



Coping with drought

Suggestions and ideas

This document includes the following:

- Increasing and maintaining soil fertility
- Water collection and conservation
- Growing drought resistant trees and vegetables
- The importance of planting trees.
- Food conservation
- Strengthening the body's immunity to harsh conditions.
- A note about *Artemisia annua* in a dry climate
- A possible training programme on the topic coping with drought
- Postscript – the bigger picture

DISCOVER works with African people:

- *to discover, use and protect local resources for health and healing,*
- *to rediscover positive skills and traditions that have been forgotten,*
- *to grow in self-confidence and become more self-reliant, and*
- *to live in peace and harmony with all members of the community.*

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July 2018

Introduction

Sub Saharan Africa has always suffered periods of drought, and when drought occurs, people suffer. But drought and the results of drought seem to be getting worse. Why? Perhaps

1. because climate change is causing more erratic weather patterns,
2. because some of the good agricultural traditions of the past have been forgotten – and must be rediscovered.

Over the centuries African farmers have developed many excellent farming skills. In the mistaken rush to be “modern”, however, many farmers use, or want to use, agricultural chemicals and even tractors. When imported fertilizers and pesticides are first available, they are sometimes subsidised. Farmers jump at this opportunity and forget their traditional practices, which were sometimes very effective. Agricultural chemicals are expensive and sometimes cause more problems than they do good. Tractors are also expensive, especially when they need repairs.

In the past farmers let their fields lie fallow for a year, but due to population increase this has become more difficult. Conflicts over land, which upon the death of the father, is sometimes divided between several sons, have increased dramatically.

Discovering how to cope with long dry seasons and erratic rainfall is central to the aims of Discover.

Important skills and traditions from the past should be rediscovered, and we need to discover how to keep the soil, plants and people healthy in all climatic conditions.

We recommend that the task of coping with drought is seen as a community and not an individual challenge. A community that works together is much more likely to be successful. Remember the very true African proverb, *“if you want to go quickly, go alone. If you want to go far, go together!”*

Acknowledgements

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Additional suggestions are always welcome! Please send to Keith Lindsey at Keith@discover-src.net



No field should ever look like this!
Activity: Read this paper, especially part 1, and then name 5 ways in which the standard of farming shown here could be transformed.

1. Increase and maintain soil fertility

Many people complain that every year the harvest gets worse. But why? Perhaps surprisingly, the main reason is usually not lack of rain, but because of poor farming methods with the result that the soil loses fertility. In the tropics and sub-tropics, the soil loses fertility quickly if it is not well-cared for.

Burning crops residues make the situation worse. Burning crop residues, or burning the bush to clear space for farming, destroys compostable material. Valuable minerals go up in smoke. The heat of the fire also destroys the soil nutrients in the upper layer of the soil.

If you work hard to maintain soil fertility, even with modest rainfall a good harvest is much more likely. In a long dry season, infertile soils dry out much more rapidly than fertile soils. One can easily see this if one has good, well-rotted compost – this is nearly always moist. Fertile soils thus withstand drought much better than infertile soils.

Soil fertility depends largely on how rich the soil is in humus. One should aim to build up the amount of humus in the soil. Humus is organic matter that has broken down as far as it can. If the soil contains a lot of humus, it

- holds nutrients which are supplied to the growing plants,
- prevents nutrients from being leached out with rain,
- feeds the microbes in the soil,
- acts like a sponge, absorbing water and releasing it only slowly,
- traps oxygen, which helps root development,
- helps the soil to maintain a constant temperature and a constant ph (that means, it prevents the soil from becoming too acidic or too alkaline).

Two small farms - Same rain, same soil, same climate ...
It's all about diversity & keeping soils covered to build organic matter
Stop stressing, you can start this, anywhere!

<p>Low input, high yield, high profit, high resilience</p> 	<p>High input, low yield, low profit, low resilience</p> 
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Kafue, Zambia after 3 weeks no rain 15/01/2018

<ul style="list-style-type: none">• Maize intercropped with pigeonpea, pumpkin, beans, rotated with soya + manure• No machines, no burning of residues, no fertilisers or agro-chemicals for 15 years• Farmer happy with rains (late planted soya clearly suffering)• Minimal pest damage due to diversity	<ul style="list-style-type: none">• A neighbour plants maize alone• Burns field after harvest, ploughs with tractor, uses fertilisers and agro-chemicals.• Late planting due to late inputs• Farmer very disappointed with rains.• High pest damage <p><i>GrassrootsTrust.com</i></p>
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Thank you to the Grassroots Trust in Zambia for this illustration

How can the amount of humus in the soil, and therefore the soil fertility, be maintained and even improved?

Here is a list of ideas. Practice not just one but several!

A. Ground cover and cover crops (sometimes shortened to gc/cc).

If the ground is covered:

- the soil is protected from the heat of midday sun. The surface temperature of bare soil can reach over 60 °C, at which temperature many microorganisms are destroyed and a lot of water is lost through evaporation.
- the earth remains soft and does not form a hard crust. When it rains, the rain mostly soaks into the ground, whereas with no gc/cc most of the rain runs away – and takes some fertile top soil with it causing soil erosion. The difference is enormous; on sloping ground it has been shown that with gc/cc, about 90% of the rain is absorbed into the ground, with no gc/cc, about 90% of the rainwater is lost.
- evaporation from the soil is greatly reduced.

What sort of gc/cc can one use?

- a) Ground cover with dry mulch. Crop residues left on the ground as mulch slowly decompose and add humus to the soil. For example, maize stalks or bean plants.
- b) Cover crops. These are low-growing plants that cover the soil. They include the *Mucuna pruriens* (mucuna or velvet bean), *Centella asiatica* (Gotu cola), cowpeas, pigeon peas, soya beans, *Lablab purpureas*. Choose a plant that you know grows well in your garden, and one that provides other benefits, for example food or medicine.

Some cover crops are leguminous and feed the soil with nitrogen, e.g. all peas and beans. All cover crops provide organic matter as they die which increases the humus in the soil. They also control weeds and prevent soil erosion.

Feedback from Pastor Olupot Charles Dickens in northeast Uganda given to Graham Knight in the UK:

Thanks a lot for the information you provided on how to use cover crops. Last year after I taught the farmers to use cover crops like black beans, cowpeas, groundnuts and green peas they got high yields. This year almost every farmer is planting cover crops, because they have realised that it adds fertility to the soil! Now all the crops are looking very healthy compared to the past when they used to plant only sorghum and cassava. Above all, every farmer is happy because I found a market for the cover crops in South Sudan, so they sell their cover crop produce and increase their soil fertility.

B. With organic compost.

Compost can be made from animal manure, crop residues and fruit and vegetable waste. Compost heaps produce humus rich soil most quickly if they are made at one time:

Where to make the heap: Choose a place in the shade, under a tree or a simple roof, to prevent evaporation. Avoid water-logged areas to avoid leaching of the nutrients.

How to make the heap:

1. Make a thick base about 2 metres square of coarse material (about 30cm high), such as twigs or maize stalks. This helps with drainage and aeration.
2. Follow with a 10cm layer of material that decomposes only slowly such as chopped dry grass and leaves. This layer serves to prevent the leaching of nutrients out of the heap to the earth below. It also provides minerals like potassium, carbon and phosphorus.

3. Follow with a 10cm layer of materials that decompose easily such as fruit and vegetable scraps.
4. If possible, follow with a 2cm layer of animal waste such as cow dung, chicken litter or goat droppings.
5. Add a thin layer of top soil to introduce microorganisms which promote the decomposition of the organic matter.
6. Add wood ash and urine to quicken the decomposition and to provide more minerals. These help to neutralise the compost and make it into a balanced, nutrient-rich food for all growing plants.
7. Add water after each layer to keep the heap moist but not wet.
8. Repeat all these layers except the first layer of coarse material until the heap is between 1 and 1.5 metres high.

Finally cover the entire heap with dried grass or banana leaves to prevent evaporation and to protect it from heavy rain.

How to check the progress of the composting: Insert a long wooden stick diagonally into the pile as a thermometer. Every few days pull it out and feel the far end; when it becomes hot, the compost is successfully rotting. At this point, usually after 3 to 4 weeks, turn the pile of compost over. This aerates the heap; the oxygen accelerates the process of decomposition.

Caution: Do not add the following items to the compost heap: meat scraps and left-over cooked food (which attract rats and mice), plant material with thorns, plants which have been sprayed with pesticide, persistent perennial weeds or non-organic matter such as plastic or metal.

An alternative method - slow composting: That is, by simply throwing all your organic waste onto a heap as it becomes available from the garden or kitchen. This method needs less work but has the disadvantage that the rotting material tends to attract rats and snakes. It is also slower.

Read more: "Composting in the Tropics", <http://www.infonet-biovision.org/res/res/files/496.Compost102.pdf>

C. Liquid manures:

- a) **Animal dung liquid manure**, e.g. chicken or goat droppings or cow dung. It is advisable not to use pig dung, as this is the source of many diseases.

Fill three quarters of a hessian (gunny) sack with animal dung and suspend it in a barrel of water for 2 weeks. Stir it every day to help the animal manure to dissolve in the water.

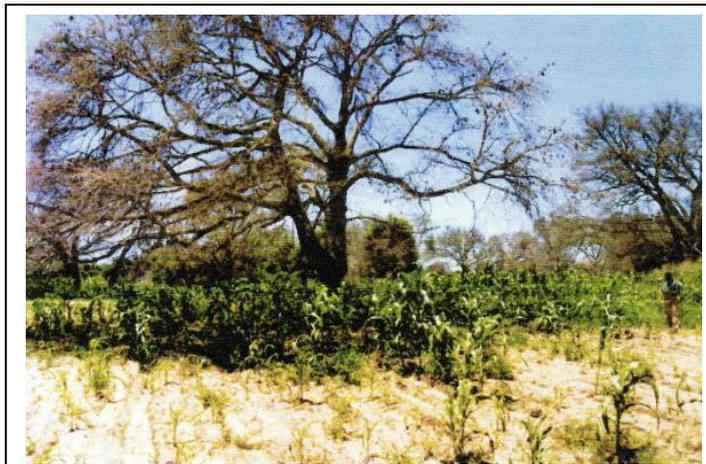
Instructions for use: Annual crops such as vegetables and maize: Mix one jug of liquid manure with two of water. Perennial crops such as banana or coffee: Mix one jug of liquid manure with one of water and apply around the plant stems.

- b) **Plant tea**: Collect soft, hairy and leguminous leaves, chop them and fill three quarters of a jerry can and add wood ash. Fill with water and cover. Place it in the shade. Stir the mixture every day starting on the third day. On the seventh day it is ready to use. Filter it. For annual crops such as vegetables mix 1 jug of plant tea with 2 cups of water and for perennial crops like coffee and bananas mix 1 jug of plant tea with 1 jug of water and apply around the root region. Repeat the entire procedure every 2 weeks.

- D. Practice agroforestry. Plant trees in your fields to increase soil fertility and to provide shade; *Sesbania sesban*, *Leucaena glauca* and *Calliandra calothyrsus* are all leguminous. That means the tree roots feed the soil with nitrogen. Their fallen leaves also contribute organic matter to the soil. Crops growing under these trees can be observed to thrive. Plant them around the farm.

Faidherbia albida is also an excellent soil improver. At first it grows rather slowly, but after 5 to 6 years it will be 4 to 6 metres high, and when mature 15 metres with a very wide canopy. This tree has the useful characteristic that in the dry season it keeps its leaves, thus giving shade, and loses them in the rainy season. The pods make good animal feed.

Ficus natalensis (Natal fig, bark-cloth fig) is a multipurpose tree that is used extensively for agroforestry in Uganda and Kenya. It provides excellent shade, increases soil fertility when it drops its leaves and has a deep root system which helps to prevent soil erosion (see Section 2).



An example from Zambia of the amazing influence of one *Faidherbia albida* tree on the crops growing beneath it. Picture: Bob Mann

Gliricidia sepium is a multipurpose tree. It adds many valuable nutrients to the soil and is often used in agroforestry when growing maize. It can also be grown as a green manure.

Trees disperse their own seeds which germinate as wildlings. One can let wildlings grow until they become a nuisance; then cut them out and use the wood as firewood or for poles.

- E.** Practice zero or minimum tillage: First work hard on increasing your soil fertility, for example by digging in a crop of green manure to a depth of about 20cm. The fertility can then be maintained with a minimum amount of work if you do not dig or plough but use plenty gc/cc. Contrary to popular belief, digging and ploughing compact the soil. Ploughing with a tractor is seen to be particularly “modern”, but this work and expense can be avoided! The advantages of not digging or ploughing together with the use of cover crops or mulch are:
- Decaying plant roots in the ground aerate the soil and provide plant nutrients.
 - The natural structure of the soil is maintained
 - The various microorganisms which exist at different depths are not disturbed. Ploughing buries the microbes from the soil surface and raises to the surface those microbes that work at some depth.

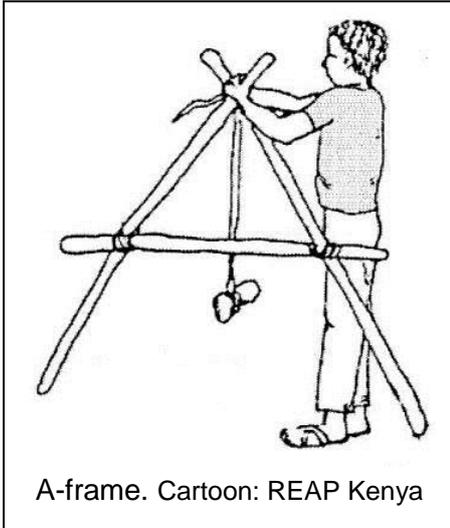
Sow seeds straight into the ground, through the mulch.

- F.** Practice intercropping. For example, between rows of maize, plant a nitrogen giving (i.e. leguminous) crop, such as beans, pigeon peas or ground nuts. Or plant larger plants which provide a lot of organic matter as well as providing nitrogen, such as *Tephrosia vogeleii*. Although not leguminous, *Tithonia diversifolia* is another useful plant that gives plenty material for mulching. All these plants may be cut at any height and left on the ground as mulch.
- G.** Practice crop rotation. Every plant takes particular components from the soil. As already mentioned, some even put nutrients into the soil. Maize is one crop that takes a lot of nourishment out of the soil. By growing different crops in any given spot, one also reduces the likelihood of plant diseases developing or plant pests multiplying.

2. Water collection and conservation

A. Catch water when it rains - on the land

A.1 First step: Find the contours



Many hillsides have suffered severe soil erosion during heavy rains. Heavy rains wash the fertile topsoil away, and sometimes heavy rains cut deep channels into the ground making the fields unworkable. The precious rainwater has also of course been lost. Such losses can be reduced with cover crops, mulch and trees. On hillsides it is also important to find the contour lines and to make barriers along them with grass or grass and trees. Because of its deep roots, vetiver grass is particularly suited to this purpose. In this way the flow of water and soil is stopped, the earth is deposited and the rainwater soaks into the ground. The hillside thus becomes terraced, with the additional advantage that they are more level and rather easier to manage.

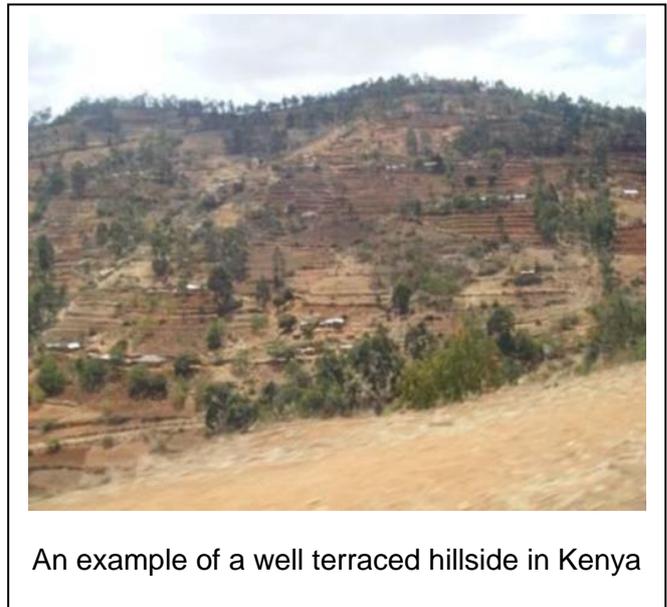
First, find the contours using an "A" frame. This is a simple device made from 3 poles, a heavy stone and some string. The one leg is placed on the ground, and the other moved until the string is in the middle of the horizontal pole. A small stick is placed in the ground at this point. The A-frame is then rotated until the first leg is in a position such that the string is once again in the centre of the horizontal pole. And so the process continues. For more information on this method, see the REAP teaching leaflet <http://reap-eastafrica.org/reap/wp-content/uploads/2015/12/AFrame.pdf>

The distance between the grass barriers on the contours you mark out depends on how steep the slope is. On steep hillsides the grass barriers should be just a few metres apart. On gentle slopes or even level ground the grass barriers may be 20 metres apart. A good rule of thumb is to plant a grass barrier along contour lines that, measured vertically, are between 1 and 1.2 metres apart. (Take a pole that is 1 or 1.2 metres long, stand it vertically on one contour line, and then mark the next contour on the hillside at the height of this stick.)

A.2 Second step: Plant grass barriers

Having marked the contours at the chosen spacing, plant barriers of grass and, if you wish, trees along them. The primary purpose of the barriers is to stop the flows of water and earth. They also form a windbreak. Always think about using multipurpose grasses and trees. One can include plants, for example, to increase soil fertility, or to provide food, medicine, fodder and timber, and, if the larger plants trimmed regularly, firewood and mulch.

Suitable grasses include vetiver, citronella, lemon grass or napier (elephant grass). Vetiver grass has the deepest roots for steep slopes. Lemongrass is nutritious and medicinal, citronella provides volatile oil for controlling pests and diseases, napier grass provides fodder and thatching grass is for thatching.



Suitable trees include leucaena or sesbania, which improve soil fertility and provide animal fodder and firewood.

A.3 Other, simple, small-scale actions

Water may also be collected in smaller quantities on sloping land by building basins and lining them with clay or concrete. Or one can dig a simple “L” shaped trench, with the vertical arm uphill and the horizontal arm below.

A.4 Build a sand dam

In dryland areas it is possible to construct a “sand dam” given that there is

- c) a seasonal river with sandy sediment, and
- d) accessible bedrock in the riverbed,

During the dry season, a dam wall must be constructed with steel reinforced concrete. This is constructed on the bedrock. During the rainy season the flow of the river is stopped by the wall, sand sinks to the bottom, the water level rises and then flows over the dam wall, carrying any silt in the water with it.

After a few rainy seasons, enough sand has been deposited that the “dam” is full of sand, but this sand contains about 40% water.

This water

- a) soaks vertically into the ground and increases the amount of ground water. This can be accessed by conventional wells.
- b) may be collected by means of constructing an “infiltration gallery” on the riverbed behind the dam wall at the same time as the dam wall is built. This consists of a pipe with holes that passes through the dam wall to a tap.

Since the water has filters through sand the water can be assumed to be safe enough to drink.

- c) soaks sideways into the surrounding area, which can be planted with trees, fruit and vegetables.

For more information about sand dams, see <https://tinyurl.com/mmk34mt>



Vetiver grass in the REAP garden in Kisumu, Kenya. After only one year, terraces had begun to build behind the vetiver plants. Vetiver grass grows 1.5 metres (4 – 6 feet) tall – it can be trimmed to about 25cm (10inches) and the trimmings used for thatching or mulch.



These water tanks can be self-made. Kighengi, Uganda. Photo: Kenja Thomas

B. Catch water when it rains - from the roofs

Rain-water catchment tanks may be built to catch water even from grass or papyrus roofs. The tanks may be on the ground or even underground. They should be covered to prevent the malaria mosquito from laying its eggs.

Much larger commercial plastic tanks are also available. They must be on a firm foundation and guttering and pipework must be installed to collect water from corrugated iron roofs. As they will serve a school, church or village the maintenance of the tanks and use of the water must be agreed and managed by the community.



This picture shows a larger tank in Ongiro village, South Nyanza, Kenya. It provides the village with water. The pipework and tank were a major investment, but now the villagers enjoy a good standard of hygiene (supported by tippy-taps) and healthy gardens. This group is a member of the Fweny (meaning Discover in Luo) Natural Medicine Network.

3. Conserve water – use it sparingly

3.1 Use little water for household handwashing; use a tippy-tap

Why is the tippy-tap so good?

- It is made from locally available materials.
- It is very simple to make and maintain.
- The waste water soaks into the ground.
- It uses only 75 cc of water to wash your hands, compared with 500 cc using a mug, which is the usual method in rural Africa.
- It is ideal in rural areas where there is no running water.
- It is operated by a foot lever. The user touches only the soap. This no bacteria are transmitted via the tap itself.
- It can easily be placed outside the latrines, e.g. at a school.



Tippy-tap in Togo. The soap could also be covered with an empty margarine pot to protect it from the rain. Picture: Agnes Ziegelmayr



It is even fun to wash your hands using a tippy tap!

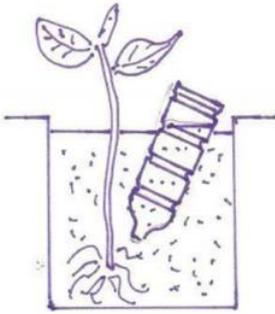
For more information, see the Discover information sheet <https://tinyurl.com/ycrce4zo>

3.2 Protect natural springs

The picture shows a protected well that was constructed and maintained by a local community group. As the water flow has declined due to leaks, the well must be rebuilt.

3.3 Use little water for irrigation; water the plants and not the entire field

a) Cut the bottoms off plastic bottles and put them in the ground when you put the plant in, as shown. The neck of the bottle acts as a funnel and supplies the water directly to the plant roots.

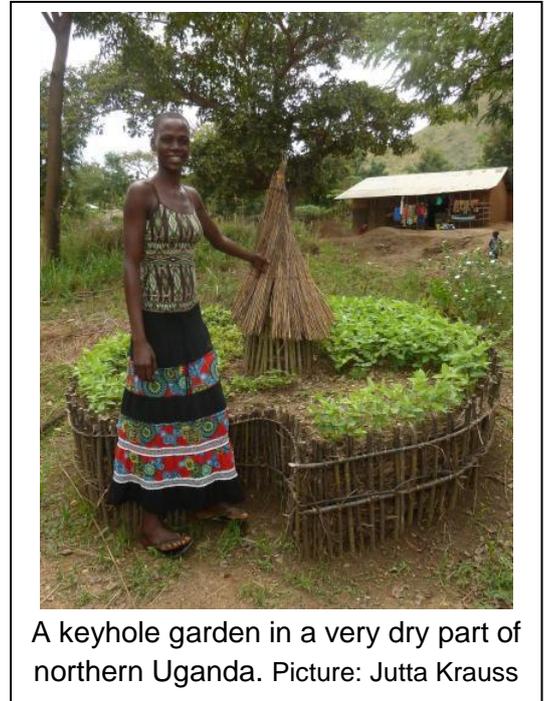


3.4 Make keyhole gardens

A wonderful kitchen garden, which can be right outside the back door. The soil fertility can be easily maintained – and working on the garden does not break your back! The water and compost placed in the centre spreads throughout the entire garden.

The overall diameter should be about 2.4 metres and the diameter of the central compost compartment about 40cm. The wall of this compartment is made from straight sticks such as bamboo, and the outside wall from bricks, stones or logs.

For detailed instructions, see <https://tinyurl.com/nakkamw>



A keyhole garden in a very dry part of northern Uganda. Picture: Jutta Krauss

3.5 Dig “Zai holes”.

That means, for each plant or tree, dig a hole, fill with good natural compost and ensure that the soil level around the plant is below that of the surrounding area.



Maize plants grown in zai holes, which are covered with mulch. Picture: Agnes Ziegelmayer

In Bassar, Togo, Gbati Nikabou succeeds in growing better maize and having an earlier crop than his neighbours. His method is to dig “zai holes”. He digs holes 30cm deep and fills them with well-rotted manure and compost. He covers this compost with a little soil. He leaves a depression in the hole so that, when it rains, the rain collects in the hole.

He sows three seeds in each hole. After they germinate, he leaves the two strongest plants. If the ground is wet, he sows the seed directly into the compost. If the soil is dry, the compost may be too hot, and he sows the seeds in the earth covering the compost.

As the maize grows, he scatters leucaena leaves onto the surface of the soil around the plants;

they provide additional fertiliser.

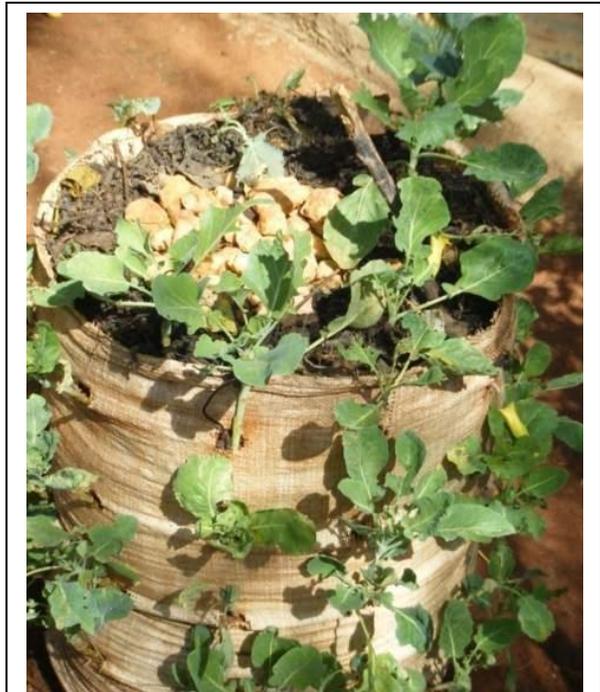
When planting trees, Gbati digs a much bigger hole. Cocoa is grown along the coast in West Africa, but people say that cocoa cannot be grown in Bassar. Using this method of zai holes, Gbati has demonstrated that cocoa can indeed be grown there. He hopes that, by cultivating cocoa, local farmers may benefit from another source of income.

3.6 Make bag gardens.

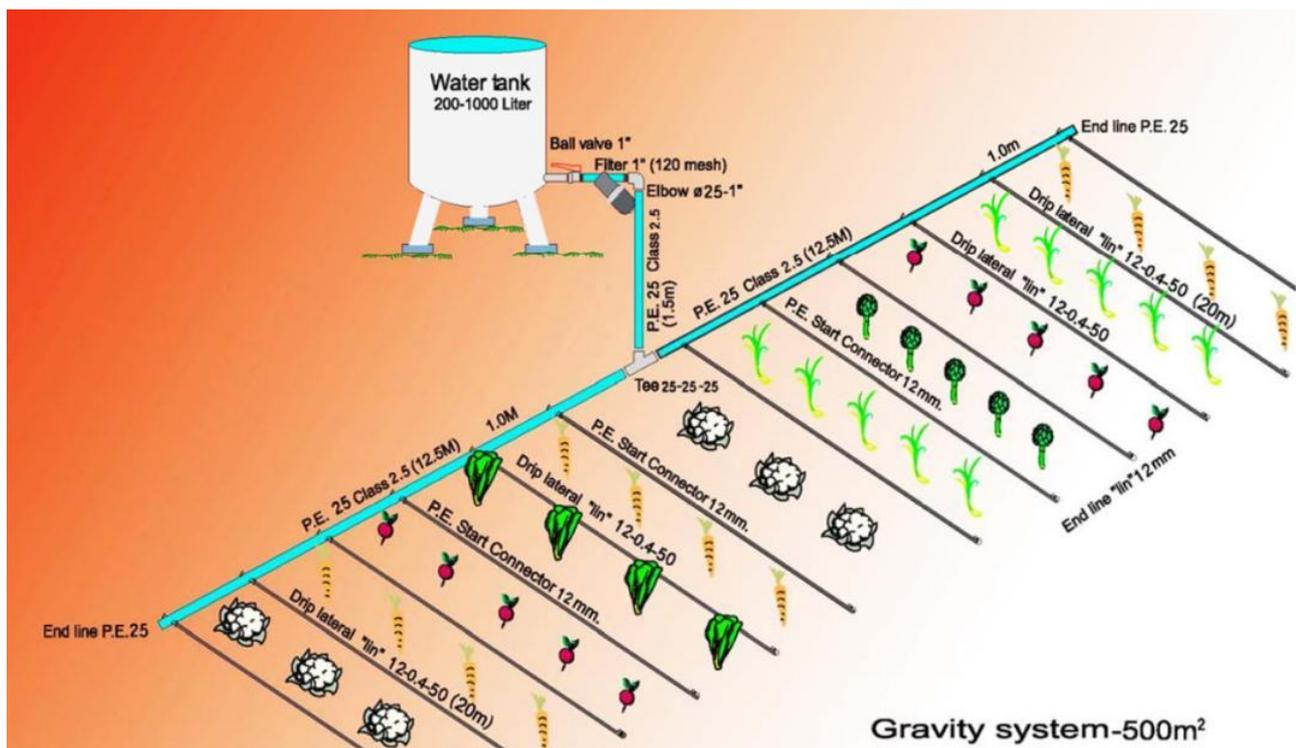
These also have the advantage of requiring little space. For construction details, see discover-src.net/de/wp-content/uploads/2016/12/Info-Bag-Gardens.pdf

3.7 Use drip irrigation.

Water runs by gravity from a tank through specially manufactured rubber or plastic pipes which have holes at intervals – where the seedlings must be planted.



In the centre of the sack is a core of stones. Water poured onto these stones spreads throughout the surrounding soil.



Picture source: Technical Brief “Drip Irrigation system (gravity force operated)” by Practical Action, UK

3.8 A general principle

Water the plants at intervals, but with a lot of water. The roots of many plants that are repeatedly watered remain close to the surface. Plants that are less frequently watered send their roots deeper in search of water.

3.9 Keep your water clean!

Dirty water is dangerous to health. Dirty streams, rivers and lake support few fish or other water life.

To keep your sources of fresh water clean you must involve the entire community. Discuss the problem and the possibilities with all concerned, possibly in a community meeting hosted by your own association, and aim to come up with the following:

- Do not wash clothes in rivers
- Do not wash cars or bicycles in rivers
- Do not urinate in rivers
- Dispose of all rubbish carefully and not in rivers. For example, batteries must be recycled. Plastic must be buried deeply or burnt quickly once a month.

4. Grow drought resistant vegetables

I believe that the British did Africa no favours when it introduced maize. Since then, maize has become the staple diet in many African countries, for example as ugali in Uganda and Kenya or sadza in Zimbabwe.

Maize is, however, particularly difficult to grow when climatic conditions are very unpredictable. Very often it may be planted, and then if the rains do not continue, the plants give a poor yield.

No family need go hungry. There are many plants that can survive the dry season:

Root crops: These tend to sit in the ground, and only start to grow when the rains finally come, such as potato, sweet potato, cassava.

Another crop that, once sown, waits for the rain is pigeon pea.

Additional vegetables, many of which have almost been forgotten, include African spinach, ochre, jute, cowpea, vegetables in the sesame family, black night shade, amaranth and pumpkin.

Use your own seeds

Using your own seeds ensures that you remain with crops that you know grow well in your local conditions. Using your own seeds means also of course that you do not need to buy seeds. Resist every temptation to try genetically modified (GM) seeds. These have been developed by international agricultural companies whose primary interest is to make profits. These seeds do not adapt to the local conditions. GM plants often need pesticides and fertilisers which are toxic to the bees and insects needed for pollination.



The sweet potato, *Ipomea batata*, which grows in dry conditions. The potato is a good source of dietary fiber, vitamin B6 and potassium, and a very good source of vitamin A, vitamin C and manganese. The green tops may also be eaten.

Read More

<http://nutritiondata.self.com/facts/vegetables-and-vegetable-products/2667/2#ixzz5Bzpkx4Tv>

5. The importance of planting trees

In Africa trees have been cut for firewood, for making charcoal and for clearing land for agriculture with no thought as to the great service they provide, completely free of charge. Natural capital has been destroyed often for relatively little immediate gain.

The sequence of floods and droughts that many communities experience, has been caused in no small part by the cutting of trees, particularly on the hills.

Trees conserve moisture in the soil: Any tree which provides shade creates a cooler environment, which results in less moisture being lost through evaporation. Further, because the soil is protected from the hot sun, it does not lose fertility. Many (but not all) trees increase the fertility of the soil.

Where there are trees, vastly more rain soaks into the soil than where they have been felled. On the hillsides, water is then released slowly into the groundwater, which is then released steadily into springs and rivers. A good groundwater level also ensures that water is available in wells. Where trees have been felled, the rain runs straight off the land and into the rivers, which then grow rapidly in size and cause sudden flooding. Then later as the dry season starts, those same rivers reduce in size and even dry up altogether, because the ground on the hillside is dry and has no water to release into the rivers.

Trees create a cooler environment which is more pleasant for living and working. They provide habitat for insects, including bees and butterflies, birds and animals. Bees, butterflies and other insects are important for pollination, and therefore for good harvests.

When the Salem project in Uganda was established 50 years ago in a hot and dry area, a variety of indigenous trees were planted on the site. Today people walk into this area and are astonished by the pleasant atmosphere. "Why do I seem to have more energy when I come here?" asked one admiring visitor, as he walked in from the hot and dry surrounding area.

Here are many reasons for planting trees

1. Plant trees for shade: Avocado pear (*Persea americana*) can grow in many soils and in hot and dry conditions. It is evergreen and gives a lot of shade. The fruits are very nutritious, it can provide timber and bees like its flowers. The same is true for tamarind (*Tamarindus indica*) which grows in areas of low rainfall.
2. Plant trees for timber. Grevillea (*Grevillea robusta*) and Melia (*Melia azedarach*) are useful timber trees which, when properly managed, do not interfere with crops.
3. Plant trees for firewood. *Gliricidia sepium* is fast growing and improves the soil at the same time.
4. Plant trees for fruit: Mango (*Mangifera indica*), jackfruit (*Artocarpus heterophyllus*) and java plum (*Syzygium cumini*) are big trees that also provide shade. Pawpaw (*Carica papaya*), guava (*Psidium gujava*), and mulberry (*Morus nigra*) are also delicious and nutritious, being full of vitamins and



A thriving vegetable garden in western Uganda belonging to a member of Vumbura Maliba (Discover Maliba in the local language) – in the shade of many trees! But where is the ground cover with mulch or plants?

minerals. Cashew (*Anacardium occidentale*) grows well in dry areas. The fruit (apple) can be eaten fresh or made into jam, and the high protein nut can be extracted from the toxic shell, lightly roasted, and eaten. Passion fruit (*Passiflora indica*) is a creeper which can be planted around the trees and in hedges.

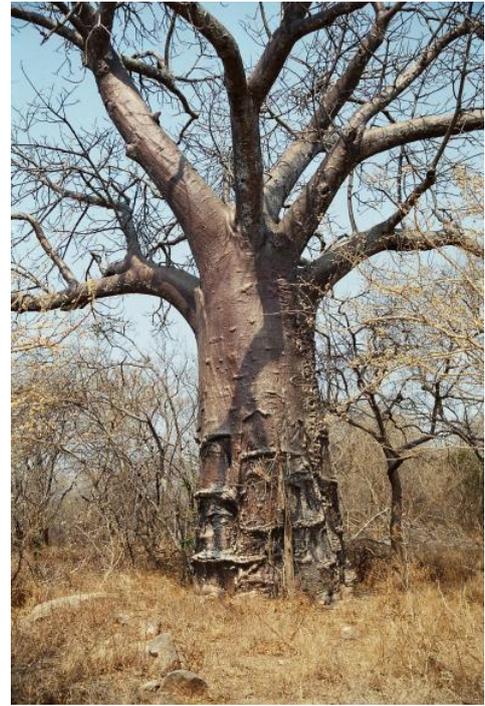
5. Plant trees for medicine: *Moringa oleifera* or *Moringa stenopetala*, neem (*Azadirachta indica*), *Prunus Africana* and *Warburgia ugandensis* may all be planted in suitable places, perhaps in a mixed woodland. *Prunus Africana* and *Warburgia ugandensis* are being scarce and need protection – another good reason for planting them. In the northern, drier areas of West and East Africa the shea butter tree, (*Vitellaria paradoxa*), provides shea butter for skin care, especially for babies. In Europe shea butter is a luxurious, natural cosmetic.
6. Plant trees to increase soil fertility and at the same time for fodder: The leaves and small branches of *Sesbania sesban*, *Leucaena glauca*, *Calliandra calothyrsus* and *Ficus natalensis* can all be used as fodder, but never as more than 20% of the total feed. Young leucaena leaves may also be used to feed fish. *Ficus natalensis* also provides wood for poles and furniture and, as the “bark cloth” tree, the bark can be used to make traditional clothing.
7. Plant trees for bees: Neem (*Azadirachta indica*) and Moringa (*Moringa oleifera* and *Moringa stenopetala*) are very attractive for bees. They help to sustain the bee population and give one the opportunity to set up bee hives and collect the honey – which is both delicious and very healthy.
8. Plant trees for beauty: For example, the flame tree (*Delonix regia*), bougainvillea and frangipani (*Plumeria regia* – which is also medicinal).
9. Plant trees in hedges as a windbreak and protection from goats etc. The trees you use may have a variety of other purposes. One hardy, fast growing tree worth considering is *Acacia galpinii* (monkey thorn) which is drought resistant, ornamental and good for timber.

The REAP project in Kenya recommend planting hedges with a variety of trees and shrubs which have a variety of uses. They call it the “six ‘F’ hedge” which serves six purposes: Fence, Fuel, Fertility, Fodder, Food and Fibre – and in fact the seventh is Farmacy! For more information, see the REAP teaching leaflet available on the REAP website:

<https://goo.gl/p1WGqk>.

Roger Sharland of REAP describes a very substantial hedge that they have planted around their garden. “At Kajulu (near Kisumu in Kenya) we planted kei apple (*Dovyalis caffra*) as a thorn hedge so that it will take over from the barbed wire, especially at the top. We also planted leucaena so that, when the wooden fence posts get eaten by termites, we will attach barbed wire to the leucaena in those places where there is no kei apple.

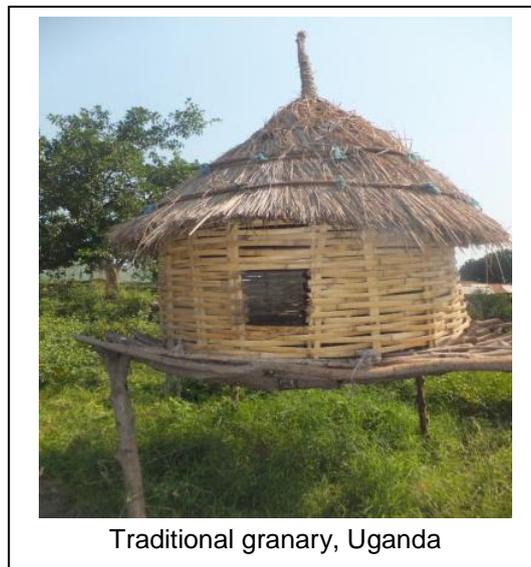
We cannot say strongly enough, if you want to conserve ground water, do not plant any species of eucalyptus, as these trees dry the soil out and make it infertile.



The beautiful baobab tree (*Adansonia digitata*) is an iconic tree in the hot areas of Africa with little rainfall. Even this tree must be protected so that it does not become extinct. In very dry seasons this tree provides water for the elephant.

6. Food preservation

- A. Use a traditional grain store, for example the one in the picture. Mix neem leaves with the grain, fresh or dried, to protect against insect pests.
- B. Dry your fruit, vegetables and herbs using a solar drier. Use for:
- fruits such as mango, pawpaw, jackfruit, pineapple or banana.
 - vegetables such as pumpkin leaves, tomatoes, sweet potatoes (after cooking and slicing).
 - herbs for food and medicine, such as moringa, rosemary, artemisia, lemongrass, roselle (*Hibiscus sabdariffa*), basil.



Traditional granary, Uganda

In order that the vitamins and medicinal properties are not lost it is important to ensure that a temperature of 45 degrees is not exceeded, to dry things out of direct sunlight and within 3 days or less. If fresh leaves are left in a heap, the temperature quickly rises as the composting process begins; the leaves are then only good for use as compost!

How dry your product is can be judged with the help of a small hygrometer. Place some of your product in a glass jar, put a hygrometer into the jar, close the lid and leave for two hours. If the hygrometer shows that the relative humidity is 40% or less, then the product can be kept in an air-tight container in a cool, dark and dry environment for up to 3 years.

Make porridge. Make a mixture of some or all the following; grain amaranth, millet, maize, sorghum; soya bean, oatmeal. Dry the grains well and store in an airtight container. Such porridge has made a big contribution to nutrition in many communities, and particularly where people are living with HIV. Grain amaranth contains all but one of the essential amino acids. Porridge made of grain amaranth plus either maize or millet contains them all.



Popped grain amaranth produced by Garner Amaranth, Iganga, Uganda. It contains eight essential amino acids

- C. Store potatoes and sweet potatoes in a cool, dark and well-ventilated environment.
- D. Smoke fish and thinly sliced meat.
- E. Moringa leaf powder is a wonderful source of proteins, minerals and vitamins. Moringa is unique in that it is the only plant that contains all the essential amino acids, which are important proteins. Stored in an airtight jar in a dark place, moringa leaf powder can help sustain a family through the longest dry season.

To make moringa leaf powder, pound moringa leaves when they are completely dry. Then rub them through a sieve. Discard the stems.

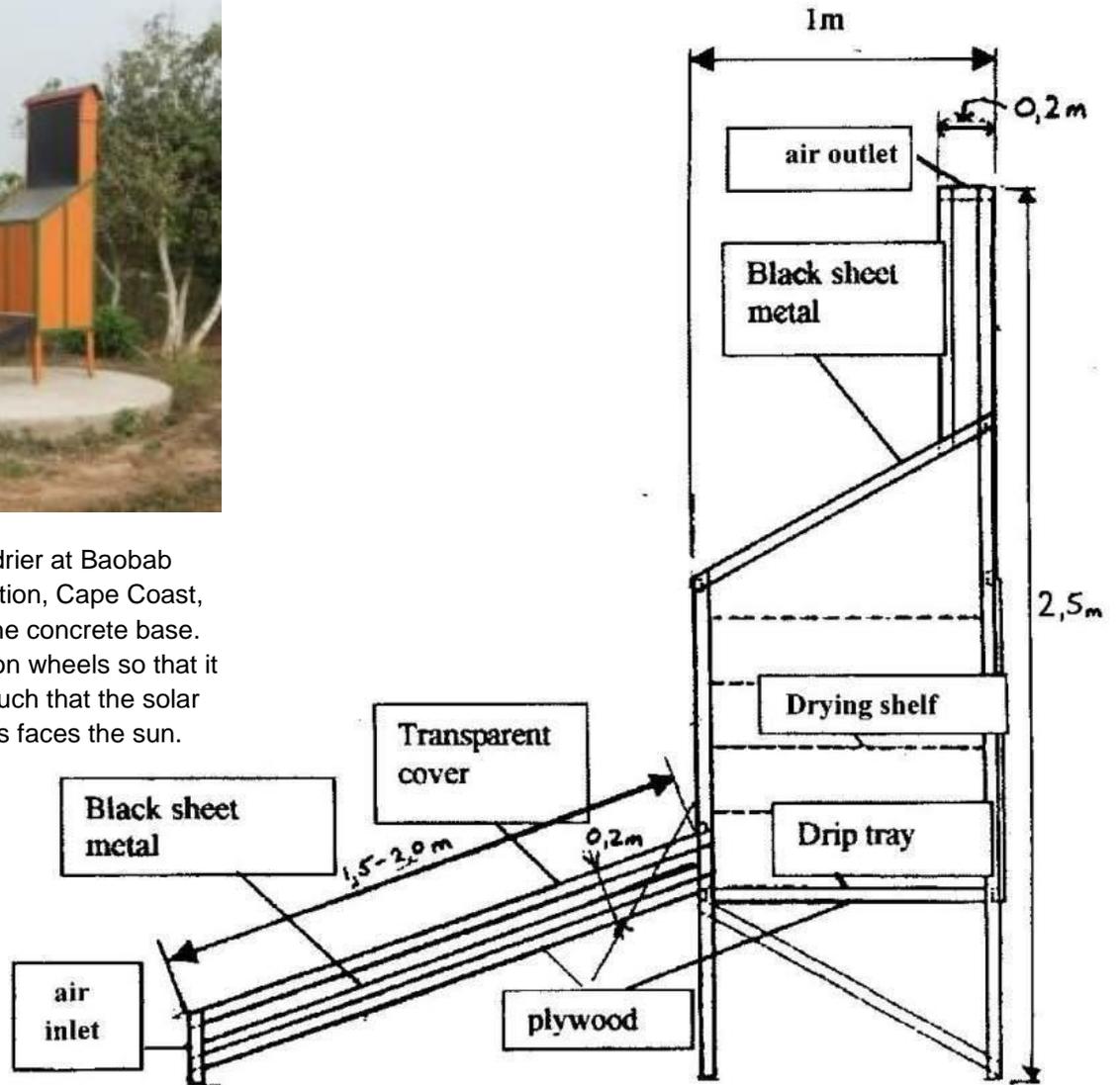


Women in D R Congo preparing moringa leaf powder

A selection of solar driers



A large solar drier at Baobab Children Foundation, Cape Coast, Ghana. Notice the concrete base. The entire unit is on wheels so that it can be rotated such that the solar collector always faces the sun.



Two more driers

On the right, a simple but effective tower drier made from timber and polythene.

Below a simple tunnel drier. This can be improved by installing a fan powered by a solar panel.



For more information about solar driers, see <https://tinyurl.com/y86kvxfj>

7. Strengthen the body's immune system

If food is scarce in the dry season, then the body becomes weaker, and the risk of becoming infected with malaria, cholera, ebola virus and other diseases increases. It is important, therefore, to have a strong immune system. This is also extremely important if you are HIV positive.

The following is most important:

Ensure that your diet is nutritious. It should include plenty fruit and green leafy vegetables, which contain vitamins and minerals.

Keep as fit as possible. Walk, cycle or do some physical work in the garden every day.

Hygiene: Wash your hands carefully after using the toilet, before preparing food and before eating. Wash the whole body every day.

In addition, use at least two of the following natural foods every day:

1. *Allium sativum* (garlic): Include as much raw garlic as possible in the daily diet. Chop garlic cloves into small pieces and stir into the food, adding it to salad or drink it with a glass of good water.

2. *Aloe vera*: Take one to two tablespoonfuls of aloe gel.

3. *Artemisia annua*: Pour 1 cup (250 ml) of boiling water over 1 moderately heaped teaspoon of dried leaves, leave to stand for at least 15 minutes, filter and drink.

4. *Azadirachta indica* (neem): Drink neem tea or eat a little neem cake (the residue from making neem oil).

5. *Citrus limon* (lemon): Lemons have a high vitamin C content. Drink the juice of one lemon every day, either in warm water (not hot, so as not to destroy the vitamin C) or squeezed onto your food.

6. *Cymbopogon citratus* (lemon grass): Boil one handful of fresh leaves for two minutes in one litre of water, leave to stand for 15 minutes and then pour through a sieve.



7. *Moringa oleifera*: The leaves of both *Moringa oleifera* and *Moringa stenopetala* contain many vitamins, proteins and minerals. For this reason, moringa leaf powder is used very successfully to bring malnourished children back to health. It is also very helpful for pregnant women and breast-feeding mothers. Taking moringa leaf powder not only builds up the body again, but often eliminates secondary problems such as diarrhoea and skin diseases. Add one heaped teaspoonful of moringa leaf powder to your food or drink as tea. Be careful if you have low blood pressure – moringa tea lowers it even further!

8. Grain amaranth: Like moringa, grain amaranth is a very rich foodstuff. It contains about 16 percent high quality protein, having a good mix of essential amino acids. Grain amaranth is also high in other nutrients such as calcium, phosphorus, iron, potassium, zinc, vitamin E, and vitamin B-complex.

Amaranth can be eaten as porridge. Porridge of amaranth together with maize or millet is particularly nutritious. A teaspoonful of moringa leaf powder may also be added.

9. Natural bee products: Mix one tablespoon of fresh aloe gel with two tablespoons of honey. Propolis is produced in bee hives and has been shown to have antibiotic, anti-fungal, antiseptic and antiviral properties. Mix 20g of propolis with 100ml of pure medicinal alcohol (98%) and shake every day for 30 days. Filter. Take 20 drops one to three times daily.

8. A note about *Artemisia annua* in a dry climate

Artemisia needs a lot of water to survive. If the soil in which it is planted dries out, then the plant will die.

Nonetheless, many people have grown artemisia successfully in very dry climates.

Firstly, they have used many of the ideas presented in this document.

Two more things are very important.

1. When you plant artemisia in the field, dig a large hole of about 50cm square by about 50 cm deep. The harder your earth is, the more important it is that the hole is large and deep. This hole must then be filled with a mixture of top soil and well-rotted compost and manure. As has already been stated. Soil that is rich in humus retains moisture much better than other soils.

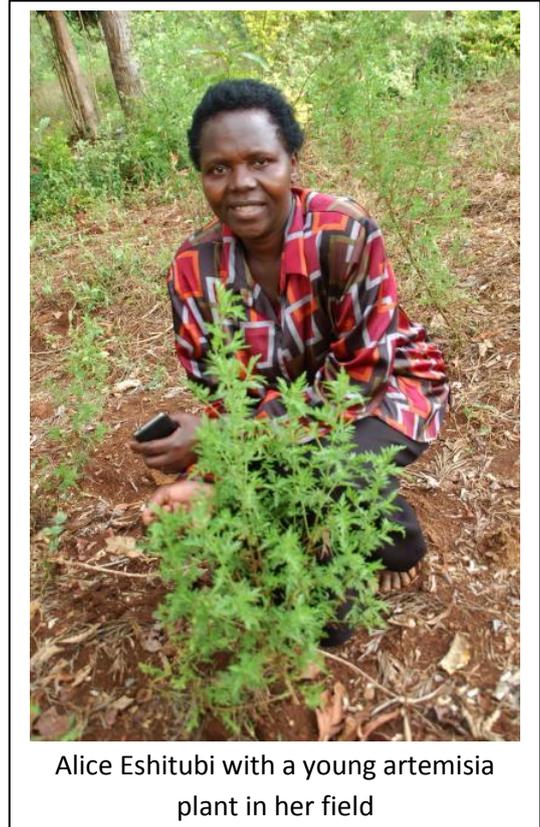
It is also important that the surface of the soil around the artemisia stem is a little lower than the surrounding area, so that when it rains, or when you water the plant, the water flows to the plant roots and does not spread out over the entire field.

2. Alice Eshitubi's artemisia plants in Butere, Kenya, survived the unusually long, dry season when her friends' plants all died. Why?

As the plant grew, Alice constantly harvested the leaves from the lower branches.

Why?

- a) The leaves on the lower branches often turn brown and are wasted.
- b) More importantly, in this way she reduced the total number of leaves on the plant, and therefore reduced the loss of water into the atmosphere through the leaves, thus reducing the water the plant needed to draw from the ground.



Alice Eshitubi with a young artemisia plant in her field

Note that *Artemisia afra* is an artemisia species that is native in the entire region from East Africa through to South Africa. Recent research has confirmed that *A. Afra* is just as effective as *A. annua* in treating malaria and assisting people living with HIV.

9. Suggestion for a five-day training seminar on “Coping with Drought”

This suggestion is based on the experience of Discover partners in the Kasese Network, Uganda in 2018.

Who to invite?

People who readily share their knowledge and experience with others, such as:

- Local leaders in the villages
- Religious leaders
- School teachers
- Community trainers who are already active

The training programme may include:

- How to increase and maintain soil fertility
- Drought management and conservation
- Drought resistant crops, e.g. sorghum and traditional vegetables
- Planning your garden, what to plant, when to plant and where to plant
- Raised beds and small gardens in boxes or hanging baskets
- Tree planting and nursery management
- Food security at household level
- Construction of solar driers
- Visiting model gardens
- Rain water harvesting and conservation
- Water purification
- How to stay healthy during drought conditions

Following this training seminar in Kasese, the participants

- started to use empty plastic bottle drip irrigation in their kitchen gardens,
- practised early planting,
- built contours on their slopes for water and soil conservation,
- dug trenches in the gardens to catch water, and
- practised mulching and growing cover crops

10. Postscript – the bigger picture

Living and working in this way not only helps you and your family and community to enjoy good nutrition and health, it also helps to ensure the survival of planet earth!

Today there are nearly eight billion people alive on our planet, more than twice as many as 50 years ago. It is not clear that the earth can supply so many people's needs or absorb that much waste and poison. The "Global Footprint Network" estimates that we use up our annual supply of renewable resources by August every year.

Everything described in this paper is, therefore, very important for us, and for our children and grandchildren:

- Planting trees helps to prevent droughts and floods, especially when planted in the mountains.
- Forests help to conserve water, they encourage rainfall, and trees and humus rich earth store carbon, thus contributing to reducing the effects of climate change.
- Planting trees and bushes, especially indigenous trees and bushes, helps to develop a rich eco system of insects, including bees and other pollinators such as butterflies. The number of insects in western Europe has declined by 75% in the last three decades – that is truly worrying. If there are many insects, birdlife will thrive. If there are forests, then animals will thrive.
 - If the bees and butterflies disappear, how will our fruit and vegetables be pollinated?
 - If the birds disappear, how will the sky be beautiful and how can we enjoy the beauty of birdsong?
 - If our African wildlife disappears, how can we enjoy our unique African heritage? How could we attract tourists to come and spend their money in our countries in the future?
- Practising organic farming also enriches the soil. Microorganisms and earthworms thrive in humus rich soils. Biodiversity in the soil is arguably just as important as biodiversity above the ground and in the sky.
- Maintaining soil fertility is important for peace-keeping. Where land becomes infertile and populations are increasing, conflicts over land occur more often.
- The correct disposal of waste is very important, whether organic (as compost), paper (ideally recycled), plastic (ideally not produced at all) or metal (must be recycled). Today we also have electrical waste in the form of broken television and electronic waster in the form of mobile phones and computers. These must be recycled, and the valuable components used again – please put pressure on your authorities to develop recycling facilities.



The leopard, a beautiful African cat
If the truly wonderful and unique African wildlife is to survive, then there must be large, well-protected areas devoted entirely to wildlife. Picture: Peter Lindsey

One more factor is crucial for life on our planet. That is education, especially education for girls. It is well proven that as the levels of education and health improve, the birth rate declines. A stable, or declining, world population is also crucial for our survival and the survival of all species, whatever the climate!