

Topic 5: Water Management Concepts

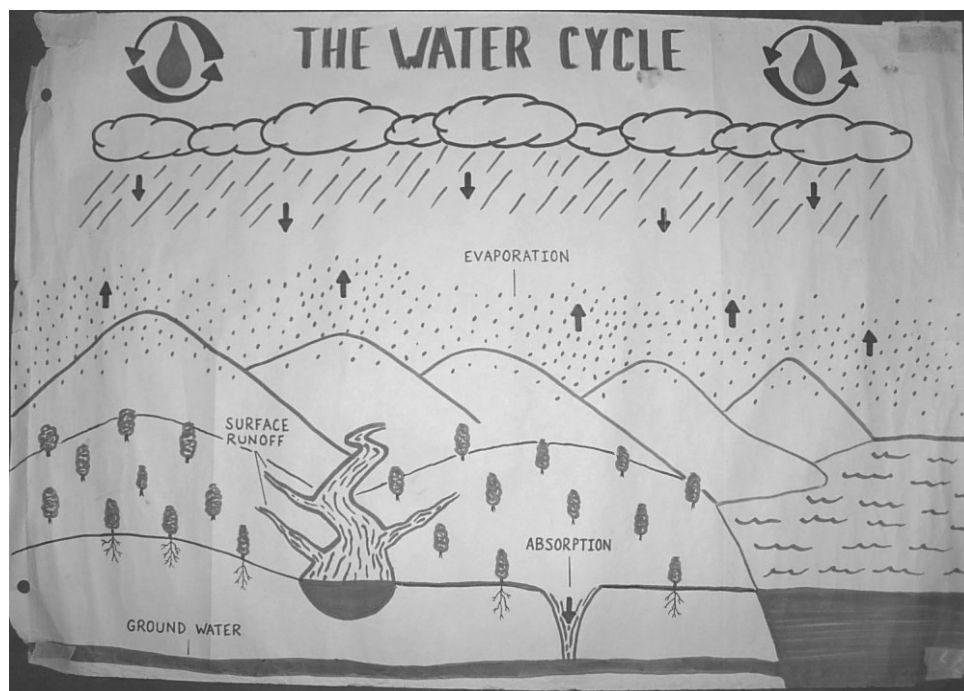
☑ Healing the soil for improved water management

Using the Soil Health Concepts begins the process of improved water management.

- ◆ Healthy Soil: Healthy soil helps water to sink into the earth instead of running across and eroding the earth. The roots of plants and trees 'drink' this water as they need it – the larger plants and trees even help to 'hold' the water and they give it back to the soil as needed.
- ◆ Mulching: Nature keeps water in the soil for a long time by putting a 'blanket' of mulch on the ground. It helps by both covering the area so that water can't escape into the air and like a sponge that soaks it up and lets water out slowly.
- ◆ Shade: Nature plants a variety of trees, bushes, climbing and crawling plants so that the soil is protected from the sun.

☑ Understanding the basic water cycle

Water has a cycle that it keeps going through over and over to maintain its health, all the time providing water for other parts of the nature cycle along the way. You can enter the cycle anywhere to follow and understand it. An easy place to start is where water falls as rain, hitting the leaves on trees and plants so it gently falls on the mulch, then filters into the soil, some absorbed by roots of plants, other drops continue filtering down into the ground water for roots to use later and for us to drink from our wells. Some water enters the rivers and flows to larger and larger bodies of water. Water slowly evaporates out of the mulch, leaves, rivers and lakes back up into the air where it later falls again as rain.



Source: Permaculture Nutrition Training Material 1999. Kristof & Stacia Nordin, nordin@eomw.net Full page handout in appendix.

What is happening to disturb this cycle of water?

- ◆ **Poisoned air:** As rain falls through the air it picks up particles along the way. If we poison our air with pollution, chemicals, burning (especially plastics), exhausts or smoke – rain picks it up along the way.
- ◆ **Clearing the land:** Removing all the ground cover by cutting trees and plants, sweeping, burning, not having roots in the soil, etc. means the rain can't fall slowly to the ground. If there is nothing for the rain to fall upon, it hits the soil, and it hits it hard, really hard. This compacts the soil, just as much as you walking on your soil as was discussed in soil structure. The rain isn't able to enter the soil when it is hard, it just runs right off. Water also can't evaporate back into the air properly without plants, trees and mulch. Hard soil isn't the only culprit, covering the earth with tar and cement surfaces also prevents the water from sinking into the soil as it should.



What are some of the results of this?

- ◆ **Acid rain:** This term is mostly used in 'industrial' countries that use a lot of fuel and chemicals, but acid rain caused by industrial countries also affects other countries as well.
- ◆ **Erosion and floods:** Water runs off the earth, taking with it the top layer of soil and whatever else is in its way. Some of this run-off blocks our roads, fills up our drainage ditches, causes dirt and chemicals to buildup in our rivers, blocks our hydro-electric production, wipes out our bridges, and poisons our un-protected wells.
- ◆ **Low water table:** The water table is defined as the highest level of damp earth.
 - **Normal rainy season water table:** In a country like Malawi that has a "rainy season", the soil should become completely saturated by the end of the rains. At this point, the water table would reach as high as the soil's surface.
 - **Normal dry season water table:** During the dry season, the water table eventually lowers as water is lost to evaporation and absorption. Many deep rooted plants and trees, such as perennials, are able to tap into the water table to keep living until the next rains.
 - **Problem:** Unfortunately in Malawi, water doesn't have time to sink into the soil because of human impact and designs. Part of the result is that the ground water doesn't fill up, leaving us and the plants with nothing to drink. The following diagram is based on a water conservation booklet that was released through the Ministry of Agriculture³ and it helps to show the current situation.

The shaded area in each box represents the level of the water table:

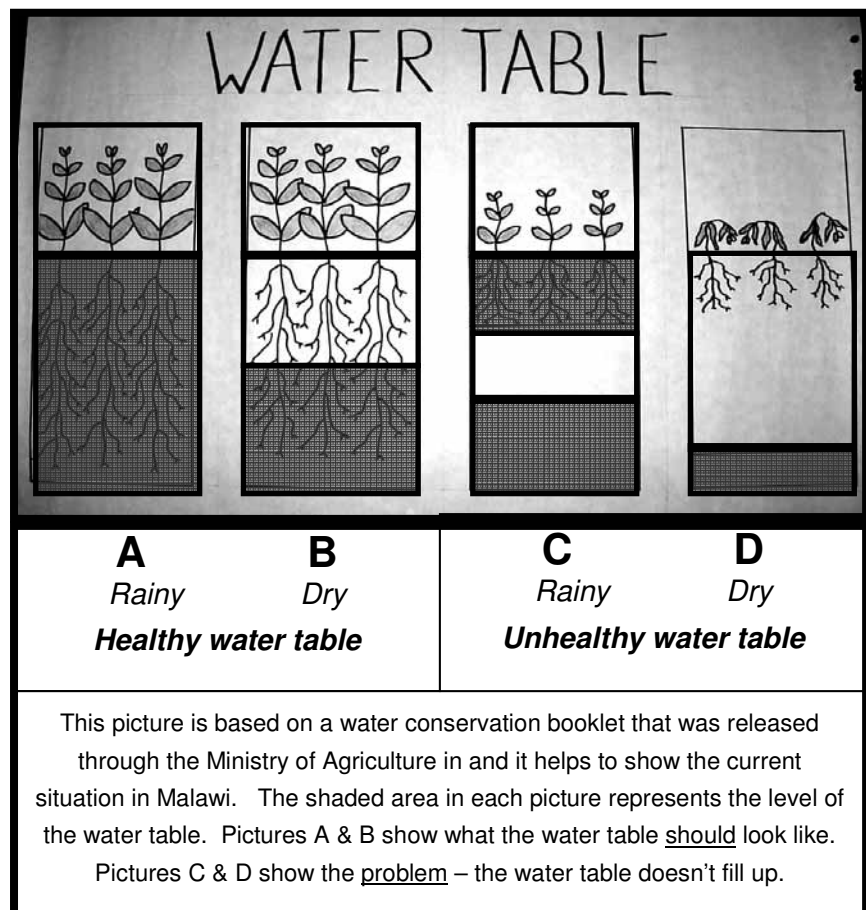
☺ **Box A** shows how the soil *should* look towards the end of the rainy season, the water table is fully saturated and the roots are able to go deep into the earth.

☺ **Box B** shows the dry season and the water table begins to lower, but deep rooted plants and trees can still survive.

☹ **Box C** shows Malawi's water table at the end of the rainy season.

You can see that soil's surface has absorbed some moisture, but it has not become damp all the way through. Plants that try to establish themselves in this setting can only send their roots as deep as the moisture will allow. These plants and trees are very vulnerable to any dry spell.

☹ **Box D** is the result. The plants and trees have not had a chance to reach the lower levels of the water table so they can't survive dry spells. In this situation the water table and ground water hasn't had a chance to fill up which will create problems such as wells drying up, rivers running dry, and making it more difficult to find useable sources of water.



Permaculture Nutrition Manual, 2003 edition, Kristof & Stacia Nordin, nordin@eomw.net. Full page handout available in appendix.

Teaching about the water cycle & water table

- **Poster:** Draw a simple poster of the water cycle and the water table.
- **Best Lesson: Go Outside!** First, take the group to a natural area that is not being ruined by humans. Ask what is happening to the water in this area. Now, move the group to an area that humans are affecting and look at harmful practices and the results (sweeping, burning, erosion, unhealthy soil, water, plants, etc.). Being outside in the rain, or just after the rain is a great way to see what is happening to the rainfall.
- **Evaporation:** Tie a plastic bag around the leaves of a tree or plant and come back in an hour, the bag will have water in it. Discuss how it happens and what happens when there are no leaves. You can connect this idea to the job leaves have of making good air for us, and for making the air cool.

Water Management: Mimic Nature!

When the water cycle is allowed to do its job, it does a great job of giving all of us the clean water that we need to live. One way to follow nature's lead and to manage water is to remember four S's:

- ◆ **Slow or Stop** – slowing down the speed of the water gives the water more time to enter the soil. Ways to slow water include using 'check dams' made from rocks, logs, sticks, old maize bags filled with dirt – again, be creative! Another way to slow down water is to catch it – from roofs, roads, or other surface the water is running off of. It can be caught into drums, clay pots, pits, or pond. You will want to consider if the water is free from chemicals or other harmful pollution or not, then make a decision how that water can be used.
- ◆ **Spread** – Now that the water is slowed down, you want it to spread out enough so that there isn't too much water in just one place. Spread the water out across the slope (along the contour) in preparation for the next step, sinking.
- ◆ **Sink** – If your soil is healthy with lots of insect tunnels, micro-organism activity, organic matter, and there are plenty of roots in the soil, the water will be able to sink into the soil. This sinking process helps to filter the water so that it is clean by the time it reaches our ground water table. Sinking will depend on the type of your soil – clay soil absorbs water slowly whereas sand absorbs it very quickly. Knowing where there is clay soil can be to your advantage if you want to create a pond or tank to collect the water.
- ◆ **Shade** – Now that the water has sunk into the soil, you want to keep it there by using mulch, ground covering plants, and bushes or trees that provide shade.

Design for the site

Now that we understand the basics of how water works, we can use it to our advantage, while at the same time protecting the water cycle so it can do its work. Again, just like we did for dietary diversity and soil health, we will want to assess the site so that we can design to make the best use of what we have. First we need to tap into all our **sources of water**:

- ◆ Rain, lakes, rivers, marshy areas, and ground water are what most people think of first.
- ◆ Think again! Think about how we take this water and use it: washing dishes, clothes, our bodies, our homes, our cars – all this water can be used again if we use some creative thinking.

Once your mind and eyes open up to all these sources you will realize that we have a LOT of water that could be used to help us grow foods.

Select seeds and animals for water in area

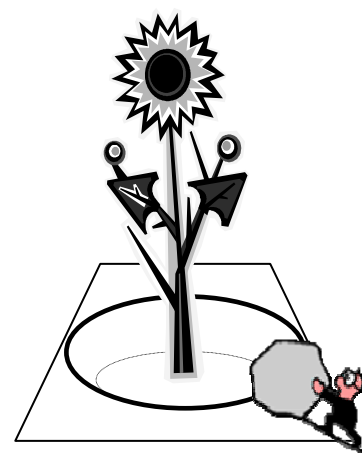
As part of water management, it is important to learn what types of plants are suited for the area in which you are planting. Some plants prefer a lot of water; other plants prefer dry sandy areas. This takes some time to learn, look to nature for what is doing well around you as a good start! People often blame God (the weather) for drought, crop failures or poor animal health, but often times it is because people have selected a crop that won't do well in the local conditions. Refer to the table in the annex for a guide to more crops.

High water needs:	Low Water needs:
Most Maize	Many Indigenous Vegetables
Most Exotic Vegetables	Many Indigenous Trees
Most Cattle	Sorghum
	Millet
Likes marshy areas:	Peanuts
Bananas	Pigeon Peas
Sugar Cane	Kalongonda
Coco Yams	Mkhungudzu
Rice	Chimbamba
Fish	Indigenous Melons
Ducks	Pumpkins
	Tomatoes
	Chickens
<i>See appendix for more ideas</i>	

Types of planting stations: sunken, raised or level

Another part of your assessment will tell you what type of beds you should make for dry or wet areas. Preferably you will design and make your beds one time and never make them again, so some thought needs to go into what the area looks like in the dry and wet seasons. By healing the soil the water will generally be regulated well on its own, but here are some planting options to consider for very dry and very wet areas.

- ✓ Dry areas: Sunken Planting Stations. Basins help to collect water and guide it down to the roots of the plants. These can be big basins for larger trees and plants and small basins for smaller things. Some people like to have sunken beds for their whole garden, but make sure your soil can handle that as there is a lot of rain that will gather in the beds and it might flood and drown your plants!



- ◆ After digging a hole the size you need for your tree, seed or seedling, plant the item low in the hole so that the earth you add back into the hole is less than you took out of the hole. Adding compost to your planting station means that even less of the hole's original soil goes back into the hole. Extra soil can be used to create a ridge around the basin, or you can use the dirt somewhere else.
- ◆ You can help to strengthen the basin by placing stones, soil or other material in a circle around the hole (or semi-circle if you are on a slope), and/or using a stone mulch in the basin, which is very useful for when there are chickens around.
- ◆ Always add mulch as the last step so that the soil is always covered! If you are using a stone mulch, you could also add a layer of organic matter before putting on the stones, just for a bit more nutrition for the plant or tree!

- ✓ Wet Areas: Raised Planting Stations. If your soil has a LOT of water, or the crop you've chosen doesn't like water, you would choose just the opposite of sunken stations. Raise the 'hole' above the surface so that water runs away from the plant.
- ✓ Level Planting Stations. You might not need raised or sunken beds or planting stations! Planting even with the earth so that the whole area gets about the same spread of water may be the best option for your land!



Design to capture rain and dew

A lot of water runs right by us in the rainy season, off our roofs and roads, down the drains that we spent a lot of time and money making, and building up the whole time until a lot of water comes out at the end. This water can be captured! We already mentioned some ways under Stop/Slow for getting the water into the soil, but we can also collect the rain water so that we can use it before putting it into the soil.

If you are designing a new building or road, you can plan in designs that harvests and uses this water. This is where we need to link up with people in public works and in architecture. All our schools, hospital, government housing, etc. could be built under a policy of harvesting water – but why wait for a policy? Do it anyway!

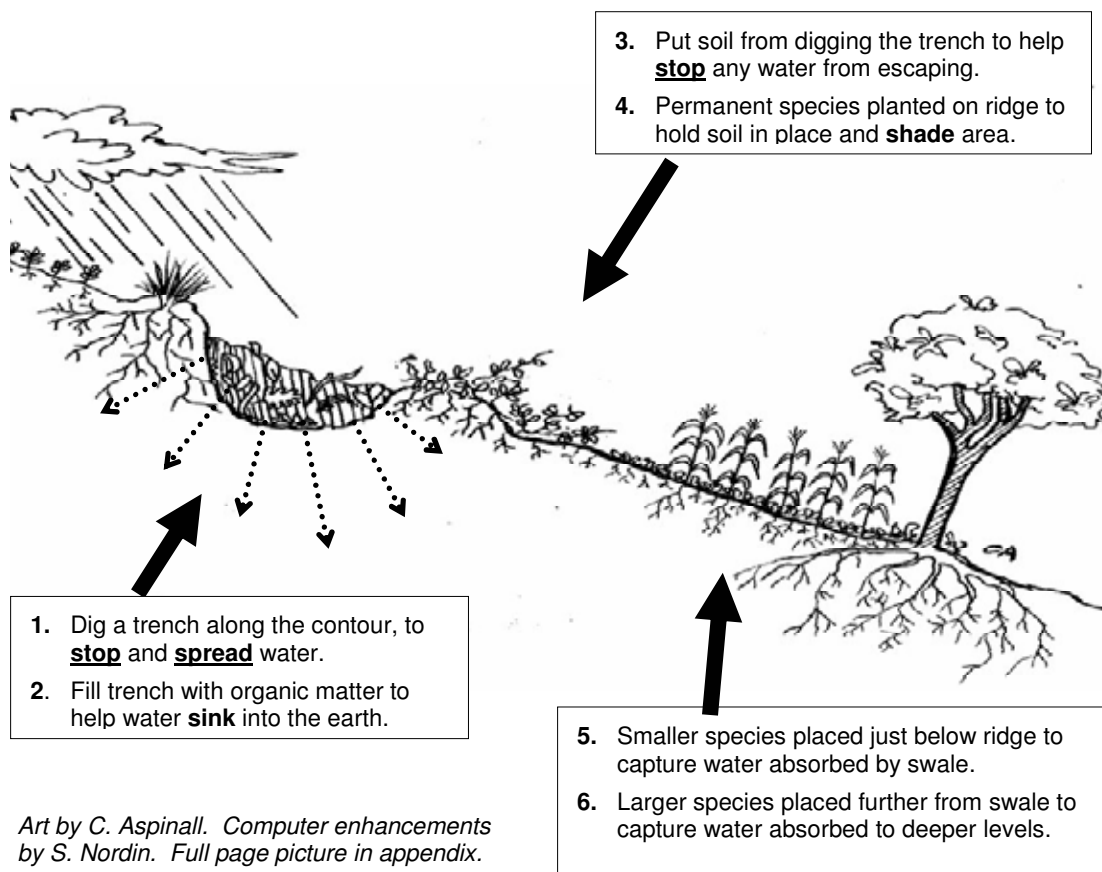
- ◆ Water Tanks: Buildings can be designed so that all water from the roof flows into water tanks. The tanks can have a tap so that people can use the water out of the tank. It is helpful to use roof gutters to catch the water off the roof and guide it into the tank.
- ◆ Other containers: If you can't build a tank, capture water into whatever you have – mtsuko (large clay pots), drums, or even sturdy perennial plants that are placed creatively where the water comes off the roof.
- ◆ Pits or banana circles: At the end of any drain, appropriate sized pits filled with organic matter and planted with bananas or other appropriate plants and trees around the edge will stop the water and create a wet, fertile area for plants.
- ◆ Frequent road drains: All roads should have check dams and drains at appropriate intervals to guide water into pits or trees or other area that can soak up the water. Removing water as it goes down the slope prevents it from building up and causing flooding at the bottom.
- ◆ Ground covers next to roads: Water can be captured at the side of the road into short grasses first, then taller plants far enough out so that people can walk down the sides of the roads and so that the plants do not prevent drivers from seeing well. A big mistake in Malawi is people hoeing up the grass growing alongside roads (and we even pay people money or food to do it!) This causes erosion and the road slowly washes away. This is true for earth roads and any pathway, too. The roots will hold the earth in place protecting your paths and roads from being washed away. It is better to slash than to hoe. People, cars,

bikes, and ox carts can pass through short grass and foot or vehicle traffic usually keeps the plants from growing too much.

- ◆ **Swales:** Swales are another way to incorporate the four “S’s” of water management. This method is similar to contour ridging or terracing except a swale is designed to be permanent. Once it is made, it is never made again, only maintained if needed. It is also a place where we provide ourselves with permanent food. **Not every site needs a swale.** Sites that have a bare, degraded slope might need a swale. Before digging a swale, think about other options that take less digging and decide if they will do the job, such as using rocks across the slope. If you decide that you do want to make a swale then:

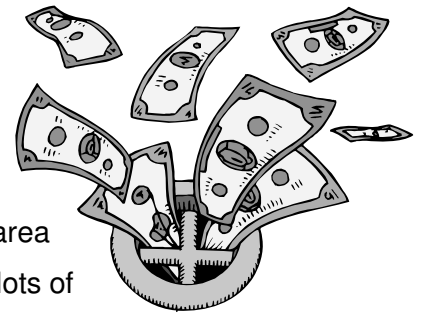
- Dig a trench along the contour of the land. This trench size and length will depend on the slope of the land. You will dig deeper, longer trenches for steep places.
- Make a ridge along the downhill side of the trench using soil from the trench.
- Fill the trench with organic matter to help cover the soil and absorb rain water.
- Plant along the ridge with strong-rooted, permanent species, preferably food! Continue planting permanent species to fill about a metre below the ridge, using smaller plants close to the ridge and bigger things like trees or shrubs further down.

As rainwater flows down the slope it will enter the trench, spread out, and be allowed to sink into the soil. As this water is absorbed by the soil underground, it will provide the roots of the plants with the nourishment that they need without washing the soil away in the process.



Design to capture 'used' water

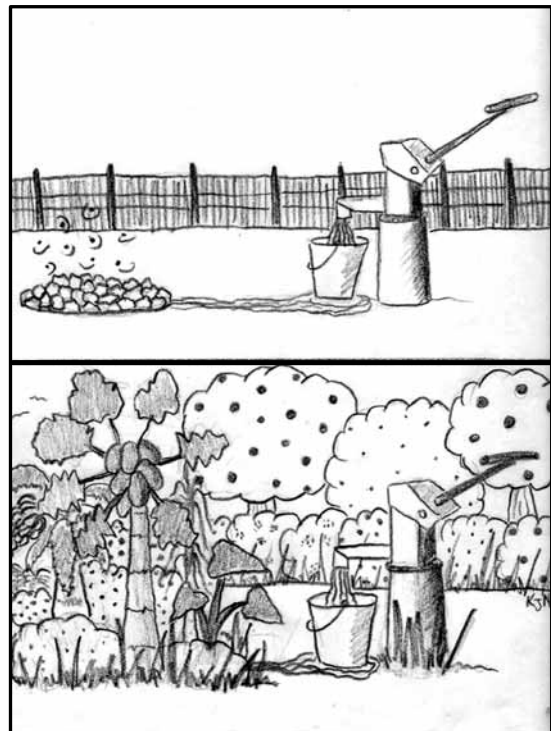
Take a look around your home, your place of work, and your community and ask: Is there any water that is being wasted? Is there standing water anywhere? Is there water that could be used more than once? Is there any water that could be run into a garden area or be used to water trees? Often the answer to this is yes! There is lots of water going down the drain or thrown on bare ground that we could be using to make food and money! Before you use your grey water consider at least these two things:



- ! Be sure to think about what might be in the water. If people are throwing dangerous chemicals down the drain, like chlorine bleach or chemical cleaners, the used water might kill the plants and trees. In this case you can change to natural cleaners such as natural soaps and wood ash that works like a scrubbing powder (i.e., Vim), or sand, or other local remedy.
- ! Consider the type of plants and trees to include in your design. You won't want to plant short leafy greens in most types of grey water because the leaves might not be safe to eat. Your choice of plants for using most used water will be things like: climbing plants, small bushes or trees where the food is not very close to the ground. The soil will filter the water and the roots of the plant will drink up what it needs and will produce great food! Be creative and think about it!

Now you are ready to think about creative designs for using your grey water:

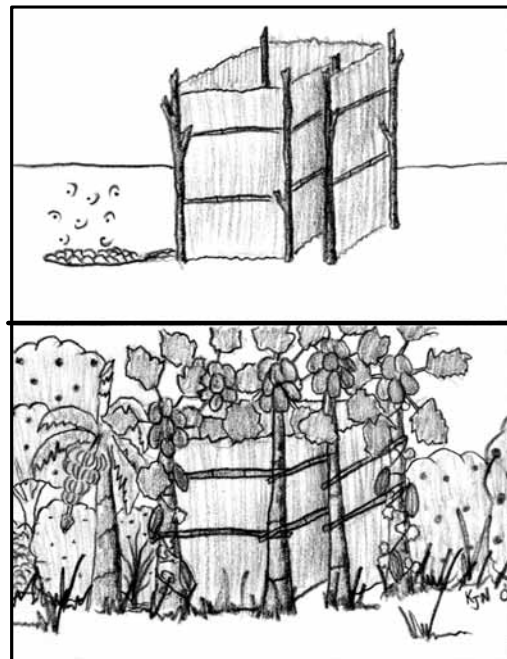
- ◆ Borehole / Wells / Taps – Areas where people draw water will often have standing water or wet areas that can be used to grow things. Standing water can breed malaria-carrying mosquitoes, so it is important to get this water to sink into the ground, by planting you not only soak up the water, you also can get food, medicine, building supplies and/or money!. Choose plants and trees that are suitable for moist conditions. If is a community water site and there is a question over whose food it will be, the community can sell it and put the proceeds towards the maintenance of the pump, or they can use all the foods for community projects, such as caring for orphans, widows, people with illnesses, and/or the elderly.



Art by K. Nordin

Full page handout available in the appendix.

- ◆ **Bath areas:** Drains from bathing areas are very easy to convert into small gardens. Simply direct the flow of where you want it, and plant! Even if people urinate in the bafa, this urine is full of urea, which is something that many people buy and add to their fields! If you plant things like vines or live-fencing around your outdoor bath structure, it will also help to improve your privacy while bathing. Plant a loofa sponge and you will have one whenever you need it!



Art by K. Nordin

Full page handout available in the appendix.

- ◆ **Reusing wash water:** Many people in Malawi go long distances to get water, wash something with it once, and then throw it away onto the bare ground. Don't waste this water! It can be used to

grow food, enhance the beauty of your home or community, or water trees that can give you fuel-wood and building supplies. It takes the same amount of work to throw water onto growing plants and trees as it does to throw it on the ground, but you will get so much more from it with just a little bit of thinking ahead.

- ◆ **Sink Drains:** If you have a house or office with piped in water, it may be possible to redirect the drain pipes into your plants or garden. Take a look at where the water exits the house to see if the pipes can be adapted – if it is not your house, ask the owners first! This is a great teaching opportunity and you can explain how it will benefit the owner. To adapt pipe you can cleverly use plastic bottles, bicycle tire tubes, bamboo, old garden hoses, and various other odds and ends that are often lying around.

- ◆ **Dish Drying Racks:** Most people in Malawi build a tall 'Tandala' rack to dry their dishes. The dishes are put on the rack soaking wet and the clean water drips onto the ground. This area is perfect for growing plants that like moisture and a bit of shade. Sweet potato vines are a great choice as you can eat vegetables while also keeping your stems healthy until the next rainy season!

<p>Typical Design:</p> <p>Water and space wasted. Need to remake rack every few years.</p>	
<p>Low Input Design:</p> <p>Water & space completely used to last for many years while providing useful items.</p>	

Art by K. Nordin

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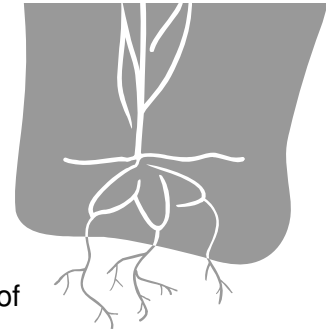
☑ **Watering, i.e. Irrigation**

When the word irrigation is used, most people think of systems that need money, labour and time to get fresh water to the plants. This might be an appropriate choice in some places, but for most places, you will first want to use the water harvesting methods listed above. In addition to these, there are many low-input irrigation methods that have been tested and shown to work well. Whatever method you choose for irrigation, you will want to keep the following guidance in mind:

Water Where it counts – the roots!

Understanding the water cycle is important, but also understanding how plants and trees use water from the cycle is just as important.

Plants and trees mostly drink water from their roots – they can absorb some moisture from the air through their leaves, but the bulk of their drinking is done by roots. You wouldn't like it if you were really thirsty and someone dumped it on your head, would you? You want the water where you can drink it – in your mouth! Plants and trees want water where they can drink it too, in their roots!



Correct amount of water: Avoid over or under watering

Using the correct amount of water will depend on the type of soil, what design you've made, what types of plants and trees you've selected, and the age of the plants and trees. For animals, the same type of ideas apply as it would for you – where they live, how much exercise they get, and what type of animal they are. Fish, for example, need a lot of water!

- ◆ **Observe the Plants and Trees:** One way to judge how much a plant or tree needs is to watch it. The leaves will tell you when the plant or tree is thirsty by starting to wilt. Try to water just before wilting starts. It will take some practice to get it right.
- ◆ **Deep Watering:** You want to give the area enough water so that it goes down to the lowest part of the roots if possible to encourage the roots to grow down as deeply as possible. This will mean less often, long, deep watering compared to the usual practice of frequent, short, shallow watering.

Conserve Water - Irrigate Foods, Not Grass!

Think about what is being watered. Why are we watering grass and flower beds when water is so scarce and people are hungry? We all need to be thoughtful of our water use. This will take a change in thinking and new eyes to live with the natural 'look' for the season, such as:

- ◆ Allowing dry grass lawns in the dry season, or
- ◆ Edible landscaping with decorative edible plants, trees, and perennials.

Prevent the formation of salts

When using any irrigation method, you will want to prevent the water from evaporating into the air very quickly and leaving salts on the surface of the soil, or from over-saturating the area which also can leave salts behind. You can usually see the salts because of the white layer that it causes on the soil's surface. These salts make it difficult for many types of plants to grow. In very hot, bare areas this risk of quick evaporation and salt deposits is the greatest.

Through an Internet search, the best information I could find on practical ways to help prevent human-caused salinity comes from *Water Wise and Salt Tolerant Plants*, Wagga Wagga Region (Australia), printed in 1999⁴.

This list of ideas to prevent salting is primarily adapted from that manual:

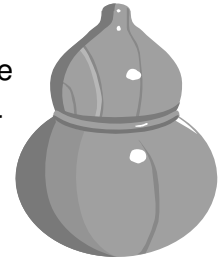
- ◆ Mulch garden beds to reduce evaporation by up to 90 percent.
- ◆ Improve soil water holding ability by adding compost which will encourage worms.
- ◆ Plant the right trees in the right place to provide the garden with shade and wind protection.
- ◆ Do not over water the area – only give the area as much as it can absorb.
- ◆ Group plants according to water needs to prevent under or overwatering.
- ◆ Water in the morning or evening to reduce water loss through evaporation.
- ◆ Deep watering once or twice a week is much more efficient than sprinkling every day. This will also make plants more drought tolerant (*refer back to section on the water table*)
- ◆ Avoid watering on very windy days.
- ◆ Avoid fine mist sprays or any sprinkler that sends water high into the air.
- ◆ Set up sprinklers and sprays to water plants at their base, not paths, fences, or plant leaves.

In a few of the model sites, especially in Mangochi around Lake Malawi, salty borehole water was a problem. I couldn't find anything on this topic other than this sometimes being a natural occurrence. The list of salt tolerant plants from an Australian list included: Lantana, Senna, Acacia, and Eucalyptus. With a further internet search I would hope that we could find a solution to this, and possibly discover a list of Malawian foods that we can plant in salty-borehole-water.

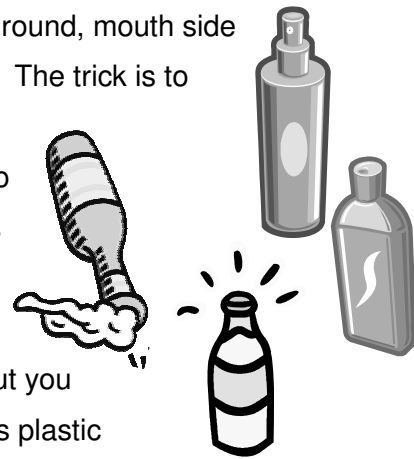
Low Input Drip Irrigation

The following are some ideas for getting water to the roots of your plants, to reduce evaporation of the water into the air, and to reduce the amount of time, water, and energy spent on irrigating. Most of these drip irrigation methods can be used from time to time with the green manure teas, compost tea or animal manure teas as described in earlier sections to provide extra nutrients to the roots of your plants and trees.

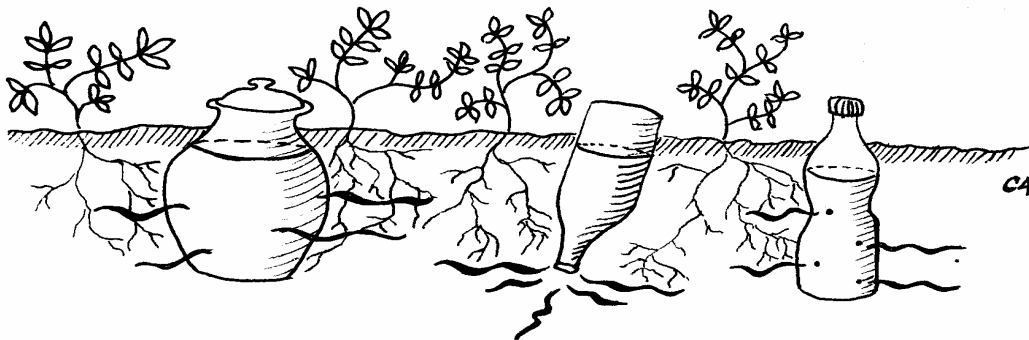
- ◆ Un glazed clay pots buried in the ground up to their rim and then filled with water allows water to seep into the ground very slowly. The pots are placed in the middle of 5 or 6 different plants so that the roots can drink the water underground. Put a lid on the pot to prevent evaporation. Only add more to the pot when the plants begin to wilt.



- ◆ Bottles without a lid, such as non-returnable beer, wine, or condiment bottles, can be filled with water and then pressed tightly into the ground, mouth side down. The water from the bottle will slowly enter the soil. The trick is to get the bottle pressed in without doing it too tight (the water leaves too slowly) or too loose (the water leaves too fast). It isn't hard to learn the trick though! Fill the bottles every week or so, depending on the conditions. Glass bottles work well because they are strong and can be pressed hard without bending. Plastic bottles work, too, but you might need to dig a hole where the bottle will be placed as plastic bottles will bend under pressure when you push them into the ground.



- ◆ Plastic bottles and tin cans can also be used in a similar way. For this method you make two or three very *tiny* holes in the bottom of a plastic bottle with a needle or thorn. For the tin, use a nail, but the holes need to be *small* or the water escapes too quickly. The top of the bottle or tin can will stick out of the soil so that you can fill them. You can put the cap on the bottle if you want to reduce evaporation, then remove the cap to fill the bottle again.

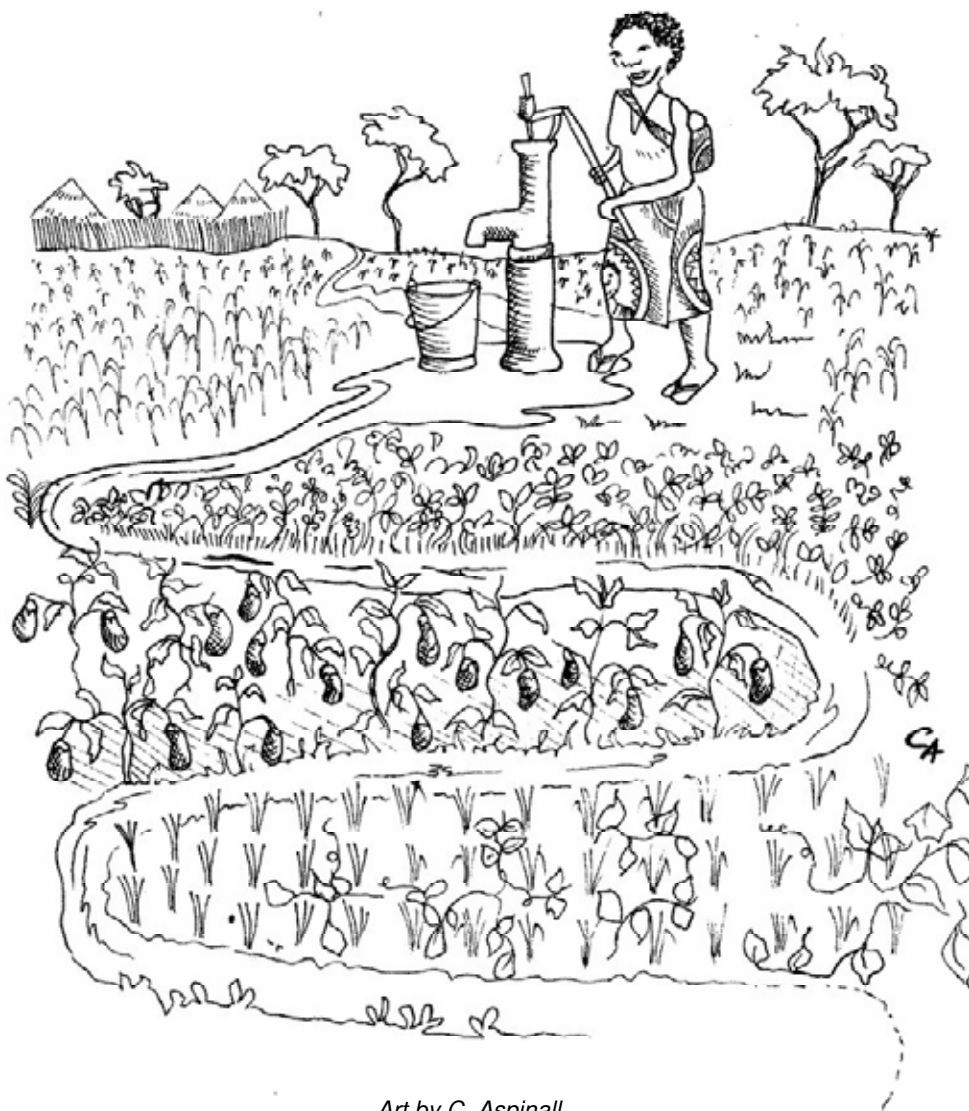


Art by C. Aspinall

Other Low Input irrigation methods

In addition to getting water down near the roots of your plants and trees, there are other strategies to help make the most of your water, time and resources:

- ◆ Spot watering. Get the water toward the roots not wasted on leaves & pathways. This may mean taking off the rose spout off your watering can and instead pouring the water slowly around the base of the plants, right onto the mulch.
- ◆ Gravity. When you have a water source uphill, you can use channels to guide the water throughout the area you want to irrigate. Using creativity, you should be able to get the channels to 'snake' their way back and forth at a slight angle to the slope. You shouldn't have to use any other watering if this is successful. If your water source is a steady stream or river, you might need a system for shutting the water off so that plants and trees don't get over-watered. This takes some practice and observation to learn how water follows down the slopes in the land, always working its way down the lowest points along the way.

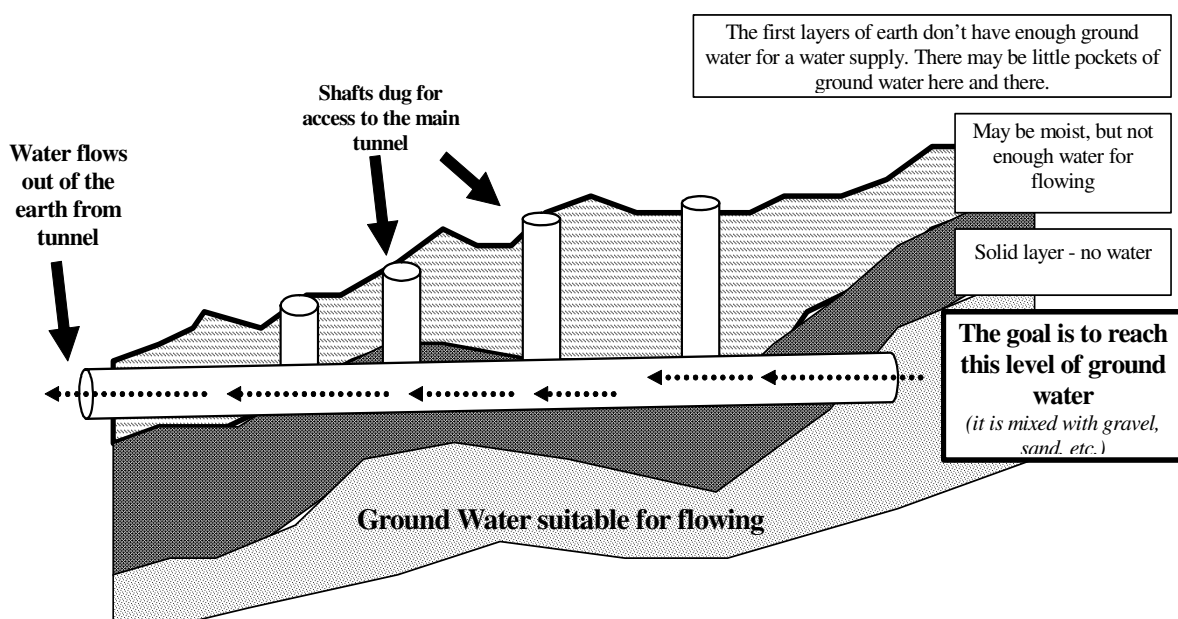


Art by C. Aspinall.

Higher input irrigation methods

Sometimes using a bit of input now means benefiting for a long time with very little input afterwards. The impact of each method needs to be considered.

- ◆ Treadle pumps⁵. Not every site is suited for a treadle pump. Treadle pumps are great if there is a lot of water at the bottom of a hill or slope and if your goal is to bring that water uphill. If you have water uphill, then it is better to let gravity do the work for you (see the previous bullet). The current types of treadle pumps have a very strong force of water and care needs to be taken not to damage or drown the plants and trees. Instead of pumping the water around the plants and trees, some people are preferring to pump the water uphill into a small pit, then use the gravity methods as described previously.
- ◆ Solar or wind pumps⁶. The sun and/or wind can be used to create energy that runs a water pump. There is an initial input to acquire and learn the technology and to do some maintenance, but then there is no pumping work as the sun or wind does the it for you!
- ◆ Artesian wells⁷. This form of irrigation tunnels horizontally into the ground water in a way that the ground water flows out by gravity. With this method you need more understanding of the different layers of earth and where water gets trapped in the layers. Malawi has had these systems since 1987 and they can be seen in Chitikkula, Kasungu and Dedza. The initial set up of most artesian well systems needs:
 - Locating the ground water - someone that knows how to find water sources (through knowing plants and trees, or by using divining with certain sticks, rods of other item).
 - Labour to dig into the ground to tap into the ground water and to dig shafts to allow for removal of dirt and maintenance of the system.



Artesian well designs computerized by S. Nordin based on sketch and description provided by F. Hakimi, Agro-In Farming. All errors are S. Nordin's! See appendix for F. Hakimi's contact information

Teaching about Water

- **Water flow** - This is a hard concept for many people to grasp. Observe water flow from any source and manipulate its flow and discuss it. Encourage people to keep practicing to learn the way water flows. Once it is learned the main tools you will use in making water harvesting designs are your eyes.
- **Water / Soil Erosion demonstration** - A simple demonstration can be set up to show people how water reacts with different types of landscapes:
 - ◆ **Three areas:** We use a wooden box that has 3 sections, one for a bare area, one for a ridged area and one for a well-planted, natural-type area. It is important to make the areas as similar as possible except for the following. **Bare area:** This area should mimic a bare swept area. Pat down the dirt in this area so that it is hard on the surface. **Ridged area:** This area should mimic a typical farm field. Pat down the dirt, then make ridges across the contour, or for worse results in terms of erosion, straight down the box. **Low input area:** This area should mimic swales, mulching, composting, and all the good practices in this model for soil and water health.
 - ◆ **Box design:** Three sides of the box have wooded sides, a wooden bottom and wooden dividers between the 3 sections. The front side of the box has screening that will allow the water from the demonstration to exit the box.
 - ◆ **Pour water, collect in container:** The box will be propped at an angle and the same amount of water will be poured at the same rates to mimic rain or irrigation and to show what happens in each type of landscape. At the screening end of the box, a clear container will catch whatever water comes out, using a separate container for each of the 3 areas.
 - ◆ **Discussion:** The container used bare area
 - ◆ **No box option:** A box isn't necessary; a pile of dirt sectioned off into three areas also works, but you will just have to observe the erosion instead of collecting the water.



Testing your understanding of water management

1. How does water cycle from rain to rain again? Describe the basic steps.
2. Name at least 3 things humans do to interfere with the water cycle.
3. Describe the water table and how perennials survive without water.
4. When managing water, what are four 'S' words that are helpful for planning a design?
5. Describe at least 3 ways you can harvest rain water at your home, work or surroundings.
6. Name at least 3 things you can do to reuse your 'grey' water at home, work or other place.
7. List at least 2 things that are important to remember in any irrigation system.
8. Describe at least 3 low input irrigation methods.