GENDER TRANSFORMATIVE AGROECOLOGY

Training Module for **Rangeland** 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.

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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 global and national food system is facing unprecedented challenges including damage to the environment which is supporting food production, low productivity and high food insecurity (UN Food Systems Summit, 2021). These problems are made worse by an increasing population, urbanization and climate change

It is now widely recognized that a major transformation of food systems is needed to achieve food and nutrition security globally in the context of a changing climate, and that this will profoundly affect what people eat, as well as how it is produced, processed, transported, and sold. Bringing about such transitions to more sustainable and democratic agricultural systems that reconcile human and environmental health with social justice and, hence, are resilient, will not happen without major shifts in public policies and private sector contributions to the governance of value chains at international, national, and local levels, as well a the active encouragement of innovation across these scales (Sinclair et.al., 2019).

The World Food Summit in 2021 is among many global initiatives that recognize that agroecology can address some of the aforesaid food system challenges. While agroecology has many definitions, they all have in common a goal to develop a sustainable food system. Following the High-Level Panel of Experts (HPLE, 2019) on Food Security and Nutrition (FSN). 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. The Constitution of Kenya also recognizes agroecology as a pathway to achieving sustainable development, and grants the rights to adequate food and clean and healthy environmental 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 favour 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.*

Agroecology is gaining ground as a movement, science, and set of practices designed to advance a food systems transformation which subverts the patterns of farmer exploitation currently entrenched in dominant agricultural models. In order for agroecology to achieve its espoused twin aims of social and ecological wellbeing, women and other historically marginalized stakeholders must be empowered and centred as the movement's protagonists. 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 with 8 modules has described principles of agroecology through a feminist lens to demonstrate the ways in which human dimensions and power dynamics are interwoven in every principle. Through this analysis, we demonstrate that a feminist approach is instrumental to establish a gender transformative agroecology for rangeland ecosystem in Kenya.

This training module 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. Others 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 us\
- 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 in the context

The module was developed as a practical tool for effective agroecology training within rangeland landscapes. It is designed in an easy-to-use format for trainers (TOTs) and farmers who wish to apply agroecological principles and practices on their farms. The module specifically targets users in rangeland ecosystems, providing them with the knowledge and skills necessary to implement sustainable agricultural practices.

Rangeland landscapes

Rangelands are vast undisturbed natural resources and landscapes in the form of grasslands, bushland, woodlands, wetlands and deserts. They grow primarily indigenous vegetation, rather than plants established by humans. Rangelands comprise about 89% of all the lands in Kenya. Rangeland landscapes are home to marginalized populations who heavily rely on natural resources for their livelihoods, and face persistent food insecurity. They are home to most of the country's livestock and wildlife, and support the livelihoods of many people. However, these rangelands are degraded and face many challenges, including climate change, land degradation, and loss of biodiversity.

The module 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. Module facilitators will therefore should create 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, solution 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, communities 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,
- use visual aids, group activities, or 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 would 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, especially in rural areas.
- **Cultural sensitivity** by tailoring training content to reflect local customs, beliefs, and agricultural and livestock practices.
- Providing **gender-sensitive** accommodations (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, a projector
- Field plots for demos and excursions
- A board or a wall where the group works and training works will be pinned throughout the training duration
- Stationary stands sufficient to the number of possible groups
- A digital camera – for taking pictures and short videos
- Small pieces of blank paper/cards

- Tapes: Sticky tape, Blu-Tack, Sticky Stuff or masking tape
- Marker pens, note pads and pens
- Post it notes, scissors, worksheets / handouts / exercises, as set on the programme

1.6 Organization of the agroecology module for rangeland ecosystems

This training manual consists of eight (8) modules organised in 23 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.

Table 1: Training Module for rangeland land scape

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	Dryland animal and crop production	11	Drylands crop production
		12	Integrated farming systems
		13	Principles of animal production
		14	Fodder production
		15	Post-harvest activities and value addition
6	Farmer field experimentation	16	On farm experimentation and participatory field trials
7	Nature positive practices	17	Agroforestry for rangelands
		18	Apiculture for rangelands
		19	Enterprise Diversity
		20	Growing indigenous fruits in rangelands for Women empowerment
8	Markets	21	Understanding marketing and markets for agroecology products
		22	Creating strategic markets for agroecology products and inputs
		23	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 stationary 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 stationary and post the stationaries 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.

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 – 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.

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 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).

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, rangelands

Training materials and resources: Stationaries, model farm visits, demonstrations, and visuals

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>Resources</th></tr>
<tr><td>1</td><td>Ice breaker
The facilitator can begin the session with an ice breaker. An example is outlined here and the facilitator may feel free to apply any other, as long it helps to break the ice while highlighting important aspects of livestock management in agroecology
Create Bingo cards with statements or terms related to agroecology (e.g., “Knows the benefits of rotational grazing,” “Has used manure as fertilizer,” ”).
Distribute the cards to participants at the start of the session.
Participants walk around, introduce themselves, and find someone who fits the description for each square.
When someone gets a row or column, they shout “Bingo!” and share a few interesting points they learned during the activity.
Here’s an example of what an Agroecology Bingo Card could look like:

<table><tr><td>Uses and can list examples of cover crops</td><td>Knows about rotational grazing</td><td>Uses manure as fertilizer</td></tr><tr><td>Has done composting on the farm</td><td>Has integrated trees into grazing systems</td><td>Uses water conservation methods for livestock</td></tr><tr><td>Has practiced rotational grazing</td><td>Knows and uses reduced tillage</td><td>Has worked with a multi-species grazing system</td></tr></table></td><td>15 mins</td></tr>
<tr><td>2</td><td>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.</td><td></td></tr>
</table>

Activity	Description	Resources
	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.	
3	**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 stationary with one principle clearly written at the top. Each table will have markers or coloured pens for participants to write and draw on the stationary. ▪ 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?"	

<table>
<tr><th>Activity</th><th>Description</th><th>Resources</th></tr>
<tr><td></td><td>
<table>
<tr><th></th><th>Principle</th><th>Stationary Prompts</th></tr>
<tr><td>1</td><td>Diversity in Agroecology</td><td>How does diversity play a role in your farming practices</td></tr>
<tr><td>2</td><td>Resilience of Agroecological Systems</td><td>“In what ways have you seen resilience in your food systems?”</td></tr>
<tr><td>3</td><td>Gender Equality in Agroecology (Feminist Principles)</td><td>“What sustainable practices have you adopted, and how do they rely on local knowledge?”</td></tr>
</table>

~ Participants write down responses, questions, or insights on the stationary.
~ 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 captured.

Because of the principles, are many the facilitator can utilise some documented agroecology case studies. 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.
</td><td>20 mins</td></tr>
<tr><td>4</td><td>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:</td><td></td></tr>
</table>

Activity	Description	Resources
	Divide 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 norms and expectations around gender. Are there preconceived biases or stereotypes that influence how we perceive gender roles? ▪ 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.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.	

Activity	Description	Resources
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.	

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

Contextual analysis of the problem (Indirect threat, direct threats and stresses)

Indirect threats	Direct threats	Stresses
Rising population, weak incentives for conservation and poverty.	Conversion of forest land into settlements and farmlands.	Degradation of habitat, increased runoff and flash floods.
Limited knowledge on suitable agro-ecological practices.	Uncontrolled abstraction of water and application of unsustainable agricultural production practices.	Water scarcity, pressure on the natural resource base and resource use conflicts.
Limited options for diversification of livelihoods and eroded resilience to climate change impacts.	Climate change.	Increased frequency of drought and water stress and reduced crop and livestock (milk) productivity.

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).

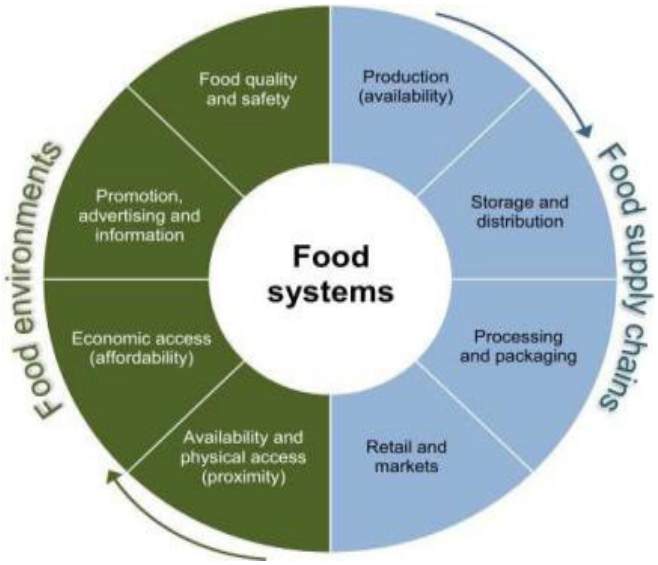


Figure 1.1: Simplified diagram for the food system (Source: HPLE, 2017)

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 favour 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.

Figure 1.2: Pillars of a sustainable food system

The 13 principles of agroecology are presented in Table 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 1.2: 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, versatile and successfully transformative movement. As Lopes and Jomalinis (2019) (p. 17) note, 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) demonstrate, agroecology is not only about lowering agri chemical 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 et al., 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 men, women, boys and girls that 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 1.3);

Table 1.3: 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.
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 dimension.

MODULE 2: WOMEN LEADERSHIP AND MALE INVOLVEMENT

This module has three (3) sessions; 1) Gender Roles and 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., gender roles are becoming more flexible, privatization and formalization of land tenure tends to marginalize women in rangeland while environmental degradation leads to differential changes in gender workload. The workload of women has increased under new land fragmentation processes in rangelands due to increased responsibilities in cattle herding and income generation, but also that due to this, women have gained higher influence in household decisions concerning the family economy. Access to resources and economic empowerment of women can be linked to nutrition outcomes and children's educational outcomes. Men's role in rangeland is that of herding cattle, ensuring that they drink water and selling the animals. Women's role on the other hand is that of milking animals, taking care of younger animals left at home, taking care of children in addition to domestic tasks. Women are not allowed to sell the animals but are allowed to sell milk products. Women's voices are critical in integrating their preferences into pastoral solutions, including technology design and implementation.

This training will focus on positive gender roles and social norms to promote women's participation, leadership and decision making in food systems. The role of men in food systems; How their role differs from women; How men and women can 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 rangeland productivity; and women from more food-secure households are more likely to participate in community leadership roles.

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 to promote **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 to reduce and address GBV.

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; Stationaries; 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 stationary, 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).

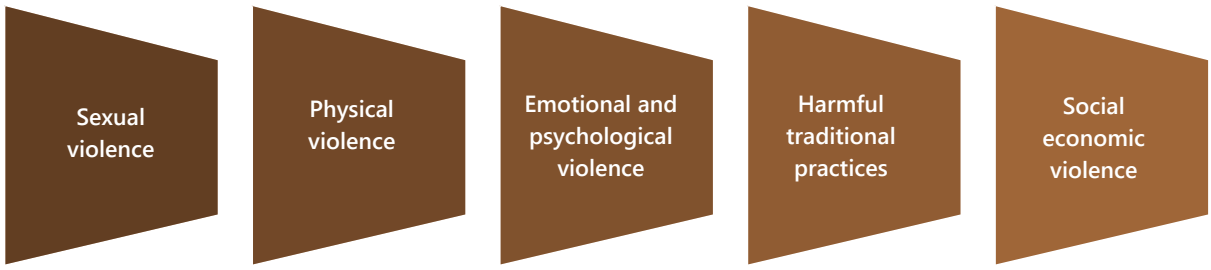
VAW is the manifestation of the historically unequal power relations between men and women in private and public life. It is characterized by the use and abuse of power and control over women, and it is a form of discrimination that seriously violates and impairs the enjoyment by women and girls of all 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 includes: -

- 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.

Emotional/Psychological violence: -
This includes: -
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:

Child sexual abuse
It 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

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

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 uniformed forces, 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 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 rangeland 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 taking action 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 **labour-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/Resources: The training materials and requirements include; Stationaries; Markers; Training manual/booklets

DELIVERY PLAN

The training will take the form of participants being given the chance to showcase their knowledge and skills (peer learning). 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.	15 minutes

Activity	Description	Duration
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.	20 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
4	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. 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.

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

Competency/Skill	Application
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.


Women participating in needs assessment sessions

SESSION 4: PARTICIPATION AND GOVERNANCE

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 agrifood 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/Resources: The training materials and requirements include; Stationaries; Markers, Training manual/booklets

DELIVERY PLAN

The training will take the form of participants being given the chance to showcase their knowledge and skills (peer learning). 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 Agrifood systems Ask the participants to state ways in which men are involved in the agrifood 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
	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.	
4	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
5	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 RANGELAND ECOSYSTEMS

CONTEXT

Water harvesting is crucial for rangelands in Kenya, where pastoral communities and livestock depend on scarce and seasonal water sources. In arid and semi-arid areas, unpredictable rainfall and prolonged droughts limit pasture growth and water availability for livestock. Traditional water sources such as rivers and seasonal streams are under pressure due to climate variability and increased demand. Proper water harvesting techniques, such as constructing water pans, sand dams, and subsurface storage, help retain runoff water for livestock and rangeland regeneration. This training equips households with sustainable water management practices to enhance resilience, support pasture growth, and ensure water availability during dry seasons.

LEARNING OBJECTIVES AND 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

The training materials and requirements include: stationaries, Markers; Demonstration farm and; Training manual/booklets

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

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.	15 minutes
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 mins
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 min
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 min
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 mins

REFERENCE MATERIAL FOR WATER HARVESTING PRACTISES IN RANGELAND 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

Important uses of water

- Efficient water harvesting supports soil health, nutrient transport, temperature regulation, and food security in rangelands.
- Gender roles in water use vary, with women managing domestic, health, and small-scale agriculture needs, while men focus on livestock and large-scale farming.
- Water scarcity unequally affects women, forcing them to travel long distances, reducing their time for economic activities, education, and community participation.
- Women play a key role in rangeland water management, especially in rain-fed agriculture, conservation, and watershed management.
- Technical training is important for women in irrigation, rainwater harvesting, and smallholder irrigation technologies to enhance sustainable water use in rangelands.

Water Harvesting Techniques

Water harvesting is crucial for rangelands, 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 and sand dams. 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

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:

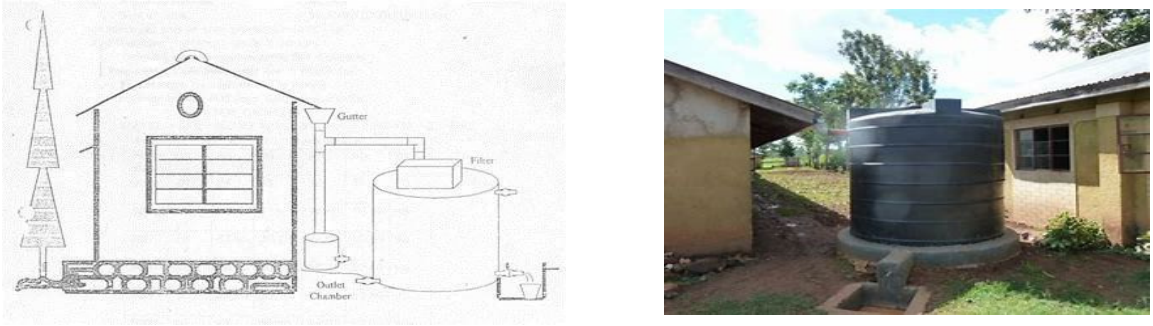
- Farm ponds – Farmers in dig farm ponds lined with plastic sheets to collect and store rainwater for irrigation during dry spells.
- Sand dams – Communities construct sand dams in seasonal rivers to trap and store water within sand particles, which can be accessed later using shallow wells.
- Roof rainwater 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 3.2). 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.



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

Dug 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 rangeland. 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.

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 dug

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 ponds with 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.

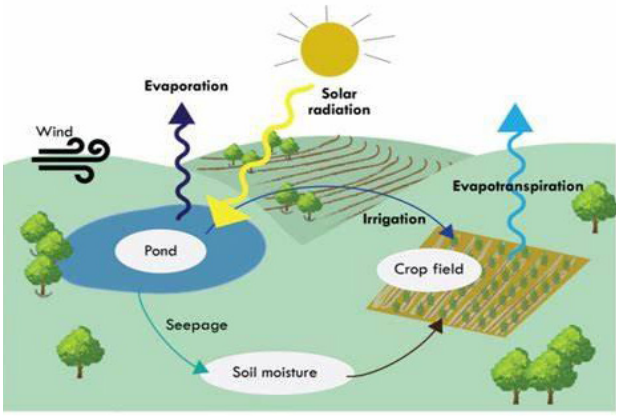


Figure 3.3: Diagram showing importance of water harvesting ponds on the farm

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

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 in arid and semi-arid areas. They help 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.

LEARNING OBJECTIVES AND 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

The training materials and requirements include: Stationaries, Markers, Demonstration farm, Training manual/booklets

DELIVERY PLAN

The training will take the form of cases, games, photographs and videos, field demonstration, field trips, and farmers will be given the chance to showcase their knowledge and skills (peer learning). 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. 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.	20 minutes
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.	20 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 national 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 rangelands

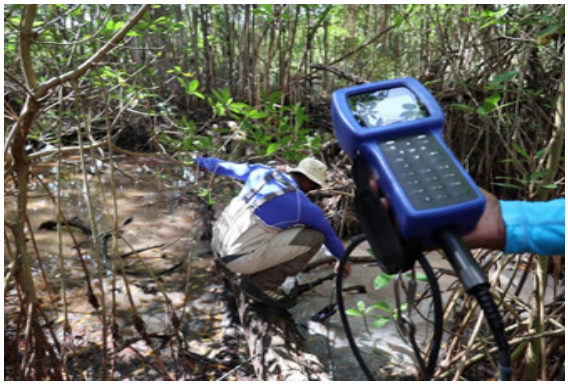
- Rainwater from ground catchment systems is not recommended for drinking unless first boiled or treated.
- Except in heavily urbanized and industrialized areas, atmospheric rainwater is pure and any contamination would usually occur after contact with the catchment.
- The chemical and physical quality 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 collection point



Water testing kits

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/Stationary, markers, projector/computer (optional for slides), handouts with key concepts and visuals.

Training Approach: The training will take the form of cases, games, photographs and videos, field demonstration, field trips, and farmers will be given the chance to showcase their knowledge and skills (peer learning).

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. Let them introduce themselves to each other, and explain the objectives of the session	15 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; 1) 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 2) 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; 1) What are the agroecological practices that ensure Water is well managed on the farm? 2) What are the agroecological practices that ensure water is conserved on the farm? 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.	30 minutes
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. 1) 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). 2) 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 3.3: 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 3.4 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:

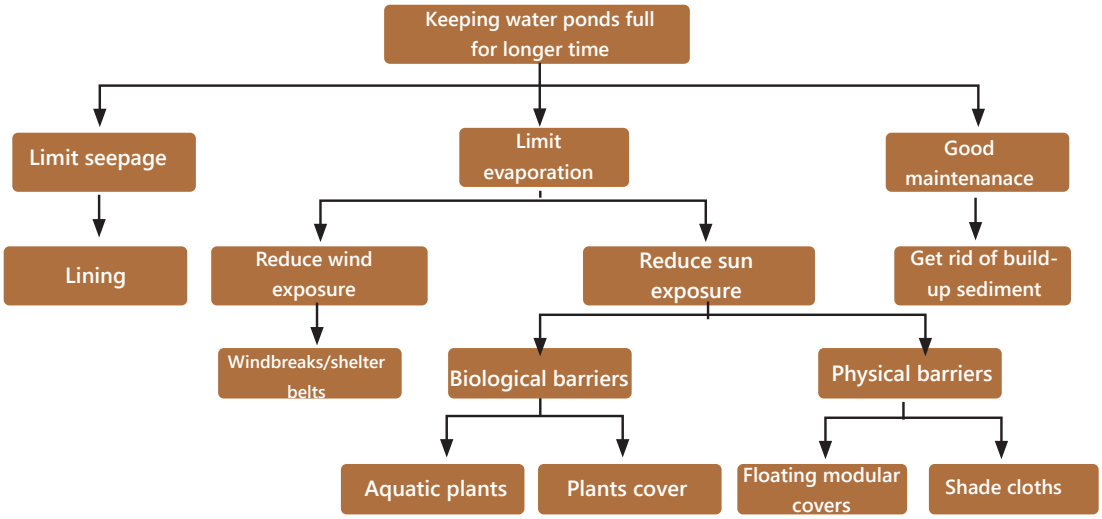


Figure 3.4: Strategies to manage water in ponds/pans

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.

What is more, gender-responsive soil management is not only beneficial for ecological health, but can also enhance women's well-being, as it can improve women's livelihoods through increased crop productivity, incomes, and other benefits such as health and food security[1]. Feminist agroecological approaches not only seek to redress women's disadvantaged status in terms of soil management, but dig deeper to examine and transform the systems of tenure and discrimination that lead to women's (typically insecure) allocation of often unhealthy lands and soils, which they have limited capacities to improve and incomplete authority to manage.

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: Stationaries, model farm visits, demonstrations, on farm practicums

1 Zhang, W.; Elias, M.; Meinzen-Dick, R.; Swallow, K.; Calvo-Hernandez, C.; Nkonya, E. Soil health and gender: Why and how to identify the linkages. Int. J. Agric. Sustain. 2021, 19, 269–287. [CrossRef]

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	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.	20 minutes
3	Now that the participants have an understanding of 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.	10 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 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.

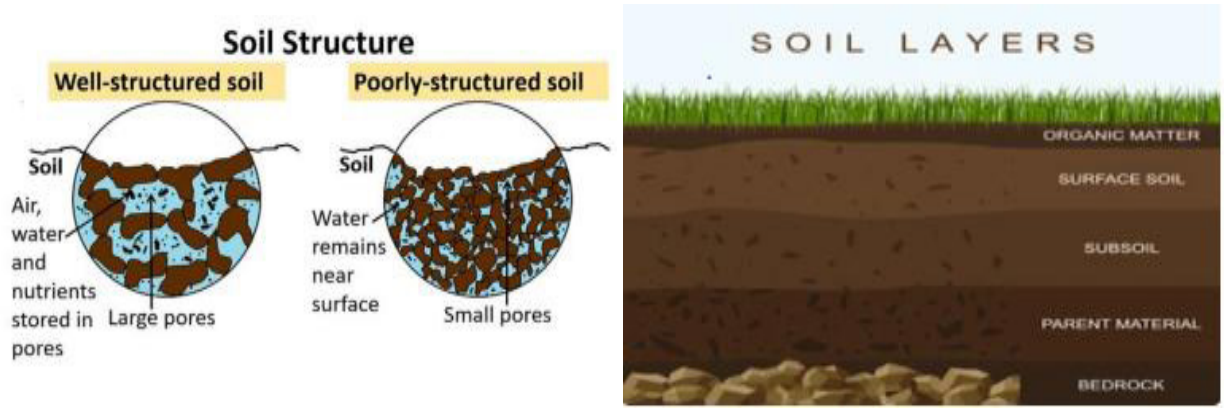


Figure 4.1: Soil structure

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

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.

Irrigation and Water Management: Apply water efficiently to prevent salinization and waterlogging; Use mulches to conserve soil moisture and reduce evaporation.

Soil pH Management: Add lime to raise soil pH or sulfur to lower it as needed, based on soil test results.

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 they 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:

(iii) Understand key natural methods/practices for improving soil health and fertility
(iv) 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 have an understanding of 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

Activity	Description	Duration
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.

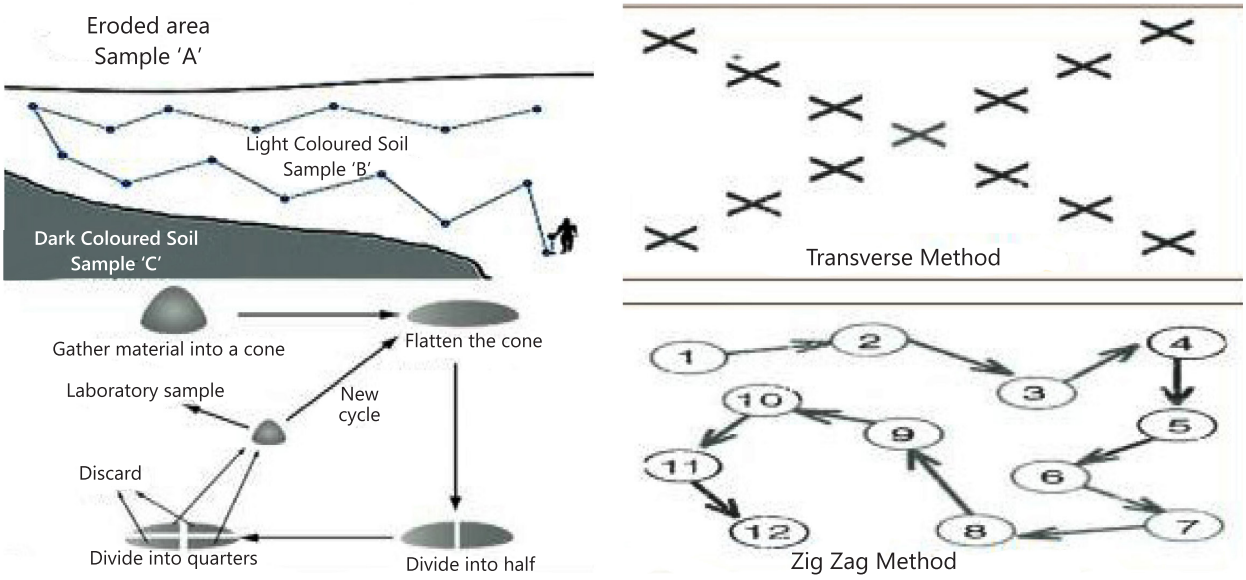


Figure 4.2: Sample areas with different properties and sampling zigzag pattern and (b) method of coning and quartering for reducing sample size

- **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.

Key terms: organic inputs, locally available materials

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

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

DELIVERY PLLAN

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
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

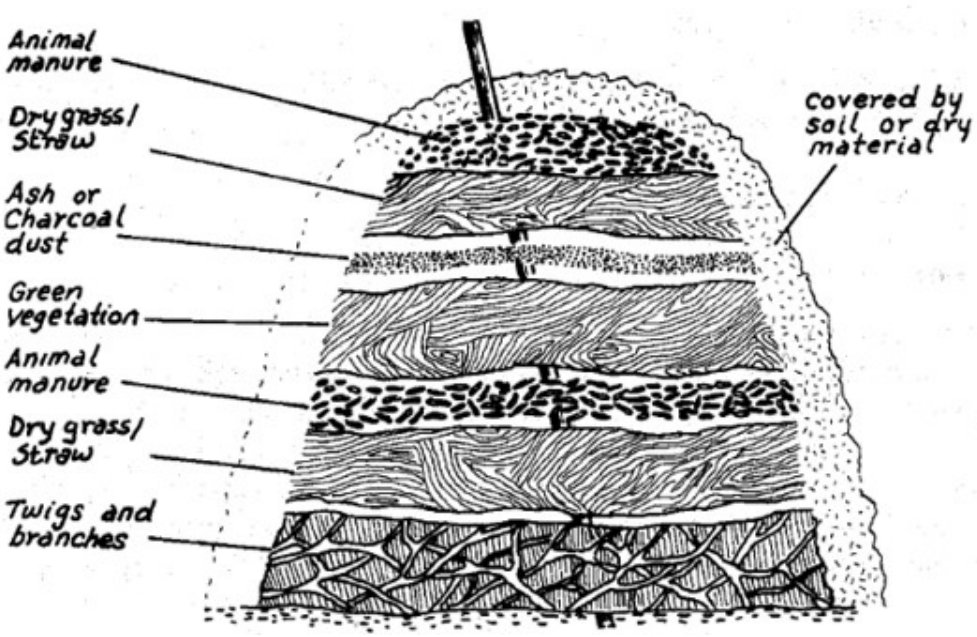
Organic inputs improve soil fertility, enhance plant growth, and promote sustainable farming by using natural materials such as compost, manure, biofertilizers, and botanical extracts. These inputs are eco-friendly alternatives to synthetic fertilizers and pesticides.

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.
8) Use in agriculture
9) Apply 100 wheelbarrows of 50kg each per acre as a soil amendment.
10) Mix compost into the topsoil before planting to improve nutrient availability and water retention.



Compost preparation

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 40 wheelbarrows of 50kg each 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:

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

Use in Agriculture:

- Apply FYM at 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.

Table 4.2: 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

- Collect fresh, healthy Tithonia leaves. If possible, use young leaves as they tend to have the highest nutrient content.
- Chop the leaves into smaller pieces to help release more nutrients during the steeping process. You can also crush or
- Place the chopped leaves into a container (plastic or non-metallic). Fill it halfway with the Tithonia leaves.
- 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.
- 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.
- Ferment the mixture by covering the container loosely to allow gases to escape and place the container in a shaded area.
- Let the mixture steep for 7-14 days, stirring daily to keep the fermentation process active.
- After fermentation, strain the liquid to remove the solid plant material. The tea should be dark and nutrient-rich.
- 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.

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

- Fresh rabbit urine (collected from rabbit pens or litter trays).
- Water.
- Fermentation container (plastic or non-metallic container with a lid).
- 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.

MODULE 5: DRYLAND ANIMAL AND CROP PRODUCTION

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 11: DRYLAND CROP PRODUCTION FOR RANGELANDS

CONTEXT

Dryland crop production involves growing crops in areas with low and unpredictable rainfall. Dryland crop production requires careful planning, efficient resource management, and adaptation to environmental challenges. Women face numerous challenges in producing crops in dryland areas. These challenges are often compounded by societal, economic, and environmental factors. In terms of resources, in many communities, women lack secure land rights, which limits their ability to invest in long-term soil and water conservation measures. They often face difficulties accessing water sources for farming, especially in water-scarce regions and also limited access to drought-tolerant seeds, organic inputs and tools hampers productivity. This guide is designed to provide practical knowledge and techniques to help farmers maximize productivity under these challenging conditions. By adopting the climate smart practices outlined, farmers can enhance their productivity and sustainability in dryland areas.

LEARNING OBJECTIVES AND OUTCOMES

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

(i) Select appropriate crop varieties for rangelands
(ii) Apply appropriate practical techniques for improved dryland crop production

Key terms: Dryland, drought resistance, water harvesting

Materials and resources: Stationaries, model farm visits, farm demonstrations, practical sessions

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 briefly highlight the objectives of the training/session. Explain to the participants why knowledge on techniques for dryland crop production is important. Emphasize that by integrating these techniques, farmers in dryland areas can enhance productivity while conserving natural resources, adapting to climate change and supporting long-term agricultural sustainability.	15 mins

	Understanding Dryland Farming ▪ Definition: Farming in areas receiving less than 500 mm of rainfall annually. ▪ Challenges: Water scarcity, soil erosion, and low fertility. ▪ Benefits: Sustainable use of resources, reduced dependency on irrigation, and cost-effective farming.	
2	Facilitate a session on dryland crop production emphasizing the following: ▪ Preparing for Dryland Farming ▪ Rain Water Management Strategies ▪ Crop Selection and Management ▪ Pest and Disease Management ▪ Post-Harvest Management ▪ Climate Adaptation Strategies ▪ Financial and Technical Support	30 mins
3	Facilitate practical sessions to focus on: ▪ Choosing Crops for Dryland Areas ▪ Planting Techniques ▪ Soil and water conservation techniques ▪ Water Harvesting	2 hrs
4	Conclude the session/ feedback	10 mins

HANDOUT/REFERENCE MATERIAL

This guide is designed to provide practical knowledge and techniques to help farmers maximize productivity under these challenging conditions.

Understanding Dryland Agriculture

Characteristics of Dryland Areas: Drylands experience low and erratic rainfall; high evaporation rates; poor soil fertility and structure; and risk of drought and water scarcity. Key Principles of Dryland Farming include efficient water use; soil moisture conservation; crop selection based on drought tolerance and diversified farming systems.

Selecting Suitable Crops

The criteria for crop selection should consider drought tolerance, duration of the growing seasons and resistance to pests and diseases. Crops that can grow with less water, reach maturity within a short time and have high resistance to pests and diseases are preferred for dry lands. Some common recommended Crops include sorghum, millet, maize, cowpeas, pigeon peas, chickpeas, sunflower and sesame.

Soil and Water Conservation Techniques

Contour Farming: Ploughing along the natural contours of the land to reduce water runoff and soil erosion. Contour of the land refers to the points within the landscape that are all at an equal elevation. To able to get the contour lines of a site, a simple tool known as an A-frame can be used. The A-frame can be used to mark these points and join them into a line, which can be used to dig a water harvesting structure that is "on contour". By being on contour, the water is encouraged to infiltrate into the soils rather than running downslope.

Preparing sunken beds commonly referred to as Zai pits: This is a traditional practice of digging a 20 x 20 cm hole 10 cm deep [dimensions of the pits can vary] during the dry season and filling it with mulch such as crop residue or manures. Zai pits are an innovation that addresses issues of land degredation, soil fertility, and soil moisture. Through the digging of zai pits, degraded, hard-pan soils impossible to plow can still be productive rather than abandoned. Organic materials such as compost and manure need only be added to the planting holes instead of spreading them over the entire field area. The improved efficiency makes it easier for farmers to obtain and apply the fertility inputs needed to maintain productive soils.

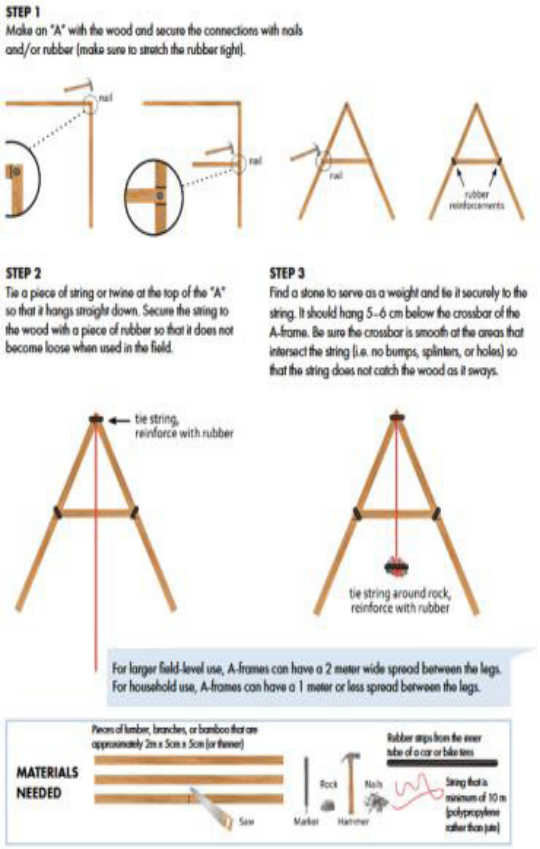


Figure 5.1: How to make an A-frame

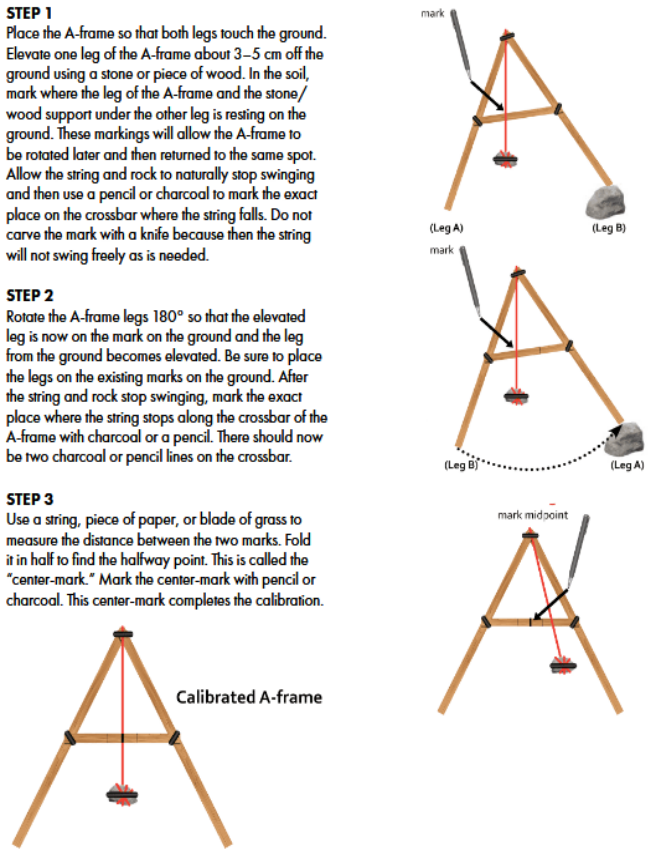


Figure 5.2: How to calibrate an A-frame

Source: https://fsnnetwork.org

Procedure for Finding a Contour Line With the A-Frame

Start at one end of your site, and set one leg of your A-Frame down and mark it with a stake. Move the other leg on your 'A' frame to the next place it is level. Then mark the other foot with a stake. Move the level over so the first leg is on the second stake. Then move the second leg again until the 'A' frame is level. Then mark the foot with a stake. Keep going until you have marked the area that you need for your contour bunds.

Figure 5.3: Bunds on a slopy land

Source: http://aashah.blogspot.com/2013/11/contour-bunding.html

Figure 5.4: Zai pits

Source: Motis, T. 2013. Zai Pit System. ECHO Technical Note no. 78.

Terracing: This is creating terraces on slopes to slow water movement and increase water infiltration.

Mulching: Applying organic or inorganic materials to the soil surface to reduce evaporation, maintain soil temperature, and improve water retention.

Rainwater Harvesting: Collecting and storing rainwater for supplemental irrigation during dry periods.

Conservation Tillage: Reducing or eliminating tillage to preserve soil structure, increase organic matter, and minimize water loss.

Crop and Land Management Practices

Crop Rotation is one of the key crop management practices in dry lands. It is the alternating different crops to improve soil fertility, reduce pest pressure, and increase resilience. The other practice is intercropping. Farmers can grow complementary crops together to maximize resource use and reduce soil erosion. Integrating trees or shrubs with crops to improve microclimates, reduce wind erosion, and enhance biodiversity is beneficial for managing dry lands. Also, planning land in a way that it can stay fallow for sometimes, then planting cover crops to restore nutrients and improve soil structure. Lastly, flatten land to ensure uniform water distribution to prevent waterlogging in certain areas is a good strategy.

Water Use Efficiency Techniques

To ensure water is used efficiently in dry lands, drip Irrigation that delivers water directly to plant roots to minimize waste and maximize uptake can be adopted. Plastic bottles can be used as irrigators. Also, water can be applied at critical growth stages only to optimize yield under limited water conditions. Farmers should plant crop varieties that have been selected for drought resistance to ensure productivity under water stress.

Soil Fertility Management

Use of organic amendments such as incorporating compost, manure, or green manure to improve soil fertility and water-holding capacity cannot be over emphasized. Farmers can consider combining organic and inorganic fertilizers to optimize nutrient availability and sustainability especially when crops exhibit nutrient deficiency symptoms. Utilizing beneficial microorganisms to improve nutrient uptake and soil health is another excellent way of soil fertility management in dry lands.

Climate-smart Agricultural Practices

Key climate smart agricultural practices include using high-yield, drought-tolerant or early-maturing crops adapted to dryland conditions. Crop Scheduling by adjusting planting and harvesting times to match rainfall patterns and avoid peak drought periods is another good practice. Though out of reach of most small-scale farmers, using technology (e.g., sensors, drones) to monitor crop health, soil moisture, and nutrient needs for targeted sustainable interventions is a practice that can adopted. Lastly adoption of conservation agriculture practices such as combining minimal tillage, crop rotation, and soil cover to build resilience and reduce environmental impact.

Pest and Disease Management

Pests and diseases are a major challenge in dry lands. Farmers are encouraged to combine biological, cultural, and mechanical methods with minimal chemical use to control pests and diseases. The use of carefully selected crop varieties that exhibit resistance to common pests and diseases in drylands can be beneficial. Early Weeding to remove weeds that compete for scarce water and planting specific crops that attract pests away from the main crop trap crops can greatly reduce pest populations.

Trap crops are plants grown specifically to attract pests away from the main crop, reducing pest damage and supporting Integrated Pest Management (IPM) strategies. These crops play a critical role in minimizing pesticide use and promoting sustainable agriculture as shown in the table below.

Common trap crops used in IPM for different types of pests

Crop Classification	Trap crop	How it works
Vegetables	Marigold (*Tagetes spp.*)	Attracts nematodes and aphids, protecting crops like tomatoes and eggplants. Repels some insect pests with its strong smell.
	Radish (*Raphanus sativus*)	Attracts nematodes and aphids, protecting crops like tomatoes and eggplants. Repels some insect pests with its strong smell. Attracts flea beetles, safeguarding crops like cabbage and broccoli.
	Mustard (*Brassica juncea*)	Attracts diamondback moths, providing protection for other brassicas like cabbage and cauliflower.
	Nasturtium (*Tropaeolum spp.*)	Attracts aphids and whiteflies, protecting crops like cucumbers, squash, and beans.
Grain and Legumes Fruit Crops	Sorghum (*Sorghum bicolor*) or Sudan Grass	Attracts stem borers in maize and millet fields
	Pigeon Pea (*Cajanus cajan*)	Serves as a trap crop for pod borers in chickpea and other legumes
	Cowpea (*Vigna unguiculata*)	Attracts aphids, protecting main crops like okra or maize.
	Banana (*Musa spp.*)	Used as a trap crop for weevils in coffee plantations
	Castor (*Ricinus communis*)	Attracts pests like Spodoptera (armyworms), protecting cotton and other crops.
Oilseed Crops	Sunflower (*Helianthus annuus*)	Attracts pests like the Helicoverpa moth, protecting crops like cotton, chickpea, and pigeon pea

Crop Classification	Trap crop	How it works
Field Crops	Okra (*Abelmoschus esculentus*)	Attracts fruit borers and whiteflies, protecting cotton and other crops.
	Pearl Millet (*Pennisetum glaucum*)	Attracts pests like stem borers, reducing their impact on maize fields. Attracts pests like stem borers, reducing their impact on maize fields

Benefits of Using Trap Crops in IPM

The benefits of using trap crops include reducing pest pressure on the main crop, lowers dependency on chemical pesticides, promoting environmental health, minimizes pest damage at a low cost compared to other control methods and enhances biodiversity and supports beneficial insects like pollinators and predators.

Best Practices for Using Trap Crops

- Proper Spacing: Plant trap crops in rows or borders near the main crop.
- Timely Removal: Destroy trap crops or pest-infested parts before pests move to the main crop.
- Companion Planting: Use trap crops alongside pest-repellent plants for maximum effect.
- Regular Monitoring: Check for pest activity to ensure the effectiveness of the trap crop.

Community and Policy Support

Community-based Water Management could encourage collective action for water harvesting and irrigation projects making crop production in dry lands very feasible. Also, providing farmers with education on best practices, climate forecasts, and modern technologies can improve production and encourage many women to venture into crop production. Other support includes, subsidies and incentives that offer farmers financial assistance for adopting sustainable practices.

Monitoring and Adaptive Management

Regular soil moisture monitoring can guide irrigation and planting decisions. Utilizing climate and weather data to plan farming activities effectively by using indigenous knowledge on weather for making farming decisions is encouraged. Finally, farmers should embrace resilience building by incorporating diversification strategies to reduce dependency on a single crop or resource.

Let participants discuss challenges of dryland crop production and give suggestions of how best they can be supported to improve production.

Session 12: 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: Stationaries, model farm visits, farm demonstrations, on farm practical

DELIVERY PLAN

Participants will visit a model farm to learn different integrated farming systems

Activity	Description	Resources
1	Welcome participants and recap on meeting 1 on agroecological cropping systems. Now introduce: (i) The concept of integrated farming (ii) Principles of integrated farming (iii) Components of integrated farming- Refer to handout.	20 mins
2	Field trip to a model farm to expose the participants to different types of integrated farming systems 11) Let the participants share their views about the model farm they visited and what they plan to implement at their homes	3 hrs

REFERENCE FOR DRYLAND 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

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.

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 13: PRINCIPLES OF ANIMAL PRODUCTION

CONTEXT

Integrating animal husbandry into crop producing farms is one of the principles of organic farming. In temperate and arid zones, animal husbandry plays an important role in the recycling of nutrients, while it is less emphasized in the humid tropics. The caring, training, and nurturing of animals is considered an art in many rangeland communities. Integrating animals into a farm help creating a closed or semi-closed system where energy and nutrients are recycled. Animals can convert non-edible biomass (e.g. grass, straw, kitchen waste) into food, while increasing soil fertility with their manure.

Given the essential and central role of animals and animal health in agroecological systems that rely on livestock as part of a low-input system, and the gender division of labor concerning animal care, women's work burden may increase in agroecological transitions that are not gender-responsive. Roess[2] (p. 5) observes that "women's work in animal husbandry is essential in agroecological transitions, both in terms of the quantity and variety of tasks performed (daily management of animals, and production of food for livestock and medicinal plants for treatment and prevention of diseases, among others) and/or in terms of the transformation and marketing of APs [animal products]". Yet, this labor is often invisible and undervalued. It must be made visible and given its due weight if agroecology is to ensure animal health without compromising women's health and well-being. Similarly, the knowledge of women and marginalized peoples tends to be undervalued and underutilized. A feminist agroecology has the potential to unlock a far greater breadth of knowledge about animal care than conventional approaches which do not take all stakeholders' perspectives into account. Understanding the social relations and gender norms that mediate farmers' differentiated experience with, knowledge around, and priorities concerning animal care is essential to developing feminist and empowering agroecological approaches. In this regard, this module aims to equip the participants with knowledge on the principles of animal production in sustainable ecological agricultural production.

LEARNING OBJECTIVES AND OUTCOME

The objectives of the meeting are to;

(i) Understand the importance of keeping animals on the farm
(ii) Understand the livestock management practices including breeding, housing, feeding and nutrition.
(iii) Understand the animal health management practices including what causes poor health in animals, identification of the sick animals and preventive measures.

Key terms: Livestock health, livestock management, feeding, nutrition, breeding etc

Delivery Approach: This training will be done on the farm where animal production is being undertaken for practical sessions.

2 Roess, A.A.; Winch, P.J.; Akhter, A.; Afroz, D.; Ali, N.A.; Shah, R.; Begum, N.; Seraji, H.R.; Arifeen, S.; Darmstadt, G.L.; et al. Household Animal and Human Medicine Use and Animal Husbandry Practices in Rural Bangladesh: Risk Factors for Emerging Zoonotic Disease and Antibiotic Resistance. Zoonoses Public Health 2015, 62, 569–578. [CrossRef] [PubMed]

Training materials/resources: Markers, Stationaries/board, demonstration farm; - where livestock production is being done, and Sticky notes

DELIVERY PLAN

The delivery of the training session will be guided by the guideline provided below;

Activity	Description	Duration
1	Welcome the participants, let them introduce themselves to each other and explain the objectives of the training session. The objectives are to; ▪ Understand the importance of keeping animals on the farm ▪ Understand the livestock management practices including breeding, housing, feeding and nutrition. ▪ Understand the animal health management practices including what causes poor health in animals, identification of the sick animals and preventive measures.	15 minutes
2	Ask the participants to state the importance of keeping animals on the farm. Elaborate using examples and ask them to refer to the handouts for further details.	10 mins
3	▪ Ask the participants to explain what they understand about "breeding" and explain to them in details, referring to the handout. ▪ Ask the participants to explain what they understand as key aspects of animal feeding and nutrition. Giving examples, state why each category of the feeds identified is important to the animal health. Refer the participants to the handout for further details. ▪ Explain how to clean the feeding area in the farm Ask the participants to state the key aspects to consider when constructing the animal houses, and refer them to the handout for further information.	30 mins
4	▪ Ask the participants to explain what causes ill-health in animals, how can one identify a sick animal and what measures need to be taken in such a case. After the discussion, explain to the participants and refer them to the handout for further reference.	30 mins
5	**Field Visit;** ▪ On the farm, ask the participants to point out key aspects of the animal housing, whether they are well constructed, and what should be improved. ▪ Ask the participants to identify different categories of feeds being fed to the animals, and their importance. Ask the participants to assess the following: ▪ hygiene practices (feeding area, dung collection and bedding area) ▪ quarantine measures in place ▪ Specific animal Record book (regular monitoring, vaccination, AI) ▪ type of housing ▪ animals in the farm and identify their health status	50 mins
6	Conclude the session by asking the farmers if they have any questions, and tell them what they will be learning in the next session.	15 mins

REFERENCE MATERIAL ON PRINCIPLES OF ANIMAL PRODUCTION

On the basis of a study by Altieri (2002), who identified the key ecological processes to be optimized, we propose five principles for the design of sustainable animal production systems:

(i) adopting management practices aiming to improve animal health,
(ii) decreasing the inputs needed for production,
(iii) decreasing pollution by optimizing the metabolic functioning of farming systems,
(iv) enhancing diversity within animal production systems to strengthen their resilience and
(v) preserving biological diversity in agroecosystems by adapting management practices.

Altieri MA (2002). Agroecological principles and strategies for sustainable agriculture. In Agroecological innovations: increasing food production with participatory development (ed. NT Uphoff), pp. 40–46. Earthscan Publication Ltd, London, UK.

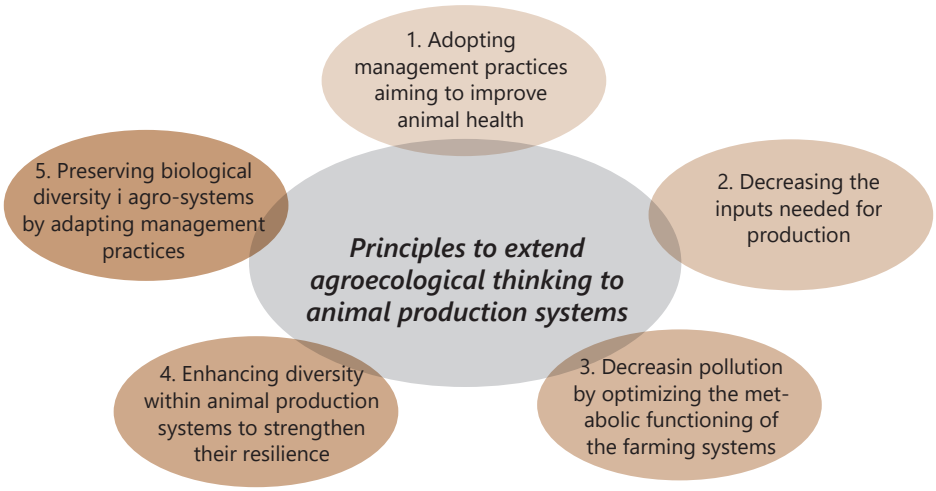


Figure 5.5: ***Principles guiding animal production systems***

Importance of keeping animals on the farm

Many farm animals have a multi-functional role:

- Produce dung which is of great importance for soil fertility.
- Yield products such as milk or eggs for sale or own consumption continuously.
- Recycle by-products such as straw or kitchen waste.
- Serve as drought animals for tillage or transport.
- Produce meat, hides, feathers, horns etc.
- Serve as an investment or a bank.
- Help in pest control (e.g. dugs) and weed management (e.g. grazing on barren fields).
- Have cultural or religious significance (prestige, ceremonies etc.).
- Produce young stock for breeding or sale.

Livestock Management

Farmers should try to manage healthy farm animals to produce satisfyingly over a long period of time. To achieve this goal, various needs of farm animals have to be considered:

- Fodder in adequate quality and quantity; for non-ruminants: diversity in fodder is usually required.
- Sufficient access to clean drinking water.
- Clean sheds of sufficient size and with adequate light and fresh air.

- Sufficient freedom to move around and perform their natural behaviour.
- Healthy conditions and veterinary follow up, when needed.
- Sufficient contact with other animals, but no stress due to overcrowding.
- For herd animals: an appropriate age and sex distribution within the herd.

Breeding

- Shift to high-performing breeds: traditional breeds have been replaced by high-performing ones, which require rich diets (concentrates) and optimal conditions.
- Higher disease susceptibility: these breeds are generally more prone to diseases, needing frequent veterinary interventions.
- Unsuitability for small farmers: the high costs of concentrates and veterinary care make them less viable for smallholder farmers.
- Optimizing performance for small Farms: breeding should focus on overall performance, considering ecological and economic sustainability.
- Examples of suitable breeds:
  - Poultry: Should balance egg and meat production while utilizing farm waste and natural forage.
  - Cattle: Should produce milk and meat efficiently, rely on roughage and farm by-products, have high fertility, disease resistance, and, if needed, be useful for draught and transport.

Livestock Housing

The type of shed should be specific to the type of livestock to be sheltered. The combination of animal husbandry and farm activities requires control of their movements so as to avoid damage to crops. For the welfare and health of the animals, sheds must be cool and aerated, and protect from rain They should be constructed in a way ensuring:

- Sufficient space to lie down, stand up, move and express natural behaviour (e.g. licking, scratching etc.).
- Sufficient light (as a rule, one should be able to read a newspaper in the shed).
- Protection from sunlight, rain, and extreme temperatures.
- Sufficient aeration, but no draught.
- Appropriate beddings
- Elements to exercise natural behaviour (e.g. for poultry: perching rails, sand baths and secluded laying nests).
- Sheltered pits or heaps to collect and store manure.

Appropriate housing on ecological farms aims at ensuring that animals have:

- Adequate space for the size and number of animals to allow for free movement, lying and resting. Animals need to express their natural behaviours, for example, pecking or digging in the ground, climbing or scratching.
- Sufficient fresh air and natural daylight, which helps prevent breathing problems and spread of infections.
- Protection against harsh weather conditions, for example, excessive sunlight, heat, rain and wind. Such unfavourable weather conditions facilitate the development and spread of infections and may stress the animals rendering them more susceptible to infections.
- Natural bedding material where animals are kept clean by avoiding direct contact with the wet ground or floor. The bedding will also absorb urine and faecal material, making it easy to collect.
- Permanent provision of clean water and routinely cleaned feeding troughs to provide clean feed.
- Security against predators without compromising the ventilation requirements and free-range housing.
- Protection from any spiky or dangerous elements to avoid injuries to the animals and the farmer.

Importance of Sustainable Practices in Livestock Housing

Sustainable livestock housing is crucial for several reasons. Firstly, it ensures the well-being and health of the animals, which is directly linked to their productivity and the quality of products such as milk, meat, and eggs. Secondly, eco-friendly shelters can significantly reduce the environmental impact of farming. This includes minimizing waste, lowering greenhouse gas emissions, and conserving water and energy. Lastly, sustainable practices in livestock housing can lead to economic benefits for farmers by reducing operational costs and improving efficiency.

Key aspects of sustainable livestock housing include:

- **Energy efficiency:** Utilizing renewable energy sources such as solar panels or wind turbines to power the shelters.
- **Waste management:** Implementing systems for recycling waste and converting it into compost or biogas.
- **Water conservation:** Using rainwater harvesting systems and efficient water management practices to reduce consumption.
- **Natural ventilation and lighting:** Designing shelters to maximize the use of natural light and air, reducing the need for artificial lighting and ventilation.

The following examples provide some valuable information for specific livestock housing designs based on the species 'natural behaviours:

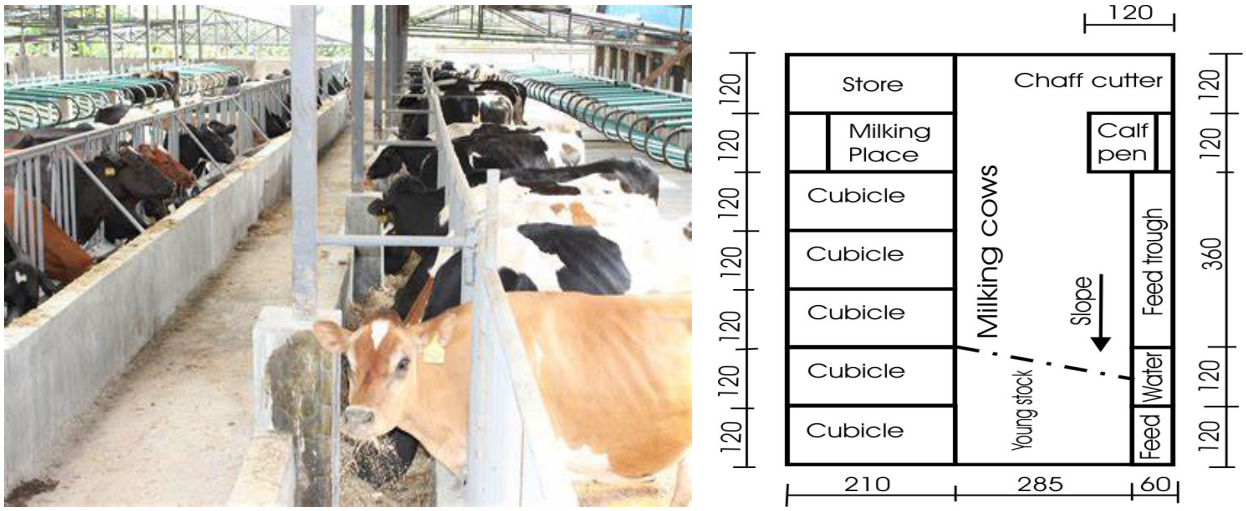
- **Poultry**, especially chicken, enjoy perching at night and, therefore, perching rails should be provided for this purpose. Chickens enjoy playing in dust baths to clean their bodies. Dark, secluded nests should be provided for layers, as they prefer laying in such places. For flying exercises, the housing should have a provision to suspend green vegetables about 0.5 m off the ground. Poultry also like to scratch for ants and worms, as this is their natural way of looking for food. Thus, they should be given access to open ground in proximity to the poultry house.
- **Pigs** naturally prefer separate spaces for resting, feeding and for relieving themselves, thus their housing should provide such separate spaces. They also like to have access to a wet and muddy area for cooling their bodies, especially in hot environments. They furthermore enjoy brushing against the walls, so the wall should be stable and not too rough so as to cause bruising or other injuries. Pigs should be given natural materials to play with such as wood logs, twigs or straw.
- **Goats** enjoy feeding on suspended forage, high enough so that they can attain an upright posture while feeding. They also like to climb, thus parts of their bedding can to be raised off the ground so they can use different layers. The social structure of goats is quite strict; therefore, they need different individual places and corners where low- and high-ranking animals can feed separately.
- **Cows** are big animals, sometimes with big horns and enjoy lying down while chewing cud (ruminating). They, therefore, need enough space to stand, turn, go past each other and lie down. If they get fed in the cow shed/kraal, every animal needs to have enough space to feed without being disturbed. A gently sloping floor is necessary to allow easy drainage of large amounts of urine through a drainage channel to a paved drainage pit outside the cattle kraal.

Note: Water points are an important consideration when constructing the houses for the above-mentioned livestock. the following should be considered in te construction of the water points

- Proximity and accessibility: Water points should be easily accessible to animals within or near the housing area to reduce stress and energy loss from movement.
- Clean and fresh water supply: Ensure a constant supply of clean water, regularly changing and cleaning troughs to prevent contamination.
- Adequate capacity: The water system should meet the daily needs of the livestock, considering

factors like species, age, and production stage (e.g., lactating cows need more water).

- Durability and material choice: Use non-corrosive materials (e.g., concrete, plastic, or stainless steel) for water troughs to ensure longevity and hygiene.
- Drainage and waste management: Proper drainage around water points is essential to prevent waterlogging, mud accumulation, and disease spread.
- Temperature regulation: In hot climates, provide shaded water points to keep water cool and reduce evaporation; in cold regions, prevent freezing.
- Automatic or gravity-fed systems: Consider automatic waterers or gravity-fed systems for efficiency and to reduce labor in refilling troughs.
- Separation for different groups: If necessary, separate water points for different livestock groups (e.g., young, sick, or lactating animals) to manage intake and prevent disease spread.



Livestock Housing

Feeding and nutrition

If farm animals are to be productive (milk, eggs, meat etc.), it is important that they get suitable food in sufficient quantities. If the fodder production of one's farm is limited (which usually is the case), it might be economically valid to keep less animals but supply them with sufficient food. The appropriate quantity and the mix of feed items will of course depend on the type of animal, but also on its main use (e.g. chicken for meat or egg production, cattle for milk, meat or draft etc.).

Feeding requirements for animals

Like human beings, animals depend on different types of foods to grow and produce well. Different animal species need different feeds. The daily ration for any farm animal should contain an average composition of 7 parts carbohydrates, 2 and half parts proteins and half a part of vitamins, minerals and oils.

a) **Carbohydrates** provide animals with energy for their exercises, production, grazing and doing work for human beings. For example, a donkey needs energy to carry goods. Roughage feeders, like cattle, goats, sheep, camels and donkeys are able to obtain their basic carbohydrates requirements from pastures.
b) **Protein** is needed in the animal 's body for growth and repair of tissues. Lack of protein in the diet leads to poor growth rates, reduced yield of animal products, loss of weight and late maturity for growing animals. Leguminous fodder is a good source of protein for most animals. Free-range

chickens are able to obtain their proteins by picking ticks, insects and worms from the environment. Earthworms for feeding chickens can be multiplied by mixing a small amount of the soil containing earthworms with fresh cow dung and dry leaves in half a drum, which is kept moist by covering with a sisal sack. The worms multiply quickly and after about two to three weeks they can be harvested and fed to the chickens. Pigs can be fed with human leftovers, which may contain protein from human diets.

c) **Vitamins** are only needed in small amounts in animals, mainly for boosting their immunity. They are plentiful in young green pasture or fodder, kales, young amaranth that have not yet seeded, and in fruit peels from the kitchen.

d) **Minerals** are essential in the animal body for different functions. For example, calcium and phosphorus are necessary for eggshell formation, bone formation, muscle contractions, synthesis of hormones and enzymes. Their deficiency results in reduced growth, soft brittle bones that fracture easily, difficult births, low egg and milk production, retained afterbirth, etc. When animals lack some of these minerals, they develop the "Pica" habit, which leads to eating strange things such as cloths, rags, bones, soap and metal sheets. Minerals are available from some plants like amaranth (pigweed), stinging nettle (Urtica dioica), black night shade (Solanum nigrum) and pumpkin leaves (Curcubitae spp.). Mixing equal parts of dry leaves from these plants and grinding them to a smooth powder will provide for most minerals in animals when placed in a mineral box and fed as often as possible. Salt (NaCl) should also be given to ruminants.

e) **Fats and oils** provide a layer of insulation below the skin for protection against the cold. They also facilitate the absorption of vitamins in the body. Sunflower seeds provide a good source of fat for (cattle), pigs, poultry and rabbits. Cottonseed, sunflower, sesame or peanut cakes, after extraction of oil, are also good sources of fat. Ruminants can build fat from roughage.

f) **Water** - While water may not be treated as a true nutrient, it is essential for providing a medium through which other nutrients are absorbed and assimilated in the body. It is also responsible for giving shape and turgidity to most tissues of the body. Clean water, which is free from contamination with chemicals and disease-causing agents, should be provided to the animals all the time. Salty water with natural minerals is suitable for livestock as it limits water intake.

Livestock health- Pest and disease management.

Similar as in crop health, sustainable animal husbandry puts the more emphasis on preventive measures in order to keep animals healthy, rather than on curative methods.

- keeping robust breeds rather than high performing but very susceptible ones.
- the conditions in which the animals are kept should be optimal ones: sufficient space, light and air, dry and clean bedding, frequent exercise (e.g. grazing) and proper hygiene.
- The quality and quantity of fodder is of crucial importance for the health of the animal. Instead of feeding commercial concentrates which make animals grow faster and produce more, a natural diet appropriate to the requirements of the animal should be achieved.

The main principal for sustainable animal health is: get to know the causes of (or factors that favour) diseases in order to enhance the natural defence mechanisms of the animal (and to prevent its manifestations in the future).

Causes of Poor Health in Animals

There are different possible causes for poor health in animals:

a) Poor feeding, both in terms of quality and quantity, affects animal health and performance as well as the ability to resist disease infections. It further causes metabolic disorders like acidosis, milk fever, acetonemia and pasture bloat in cattle caused by nutritional imbalances of minerals, vitamins, protein and energy supply from feed.
b) Poor hygienic conditions of the animal housing provide good breeding grounds for a number of parasites and other disease-causing organisms. Feeding troughs contaminated with animal faecal material is a very common source of infections.
c) Endo-parasites like nematodes and other worms, and ecto-parasites such as lice, ticks and mites cause infections, which reduce feed intake, and the rate at which the food is broken down inside the body for its different functions. This again affects body weight gain, production and reproductive performance of the animals.
d) Injury to the animal due to poor handling or exposure to dangerous physical materials such as glass and metal can result in infections that weaken the animals.
e) Disease causing organisms (pathogens) and parasites that are transmitted when infected animals, human beings and equipment or materials are moved from one flock or farm to another.

Early Awareness of Sickness in Animals

The early awareness of sickness in animals is important to successful treatment. The longer an animal is sick the more difficult it will be to cure. Early signs of sickness:

- Stops eating and possibly also drinking
- Becomes dehydrated
- The temperature rises
- Respiration rate increases
- The animal becomes dull and lags behind the others
- The coat becomes rough and loses its shine
- Production reduces e.g milk or eggs

Always observe a sick animal before rushing into conclusions. Take its temperature, look for outward signs such as coughing, wounds, diarrhea etc.

Dehydration (lack of liquid in the body) can kill the animal, so the first thing is to provide the animal with shelter and plenty of clean drinking water. Then the sick animal needs energy to fight off the disease. A thin porridge made with any clean grain flour and boiled up with a bit of salt, sugar or honey and cooled is a good supplement to feed a sick goat. Depending on the size of the goat they can be given up to 4 bottles a day at regular intervals. Alternatively make a rehydration solution from 1 liter of boiled water, 4 tablespoons of honey or sugar and 1 teaspoon of salt and give as a drench. A sick goat will respond better to treatment in the company of another goat.

Preventive measures in animal health management.

Organic management of animals primarily focuses on precautionary and preventive measures, which include:

- **Proper selection of suitable animal breeds**

  The breed of the animal is the starting point in organic management. Only breeds adapted to local

conditions in terms of feed requirements, weather, common parasites and disease tolerance should be chosen. This will minimise the cost of management as well as the risk of losses due to deaths.

- **Quarantine measures**

  Any new animals introduced in the farm should first be well treated and isolated for a while to allow for closer monitoring of their health status. Movement of any materials including manure, and equipment should be restricted from areas and farms unless the healthy status of such farms is ascertained to be safe. Visitors to the farm should also sanitize their feet before moving into the animal houses or grazing areas to minimise transfer of infections.

- **Regular monitoring of animals**

  Close observation of animals is important to identify and treat infections before they worsen or infect other animals. Thus, organic farmers keep daily or frequent records to assist in assessing possible signs and causes of the diseases or injuries. Signs of illness may include reduced appetite resulting in reduced feed and water intake, reduced productivity or, for example, a drop in milk or egg production, apathy observable as a lack of vitality, head down or abnormal movement, abnormal discharge from bodily orifices, difficulty in breathing observable as fast, labored, coughing, and gasping, inflammation of mucus membranes in the mouth, conjunctiva, and vulva lips, where the membrane may be pale or dry in cattle, rise or drop in body temperature,

- **Vaccination**

  Vaccination is recommended especially for diseases that are difficult or impossible to cure and which cause great losses by causing high mortality rates. Examples of such diseases include foot and mouth disease, anthrax, pneumonia, African swine fever and avian influenza. For certification, organic standards classify the use of vaccines as restricted. This means that their routine use is discouraged and is only permitted when it can be demonstrated by the organic farmer that a specific disease is endemic in the region or on the organic farm, or where their use is required by law or if a veterinarian recommends it.

SESSION 14: FODDER PRODUCTION

CONTEXT

The availability of fodder is one of the limiting factors in animal husbandry. Unlike landless systems in conventional farming, ecological farms animal husbandry should be mainly based on the fodder produced on the farm itself. As is the case with humans, there is a direct link between the quantity and composition of the food and the health status of the animals. The grazing animals feed on natural pastures with concentrate supplementation for the high yielding herd while non-grazing animals are fed on roughages/fodder mixed with concentrates to meet nutrient requirements. The concentrates used are from cereals (maize, wheat, barley, oats, millet, and sorghum), legumes and oilseed cakes (soybeans, cottonseed cake and sunflower cake) and animal by-products (fish meal, blood meal, meat and bone meal).

LEARNING OBJECTIVES AND OUTCOME

The objective of the session is to understand fodder establishment and management.

Key terms: Fodder, animal husbandry,

Delivery approach: The meeting will be a practical/field learning session.

DELIVERY PLAN

The delivery of the training session will be guided by the guideline provided below;

Activity	Description	Duration
1	Welcome the participants, let them introduce themselves to each other and explain the objective of the session which is to understand fodder establishment and management.	10 minutes
2	Ask the participants to state different types of fodder and elaborate using the reference material.	10 mins
3	Explain to the participants the procedure for selecting and making of hay and silage, using the reference material.	30 mins
4	Engage the participants in a practical hay making and storage session as guided in the handout.	50 mins
5	Conclude the session by asking the farmers if they have any questions, and tell them what they will be learning in the next session.	15 mins

REFERENCE MATERIALS

In general, there is shortage of feed supply and seasonal variation in feed quality and quantity. Both the quantity and quality of feed resources are lower during the drought and floods thus exacerbating the situation. The available feed resources dominated by poor quality natural pastures and crop residues. Grazing areas are decreasing from time to time due to expansion of cropping and other development intervention on traditional grazing areas. The commonly available feed resources are characterized by low content of essential minerals and vitamins. The production and utilization of cultivated forage and pasture crops is significantly limited. Feed industries are at low level of development and the supply of agro-industrial by products and nutritionally balanced concentrate feeds is limited. As a consequence, the utilization of available feed resources is inefficient.

Fodder Establishment and Management

Pasture

Pasture can be defined in many ways depending on purpose:

- Pasture is defined as an area of land occupied with forage plant species either natural or planted by man for the purpose of providing qualitative feed to livestock at the right quantity.
- It could refer to any forage specie valuable as livestock feed
- It can also refer to an act of feeding; grazing or browsing animals on pasture plants or pastures.
- Importance of fodder planning: Success in animal husbandry requires advance planning for a consistent fodder supply, especially for zero-grazing systems.
- Zero-razing dependency: Smallholder farmers practicing zero-grazing must provide all the feed, similar to caring for a month-old baby that fully depends on them.
- Land competition: Fodder cultivation often competes with crop production, making it essential to assess economic benefits on a case-by-case basis.

- Integration of fodder crops: Farmers can integrate fodder crops into their farms using intercropping, alley cropping, or growing fodder on field edges to minimize land sacrifice.
- Types of fodder crops:
  - ~ Green (Fresh) Fodder: Napier grass, Lucerne, Desmodium, Sudan grass, Sweet potato vines.
  - ~ Dry Fodder: Hay, Silage, Maize Stover, Sorghum Stover, Rice Straw.

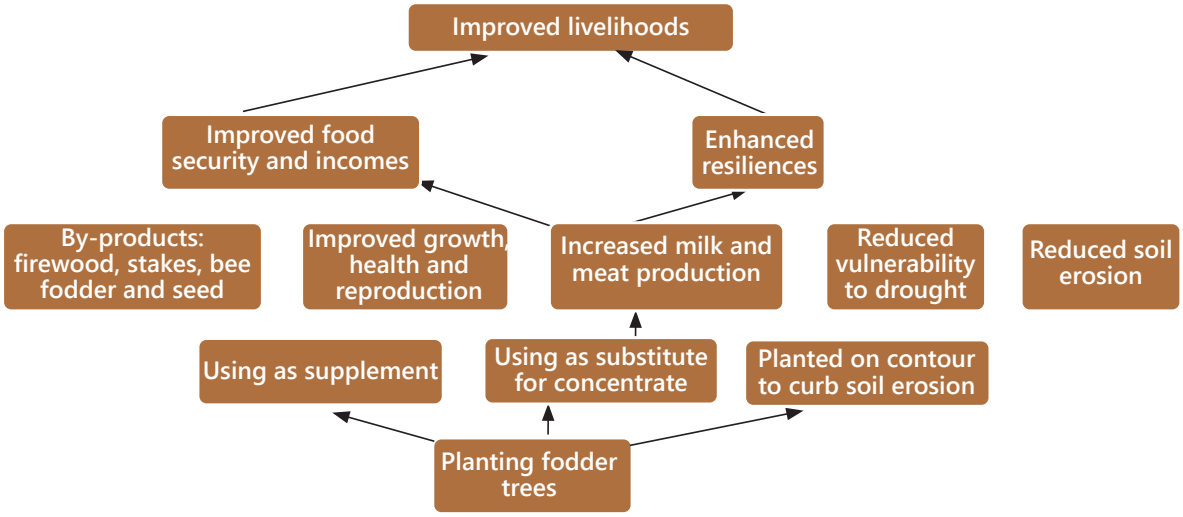
Grass	Legumes	Green Parts
Nappier grass (penisetum purpureum) Bana grass- a cross between p. purpereum and p.typhoides Setaria Rhodes (chloris gayana) Guines grass Star grass Thatching grass Columbus grass	White clover Desmodium Lucerne	Green parts of the tree, shrub for example leaves or sometimes flowers and pods, eaten by browsing or grazing animals. Acacia, Leucaena, Prosopis Calliandra, Sesbania Gliricidia etc

So, if you want them to deliver the best, you should also give them the best in return. It is therefore worth nothing that the production from the animals is directly proportional to the quality and quantity of the feeds allocated to them. The type of fodder given to the animal is grouped into three main categories: -

a) **Dry feeds** e.g. hay, crop residues after harvesting (stalks etc). Dry feeds include the use of hay. The best type is that from Boma Rhodes, star grass, Desmodium or Lucerne.
b) **Green feeds** e.g. pasture (grass, Lucerne, Desmodium etc.
c) **Silage**

Green feeds and silage

How fodder trees improves livelihoods



Criteria for selection of fodder species:

(i) Edible to livestock and rich in protein
(ii) Easy to manage
(iii) Drought tolerant
(iv) Tolerant of trampling if to be grazed
(v) Able to resprout easily

For the cow in particular, the fodder should be supplemented with concentrates in the ratios proportional to the amount of milk they produce. The fodder should be planted before the onset of rain to maximize on their establishment and faster maturity.

Hay making

- Harvest grass e.g. Rhodes, kikuyu grass etc after 4-6 weeks of re-growth or just after flowering and seed production when the nutritive value and dry matter yields are equal
- Mixture of grasses and legumes with a lot of leaves is ideal because they increase digestibility and feed intake.
- Dry the cut pasture as quickly as possible in 2-3 days during the dry season or one week in the cold season
- Once dried, the product can be stored loose or in bale stacks in the field or in the barn.

Box hay Baling

This is simple manual method of producing bales of hay. Small-scale farmers may be interested in this technology because hay is both easier to store and easier to transport when it has been baled.

Also, baled hay retains a higher nutrient content than hay that has been cut and left exposed to the sun. The bales are pressed in a wooden box with no bottom.

Compression is achieved by using a lever arm and tamp attached to the wooden box.

Attach the lever arm with a pin that is substantial enough to withstand the pressure applied to the hay.

Dimensions and materials can be modified in order to suit local needs.

Silage

It is the fodder we get from green maize, Napier grass, cow candy, Lucerne, etc.

These are cut while still green before they start drying and chopped into small pieces. The pieces are then put into a silo and compressed to remove as much air as possible.

Alternatively, they can be stored in airtight containers after serious compaction. This prevents rotting and helps in facilitating fermentation.

The most ideal material to use is the 1000-gauge polythene sheets. Molasses is also added to the silage to feed the bacteria and also increase the quality of the silage.

The best silage is olive green in colour. It is stored for 2-3 weeks before being opened for use by the animals.

Silage making Method 1

A method of preserving green forage by controlled fermentation. Materials used include Nappier grass, maize, sorghum, sugarcane tops etc. Requirements: Ensiling materials, molasses, 1000-gauge polythene. Water.

Procedure

- Harvest material and chop into small pieces about 2cm.
- Dilute molasses with water at the ratio 1:3 and sprinkle on the chopped pieces when spread or as you put in the bag.
- Tie one end of the polythene bag and start packing and compact the pieces well.
- When full, tie and put heavy objects e.g. stones to put away air.
- Ready for use from 3-8 weeks.

Feeding

- Introduce gradually to make the animal used.
- Feed after milking to avoid smell in milk.
- Cover after getting days 'ration.

Method 2 Trench Silo Silage Making

- Dig a pit should be smaller at the bottom than at top i.e. should be slanting.
- Align the sides and bottom of pit with a polythene sheet - to avoid contact with soil.
- Cut the crop to be ensiled (fodder) and leave to dry in the sun for 2 – 3 hours, then chop into small pieces about 2 cm in size.
- Mix molasses and water in the ratio 1:3
- Place chopped materials into the pit spread uniformly into layers of 30 cm thick
- Sprinkle water molasses mixture and compact thoroughly

Note: Use watering can for uniform distribution of solution Repeat step 5 and 6 until the pit is full then cover with a polythene sheet finally cover with soil /mud to prevent air and water.

Hay

Maize silage

Concentrates

Concentrates are feeds which are high in energy but low in fiber i.e. < 18 % crude fiber. They contain a high level of a particular nutrient e.g. carbohydrates or proteins. Their use depends on price and availability. Concentrates can be substituted with locally available materials such as: - grains (maize, sorghum, barley, (Mollases, loop wheat etc, By-products crops, bagasse), Protein Supplements with > 20% crude proteins e.g. slaughter house by-products such as (meat meal, feather meal, cotton seed cakes, fish meal, bone meal, groundnut cakes.

Fodder trees than can be considered in the place of green and dry fodder

SESSION 15: 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:

1) Identify key post-harvest activities to ensure quality and reduce losses
2) Prepare some value-added products on farm using harvested produce

Key terms: Post harvest, value addition

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

TRAINING APPROACH

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

DELIVERY PLAN

Activity	Description	Resources
1.	Welcome participants to the session. Introduce the main topic (i) Post harvest handling (ii) value addition on produce such as canning, drying,	20mins
2.	Practical on how to make some simple On-farm storage facilities using locally available materials. Refer to handout	1 hr
3.	Practical on how to add value to farm produce to increase shelf life. Refer to handout	2 hrs

REFERENCE MATERIALS FOR 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

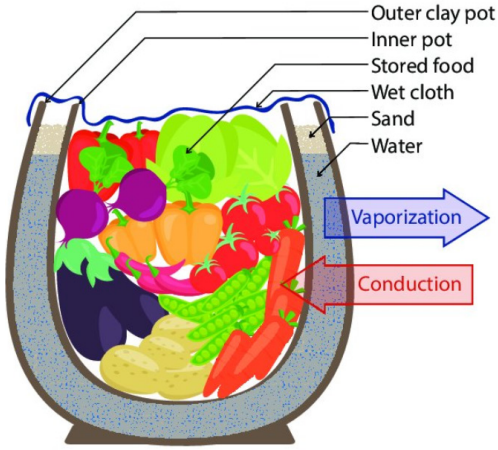
2) **Grain Silos and Bins**: Simple grain silos or bins are used to store cereal crops like wheat, rice, maize, and other grains after harvest. The grains are stored in airtight containers to prevent moisture buildup, pest infestations, and spoilage. For larger-scale storage, silos can be used, while 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.



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 6: 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 16: 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.

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

- 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.
- 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.
- Understand farm record keeping (animal records and crop records)

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

Teaching aids and materials: The training materials and requirements include; Stationaries, 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.)

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

DELIVERY PLAN

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 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	Trainer to prepare a sample of farm record (animal or crop) for reference during the field visit Data Analysis: Techniques for analyzing 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).
- 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.

How to do data analysis: For farmers to understand their field experiments, it is important to analyze the results in a simple and straightforward way. These methods should be easy to learn and apply, allowing them to quickly interpret the outcomes of their trials.

MODULE 7: NATURE POSITIVE PRACTICES

Food production depends on 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, climate change such as 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. To move from nature-negative to nature-positive production, we must protect nature, manage agriculture in ways that enhance our biodiversity and restore our degraded ecosystems. This module covers three important elements of NPP namely; agroforestry, apiculture and enterprise diversity and growing indigenous fruits in rangelands.

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, important

SESSION 17: AGROFORESTRY FOR RANGELANDS

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.

MODULE 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 trees, agro forestry plant methods

Teaching aids and materials: The training materials and requirements include; Stationaries; 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 7.1)

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 rangeland will be 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, especially rangelands (Table 7.2)

Common agroforestry trees used in Kenya

Species	Ecology	Management System	Remarks
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%).
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
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

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 rangeland agroforestry.

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 7.4); 19.3: Ex**amples of exotic fruit trees/ shrubs**

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 7.3 provides the list of fruit trees that may be cultivated.

Selection of important fruit tree species suitable for cultivation in dry midlands (<1500 m and lowlands of Kenya

Exotic species for drylands		Indigenous species for drylands	
Scientific name	**English name**	**Scientific name**	**English name**
Annona squamosa	Custard apple	*Adansonia digitata*	Baobab
Citrus sinensis	Orange	*Balanites aegyptiaca*	Desert date
Mangifera indica	Mango	*Diospyros mespiliformis*	African ebony
Psidium guajava	Guava	*Phoenix reclinata*	Wild date palm
Punica granatum	Pomegranate	*Sclerocarya birrea*	Marula
		Strychnos spinosa	Monkey orange
		Tamarindus indica	Tamarind
		Vangueria madagascariensis	Wild medlar
		Ximenia americana	Wild plum
		Ziziphus mauritiana	Jujube

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.

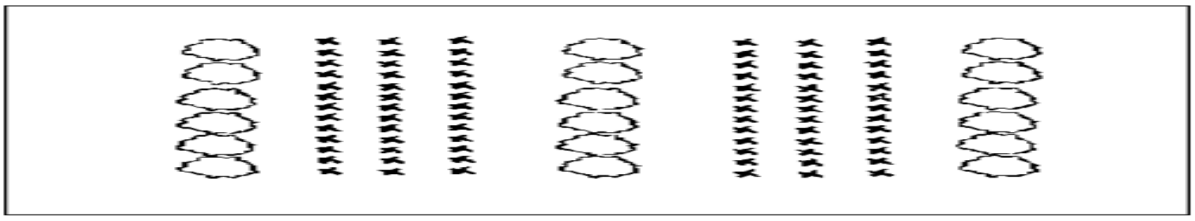


Figure 7.1: Alternative strips or alley cropping

Source: B.T. Kang, IITA (1996)

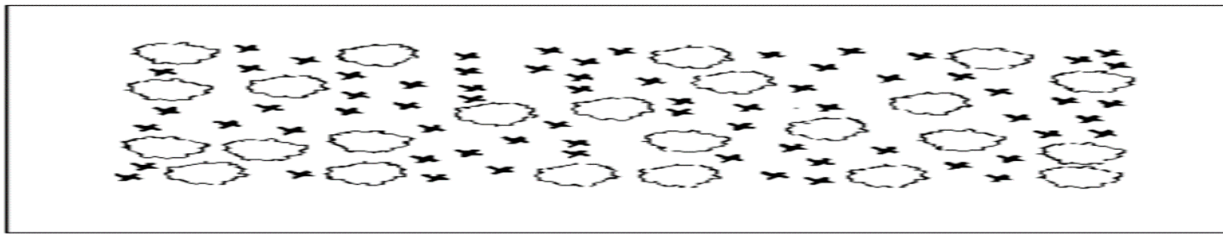


Figure 7.2: Random mixture of plant components B.T. Kang, IITA (1996)

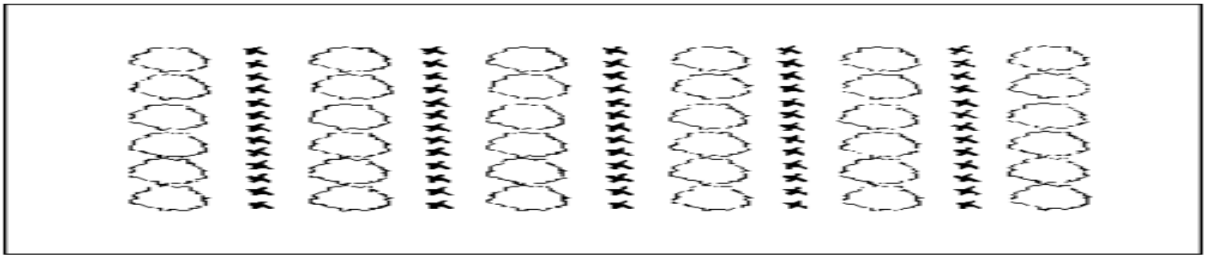


Figure 7.3: Alternative rows of plant components B.T. Kang, IITA (1996)

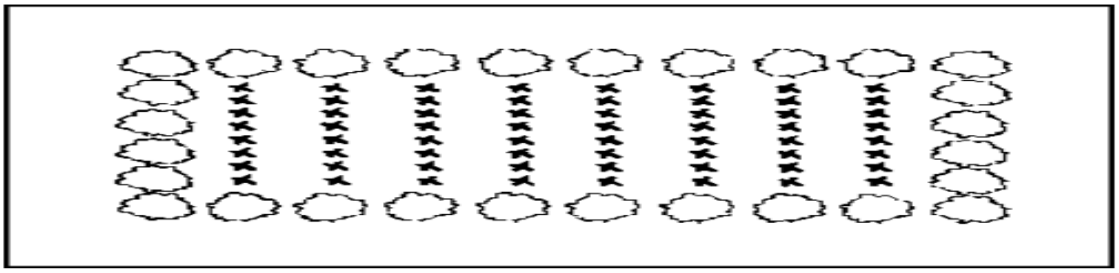


Figure 7.4: Alternative strips rows of plant components B.T. Kang, IITA (1996)

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 18: APICULTURE FOR RANGELANDS

CONTEXT

Apiculture (beekeeping) offers a sustainable solution for enhancing biodiversity, improving crop yields, and diversifying income streams for smallholder farmers. This session explores how apiculture can be effectively integrated into rangeland systems in rural Kenya, highlighting its advantages, strategies, and synergies. This training module provides smallholders' farmers with knowledge on the agro ecological approaches/ practices of apiculture that integrate the principles of sustainable agriculture and ecological balance with the practical and commercial aspects of beekeeping.

MODULE LEARNING OBJECTIVES AND EXPECTED OUTCOMES

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

(i) Identify and explain the types and species of bees.
(ii) Identifying and understanding the different beekeeping equipment and infrastructure.
(iii) Understand the different hive management practices
(iv) Understand the process of pollination and product production.

Key Terms: Bee species, hive management, beekeeping equipment, pollination and product production

Teaching aids and materials: The training materials and requirements include; Stationaries; Markers; Demonstration farm; Training manual/booklets.

DELIVERY PLAN

The training will take the form of field demonstration, field trips, onsite demonstration 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. By the end of the meeting, the participants should be able to identify and explain the species of bees, beekeeping equipment & infrastructure, hive management and the product production systems.	15 minutes
2	Write the words "Apiculture" and "Bee Keeping", 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 the definitions of the terms. Explain the definitions using examples that resonates with the participants as follows; Apiculture - The science of raising or maintaining colonies of bees and their hives (beekeeping).	20 minutes
3	Inform the participants that they will spend some time discussing the importance of apiculture to their farms, and the most common beekeeping methods they know and use. The discussions will be guided by the following questions; What are the main benefits of rearing bees? What are the main beekeeping equipment known to them? What are the species of bees (if any) known to them? What are the different hive management practices they may know?	30 minutes
4	In order to help the participants understand better apiculture, breakdown the different components of apiculture ranging from bee species, beekeeping equipment & infrastructure, hive management and product production. Explain in detail the various components and take questions where necessary.	15 minutes

5	Organize the participants in three groups, and ask them to choose a secretary and a chairperson for their groups. Allocate each group a hive type to indulge in, varying from traditional log hives, top bar hives and langstroth hives. Ask the group members to discuss and answer the following questions based on the allocated technique, and write their answers on the board. ▪ What are the advantages and disadvantages of each hive type mentioned? ▪ What are the suitable construction materials and area to construct the different hives that is accessible to women, children and persons with disability? (materials, size/measurements, etc) For 20 minutes, facilitate a discussion to ensure the participants have a deeper understanding of what each hive type, in terms of the materials required for construction, measurements and their advantages, disadvantages. Refer the participants to the handout for more information the water harvesting techniques.	20 minutes

HANDOUT/REFERENCE MATERIAL

Benefits of Integrating Apiculture

The integration of apiculture into agro ecology and nature-positive systems offers numerous advantages:

- **Increased Crop Yields:** Bees significantly improve the pollination of fruits, nuts, and vegetables, enhancing agricultural productivity. Studies show that crops reliant on pollination can see yield improvements of up to 30% when supported by healthy pollinator populations (Klein et al., 2007). This increase in yields can also stabilize food supply chains in vulnerable regions.
- **Enhanced Livelihoods:** Honey, beeswax, and other bee products provide additional income opportunities for smallholder farmers. Moreover, the market demand for organic and sustainable honey products creates economic incentives for adopting eco-friendly practices (FAO, 2015). Value-added products, such as medicinal honey and cosmetics, further expand income streams.
- **Climate Resilience:** By promoting biodiversity, apiculture enhances ecosystem stability and resilience to climate change. Pollinator-friendly practices reduce the vulnerability of agricultural systems to environmental shocks (Pretty et al., 2020). In regions prone to drought or flooding, pollinator-dependent plants can act as buffers against climate extremes.

Bee Species and Biology

Apiculture, or beekeeping, is an essential practice that aligns with the principles of agro ecology and nature-positive farming. As global food systems face increasing challenges, integrating apiculture offers a sustainable pathway to enhance biodiversity, improve crop yields, and provide additional income streams for farmers. Furthermore, apiculture strengthens ecological resilience by promoting pollination and fostering plant diversity, which are critical for sustainable agricultural ecosystems. Apiculture has four main components.

Figure 7.5: Components of apiculture

Bee Species and Biology

Understanding the biology and behavior of bees is foundational to successful apiculture.

Key Elements:

- Bee Species

Figure 7.6: Bee species

- Colony Structure

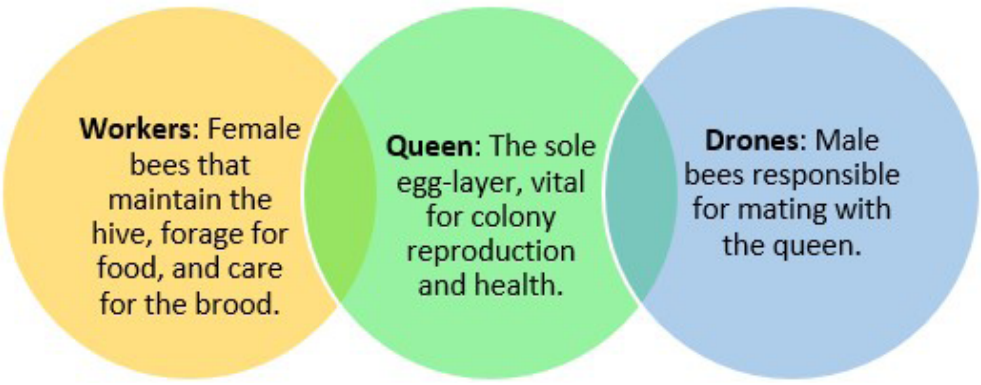


Figure 7.7: Colony and Structure

- **Life Cycle**:

Figure 7.8: Life cycle of a bee

- **Behavior**:

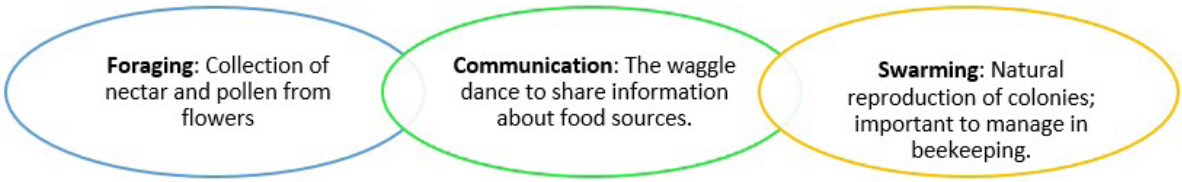


Figure 7.9: Showing bee behavior

BEEKEEPING EQUIPMENT AND INFRASTRUCTURE

Proper tools and infrastructure ensure safety and efficiency in beekeeping.

Key Elements:

- **Beehives**:

The traditional log hive: This is the traditional hive made by using relatively aged tree trunk and creating a hollow where bees are expected to dwell. Both ends of the hollow are covered with piece of wood, made to uniformly fit the hollow size. Bee-sized holes are drilled on one side for bee entry and exit. The bees will construct honey combs in regular half circles, slanting half circles or along the length of the roof. This hive is known to produce 8-12 kg of honey per harvest.

Kenya Top Bar hive: This hive was designed by Agriculture Research Division, Ministry of Agriculture, Kenya to manage honey badgers, extreme weather conditions and for increased honey yields. There are two types: original type and improved type (with queen excluder). The improved type has enhanced honey quality and ease of harvesting. Occupancy is usually dependent on the area and placement.

Showing different types of hives

Langstroth hive: The hive comprises two or more boxes placed on top of each other. The lower box is for bee production while the rest of boxes (supers) are for honey production. Between the lower and super box (the super), a queen excluder is placed to prevent the queen from moving to the supers. Honey production is 10kg per harvest from the super chamber. There exist diverse modifications in the market.

Other Infrastructure Includes;

- Protective Gear: Beekeeping suits, gloves, and veils protect from stings; Rubber or leather gloves for safe hive handling
- Tools:
  - ~ Smoker: Produces smoke to calm bees during hive inspections;
  - ~ Hive Tool: A multifunction tool for prying open hives and scraping and Extractors: Used to harvest honey without destroying the comb.
- Additional Infrastructure
  - ~ Feeders: Provide supplemental food during dearth periods.
  - ~ Queen excluders: Control where the queen can lay eggs.

HIVE MANAGEMENT

The practical upkeep of bee colonies to maintain their health and productivity.

Figure 7.10: Components of hive management

Hive management Techniques

Effective hive management is crucial for maintaining healthy bee colonies, maximizing productivity, and ensuring the sustainability of beekeeping operations. Here's a comprehensive guide to key hive management techniques:

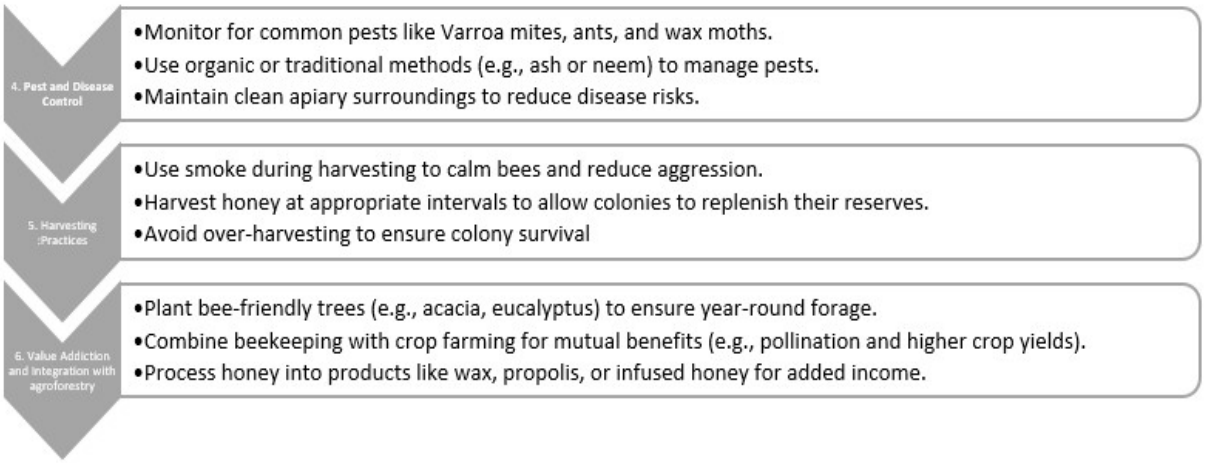


Figure 7.11: Showing hive management techniques

SESSION 19: ENTERPRISE DIVERSITY IN RANGELANDS

CONTEXT

Discussions of diversified farming systems rarely mention rangelands, even though they are a significant part of the land base used for agricultural production. The omission may reflect the fact that rangelands are not cultivated, and therefore seem unrelated to farming. To achieve sustainability there is need to diversify between crop and livestock production within rangelands

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; Stationaries; 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 min
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; 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 min 10min 25 min

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 min 10 min
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 min

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 7.12: 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

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.

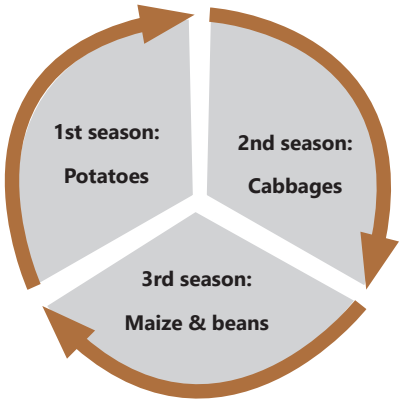


Figure 7.13: Crop rotation idea

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;

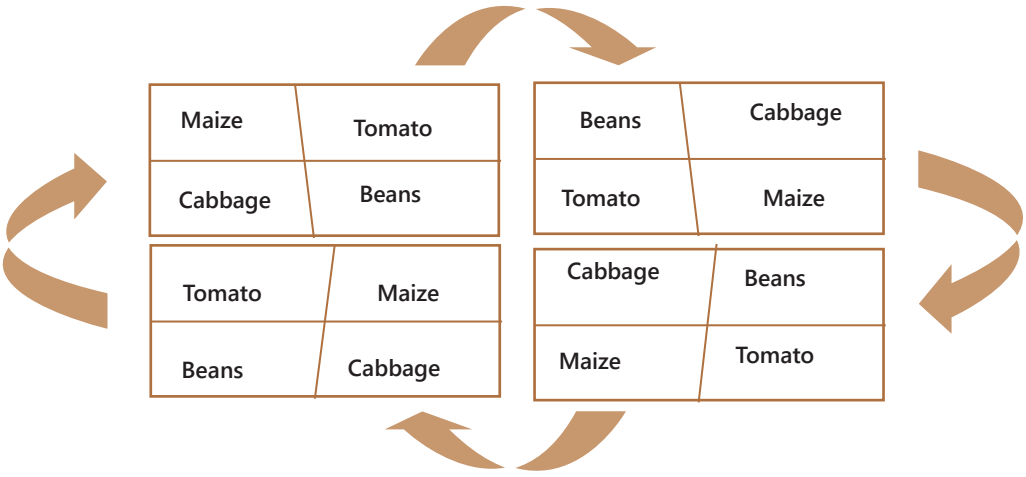


Figure 7.14: Crop rotation suggestion for a parcel of land divided into different plots.

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 20: GROWING INDIGENOUS FRUITS IN RANGELANDS

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 farms.

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 farms
(ii) Construct a simple fruit orchard in their rangelands

Key terms: Fruits, indigenous, underutilized, rangeland

Materials and resources: Stationaries, 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 mins
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 mins
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 min
4	Conclude the session/ feedback	10 mins

REFERENCE MATERIAL FOR GROWING INDIGENOUS FRUITS ON RANGELANDS 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.
- 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.

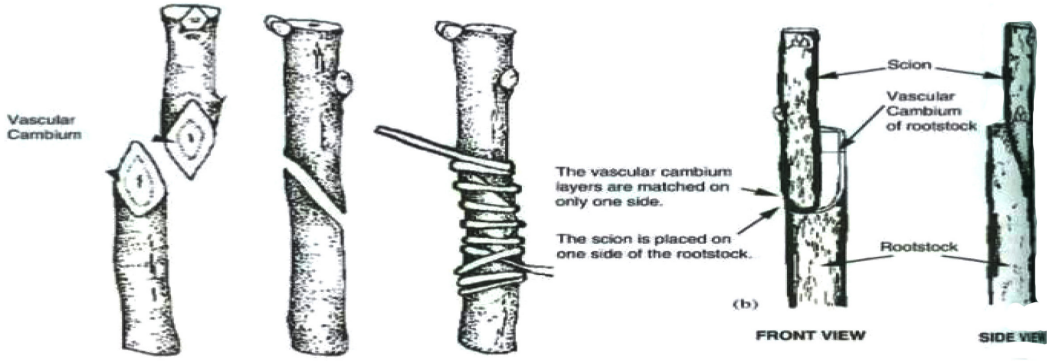


Figure 7.15: Whip grafting Source: www.slideshare

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, Girdle a stem. Remove several leaves around the wound. Pack area with moist sphagnum or 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.

Figure 7.16: *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 Land

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. Refer to session 15.

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)*

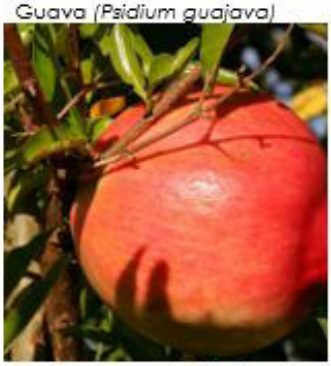
Dragon fruit *(Selenicereus undatus)*

Kei apple *(Dovyalis caffra)*

Guava *(Psidium guajava)*

Black plum *(Syzygium cumini)*

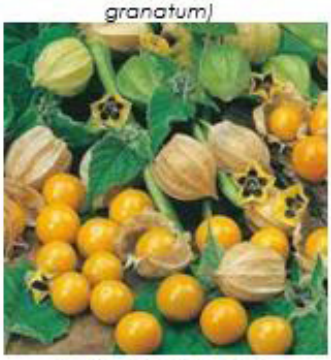
Tree tomato *(Solanum betaceum)*



Pomegranate *(Punica granatum)*

Soursop *(Annona muricata)*

Giant yellow mulberry *(Myrianthus arboreus)*



Cape Gooseberry *(Physalis peruviana)*

Jackfruit *(Artocarpus heterophyllus)*

Tamarind *(Tamarindus indica)*

MODULE 8: MARKETS

Women make up the largest labor force in rangeland "agroecology can be an instrument for empowering women, as long as women's work is recognized and valued." To put a finer point on this argument, agroecology, as a worker-led and socially reflexive model, has the potential to subvert the current top-down patriarchal structure which invisibilizes women's work and neglects to monetize much of the essential rangeland and care work that women perform. Much of the work that female rangeland farmers engage in is unpaid and they are often burdened with numerous responsibilities, including caring, feeding, milking of animals; 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 21: UNDERSTANDING MARKETING AND MARKETS FOR AGROECOLOGY PRODUCTS

CONTEXT

Male rangeland farmers often feel powerless in the face of low prices of animals, and animal products, similarly women experience the same with low prices of milk, 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. During climate disasters like drought and floods, well-meaning government officials or NGO representatives visit their communities to buy animals before they die of hunger/swept away by floods, sometimes support with pasture. However, the key issue remains: where can they sell these products at fair prices?

This meeting is designed to help unlock the negative mindset women rangeland 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

(i) Recognize the key elements of marketing and its process: Participants will be able to 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 4ps**Resources**

Training Materials/Resources: Whiteboard/Stationary, 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
▪ Rabbit urine
▪ Animal manure</td><td>▪ Honey
▪ Wild fruits
▪ Grass</td><td>▪ Vegetables
▪ Fruits
▪ Maize
▪ Milk
▪ Livestock</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 making reference to the visual on the Handbook.</td><td>10 minutes</td></tr>
</table>

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, provide an introduction to 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

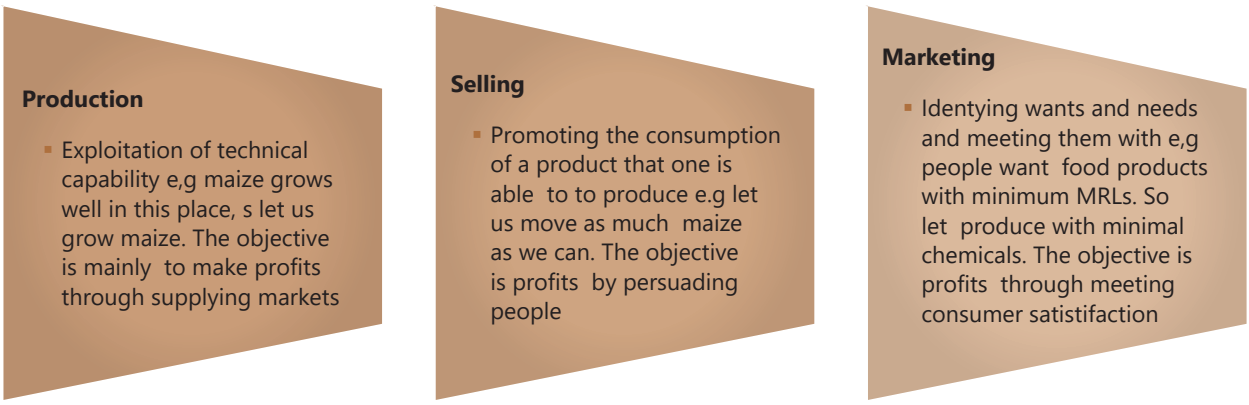
4	When the groups have finished their discussions, facilitate a question-by-question discussion in the plenary. Emphasize that it is important to know what market outlets are available for your products. It is also important to know about these markets, with regard to time, access, terms and conditions 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 8.1).



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 4.1);

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 8.2);

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. Rangelands produce a variety of products, including forage, water, wood, and minerals. They also provide recreational opportunities and support ecosystems.
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 22: 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;

(i) 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.
(ii) Identify market entry barriers for smallholder farmers, such as access to finance, certification costs, infrastructure, and information, and propose strategies to overcome these barriers.
(iii) 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/Stationary, 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/stationary. 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.

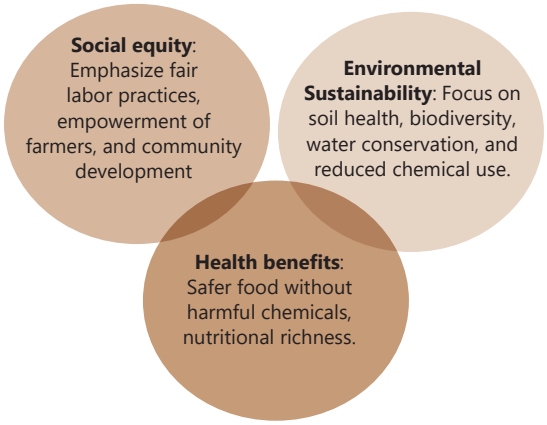
Typologies of markets

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 (Figure 8.3).



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	KS1758 'Horticulture Code of Conduct'	Participatory Guarantee Systems (PGS)
▪ 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, 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	▪ 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 23: 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:

- Embrace an entrepreneurial mindset in operating their agroecology practices
- Have a basic understanding of how to assess their farm's internal and external situations.
- Be able to develop strategic goals, objectives, and an action plan.
- Have gained insight into financial considerations and how to incorporate them into a business plan
- 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 stationary, 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 mins

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 stationery 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 mins
3	The facilitator should lead a debrief session where participants share what they learned from the activity.	5-10 mins

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 mins
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 mins

REFERENCE MATERIAL FOR PLANNING AND DEVELOPING VIABLE AGROECOLOGY ENTERPRISES

A farm is an agribusiness unit (firm) where inputs are transformed into outputs (Figure 8.4)

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].

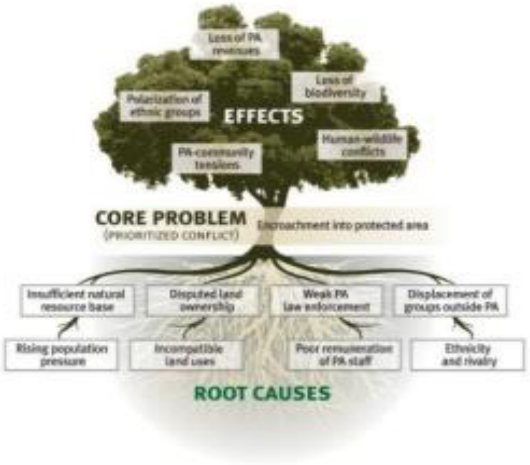
The facilitator should lay emphasis on the view that this module has been developed to build the capacity of the participants to plan, implement and evaluate their farm enterprises as shown in table below:

Key management functions

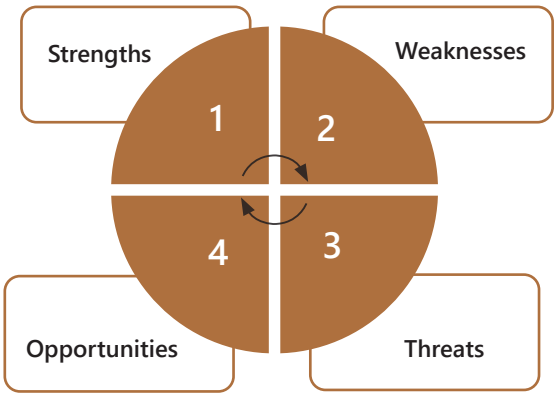
Planning	Implementation	Monitoring & Evaluation (Controlling)
▪ Planning is the basic function of dairy farm Management. ▪ It is deciding in advance - what to do, when to do & how to do. ▪ It bridges the gap from where we are & where we want to be.	▪ Implementation is execution of planned activities 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.

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 Figures below);



Tools for farm planning (problem tree analysis)



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.

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.

Elements of a good business plan: A business plan is meant to enable you translate ideas – into viable profit-making businesses. A good business plan should include the following elements (Table 8.3)**:**

Element	Description
Farm Description and operations Plan	When you ask a farmer to describe his or her operation, the response will usually begin with information on the number of acres farmed, the type of crops grown, and livestock raised. but we encourage you to consider starting with an assessment of the markets you serve and your strategies for serving them. 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.
Market analysis and plan	This section should outline the marketing and sales strategies that the micro miller will use to reach its target customers and promote its products or services. It should also include the pricing strategy and sales projections (4Ps). It should be preceded by a market analysis and here you assess your critical strengths, weaknesses, opportunities and threats
Financial Plan	This section should provide a detailed financial analysis of the micro milling business, including revenue projections, profit and loss projections, cash flow projections, and a break-even analysis. It should also include the start-up costs and the funding sources.
Risk Management	This section should identify potential risks and challenges that the micro milling business may face and outline strategies to mitigate those risks.

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