



WATER MANAGEMENT

Water: the resource number one in agriculture

There is no life and no agricultural production without water. Farmers in most regions of Kenya have to cope with scarce and sometimes unreliable rainfalls. It is not only the climate change which is to blame for a worsening situation. There has been a rapid population increase and extensive deforestation. Water catchment areas like the Mau Forest supply water for the surrounding region and the lowlands downstream. Where forests disappear, rain water runs off faster from the surface, carrying the soil with it. Water retention, evaporation, and formation of clouds that provide rain are reduced, and water supply to streams and groundwater decrease. How can farmers cope with these challenges? It will not be possible without a very active approach and investments in water harvesting structures.

Water conservation and soil conservation

Water and soil conservation are closely linked to each other. Agricultural methods and physical structures which prevent soil erosion will at the same time lead to reduced run-off, increased water infiltration into the soil, and improved water retention and availability for crops. In areas with high rainfall, the major concern will be prevention of erosion and nutrient loss through wash-out and leaching, while in dry areas the focus lies on water conservation, storage and efficient use of water.

The most important measures farmers should take

Tillage

Tillage and turning the soil is the agricultural method which has the highest impact on soil erosion. When the soil lies bare after conventional soil preparation, it is easily carried away by rain. Water infiltration is reduced, and the soil dries out easily. In tropical regions, and especially on slopes, the damaging effect is much higher due to much stronger rains compared to temperate regions. Reducing tillage will therefore contribute most to soil and water conservation. For this reason, conservation agriculture is seen as the most promising method to stop soil fertility decline (see TOF-leaflet No 7: Conservation agriculture).

Soil cover

Plant canopies and litter layers protect the soil from erosion, increase water infiltration and keep moisture in the soil. Trees are highly beneficial because they break the erosive force of rain and wind and store large amounts of water in their root zone. The canopy in the fields can be improved with cover crops. After the harvest of the main crops, they are left to protect the soil during the dry season. A litter or mulch layer is provided by leaving crop residues on the field or by covering bare soil with vegetative materials like cuttings from trees and shrubs (see TOF-leaflet No. 6: Green manures, cover crops, mulching and weeding)

Increasing soil organic matter

Keeping the soil covered and reducing tillage will automatically increase soil organic matter. Organic matter is also provided with organic manures like compost and livestock manure. This will at the same time improve soil structure, reduce erosion, and increase water infiltration and water storage in the soil. It will also improve crop nutrition and soil productivity.

Structures to improve water infiltration and reduce run-off

Vegetative barriers can be very effective: plant vegetative strips, hedges, live fences and trees along field borders, and along the contours of slopes. On sloping land, this should be accompanied by structures that break the speed of rainwater flowing downward: contour ridges, Fanya Juus, banks, bunds, ditches. On terraces, rainwater is stopped and forced to infiltrate on each "floor".

Water harvesting

Water harvesting during the rainy season is essential where rainfall is scarce. All possibilities should be used: water from roofs should be stored in tanks, and runoff water from roads and other surfaces should be directed into ponds.

Efficient irrigation

Irrigation requires high volumes of water. Therefore, a good irrigation system is an efficient water saver where water is scarce! (See TOF-leaflet No 9: Drip irrigation and greenhouses).



Agricultural structures reducing run off and erosion

Contour farming

Contour farming involves ridging, pitting, and planting along the contour, across a slope. Never cultivate soil up and down a slope as your soil will disappear downhill quickly! Protective vegetation cover slows the flow of running water down and absorbs it. Contour ditches are dug behind banks to retain runoff water and to spread it all over the farm.

Contour vegetation strips

Along the contours of slopes, strips of vegetation may be planted or simply left uncultivated to be overgrown. These can be strips of grass, shrubs, or trees, 0.5 to 2m wide, which hold the soil together and prevent erosion. They provide fodder, shade, poles, firewood etc.

Bench terraces

Fanya juu terraces are made by digging a trench along the contour and throwing the soil uphill to form an embankment. Fodder grasses are then planted to stabilize the embankment. It later develops into bench terraces which harvest and conserve water effectively.



Broad new Fanya juu terrace with bananas planted in the ditch

Terraces

Terraces are built on steeper slopes and hills. They provide flat areas of land that can easily be planted with crops.

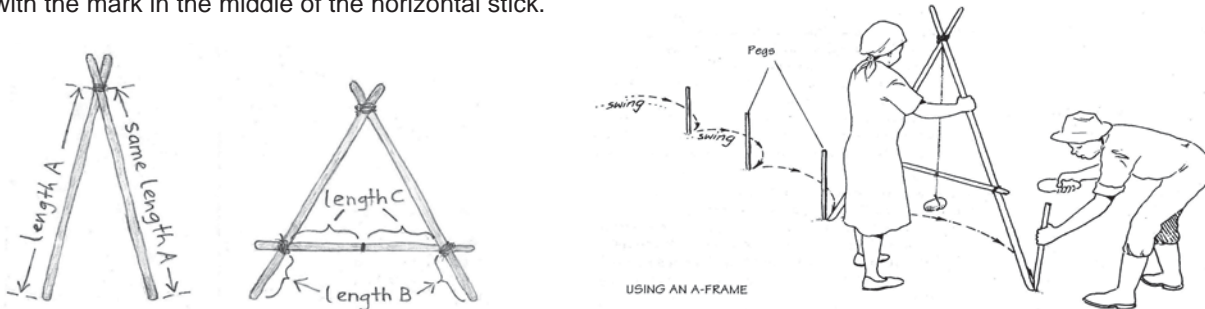
Terrace canals, usually one to two feet deep and wide, act as retention ditches and make run-off water infiltrate into the soil. Grasses, shrubs, and trees should be planted on the ridges to stabilize the soil, to provide mulch and to protect from wind. Shrubs and trees will offer more protection from erosion than grasses.

Stone Terraces: Stone terraces are built on steep slopes. They can be very stable, stop soil erosion completely and last for a long time if maintained properly (picture: traditional rice terraces in the Philippines, 2000 years old).



Determining contour lines

To outline a horizontal contour, the well-known "A-frame" may be used: The string with the attached weight must be in line with the mark in the middle of the horizontal stick.



Tumbukiza planting

Tumbukiza pits may be arranged along the contour. Dig pits around one to two feet wide, mix the soil with manure, fill it back (but not completely) and plant maize or Napier grass inside. Trash from weeding, crop residues etc. are thrown into the pits occasionally. Water from run off will collect in the holes.

Cutoff drains

Cutoff drains are dug across a slope to intercept surface runoff directing it to an infiltration ditch, a pond, or a reservoir. They protect cultivated land, compounds and roads from uncontrolled runoff, and divert water from gully heads.

Trenches channeling water directly into the fields should be avoided, because uncontrolled water flow during heavy rainfalls leads to soil erosion and development of deep gullies in agricultural land.



Cutoff trench

Infiltration ditches

2 to 5 feet deep infiltration ditches are dug along the contour above a crop field. They retain water from a roadside or another source. The water will infiltrate the soil and move slowly downslope towards the crops in the fields below.

Water harvesting

Make good use of the rains!

Billions of cubic meters of water pour down during the rains. With the diminishing water resources, farmers should collect as much water as possible to have it ready for use during the dry season. All available water resources and all ways in which water can be collected, stored, and treated should be considered. In the same way as crops must provide enough food for the family all year round, an adequate amount of water should be available to all family members, to livestock, and to crops in the shamba during the dry season.

How much water do you need to store?

For a rough estimation, the figures from the table below can be used. High volumes of water are necessary if crops are irrigated. Considerable amounts of water are also needed for dairy cows.

Average water requirements on farms	Liters per day
1 person	15
1 graded dairy cow depending on production level and feed	50-80
1 local cow (rule: life weight / 10)	35
1 goat or 1 sheep	2 - 5
1 hen	0.25
1 acre with drip irrigation (4000sqm; 3.3 mm / d)	13,200
1 acre with furrow irrigation (5 mm of water)	20,000

Example: A home with 6 persons, 1 dairy cow, 4 goats and 20 hens will need a total of around 21,000 liters water during a dry period of four months. The dairy cow will be using more than one third of this amount.

If one quarter acre is irrigated with drip irrigation during 60 dry days, around 200,000 liters of water will be needed in addition. Since losses from evaporation and leakage have to be considered too, at least 25% more water than actually required must be stored.

Clean roof water for domestic use

For the household, clean water is required. The best clean water source is rainwater. Iron sheet roofs supply free water – it only needs to be caught by gutters and drained into a storage tank.

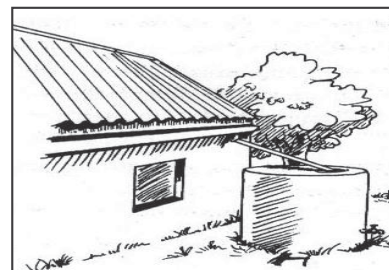
Use all roofs on your farms to harvest rainwater! Also water flowing from smaller roofs of sheds and stables can be collected in smaller tanks or drums.

In a household with 6 persons consuming 100 liters of water per day, 36 cubic meters of water are required throughout the year. In a semi-arid climate (600 mm of rain per year), this amount of water can be harvested from a roof area of 60 square meters. This corresponds to a house or roof of 6 meters x 10 meters.

Storage tanks

Well maintained gutters and a clean and covered tank are vital in dry regions. No matter whether a storage tank and reservoirs is made of plastic, bricks, steel sheets, or concrete, whether it is constructed above ground or below ground - it must be tightly covered to prevent evaporation, pollution, and mosquitoes breeding inside.

An overflow should redirect excess water to a smaller water container or tank. Before the rains start, the tank must be inspected and cleaned. The first flush of rainwater should not be directed into the tank, since it contains all the dirt from the roof.



Water for livestock and for crops

Water for livestock and for irrigation can be collected from surface runoff which is directed into ponds or reservoirs. Such structures can hold large amounts of water. Usually, soil is excavated and the material is used to form a dam. The ground of the pond or pit has to be compacted to reduce leakage. Trees and shrubs are planted on the dam for soil stabilization, as windbreaks, and to reduce evaporation.

Pits, ponds and dams

Natural depressions where rainwater flows or accumulates naturally, or pits left by road constructors can be used for water storage if water drains slowly from them. A trench can be dug to divert water from a road or from gullies into the pit.

Dams should always be circular or oval in order to have an evenly distributed water pressure preventing cave-in of the walls. Their sides should slope at least 45 degrees to be stable. They should be lined with clayey soil to make them more impermeable.

On slopes, a dam of half-circular shape may be sufficient to hold the water in the pond. A spillway lined with stones is built at each upper end of the dam wall to discharge surplus water safely.

From the pond, small channels direct the water to infiltration ditches in the shamba.

Enlarge your pond gradually

A farmer can start with digging a small pond during the dry season and enlarge it every year, until he is satisfied with the capacity of his pond.



Protect your family from malaria!

Open water areas with standing water are breeding places for mosquitoes, also in the dry season when malaria transmission is normally decreased. All measures to reduce the opportunity for mosquitoes to deposit their eggs should be taken together with neighbours and the entire community. Mosquitoes do not respect shamba boundaries! The smallest puddle can be infested by these dangerous insects.



What you can do

Use covers

Cover tanks and all inlets where mosquitoes may invade (taps, ventilation pipes) with screens and mosquito-proof mesh! Manholes and unused wells must be covered tightly to prevent mosquitoes from laying their eggs in the water. Water containers must be covered at all times. Plastic tanks should always be covered with the screw cap.

Remove any stagnant water

Rain water often collects in flower pots, used tires, tin cans, thrown away plastic bags, wreckages of cars, tractors and agricultural machinery, etc. Remove them!

No puddles!

If you irrigate your crops, do not use more water than required. No puddles should be left after irrigation. Keep your irrigation trenches open, so that the water is able to flow freely. Mosquitoes do not breed in flowing water. Remove grass and any rubbish that may have accumulated in the trenches. Drip irrigation should be preferred as it does not produce standing water.

Ponds and water points for livestock

Ponds are difficult to keep free of mosquitoes. The presence of fish would be ideal. Fish devour hundreds of mosquito larvae every day. It is recommended to contact the fisheries department for advice on larvae-eating fish.

Irrigation

Where rainfall is low and unreliable, crop cultivation can be a risk. Irrigation systems overcome this difficulty. Drip irrigation as the most efficient system opens new possibilities for small-scale farmers. Irrigation kits (pipes, buckets, drums) are not over-expensive and the investment is usually worth the money.

Overhead irrigation

Overhead irrigation is the most wasteful irrigation system and not suited for areas where water is scarce. In addition, some plants, especially vegetables, do not do well with overhead irrigation, as it encourages the spread of fungal disease.

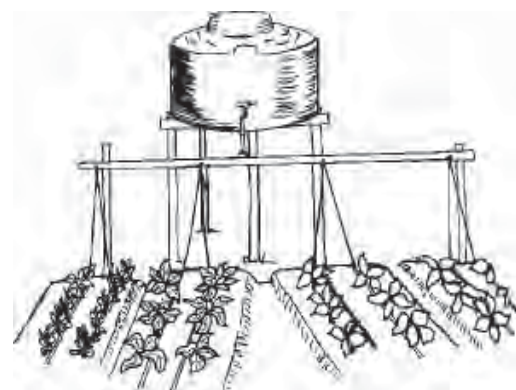
Furrow irrigation

Some plants are suited to furrow irrigation if managed well. Problems occur when there is too much water, resulting in stagnation around the plant roots. This encourages root rot and other diseases to spread between plants. Furrow irrigation is difficult to practise on slopes.

Drip irrigation

The most efficient irrigation system is drip irrigation, as it brings the water directly to the place where it can be taken up – to the roots of the plants. Less water is required, and it allows cropping 12 months a year. It is suitable for all crops and is easy to install, maintain, and move if necessary.

Our TOF-leaflet No 9 “Drip irrigation and greenhouses” provides more detailed information on drip irrigation.



Kenya-specific information on water management: www.infonet-biovision.org (go to “Environment”)

This internet site provides detailed information about topics like community management of water sources, surveys, designs and permits for water projects, seeking funds for water projects, water as a business, and more.

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