



Ministry of Agriculture and Livestock Development
State Department for Crop Development
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Emergency Locust Response Program
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2.3.2 SUB-MODULE 2: SELECTED CROPPING SYSTEMS AND TECHNOLOGIES

Introduction

A cropping system refers to the type and sequence of crops grown and practices used for growing them. It encompasses all cropping sequences practised over space and time based on the available technologies of crop production. Cropping systems are an important part of sustainable agricultural production.

Cropping systems and technologies commonly practised include: organic farming, crop rotation, intercropping and relay cropping.

Organic Farming

Organic agriculture is an integrated production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasises the use of natural inputs (i.e. minerals and products derived from plants) and the renunciation of synthetic fertilisers and pesticides. The organic agriculture techniques are known to be ecologically sustainable by:

- Improving soil structure and fertility through the use of crop rotations, organic manure, mulches and the use of fodder legumes for adding nitrogen to the soil fertility cycle.
- Prevention of soil erosion and compaction by protecting the soil, planting mixed and relay crops.
- Promotion of biological diversity through the use of natural pest controls (e.g. biological control, plants with pest control properties) rather than synthetic pesticides which, when misused, are known to kill beneficial organisms (e.g. natural parasites of pests, bees, earthworms), cause pest resistance and often pollute water and land.
- Performing crop rotations, which encourage a diversity of food crops, fodder and under-utilised plants; this, in addition to improving overall farm production and fertility, may assist the on-farm conservation of plant genetic resources.
- Recycling the nutrients by using crop residues (straws, stovers and other non-edible parts) either directly as compost and mulch or through livestock as farmyard manure.
- Using renewable energies, by integration of livestock, tree crops and on farm forestry into the system. This adds income through organic meat, eggs and dairy products, as well as draught animal power. Tree crops and on-farm forestry integrated into the system to provide food, income, fuel and wood.

Conversion to Organic Agriculture

Conversion to organic agriculture describes the process of learning and implementation of changes



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on the farm towards a more sustainable and natural way of farming. The form the process takes depends on the local circumstances and the predisposition of the farmer or the community, and it varies from farm to farm.

The conversion from a conventional to an organic system requires a transitory period, where the organic practices are applied progressively following an organised plan. During this period, it is important to analyse carefully the actual situation of the farm and identify the operation to be taken.

The analysis of the farm must include;

- Farm characteristics: size, plots and crops distribution; kind of crops, trees, animals are integrated in the farm system.
- Soil Analysis: an evaluation of the soil structure, nutrient levels, organic matter content, erosion level, and/or the soil have been contaminated.
- Climate: rainfall distribution and quantity, temperatures, frost risks, humidity.
- Organic matter sources and management (manures).
- Presence of animal housing systems and/or machinery.
- Limiting factors such as capital, labour, market access, among others.

Processes that aid in the conversion process include:

- **Diversify the farming system:** Select appropriate annual crops for the area and rotate them in a planned sequence. Include legume crops such as beans or leguminous fodder crops in the rotation to provide nitrogen to the subsequent crops. Plant hedges and flower strips to encourage natural enemies to control pests.
- **Start recycling valuable farm by-products:** Establish on-farm compost production based on harvest residues and manure, if available, and mix the compost with the topsoil. This will bring stable organic matter into the soil and improve its structure and capacity to feed the plants and store water. Green manures can provide plenty of plant material to feed soil organisms and build up soil fertility.
- **Introduce farm animals into the system:** Farm animals provide valuable manure and diversify farm income through additional animal products.
- **Grow cover crops:** Cover crops or lay out mulches in perennial crops provide protection to the soil.

Intercropping

Intercropping is a cropping system that involves growing of two or more crops simultaneously in alternate rows or otherwise in the same area, where there is significant amount of inter crop competition. Intercropping can be done in different ways including;

- Broadcasting the seeds of either crops, or dibbling the seeds without any row



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arrangement. This is called mixed intercropping. It is easy to do but makes weeding, fertilisation and harvesting difficult. Individual plants may compete with each other because they are too close together.

- Planting the main crop in rows and then broadcasting the seeds of the intercrop (such as a cover crop).
- Planting both the main crop and the intercrop in rows. This is called row intercropping. The rows make weeding and harvesting easier than with mixed intercropping.

A possible problem is that the intercrop may compete with the main crop for light, water and nutrients. This may reduce the yields of both crops.

Relay Cropping

Relay cropping is a method of multiple cropping where one crop is seeded into standing second crop well before harvesting of second crop. Relay cropping is a sustainable approach that optimises system productivity and compensates yield of two crops at a time and can solve time contravention among sowing of different crops.

Relay cropping has still been recognized, especially by smallholder farmers, because of its potential to increase land use efficiency, moisture reduce fertiliser consumption, enhance crop yield and nutrient accumulation, and improve biological activities

Advantages of Relay Cropping include:

- It possesses the capability to improve soil quality.
- Increases net returns and land equivalent ratio.
- Helps in the control of weed and pest infestation thereby decreasing chemical pest control measures.
- Relay cropping facilitates the farmers to cultivate two crops in 1 year especially in those areas/cropping systems where the growing season is shrinking for sequential farming due to climate change.
- Environmental benefits associated with relay cropping include improved soil, air, and water quality by reducing the leaching, emanations, and eutrophication of nutrient compounds.

Crop Rotation

Crop rotation means changing the type of crops grown in the field each season or each year. It is a critical feature of all organic cropping systems, because it provides the principal mechanisms for building healthy soils, a major way to control pests, weeds, and to maintain soil organic matter.



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Benefits of Crop Rotation

- It improves the soil structure:** Some crops have strong, deep roots. They can break up hardpans, and tap moisture and nutrients from deep in the soil. Others have many fine, shallow roots. They tap nutrients near the surface and bind the soil. They form many tiny holes so that air and water can get into the soil.
- It increases soil fertility:** Legumes (such as groundnuts and beans) fix nitrogen in the soil. When their green parts and roots rot, this nitrogen can be used by other crops such as maize. The result is higher, more stable yields, without the need to apply expensive inorganic fertiliser.
- It helps control weeds, pests and diseases:** Planting the same crop season after season encourages certain weeds, insects and diseases. Planting different crops breaks their life cycle and prevents them from multiplying.
- It produces different types of output:** Growing a mix of grain, beans, vegetables and fodder means a more varied diet and more types of produce to sell.
- It reduces risk:** A single crop may fail because of drought. It may be attacked by pests. Or its market price may be low when time comes to sell it. Producing several different crops reduces these risks.

Selecting Crops in Cropping System

- Choosing the right crops and crop combinations.** Factors to consider when choosing the right crop combinations for a cropping system include;
 - What does it produce?** Crops produce many different things: food, fodder, firewood, fence poles, thatch and medicines. Farmers grow some crops (such as cotton) only for cash. For other crops, such as cereals or vegetables, you may be able to sell what you do not use yourself. Make sure there is a market for the output.
 - Will it grow well?** This depends on many things: the amount of rain or moisture in the soil, the season (some crops and varieties do not grow well at certain times of year), the soil fertility, and so on.
 - What inputs are needed?** How much work does it take to grow the crop? Can you get seed? Do you need other inputs, such as fertiliser or insecticide?
 - What are the roots like?** Tall cereals (millet, maize, and sorghum), finger millets and some legumes (e.g., pigeon pea) have strong roots that penetrate deep into the soil – up to 1.2 m for tall cereals. Their roots improve the soil structure and porosity, so are a good choice if the soil is compacted
 - Does it improve soil fertility?** Legumes improve the soil fertility by fixing nitrogen from the air. They use part of it for their own needs, and leave the rest in the soil. Cereals and other plants can use this nitrogen if they are intercropped with the legume, or if they are grown as the next crop in the rotation.
 - Does it cover the soil well?** Tall cereals do not cover the soil well because they have upright



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leaves and they are planted far apart. Short grasses (*Brachiaria*, *Andropogon*) and many legumes (lablab, groundnut, cowpea, and beans) cover the ground very quickly after they are planted. When their main use is indeed to provide cover, we call them cover crops. If their main use is to provide food, we call them food legumes (beans, groundnuts). Does it work with other crops? Try to find combinations of crops that complement each other well. For example, cereals grow well with legumes (either food legumes or cover crops): the cereals benefit from the nitrogen fixed by the legume. Two different legumes or two different cereals do not usually work well together.

Grouping of Crops in a Crop Rotation Program. Generally, the crops are grouped based on their feeding habits and their belonging to a crop family eg *solanaceae*, *crucefarae*, *leguminaceae*.

Most vegetable small-scale farmers in Africa distinguish 4 categories of vegetables. These are based on their botanical, but also consider the crops' nutrient requirements.

- Leaf crops or high feeders: broccoli, cabbages, cauliflowers, kales, spinach, etc.
- Fruit crops or medium feeders: chilies, egg plants, peppers, tomatoes, etc.
- Root crops or low feeders: carrots, beet roots, potatoes, onions, radishes, turnips, etc.
- Legumes: beans, chickpeas, cowpeas, grams, peas, pigeon peas, etc.
- Solanaceae- Tomatoes, potatoes, Bringels
- Brassicaeae- Kales, cabbages, carliflower

Kitchen Garden

It is one of the technologies in nutrition sensitive agriculture that involves 3 pathways: diverse own food production, women empowerment and economic empowerment to access nutrition food. Kitchen garden entails any convenient size of plot or structure located near homestead, where a variety of crops are grown and small domestic animals reared, mostly for family consumption and for generating income.

Advantages of Kitchen garden include:

- Supply of fresh and adequate fruits and vegetables high in nutritive value
- Supply fruits and vegetables free from toxic chemicals/ safe food
- Help to save expenditure on purchase of vegetables
- Effective utilisation of kitchen waste water and kitchen waste materials
- Exercise to the body and mind
- Empowers women economically to buy, access nutritious foods
- Promotes diverse food own production

Kitchen gardens are best suited at the backyard of house and in open areas with plenty of sunlight near the water source



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There are different types of kitchen gardens including

The wick irrigation garden. This is a simple garden that employs the use of jerry cans and a wick measuring 30cm long and 2cm in width. The wick – much like with a kerosene lamp – draws water up to the soil where the crop is growing. The can is sliced in such a way the lower half holds water in which the wick is dipped and the upper half holds the soil, the plant and the wick. Most medium-sized vegetables like spinach and cabbages would do well in a wick garden. Mounted on a wooden frame, the wick garden would easily fit in any amount of space.

Tyre garden. Do you have used car tyres of any size? If you do, do not worry about how to dispose of them. Cut the tyre to remove the inner rims on both sides. Place it on the ground to form a circle and fill it with soil and manure. The tyre garden can be used to grow herbs like rosemary, fruits like strawberry and vegetables like kales.

Simple drip irrigation garden. With used plastic containers and a wall (or a pole) one can establish a simple drip irrigation garden. The best containers would be 5-litre jerry cans. The cans are cut in such a way they would be easy to fix on the wall or a pole and placed vertically one above another. At the top of the cans, a water- holding container with a hole at the bottom – from which water would drip when the cover is open – is erected and operated.

Micro garden. The micro garden is simple to develop and best suited for city dwellers with nothing much than a balcony to grow food. It involves use of plastic containers like buckets to carry soil and manure. One can hang the buckets from the balcony ceiling or just arrange the buckets on the floor. The micro garden is watered regularly based on the crop's water needs.

The Multi Storey Garden. This garden uses sacks and nets. One can also improvise with linen shaped like sacks. Holes with diameters measuring about 3cm are cut out and properly spaced on the sack. Soil mixed with manure is then placed in. Ballast (or medium sized stones) is stacked at the centre of the sack to form a midrib through which watering will be done. The sack is pulled up until it is full and upright. Vegetables – especially spinach and green collard (sukuma wiki) -are transplanted from a nursery into the holes on the wall of the sack and a few at the top. Links www.kilimo.go.ke/kitchengardens

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