

**TRAINING MANUAL FOR EXTENSION OFFICERS ON
ORGANIC FARMING TECHNOLOGIES FOR THE
RESTORATION OF DEGRADED LANDS**



**TRAINING MANUAL FOR EXTENSION OFFICERS ON
ORGANIC FARMING TECHNOLOGIES FOR THE
RESTORATION OF DEGRADED LANDS**

Prepared by

Ruth Bruno Madulu

Betty Ngwega Chalamila

Godfrey B. Mwingira



TABLE OF CONTENTS

PREFACE	iv
INTRODUCTION	v
MODULE 1	1
1.0 Organizing Training.....	1
MODULE 2	3
2.0 Understanding Principles of Organic Farming	3
MODULE 3	7
3.0 Organic fertilizers	7
MODULE 4	13
4.0 Intercropping.....	13
MODULE 5	15
5.0 Crop Rotation.....	15
Planning of crop rotation	16
MODULE 6	17
6.0 Agroforestry	17
MODULE 7	20
7.0 Ngolo technology for soil restoration	20
8.0 References.....	23

PREFACE

Organic farming technologies are an alternative agricultural system which advocates the use of appropriate and affordable farming techniques in improving soil fertility. Fertile land is crucial for sustainable land productivity in Tanzania. Agriculture land in Mpwapwa and Kondo districts is under enormous pressure from soil degradation, deforestation, inappropriate farming and grazing practices and fuel wood shortage. These factors contribute to low agriculture production, hence increased food insecurity.

This manual has been developed with the aim of providing guidance to extension workers in matters related to the setting up and conduct of training of trainer's workshops, as well as Farmer Field Schools (FFS) on organic farming technologies for soil and water conservation. It provides a framework, relevant information and tools to build on these activities according to specific needs. Although the training manual shows how to conduct a training workshop, the responsibility of achieving sufficient impact rests with the users.

Acknowledgements

This manual is the work of many people. Ms.Ruth B.Madulu, Ms.Betty N.Chalamila, Mr. Geoffrey Mwingira who developed the original concept and drafted the first technical write-up.

Special thanks go to Dr. Albi of CDE who edited the manual for user-friendliness during the development of this manual.

We also acknowledge with thanks districts and village agriculture extension officers of Mpwapwa and Kondo. We are grateful to village leaders and farmers of Tura, Chunya, Makutupa, Changaa and Mongoroma.

Our special thanks and appreciation go to the Officer Incharge – ARI Mikocheni for the technical support and CDE, ESAPP who provided financial support for the production of the manual without which it would not have been possible to produce this manual.

INTRODUCTION

Among the many problems facing the agricultural sector is diminishing good agricultural land. Consequently, there is a need to intensify land use. However, this may not be sustainable through production based on the natural fertility of the of the soil type in Tanzania. Increased output of agricultural products can only be achieved if nutrients removed from the fields with the harvests are continuously replaced. The result of high cost of external inputs, limited knowledge on soil fertility management, over exploitation of the soil is a diminished resilience of the soil system to provide a suitable medium for crop growth. In short, farmers are increasingly less able o overcome the soil constrains to crop productivity as it becomes more crucial that they be able to do so. These notes attempt to look at some soil management practices that could help alleviate these problems.

This training manual focuses on technologies, which are more readily available at the local level for optimization of the local resources and improvement of the faming systems. The relevant technologies include agricultural practices as well as conservation practices.

The training will cover the following modules:

- Module 1- Organizing the training
- Module 2- Understanding Principles of Organic Farming
- Module 3- Organic fertilizers
- Module 4- Intercropping
- Module 5- Crop Rotation
- Module 6- Agro forestry
- Module 7- Ngolo technology for soil restoration.

MODULE 1

1.0 Organizing Training

Training Preparation

The training process starts with the identification of the available indigenous technologies available in the study area and the knowledge of the trainees on the problem in question. This information is essential when preparing the curriculum for the training. It is important to bear in mind that trainers should come to farmers with concrete proposals of alternative technologies as a basket of tools, which farmers will later adapt to the local conditions.

The main objectives of the workshop are to:

- Increase knowledge on land degradation and strategies for sustainable use and conservation of available farm resources in the area.
- raise awareness on organic farming technologies
- inform interested parties and local institutions of the overall training process on alternatives;
- identify major land degradation problems;
- identify available indigenous technologies and discuss their feasibility;
- identify the participants, i.e. agricultural extension workers and farmers for the Training of Trainers (TOT)

Guidelines for undertaking training

During the training participants are acquainted with the new alternatives, methods to improve soil fertility, cultivation methods and the agro-ecosystem, with emphasis on soil erosion control. The focus will be on hands-on activities in the field and facilitation skills based on non-formal adult education.

Usually the main facilitator is a specialist in organic farming techniques. Trainers should have knowledge and experience of the organization and running of Farmer Field Schools (FFS). The TOT is normally delivered throughout the crop season in order to follow through and observe the results of the experiments. However, in some circumstances this training may be shortened if extension workers already have sufficient

knowledge and experience of Organic farming techniques. One possibility could be to organize an initial short TOT with complementary field days later. In this way, the technicians will have time to digest all the new elements related to Organic farming technologies. The TOT may also be conducted in parallel with an FFS.

MODULE 2

2.0 Understanding Principles of Organic Farming

Introduction

Organic farming can be defined as an approach to agriculture where the aim is to create integrated, humane, environmentally and economically sustainable agricultural production systems. Maximum reliance is placed on locally or farm-derived renewable resources and the management of self-regulating ecological and biological processes and interactions in order to provide acceptable levels of crop, livestock and human nutrition, protection from pests and diseases, and an appropriate return to the human and other resources employed. Reliance on external inputs, whether chemical or organic, is reduced as far as possible. In many European countries, organic agriculture is known as ecological agriculture, reflecting this reliance on ecosystem management rather than external inputs.

The objective of sustainability lies at the heart of organic farming and is one of the major factors determining the acceptability or otherwise of specific production practices. The term 'sustainable' is used in its widest sense, to encompass not just conservation of non-renewable resources (soil, energy, minerals) but also issues of environmental, economic and social sustainability. The term 'organic' is best thought of as referring to the concept of the farm as an organism, in which all the component parts - the soil minerals, organic matter, micro-organisms, insects, plants, animals and humans - interact to create a coherent and stable whole.

Objectives: To gain knowledge and skills of organic farming principles

Learning methods

Group discussion and field visits

Materials required

Note books, pen, and pencil, marker pen, flip charts and handouts

Time allocation

90 minutes

Contents of discussion:

Key characteristics of organic farming

Principles of organic farming

Advantages of organic farming

1. The key characteristics of organic farming include:

An understanding of the characteristic of organic farming is fundamental to management of degraded land especially in multiple land use area. Some of these characteristics are:

- Protecting the long term fertility of soils by maintaining organic matter levels, encouraging soil biological activity, and careful mechanical intervention;
- Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock manures;
- Weed, disease and pest control relying primarily on crop rotations, intercropping, natural predators, diversity, organic manuring, resistant varieties.
- Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats.

2. Principles of organic farming

- Diversity: Having many different plants and animals-
Practical methods for diversity:

Agroforestry- Planting trees together with crops, pastures or crops, pastures and livestock.

Multiple cropping- growing different plants together in a manner that maximizes land use while ensuring good and stable production

On-farm seed selection- Use of different crop varieties to ensure sufficient yield under varying climatic, management and soil conditions.

Rotations

Integration of animals- Different animals utilize different plants or plant parts and produce manure of different quality. All these are beneficial to the farm.

- Living soil: Fertile, productive soils with lots of organisms (micro and macro)
Practical methods for Living soil:

Mulching- Covering the soil with crop residues reduces run –off, increases infiltration and adds organic matter to it.

Cover crop increases water infiltration while reducing erosion.

Green manuring

Composting of crop residues, household wastes, etc.

Using bio-gas slurry

Using bio-fertilizer (inoculants) and animal manure.

- Cyclic flow emphasis on recycling of available resources such as energy, nutrients, water.

Practical methods for cyclic flow:

Cover crops.

Encouraging nitrogen fixation by legumes

Planting deep-rooted plants which act as nutrient pumps.

Composting crop residues and kitchen waste.

Keeping animals according to their nature- Roomy housing, variety of feeds.

Practical method for keeping animal:

Animals should be kept in ways that meet their instinctive needs e.g. housing which allows chicken to roost or scratch, grazing in the fields for cows etc.

Advantages of organic farming

- Soil and water conservation
- Efficient use of soil nutrients
- Efficient use of space

Facilitator notes

Present a lecture on the components of this topic. Allow more participation from trainees as variations with regard to the concepts of organic farming in relation to land degradation and restoration.

MODULE 3

3.0 Organic fertilizers

Objective: -To gain insights of organic fertilizers making
-To develop skills for making and using organic fertilizers

Learning methods

Group discussion and field experimentation

Materials required

Marker pen, flip chart, note books, pen

Time allocation

150 minutes

Contents of the training

Introduction on types of organic fertilizers

Discussion on compost heap/pile making

Discussion on green manure

3.1 Types of organic fertilizers

- Compost heap/pile
- Green manure
- Mulching

3.1.1 Compost heap/pile

Introduction

The trainer outlines the procedure of making pile/heap compost. An initial demonstration of each composting technique is done together with the whole group to show the participants what they are expected to do.

The participants guided by the trainer, discuss the process of making compost and identify its weak and strong points. They also give their recommendations.

Objective: To gain an insight into the methods of making compost

To develop compost making skills

Materials: Fork, hoe, wheel barrows, manure/old compost, ash, top soil, spades, water, watering cans, dry vegetation/stalks/grass, pangas, green vegetation/grass, a pole of 2.5-3 meters long.

Time: 90 minutes

Compost making procedure

Activities

- **Group formation:** Participants are divided into small groups of not more than 6 people and each group makes its own compost.
- Each group selects a location where the compost will be used but should be sheltered from wind, sun and rain.
- Measures out an area 1.5 to 2 meters wide
- Dig the ground to 50 -100 cm deep where the compost pile will be made.
- Lay down the bottom layer with rough vegetation such as sorghum stalks and it should be 30 cm thick. Long stalks should be chopped.
- Second layer of about 10 cm thick should be of manure or old compost
- Then sprinkle top soil to cover the material.
- The next layer should be made up of green vegetation/grass of about 15-20 cm thick. Then sprinkle wood ash.
- Water the whole pile and make sure the pile is well watered.
- Repeat the process, starting with rough vegetation, then manure, top soil green vegetation ash and water again.
- Build the pile to a height of 1.5 to 2meters
- The pile should be completed with covering with a layer of top soil about 10 cm.
- Finally cover whole pile with dry grass to prevent loss of moisture through evaporation.



Arranging layers of stalks for compost making



Trainees sprinkle a layer of ash



Trainees sprinkle a layer of soil



Trainees monitor compost pile progress

Tips for better composting

- Keep pile moist
- Keep the pile well aerated

3.1.2 Green manure

Introduction

The trainer outlines the procedure and concepts of green manure. Green manure training demonstration will be done together with the whole group to show the participants what they are expected to do.

The participants guided by the trainer, discuss the process of making green manure and identify its weak and strong points. They also give their recommendations.

Aim: To develop skills and knowledge on green manure

Materials: Fork, hoe, spades, legume seeds, flip charts, note book pen, pencil

Time: 60 minutes

Advantages of green manure

- Increasing organic matter, earthworms and beneficial micro-organisms
- Increasing the soil's available nitrogen and moisture retention
- Stabilizing the soil to prevent erosion
- Bringing deep minerals to the surface and breaking up hardpans
- Improving water, root and air penetration in the soil
- Smothering weeds

Steps for making green manure

- Growing a green manure crop is as easy as throwing out a handful of seed onto freshly cultivated ground, followed by raking to cover the seed.
- "Digging the crop in" at the end isn't necessary, as by cutting the plants at the base while still green and lush, usually just as flowers form and leaving the green manure crop on the surface you have 'instant' mulch. This is cheaper than constantly buying in mulch and doesn't introduce new weeds. A combination of a legume and a grass works well, the legume providing nitrogen.
- Green manures can be used to interrupt pest and disease cycles in much the same way as crop rotation. Particular green manures can be used to control root knot nematodes and root rot fungal pathogens, reducing the need to use toxic chemicals for soil fumigation.
- Green manures can be used to smother persistent weeds.



A trainee is observing legumes crop which is ready to be ploughed under as green manure

3.1.3 Mulching

Introduction

The trainer outlines the procedure and concepts of mulching. The participants guided by the trainer, discuss the advantage and basic concepts of mulching.

Aim: To develop skills and knowledge on mulching

Materials: Flip charts, note book, pen, pencil

Training methods

Facilitation, group discussion, field visit and practice

Time: 30 minutes

Contents of the training

Introduction

Discussion on mulching basics

Discussion on mulching advantages

Mulching basics:

Mulching is a soil cover made of straw, chopped up branches or other protective material.

- In order to reap maximum benefits, a layer of mulch should be two to four inches thick.
- Coarse mulch will help to keep weeds from erupting in your farm.
- Fine mulch will decompose quickly, leading to more frequent mulching.
- Before mulching, remove all weeds and give the soil a good, thorough soaking.

Advantages of Mulching

Mulching is serving many purposes such as:

- Soil fertility improvement;
- Evaporation control;
- Soil and water conservation, as it prevents water evaporation
- A protective cover for the soil;
- Regulating soil temperature and micro-climate.
- It's designed to retain moisture, deter weeds and keep the soil from eroding.
- Mulch will enrich the existing soil and will prevent rain and other elements from washing it away
- It keeps the soil moist, reducing the need for constant watering or frequent rain.

Facilitator notes

Present a lecture on the components of this topic. Allow more participation from trainees on the make and use of organic fertilizers.

MODULE 4

4.0 Intercropping

Introduction

Intercropping is the cultivation of two or more crops simultaneously on the same field. It also means the growing of two or more crops on the same field with the planting of the second crop after the first one has completed its development. The rationale behind intercropping is that the different crops planted are unlikely to share the same insect pests and diseased-causing pathogens and to conserve the soil.

Objectives: To develop skills and knowledge on intercropping

Training methods

Facilitation, group discussion and field practical

Training Materials: Flip charts, note book, pen, pencil.

Time: 180 minutes

Contents:

Introduction

Discussion on types of intercropping practices

Discussion on advantages of intercropping

Types of intercropping practices

- Mixed or multiple cropping is the cultivation of two or more crops simultaneously on the same field without a row arrangement
- Relay cropping is the growing of two or more crops on the same field with the planting of the second crop after the first one has completed its development
- Row intercropping is the cultivation of two or more crops simultaneously on the same field with a row arrangement

- Strip cropping is the cultivation of different crops in alternate strips of uniform width and on the same field. It has two types; contour strip cropping and field strip cropping. Contour strip cropping follows a layout of a definite rotational sequence and the tillage is held closely to the exact contour of the field. Field strip cropping has strips with uniform width that follows across the general slope of the land.

Advantages

- Reduces the plant diseases as it attracts more beneficial insects, especially when flowering crops are included the cropping system.
- Reduces erosion and protects topsoil.
- Minimizes labor cost on the control of weeds. A mixture of various crops gives often a better coverage of the soil leaving less space for the development of weeds.
- Utilizes the farm area more efficiently.
- Results in potential increase for total production and farm profitability than when the same crops are grown separately.
- Provides 2 or more different food crops for the farm family in one cropping season.



Facilitator explaining the basics of intercropping

Facilitator notes

Present a lecture on the components of this topic.

MODULE 5

5.0 Crop Rotation

Introduction

Crop rotation is a planned order of specific crops planted on the same piece of land. The planned rotation may vary from 2 to 3 years or longer period depend with land availability. Some insect pest and diseases causing organism are host specific. For example, rice stem borer feeds on rice, if you don't rotate rice with other crops belonging to a different family the problem continues as food is always available to the pest. However, if you plant legume as the next crop, then sorghum, and later beans, the insect pest will likely die due to absence of food.

Objectives: To gain knowledge and skills of organic farming principles

Learning methods

Group discussion and field visits

Materials required

Note books, pen, and pencil, marker pen, flip charts and handouts

Time allocation

210 minutes

Contents:

Introduction on crop rotation

Discussion on planning crop rotation/sequence

Discussion on Advantages and practice of crop rotation

Planning of crop rotation

- You should know the family name of all the crops you want to grow per season, and the quantity of seeds you have for each crop.
- It is advisable to start growing legumes before cereals
- Draw a plan of a growing area. Divide your farm into equal sized sections according to the number of years that you want to rotate. Distribute the crops that you want to grow within these sections. The first rule is to try and keep crops belong to one family together. If a section is to hold more than one family, try and keep those crops with similar growing requirements together.

Advantages of crop rotation

- Prevents soil depletion
- Maintains soil fertility
- Reduces soil erosion
- Controls insect pests.
- Reduces reliance on synthetic chemicals
- Reduces the pests' build-up
- Prevents diseases
- Helps control weeds

Facilitator notes

Present a lecture on the components of this topic.

MODULE 6

6.0 Agroforestry

Introduction

Agro forestry system makes maximum use of land. Every part of the land is desirable for useful plants. Emphasis is placed on perennials and multipurpose crops that are planted and yield benefit over the long time. Trees in agro forestry systems have important uses such as holding the soil against erosion and improving soil fertility.



Trainees are observing the benefits of agroforestry in Farmer Field school plots at Maktupa -Mpwapwa

Objective: To equip participants with skills on the application of incorporating agro forestry in their farming system.

Training method

Facilitation, group discussion and field visit

Materials required

Seeds, note book, pen, pencil, flip chart, marker pen

Time allocation

180 minutes

Content of the training

Introduction

Discussion on steps in implementing agroforestry

Discussion on advantages and practice of agroforestry

Steps in the implementation of the Agro forestry system

1. Decide whether agro forestry systems are appropriate:

- Identify households and community needs.
- List the needs that could be met with an agro forestry system.
- List the potential benefits, and their relative importance, of an agro forestry system in the area in question.
- Find the limiting constraints in agriculture, including markets and marketing.
- Consider whether the community members in the villages are willing or capable of adopting the system.
- Then decide if it is worth the effort to develop one.

2. Design a system:

- Select the area.
- Characterize its strengths and weaknesses with respect to existing soil, water, and crops.
- Select the trees, shrubs, or grasses to be planted.
- Characterize the minimum space requirements, water and fertilizer needs.
- Ensure that the desired crops are tolerant to the local conditions.

3. If the system is temporary:

- Plan the features of soil erosion control, earthworks, and gully maintenance first.
- Plan spacing of fruit trees according to final spacing requirements.
- Plan a succession of annual or short-lived perennials, selecting the most shade tolerant.
- Identify crops for the final years of intercropping.

4. If the system is permanent:

- Plan the proportion of the permanent fruit and lumber trees on the basis of relative importance to the farmer.
- Plan the spacing of long-term trees on the basis of final space requirements.
- Plan succession of annual and perennial understory crops, including crops for soil protection and enrichment.
- As large permanent trees grow, adjust planting plan to place shade tolerant crops in most shady areas.

5. Factors to consider for both temporary and permanent systems:

- Always keep the ground covered, using various crops-to protect soil from sun and erosion.
- Try the system on a small scale first.
- Measure the inputs and outputs of the system.
- Evaluate whether the benefits expected have been achieved.
- Expand or extend any new system cautiously.

Advantages of Agroforestry

- Reducing deforestation and pressure on woodlands by providing fuel wood grown on farms.
- Contributing to food security by restoring farm soil fertility for food crops and production of fruits, nuts and edible oils.
- Increasing diversity of on-farm tree crops and tree cover to buffer farmers against the effects of global climate change.
- Reducing poverty through increased production of agroforestry products for home consumption and sale.

Facilitator notes

Covering the content of agroforestry topic in relation to land degradation and restoration.

MODULE 7

7.0 Ngolo technology for soil restoration

Introduction

Ngolo or Matengo pit system is essentially a soil and water conservation system as well as a fertility restoration technique, through refuse decomposition and crop yield enhancement,

Objective: To make farmers acquire practical knowledge on ngolo making techniques.

Training method

Facilitation, group discussion and field visit

Materials required

Machete, sickle, slasher, hoe, note book, pen, pencil, flip chart, marker pen

Time allocation

180 minutes

Contents of the training

Introduction on concept of Ngolo cultivation techniques

Discussion on the advantages and practice of Ngolo techniques for soil and water conservation

Steps in ngolo formation

Advantages of Ngolo technology

- Soil Mulching
- Water harvesting
- Weed control
- Reduce surface run off

- Maintains soil fertility

NGOLO FORMATION PROCEDURES

- Slash grass with a *nyengo* (sickle), panga or slasher to the ground level.
- The slashed materials are allowed to dry for 10-14 days.
- Then arrange the dried grass in rows forming grids of 2sq m each over the whole area.
- The soil is dug from the center of these squares and thrown over the grass squares forming ridges on all four sides and consequently, a pit is formed in the center.
- The dimensions of the pits range from 2-2.5 meters and 0.3 m to 0.5m deep
- On average, pits occupy about half of the area of a given field and the other half by ridges on which crops like sorghum, millets and groundnuts are planted.
- Normally pits are formed every two years following a 6 to 8 month fallow. The new Ngolo are formed in the same way, but this time the lines are laid across the centre of the pits and ridges. Soil is dug from existing ridges and placed over the grass to form new ridges. Thus, what was previously a pit becomes a ridge.
- Throughout the year, weeds and crop debris are thrown into the pits to form compost.

Participants/trainees of Mpwapwa and Kondoa are practicing Ngolo cultivation technology





Facilitator notes

Facilitator gives in depth description of the topic.

8.0 References

1. Njoroge, J.W (1999), Training manual on organic farming in Medium and High Potential areas.
2. An overview of Organic crop Production. www.attra.org/attra-pub/organiccrop/tools2.html.
3. Ruth B.Madulu, Betty N. Chalamila (2007). Report on Organic farming technologies for empowering women in Mkuranga district.