DRIP IRRIGATION AND GREENHOUSES

Simple drip irrigation

Drip irrigation makes the most efficient use of water where it this resource is scarce, and when there is insufficient or no rainfall. Conventional large-scale irrigation is a sophisticated technology that requires high investments, technical understanding, professional maintenance, and a good market access. As experience shows, this is usually not within the reach of small-scale farmers. In the last decade, these systems have therefore been simplified and adapted to the possibilities of smallholders. There are now several companies in Kenya that offer simple low-cost drip irrigation kits. They are gravity fed and easy to understand and manage.

What are the minimum requirements?

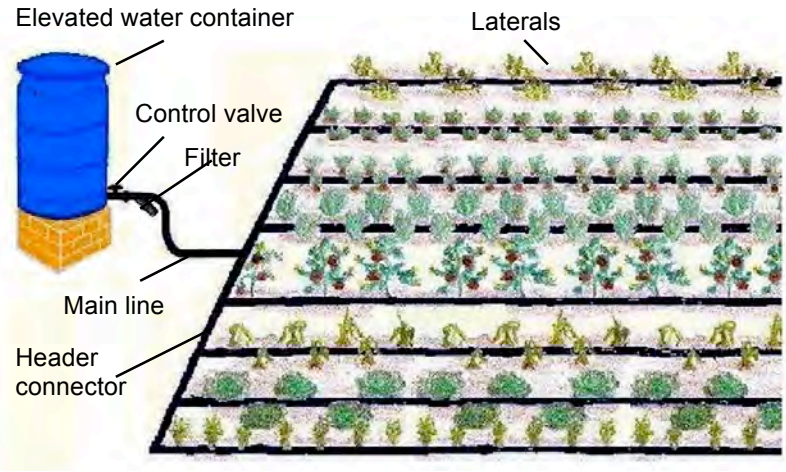
- Level ground or only very slight slope: even water distribution to all plants is essential.
- A good water source: you will need about 2 - 4 liters per square meter and per irrigation day. For a small plot of 10 x 10 meters, this is 6'000 - 12'000 liters of water during one month without rainfall.

What is important before buying?

- Make sure you understand the system. You will have to check, maintain and repair it continuously. A simple system may be better.
- Calculate the area you can irrigate with the water resources that are available.
- Make sure you get comprehensible and competent advice and assistance from the company that sells the material.
- Make sure the lines are suitable for a low pressure system.
- Make sure that spare parts are available (filters, tubes, etc).

Understanding the system

A gravity fed system with a water container is easy to handle and allows good control over the amount of water that is fed to the plot. The container is raised above ground to allow the water to flow downward. When the valve is opened, water will flow through the main line and into the header connector which must be laid out level (no slope) to ensure even water distribution to all laterals. Water must always go through some kind of filter to prevent clogging of the lines and drip holes (emitters). These are the small openings in the lateral drip pipes from which the water trickles into the soil.



The most common drip kit sizes

Materials are cheaper if they are bought in bulk. Small-scale farmers can buy them in groups and bargain for a discount.

20-litres bucket kit: This kit usually feeds 30 m of drip tape (e.g. 2 laterals of 15 m or 4 laterals of 7.5 m). It can irrigate a family vegetable plot (around 100 plants that are spaced 1 foot apart along the lines). The bucket is placed at least 1 meter above the ground and is usually filled 2 to 4 times a day. A bucket system costs between KSh 900 and 1500 (US$ 15 - 25).

100-litres jerrican kit: This size can irrigate about 150 m drip line (e.g. 10 laterals of 15 m or 20 laterals of 7.5 m).

200-litres mini-tank/drum kit: It irrigates up to 300 m drip line (10 to 20 laterals of 15 m or 10 to16 laterals of 20 m). The drum is fixed on a platform at least 1 meter above the ground. This kit costs between KSh 6,000 and 10,000 (US$ 100 - 170).

500-litres mini-tank kit: For irrigation of up to 750 m drip line (20 to 30 laterals of 20 - 30 m) or 1/8 acre (500 sqm). The tank is filled 2 to 4 times a day. It costs about to US$ 350.

A bucket kit will supply vegetables and other crops for the family. For production on a larger scale, a larger drum or tank system is more adequate. The investment can be recovered within the first season!

Installing a simple drip system

Your drip system will only work well if it is installed properly. In this section, you find the most basic points to consider. Please ask your provider for further details on specific systems.

Preparation

- Once you have identified a suitable flat place, prepare level, fine beds with a smooth surface.
- The platform for the container is between 0.5 m and 2 m high. Make sure you can fill the container with ease.

Pipes and joints

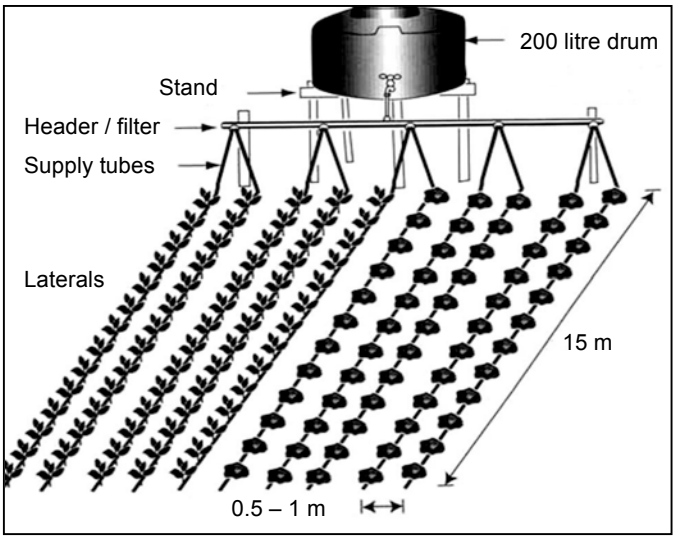
The system should be easy to assemble and disassemble again for cleaning or for moving to another place.

Water filter

Any water, regardless of its source, must be filtered before it can be introduced into the irrigation system. Otherwise, the emitters will soon clog and stop working. There are various options.
A very effective and simple way is straining the water through a cotton cloth. Tie it well over the opening of the irrigation container and let the water pass through it. Other types of filters are screen filters from metal or plastic mesh and disk filters. They can be bought from the equipment provider. All of them have to be removed and cleaned regularly by washing, brushing and flushing.

Control valve

A valve is necessary for larger containers. It is opened only after the water container has been filled completely.



Header connector

- The header connector must be laid out horizontally for even water distribution to all laterals.
- It should have removable end plugs for flushing particles that may have passed through the filter.

Laterals

- The lateral connectors are fitted to the header connector.
- The spacing between the rows depends on the crops grown. Choose a spacing that is suitable for various crops as you want to have a crop rotation on your drip field.

Emitters

- There are also different types of emitters. These may be simple holes made by the farmer. Other systems have inbuilt outlets. External emitters are a worthy investment; they are fitted to the tube and can be removed and cleaned easily and separately.
- The spacing between the emitters is 30 to 60 cm. 3 emitters per meter drip line are commonly used in vegetable production. Irrigation should produce a continuous wetting strip as the wet spots produced by the emitters are touching.
- In sandy soils, the emitters may be closer together than in clay soils because of fast vertical drainage.
- The lines are laid with the emitters facing up to reduce the problem of sediment settling on them.

Planting

Use rocks or wire pegs every 1-2 meters to fix the lines and hold them down on the ground. If they move, they may injure the delicate seedlings. This may also happen when the pipes expand in hot weather. Seedlings are planted into the pre-moistened soil near the pipe, usually 1 per emitter.

Ensure uniform water distribution!

All plants should receive an equal amount or water. Here are some general rules to achieve this, also on slightly sloping land:

- The longer the drip lines, the higher the containers should be placed to increase water pressure.
- On slopes, water will flow quickly downhill and the lower part of the field will usually receive more water.
- The water containers are placed upslope (on the higher side of the field).
- Make sure the header connector does not slope.
- On slopes, the drip lines should be short (max. 8 m).
- Increasing pressure (by placing the container higher above the ground) improves even distribution on sloping land.

What you can do in case of uneven water distribution

Differences in water distribution of drip lines are frequent. They may be caused by uneven ground, leakage or clogging. Always try to correct this first! If you can not change the situation you may as a last solution grow crops with higher water demands along the places that receive more water, e.g. on the lower part of sloping land.

Basic irrigation guidelines

- Germinating seeds and seedlings after transplanting need to be kept uniformly moist.
- Developing plants need to be watered deeply, but less often, to encourage deep root growth. Frequent, shallow watering promotes superficial root development. Such plants will be susceptible to drought. Water to a depth of about half a foot; then let the surface dry out to a depth of one or two inches (3 to 5 cm) before irrigating again.
- Shallow rooting crops such as green beans or onions draw water from the top soil. They should be soaked thoroughly, but irrigated again only when they show signs of needing additional water such as wilting during the hottest time of the day.
- Deep rooting plants (e.g. maize, tomatoes or asparagus) can draw water from 2 feet down. They need water less frequently, but more water each time to moisten the soil deeply.
- Observe your plants every day, and respond promptly if they show signs of needing water! Postponing irrigation can damage plants very quickly, especially in hot weather.
- During dry, hot, and windy weather, plants need more water than during humid and cloudy conditions, as the soil dries out faster.
- Avoid also over-watering. Plants can drown in very wet soil when their roots are left without oxygen.
- Check the soil to see how deep the moisture goes. The surface may look dry while the rooting zone is still wet.
- Sandy soils need more water because water can drain twice as fast through sand than through clay.
- Mulches are very beneficial as they conserve soil moisture reducing the amount of water needed. They also suppress weed growth.

Calculate the required water quantity

As a rule of thumb, 2 to 4 liters of water per day and per meter drip line are required during dry weather. This can sum up to 12 000 liters of water for a plot of 10 m x 10 m if it is irrigated for 30 days (400 liters every day). Plan accordingly and make sure you are able to provide the required amount of water!

Fertigation

Fertigation is the application of liquid fertilizer through the drip lines. You may use filtered plant and manure teas. Take care to flush the system afterwards, because nutrients and organic substances that remain in the tubes and emitters promote growth of algae and bacteria, and formation of slime and biofilms that can clog the system.

Picture: A lush vegetable field.

Maintenance of drip systems

Regular maintenance is essential and should never be neglected! Clogged lines and emitters that stopped working are difficult to repair and may have to be replaced. Conventional large-scale drip systems are kept clean by regular application of chemicals (acids against mineral deposits and chlorine against bacterial growth). This is difficult for small-scale farmers. However, they can and should do at least do the following:

- Check and clean your filter(s) at least once every week, or even every day if the water is dirty.
- In addition, check your lines for leakage. Fix holes as soon as possible to prevent uneven irrigation. Wrap a piece of cloth around a leak or fix it with tape.
- Flush your irrigation pipes thoroughly at least once every month. Open the ends of the header, flush it and close it again. Then open the far ends of a portion of the tubes at a time and allow the water to rush out the sediment.
- Disassemble the system when it is not in use, clean it well and store it in a safe place.

The most common problems

Filters: if they are too small, they clog very quickly.

Emitter clogging: can shorten the lifetime of a drip system considerably.

Leakage: is frequent if fittings are not done properly, especially at connections.

Fragile drip line material: Avoid damage while handling or during weeding. Plugs, pipes and hoses may also break due to brittleness of the plastic.

Animal damage: insects, rodents or other animals may damage the pipes in the field and during storage. Thin-wall hoses and thin polyethylene pipes are most susceptible.

Pest attraction: Pests may find a refugee in the drip field, especially during dry spells or in the dry season, when everything else is dry.

Kits, spare parts and reliable extension services: They may be lacking.

Theft may be a problem if the system is installed far from the house.

Farmers interested in buying drip pipes can make enquiries at the following institutions:

- KARI-NARL (KARI National Research Laboratories), Waiyaki Way, Nairobi, Tel. 0722 397750, ask for Esther Muriuki.
- SHADE NETS LTD, P.O.Box 2127, Thika, Tel. 067 31051/6, Ask for Judy. E mail: shadenet@wananchi.com
- "DREAM DRIP KIT" (20l to 500l systems). Information and contact: Stephen N. Ngigi, Ph.D Projects Coordinator, KRA/GHARP Secretariat, C/O Kenya Rainwater Association, P.O. Box 10742-00100, Nairobi, Kenya. Tel.: (0)20-2710657; 0722-864606; 0722-338807 E-mail: gharp@wananchi.com
- Fresh Produce Exporters Association of Kenya (FPEAK)

A very informative book: RELMA (Regional Land Management Unit): "Drip Irrigation:Options for Smallholder Farmers in Eastern and Southern Africa";" Technical Handbook No. 24, Nairobi

Greenhouses

Greenhouses have recently caught the interest of many small-scale farmers in Kenya. We provide some basic knowledge that is important to consider before rushing into the construction of a greenhouse. Greenhouses have as many advantages as risks, especially if no chemicals are used. A drip irrigation system needs to be installed. Construction and maintenance of a greenhouse are labour-intensive and high investments are needed.

Which type of greenhouse is best?

Greenhouses in tropical regions serve different purposes than greenhouses in temperate climates. They have to protect crops from heavy rainfall, high solar radiation, hail, and strong winds that can hamper open field production. In hot regions, they should reduce water stress through shading. The regional climate is therefore very important and will determine the type of construction.

- **Frequent and heavy rainfall:** The covering should be impermeable to rain to give good protection
- **Humid conditions during the rainy seasons**: The ventilation openings should be large. As rule of thumb, an area of at least 20% of the greenhouse floor area should be ventilated (sidewalls / ridge).
- **Low night temperatures (highlands and dry climates)**: If night temperatures drop far below day temperatures, greenhouses can be equipped with closeable ventilator openings to prevent cooling out during the night. Example: sides that are rolled up during the day.
- **Humid, warm climates (no strong temperature drop at night)**: The greenhouse should have open sides to ensure permanent ventilation and to prevent too high humidity. Only a roof structure is needed for protection. An additional ventilation opening at the ridge of the roof is very beneficial.
- **Climates with irregular rainfall and dry seasons**: The greenhouse should have gutters to collect rainwater for irrigation during dry spells, combined with water storage facilities.
- **Frequent problems with insect damage**: All open areas can be covered with insect netting. Because the fine insect nettings decrease the ventilation effect, the ventilated area should be increased to at least 30% of the floor area.
- **Dry, hot climates**: Closeable ventilators increase humidity. Crops need to be protected against too high solar radiation and high temperatures, too. Choose a covering that reduces radiation. A propeller-driven fan-and-pad system increases humidity inside the greenhouse and has a cooling effect. However, greenhouses are not suitable for very hot climates with day temperatures above 36°C, and cultivation may have to be suspended during hot dry seasons.
- **Shade houses**: For nurseries and vegetable production, a shade house may offer sufficient protection against the impact of rain, sun, wind and hail. Shade houses consist of horizontally stretching, water permeable roofs made from natural materials or plastic nettings.

Typical greenhouse problems and solutions

- Diseases and pests that increase heavily each season: Keeping a crop rotation (TOF leaflet No.2) is most important. Reconstructing / moving the greenhouse after a few years, and good ventilation will also help eliminate this problem.
- Brittle plastic material: Only new and UV-stabilized PE films will last longer than one year. A film of 0.2 mm thickness will last 2 to 3 years and has to be exchanged after that.
- Condensation water dripping from the roof on the crops, promoting diseases: Avoid round-arched greenhouse constructions and prefer pointed-arched ones, as water will run off better inside the house.

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