STORIES FROM OUR FOOD GARDENS

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for Mandie

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Healthy field

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FARMING FOR THE FUTURE

One of the nicest things we discover in our practical and theoretical work is that permaculture food farming IS farming for the future. Using organic and permaculture principles, the land grows stronger and more self-sufficient each preparing and planting season needing less and less input by man to sustain itself WHILE it is producing food.

We offer here a report both of **experiences** from food garden educational projects between 1996 and 2012 and the permaculture-inspired **principles** and **methods** used in helping us at the start of our journey towards becoming future farmers.

NO NEED

No need for continual applications of **chemical fertilizers** that feed the plant instead of enabling the soil to feed itself which then feeds the plants.

No need for routine **chemical pest controls** that kill off natural pest predators.

No need for **chemical herbicides** that destroy plant environments that inhibit destructive pests, attract pest predators, fix nitrogen, prevent soil erosion, build top soil, retain water, provide animal fodder, create biomass for compost and mulch.

No need for **regular use of heavy machinery** which impacts the soil-inhibiting effective microbial life, restricts the land's ability to absorb water, and plants' ability to absorb nutrients.

No need for distributing **increasing quantities of irrigation water**.

No need for **repeated additions of minerals to balance soils** thrown into crisis by damaging farming practices.

No need for **inflation-related annual capital investment** in land and soil preparation.

No need for **diesel guzzling tractors** dominating and compacting the land every hour of the day.

WHAT WE DO

Permaculture inspired farming is really not just about **what we don't do.** This modern technology, which is in many ways based on very old people-less and traditional technologies, is about **what we do**.

Incredible cos lettuce

Couldn't be better

Happy learners celebrating the first harvest

How do we produce such magnificent lettuces?

IT IS TEAM WORK

The permaculture garden teams are formed, including some or all of the following: a school principal, community leader, a teacher, a farmer, a farm manager, a garden supervisor, learners, drivers, a photographer, and permaculture facilitators. After a time of chaos, truancy, ducking and diving behind shady trees, misunderstandings, feelings of disappointment which are always part of the shared journey however carefully navigated, we find that successful permaculture food farming requires certain things.

practical experience theoretical knowledge
technical skills
personal leadership qualities

To enable us to master these, we need hard work, discipline, planning, our own management and communication skills, physical strength, classroom study, lots of fun, a will to work in pouring rain, cold winds, blazing sun, and passion.

AND WE DO IT!

PERMACULTURE MAKES IT POSSIBLE ON POOR LAND

With the help of all, we are allocated a piece of land by school management, the farmer, a community, or government representative. A few classroom days are helpful to learn about permaculture principles and method. In a small project, we take a few weeks to create the design and infrastructure. If there are time constraints such as at a school, we dedicate a few sessions per week with the new permaculture gardeners to prepare beds, plant, irrigate, harvest, keep records, and market our product. Purposeful and informed work on the land can produce unimaginable quantity and quality.

An excellent team

In one project, the donors appointed a full-time garden supervisor, and funded a training course for him in permaculture. This sped up the production process. Our mandate in that project: to create a sustainable school permaculture garden learning environment from what was then the institution's enormous rubbish site with two massive concrete slabs.

With help from our supporters, we cover all bases.

Resources are slowly but surely tracked down and made available. We know we need knowledge, skills, financial resources, management strategies, tractor and trailer, TLB, tractor and ripper equipment (often borrowed), tools, seeds, seedlings, irrigation tanks, sprinklers, porous and other piping, taps, hoses, and fencing.

START WITH SOIL NUTRITION

SUPER compost grows **SUPER** food.

There are many ways of creating organic, **ecologically sound** soil food. As long as compost heaps do not contain chemicals, pesticides and growth hormones, and do contain disease free plant material, ground rock minerals, animal manures where possible (not essential), eventually decomposition will take place and compost will be the result.

Classroom and practical lessons in the **best practice** of compost making help us to make black gold. Eager students enjoy the presentations on the theory and practice of compost making.

We look at photographs of **large scale** compost farming in countries neighbouring our Northern borders. Explanations on the **values** of compost hold the attention of all of us:

- building the soil rather than simply feeding the plant
- adding slow-release soil nutrients
- adding and attracting nature's workers such as beneficial bacteria, earthworms, and fungi
- the cost effectiveness of compost as opposed to chemical farming

Different ways of composting show us how versatile composting can be:

- home composting - the three bin system
- home made liquid manure
- worm farming
- commercial non-organic compost
- small scale cold static pile compost (not turned)
- big scale hot static pile compost (not turned)
- hot, fast non-static pile compost (turned frequently)
- anaerobic compost
- aerobic compost[1]

Learners find the information very useful, describe it as a wonderful experience, often say they would like to share all that they learn so that other people can know where their food comes from. Most participants respond enthusiastically to the **opportunity** given by an ecologically sound gardening and farming system.

DOING IT

A few sessions are set aside for a facilitated compost action learning event.

BE PREPARED: ALWAYS PLAN BEFORE DOING

Before starting any practical activity, we collect all tools, equipment and resources need for the job. A list of ingredients is drawn up.

Fresh cattle manure

FOR ONE HEAP (2M x 3M x 1.8M)

- 20 x 50kg fresh cattle manure (not more than five days old)
- 10 x full trailer loads cut dried grass
- loads of green vegetation e.g. cabbage leaves, bugweed leaves, comfrey, yarrow, weeds
- piles of small sticks and medium branches for ventilation, and two straight branches for chimneys 2.2m long, sharpened at one end
- cardboard
- unchlorinated water
- organic bonemeal
- wood ash
- 20 litres EMs (effective microbes)
- small bag dolomitic lime[2]

Molasses


Nettles! YAY! Nitrogen-rich green leaves


Tractor and trailer


Collect sticks


Grass

WE MAKE SURE WE HAVE EVERYTHING AT OUR SITE

Compost making ALSO needs the following:

- **Tools**
  watering can, hose pipe, bags, bush knife, wheelbarrow, plastic containers, hoes, spades, EMs making equipment
- **Equipment**
  tractor, trailer, diesel
- **Other Resources**
  molasses, bacteria stock for breeding EMs

TO MAKE BEST PRACTICE COMPOST

In preparation for making compost

- collect branches and small sticks **any time**
- collect dry grass **any time**
- collect fresh manure (not more than five days old to retain high nitrogen level and active micro-organisms but dry kraal manure is better than no manure) and green leaves the **day before construction**

To Do

- mark out 2m wide area, as long as you like
- push chimneys, 30-60cm diameter x 2m long at 1m spacing down row for ventilation
- line outside 2m wide area with cardboard to restrict invasive grass
- place branches over soil in 2m area for ventilation
- cover branches with small sticks and pieces of rough shrubs for ventilation

- make level layers of the following over sticks:
- dry grass for carbon
- unchlorinated water on dry grass
- green leaves for nitrogen – use alien vegetation, fleshy vegetable leaves, nettles, or comfrey
- dry grass
- pour on diluted EMs (effective micro-organisms), worm tea, or liquid manure diluted with unchlorinated water
- dry grass
- manure
- sprinkle small quantity dolomitic lime to balance ph and add magnesium
- dry grass
- green leaves
- sprinkle untreated wood ash and organic bonemeal
- water diluted micro-organism mixture (EMs or worm tea)

- continue layers till pile is 2m high
- spread dry grass up sides and over the top for insulation of moisture and heat[4]

We locate our compost making areas **close** to the planting area, materials, and beds to be composted. We do not try to hide it: remember "**Garbage is Gold; Compost is Beautiful**".[3]


Two chimneys


Grass


Unchlorinated water on dry carbon


Nitrogen rich cabbage leaves over wet grass


Second layer dry grass


More EMs and water


Nearly there


Grass insulation

EFFECTIVE MICRO-ORGANISMS

EMs are **essential** to human, animal and plant life. We use EMs mostly in compost making and bed preparation but they have many uses.

EMs used in livestock production:
added to animal feed:

- improves interflora in livestock
- improves feed conversion rates
- enhances egg laying perfomance
- reduces animal mortality rate
- produces high quality meat, milk, and eggs

EMs as a biosecurity measure:
as a bedding and animal shelter spray:

- reduces build up of pathogens, ticks, flies, and odours

EMs used in horticulture:
as a spray or drench:

- wards off or destroys harmful micro-organisms
- improves water quality
- acts as a compost accelerator
- creates highly nutritious compost[5]

To make **best practice** compost, EMs are **best** but can be replaced with worm leachate, liquid manure, lots of comfrey, yarrow leaves, or LEAFY GREEN WEEDS AND SHRUBS before they go to seed.

Because we are making compost on a regular basis, daily, weekly, or monthly, depending on the size of our project, we need to keep EMs on hand at all times if possible.

TO MULTIPLY AND ENSURE YOUR OWN SUPPLY OF EMS STOCK

Materials and Equipment

- 100 x litre plastic drum with 10cm diameter hole in lid (do not use metal drum)
- 1 litre plastic bottle for non-return valve
- 5 x litre molasses
- 10cm diameter x 2m length plastic piping
- 1 litre x EM stock[6]
- 94 x litre unchlorinated water

To Do

- cut 10cm hole in a plastic container lid
- insert 10cm plastic pipe from outside the lid into the lid hole
- mix the molasses, stock and water in drum:
  - stock: 1% / molasses: 5% / unchlorinated water: 94%
- place the pipe end inside the lid in airspace above liquid
- close lid
- place the other pipe end in unlidded bottle of water as non-return valve for gases to escape and to restrict entrance of unwanted bacteria
- store container two weeks in shaded, warm, protected place

To Use

- dilute with unchlorinated water:
  - for garden soil 1:500
  - for foliar spray 1:1000
  - for compost accelerator 1:200[7]

OTHER WAYS TO IMPROVE SOIL NUTRITION

THE TRENCH COMPOST GARDEN

This is an effective, quick, low cost way to create a small, moist, nutritious garden using readily available materials.

TO MAKE A TRENCH GARDEN

To Do

- dig trench 2m long x 1m wide
- remove top soil place to one side
- remove subsoil place to other side
- bed should be 45cm deep
- place a few tins on bottom (optional – corrosive metal leaches into soil, rather use branches and sticks)
- water bed well
- fill half the bed with paper, cardboard, scraps of material, sawdust, dry grass, green leaves, wood ash, animal manure
- water well
- cover with subsoil
- fill the bed with top soil
- plant seeds or seedlings
- mulch with dry grass and dry leaves[8]

VERMICULTURE: WORMS WONDERFUL WORMS

Using red wriggler worms to recycle kitchen and garden waste, we get very high nitrogen **worm tea** and **worm compost.** The only other fertilizer that is better than this is our **best practice** compost because it adds humus as well as nutrition to the soil.

The worms eat vegetable, fruit, and vegetative matter, including paper, and excrete rich **worm castings**. **Leachate** is caused by liquid running through the worm **castings** and out through the hole at the bottom of the container. The **castings** form a compost made by food eaten by the worms and passed through their bodies.

The leachate can be used as a **liquid foliar spray** (on the leaves), or watered onto the soil before or after planting. The castings can be used in small quantities, due to its exceptionally rich composition, as sheet compost, to be spread on the soil and mulched to preserve its micro-organisms.

There are no flies, no harmful pathogens, and no unpleasant smells in this method.

TO MAKE A BUCKET OR BIN WORMERY

To Do

- find a sheltered and shady place
- make 20cm holes at bottom of plastic bucket or bin, or oil drum from 50 litres up to drain worm leachate (liquid worm wee and compost tea), to prevent decomposition and prevent worms from drowning
- stand bucket on rocks in shady place
- place tray under drainage holes in worm bin to collect worm leachate
- cover bottom with shadecloth to prevent worms from escaping
- place layer of shredded paper or dry grass over cloth for worm bedding
- water bedding
- place red wrigglers on bedding
- place kitchen and garden waste worm food over worms
- place a few handfuls of old dry cattle, horse or goat manure over waste worm food
- cover with folded newspaper
- lift newspaper and feed paper, fruit, vegetable, and leafy garden waste every few days
- replace newspaper
- check that worms are not too wet or dry – adjust with shredded paper if too wet, add a little water if too dry[9]

To Use

castings:

- when bin is three quarters full, remove worms and top layer of waste and place on wet paper in the shade
- remove worm castings (the “compost” created by worms)
- spread sparingly on soil and cover with mulch

worm tea:

- collect tea regularly, best used at less than five days old
- dilute 70% to 30% water to worm leachate
- water on to leaves as foliar feed and for prevention of disease
- water on to soil before planting
- water in seedlings with it

worms:

- introduce into cold compost heaps
- feed chickens

start replacement and new worm bins regularly

Worms can also be farmed in a **trench** on a **bigger scale** if you have sloping land. The leachate is collected in a bucket placed at the lowest level of the slope.

TO MAKE A TRENCH WORMERY

To Do

- place on sloped, sheltered ground in shade
- dig 30cm round-bottomed trench
- dig sump hole at lower end of trench
- place 5-50 litre plastic (not corrosive metal) bucket in sump hole to catch liquid; must be same diameter as width of plastic funneled sheeting to prevent spillage
- line trench with one half thick plastic sheet, keep other half to fold over trench to keep rain out
- line plastic sheet in trench with shredded cardboard and paper or dry grass
- water bedding
- place red wrigglers on bedding
- place kitchen and garden waste worm food over worms
- place a few handfuls of old dry cattle, horse or goat manure over waste worm food
- cover with folded newspaper
- cover with second half of plastic to keep out rain, cover with thick layer of grass or old carpet to insulate, not too hot, not too cold
- lift plastic, grass, and fold to one side
- lift paper
- feed kitchen and garden waste every few days
- replace newspaper and plastic cover
- check that worms are not too wet or dry – adjust with shredded paper if too wet, add a little water if too dry[10]

To Use

- when trench is full of castings, stop feeding worms progressively from the higher end of the trench
- when worms have migrated to feed areas lower down trench, remove castings
- repeat down the trench till all castings have been harvested
- start feeding again at the top

worms:

- introduce into cold compost heaps
- feed chickens

Easy to make, affordable bucket wormery

Wonderful red wriggler worms

LIQUID MANURE

This is a good way to recycle alien invasive plants, including their leaves, small sticks, seed, and retooning (regrowing) roots and bulbs. Any vegetable matter from the garden or kitchen waste, and manure, can also be turned into this type of foliar feed.

TO MAKE LIQUID MANURE

To Do

- fill drum 20 litre – 210 litre with water leaving space at the top
- fill grain bag or orange pocket with animal manure and composting plants (bug weed leaves, syringa, lantana, setaria grass, nettles, wild spinach, green grass – even kikuyu)
- place bag in drum and cover tightly to prevent fumes from escaping
- stir every few days
- when no solid materials remain, dilute liquid manure 1-3 for field crops and 1-4 for nursery[11]

OR

- place composting and invasive alien plants, roots and all, into water
- add half bucket manure, or worm wee, or mature liquid manure as accelerator[12]

GREEN MANURE, GREEN MULCH

This is a slightly more expensive, but very useful way we condition soil. By using fast growing leafy annuals (for maximum biomass) or leguminous plants (for nitrogen fixing), soil can be dramatically improved over one season. Plant seed or cuttings closely together to form a living groundcover. Hoe in **just before flowering**, or chop leaves and drop them as a green mulch.

Using green manures or mulches makes excellent sense in a polycutural planting system because many of the plants serve more than one purpose.

Green manure

Use **annual** or short term plants such as lupin, mustard, fenugreek, sunhemp, sesbania, trefoil, vetches and tares (legumes), broad beans, cowpeas, rye grasses, and Japanese radish.

Perennial plants can also be useful as green manure or green mulch. By planting nitrogen fixers, plants around them can benefit. All the perennials below can be chopped and dropped as mulch, or chopped and dug in as green manure: lucerne/alfalfa, clover, and comfrey (also a compost accelerator) can be used as permanent, deep rooted green mulches. They can also be slashed and used as chicken food. Some of these can be used as grazed or cut and carry fodder crops before returning to the soil.

WE ALL LOVE IT!

We feel great excitement in turning garden and kitchen waste into nutritious soil food and watching our land being healed.

REMEMBER
WORK WITH NATURE

Robert Rodale says “soil is a living, breathing organism, and because it is alive it should be fertilized and cultivated in a manner as close as possible to nature’s own methods”[13] Making and using compost is the most natural way of developing the land and producing healthy food.

REMEMBER
MAKE COMPOST REGULARLY

In farming for the future, or organic farming and permaculture, the most work, i.e. time and sweat, is put into making compost. Everything in ecologically sound farming rests on continually making and spreading compost, using EMs, worm leachate, and liquid manure. They are all beneficial, easy, and cost effective to make.

REMEMBER
MAKE EMS EVERY FEW WEEKS

It is much more cost effective to make our own EMs than to buy it. It takes two or more weeks for EMs to multiply depending on the environmental temperature at the time. Simple and quick!

REMEMBER
COLLECT COMPOST MATERIALS REGULARLY

In any spare hours, collect and store dry grass, leaves, and small sticks for compost carbon; and small and big sticks for ventilation. Cardboard, for an anti-grass barrier, is very expensive but can be recycled from offices and kitchen stores. It must be kept in a dry place.

REMEMBER
USE FRESH MANURE

Any fresh organic manure (not more than five days old, with no antibiotics, growth hormones, or pesticides) can be used. It must be collected the day before making compost and kept under a thick grass mulch until used to protect the micro-organisms.

REMEMBER
PROTECT MICRO-ORGANISMS

Keep compost heaps, waiting piles of manure, and sheet composted beds covered with mulch all the time when not actually working with them. Exposure to the harsh sun kills effective microbes and earthworms.

REMEMBER
GROW YOUR SOIL FOOD

Compost and liquid manure materials, worm food, mulching material, green manure can all be created, grown by us. We can do it on ANY piece of land as long as there is water available.

REMEMBER
COMFREY AND YARROW

These are mineral and nutrient rich accumulator and accelerator plants that speed up the decomposition process and produce a very rich compost.

REMEMBER
WEEDS ARE WONDERFUL

Allow weeds to grow in spaces where they will not damage tree, vegetable, staple, or herb crops. Harvest them before they set seed for best rewards. Chop or pull and compost for high nitrogen matter in the compost.

Beautiful soil condition

SOIL NUTRITION CONCLUSIONS

A learner said at the end of one of our compost training sessions that he noticed that after years of abusing land, farmers are now realising that by using the wrong methods to make agricultural produce grow to support a rapidly growing population, they are working against "Mother Nature". Instead of making things better, they are multiplying the crisis of food shortage due to their harmful methods. Nowadays, he observed, many farmers see the need to make better use of the soil and ensure we maintain a balance of fertility and richness in it. That is why organic farming, he concluded, related to permaculture, is a growing practice to ensure rich soil with a balanced ecosystem. **The keys to a rich soil are compost, EMs, vermiculture, liquid manure, green manure and mulch.**

ENDNOTES

1 Paul Duncan. Compost Presentation, Dovehouse Organic Farm and Training Centre.

2 Paul Duncan. Composting Workshop, Dovehouse Organic Farm and Training Centre.

3 Robert Rodale, ed. The Basic Book of Organic Gardening. 1971. p2.

4 Paul Duncan. Composting Workshop, Dovehouse Organic Farm and Training Centre.

5 Brett Sanders. "Introduction to EMs (Effective Micro-organisms) and Poultry Production with Effective Micro-organisms". New Horizons – Earthcare Solutions cc.

6 A 9 bacteria starter stock is available from Dovehouse Organic Farm and Training Centre OR New Horizons – Earthcare Solutions cc.

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8 The Earthcare Garden: Sixosha Indlala. 1993. Ecolink.

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13 Robert Rodale, ed. The Basic Book of Organic Gardening. 1971. p2.

FURTHER READING

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- SEED. "Nutrient Cycles" in Growing the Living Laboratory: Permaculture for Environmental Education in the NCS. 2006. pp23-43.

Learning by words and doing

PERMACULTURE PRINCIPLES AND PRACTICES

2

WHY PERMACULTURE? WHAT IS PERMACULTURE?

The good news is that agro-ecology (ecologically sound agriculture) is found in many forms apart from permaculture. These include organic farming, biological grass fed beef farming, rice polyculture duck farming, indigenous plant reforestation, and many others. For small farms and community gardens permaculture has much to offer.

Our learners are given a keyhole glimpse of permaculture food security gardening, what it can do FOR US, and what we can do WITH IT. We are inspired by permaculture offering us an **ethical** way of **maximising efficiency** (making ***less work*** for ourselves) and using nature to its best possible horticultural and ecological advantage.

Trees, which act as CARBON SINKS, are significant in reducing green house gases and **reversing climate change damage**. They are used a lot in eco farming both as air purifiers and nitrogen fixers. Fiderbias, and other leguminous trees, are often called "**fertilizer trees**" in countries to the North of South Africa because they fix nitrogen from the air through **rhizobium bacteria** in the roots and release it into the soil for use by other plants.[1]

Crops can be grown right to the bottom of the Fiderbia tree trunk to make the best use of its root nitrogen.

In South Africa indigenous acacia varieties and sesbania sesban are also used as "soil food trees".

TREE SOIL FOOD IS FREE SOIL FOOD!

Trees also provide shelter from hot or cold winds, and provide shade for livestock. Their **leaves drop**, or are "chopped and dropped", putting nitrogen rich humates into the soil. They supply carbon for composting, animal fodder, and wood for fuel.

PERMACULTURE RECYCLES SOLAR ENERGY

The **SUN** moves through **PLANTS** which convert it through **photosynthesis** for their own growth.

Plant-, grain-, or flesh-eating animals, insects, and humans consume plant products or they fall to the soil, supplying **humates,** which decompose, to the soil. Manure and decomposed plant materials **go back to plants** themselves, and the cycle begins again.

Decomposers (mainly bacteria and fungi) turn dead organic matter into humus and nutrients which continue the cycle of all life. This is an ecological self-balancing, self-regulating cycle, which, **like a forest, provides for itself**.[2]

CULTIVATED PERMANENT AGRICULTURE

Through **permanent agriculture**, or permaculture, we CREATE and develop a **cultivated ecology** which is designed to produce more human and animal food in a shorter time than is generally found in nature. By what **WE DO**, we speed up and enrich nature's processes; we cultivate a system which **makes nature more productive**. It can supply all our needs without abusing natural resources, without polluting water, soil, air, or ourselves.

Our methods are **BASED** on **ecology**. We use animals to reduce pests and to reduce our own work load. By redesigning what has been observed in ecological systems, we improve on, **produce more** than nature.

For example, **fungi** are found in natural ecosystems and can be used effectively, along with certain plants, to **detox badly polluted** land.

On one piece of land that we worked on, there was a mass of large, medium, and small alien trees and shrubs, and toxic industrial waste substances.

Knowing that fungi and certain plant enzymes have the capacity to degrade and ultimately destroy industrial pollutants, we created an environment that was conducive to the growth of fungi and pioneer vegetation. Aliens were dropped and left to decompose; dolomitic lime was lightly spread; urine-soaked and dunged stable bedding was placed on top of the small sticks and around the logs; and this was left to decompose for one rainy season. Cleansing plants such as comfrey, vetiver grass, red hot pokers, reeds and sedge grasses were planted. Over time thirty-five different types of fungi grew and within five years, there was no sign of pollution and the land was ready to plant for food.

Using **diversity** in our cultivated permanent ecosystem we create stability and strength. A harmonious combination of land, animals, and people is the sustainable way. **Polycultural** agriculture (cultivation of many species), rather than **monoculture** (cultivation of one species), is one of the most important building blocks of permaculture. We can leave a mature permaculture system for ten years and it only gets better. A conventional agricultural system would collapse totally.[3]

MAXIMISING EFFICIENCY: USING CONNECTIVITY

We all relate to the permaculture design principle of preventing the waste of resources. One of our most important resources is our own labour. By effective design, we do less work.

There are **SO MANY** ways to make **OUR WORK** less by using permaculture technology.

One of the **most important** permaculture **principles** is that every **single** thing we do has **MANY purposes**, **MANY functions**, does **MANY things** for us and our land.

Another way of saying this is that all permaculture **inputs** (needs) have many **outputs** (products).[4] When choosing to use resources, money, materials, equipment, our own labour, we invest them into things that fulfil the most purposes. One unit's needs (input) can be another unit's product (output). All things are systematically **connected** and **support** each other. For example, plants and animals provide food and the humus and manure to feed the soil to grow the food to feed the plants and animals. A borage plant attracts beneficial insects, it accumulates potassium, dies back to create excellent mulch, chickens like to feed on the leaves, flowers, and seeds, and it is a self-seeding permanent part of our polyculture.

We place the things we visit most often together, and near to our house or pack shed. Vegetables and herbs picked most often for our kitchen or our market and requiring the most maintenance, such as irrigation, are placed near by. Chickens needing to be fed and watered daily are placed in the same area. This way we prevent having to walk to two different areas; multiple tasks can be performed in one walk. Orchards, maize fields, and bee hives are placed further away because they need less attention and are visited less often.

ELEMENTS OF DESIGN

ZONE PLAN

Elements are placed according to **how many times you need to work in them**. We are lucky at one project, that the land allocated to the permaculture project, the Zone 1 food security garden, the nursery, and chickens, is placed near to the practical study registration area, the permaculture storeroom, the taps for cleaning the harvest, an area to pack the vegetables for market, and the school kitchen. Cattle and orchards would be placed further away.

On a usual farm, the following zone plan would apply:

Zone 0 house, business, office, pack shed, workshop, and warehouse
Zone 1 intensive vegetable, herbs and small fruit (food security garden)
Zone 2 mixed food forest, trees, longer-season staple foods (sweet potato, pumpkin, potato, mealies, sorghum), cash crops, duckpond
Zone 3 semi-managed woodlots, animal fodder fields
Zone 4 semi-managed indigenous forest, grassland and shrubs
Zone 5 unmanaged indigenous species and indigenous wildlife [5]

SLOPE PLAN

At one bed and breakfast food security garden project, we placed the garden at a low point to be fed by piping from a mountain spring. Three slopes were used to further harvest water and to spread some of it to a low thirsty flower garden.

The farm staff garden was placed next to the staff houses which had water points on the spring pipeline. Due to heavy clay and a difficult slope, some swales were used to sink water and others to drain it to a lower area full of thirsty trees.

At another, we placed the food security garden next to the old organic garden, along the small perennial river, stretching up the slope to the road and the nursery. Water storage tanks were placed above the gardens, short keyhole paths were dug down the slope so that water would be retained at the lower end of the path by small berms. Effective use was also made of the slope and contours to harvest water in contoured swales, reduce erosion, hold water on our land, and gravity feed water from the tanks above the gardens.

At one community garden problems of high irrigation and fertiliser costs, and poor products, was solved by turning the garden design around completely. The gardeners were simply not making the slope direction work FOR THEM. The paths and beds had been made running down the slope rather than on the contour. The water was running down the slope with great losses, washing away the top soil, drying out, and leaching the soil nutrition away from the beds. **Changing the design direction**, **introducing contour swales**, and **applying sheet compost and mulch** have produced a **thriving garden**.

As all the gardens develop, **windbreaks** that control wind speeds and cold damage are planted. The wind is cold at the bottom of the slope and increases speed as it starts to rise up the slope. Nitrogen-fixing trees, and indigenous trees such as the water loving ficus family, mdoni, and Natal yellowood are planted along the river banks to change the direction of cold winds up and over the gardens, reducing the severity of the frost and reducing the size of the area **below** the **frost line**. Tree lines around the Northern and Western borders in our area protect our gardens from exposure to hot winds and drying afternoon sun. They are also planted throughout the middle and upper slopes to provide dappled shade for protection from increasingly hotter summers. Horseshoe shaped tree and shrub plantings facing North and East create sun traps that reduce damage from unseasonal frosts and unusually cold nights.

SECTOR PLAN

We plan our layout with strong winds, daily sun paths, and winter frosts at the lowest and highest points in mind. Threats from antelope are countered with strong wood or wire fencing, and we grow reeds, vetiver grass, indigenous protective flowering shrubs, and indigenous thorny plants as thick hedges to make the fencing more impenetrable. We also reinforce the fences along the bottom with layers of stones. Enquiries from people living and working in the area who had been there a long time tell us details about flood and frost lines.

WATER HARVESTING

From the planning phase to preparation of the land and the vital collection of mulch, we think of permaculture's **PSSS**

P PROTECT - from pollution
S STORE - catch and store runoff
S SINK - put water INTO ground, increase seepage, slow down flow and evaporation
S SPREAD - move water to where it is most useful

To **protect** water from pollution we need to keep rubbish dumps and workshop chemicals away from rivers and streams. Chicken droppings from animals fed with growth hormone and antibiotic-treated feed will pollute water. Pesticides, herbicides, high nitrate fertilizers, and plant hormones are toxic everywhere, and will be even more destructive near waterways. Invasive aliens growing along river banks will lower the water table and spread seeds rapidly over a very wide area creating an alien plant crisis which will reduce oxygen levels in rivers and dams, and kill fish and indigenous plants in the area.

Water is **collected** and **stored** in tanks or dams from ground runoff, roof tops, or pumped from rivers by rampumps (no external energy source required), solar, diesel or electric pumps.

To **sink** water **into** beds, contour swales and berms are efficient and effective. Drip irrigation, mulch, minimum tillage, and well defined pathway and keyhole beds keep our farmers off the beds. This avoids compaction of the soil and contributes continuously with little added effort after the initial infrastructure has been done.

Water is **spread** by piping, diversion ditches, porous and drip irrigation pipes, and sprinklers.


Encourage fungi


Ram pump


Ram pump weir


Slab for four tanks


Burying porous pipes in mulch

Polyculture

Raised beds, swales, berms, compost, and mulch

Tap connection and filter for porous pipes

Incorrect use of slope,
start of contour swales

Correct use of slope

Now flourishing contoured, composted and mulched garden

WEEDS ARE OUR FRIENDS!!!!

SUCCESSION AND PIONEER PLANTING REDUCE OUR WORK

In a natural environment, i.e. land that it is not being cultivated by man, a polycultural system will evolve by **successive** growth (over a period and one step at a time). Weeds, herbs, short term small trees and understorey shrubs, all of which are **pioneer plants** (come before), and eventually, tall, very old climax trees, which are the top of the evolutionary plant chain, will grow successively on land left to nature.

Pioneer plants can fix nitrogen, loosen heavy soil, reduce salt in soil, stabilise steep slopes, deepen top soils by producing biomass for mulch and humus, absorb excess moisture, provide animal, bird, insect, and reptile food for nitrogen rich manure, or provide shelter for plants and other life. In pure permaculture design, we therefore plan our pioneers first.

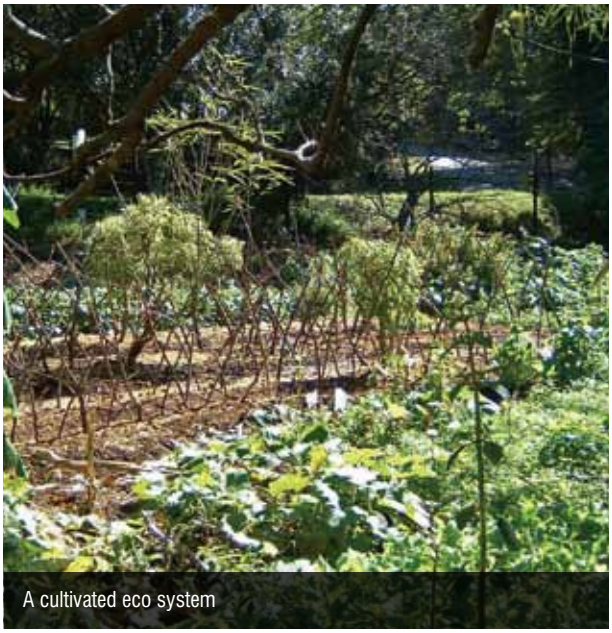
We use **succession** to reduce our own labour, and invite nature to do most of the work for us.

We put our **cultivated** system in at the same time, building in a successive cycle that will promote an eco-friendly garden:

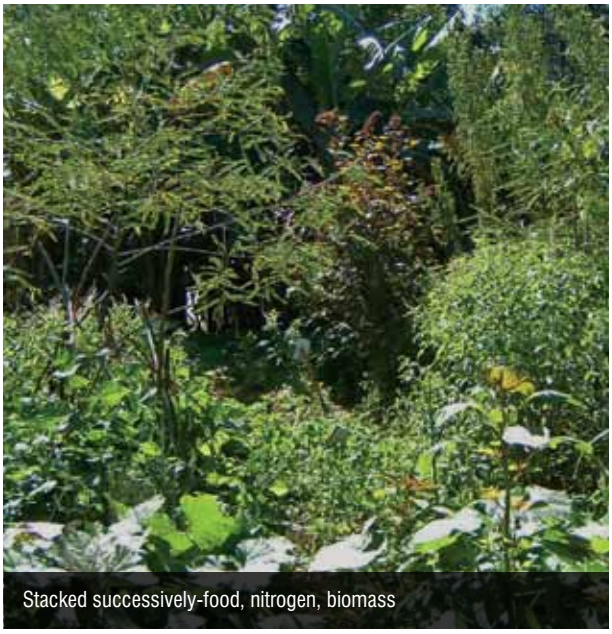
- **long-lived** tall trees like avocados, with **shorter-lived** smaller fruit trees like oranges and naartjies
- **fast-growing** leguminous pioneers like acacia and sesbania sesban for mulch, shade, and nitrogen
- short-lived **perennials** like comfrey, to provide weed control, mulch, and high nitrogen vegetation for making compost
- **perennial** shrubs like Natal sage to attract beneficial insects; and **annuals** such as yarrow, cowpeas and Zulu pumpkin

We learn from **natural systems** which include medium canopy trees, smaller trees, shrub layers, and a herb layer in **stacked patterns**. We plant in relation to each plant's heights, shade tolerance, and water requirements. If we get the spacing, water, light, and ventilation requirements right, we can do it all on a small piece of land.[6]

Then we let nature do the work **for us,** by **succession**, but **more slowly**. To conventional farmers, and gardeners, **WEEDS** are the **ENEMY**. Conventional farmers invest a big part of their budget on weed herbicides and weed control equipment and chemicals. The most physical work on small farms and gardens is invested in tilling, weeding or hoeing. But in permaculture we aim to harness the **natural healing, evolutionary process of weed growth** by cultivating and accelerating its steps.



A cultivated eco system



Stacked successively-food, nitrogen, biomass

TO CULTIVATE FOR SUCCESSION AND DIVERSITY

We allow to grow, cultivate, manage, and use weeds

- we sheet mulch smother weeds or other plants with cardboard
- we simply chop or pull and drop weeds while opening space for other purposes
- we remove some roots to make more space: most roots are left
- we PLANT annual or perennial pioneer plant "weeds" like dandelion, chickweed, amaranthus species, feverfew and allow them to self-seed
- we keep adding seasonal vegetables, and herbs like tansy, yarrow, borage, comfrey, fennel, and parsley which leave a space when they die back for other plants to colonise the vacancy
- we allow vegetable, flowers, and herbs to go to seed, to colonise other areas
- we bring in other mulch material, green or dry, from zones two and three

We grow green manure crops

- by broadcasting fast-growing weed or other seed close together and chopping it shallowly into the ground we speed up the rehabilitation of overused or polluted land

We add sheet compost, or in some cases, sheet manure

- we spread compost or manure on top of the ground without digging it in

We cultivate food and animal fodder in a diverse plant environment

- in between, over, around, and under our pioneer tree, shrub, and ground cover plants, including weeds, we grow our food and animal fodder

We keep ducks, chickens, quails, goats, rabbits, sheep, cattle

- free ranged livestock, kraaled or housed at night, sheet manures the land daily and provides rich kraal bedding, manure and urine for composting

We use chicken and pig tractors

- to forage, clean, loosen, and manure the land with minimal use of resources

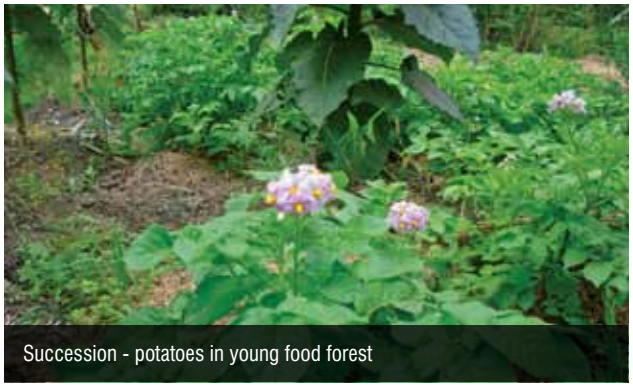
Stacked amaranth "weeds", plectranthus, tamarillos, fig, bay leaf, basils, naartjie, weeping boerboon

In one project with a 15cm grey, clayey, cracked, sunbaked topsoil over a hard clay pan, we **GREW** a 40cm black, loamy topsoil over a period of eighteen years. We planted a wide variety of **biomass producing pioneer plants** over a number of years, chopping and dropping regularly. We sheet manured as each section was mulched and spread dolomitic lime regularly in small quantities, what we called "homeopathically" – a little but often – and watered a few times when plants were self-seeding to bring on the new growth. As the soil started to live and breathe more healthfully, we introduced edible herbs and vegetables, then medium sized fruit trees, and the land continued to heal itself. We watched our land move slowly but steadily **from biomass to beds**.

We did all this continuously **building** our soil and planting environment season by season while harvesting fruit, vegetables, herbs, chicken fodder, eggs, a yearly supply of fire wood, and carbon for composting and mulching.


From biomass to beds


Succession - mature tamarillos take over from harvested potatoes


Succession - potatoes in young food forest


Giant pumpkins stacked with tamarillos

HOW DO WE TURN A POOR PIECE OF LAND INTO A SUSTAINABLE FOOD SECURITY GARDEN?

WITH TECHNICAL KNOWLEDGE AND OBSERVATION SKILLS.

A lot of visitors to permaculture gardens say - I don't know what I'm looking at, it looks messy to me, I can't find what I'm looking for. Well, **nature is messy**, natural land is a muddle of different trees, creepers, and shrubs, reptiles, insects, mammals, all living in close proximity. It takes a patient, concentrated, knowledgeable eye to be able to recognise, identify, and respect the self-regulating systems that sustain life there for centuries.

An ability to **observe nature's ways** is essential to create and sustain a permaculture garden or farm. **Planning** and **management** of the garden are more productive than investing hours of **manual**, **mechanical**, or **chemical energies**. When you know how to create and manage this system, you can't understand why others can't "see" it.

OBSERVATION AND INTUITION

All creative acts are strengthened by the senses of feel and intuition. In permaculture, a creative act itself because we are working with nature and natural processes, observation with intuitive awareness becomes our **strongest tool**. There is a saying “the best possible fertilizer in the world is the farmer’s shadow”. It is only working on the land, with a **sensitivity** to it, that we can make the best use of its natural resources. After learning about soil nutrition, we proceed to **observation of the land**, and **always use it** in managing and planning the farming activities.

Permaculture gardeners and farmers work with what is already there: soil, sun, wind, water, trees, grass, livestock for manures, weeds, shrubs, worms, beneficial insects, birds, bacteria and other micro-organisms, and design their production in such a way that these **found resources** are not only preserved, but grown faster than they would otherwise have been.

For example, in order to get the best quantity and quality in our product, we **look at patterns in nature**:

- which water patterns can we use?
  water harvesting
- what grows together well or not?
  companion planting
- what is already there that prepares the soil with a little bit of additional effort from us, and self-regulating work from nature?
  pioneer plant succession
- what grows better, i.e. most efficiently, in the middle of a field or on the edges, under a tree or up a tree, produces human food or animal fodder, or composting and mulching carbon, or fixes nitrogen?
  intercropping and stacking
- what makes a small piece of land give us more planting space, more efficient use of our land?
  edges, curves
- what makes some areas of our land suitable for some crops, while other crops do better just metres away?
  micro-climates, micro-soil systems, **micro-water systems**
- what are the patterns of **change** from season to season, month to month, even day to day?
- what succeeds or fails?
  planning, management, and evaluation
- what is or becomes a possible threat?
  biosecurity
- what requires some action or can be left unattended for a while?
  priorities

The choices we make as revealed by these patterns are influenced not only by season, soil and plant type, but slope shape and intensity, North South East West aspects, sun, rain and wind patterns. Changes in environmental or human activity can affect what we do from year to year. We are continually learning our craft, responding to needs, making careful choices about what, where, when, who, and how.

We also need to **observe** what is happening in our neighbouring **region** and the **strengths** of **our team**:

- what will our **best** market be?
  sales
- what will our market prefer to buy?
  marketing
- how will we get our product to the market?
  delivery
- who will do the harvesting, preparation and packing, marketing and record keeping?
  human resources and capacities

MAPPING

MAPS ARE HELPFUL IF BASED ON OBSERVATION

When drawing up a base map we always start with observation, and draw on intuition and content knowledge to get **the most out of the least**. It is also helpful for us to use a specialist or aerial map to which we add local features gained in a situational analysis based on **observation.** A map can not tell the complex details of any piece of land, only **LOOKING** at the pioneers, the behaviour of organisms, water, wind, and micro-systems can tell us what is really happening. Vegetation will tell us about soil fertility, the availability of moisture, acid soils, and micro-climates.

Under a facilitator's supervision, we break into groups of learners and facilitators armed with notebooks and pens. We walk over the land, eyes and minds open to what is being given to us. We look for types of plants, conditions and types of soils, slope patterns and directions, sun, wind and rain paths, water runoff patterns, large natural features like trees, and potential wildlife threats. We find small perennial streams, seasonal springs, a bordering forest, or indigenous plants to be preserved.

The garden perimeter is marked out on the aerial map, tracing paper is laid over it and the perimeter is marked out onto the tracing paper. Each group marks in the features we have observed onto our maps: sandy soil, clay soil, rocky soil, steep slopes, gentle slopes, large trees, insects, plants, sun paths, slope aspects, and water runoffs. Some use **KEYS**, others use **COLOURS**, some write **WORDS**, others **DRAW PICTURES**. **ALL** our maps note the most important features.

Small group mapping work

Presenting our maps

THIS IS A GREAT EXPERIENCE!

We all feel instinctively that this is good. We are learning by doing, sharing, looking, really seeing, and documenting. We already feel we know our land better; it starts to feel like ours, as though we are given this **PRIVILEGE** to protect it and develop it, and to use it to produce healthy food.

REMEMBER
PERMACULTURE IS ETHICAL AND WORKS WITH NATURE

Ethical treatment of people, livestock, and the land is permaculture's key principle. Working with nature heals our land and our people.

REMEMBER
TREES ARE ENCOURAGED IN OUR FOOD SECURITY GARDEN

Fertilizer trees give us free soil food. All trees help to clean air carbon and other pollution.

REMEMBER
PERMACULTURE IS BASED ON ECOLOGY

It is a cultivated ecology, created by nature, and by design and diversity.

REMEMBER
PERMACULTURE IS EFFICIENT

Planning for efficiency prevents the waste of human, ecological, financial, and material resources. Every technique, every plant, every tool performs more than one task, achieves more than one result.

REMEMBER

FOOD SECURITY BY DESIGN

By using slope, sector, water harvesting, succession, pioneer plants, stacking, and cultivating weeds we copy natural evolutionary processes by design.

REMEMBER

OBSERVATION IS THE KEY TO GOOD LAND MANAGEMENT

If we do not observe what we are looking at with our minds and our feelings, we do not really see it.

PERMACULTURE DESIGN CONCLUSIONS

Permaculture design seeks to provide a sustainable and secure place for all living things on this earth.[7]

ENDNOTES

1 Paul Duncan. Workshop.
2 Paul Duncan .Workshop.
3 Paul Duncan. Workshop.
4 Growing the Living Laboratory: Permaculture f or Environmental Education in the NCS. “About Permaculture”. 2006. p2.
5 “Resource Manual: Introduction to Permaculture Design Principles at Dovehouse Organic Farm”. Compiled by Paul Duncan.
6 Bill Mollison and Reny Mia Slay. 1991. Introduction to Permaculture. pp22-24.
7 “Resource Manual: Introduction to Permaculture Design Principles at Dovehouse Organic Farm”. Compiled by Paul Duncan. p16.

FURTHER READING

- Bill Mollison and Reny Mia Slay. Introduction to Permaculture. 1991.
- Growing the Living Laboratory: Permaculture for Environmental
- Education in the NCS. “About Permaculture”. 2006. pp1-4.
- “Resource Manual: Introduction to Permaculture Design Principles at Dovehouse Organic Farm”. Compiled by Paul Duncan.

Swales, keyhole paths in

Companion planting

PRACTICAL MATTERS: GETTING STARTED ON THE LAND

3

MAXIMISING EFFICIENCY

Starting a permaculture inspired food garden or farm involves the **biggest costs**. That means the **biggest investment** in money, time, equipment, materials and human resources (sweat) is made at the **start of the project**. If it is **done correctly**, these **costs diminish** from season to season, and year to year. Maintenance of the infrastructure, repairing beds, and planting **becomes easier, cheaper,** and **requires fewer people** to do the work as nature takes over increasingly, and designs for efficiency show their potential. M**aintenance work** then becomes chopping and dropping for mulch, compost making and spreading, and maintaining the wormery.

When planning for efficiency we remember that every **single** thing we do or use has **MANY purposes**, **MANY functions**, does **MANY things** for us and our land. We use the connectivity of systems and zones to reduce usage of resources.

In a project managed by one woman of mature years, an **immobile** chicken A frame is used rather than a chicken tractor. Dragging a tractor across the land alone was using too much energy and time, **was inefficient**. The chickens in the immobile A frame are used as composters of biomass with **built in** nitrogen (manure), carbon (biomass for dry bedding cut and added frequently), green fodder (cut kikuyu, comfrey, fodder radish), and aerator (chickens scratching) on hand.

Apart from the excellent compost output, the chickens are fed fallen fruit which reduces fruit fly, the odd cutworm and snail, and aphid-populated bean and pea tips. The fruit fodder, snails and insects reduce chicken feed costs and provide a biological form of pest control. The chickens are strong and supply healthy eggs and meat.

The A frames are placed close to the vegetable gardens and food forest in a frequently visited area, saving time walking backwards and forwards. The light tasks of cutting and collecting bedding, and picking up fallen fruit, take less time and energy than moving a chicken tractor every few days.

If we have maximised the efficiency of our land, our most essential and constantly used tools are small hand tools like a dibbler, hand trowel, kitchen knife, bush knife (machete), and pruning clippers, most of which fit into a small bucket. We use small tools mostly, because once the land infrastructure and companion planting is in place, nature does most of the work, our work is light, and one person can manage a large area with a few small tools. The **most tiring work** in an efficient garden is in **harvesting** and **preparing for market** the **abundance** that this type of horticulture produces.

Immobile A frame chicken composter

CLEARING THE SITE

After identifying a possible site, we go out on to the land armed with gloves, bags, TLB, tractor and trailer, or hand tools. Foul smelling and unhygienic rubbish dumps are removed and preferably recycled keeping potential pollutants **away** from rivers, **away** from living areas, and **away** from the new food security gardens. It is essential to prevent the **pollution** of water and the food to be grown for and cooked in the kitchens, and grown for the market to generate income to maintain and develop a **sustainable** project.

Weeds are slashed by hand or tractor-driven mower, old concrete foundation slabs, and derelict buildings are then broken up and carted away.

RIPPING

A tractor-drawn **ripper**, or **gecha fork** (strong fork head on end of hoe handle), is used to loosen the soil, rocks and weed roots. This is **preferable to ploughing** which turns over the soil and damages cell structure, earth worms and micro-organisms already in the soil. Stones and large rocks are collected and stockpiled for later use in protecting the swale and pathway banks to **prevent soil erosion**.

FRUSTRATION! FRUSTRATION!

As we know, not everything goes forward without some problems. The TLB breaks down, the ripper tines are damaged, and the trailer gets a flat tyre. We are reminded by this frustration that being well-organised, looking after our equipment and tools, regularly servicing them and protecting them against rain and rust can limit the challenges and enhance our success rate.

In spite of these problems, frustrations and delays, the land is cleared. The TLB is used to **dig the irrigation piping trenches** and then we are really ready to start preparing the land.

DESIGN APPLICATION

The **design** of the garden is planned remembering water harvesting, slope shapes, and intensity, and North, South, East, West facing aspects. At this point, we can all feel the excitement starting to rise. We can **now see** what we **visualised**!

One of our gardens has a North East facing slope, with level land along the river plain, with increasingly steep slopes rising to the West. A lovely aspect to work with! There is lots of early morning sun, not too much damaging afternoon sun, good drainage and opportunity to practise our PSSS water harvesting methods.

Tractor and ripper

P - PROTECT by removing the **garbage** piles

S - SINK by **deep ripping** along the contours to 1m depth to open the soil up for good water infiltration, and to allow better oxygen and root penetration; **swales and berms** to collect water runoff from the slopes; contoured **raised beds** to increase topsoil depth, and contoured **pathways;** keyhole **pathways** to prevent gardeners impacting the soil by walking on the beds; and **lots of mulch** over everything to slow down evaporation

S - SPREAD by **water taps** and **piping** at points which reach all areas, and **diversion drains** at a slight angle across contours to transfer water to other areas

S - STORE by **rampump** and **weir** in the river to collect and pump water up to **tanks** at the top of the slope, which we connect to the piping for **gravity reticulation** down to the garden

To do this, we peg off the **contoured swales** at 30m apart on the **gentle slopes**, and 15m apart on the **steep slopes**, using a **theodolite to find the contours**. Marking the swales and contours can also be done with an **A-frame**.

TO CONSTRUCT A SIMPLE A-FRAME

Materials Needed

- 2x3m poles x 4cm diameter
- 1x2m pole x 4cm diameter
- 2m string
- 1 small stone
- permanent marker pen and tape measure
- hammer
- saw

To Do

- place two longer poles exactly the same length in A shape and tie tops together
- tie ends of the short pole to legs of A-frame for the crosspiece exactly the same distance from the bottom of each leg
- tie string at the top point of A shape legs
- tie stone to bottom of string hanging down well below cross piece
- measure crosspiece, divide by two and mark middle with pen

To Use

- place leg of frame at start of swale to be
- when string touches midpont mark on crosspiece it indicates the two points where legs touch the ground are the same level
- move one leg up or down until the string is at the midpoint
- mark ground with pegs to show levels
- swing one leg round and mark the next level points along the swale you are making[1]

MAKING OUR SWALES AND BERMS

If we are lucky, we have access to a small tractor for this task. Having **already ripped** and cleared the land, we attach a triple mould board plough to the tractor, loosen the bolts of the two front plough shares, pull them up off the soil, retighten the bolts, so the back share is left to plough the swale furrow and build up the berm mound. As the driver moves forward slowly, the wooden pegs marking the contour are removed until the whole length has been drawn by the plough. Two or three repeated passes at an optimum tractor speed leaves a deep swale having folded the ploughed soil over to create a berm mound on the lower side of the slope.[2]

Swales and berms are **neatened up** by the learners with rakes and spades so the **bottom** of the swale is completely **level** and the **berm** is of **equal height** with **no gaps** from swale beginning to swale end.

We make all our swales up the slope at 30m apart on the gentle slope and 15m as it gets steeper. The width of swales apart from each other will always depend on the steepness of the slope.

PREPARING BEDS AND PATHS

CREATE GROWING SPACES WITH CARE AND PASSION

The way we prepare our garden beds determines the quality and quantity of our fruit and vegetable product. We do not take short cuts, behave roughly on our soil, or allow ourselves to get tired of carting compost and mulch before we have enough on our land to ensure good soil nutrition.

OUR GARDEN INFRASTRUCTURE IS READY FOR US!

Preparing planting station

TO PREPARE BEDS AND PATHWAYS

- mark out the contour beds, paths, and vertical keyholes
- lift top soil from the paths, place it on the bottom of the bed above the path (higher up the slope) to create raised, and slightly levelled beds
- line steeper edges of paths and berms at the top of the slope with rocks and stones stockpiled earlier on
- mulch the paths with dry grass, leaves, or cardboard
- loosen the soil by digging our forks into it and moving them backwards and forwards, up and down, only disturbing the soil thoroughly if deep rocks have to be removed
- sheet compost the beds with our beautiful, sweet-smelling, black, moist compost we have made at the start of our garden preparation
- spread the compost 3cm deep on top of the soil, without digging it in (sheet composting), to minimise disturbance of the soil and compost structure, and to prevent damage to worms and micro-organisms, retaining any moisture already in the soil and the compost mulch the beds well and water them to activate the micro-organisms and keep the soil loose

Finding contours with theodolite

Ploughing swale and berm

Beautiful - ready to plant

OUR FIRST PLANTING

HOW WE PLAN CROP PRODUCTION

Our stories in this section are based on commonly asked questions and our own discoveries in planting crops.

We always **start with edible crops**, contrary to permaculture theory. We find this gives us a **less contested entry** into other and multicultural communities where everybody relates to the need for food. Non-food work energy is fairly often associated with wasteful and privileged societies, and their philosophies. Removing sometimes **contentious** or **alienating** culture-specific concepts as we start our projects, and learning by redefining them in our local cultural frames of reference as we live them, is a **wonderful** way of creating **new unity**, **bringing outsiders**, who often have the MOST to learn, **into the community**.

Putting sweat into the development of a **polycultural environment comes gently in our projects**. Using voluntary (grow without our intervention) and found (already present) plant (weed and tree) growth as a labour-free example of what benefits from focusing on mulching, compost making, and pest control, we can **see** and experience the **abundant returns** before applying a new theory and hard won resources to non-food producing work, ideas often not seen as **belonging to us**.

In these contexts, we focus on the following **in this order**.

- methods of making compost, vermiculture, and foliar sprays
- contoured, swaled, and mulched infrastructure and water harvesting
- irrigation system
- leguminous clover and lucerne in the swales
- what vegetables and herbs to plant when, where, and how
- planting vegetables using intercropping, staggered planting, and companion planting, thereby avoiding monoculture
- mixed flowering and medicine species round the edges
- leguminous trees and indigenous shrubs as windbreaks
- fruit orchards, protective, and leguminous trees and understory plants

However, due to permaculture's emulation of nature's succession and stacking principles, and to diversity as a priority objective, a **variety** of **crops** AND **companions** can be planted in an area **at the same time if permaculture principles are applied completely from the beginning.** In both plans, we continue planting in that area over time as some crops growing between others are **harvested** and **replaced with new crops**. An ongoing system of planting and harvesting in these applications takes place over a long period of time.[3]

When choosing **what** to plant and **where** to plant it, there are a number of things we have to remember. **Careful design** planning involves

timing: days to vegetable maturity (ready to harvest vegetable), harvesting period (days over which harvesting can be prolonged), and days to seed maturity (ready to harvest seed).

Planting intervals, patterns and depths; soil types; sun or shade; companion, intercropping and staggered planting; the location of different species and crop rotation; plant growth shapes and heights; and nutrition and moisture requirements are key to high production quality, quantity, and a continuous supply.

By choosing what to plant and where to plant it we can **also** build our own topsoil, attract beneficial insects, inhibit other insects, and protect our plants from damaging wind. Some **deciduous** plants (die back in winter) can be planted on outer edges of beds, in swales, on and below swale berms, and on very poor soil as **dynamic accumulator** (collect nutrition and minerals in leaves) and **insectary plants** (attract beneficial insects). They can be left to drop their leaves in winter, or be cut back for mulch, high nitrogen compost activators, ph balancers, and as mineral depositories. Examples of these are nasturtium, borage, comfrey, yarrow, feverfew, tansy, amaranth (mbuya and uboloko), lucerne, clover, dandelion, chickweed, and nettles (mbabazane).

Annuals (planted every season) and **perennials** (which grow for a number of years), doing the same job, can be grown in weed breaks for cutting and mulching, or cutting for compost carbon. Setaria and vetiver grasses, sunhemp, dock weed, fat hen (belikicane), amaranth, elderberry, and river reeds such as ikhwane, grow very large amounts of biomass which can be turned into humus that builds topsoil and attracts earthworms.

PLANT PREFERENCES

sun or shade

- mealie, pumpkin, bean family, cabbage family, potato, sweet potato, tomato, carrot, beetroot, brinjal and onion family do better in **full sun**
- lettuce, spinach, parsley, coriander, fennel, New Zealand spinach, and celery can tolerate **partial shade**

damp or dry

- all herbs and maturing sweet potato prefer **slightly drier** conditions; pumpkin family prefers **water** placed **on soil** around their roots, not on their leaves

bush or head outwards

- large headed cabbages, cauliflower, broccoli, potato, iceberg lettuce, bush beans grow upwards and **bush ou**t as they mature

spread sideways

- pumpkin, calabash, New Zealand spinach, and sweet potato need **lots of space** to spread across the beds

grow upwards

- tall, slim, upright plants like leek, onion, cos lettuce, Swiss chard, beetroot, mealie require **less sideways space** than bushy plants

climb

- some plants that spread sideways can also be **stacked** to grow up trees, shrubs, or trellises such as pumpkin, cucumber, runner bean, and pea

Number your **planting areas** to aid good planning.

THINGS TO CONSIDER: PLANNING TO PLANT

THE SEASON

In one project our beds were ready at the **end of March/April** which is the end of summer and the start of autumn. Most of these plants would **still be growing during the winter,** and frost, cold nights, and the need to irrigate frequently in the early growing stage of the plants affected our choices.

Planting would also be going on in **spring** as we worked through all the beds, with more rain and warmer weather.

In Kwazulu-Natal we are blessed with **three planting seasons**: Autumn, Spring, and Summer. We must remember that some plants do better planted at the beginning, middle, or end of the season.

TABLE ONE

PLANTING SEASON ONE: END OF SUMMER/AUTUMN

February March April May June - FMAMJ

Month	Crop	Harvesting Over ? Days	Planting Interval - Weeks
FM	bean bush, bean runner	50	3
FM	bean dry, cowpea, soya	20	3
F	beetroot	50	3
FMAM	broccoli	10	3
FMAM	cabbage	35	3
FMAM	carrot	50	2
FMAM	cauliflower	10	3
FMA	celery	50	2
F	cucumber	50	4
FM	garlic	20	2
FMAM	leek	150	2
MAM	onion bulb	20	4
MAM	onion spring	150	4
MA	parsley	90	20
MA	pea dry	20	4
MAMJ	pea shelling	50	3
MAMJ	pea shoots	60	2
MAMJ	pea snap	60	4
M	potato (frost free areas)	30	4
FM	radish fodder	40	2
JFM	radish table	20	2
FM	Swiss chard	150	8
JFM	all tomatoes (frost free)	60	5
JFM	turnip	30	3

TABLE TWO

PLANTING SEASON TWO: SPRING/EARLY SUMMER

July August September October - JASO

Month	Crop	Harvesting Over ? Days	Planting Interval - Weeks
JASO	bean bush, bean ndhlubu, bean runner, cowpea	50	3
JASO	beetroot	50	3
ASO	brinjal	30	4
JA	broccoli	10	3
JAS	cabbage	35	3
JASO	carrot	50	2
JA	cauliflower	30	3
AS	celery	50	2
ASO	chillie all peppers	270	24
AS	cucumber	50	4
ASO	leek	150	4
AS	madumbe (taro)	90	2
ASO	mealie, sweetcorn	14	4
AS	onion spring	150	4
JA	pea shelling	50	3
JA	pea shoots	60	2
JA	pea snap	60	4
JASO	potato	30	4
SO	pumpkin greens flowers young pumpkin green growing tips imifino	100	8
AS	radish fodder	4	2
ASO	radish table	20	2
ASO	sorghum	30	4
JSO	squash marrow calabash butternut	50	5
ASO	sweet potato	30	4
ASO	Swiss chard	150	8
ASO	tomatoes - all	60	5
JAS	turnip	30	3

TABLE THREE[4]

PLANTING SEASON THREE: MIDSUMMER

November December January - NDJ

Month	Crop	Harvesting Over ? Days	Planting Interval - Weeks
ND	bean bush, bean runner	50	3
N	beetroot	50	3
N	brinjal	30	4
N	chillie all peppers	270	24
ND	cucumber	50	4
NDJ	madumbe (taro)	90	8
NDJ	mealie, sweetcorn	14	4
ND	pumpkin greens flowers young pumpkin green growing tips (imifino)	100	8
NDJ	sorghum	30	4
NDJ	sweet potato	30	4
N	Swiss chard	150	8

LOCATION

ASPECT

We spend time becoming super familiar with **OUR** gardens. There are many **micro-ecosystems** in all gardens with varied consequences of their personal character.

For example, beds at the bottom of the slope would be colder and have **more moisture**. Plants on the upper slopes, or Southern or Western **side** of the beds should be taller than those below them on the slope or those North or East of them for both tall and short to get the **full benefit** of the **morning** and **midday sun**. Tall plants will then **shade** shorter plants from the drying afternoon sun. Flat gardens will present their own needs and opportunities.

PLACING, SPACING AND DEPTH

Placing, spacing, and **depth** are **critical**: stacking, intercropping, staggered and edge planting are important principles in maximising efficient usage of resources. They also give plants their **preferences** in access to sun or shade, more water or less. By using space effectively, we make it possible for plants to bush or head outwards, to spread sideways, or to use space by growing upwards or climbing.

In our gardens, we loosen all seed and seedling beds to the depth of 30cm. We then plant our seeds and seedlings at different spaces and depths depending on the **size** of the **seed** and **growing style** of the **seedlings**. Some plants like to grow close together; others need to grow further apart.

How deep you plant your seeds can affect germination quality.

Fine seeds need to be sown on the **top** of loosened soil and covered finely with a little soil. Bigger seeds need to be planted a **little deeper**. Seedlings of plants with **heavy** leaf growth, such as the cabbage family, need to be planted **a lot deeper** than others to support their prolific leaf growth.

EDGE AND INTERCOPPING

We use edge and intercropping for many purposes. Crop production in any area can be dramatically increased by using edges around the main crop and by putting fast growing or tall thin shaped plants in between slower and late spreading or heading plants. Our main purpose is to use **less land** to **produce more**.

We do this

- to reduce the impact of human practices on the land
- to leave more land available for conservation
- to make land available more fairly and generously for more people to garden or farm

good edge and intercropping plants

- lettuce, fenugreek, coriander, spring onion, leek, radish, Swiss chard, thyme, marjoram/oregano, calendula, zinnea, marigold

good bank holding edge plants

- vetiver, comfrey, setaria grass

good corner and barrier plants

- rosemary, pineapple sage, perennial basils, comfrey, nasturtium, leonotus leonora, iboza, buddleia varieties

SOIL

In permaculture gardens, soil types are less critical in choosing what to plant where. Sheet composted, mulched, and pioneer planted soil, regardless of original cell structure, holds more moisture, nutrition, micro-organisms, earthworms, and becomes better ventilated season by season. Therefore, composting, mulching, pioneering, stacking, and companion planting are greater determinants for success because they create a **more universal balance** of conditions required for horticultural production. This gives permaculture gardeners a much wider choice of planting areas.

However, some plants **are still happier** to be placed in one soil type rather than another, on a draining edge or on top of a swale, or on a moisture-holding middle or edge of a bed.

Composted and Mulched Sandy, Dryer, and Well-drained Soil

- perennial herbs, thyme, oregano, sweet potato (not too much kraal manure), tomato, garlic, all legumes

Composted and Mulched Loam, Damper Soil

- Swiss chard, cabbage family, onion family, parsley, coriander, fenugreek, mealie, carrot, beetroot, all beans, all peas, pumpkin family (with added kraal manure), radish, lettuce

Composted and Mulched Wetter, Clay Soil

- madumbe (taro), leek, celery, potato

PLANNING FOR DIVERSITY: POLYCULTURE AND COMPANION PLANTING

Polyculture and companion planting, where vegetables, herbs, shrubs, weeds, fruit, and trees grow together, are the **most visible** expression of biodiversity, and an essential, definitive **cornerstone** of permaculture and eco farming.

It involves **stacking** diverse plants in what Paul Duncan calls the careful arrangement of space, how plants fit physically into a physical area, on the ground, in the air, in the middle of the bed, on the edges, in the swales, and on the berms. ***5***

It is the careful arrangement of plants sharing soil types, climate preferences, humidity or dryness, and benefits from nutrients and minerals **cycled** by accumulator plants and nitrogen fixers. Companion planting also offers the provision of **support** for climbers, and the **protection** of **slow growers** by established or fast growers. Some plants are insect **repellents**, or insect or bird **attractors** which they do with food, fragrance or colour. Some are growth inhibitors or stimulators, or simply have disagreeable root enzymes disliked by others.

Plants are used for **protection** against harsh weather, wind breaks, weed breaks, dappled shade, and **medicine** for people and plants. We use msobe berries as a **trap crop** for leaf sucking ladybirds which do enormous damage to pumpkin

and squash plants. The ladybirds gather on msobe berry leaves in great numbers, where their predators find them easily and devour them.

Many succession, insectary, companion plants, nitrogen fixers, humus builders, and compost material plants **may not be edible** or **have a market value**. We still consider them a **significant part of our harvest**.

SOIL BUILDERS

Companion plants often serve as soil builders. Some **accumulator** (collector) plants are useful **just** as soil builders. Although they might not all be edible we "harvest" them as accessible and cost effective nutrients, minerals, and carbon (biomass, humates) to support microbial and earthworm life. They put down deep tap roots (lucerne), or shallower spike roots (comfrey and dandelion), and bring up nutrients, potassium, or calcium, for example, which they accumulate in their leaves and stems.

Others process **atmospheric nitrogen** in their roots, and release it by nitrogen-fixing bacteria in a form accessible to other plants.

Accumulator plants are eaten by animals, die back, decompose, or are cut by farmers for use as mulch (chop and drop), put in compost, wormeries, and liquid manure. They are also planted to rehabilitate disturbed or damaged soil, as pioneers before and during other planting, some perennials, and some annuals. We use them continuously in our eco farming. **Pioneer** plants that come before, and work in the **succession** process, lead to deeper, richer soils that can support more and more demanding plants.

Some of these pioneer plants are amazing **medicines and fodder for livestock**. We keep our **enclosed poultry healthy** with ubusuku mbili (two days to health), also called munyane (leonotis leonora), iboza (Natal ginger), and icena (aloe) to prevent and treat respiratory illnesses. At the first cough we crush a handful of their leaves and drop it into the drinking water. We **feed** the chickens edible greens from our gardens, and a handful of mixed grain per bird. We use setaria, vetiver, and lemon grass as thick bedding and **nesting** material to prevent disease and cold. We have healthy chickens, healthy eggs, healthy baby chicks, magnificent manure accelerator, sheet manure, and compost from excellent soil builders.

USEFUL PLANTS

Many of these are called weeds by the uninformed, and some have more than one function, thus supporting another cornerstone in permaculture**,** that of **multi-functionality**. One of these may be human food, a soil builder, an insect protector, a medicine and more at the same time, for example **fenugreek**. This is a delicious leaf and seed component of traditional Indian curry; it fixes nitrogen, attracts beneficial insects, and, it is said, balances blood pressure. New Zealand spinach (edible, soil conditioner), mustard, chickweed (a lovely delicate wild "spinach" or imifino), plantain bananas, plantain herbs, other bananas, vetches, sesbania sesban (yellow), lab lab (biomass), buddleia, tansy, madumbe, sou sou, and Japanese radish all find a seasonal place in our systems.

Conservative farmers see **flowers** as **space wasters**. We encourage them for the **protective barrier** they bring to our eco gardens and farms. Zinnia, petunia, pansy, marigold, calendula, feverfew, nasturtium, all the basils, pineapple sage, and evening primrose are the most efficient for use in our area. We allow many of our vegetables to **go to seed** both to contribute to our protective flower barrier and to provide acclimatised, inexpensive, and sometimes **self seeded** plants for seasons to come.

FOOD FOREST

A food forest is a combined fruit orchard, vegetable, herb, and protective plant garden. It is a **polycultural** fruit orchard. We plant the small fruit and nut trees first, 25m or more apart. Low mixed ground cover pioneers, and two or three protective (from wind and harsh weather) and pioneer nitrogen fixing trees are placed around and between the fruit trees. The pioneer and protective

trees may be cut back (pollarded) or down for mulch and firewood later, providing space for the maturing fruit tree. A crop like potatoes may be grown between the young trees which will spread into the space left once the potatoes are harvested. Non-food bearing trees are placed in the orchard in relation to the space requirements of each fruit tree: 25m – 60m. **Windbreaks** of trees and indigenous flowering shrubs in the orchard's borders protect the flowering and fruiting trees during storms, wind, cold, and very hot weather. Leaf transpiration raises the moisture levels of the whole area. Free range poultry forage on fallen fruit and insects. In this way, we **harvest** off the top tree canopies (fruit, biomass, and moisture), between the fruit trees, and off the ground while the orchard trees are getting bigger and stronger.

We use

on the ground

- clover, alfalfa, sweet potato, New Zealand spinach, cow pea, bush bean, nasturtium, mustard, Japanese radish, fenugreek

on the ground and climber

- Zulu pumpkin, calabash, butternut, sou sou

medium height

- pea, runner bean, morogo (red herb), belikicane, uboloko, sages, and basils

taller

- plantain banana, cavendish banana, lady finger banana, lemon, naartjie, orange, kumquat, guava, mulberry, avocado pear, tamarillo, pecan, macadamia, pigeon pea, acacia, sesbania sesban, pigeon berry, halleria lucida, erythrina, bauhinia galpinii, buddleia and indigenous solanum varieties

To have **biodynamic** control of pests, eco gardeners aim for a **balance between pests** and **beneficial insects**; a few adverse pests are left to provide a food bank to attract the predators. We must have both to avoid epidemics. For example, we throw aphid infested bean and pea growing tips to our chickens, while always leaving some aphids in the garden to attract beneficial ladybirds.

Certain plants attract beneficial, predatory insects, particularly when they are in flower. We also place logs, drinking stations, chopped and dropped branches and plenty of mulch to **attract** birds and beneficial insects, especially bees, bumblebees, prey mantises, ladybirds (the good ones), and wasps, and provide **shelter** for beetles, centipedes, frogs, lizards, and snakes.

When planning a **crop production schedule**, we tell people if they only remember what **not** to plant together, they are taking a big step forward toward critical **companion planting** practices. For example, we remember that legumes and potatoes dislike the onion family intensely. It is, however, more complex than that. Good companions promote growth, repel insects, or attract beneficial insects that protect their neighbours. **All vegetables grow better in a polycultural rather than in a monocultural system**

We carry a small condensed list of good (most of them like to grow together) and bad companions – the permutations are just too numerous to remember. It goes in our pockets into all projects, along with our note paper and pen for documenting our observations.

USING OUR SPACE WELL

Crop production planning is **not just** about planning the planting of crops.

We plan, at the same time, for a diverse range of productive small to large edible and non-edible productive and protective plants, as mentioned above, at a few selective central and corner positions, and some edges of our beds. All the surrounding points in our gardens are planted to fruit, indigenous, and other protective trees and shrubs.

Our **planting schedules here**, however, reflect the planting of **edible crops** and **their companions**.

In our planting space, depth, and companion **tables**, measurements are **approximate**. It is important for us to **observe** the **results** of our planting strategy, to moderate it according to what we **experience**, and to make the new information an **intuitive part** of **our planting aids**.

PLANTING PATTERNS

We find planting on narrow contoured beds served by pathways on either side makes our gardens more manageable for fairly large groups of people than spiral, keyhole, or mandala beds. They are easier for groups **focusing on food** to prepare, plant, irrigate, and maintain our gardens, and harvest our products.

Seeds are either broadcast, sown in shallow drills, or placed in holes along contoured beds. Some seeds are sown **directly** into **permanent** growing stations. Some are sown in small seed beds or trays and **later transplanted** to bigger areas. We make sure all seed nursery beds, which require **frequent watering**, are **easily reached** by contour pathways or keyhole paths, are close to watering points, and to zone 0.

We use **staggered, zig zag spacing** for planting all **seed directl**y and transplanted seedlings.

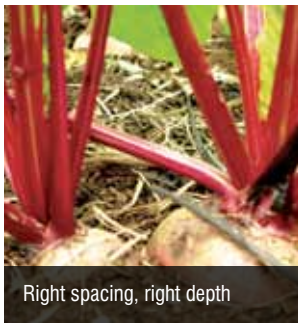
ZIG ZAG PLANTING PATTERN

```
X   X   X   X
  X   X   X   X
X   X   X   X
  X   X   X   X
X   X   X   X
```

This allows **more air movement** and **sun exposure** for good **ventilation** and rapid **photosynthesis,** and **reduces vulnerability** to attacks by pests, viruses, and mildews.

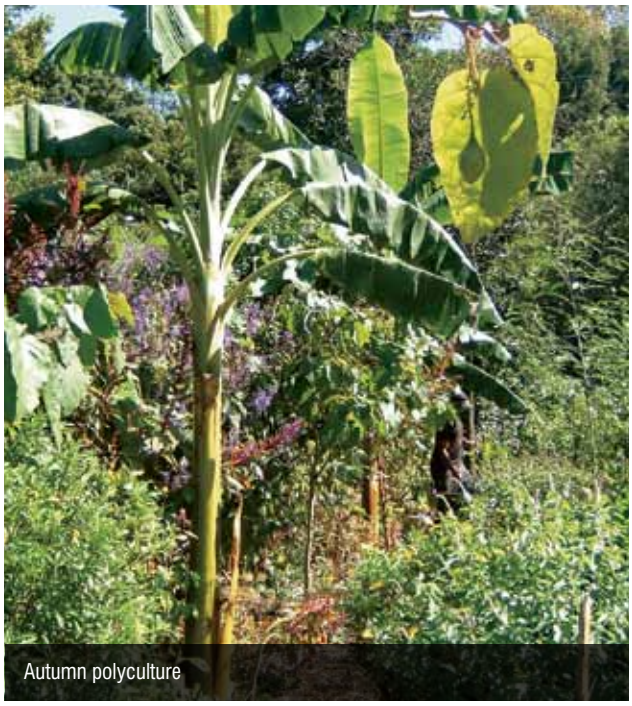

Intercropping fast and slow growers


Good companions - carrots, beetroot, bush beans


Right spacing, right depth


Leaf sucking ladybird


Msobe berry trap crop - leaf sucking ladybird and predator insect


Autumn polyculture

PLANTING SPACE, DEPTH, AND COMPANION PLANTING

We work from planting schedules giving seasonal, growth period, spacing, and companion preferences.

NOTE

In the following tables

- seeds planted for later transplanting, only have their poor companions listed, alongside which they must NOT be planted even in seed beds
- “all peppers” includes green, yellow, red peppers, bell peppers, and chillies
- “onion family” includes red and white bulbing onions, soup, spring, or green bunching onions, leeks, and garlic
- “bean and pea family” includes bush, runner, broad beans, sugar and other beans for drying, pod and snap peas, peas for drying, and cowpeas
- “cabbage family” includes drumhead cabbage, sugar loaf cabbage, savoy cabbage, cauliflower, sprouting and heading broccoli, and kale
- parsley includes moss curled, and Italian flat leaf which is hardier, more prolific, tolerates higher temperatures, and can be harvested over a longer period

TABLE FOUR
PLANT SPACES, DEPTH, COMPANION: SEEDS

Crop	Spacing	Depth	Companion - Good	Companion - Bad
bean bush	15cm apart in row	2 seeds directly in 2cm holes	khakibos marigold beetroot cabbage carrot celery cucumber fenugreek feverfew mealie parsley potato radish	onion fennel sunflower
bean runner	stick trellis 15cm apart	2 seeds directly in 2cm holes	radish Swiss chard carrot feverfew potato	peppers onion family
beetroot	10cm apart in row	3 seed clusters directly in 2cm holes	onion family calendula morogo radish spinach all bean and cabbage families parsley all peppers lettuce	marigold
borage	self-seeding or broadcast	top of loosened soil		
brinjal	5mm apart	10mm shallow drills transplant seedling		apple apricot
broccoli	1mm apart	10mm shallow drills transplant seedling		carrot garlic
cabbage	1mm apart	10mm shallow drills transplant seedling		carrot garlic
carrot	1mm apart	10mm directly in shallow drills thin out maturing seedlings to 3cm apart	tomato radish rosemary sage mint parsley pea all peppers lettuce oregano marjoram basil all bean pea or onion families (not onion WITH beans)	fennel potato cabbage family

Crop	Spacing	Depth	Companion - Good	Companion - Bad
cauliflower	1mm apart	10mm shallow drills transplant seedling		carrot garlic
celery	broadcast	top of loosened soil cover thinly with fine sand transplant seedling		
clover	broadcast mixed with lucern	top of loosened soil dig in with rake good for edges or in swales	cabbage family all fruit trees	
coriander	self-seeding or broadcast	top of loosened soil dig in with rake good for edges or in swales	mealie spinach marrow butternut gem squash calabash tomato potato	fennel
cowpeas mbumbe	self-seeding or 15cm apart in row	2 seeds directly in 3cm holes	khakibos marigold beetroot cabbage carrot celery cucumber fenugreek feverfew mealie parsley potato radish	sunflowers fennel onion family
fennel	self-seeding or broadcast	top of loosened soil dig in with rake	cabbage family lettuce onion family	beans peas carrots coriander tomato
fenugreek	self-seeding or broadcast	top of loosened soil dig in with rake good for edges or in swales	all except	onion family
feverfew	self-seeding or broadcast	top of loosened soil dig in with rake directly or seedlings transplanted	all	
jugo bean ndhlubu	15cm apart in row	2 seeds directly in 2cm holes beans grow underground like peanuts	khakibos marigold beetroot cabbage carrot celery cucumber fenugreek feverfew mealie parsley potato radish	onion fennel sunflower
leek	broadcast	top of loosened soil dig in with rake transplant seedling		bean and pea family potato
lettuce	broadcast mixed with fenugreek	top of loosened soil dig in with rake transplant seedling		
lucern	broadcast mixed with clover	top of loosened soil dig in with rake good for edges or in swales	all fruit trees cabbage family	

Crop	Spacing	Depth	Companion - Good	Companion - Bad
mealie sweetcorn	15cm apart in row	2 seeds directly in 4cm holes	amaranth/morogo beans coriander peppers potato pumpkin family soya bean sunflower (not sunflower WITH beans) yarrow	
mustard	self seeding or broadcast	top of loosened soil dig in with rake good for edges or in swales	cabbage family all fruit lettuce mealie potato tomato	acid loving plants
New Zealand spinach	self seeding or broadcast	top of loosened soil dig in with rake good for edges or in swales	all wonderful soil conditioner	
onion bulbing	broadcast	top of loosened soil dig in with rake transplant seedling		bean and pea family potato
onion spring	broadcast	top of loosened soil dig in with rake transplant seedling		bean and pea family potato
parsley	broadcast	top of loosened soil dig in with rake transplant seedling		
pea	stick trellis seeds 15cm apart	2 seeds directly in 2cm holes	radish Swiss chard carrot feverfew potato	peppers onion family
peppers	broadcast	top of loosened soil, dig in with rake transplant seedling		
potato	30cm apart	old manure filled 30cm deep trench 10cm soil over manure sprouted seed potato on soil 10cm soil over seed earth up stems of small growing plants with soil	amaranth beans peppers marigold mealie mustard pea coriander parsley fennel fenugreek	apple apricot carrot melon pumpkin raspberry sunflower tomato onion family
pumpkin family	90cm apart	good stacking plants richly manured and composted soil seeds directly n 4cm holes	mealie morogo sunhemp most fruit trees sesbania pigeon pea	apple apricot carrot raspberry sunflower tomato onion family
radish fodder	broadcast	top of loosened soil dig in with rake	onion family lettuce peppers tomato turnip beans beetroot cabbage family carrot feverfew	radish fodder
radish table	broadcast	top of loosened soil dig in with rake	onion family lettuce pea peppers tomato turnip family carrot feverfew beans beetroot cabbage family	

Crop	Spacing	Depth	Companion - Good	Companion - Bad
soya cowpea mbumbe	self-seeding or 20cm apart	2 seeds directly in 2cm holes	khakibos marigold beetroot cabbage carrot celery cucumber fenugreek feverfew mealie parsley potato radish	onion fennel sunflower
Swiss chard	broadcast	top of loosened soil dig in with rake transplant seedling		
tomato	self-seeding or broadcast	top of loosened soil dig in 2cm deep with rake transplant seedling		potato
turnip	broadcast	top of loosened soil dig in with rake	marigold calendula leek lettuce radish spinach	

TABLE FIVE
PLANT SPACES, DEPTH, COMPANION:
TRANSPLANTED SEEDLINGS, ROOT PIECES, GARLIC CLOVES

Crop	Spacing	Depth	Companion - Good	Companion - Bad
brinjal	30cm apart in row	5cm hole	thyme carrot bean marrow Swiss chard basil oats pigeon pea borage marjoram oregano	apple apricot
cabbage	25cm apart in row	7cm hole to first leaves above roots	beans beetroot feverfew lettuce radish rosemary sage geranium thyme tansy coriander fenugreek onion leek mustard parsley sage celery clover fennel	carrot
cauliflower	25cm apart in row	7cm hole to first leaves above roots	beans beetroot feverfew lettuce radish rosemary sage geranium thyme tansy coriander fenugreek onion leek mustard parsley sage celery clover fennel	carrot
broccoli	25cm apart in row	7cm hole to first leaves above roots	beans beetroot feverfew lettuce radish rosemary sage geranium thyme tansy coriander fenugreek onion leek mustard parsley sage celery clover fennel	carrot
celery	25cm apart in row	7cm hole	cabbage family calendula onion family parsley peppers Swiss chard, tomato marigold khakibos bean	
garlic	cloves 10cm apart in row	3cm deep pointy end up	beetroot carrot lettuce spinach tomato	cabbage family bean and pea family
ginger	root eye 30cm apart in row	7cm deep eye up	madumbe	

Crop	Spacing	Depth	Companion - Good	Companion - Bad
leek	20cm apart in row	drop seedling into 8cm deep narrow hole dribble water into hole to pull in soil loosely for long thick white leek	good edge and intercropping plant all except	fenugreek potato bean and pea family
lettuce	20cm apart	5cm hole in row	good edge and intercropping plant all	
marjoram oregano	25 cm apart	7cm deep in row	cabbage peppers tomato brinjal marrow	
onion bulbing	15cm apart	compact 5cm loosened soil with back of your hand spread trimmed roots over compacted soil pull small amount of soil over roots press down firmly but gently	tomato brinjal peppers	fenugreek bean and pea family potato
onion spring	20cm apart	drop seedling into 8cm deep narrow shaped hole dribble water hole to pull soil loosely for best long white spring onions if left will send up new onion seedlings from root to make big bunch	good edge and intercropping plant all except	fenugreek potato bean and pea family
parsley	25 cm in row	5-20cm deep depending on maturity size of seedling	Swiss chard carrot celery lettuce pepper tomato cabbage family beans beetroot	
peppers	40 cm apart in row	5-20cm deep depending on maturity size of seedling	beans beetroot pepper tomato Swiss chard carrot celery lettuce fenugreek mealie onion family parsley marrow gem squash calabash radish amaranth marigold khakibos tansy	
sage	25 cm apart in row	10-20cm deep depending on maturity and size of seedling good edge and intercropping plant	brinjal marrow cabbage pepper tomato	25 cm apart in row
Swiss chard	25 cm apart in row	5-10cm deep depending on maturity and size of seedling	good edge and intercropping plant good companion for all	
thyme	25 cm apart in row	10-20cm deep depending on maturity and size of seedling good edge and intercropping plant	brinjal marrow cabbage pepper tomato	

Crop	Spacing	Depth	Companion - Good	Companion - Bad
tomato	40cm apart in row trellis for vine varieties	6cm hole or to first leaves above roots	onion family coriander fenugreek lemon balm marjoram/ oregano mint mustard parsley radish sage thyme yarrow tansy borage carrot celery basil marigold	

SAVING OUR GARDEN SEED

We find many good reasons to collect and store our own seeds.

We know they have been grown in **ecologically sound conditions** and that we **only keep** healthy, strong seeds and **destroy** those that have been attacked by pests and disease. The seed we keep is hardier because it is **acclimatised** to our micro-ecosystems. It is also very **much cheaper** than bought organic or non-organic seed. We love the fact that **sharing** the harvested seed from our gardens and farms with neighbours, family, and visitors helps to **sustain genetic diversity** as well as building communities.

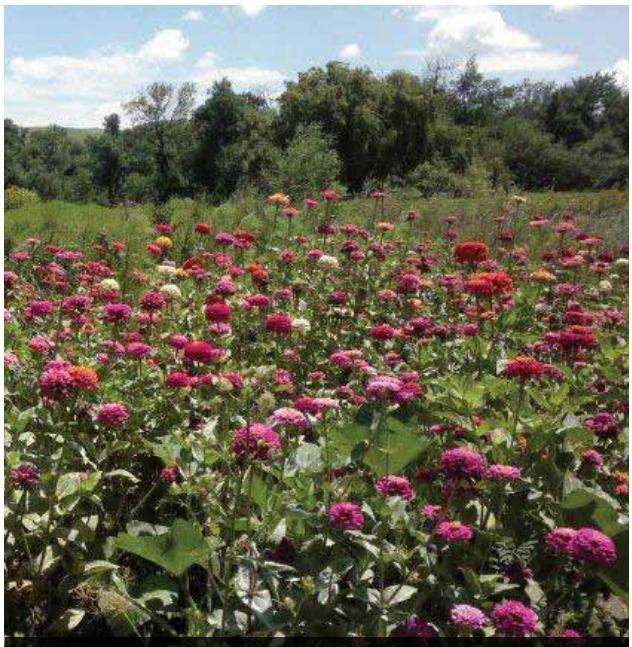
In our bed and breakfast garden project, we leave zinneas to seed themselves in large numbers because they attract beneficial insects and insectivorous birds, and supply cut flowers for the guests' rooms. Visitors from far and wide enjoy the organic food and a beautiful environment.

We start off by collecting **bigger, hardier** seed like pumpkin and squash family and bean and pea family, and then go on to **hardier small** seed like peppers and chillies, spring onion (large Welsh bunching onion species), cabbage family, mustard, coriander, fennel, fenugreek, celery, tomato, lemon, naartjie, and tamarillo. We keep seed that comes from **open pollinated** parent plants (**not hybrids**). Plants **will hybridise naturally** in our gardens and can produce **wonderful, disease free** vegetables. For example, one project produces 70cm long disease free butternuts (we call them our giant butternuts), mostly fleshy neck, thin skin, and almost red flesh.

They have hybridised over thirty-five years with Zulu pumpkin, and marrow. However, it is best to start with heritage species that have been bred from true plant to true plant for decades, if not centuries.


Self-seeded evening primrose


Seed collection


Self-seeded zinneas

HOW TO SAVE AND STORE SEED

To Do

- collect all seeds on a dry, wind free day
- collect ripe seed heads as they dry on healthy plants
- separate seeds from pods
- collect seeds in wet skin and fleshy fruit, wash and put through a sieve to clean, dry all seeds in sunny (if possible), airy, and dry area
- dry seed in labelled trays; species, date, source
- when completely dry, place in labelled packets in airtight glass or plastic bottles
- place in deep freeze for twenty-four hours if possible to kill seed born pests
- place bottles in dark, cool, airy place to store: on shelves, in cupboards, in refrigerators, or cold rooms

To Use

- do not plant mouldy, smelly seed
- plant lettuce, celery, carrot, fennel, parsley the following season – must be fresh
- bigger, soft-skinned seed can be stored for two to three years before becoming unviable
- big, hard seeds like pumpkin can be viable after six to eight years
- some seed must be collected fresh from fleshy fuit, placed in a container of water, allowed to ferment for a few days, washed in clean water, and planted immediatley

PEST CONTROL

In a **mature, self-regulating garden**, we have to **intervene very little** to control pests.

However, we have noticed that with late changes of seasons and more, and sometimes, unseasonal rain in our area, we are experiencing, even in our mature gardens, and often **for the first time in twenty years**, some pest damage, especially in young seedlings of the cabbage family. The leaves and growing points are being eaten off completely by grasshoppers and certain beetles.

In the past, the only intervention we were required to do was to **collect snails** for the chickens at times; **spread wood ash** after rain or irrigation on cabbage family plants up to half maturity to inhibit diamond backed cabbage moth larvae; and sometimes, fairly rarely, to **wash off aphids** with **soapy water** or **prune tips** infested with **aphids** to be fed to chickens.

Fruit fly numbers are dramatically reduced by collecting every piece of fallen fruit, or by running poultry free range in the food forest. If you have no poultry, it is best to **burn** or **place** fallen fruit in a **very hot compost heap**. Just burying in soil **does not kill the eggs** in the fruit adequately. Similarly, **standing** on bigger pests **does not kill eggs** in the body at the time. We treat pumpkin protection from pumpkin fly in a similar manner. We remove every drop of soggy, stung pumpkin bits and feed it all to our poultry which eat larvae, eggs, soggy bits, and all.

With new threats from pests, other methods found to be useful are **garlic spray** made by soaking a few cloves in a little paraffin for two days. Dilute it with water, one to five litres, and strain to use as a pest inhibitor spray. Add **chillie, onion**, and **garlic chives** to your garlic spray for a **drench.** Dilute with water, one to two litres and pour it on the soil around damaged plants to deter grasshoppers and beetles.

We prefer to **avoid paraffin** which is toxic to our gardens. This is also true of many other **organic sprays,** both home made and commercial. Avoid them if possible. They are often more toxic than chemical sprays. We substitute a non-detergent soap for paraffin in our mix with good results.

MAINTENANCE

Our project progress, maintenance, and expansion programmes are shaped by permaculture's saying "start at your back door" however big your land is. We start close to Zone 0, prepare, plant, maintain, harvest, prepare again, plant, maintain, and harvest again. We make sure that our **first** sections are sustainable BEFORE we move on to the preparation of the next.

Maintenance is done frequently and regularly, maybe daily, or weekly, depending on what and where it is needed.

Daily chores

- harvest
- check moisture levels and irrigate
- feed and give fresh water to chickens
- collect aphids, snails, fallen fruit, and greens to feed chickens
- collect kitchen waste for wormery, compost, or chickens
- sort all recyclable materials

Weekly chores

- loosen soil in recently harvested areas between crops, sheet compost and mulch
- replant with seasonal plants, green manure, or mulches; we try to allow not more than seven days between harvesting and replanting unless we are in the middle of winter or summer; this helps to ensure a steady flow of food
- ripe compost must ALWAYS be available, make it weekly
- check for pest damage or disease
- feed the seriously damaged plants to the chickens if safe for them to eat, or burn them in a small controlled fire pit

Seasonal chores

- chop and drop for mulch or cart for compost according to the seasonal growth stage of each plant – perennial basils three times per year, perennial plectranthus once per year after flowering, comfrey up to nine times per year depending on the growing conditions of each plant
- check for mature seeds to be harvested at the end of the growing seasons

Once there is a sense of sustainability, renewable resources, and manageable physical and material demands in our project, **THEN** we can expand, drawing on what we have learnt in our first phases.

Part of our maintenance plan is **evaluating** the growing, teaching AND learning experience.

AND IT WORKS

Despite small incidental failures that we have experienced in our projects, we find that if we **DO** what we plan and what we know using these permaculture food security techniques and our powers of observation and intuition, we really cannot go wrong. We create a low input, high return system which gets close to the ideal:

DO NO HARM

Bottoms up, getting it right

Puddle in seedling

REMEMBER
MAXIMISE EFFICIENCY

We hold on to no more land than we need, than we use, than we conserve. We make the most of the least by intercroppng, stagger planting, stacking, and using the least resources with the most beneficial outcomes. We observe the ways all food security systems are connected and use this to reduce waste.

REMEMBER
RECYCLE

By recycling kitchen, garden, and household waste in biodynamic procedures, we contribute to the reduction of global warming, pollution, and land rehabilitation.

REMEMBER
MINIMISE SOIL DISTURBANCE

Ripping our land or using hand tools to loosen soil rather than ploughing does not destroy soil structure and evaporate moisture unnecessarily. Working on our contours retains moisture.

REMEMBER
HARVEST WATER, USE SMARTLY

Helping ground and rainwater to filter slowly and cleanly from our catchment and storage points, through our plant and animal life, and soil, reduces energy expenditure and prevents the pollution of our rivers and seas.

REMEMBER
USE CONTOURS

When tilling, creating swales, berms, beds, pathways, and planting, we ALWAYS work along the contours.

REMEMBER
PLAN CAREFULLY

Learning to make informed choices about when, where, and what to plant makes it possible to turn poor land into a productive garden.

REMEMBER
PLAN FOR DIVERSITY

Polyculture is nature's way.

REMEMBER
SAVE YOUR GARDEN SEED

Good seed is one of the farmer's most valuable assets.

REMEMBER
MAINTAIN AND EVALUATE FOR SUSTAINABILITY

Without managed maintenance and evaluation there can be no stability, sustainability or growth.

CONCLUSION: PERMACULTURE IS A WORK IN PROGRESS

We plan well for our seeds, seedlings, shrubs, and trees; for the land, ourselves, and other people; for bumper harvests, joyous discovery, growing confidence; and for personal and communal fulfilment. We know we have developed our own leadership and management skills by using nature's gifts of connectivity and messy order responsibly and wisely to empower ourselves, and thereby, others. After a series of workshops, one of our learners advises us to "**Go natural & organic Africa"!**

Unlike garden landscaping, permaculture gardening is never "done". Continual observation gives us new objectives, pointers towards maintenance improvement, ideas for additions to our polycultural environment. Goals will be met, deadlines also if we are lucky. Seasonal planting will be completed. Harvests will be eaten, sold, or just identified in our garden's protector and biomass plants, predator insects, birds, carnivorous snails, lizards, frogs, and indigenous plants not seen in that area for years. But **CULTIVATING THIS agriculture is PERMANENT.**

ENDNOTES

1. Paul Duncan. "Guidelines on How to Develop a Permaculture/Organic School or Homestead Garden System." Dovehouse Organics. pp24-25.
2. Paul Duncan. Workshop.
3. Paul Duncan. "Guidelines on How to Develop a Permaculture/Organic School or Homestead Garden System." Dovehouse Organics. p40.
4. Based on Paul Duncan. "Guidelines on How to Develop a Permaculture/Organic School or Homestead Garden System." Dovehouse Organics. pp39-40.
5. Paul Duncan. "Organic Garden Companion Planting Manual." Dovehouse Organic Farm and Training Centre.

FURTHER READING

- Bill Mollison. Permaculture: A Designers' Manual. 1988. Tagari Publications.
  Bill Mollison and Reny Mia Slay. Introduction to Permaculture. 1991.
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- Great Abundance Natural Wealth: Permacultural Entrepreneurial Projects for Education and Income: Teacher's Guide. 2009. SEED.
- Growing the Living Laboratory: Permaculture for Environmental Education in the NCS. 2006. SEED.
- Louise Riotte. Carrots Love Tomatoes. 1975. Storey Publishing.
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- Paul Duncan. "Introduction to Plant Propagation Resource Manual." Dovehouse Organic Farm.
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- The Organic Classroom. 2004. SEED.
  Vetiver Grass: A Thin Green Line Against Erosion. 1993. Board on Science and Technology for International Development, National Research Council. National Academy Press.

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