

## Topic 4: Soil Health Concepts

The groundwork has been laid so that, hopefully, you now want to know how to get these foods out of your soil. All food originally comes from soil whether you are harvesting a plant food directly from soil, or harvesting an animal food that eats the plants— soil is the basis of our food production. Take a step back to the Nature Cycle and to the Cycle of Better Living to remember what else goes into growing food. We have to have the sun, air, water, and nutrients. How do these work together with our soil to create a healthy diet for us?

### Understand how soil works

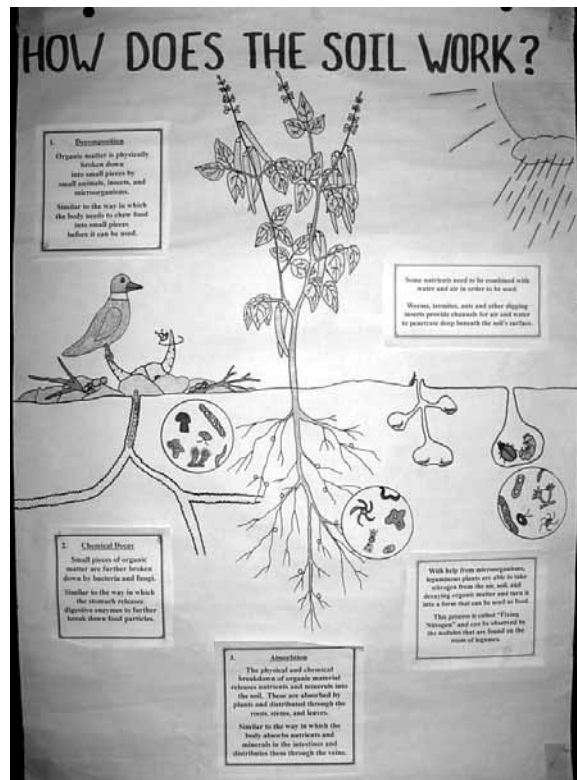
All living things rely on and eventually return to the soil. The health of our soil is directly connected to our own health. Whatever we do to the soil we are eventually doing to ourselves. If the soil becomes ruined, this will affect the nutritional value of our foods. If, on the other hand, we are able to learn from nature about methods that help the soil, we will have taken the first step towards making our lives better. In David Patient's Positive Health manual, he describes the soil like a savings account. The more we put into it, the wealthier we become. But if we continue to take from it without making any deposits, we will eventually end up broke.

How does nature keep soil healthy? Think of a natural area, does anyone go to natural areas to dig to keep the plants healthy? No! Nature uses roots of plants, animals that scratch the earth and decomposing organic matter to dig the soil at different depths.

Does anyone buy fertilizer and pour it near the wild plants and trees so that they have food? No! Nature returns everything back to the soil. The leaves fall to the ground along with every other living thing and this is what feeds the soil.



*Take care of your soil so you can get your 'money' out of it!*



*Full page poster available in appendix*

Also think about what nature plants – is there just one type of tree in a natural area? No! Nature has a wide variety of different trees, plants, vines, roots, animals, insects, and very small creatures in the soil that our eyes can't even see. This variety helps to keep the soil healthy. The roots of the different plants and trees dig at different levels under the soil – some go deep to break up rocks far below and bring up minerals, others work to dig shallow, while others dig wide, like tubers. The animals and insects are working all the time to drop manure, to crush organic matter, to scratch the soil looking for insects to eat, and to keep a balance in nature.



Now take a minute to think what humans are doing to interfere with this. You should be able to come up with a long list! The soil is harmed by:

- |  |  |
|--|--|
| ☹ paving the earth                             | ☹ sweeping the earth                             |
| ☹ chemicals in the soil and/or killing insects | ☹ digging into the soil disturbing insects       |
| ☹ burning the bush or any organic matter       | ☹ compacting the soil by stepping on it too much |
| ☹ mono-cropping forests and agricultural areas | ☹ clearing away plants and trees                 |
| ☹ overgrazing                                  | ☹ erosion from steep planting                    |



The list is longer than this in real life, and it includes things that are happening in every part of the world, unfortunately. What can we do to care for our soil without a lot of work? Mimic Nature's lessons!

**This model will focus on 2 concepts that are key for helping the soil maintain its health:**

- 1.) Conserving the Soil      2.) Fertility and Structure**

**Teaching about how the soil works:**

- **Nature Cycle:** Refer back to the Nature Cycle poster and discussions that you had with your group (see table of contents).
- **Soil structure:** Draw a picture of what is happening under the soil. The poster the Permaculture Nutrition project uses shows one large bean plant showing equally the top green part of the plant and the roots underground. See the appendix for a sample poster
- **Connect to Digestion:** The processes that happen under the soil are just like digestion Highlight decomposition happening at the surface with insects and small animals chewing up the organic matter; then show worms, termites and microorganisms breaking down the food further like enzymes in our mouth, stomach and intestines; and finally show the roots taking up the nutrients like how our intestines absorb food.
- **Go Outside!** : After discussions, go outside and look at different types of soil - healthy and unhealthy and discuss what is happening in each situation.

## Conserving the Soil

### **Mulching: Dead or Alive Nature is always covered!**

Nature is always covered! Mulching is when there is a layer of leaves, grass, husks or other organic matter on the soil between the plants. Mulching can be alive or dead such as dried leaves, stones, sawdust, and /or live vines. This layer is similar to a 'blanket' or 'clothing' that we put on our body to protect it from the environment. Mulching has many benefits, it:

- ☺ Keeps the soil cool and moist, even when the weather is hot. This reduces the number of times that you need to water the plants in the dry season.
- ☺ Creates a soft layer of dirt that is easy to plant directly into during the rains or irrigation – no digging is needed! You might want to make a small hole for the seed or seedling, depending on the situation.
- ☺ Keeps the soil protected from rain and wind so that the soil isn't washed or blown away.
- ☺ Keeps the plants protected from being splashed with soil when it rains or during watering.
- ☺ Adjusts better to either very little water (drought) or a lot of water (flooding) than when organic matter is cleared away.
- ☺ A heavy layer of thick mulch prevents unwanted plants from growing between the plants. (These are commonly called 'weeds', but all plants have very useful purposes!). A light layer of thin mulch still allows small seeds to sprout.
- ☺ And best of all, this means less work each day!



**Why doesn't everyone mulch with all these great benefits?** As we developed this model, there were only two projects that were mulching their soil – myself and the Malindi Orphan Care Group. The Malindi group has another way of helping people understanding mulching. They ask us to think about the difference between a bald man standing in the sun and a man with hair. The man with no hair will be burned by the sun very quickly, whereas the man with the hair will be protected from the sun for much longer. This is just like mulching – it is 'hair' that covers the soil to protect it.

Most participants are very wary about mulching their soil for the following reasons:

- **A fear that mulch is dirty** – This depends on whose eyes are looking at it! Nature is always covered and this is the way the creator intended it to be. Uncovered soil is actually dirtier – it is dusty in the dry season and muddy in the rainy season – what a mess!

- **A fear that mulch will bring snakes** – But, where do snakes *really* like to live? Snakes don't want to be around humans, they prefer to be up in a tree, under a nice pile of rocks or sticks, or in a hole.
- **A fear that mulch will bring termites that will hurt our plants** – Think about a termite and what it does in nature. Their job is to decompose the dead or dying organic matter and make it back into soil. Their job is not to eat live healthy plants. But, if we sweep away and burn all the termites food, they are going to look for the deadest things they can find and eat it! Most people in Malawi know that termite mud is full of nutrients and will collect the mud and put it in their gardens – yes, termites are a great thing!

### **Reduce sweeping the dirt!**

In Malawi people are taught that sweeping the dirt is 'clean'. The sweeping lessons start for a young child at home and then are reinforced in our schools where our children spend hours of their lives sweeping dirt, and then just about every program reinforces it more. But is sweeping the dirt really clean and healthy? There are many projects now in Malawi, including over half of the people that took part in making this model, who are reducing or eliminating sweeping.



*Art by C. Aspinall. Based on a photo of Ethel Kathumba of Chitedze demonstrating the harmful habit of sweeping.*

Sweeping removes organic matter from the top of the soil, which removes the food and protection the soil needs to stay healthy. Sweeping makes the earth hard and doesn't allow water to sink into the soil, causing erosion through wind and rain. When large areas are swept, it reduces the amount of land that we can use for growing food and other useful items.

This model is just asking people to think about sweeping. The following issues are written in the form of questions so that you think about them and discuss them with others around you.

- ? What is dirty about the leaves and grass that is swept away causing the real dirt to be exposed? Leaves and grass do not cause disease or health problems, in fact they do just the opposite by feeding our soil, which can then feed us better and improve our health!
- ? Isn't uncovered dirt actually more exposed and therefore dirtier? It is definitely dustier and muddier! What about all the dust that sweeping causes, what does that do to our lung and eyes? It is very hard to breath and see with a lot of dust in our air.

- ? Woman, young girls and students put a lot of time into sweeping everyday. Men put much less time into slashing an area as it only needs to be slashed one or two times a month. It takes a lot less time for men or women to slash an area than it does to sweep. Just think about what we could do with all that extra time - and even less time is needed for slashing when most of the ground cover is edible plants instead of grass!
- ◆ Shouldn't we be concentrating on really unhealthy things such as animal manure that needs to be moved, plastics which are blocking the nature cycle, and food scraps that attract flies? Organic items should be picked up with a stick, a rake, or other simple tool and put into a compost pile with a layer of dried organic matter or dirt put on top. Food scraps shouldn't be thrown on the ground in the first place unless it is in a garden bed, but even then it should be covered with dry material to prevent flies. A system of reusing plastic should be developed for every household and community. One community uses clean plastics to use as a soft stuffing for dolls, cushions and pillows. They rip the plastic in to small pieces and stuff it into a cloth the shape of the item they want.

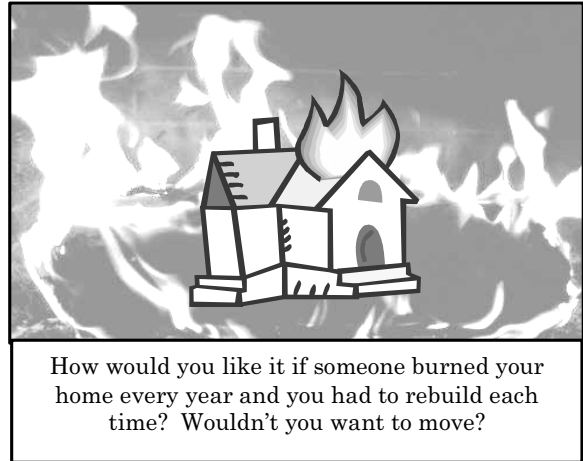
### **What are some ways that people can take steps to reduce sweeping the dirt?**

- ✓ Mark out areas: Start by choosing areas not to sweep and instead start putting all organic matter in that area. Use rocks, or logs, or mound up the dirt, or any other way to mark out the area so that *looks nice* and people can tell that what you are doing is on purpose.
- ✓ Improve the non-swept areas: Start throwing all your waste water (from clothes, dishes, bathing, mopping, etc.) in the un-swept area and sprinkle some natural seeds from food plants. Over time you can move the rocks/logs further out, reducing the swept area and at the same time making the gardens bigger! Keep going!
- ✓ Rake instead of sweep: In areas that you still want to sweep, think about using a rake instead. To make a rake, use larger branches to make your 'broom' so that will just remove large things but not damage the soil or make dust. If you use raking, you can still make the area look neat but leave small pieces of organic matter that will allow plants to grow in your pathways. These plants can be slashed from time to time so people can walk or drive through. Most of the time the pressure of walking and driving keeps the plants low.
- ✓ Pardon our appearance: When you are changing from sweeping to not sweeping the area may look messy at first while you are establishing new plants and trees in the swept area. This is similar to any building construction project – it looks messy during the construction. Most construction sites put up a sign that reads “Please pardon our appearance as we are constructing”. You may wish to create a similar sign!
- ✓ Education opportunity: The hardest part of reducing sweeping is to convince your neighbors why you are doing it. This is a great opportunity to explain about why you are caring for the soil and eating differently and that they could do it, too. Offer to work with them at their home to discuss ideas.

### **Eliminate bush burning**

The next harmful practice that is not so difficult to convince people about is burning. Pretty much everyone will respond that burning is harmful to:

- the air;
- insects and micro-organisms who are trying to keep the soil healthy; and
- the foods, medicines, fuel trees and thatching that is trying to grow for us to use.



The hardest part is to get people to stop! Everyone blames burning on everyone else, but no one is stopping it which is just as harmful. So from June through November every year, practically the whole country turns black and filled with smoke.

There are many ways to start reducing burning in Malawi. We need to start with ourselves, then next with the people who are closest around us. Help them understand the nature cycle, the importance of the things that are burning, the harm that the smoke is having on the birds and the bees and other things that breathe the air. Together you can work on the whole community, then the district, the region and the nation! It would be helpful to have the nation support these ideas now with a law against burning like some countries have. It is a simple, yet difficult thing to stop, but we do have the power to start working on it!

### **Reduce tilling**

What does a hoe do to the nature cycle's decomposition stage? Disturbs it! All those insects, worms and micro-organisms are busy under the earth working for you, why would you want to cut into their work and disturb them? It is much better to feed the soil's creatures organic matter and disturb them as little as possible. It is helpful to look at nature and how it digs.

Nature has some deep roots to go down and break up rock and get minerals. There are wide roots that open up the soil to let water and air enter the earth. There are animals that scratch the surface and insects, worms and animals that make tunnels beneath the earth. All these methods combined means that nature doesn't use a hoe to till before it plants seed.

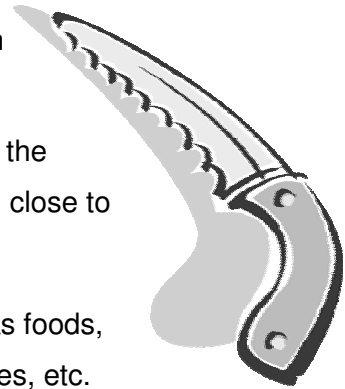
We can mimic this in our own lives by inter-planting trees and other deep rooted plants; inter-planting root crops such as yams or ground beans (*nzama*); allowing chickens to scratch around the mature plants; and keeping the soil covered with organic matter to protect and feed the insects and worms.

## **Clear the land carefully – use your eyes!**

Clearing the land to make a garden always makes me cringe and have a vision of destruction because that is just what most people do when they 'clear the land'. They walk into an area, cut out everything, burn it all, then replant seeds in the area, all the while complaining about the heat and the amount of time and energy they have to put into their garden! Funny how we do things, isn't it?

A better way to clear the land is to do it carefully. When clearing an area try using these methods:

- ✓ **Sickle**: Use a tool that allows you to use your eyes to examine the area. A good choice is to use a short hand sickle that puts you close to the ground.
- ✓ **Trim**: Cut out and trim or just slash around useful items such as foods, medicines, leguminous plants that feed the soil, building supplies, etc.
- ✓ **Keep the Roots**: If you decide that you don't want a plant or tree don't 'weed' it out, cut the plants close to the ground and keep the roots in the soil so they can rot. The areas where the roots rot underground will create a pathway for water and air to pass through the soil.
- ✓ **Mulch**: Cover the area with a heavy layer of mulch. If you have enough mulch, this is a great way to start preparing the land for planting. Let the mulch sit on the ground for about a month then plant directly into the mulch, or as is proposed in the next bullet, starting planting some now, then some the next week, etc. If the area was heavily swept and very, very hard, there probably aren't that many worms and insects living there. In that case, you will probably want to dig into the dirt the first year to loosen it up, just to speed up the process, and then mulch. You should never need to dig there again and the worms and insects will come back to live there and assist you.
- ✓ **Dig only where you have to**: You may need to dig small holes here and there through your land to put in tree seedlings or to capture water, but really think about it before you do!
- ✓ **Small sections**: When you decide what land you want to carefully clear, just clear enough to start planting some foods, then move on and carefully clear more and plant another section, then move on and carefully clear more and plant another section! Using this method you will be able to start eating from the first section by the time you are finished clearing.



### **Consider landscape slope**

It is even more critical on slopes that you clear the land with care! Land that has a slope needs special attention to make sure you don't cause erosion. Using a mulch helps to hold soil in place, but with steeper slopes you will want to make sure that you have some permanent contours or terraces using rocks and strong rooted plants to keep the soil in place.

More detailed ideas for this topic will be covered in the sections on water and designs.



### **Long lasting roots – Perennials**

Another way to conserve soil is to have some plants and trees that stay in the soil every year without replanting. These are known as perennials and they are great for many reasons:

- ✓ You only plant it one time but harvest for many years;
- ✓ They are usually very tolerant to a lot of rain and very little rains even to the levels of flooding and droughts;
- ✓ The roots help water go down deep into the water table helping to keep water in our soils throughout the dry season;
- ✓ Their roots hold the soil and their stems trap organic matter;
- ✓ The taller perennials can block the wind.



The appendix has a list of plants and trees which last for many years without replanting.

### **Windbreaks**

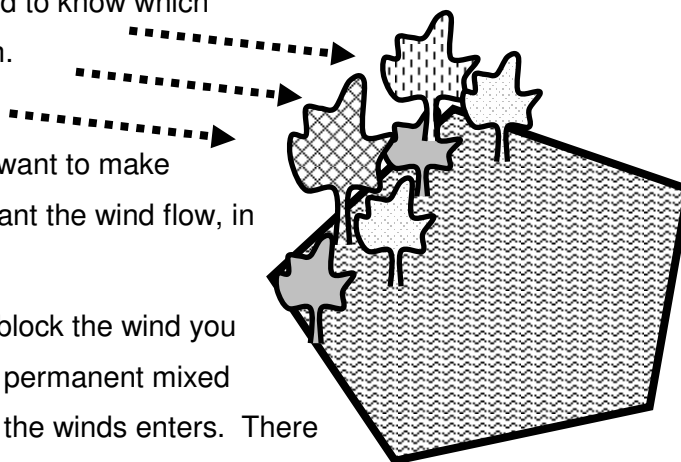
It gets very windy in Malawi during the dry season, especially during the months of September through November. During this season you commonly see dirt being carried away by small wind storms; plants, trees, buildings, and clothing are covered with dust; and sometimes we even see roofs being blown away. Wind can negatively effect the growth of small plants and seedlings. Wind can be very destructive!

But, the wind is blowing at this time of year to help us, too. It:

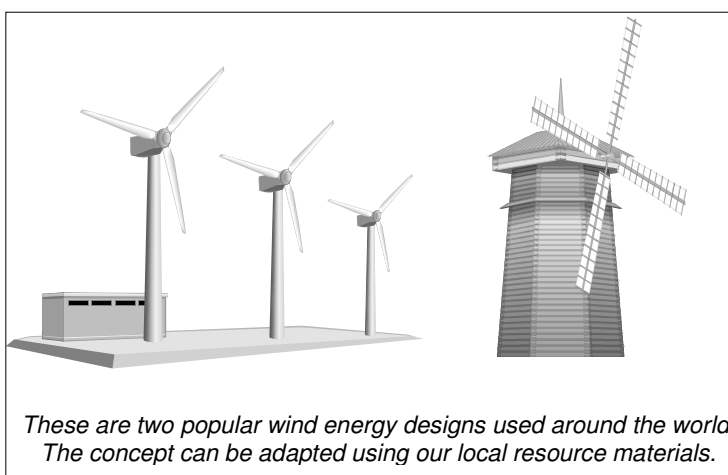
- ✓ Helps to blow down the leaves from the trees to feed the soil in preparation for the rains;
- ✓ Helps spread seeds so that they are ready to grow during the rains;
- ✓ Knocks down fruits for us, like those nice mangos that are just coming into season; and
- ✓ Keeps us cool!

In our designs we will consider all of these factors to create windbreaks that help protect us from the problems of wind, yet helps us make the most out of the positive aspects of wind, such as keeping us cool. To decide where you might want to block the wind you need to answer:

1. Where is the wind? First you will need to know which direction the wind usually comes from.
2. Why? Next you want to know why you want to block wind – or how you want to make use of it. In some cases you might want the wind flow, in other cases you might not.
3. How to use the wind? If you want to block the wind you may want to intersperse an area with permanent mixed species at the edge of the plot where the winds enters. There are many species that can be used – leguminous species, fruits, animal fodder, species that attract birds, tall trees mixed with short shrubs, climbing species – the design options are endless!



More advanced designers will want to capture their wind for energy production, a design that is popular in some places in Europe (like the Dutch who have used the technology for centuries), and the ideas are now spreading with concern about the shortage of energy taking place around the world. Wind energy can



*These are two popular wind energy designs used around the world. The concept can be adapted using our local resource materials.*

be used for pumping water so that we can drink or have additional irrigation sources, and it can be converted to fuel for cooking, lighting and all the other energy uses the same ways that we use our current sources of electricity. There are some renewable energy projects in Malawi that use the wind that are listed in the appendix under resources.

### Teaching about Soil Conservation

- **Definitely the best place is outside.** Look at Mulching, Sweeping, Burning, Tilling, Clearing land carefully, Slopes, Perennials, and Wind. Before you speak with the group, walk around the area yourself and have some places picked out that you will go to. As a facilitator in this model, you always need to have all your senses open and alert to teaching lessons!
- **Dramas with thorough discussions:** Especially on the cultural habits of sweeping, burning and hoeing would be entertaining and enlightening.

## Fertility and Structure

Some of the methods listed above for soil conservation also can assist with soil fertility and structure, such as mulching, reduced tilling, reduced sweeping and reduced burning.

### Assess Soil Type

Before doing anything to your land, you will need to study and assess the site, which will include looking at the types of soil you have. A single plot of land can vary a lot in soil type such as sandy, rocky, clay or loam. All types of soils were created for a reason and there are plants and animals that do well in all these natural conditions. Other times, humans have had a negative effect on an area causing an area to change – such as forested areas that had loam soil but have now become deserts covered in sand. There are different ways to work with whatever soil type you have:

1. **Keep the soil the way it is** and choose plants, trees, and animals that like that soil.
2. **Change the soil** and design to suit the plants, trees, and animals you want to raise. With this choice you can only do so much with, sometimes you are just stuck with what is there and it is better not to fight it!

Here are some ways for 'dealing' with your type of soil:

- ✓ **Sand:** Plant things that like sand such as jujube (masawo) or melons. You can help the sand hold water and nutrients by using a lot of compost and organic matter. You can also dig down about adult-knee-height-or-so under where you want to plant and put a layer of organic matter, rocks, or the like that will help trap the water from going deep into the earth.
- ✓ **Clay:** Plant things that like clay, sugar cane is one example. You can help loosen the clay by adding a lot of organic matter into the soil. You could also get some sand and mix it into the clay.
- ✓ **Rocks:** Plant things that like rocks, aloe or pineapples are two examples that will grow out of rocks. You can move some of the rocks from near the surface and use those same rocks for decorations, to line the pathways, to stop water from running down a slope, or other creative use.



In the appendix there is a start-up list of some of the species in Malawi and what conditions they tend to like.

## Organic production

Why should we encourage organic production instead of using chemicals?

- ✓ Chemicals are expensive to make. They use up a lot of the earth's resources such as fuel.
- ✓ Chemical fertilizers do not feed the soil, they provide a treatment like 'medicine' for the plant or animal so it can survive in poor soil.
- ✓ Chemicals can be toxic to humans, especially children, the elderly and those with reduced immune systems such as with HIV infection.
- ✓ Special training is needed in how to handle chemicals without getting poisoned or burned.
- ✓ Chemicals can poison the environment, especially our water sources and soil.
- ✓ Chemicals can kill beneficial insects, worms and micro-organisms either directly or by the effect the chemicals have on their environment.
- ✓ Insects and disease can develop resistance to chemicals.
- ✓ There are better options for designing our agricultural systems and homes so there is no need for these chemicals in the first place!

Chemicals are generally promoted when the soil is degraded, or the plants, trees or animals are unhealthy. This model aims at restoring soil health and design an environment that creates healthy plants, trees and animals. In the section on design, the model provides specific ideas on reducing and eventually eliminating the use of chemical fertilizers, pesticides, herbicides, fungicides and the like. In this section we will look at how to heal the soil's fertility and structure to put nutrients back into the soil and give the soil the ability to manage different levels of water.

## Including legumes in your design plans

One nutrient that most food plants need is nitrogen. Legumes are a type of plant or tree that help other plants use nitrogen (i.e., nitrogen fixing). Some legumes can be eaten and others cannot. You can tell a legume pretty easily because they have seeds inside a pod, such as:

- ✓ **Edible legumes:** beans, peas, ground nuts and ground beans (local names include *kamumpanda*, *kabaifa*, *nzama*, *mtedza*)
- ✓ **Non-edible legumes:** acacia species (*msangu*, *mtete*, etc.), tephrosia, leuceana, cassia (some can be eaten by animals)



Legumes can be inter-planted, rotated with other types of crops, or as a green manure (covered next as a separate method). Different types of plants and trees each have different nutrient needs, some need a lot of nutrients to grow and others need very little. Using inter-planting gives you more variety in your garden, farm, flower garden, and in your diet, too. Nature keeps itself healthy by inter-planting and planting things in different places over the years (rotating).

Inter-planting is quite simple (again, look at how nature plants), all you do is plant beans, peas, peanuts or a non-edible legume between the other foods. Legumes come in many different shapes and sizes so you will choose the legume that best fits in with the other crops and animals you are raising. You don't have to plant in rows or square beds (nature doesn't plant in rows or square beds), but you can if you prefer to. With row gardens insects and animals can find what they want to eat easier, with natural inter-planting these 'pests' have a harder time finding what they want. The design method used in this manual combines inter-planting and rotation and will be covered more under plant and animal health.

**Eat more  
Legumes & Nuts  
for a Healthy body  
and Healthy Soil!**

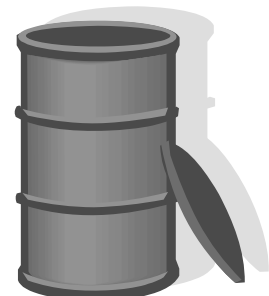
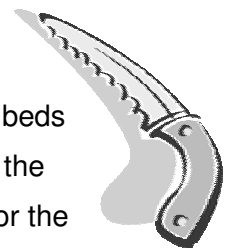
### **Green manures**

Green manure means adding fresh plant matter to the soil. You can use leguminous plants or other types of plants that provide other benefits. Some types of useful green materials are:

- Any legumes as we just reviewed, or
- Other greens such as tithonia, amaranthus (*bonongwe*), comfrey or other green.

There are different methods you can use to get green manures around your plants and trees:

- ✓ **Mulching**: Fresh green material can be trimmed off of plants and trees at any time of the year and laid on the ground like mulch;
- ✓ **Under-sowing**: This involves planting leguminous species throughout your beds then chopping them down in the dry season while they are still green. Use the green material as mulch on your beds and they will help prepare the area for the next rainy season. The timing of planting will depend on the species you choose and when it is mature. Agro-forestry species can be planted with the rains and they will be ready to trim in the dry season. Medium sized legumes, such as mucuna (*kalongonda*) would be planted mid-way through the rains so they are ready for trimming out in the dry season. Small legumes, such as
- ✓ **Cover-cropping**: Instead of planting something that you will harvest and eat or sell, cover-cropping focuses on planting the whole area with a variety of green manure species that will all go back into the soil from where it grew. This can be a good option for people who have enough land to grow their food needs somewhere else that year.
- ✓ **Green manure tea**: The green material can be put in a bucket of water (about 1 handful of green material per litre of water) and allowed to sit until it ferments. You can stir it occasionally to assure the plant material mixes well with the water. After it is fermented (2-3 weeks) you can start using it by watering it down at about 250 ml of green manure tea to 10 litres of water.



## Animal manure – human and others

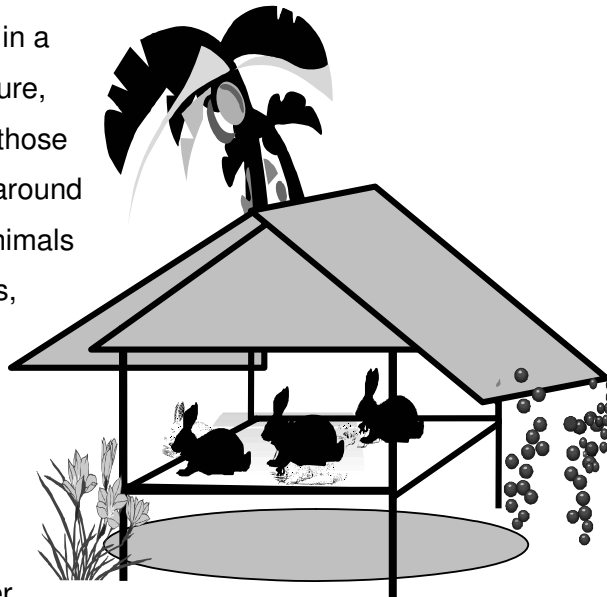
Integrating animals into designs has many benefits for food security, money, labour, and manure. Humans are also an animal that can provide manure. Whatever type of manure is used, care is always needed in handling fresh manure, as manure is made up of the waste products that the body did not want or need such as bacteria, worms, fibers, plus a lot of nutrients needed for the soil!



- ✓ EcoSan or composting toilets – Most of the current toilets in Malawi are missing out on a great opportunity of producing a wonderful fertilizer for us to feed to our plants and trees so that they can feed us. So-called modern toilets go one step further and waste a lot of precious water with every flush. There are several sites in Malawi teaching people to use human manure and make it into a rich compost (see the appendix for contact details). We personally have used different types of composting toilets for the past 10 years.
  - The idea is that each time the EcoSan (ecological sanitation) toilet is used, a handful of soil and a handful of organic matter is added. A large clay pot with soil and one with organic matter can be kept right inside the toilet. Over time there is a layer of human manure—soil—organic matter, then human manure—soil—organic matter, etc. This allows the micro-organisms to digest the food and to create a healthy soil. (Current outhouses in Malawi just have layer after layer of manure and urine which doesn't break down well.) Another benefit to layering with organic matter and soil is that the person generally scoops them up with their hands, providing a good reminder to wash them!
  - With some designs, when the hole is almost full, you cover it with soil and plant around the hole so that the roots of the plants and trees tap into the nutrients. These designs use a privacy structure that is easy to move, such as a small grass house, or a woven mat. Some designs include a moveable sanitation platform (san plat), too.
  - Other designs use the same concept but, in a permanent structure. The manure-soil-organic matter layers are captured in a container or hole, and when the container is full, it is covered and another container is used. After a specified time frame (6 months to a year), the compost is taken out of the container or hole, and used just like any other compost. When you hold this compost in your hand, you will never know that it came from a composting toilet – it just looks like the best rich compost that you've ever seen!



- ✓ Animal Pens “Khola” – keeping animals in a *khola* makes it easier to collect the manure, but it also means that you need to feed those animals instead of the animals walking around finding their own foods. Uncontrolled animals are a BIG problem in Malawi for vehicles, dropping manure in public places, and eating our plants and trees. There are creative designs for raised pens that make it easy to collect the manure, or allow the manure to drop right into a compost pile that you add organic matter



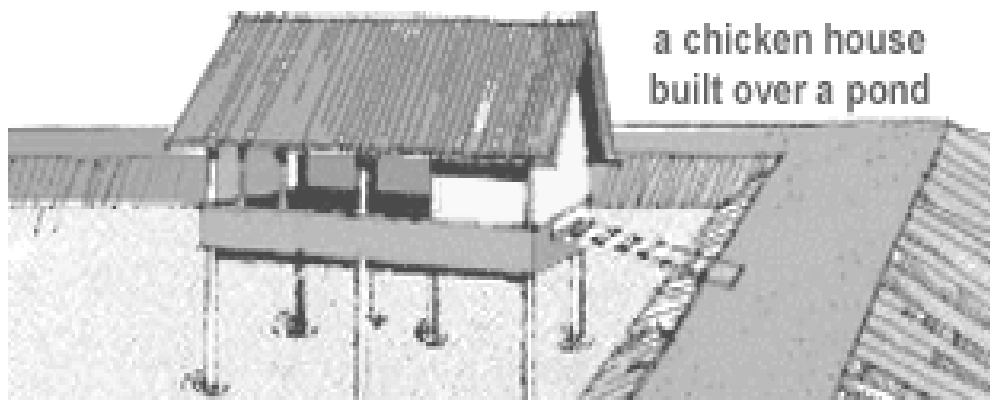
This drawing shows one possibility for an integrated animal pen – there are many other shapes and sizes depending on the animal you are keeping and what that animal’s needs are. Designs can be made with mud, bamboo, live trees, etc. and plants and trees can be put close to use the nutrients that are near the pen and at the same time to provide shade and food for the animals. They can be integrated with worm growing, fish farming, or other soil fertility design.

layers to once and a while, or allow the manure to drop right into a fish pond to feed the fish, taking care not to over manure the pond. Live fence poles can be used – some people in Malawi already use live fencing to keep cattle and goats contained. These pens can be built with several separate areas so that the animals stay in one area for a few months and cropping takes place in the other pen, then switch the animals and crops. Bedding can be used inside the pen and changed from time to time as one way of collecting manure and urine.

- ✓ Integrated Fish Farming - The following information on integrated fish ponds is adapted from FAO Training Series, Handbook on Small-scale Freshwater Fish Farming. Chapter 17: Your farm and your fish ponds<sup>2</sup>. See the resources in the appendix for information.

Today, many farmers have learned that they can manage their fish ponds together with their farm animals, gardens and fields so that they will all grow better and produce more. Fish, animals and plants live and grow in different ways and produce different things that can help all of them to live

and grow better. You have already learned how to put animal maure into your ponds so that the water



will be rich in the natural foods that your fish need to eat. In this way, the animals help the fish to live and grow better. Here are some other ways to manage your farm animals, gardens and fields so that they will help each other to grow better and produce more.

- ✓ **You can raise ducks** in your fish ponds so that much of their manure will go into the water.

This will help your fish to grow. At the same time, the ducks will feed on the plants that grow in your ponds and help to keep your ponds free of plants, weeds and snails.



- ✓ **You can raise chickens or pigs** near your ponds. If you build chicken houses and pig pens on the banks or over the ponds, you can sweep the manure into the ponds. If you have built your ponds side by side, you can build a chicken house or pig pen on top of the bank between two ponds and sweep the manure into both ponds. Your ponds will supply water for the animals and the animals will supply fertilizer to help keep the water in your ponds rich. be careful not to put too much manure in your ponds, per 100 square metres of water use at most the manure of:

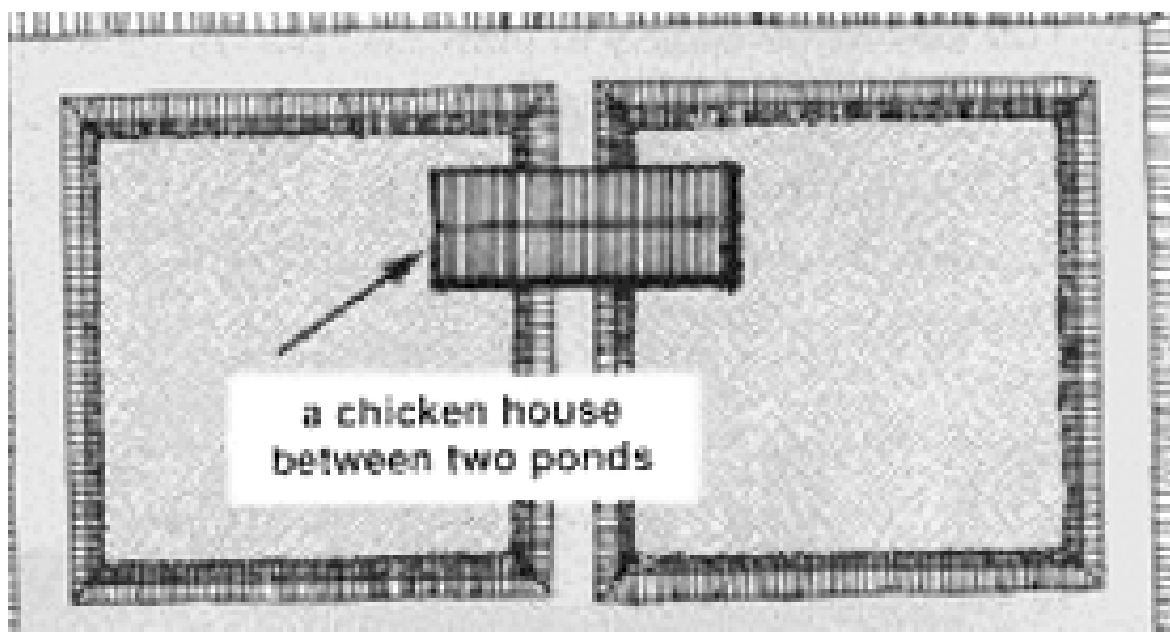
→ 4 to 5 ducks or



→ 5 to 8 chickens or



→ 1 to 2 pigs

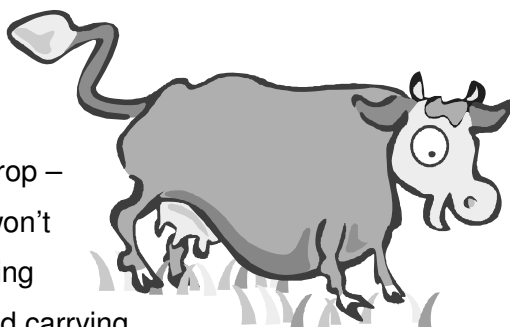


- ✓ **You can plant your guild** on the banks of your ponds. It will be easier to irrigate your plants and trees if they are close to a pond.

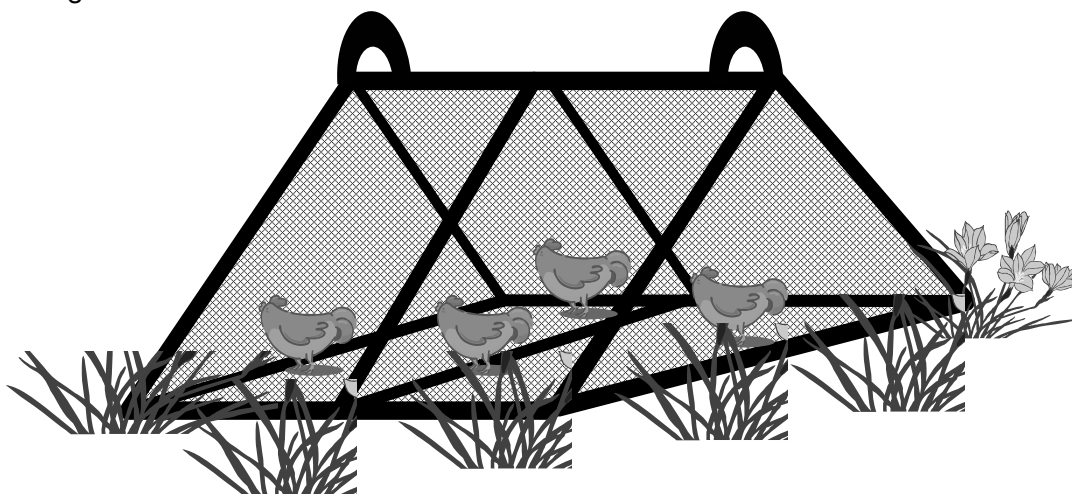
- ✓ **Pond mud, great fertilizer:** If you drain the water from your ponds to harvest the fish, you will find a layer of soft mud on the bottom. This soft mud is a very good fertilizer to put on your garden or fields, or on your pond banks if you are growing vegetables there.
- ✓ **Irrigation:** Any drain from the pond can be guided into your plants and trees.
- ✓ **Plant and tree wastes** such as plant leaves and stalks can be fed to your chickens, ducks or pigs or they can be put into your ponds for your fish to eat or made into compost to help keep the water green and rich.

So, you can see that with very little extra work you can manage your fish, ducks, chickens, pigs, farm fields and garden in such a way that they will help each other to produce more, meaning less work in the long run, a healthier balanced environment and more food and money!

- ✓ **Free range animals.** If you don't keep your animals in a pen, then you can encourage your animals to range where you want the manure to drop – such as in a field, an orchard, or other area they won't destroy. You can also collect the manure by walking around and scooping it up into a basket or pail and carrying it to where you want it, that's a job that will get people's attention!



- ✓ **Animal tractors** – this is a combination of using a *kholā* and semi-free ranging. It uses a movable animal pen that allows the animals to graze in an area, then after the area is grazed, the pen is moved to another area. It works well with chickens, guinea fowl, ducks, rabbits, guinea pigs and other smaller livestock. An easy animal tractor to make is made like a tent frame, the covered in chicken wire or reeds. The bottom of the structure does not have to be covered as that is where the animals will graze, but if you have chicken wire you might choose to use it.



Using animal manures. If you are collecting a large amount of fresh animal manure, take care when handling it. Fresh manure can carry disease that can cause problems for your plants, trees, and you, so take care in handling any types of manure. It is important to let fresh manure decompose before putting it onto plants and trees. Using bedding inside of pens helps to breakdown the manure and to provide a mixture of nutrients.

- ✓ Include as a layer in compost piles. Composting is covered in the next topic. After your various layers of organic matter, you can include a layer of manure, then more organic matter. Fresh manure should never be the top layer of compost piles to avoid flies.
- ✓ Make liquid manure. The process is the same as for green manure plant teas.

### **Low Input Composting**

Many projects and individuals jump to compost as an intervention as their first line of improving soil fertility and structure, but, as we just discussed, there are many other ways to improve fertility and structure. Before choosing composting as a method for your land, consider the options and choose what is best for the site. It may be better for you to combine mulching with a variety of materials, inter-planting leguminous plants and trees, integrating animals, and reducing tillage instead of composting. Most sites will have some level of composting integrated into them, but composting alone isn't the answer to most of the soil problems that we are having!

Composting is a way of copying natural decomposition. Nature mulches the soil with a variety of different dead plants, trees, animals, and insects and then when moisture is present from dew or rain, the organic matter disappears into the soil very quickly. There are many different ways to make compost, none are really right or wrong so choose the way that works best for your lifestyle – ***most importantly, just get all organic matter back into the soil!***

How does the soil work? Before talking about methods of composting, it is useful to review what happens inside the soil. This is a good review of the way we as humans digest and absorb our foods the processes are very similar!

- ✓ Chewing: Insects and animals 'chew' the organic matter into smaller pieces just like we use our teeth to chew.
- ✓ Digestion: The smaller pieces mix with chemicals in the soil and release the nutrients from the food. This is similar to the chemicals (enzymes) in our saliva and other juices in our stomach that mix with the foods.
- ✓ Absorption: The nutrients enter the plants and trees through the roots so that the plant can have energy to grow, breathe, and protect itself from disease. This is similar to how we absorb nutrients in our intestines.

## **Basic Principles for Making any type of Compost**

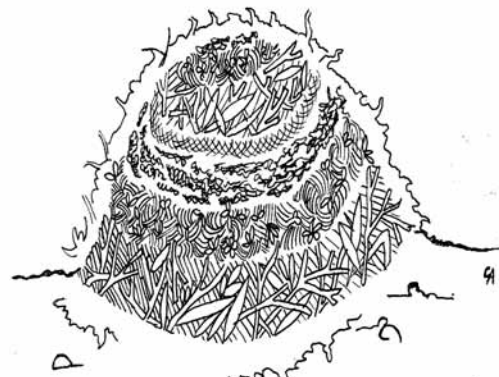
- ✓ Use a variety of different natural items – anything natural can go into compost. The key is variety and balance. The compost needs a variety of foods to be healthy just like we need to eat a variety of foods to be healthy!
- ✓ Balance the amount of air, water and heat to make the compost work quickly. With too much air or too little water the pieces will break down slowly, with too much water the pieces will become waterlogged and the compost will slow down. Luckily, it's easy to learn this balance with a little practice.
- ✓ Do not use plastic or other items made from chemicals, commonly referred to as 'man-made'. You will have to think about where the items came from – paper, leather, and cotton clothes all come from natural materials and will eventually be food for the soil (you'll also have to think what happened to the item along the way, such as whether it was painted or dyed with chemicals).
- ✓ Put the compost pile where it will be most useful. Do you have a tree you can put the pile near so the tree can protect the compost from sun and so the tree can benefit from the nutrients in the compost? Is it better for you to have your compost in your field or around your home? Or, better yet, have many compost piles/pits in many places! Get creative, compost can go anywhere and can be any size!

### **A few ideas of natural materials for a compost pile:**

- ✓ Dry leaves or grass
- ✓ Sticks or twigs
- ✓ Dead "weeds" (unwanted plants)
- ✓ Torn paper or cardboard
- ✓ Tin cans or other metals that rust
- ✓ Kitchen scraps: peels, cobs, ANY inedible skins (*eat all edible skins!*), unwanted pieces of food
- ✓ Manure (ANY type)
- ✓ Bones
- ✓ Feathers, fur or hair
- ✓ *Anything from nature!*

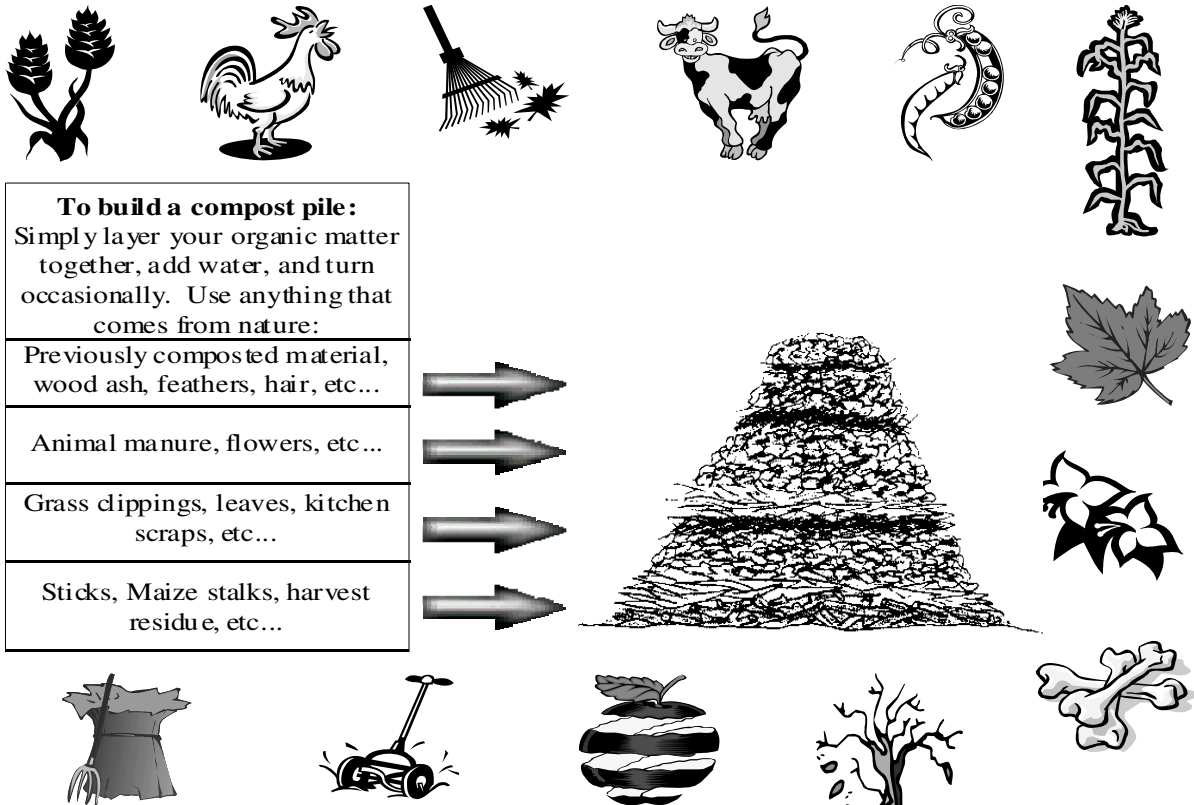
**Pile Compost:** These usually take the least work as you just pile items on top of each other. But, to finish quickly they need a bucket or two of water every week in the dry season. You can just let them sit, but it will take longer and the process will slow down until there is moisture.

- ✓ Start with the largest pieces to allow air to enter the pile from the bottom.
- ✓ Layer different items changing from dry materials to wet materials (*like fresh food, fresh manure, freshly cut grass*). Always cover the wet materials well with dry materials so insects aren't attracted to the pile. (*Optional: Some people like to cut up items which will speed up the compost, but means more work for you. Decide how quickly you need your compost!*)
- ✓ Keep layering until about chest height then stop adding new materials (*start another pile with new materials*). You can add a pail of water in between layers if you have it (this can be 'grey' water, like from washing).



Art by C. Aspinall

- ✓ If it is a very dry area you can cover the pile with large fresh leaves (like banana, palm or papaya), or with mud to help keep moisture in the pile.
- ✓ Heat monitoring pole. The compost should get hot inside after a few days. You can put a pole in the middle of the pile then pull it out after a few days and the pole should be warm.
- ✓ After about 3 weeks turn the pile over and add water (if you have it and if the pile needs it). Observe the pile as you turn it. Use it after 1-2 turns (6-9 weeks). Allowing chickens or other animals to scratch through your pile will make a mess, but they also mix the materials up for you. Just pull together the pile with a rake, your hands, feet, or other tool.



**To build a compost pile:**  
 Simply layer your organic matter together, add water, and turn occasionally. Use anything that comes from nature:

Previously composted material, wood ash, feathers, hair, etc...
Animal manure, flowers, etc...
Grass clippings, leaves, kitchen scraps, etc...
Sticks, Maize stalks, harvest residue, etc...

Source: *Permaculture Nutrition training manual, draft 2003, Kristof & Stacia Nordin, [nordin@eomw.net](mailto:nordin@eomw.net)*  
 Full page handout available in the appendix.

**Pit compost:** These generally take more input than pile composts, but it is not always the case. These require digging a pit, or using a pit that is already dug, such as from where bricks were made, or an old burning pit (*since you are now making compost so you will burn a LOT less!*). A pit compost may be the right choice for you, depending on your situation, but a few points to consider before digging a pit are:

- (1) These pits require reaching down and getting the compost back out of the pit when it is done, which is more work than using the pile compost.

- (2) This compost isn't turned over; it just sits until it is done. It also doesn't need water added after it is made as the pit prevents water from escaping as quickly from the compost.
- (3) It takes longer for the compost to finish.
- (4) Many people find it most useful out in their fields so they just layer in organic matter at harvest time and cover it, then it is ready for use in the next planting season. People that use diversity in what they raise will have nice healthy compost!

If you do choose the pit-type of compost, use the same concepts as for pile composts, layering a variety of different natural materials. Adding a bucket or two of water while it is being made may be helpful, depending on how moist the area already is. When the pit is filled, cover it with a layer of dirt and then mulching to help trap moisture and protect from sun and wind.

**Using compost:** The nutrient levels in the compost will vary depending on what you used to make the compost. Compost can be used as:

- ✓ Food to fill planting stations for seeds, seedlings, pots, or planting tubes (or reused bags!).
- ✓ Top dressing for plants and trees (*then add mulch to protect and hold the compost nutrients*)
- ✓ Liquid compost using the same recipe as was discussed in green manures tea.
- ✓ Food for animals such as chickens or fish.

### **Avoid compacting the soil**

Now that you've made fertile and well-structured soil, avoid disturbing it.

- ✓ Avoiding hoes, tractors and other things that disturb the soil is one way as was discussed in soil conservation.
- ✓ Another important thing is not to put heavy things on it – like yourself! Avoid stepping on places that you want plants or trees. Make pathways for people to walk on, and encourage their use. Think about a pathway that is walked on over and over, it gets really, really hard. You don't want this to happen to your gardens or farms. We will discuss permanent pathways and other methods under design.



### **Testing your understanding of Soil Health**

1. How does the soil maintain its fertility and structure?
2. Name 3 actions that negatively affect the soil's fertility and/or structure.
3. Describe at least 3 ways to conserve the soil and how you can use them in your own life.
4. Describe at least 3 ways to improve soil fertility and structure and how you can use them in your own life.

## Teaching about Soil Fertility and Structure

- **Posters:** Refer back to nature cycle poster. Use simple drawings to show the structure of the soil under the ground - all the insects, organisms, roots, rocks, sand, clay and discuss how they interact. Draw a picture of compost and how it works.
- **Connect to human health and illness:** Refer back to nutrition and the food groups for humans and link it to the diverse food the soil needs to have 'good nutrition'. As nutrients are used up in the soil, they have to be replaced, just like we need to keep eating to replace the nutrients we use to live. In most places in Malawi, the soil nutrients have been 'used up' without replacing them, so people have become dependent on adding chemical 'nutrient pills' - similar to a very malnourished person who may need medicines and nutrient pills until they are healed. Once the person is healed, they can get all their nutrients from a balanced diet. It also takes time to heal and rebuild the soil using the techniques in this model - but the chemicals will be reduced every year. Specific guidelines should be developed to help people wean themselves off of fertilizers - such as how much compost, manure, and legumes are needed.
- **Or, another option - stop using fertilizer now!** People can immediately and completely stop using fertilizers if they choose to raise and interplant crops that don't take a lot of nutrients such as beans, nuts, sunflowers, root crops, millets, sorghums, fruits, melons, etc. Add some animals, such as ducks, chickens, or guinea fowl into the fields and have even better soil fertility and structure more quickly!
- **Connect to purchased NPK, CAN, etc.:** Malawi generally uses NPK 21:23:0 meaning 21 percent of the bag is Nitrogen, 23 percent is Phosphorus, and 0 percent is Potassium. The other 56 percent of the bag is nothing - just filler! Explain where these nutrients come from in nature and that there are many other nutrients that the soil, plants, trees, insects and micro-organisms need.
- **Activity or discussion:** Katie Greenwood shares this experience: At a 'health awareness' session, we looked at what strong soil needs and related it to what strong people need. Since we were also teaching about natural medicine, we said compost is like food and fertilizer is like medicine (tablets): food (compost) gives you a lot of different things every day and keeps you healthy most of the time, medicine (fertilizer) is for emergency use only because it is expensive, doesn't satisfy all needs, and dangerous if used for a long time. We had listed the requirements for "strong people" earlier, and then after listing the requirements for "strong soil" later in the workshop we listed parallels. The people in the training thought this was a good way to show the connections to subsistence farmers. Some of the other parallels we listed:

<u>Strong soil</u>	<u>Strong people</u>
Compost	Wide variety of food
Sunshine	Sunshine
Water	Water
Air	Air
Insect and disease control	Natural and emergency medicine
Diversity	Good relationships/diversity
Mulch/erosion control	Good house
Good gardener	Community health support