occurring resources.

Limitations: Risk of damaging the root system during transplantation and low success rate if not handled carefully.

Preparing the Farmland

Site Selection: Choose areas with adequate sunlight and good drainage and avoid areas prone to flooding or waterlogging then clear it of weeds and debris.

Planting and Establishing Fruit Trees

Planting Techniques: Dig holes 60cm deep and 60cm wide during the dry season. Mix topsoil with compost and fill the hole. When rains begin, plant the fruit tree seedlings taking care to maintain the nursery level. Ensure to keep the soil moist after planting.

Spacing: Maintain proper spacing between trees to allow for growth and air circulation. Big trees require 8- 10 meters while shrubby trees e.g guavas can do with 4–6 meters. Size of the mature tree is the determining factor for spacing.

Caring for Fruit Trees

There is need to water young trees frequently until they are established. To avoid the seedlings from drying out, always plant during the rainy season to ease on watering. Mulch with dry grass to conserve moisture and suppress weeds. Farmers may slash the orchard to keep weeds low but it is not necessary so long as the area around the seedling is weed free. For soil management, apply compost or manure annually to improve soil fertility and practice agroforestry by intercropping with legumes to fix nitrogen.

Pruning and Training: Framers should prune trees to shape them and remove diseased or dead branches and train branches to optimize fruit production and accessibility.

Fertilization: Applying organic and inorganic fertilizers during key growth stages is important, and farmers should avoid over-fertilization to prevent damage to the roots.

Pest and Disease Management: Farmers should be encouraged to use natural remedies (e.g., neem oil) and Integrated Pest Management (IPM) techniques. Also monitor trees regularly to detect and manage problems early.

Harvesting and Post-Harvest Management

Harvesting: Farmers should harvest fruits at the right maturity stage to ensure quality, and use clean tools to avoid damaging the tree during harvesting.

Storage: Farmers should store fruits in a cool, dry place or refrigerate (locally) to extend shelf life.

Value Addition: Training is important to the farmers to learn how to process fruits into juices, jams, or dried products to increase income.

Marketing and Selling Fruits

Market identification: Identify local markets, cooperatives, or direct sales opportunities where fruits can be sold. Appropriate packaging is necessary to preserve freshness and appeal to buyers. To ease marketing,

collaboration to be encouraged for collective marketing through women's groups to access larger markets and negotiate better prices.

Empowering Women Through Fruit Farming

To empower women, there is need to develop their skills by conducting regular training on advanced fruit farming techniques; provide support for access to tools, seedlings, and credit facilities; build women's farming groups for mutual support, knowledge exchange, and advocacy; share success stories to inspire other women and advocate for Indigenous fruits by raising awareness about the nutritional and environmental value of indigenous fruits.

Sustainability and Environmental Conservation

To ensure sustainability, farmers can start tree planting initiatives by partnering with community organizations to promote tree planting; integrate indigenous fruit trees with other crops for diversified farming systems and preserve biodiversity by encouraging the planting of a variety of indigenous fruit trees to sustain local ecosystems.

By implementing these practices, women farmers can establish profitable and sustainable fruit farming ventures, improving their livelihoods and communities.

Selecting Suitable Fruits

Some recommended indigenous fruit varieties that should be promoted among women farmers include the following;

Loquats *(Eriobotrya japonica)*

Dragon fruit *(Selenicereus undatus)*

Kei apple *(Dovyalis caffra)*

Guava *(Psidium guajava)*

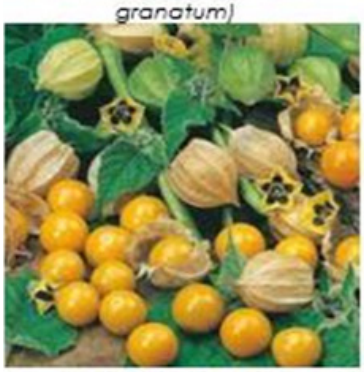
Black plum *(Syzygium cumini)*

Tree tomato *(Solanum betaceum)*

Pomegranate *(Punica granatum)*

Soursop *(Annona muricata)*

Giant yellow mulberry *(Myrianthus arboreus)*



Cape Gooseberry *(Physalis peruviana)*

Jackfruit *(Artocarpus heterophyllus)*

Tamarind *(Tamarindus indica)*

MODULE 9: MARKETS

Women make up the largest labor force in farmland. Much of the work that female smallholder farmers engage in is unpaid and they are often burdened with numerous responsibilities, including sowing, weeding and harvesting; processing food after harvesting; making food for their families and collecting firewood and water. In addition, women usually take care of children and the elderly and are the ones responsible for food security in the home. When food is limited, it is women who often receive the smallest portions within the family, and mothers are the ones most likely to miss out on a nutritional diet or access to medical care. Recognizing the specific needs of women by understanding marketing and markets is of vital importance to rural economies and is by far the most effective means of fighting hunger and poverty in a sustainable way. The module is divided into three sessions/meetings; (1) Understanding marketing and markets for agroecology products; (2) Creating strategic markets for agroecology products and inputs, and (3) Planning and developing viable agroecology enterprises.

SESSION 22: UNDERSTANDING MARKETING AND MARKETS FOR AGROECOLOGY PRODUCTS

CONTEXT

Women smallholder farmers often feel powerless in the face of low prices for their crops, believing they have no control over the market. Their focus tends to be on the greed of middlemen, which leads to a sense of helplessness and stagnation. As a result, they continue to grow a mix of food and cash crops to sustain their families, hoping for a better future for their children, even if it means remaining in rural poverty. Occasionally, well-meaning officials or NGO representatives visit their communities to offer advice and new ideas, like planting aloe vera or making peanut butter. However, the key issue remains: where can they sell these products? The middlemen are often unwilling to purchase locally made products.

This meeting is designed to help unlock the negative mindset women smallholder farmers have about the market. Through learning and discovery, the module will guide farmers in understanding how the market works, how value chains operate, and the various actors involved. Through this learning, farmers will realize that there are opportunities to explore, and that by becoming knowledgeable about the market, they can make better decisions about what to produce and how to access these markets and explore new ways of reaching the market. This shift in perspective empowers farmers to understand market requirements, plan their production to meet market demand, secure more favorable prices, improve the quality and consistency of their products, and find new opportunities to add value, such as through packaging or semi-processing.

By promoting agroecological principles, this session will equip them to create more sustainable and resilient farms, ensuring long-term success in both production and market participation.

LEARNING OBJECTIVES AND OUTCOMES

By the end of the session the participants will be able to:

(i) Identify the core components of marketing, including product development, pricing, distribution, and promotion, and understand how these elements work together to influence market access.

(ii) Identify key challenges facing agricultural markets and link them to the structure and nature of agricultural commodities.

Key Terms: Agricultural markets, agricultural markets, marketing functions, the 4psR

Training Materials/Resources: Whiteboard/Flip chart, markers, projector/Computer (optional for slides), handouts with key concepts and visuals of certification labels. case studies or examples of agroecological practices, printed or digital copies of market entry barriers for smallholder farmers, examples of certifications (logos, labels).

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

<table>
<tr><th>Activity</th><th>Description</th><th>Duration</th></tr>
<tr><td>1</td><td>Welcome the participants and share with them the objectives of the session. Make sure that all participants have their handbooks with them, the objectives of the session include;
Enhance understanding on the key elements of marketing and its process.
Identify key challenges facing agricultural markets and link them to the structure and nature of agricultural commodities.
The trainer should use the following examples (but not limited) to explain the concept of markets clearly to the participants. The trainer should use examples of market experiences specific to the area to ensure the participants have a better understanding of the market opportunities, challenges and the possible solutions that could be used.<table><tr><th>Inputs</th><th>Extractive resources</th><th>Agroecologically produced products</th></tr><tr><td>Compost manure
Vermicompost
Animal manure
Biopesticides</td><td>Eco-tourism
Wild fruits</td><td>Vegetables
Fruits
Maize
Milk and milk products</td></tr></table></td><td>10 minutes</td></tr>
<tr><td>2</td><td>Write the word ‘Marketing’ and ask participants what they understand by this term. Note key words from their responses under the word ‘Marketing’. Then write ‘Market’ on the right side of the board. Again, ask participants what they understand by this term, and note their responses under the word ‘Market’. Conclude this discussion by referring participants to their handbook, and explaining the definitions.
Ensure to bring out the distinction between the selling and marketing concepts and the selling concept referring to the visual on the Handbook.</td><td>10 minutes</td></tr>
</table>

Activity	Description	Duration
3	Inform the participants that you would like them to spend some time discussing their experiences in marketing. In order to deepen participants' understanding of marketing and to anchor the learning to their own farms, organize the participants into groups of three to five. Ask each group to select a product that they are familiar with and ask them to answer the following questions (write these on the board) with regard to the chosen product: ▪ Who is the final consumer? ▪ What are the different ways to market this product? ▪ How does demand and price for the product vary at different places and times; Are there differences for men and women? ▪ What information about prices is available to farmers? ▪ What are the different market outlets available for the product? What prevents you from utilizing an alternative outlet? ▪ What influences the outlet that you choose? ▪ What are some of the constraints or problems you might experience when selling the product? After 20 minutes, facilitate a discussion to ensure that the key marketing concepts are introduced and challenges facing agricultural markets emerge. Conclude this discussion by referring participants to the Table in the Handbook on marketing functions and reiterating the following: ▪ A product may pass through a number of hands to get from the farmer to the final consumer or user. All the stages together from farmer to the final consumer are called the marketing channel. ▪ At each stage value is added to the product. And at each stage a cost is also added to the product. The costs include things like transport, storage, packaging, and handling fees. ▪ Explain that if farmers sell in the local market their profit margin might be high, but they can only sell small amounts. If the product reaches the city market or the international market, then the farmers can sell larger amounts. But such sales would need the support of traders and others along the way. Each of them would add value and cost to the product. Because the costs are higher, the profit margin will be lower.	30 minutes
3	As a last exercise for the step, introduce the 4Ps of marketing (Product, Price, Place, and Promotion) and explain how each element can be used to develop effective marketing strategies. Tell the participants that you will divide them into four groups, where ach group should discuss the strategies for overcoming the challenges identified in the previous activity. Assign each group a specific element of the 4Ps to focus on. Ask each group to select a commonly produced commodity from their local area to analyze and discuss. In their groups, participants should discuss the following questions related to their selected commodity and assigned 4P element: **Overcoming Challenges:** Each group should also discuss the challenges identified in the previous activity and explore strategies to overcome them using their assigned 4P element.	15 minutes

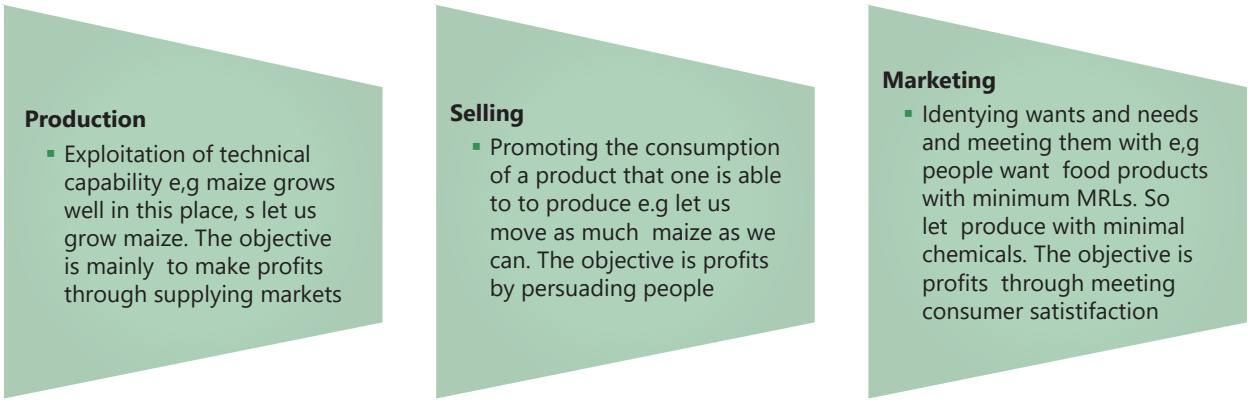
Activity	Description	Duration
4	When the groups have finished their discussions, facilitate a question-by-question discussion in the plenary. Emphasize that it is important to know what market outlets are available for your products. It is also important to know about these markets, with regard to time, access, terms and conditions and other facilities. In this way they will be able to make informed decisions about which market to use.	20 mins
5	The facilitators ask the participants to mention what they have learned during the session. They will then be able to raise questions of things they found difficult or did not understand – as well as issues they liked a lot and why. Conclude the meeting by telling participants that in the next meeting they will discuss how to find out more about markets and marketing.	15 mins

REFERENCE MATERIAL FOR UNDERSTANDING MARKETING AND MARKETS FOR AGROECOLOGY PRODUCTS

Agricultural marketing is the process that involves all activities and agencies related to the movement of farm-produced goods, such as food and raw materials, from producers to consumers. It encompasses the decisions and operations involved in **producing, assembling, grading, packaging, and distributing agricultural products**, considering both technical and economic factors. This process also includes pre- and post-harvest activities and the financial and institutional systems that support the flow of goods.

An **agricultural market** is a platform or system where buyers and sellers of agricultural products (such as crops, livestock, or processed goods) interact to exchange goods for money or other forms of compensation. It encompasses all activities related to the buying and selling of these products, including the processes of **production, distribution, pricing, and consumption**. Agricultural markets exist in both **formal** settings (such as local markets, cooperatives, or online platforms) and **informal** settings (like street vendors or direct trade between farmers and consumers).

Participants need to understand the distinct between **marketing and selling**. The selling concept and the marketing concept represent two distinct approaches to business, with key differences in focus and strategy (Figure 9.1).



A marketing system has two distinct dimensions. One of those dimensions is the institutions, organizations and enterprises (actors) which participate in a market and the second is the functions that those participants perform. The functions include (Table 9.1);

Functions	Examples
Exchange	▪ Buying ▪ Selling
Physical functions	▪ Storage ▪ Transportation ▪ processing
Facilitating functions	▪ Standardization ▪ Financing

The existing models for distribution and marketing of agricultural commodities are associated with several challenges, including;

- Weak linkages between producers, consumers and other food system actors.
- Inefficient food supply chains and markets characterized by high transaction costs, increased cost in logistics,
- Long value chains which increase the carbon footprint.
- Price fluctuations
- Information asymmetries, opaqueness and lack of transparency
- Lack of basic infrastructure for product handling and storage
- Competition from cheap imports
- While markets for conventional inputs like hybrid seed, fertilizer and pesticides are well developed, those for organic and biological inputs are still nascent (Place et. al., 2022).
- The hidden social and environmental costs of unsustainable farming remain invisible in market prices (Negowetti, 2017).
- Limited uptake of certification or standards on the use of the agro ecological practices

Small-scale producers must navigate this barrier and other challenges in order to benefit from opportunities afforded by emerging market dynamics. By understanding and adapting to these trends, small-scale producers can enhance their market access and profitability. In this meeting, we will explore key concepts in marketing that could help small-scale farmers make informed decisions about what to produce, identify target markets, enhance the value of their products, overcome challenges of market access, understand market needs and develop effective marketing strategies.

The marketing plan: While producers have traditionally done a good job of producing, they have often neglected marketing. Now, with the emerging market dynamics small-scale producers must start understanding and adapting to these trends, and come up with strategies to navigate these barriers. Developing a good marketing plan will help you identify and quantify costs, set price goals, determine potential price outlook, examine production and price risk, and develop a strategy for marketing your crop. The meeting facilitator will help participants cover the 4Ps of marketing (Product, Price, Place, and Promotion). By addressing each of these key elements, participants will gain knowledge on how to make informed decisions that can improve their market outcomes.

Here's why each element is crucial (Figure 9.2):

1) **Product**: Understanding the concept of "product" helps farmers focus on what they are offering and how to improve it. This could include quality, packaging, or even diversifying products to meet market demand.

2) **Price**: Learning about pricing strategies is vital for smallholder farmers who often face challenges

with low market prices. By understanding how pricing works and the factors that influence it, farmers can better negotiate with buyers, set competitive prices, and explore ways to ensure fair pricing, which is essential for their profitability.

3) **Place**: "Place" refers to the distribution channels that get products from the farm to the consumer. Knowledge about where and how to sell products—whether through local markets, cooperatives, or direct-to-consumer models—allows farmers to optimize their sales and reduce reliance on middlemen who often take a significant cut.

4) **Promotion**: Understanding promotion helps farmers to communicate the value of their products to potential buyers. This could involve branding or creating awareness, of their produce more effectively.

Promotion is key to creating awareness about the value proposition of agroecology products.

Covering the four Ps, will provide a holistic understanding of marketing, which empowers farmers to navigate market dynamics effectively, enhance their competitiveness, ultimately secure better prices and opportunities for their products.

SESSION 23: CREATING STRATEGIC MARKETS FOR AGROECOLOGY PRODUCTS AND INPUTS

CONTEXT

Creating strategic markets for agroecology products and inputs key areas for investment: improving women's leadership and decision-making in food systems, promoting equal and positive gender norms, improving access to resources. The link between markets and sustainability of food systems is crucial, since markets are central to shaping how food is produced, distributed, consumed, and valued. For small-scale farmers, marketing is becoming more important than ever.

In Kenya, food production is predominantly small-scale and dominated by women, accounting for 75% of total production. However, the declining size of farm units means that small-scale producers often produce low quantities of surpluses, which do not meet the market requirements of large-scale off-takers.

Even though most consumers in urban areas in Kenya exhibit a preference for agroecologically produced food, in part as a result of concerns over health, access to such food is still very limited. Moreover, supply of such food is low and most of it finds its way into, either high-end supermarkets where it can only be enjoyed by a wealthy minority, or to exporters. Access to such food should be available to all and so systems are needed that enable farmers to transition to more sustainable agriculture like agroecology and which can deliver this food affordably to mass markets.

LEARNING OBJECTIVES AND OUTCOMES

The session aims to help participants gain comprehensive understanding of agroecology's unique value propositions in the market and be equipped with strategic insights and practical tools to support smallholder

farmers in accessing markets, building sustainable value chains, and increasing their profitability through agroecological practices. By the end of the session the Participants will be able to;

- Describe the unique features of agroecological products, including their environmental sustainability, social equity, and health benefits, and how these factors differentiate them from conventionally produced products.
- Identify market entry barriers for smallholder farmers, such as access to finance, certification costs, infrastructure, and information, and propose strategies to overcome these barriers.
- Identify certification schemes (e.g., organic, fair trade, eco-labels) and their role in improving market access for agroecological products.

Key terms: Local (territorial), regional and international markets, organic certifications, Participatory Guarantee Systems (PGS, environmental sustainability, social equity, health Benefits.

Training Materials/Training: Whiteboard/Flip chart, markers, projector/Computer (optional for slides), handouts with key concepts and visuals of certification labels. case studies or examples of agroecological practices, printed or digital copies of market entry barriers for smallholder farmers, examples of certifications (logos, labels).

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Duration
1	Welcome the participants, and share with them the objectives of the meeting. Hight the fact that linking markets with agroecology involves creating a connection between sustainable farming practices and the market opportunities that value these practices. Agroecology focuses on environmentally friendly, socially equitable, and economically viable farming systems, while markets are essential in ensuring these products reach consumers.	10 minutes
2	Some niche markets, especially organic or fair-trade markets, require certifications that can be costly and difficult for smallholder farmers to obtain. This can create barriers for smaller producers, limiting their ability to participate in these markets	25 minutes
3	Ask participants to describe what they know about conventional vs agroecological farming. Write responses on the board/flip chart. In order to deepen understanding on the unique features of agroecological products, the facilitator will divide the participants into small groups. Ask each group to discuss and identify differences between agroecological and conventionally produced products, focusing on the environment, society, and health. During the plenary, highlight that agroecology as a holistic farming approach that integrates ecological, social, and economic considerations. Explain that agroecological products are produced in ways that promote environmental sustainability, social equity, and health benefits. **Visual Comparison:** show images or charts comparing agroecological vs. conventional products (e.g., soil degradation, chemical residues, community health, pesticide use).	30 minutes
4	In groups, have farmers brainstorm barriers to accessing markets for agroecology products and inputs. What strategies can overcome the barriers.	20 mins
5	When the groups have finished their discussions, facilitate a question-by-question discussion in the plenary. Emphasize that it is important to different typologies of markets and strategic options	20 mins

6	Q&A: Open the floor for questions and answers. Encourage farmers to share their thoughts on how they can apply the concepts learned in their own practices. Conclude the meeting by telling participants that in the next meeting they will discuss how to plan and develop agroecology enterprises.	10 mins

REFERENCE MATERIAL FOR CREATING STRATEGIC MARKETS FOR AGROECOLOGY PRODUCTS AND INPUTS

Description of Current Markets for Agricultural Products

In most developing countries, 80–90% of agricultural goods are sold informally, through transactions at the farm gate, roadside sales, village and rural assembly markets, and urban wholesale and retail markets. Prices are typically based on a combination of supply and demand, trader cartels and customer loyalties. Having few regulations and often no taxation, these markets are the most accessible to smallholder farmers. No grades and standards, means flexibility in value propositions and often low postharvest losses. These informal markets therefore attract the bulk of smallholder farmers' produce, from high volume, low value grain and pulse crops to higher value fruits, vegetables and meat products. However, they are often controlled by cartels of traders who limit competition, enforce arbitrary stall fees, and make choices that favor their allies and relatives. A lack of investment and poor transparency often result in crowded, unsanitary market conditions, where food safety issues are often overlooked.

In contrast, formal markets are, by definition, more regulated and transactions are based on defined legal frameworks. Farmers must meet specific quality standards and apply best practices for the production and handling of goods (and firms may require traceability of lots). Formal buyers require regular, high volumes, so smallholders have to be well organized. They can link farmers to a consistent source of income, but in exchange for longer term buying arrangements and other benefits, prices may be below those in informal markets. Farmers who link to formal markets can generally access more support services. There are several challenges, though. Buyers and sellers rarely meet, so trust in transactions is based on written standards and, often, certification. Also, traders extend credit to producers (e.g., a cash prepayment) in almost all market transactions. The size of a deal is thus limited by the traders' access to and willingness to carry large amounts of cash.

Typologies of markets

Typology	Description	Agroecology principle /remark
Inclusive Markets (Social and Solidarity Economy)	Focused on social equity and environmental sustainability, often aimed at marginalized groups, such as smallholder farmers, women, and indigenous communities.	▪ Social equity by addressing issues of power and wealth imbalances in traditional markets, ▪ Markets prioritize the inclusion of these groups in economic activities and seek to address the imbalances of power and wealth in traditional markets.

Typology	Description	Agroecology principle /remark
Local and Regional Food Systems	This market typology emphasizes local and regional food networks where agroecologically produced goods circulate within a specific geographic area. These markets aim to reduce the environmental footprint of transportation and promote local food sovereignty.	▪ Resilience by reducing dependency on global supply chains. ▪ Circularity in local food systems putting emphasis the sustainable use of local resources and closing nutrient loops.
territorial markets	Focuses on building strong, localized food systems that are deeply embedded in the cultural, social, and environmental context of a specific territory.	▪ Food Sovereignty by prioritizing local control over food production and recognizes the right of communities to define their own food systems. ▪ Resilience by reducing dependency on global supply chains. ▪ Circularity: due to likelihood to adopt circular practices, such as composting,
Niche markets	Focus on specialized agroecological products that cater to particular consumer segments, often driven by a preference for organic, locally produced, or sustainably grown products. These markets often pay a premium for products that meet set environmental and social standards	While niche markets often support sustainable and ethical practices, they can sometimes be exclusive or elitist. Products in these markets may come with higher prices, making them inaccessible to lower-income consumers Some niche markets, especially organic or fair-trade markets, require certifications that can be costly and difficult for smallholder farmers to obtain. This can create barriers for smaller producers, limiting their ability to participate in these markets
Direct-to-consumer markets	Involve direct transactions between farmers and consumers, bypassing intermediaries and characterized by shorter supply chains, stronger connection between consumers and producers and focus on sustainability, quality, and transparency.	Consistent with social equity, food sovereignty, and resilience principles since they create fairer, more transparent relationships between farmers and consumers.

Understanding of Agroecology Markets

Linking markets with agroecology involves creating opportunities for smallholders to tap into the growing consumer demand for sustainable, healthy, and locally produced food. By promoting agroecological practices that align with market needs and trends, farmers can enhance the value of their products, strengthen their market position, and contribute to more resilient and sustainable food systems. **Agroecology** focuses on local resource management and supports diversified production systems that can adapt to local conditions.

By strengthening local food systems, agroecological farmers can establish direct marketing relationships with local consumers, retailers, and food businesses, reducing transportation costs, and ensuring fresh, healthy products. These markets are increasingly popular as they emphasize traceability, sustainability, and community-based food systems.

Characteristics of agroecology markets: The value of agroecological food is found in; 1. Its characteristics as organic, healthy, natural, safe food that is free from agrochemicals. 2. Direct contact between producers and consumers or via trusted intermediaries is the most common means to communicate quality. 3. Labels are important in these initiatives as a means to communicate agroecological quality. 4. The majority of the prices are seen as being fair and are set in a fair way. 5. The consumers in these networks are relatively price insensitive

Put emphasis that all these agroecological approaches have common impacts: reduced use of inorganic inputs; safe, nutritious food and improved human health; improved local livelihoods; more sustainable agriculture resilient to shocks; and, as a result, healthier local economies.

Constraints: Most consumers do not have access to this type of food, despite the fact that they would prefer to buy it. There are two major constraints that explain this:

The costs of basic foodstuffs in Kenya have been rising for the past few years and for poor households, for whom food accounts for about 36% of spending, this is a serious problem. Food products that include agroecological characteristics in Kenya are either certified organic or have KS1758 certification and both are sold with a premium price.

Farmers vary widely in their assets, natural resource base, farm size, expertise, technology use, access to markets and agricultural services, level of organization and their products. Linking to formal markets should not be the goal for all smallholder farmers – trying to link the most vulnerable farmers to the highest value or most dynamic markets would be a mistake.

Strategic markets for agroecological products: To successfully access agroecological markets, farmers can leverage a variety of strategic market mechanisms that support sustainability, transparency, and trust. Participatory Guarantee Systems (PGS), third-party certifications, and standards such as KS 1758 are essential tools that empower farmers to demonstrate their commitment to agroecological principles

Physical outlets in mass markets, such as Kangari Earth Market, provide an opportunity to market PGS produce alongside conventional products (slide). Other marketing opportunities include government procurement for schools and other institutions.

Awareness of PGS is low within national and county governments. Formal recognition is needed on the role that PGS can play in supporting local food supply. KOAN is supporting the development of a national network of PGS assessors, in partnership with Slow Food Kenya, PELUM Kenya, and the Biovision Africa Trust. This will help improve coverage and keep costs down. PGS costs are a fraction of third-party organic certification and have several additional advantages such as the empowerment of farmer groups, peer-to-peer spreading of knowledge on farm and market best practices. It is important to note, however, that not all countries recognize PGS as a certification system. PGS is the more applicable to small farmers and has potential to provide affordable food to mass markets. If this potential is to be achieved, a number of constraints need to be overcome:

Third party organic certification

- Third party certification remains a costly challenge for many, and the need for price premiums means that third party certified organic can only meet a relatively small amount of the demand among Kenyan citizens

KS1758 'Horticulture Code of Conduct': KS1758

- KS1758, introduced in 2022, aims to ensure food safety and protect the environment. It includes measures to minimize use of chemicals and encourage use of organic inputs and is benchmarked against EurepGAP, but is not an organic standard

Participatory Guarantee Systems (PGS)

- PGS are locally run quality assurance systems that incorporate the participation of farmers and other stakeholders. In Kenya the main PGS network is coordinated by the KOAN. Approved PGS groups use EAOPS to benchmark their internal regulations and are allowed to use the Kilimohai mark, which has been endorsed by the Kenya Bureau of Statistics

SESSION 24: PLANNING AND DEVELOPING VIABLE AGROECOLOGY ENTERPRISES

CONTEXT

At its core, agroecology is not just about promoting environmentally friendly farming practices; it's about reinforcing the local economy. By fostering biodiversity, improving soil health, and reducing reliance on external inputs, agroecology offers means to keep more revenue within the local communities. When effectively integrated with a solid business model, it can lead to greater profitability for smallholder farmers (SHFs), better wages for farm workers, and more competitive local businesses. The benefits of agroecology for the local economy are manifold. Beyond the direct economic advantages to farmers and local businesses, there's the ripple effect: healthier communities due to safer, chemical-free products, a boost in local employment, and the conservation of local ecosystems.

Like any other business or project, the successful transition from conventional to agroecological production is dependent on the integration of robust business models and understanding the dynamics of implementing the plan. Business planning is an on-going, problem-solving process that can identify business challenges and opportunities that apply to an agricultural enterprise and develop strategic objectives to move farm beyond its current situation toward your future business vision. Once developed, the business plan can be used as a long-term, internal organizing tool, pursue long-term personal, economic, environmental and community goals and develop ways of communicating within or outside your farm to potential business partners, lenders and customers.

The meeting is intended to enable participants have a clear understanding of the key components of business planning in the context agroecological transition. While participants may not be able to develop full business plans themselves immediately, they will gain the knowledge and skills to make informed decisions, understand market opportunities, manage risks, and improve the financial sustainability of their agroecological practices. The participants will also be equipped to work with advisors or use templates to develop simple, actionable plans that support both ecological and economic sustainability.

LEARNING OBJECTIVES AND OUTCOMES

This training has been developed to build capacity of smallholder farmers agri-prenuers to plan, implement and evaluate their agroecology enterprises. By the end of the session the participants should:

(i) Embrace an entrepreneurial mindset in operating their agroecology practices

(ii) Have a basic understanding of how to assess their farm's internal and external situations.

(iii) Be able to develop strategic goals, objectives, and an action plan.

(iv) Have gained insight into financial considerations and how to incorporate them into a business plan

(v) Work with advisors or use templates and tools to develop simple, actionable plans that support the transition from conventional to organic 9agroecological) production management.

Key Terms: Agri-prenuers, function of farm management, problem tree, SWOT analysis, business plan,

Training Materials/Resources: Whiteboard or large flip chart, markers, sticky notes (different colors), pen and paper for participants and printouts of a SWOT template (optional).

DELIVERY PLAN

In order to ensure effective delivery of the content and achievement of the learning outcomes, the following outline will be implemented during the meeting;

Activity	Description	Duration
1	Welcome the participants, and share with them the objectives of the meeting. The main objective of the meeting is to build capacity of smallholder farmers agri-preneurs to plan, implement and evaluate their agroecology enterprises.	10 minutes
2	Facilitate a plenary discussion with the trainees and ask them to identify limiting factors to agricultural entrepreneurial growth amongst them. Some of the factors may include; ▪ Rapidly changing climate ▪ Decreasing farm productivity ▪ Inadequate infrastructural facilities ▪ Poor entrepreneurial culture among the population ▪ Lack of policy incentives During the discussion let it emerge that the farmer is the manager of his farm and needs to carry out the function of management. In order to deepen participants' understanding of business planning, introduce plenary the key components of planning; a) Assessing internal and external situation of the farm b) Setting objectives of the farm c) Designing strategy to realize those objectives. Organize the participants into groups of three to five and introduce them to the tools that are used for farm planning such as the problem tree approach and SWOT analysis. Briefly explain that internal factors (strengths and weaknesses) relate to what the farm can control (resources, management, production capacity, etc.), while external factors (opportunities and threats) are elements outside the farm's direct control (market conditions, government policies, weather conditions, etc.) Give each group a whiteboard or flip chart with the SWOT template drawn on it. Alternatively, provide sticky notes in different colours for each quadrant of the SWOT analysis. Each group starts by analysing the **internal factors** (Strengths and Weaknesses). They should brainstorm and write down all relevant points for each category. Encourage participants to think about things that affect day-to-day operations as well as long-term sustainability. Each group now focuses on **external factors** (Opportunities and Threats). They should brainstorm and write down all relevant points. Encourage participants to consider social, economic, technological, and environmental factors. Each group will review and categorize their points for both internal and external factors and discuss farmers can leverage on their strengths to take advantage of opportunities? What weaknesses need to be addressed to minimize threats? How can the farmers build resilience to external challenges like market volatility or climate change? Which opportunities are the most feasible and valuable to pursue? As a final step, ask each group should develop an action plan or strategic recommendations based on their SWOT analysis. This can include specific actions the farm should take to build on its strengths, minimize weaknesses, capitalize on opportunities, and address threats. Each group can propose 3-5 actionable strategies to improve farm sustainability.	40 minutes

3	The facilitator should lead a debrief session where participants share what they learned from the activity.	10 minutes
4	The output of the SWOT analysis can be used to create the foundation for a business plan, including strategic goals, operational plans, and initial financial considerations. Provide a brief overview of what a business plan typically includes: Executive summary; farm description; market analysis; SWOT analysis; strategic goals and objectives; action plans/strategies; financial projections (if applicable) and conclusion. Mention that while the session is condensed, they'll create a foundational business plan that they can expand on later. This structure will give participants a practical, action-oriented business plan while ensuring there is enough time for each section. This should be based on the crops produced. These are the key questions you'll need to answer: ▪ Product: What is our product? ▪ Customers: What markets do we serve? ▪ Unique features: What are the unique features that distinguish our products? ▪ Distribution: How do we distribute our products? ▪ Pricing: How do we price our products? ▪ Promotion: How do we promote our products? ▪ Market and Industry: How is our market changing? It should be emphasized that the value of agroecological food is found in its characteristics as organic, healthy, natural, safe food that is free from agrochemicals.	40 minutes
5	Conclude the meeting by telling participants that in the next meeting they will discuss how to find out more about markets and marketing.	10 minutes

REFERENCE MATERIAL FOR PLANNING AND DEVELOPING VIABLE AGROECOLOGY ENTERPRISES

A farm is an agribusiness unit (firm) where inputs are transformed into outputs (Figure 2.2)

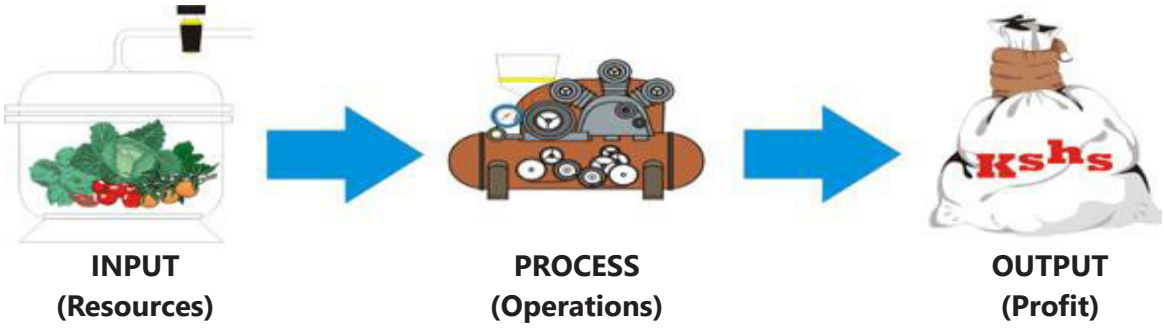


Figure 9.3: Illustration of Functions of a Farm Manager

Farm management is defined as, "a decision-making process in which the available but limited production resources are allocated to selected production alternatives, so as to operate the farm business in such a way as to attain some set objectives''. The objective could be to maximize profits/or achieving some

other social outcomes. Similar to other management responsibilities, farm management includes three key management functions. These are (i) planning, ii) implementation and iii) monitoring & evaluation [controlling].

The facilitator should lay emphasis on the view that this module has been developed to build the capacity of the participants to plan, implement and evaluate their farm enterprises as shown in table below:

Planning	Implementation	Monitoring & Evaluation [Controlling]
▪ Planning is the basic function of dairy farm Management. ▪ It is deciding in advance what to do, when to do & how to do. ▪ It bridges the gap from where we are & where we want to be.	▪ Implementation is execution of planned activities as per the schedule and allocated resources to bring the intended results ▪ It bring together the necessary resources to realize objectives. ▪ The resources could be internally or externally sourced.	▪ The function involves measuring performance and comparison of plan versus achievement, and taking corrective action. ▪ Involves asking howis the farm doing and what need to change to be successful.

Figure 9.4: Key management functions

The planning function of includes the following components;

1) **Assessing internal and external situation of the farm**: Assessment looks at the whole farm system to identify and prioritize key issues, opportunities and options for change. It can be done using analysis problem/objective analysis and SWOT analysis. (see illustration in Figure 3 below);

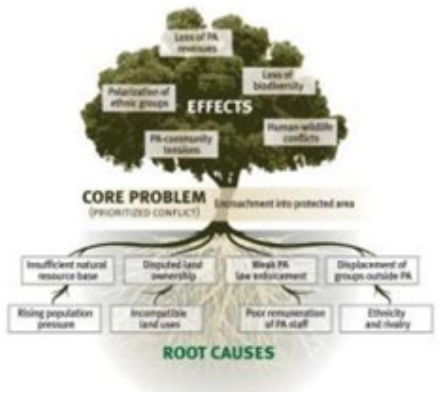


Figure 9.5: Tools for farm planning (problem tree analysis)

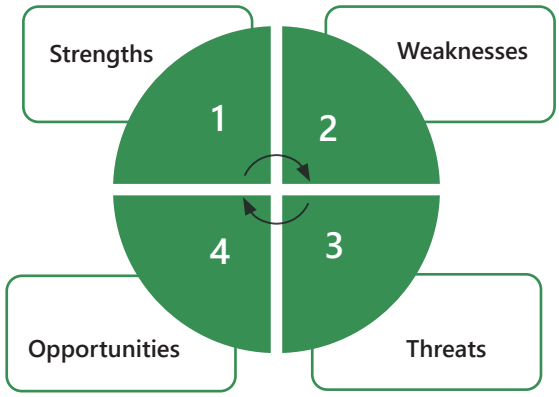


Figure 9.6: Tool for farm planning (SWOT analysis)

A Problem Tree is a visual tool used to identify the core problems (the "trunk") of a farm and then break them down into the root causes (the "roots") and the effects or consequences (the "branches"). The SWOT analysis is the other tool that can be used assess the farm's internal and external situation.

Strengths: What does the farm do well? (e.g., high-quality production, experienced labor, efficient irrigation system, established customer base, etc.)

Weaknesses: What are the areas of improvement? (e.g., limited storage facilities, outdated equipment, labor shortage, low marketing presence, etc.)

Opportunities: What external factors could the farm take advantage of? (e.g., emerging market trends, government subsidies, new farming technologies, improved transportation routes, etc.)

Threats: What external challenges could negatively impact the farm? (e.g., climate change, competition, rising input costs, changing consumer preferences, fluctuating market prices, etc.)

2) **Setting objectives of the farm**: Objective is a specific result that a person, a system or a business entity would like to achieve in a specified period and with allocated resources. Objective setting is a very important process in the planning process. In farm planning setting objectives could be done for a single enterprise e.g. dairy farm/ as a whole [for example generating a certain amount of income), but also for specific components of the farm (such as fodder production, conservation, storage and feed supply). Objectives should also fulfil the SMART Criteria (Specific, Measurable, Achievable, Realistic and Time bound). The farm will undertake to achieve its objectives, along with the implementation timeframe, required resource, and responsible person.

Table 9.1: Examples of objectives of the farm

	Component	Objective
1	Feed	Increase sourcing of livestock feed from own fodder production by 40% by the end of 2025
2	Productivity	Increasing average milk production per cow per day from 5 lt./day to 10 lt./day by the end of 2024
3	Soil health	Increase of area under bio fertilizers from 20% of farm to 45% by in the coming three years [2022-2025].

3) **Strategy design**: Once objectives have been set, the next step in the planning process is designing strategy to realize those objectives. Strategy is the method or approach chosen to bring the achievement of the desired results or objectives. This could involve determining

- What resources are required,
- How much is required and
- From where the required resource will be obtained (source).

This relates to the strategic initiatives the farm can undertake in order to achieve its vision, mission, goals and objectives. They include the followings:

- Adopting new technologies
- Adoption of adaptable precision farming technologies and use of digital innovations
- Enhance water harvesting, storage and water use efficiency in food production
- Enhance on-farm diversification through crop, livestock, trees and fisheries combination for healthy food, income, and ecosystem restoration Strategic location

Incorporating gender considerations into business planning training is crucial to ensure equitable and sustainable outcomes for all members of the household, particularly in agroecological practices. The design of the business models should address gender imbalances by recognizing and actively working to mitigate disparities in power, access to resources, and information.

During the business planning training, participants should be encouraged to consider how the commercialization of their agricultural activities may impact gender roles within the household. Evidence shows that following commercialization, men often take control of the increased farm income, which may not always be used to improve household welfare or support women's empowerment (Ogutu et al., 2019). Therefore, it is essential to build gender-sensitive strategies into business plans.

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