Farmer Workbook

Integrated Agriculture Training Program

Land-Use and Soil Fertility

The production of this manual has been a team effort.
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1. Toksave long yumi wanwan

Pastain yumi statim dispela training i moa gutpela long wanwan trainee i givim liklik stori long em iet.

As One Group:

Insait long grup statim long han sut wanwan bai sanap na tokim yumi long;

- **Name bilong yu?**
- **Ples bilong yu?**
- **Wonem wok yu save mekim? Yu fama; or wok man-meri na narapela.**
- **Wonem bilip bilong yu dipela trening bilong Usim na lukautaim giraun bai halvim yu?**

1.1. As tingting bilong dispela trening

Long pinis bilong dispela skul "Yusim na lukautim giraon", mipela i bilip olsem:-

- **Yupela bai save long lukautaim gut giraun**
- **Luksave long sampela gutpela wei long yusim giraon,**
- **Kamap long sampela tingting long ol sampela samting yu ken wokim nau long impruvim wei yu save yusim giraon.**

Mipela i bilip tu olsem bai yupela-

- **Bai yupela kisim save long kainkain gutpela wei yu ken wokim bai ol giris long giraon bilong yu bai ino inap lus, na long longpela taim bihain.**
- **Luksave ong women samting em irousen, na tu wokim prektikal long daonim irousen.**
- **Wokim prektikal long kamapim treslaening wantain sampela niupela na olpela liklik diwai na gras olsem vetiva, lemon gras, valangur, pitpit, stik guka na kalava.**
- **Kamapim wanwan eksen plen long hau yu ken yusim gut hap giraon bilong yu.**

2. Tok igo pas – Lukautim ol senis i wok long kamap

'Taim mi bin yangpela mipela i save gat bikpela giraon tasol nau mipela i sot olgeta na dispela i kamapim planti kros pait long giraon. Bai ol bubu bilong mi i kisim giraon wei nau?

Taim Bipo	Nau
➢ Planti giraon	➢ Pait long giraon
➢ Planti diwai	➢ Nogat planti diwai klostu long ples
➢ Nogat planti man/meri	➢ Igat planti man/meri
➢ Bikpela famili	➢ Inap yumi senisim tingting na pasin bihainim dispela?
➢ Nogat gutpela helt	➢ Gutpela helt i stap
➢ Ol man i save kirapim niupela ples kostu klostu	➢ Skul, sios, rot, stoa, ples balus i mekim ples i stap long wanpela hap tasol.

Bung na toktok wantaim- 10 pela minit tasol

Tingting igo bek long tripela mep yupela i bin droim long skul bilong livelihood.

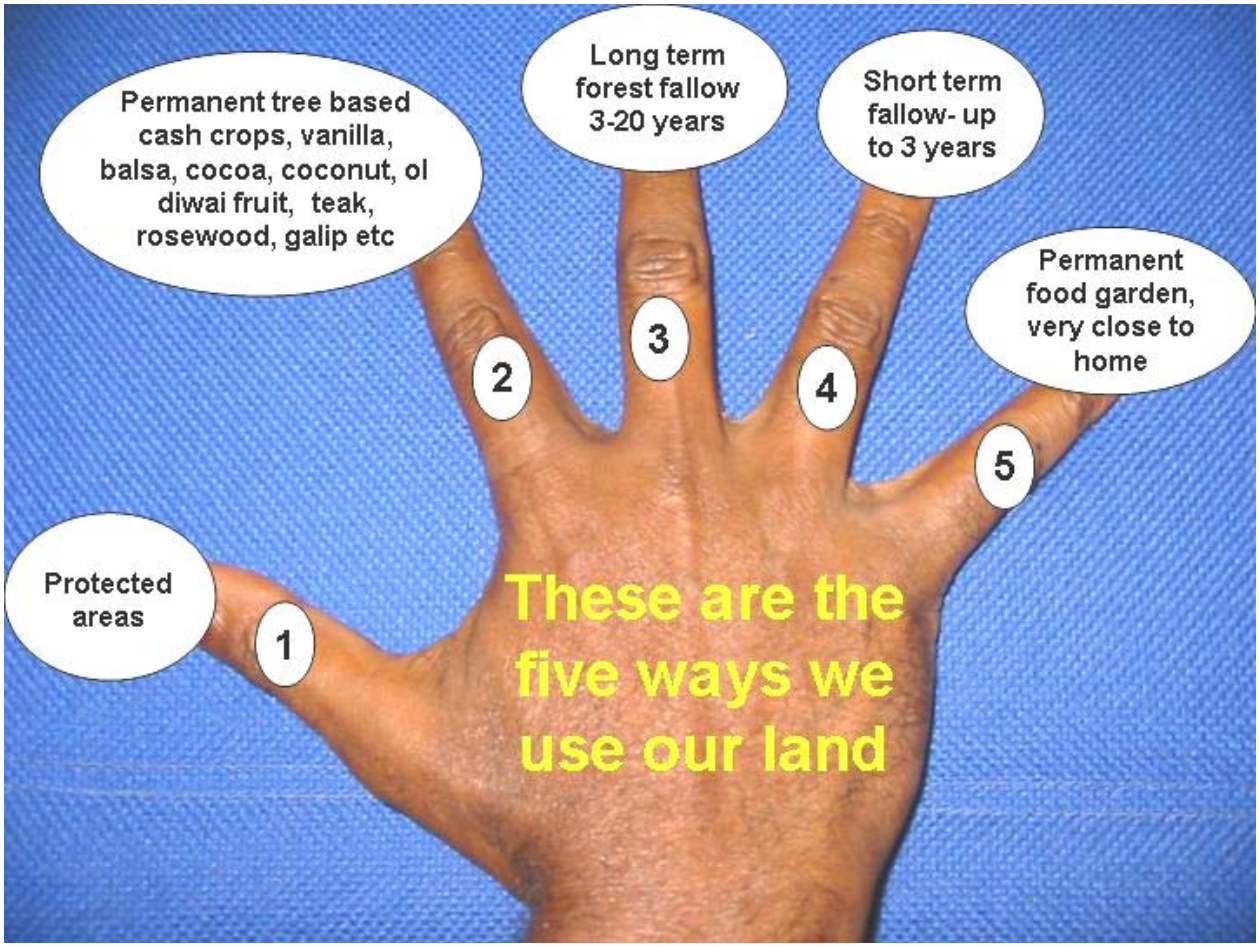
- **Long dispela skul bai yumi kamapim ol niupela wei long lukautim giraon bilong yumi bai ol gutpela tingting bilong bihain taim bai kamap olsem eksen plen.**
- **Bai yumi senisim pasin long yusim giraon bilong yumi olsem wonen?**

Husat i bin save papa long giraon?

- **Insait long ples em klan i papa long giraon. Dispela trening nau i luksave long nid bilong wanwan man/meri long toktok bung wantain ol narapela klan memba long wonem plen na eksen bai ol i wokim long lukautim na yusim giraon**
- **Taim klan i papa long giraon, bai i luk olsem wanwan man/meri bai i les long wokim planti wok long kamapim na lukautim gut giraon, bikos sapos ol narapela klan memba i lukim ol gutpela wok kamap long giraon, bai ol i traim pulim dispela giraon.**
- **Kaikai bilong tingting. Painim taim long sidaon wantain ol wantok na toktok long ol dispela hevi long giraon.**

- **Yumi nogat planti taim long toktok long ol dispela samting long dispela skul. Samting bilong yupela long ples long toktok wantaim ol klan membas.**

2.1. The five ways we use our land



In this training we will discuss these five ways of using our land.

We will think together about how we can use our land better, making sure it stays good for our children and their children.

Notes on the five main ways we use our land

1. **Protected areas. These are areas that you all set aside as places where people will not hunt or harvest or make gardens. How much of your land is used like this?**

2. **Permanent tree crops- cocoa, copra, balsa, vanilla etc. How much of your land is used like this?**

3. **Long fallow – How much of your garden land can lie in fallow for more than three years? (Graun bai malolo long pela taim)**

4. **Short fallow – How much of your land is often being gardened- with fallow or rest periods of less than 2-3 years?**

5. **How much of your land is always producing food? This kind of garden is right at home. Some people don't have this kind of garden.**

Working Together

- **Draw a large circle on one piece of paper, and allocate to various segments of your circle the proportions of your land that are in each of the five land-use types.**

Discussion

Discuss together how you feel about the way you use your land. Here are some questions to think about together.

- **Is there enough land for your needs and that of your children and grandchildren?**

- **What can you do about land shortages?**

2.2. Village walk- Land-use and Soil Characteristics

It's time to take a walk. Let's go and look at gardens and the way people are using their land- fallow, trees, gardens- all of it.

(We will also dig some holes and test the soils)

Wokabaut long ples

Take half an hour together, to walk around some gardens. Look at each garden, and identify how the land is being used. Refer to the diagram on the previous page.

Think about-

- **The amount (proportion) of land in each kind of system,**
- **The people who can use or benefit from each kind of land use.**

Working together

- **Dig a hole and look at what people call horizons.**
- **You should find lots of leaves and dead material lying on top of the A-horizon. Lots of the soil fertility in many tropical soils, is held in the A-horizon, and in the nutrients stored in all the green and dead leaves and twigs.**
- **(Texture- Place in the palm of your hand about a teaspoon of your soil, add some water, and rub the soil into a wet paste. Now with your other thumb rub hard on the soil and water mixture.**

  Does it all feel slippery, indicating lots of clay, and an ability to store lots of water-

  or is it rough, with lots of sandy material in it. If so, you have a coarse textured soil which is likely to be well drained. However, during dry spells, your plants are likely to be affected by drought.

If your soil is very fine textured, with lots of clay, the soil is likely to be poorly drained, but may also hold lots of water when wet)

2.3. Fire, Mulch and the role of Compost

We start by thinking about organic matter- and the way in which we can use it or lose it! The quickest way to lose organic matter is to burn it.

Discussion- 10 minutes tasol

- **In small groups, make two lists-**

Good things that fire does for us		Damage that fire does
1		
2		
3		
4		

Lukaut

- **We all know that fires do lots of work for us, cleaning up the ground, killing insects and diseases, helping to get ready for a new garden.**
- **But fires also burn organic matter that we need for the slow release of (gris) soil fertility, to grow good crops.**
- **Fires also destroy lots of good timber and trees, and may get out of control, damaging gardens and houses.**

Mulch

- **This is all the organic matter, (weeds, leaves, animal manure) that we can choose to either use on our garden, or we can burn).**
- **Don't burn your mulch- you can use it in your garden.**
- **When you next go to a garden, see if there is some mulch that you can make a simple experiment with, to see if it helps to control weeds, reduce erosion and give bigger crops.**

Without mulch	With mulch –
• cabbage doesn't grow well • many big weeds	• cabbage grew bigger • weeds are only small

2.4. Compost and Green Manures

International Experience

- **Many people in cold countries take their mulch (green and dead material that will rot) and in a special place, make compost. They use wheelbarrows to shift it to their (small) vegetable gardens.**
- **But, most of us have large gardens and we can't make enough compost to make a real difference in these large gardens.**

Compost or Green manures?

- **We need lots of mulch to make lots (and lots) of compost to help our soils. It is very hard to do this in traditional compost heaps.**
- **Later on we are going to plant green manure crops. These produce lots of mulch for us.**
- **These green manure crops (cowpea, snake bean etc) will also provide some food for us, and for our animals.**

Using Compost for seedlings

- **For nursery seedlings of fruit and vegetables some compost is really helpful. See below.**

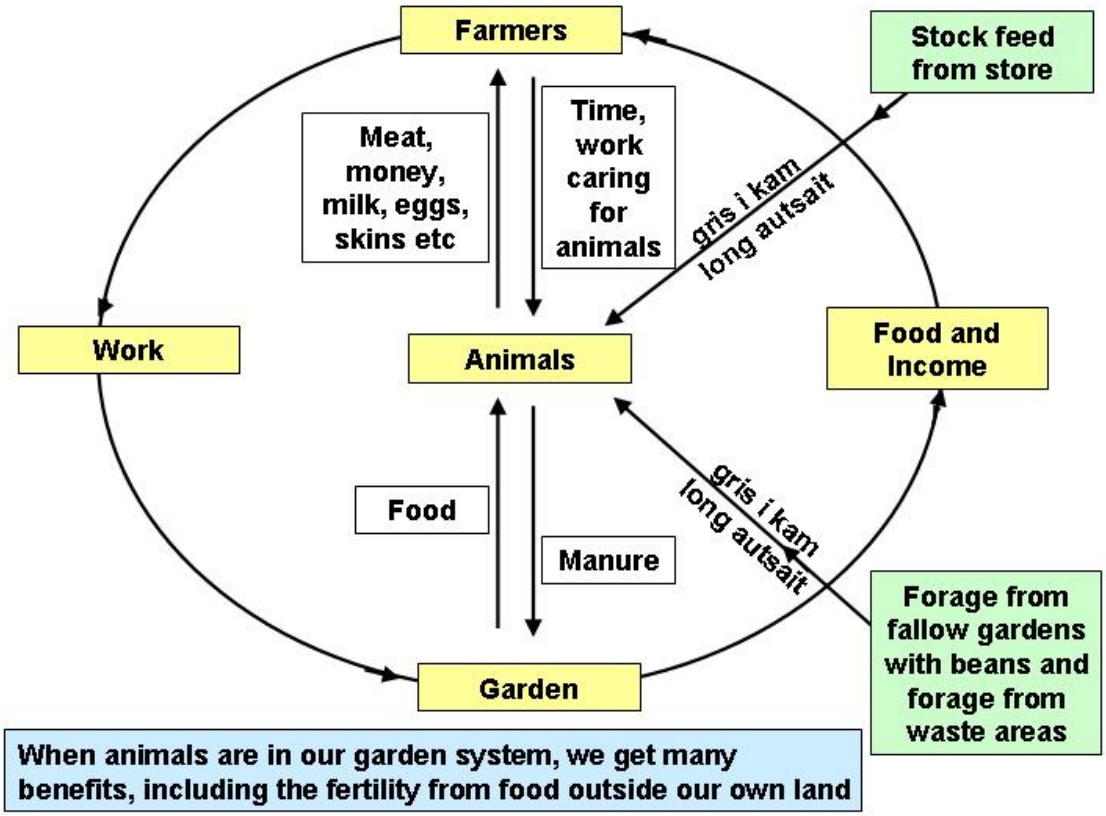
Making compost:-

Mix 7 spades of green leaf material, 2 spades of good soil, 1 spade of banana trunk material that is chopped up, and 1 spade of dry leaves. After mixing, put these all into a compost heap and keep adding material in a similar ratio. The amounts are not too important. Make sure that the material is moist- if need be add water. Stand on the material to get it compacted. Add more until your heap is full and cover with leaves or even some plastic. Keeping rain out is important. Within a few days the heap should be hot, which is good- as it will help to kill weed seeds and the green plant material that must rot to form good compost.

After about 2-3 weeks it is good to open up the compost, turn it over with a fork or spade and put it back to finish working.

You can use your compost to grow good seedlings and young fruit trees. Of course you can use it in your garden.

2.5. Role of animals in soil fertility



The diagram above, and the picture below, helps to show the way animals can help us in our gardens. When we grow some legumes in our resting or fallow land, these legumes provide food for our animals, and our animals provide manure for our crops as well as protein for our families and some income.

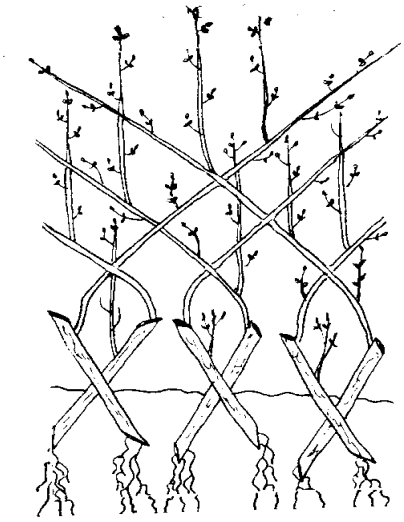
Chinese cabbage, with manure and without manure

- **Collect some manure and make a simple experiment with a crop like pak choi or corn.**

2.6. Live fences may help control animals

Background

- **Live fences may be a good and cheap way to control animals that often destroy gardens.**
- **They must be established and grow strong before livestock are able to reach them.**
- **Live Fences may also help stop theft- esp if thorny bougainvillea is used. (Photo refer page 47)**



Live fences can be effective- but the stakes need to be planted very close together so that branches that grow can be twined together.

Trees that can be used include Rosewood, quickstick (*Gliricidia sepium*), willow, balbal (*Erythrina* sp), bougainvillea, tanget, mulberry and a range of native species- pitpit, bamboo kalava, valangur and others

A very good live fence- cuttings have been planted very close together- during a training in May 2004, Kerevat.

Note Valangur, MarMar and also vetiver have been planted, to make a strong fence to help keep unwanted animals out of the area.

Working together

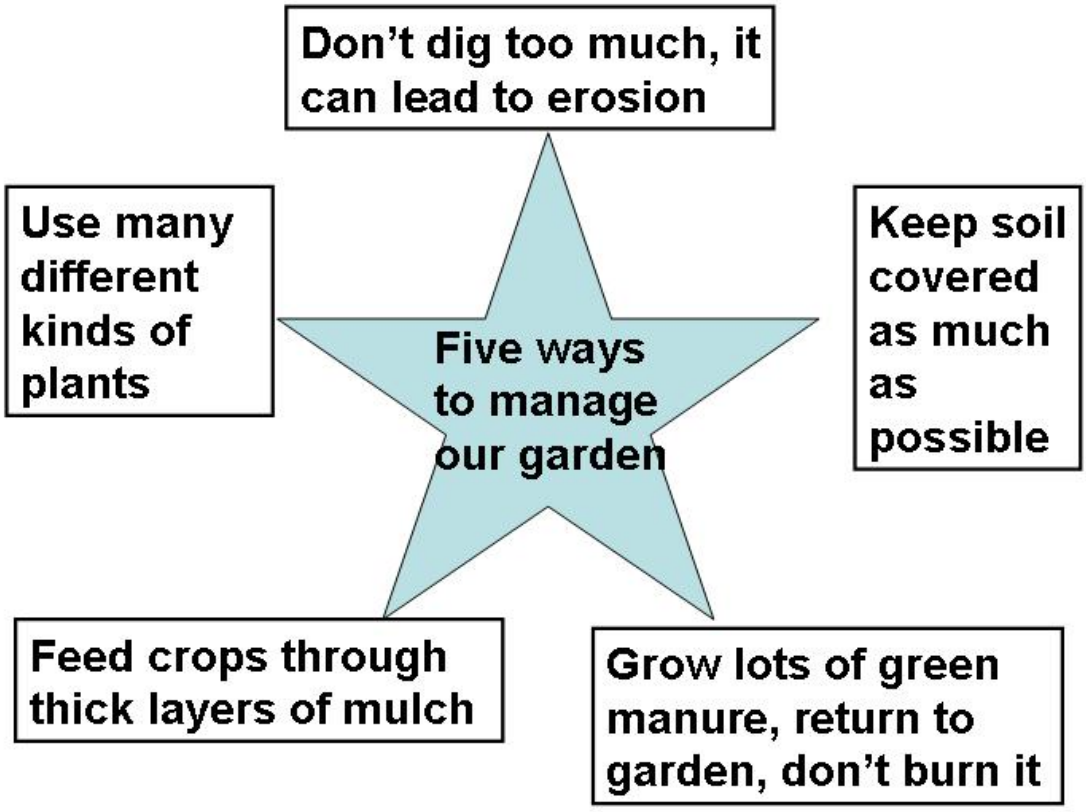
- **Plant a live fence and manage it so that any gaps are re-planted.**

3. Improving fallow- when the ground is resting (taim bilong malolo)

3.1. Introduction -

Five ways of caring for our gardens

- **Look at the picture below.**
- **Rainforests help to protect and improve soils in these ways.**
- **We can learn from nature. The diagram below helps to explain how rainforests care for soil, and how we can care for our gardens, in the same way as rainforests.**



Soil is like a bank- we get out what we put in

3.2. Managing fallow land

Managing fallow land

A key feature of this module is learning how to improve soil fertility in your fallow land- the time when the garden land is resting.

We want to develop ways of managing gardens so that the fallow period can give you some or all of the following:-

Less work	➢ **Reduced weed seeds in the next garden- through reductions in weed seed bearing plants in the fallow,** ➢ **Cultivation will be reduced because of the large amount of green manure that has grown on your land,**
Better water holding capacity	➢ **Reduced burning of organic matter, which helps to reduce erosion losses of soil and nutrients, and increases water holding capacity of soils,**
Less erosion	➢ **Increased cover of your soil because you have planned your fallow,**
Improved yields	➢ **There will be more mulch with a high level of nitrogen to help in growing your next crops.**
Food for animals	➢ **Animals can get food from our gardens- legumes are high in protein and this is good for our animals.**

3.3. Using Green manure legumes

What is a legume?

Legumes are plants like snake beans, peas, peanuts and rambling plants like Calopo and Pueraria (refer to page 47 for photos). They take nitrogen from the air and through small lumps or nodules on their roots, they turn that nitrogen into protein. This protein is what helps make legumes really good for us and our animals.

The nitrogen that they 'fix' from the air also helps to build soil fertility.

- **Many trees are legumes - examples include balbal, marmar, lamtoro, rosewood, rain tree, Albizia, Acacia etc.**

Green manure legumes are beans and other legumes that grow easily. They :-

- **help build soil fertility.**
- **provide food for people, (snake bean, soybean, peanuts)**
- **provide food for animals which in turn provide food and meat/eggs for us.**

Look at the diagram on page 15- it helps to show how animals eat plants from road-sides or fallow areas, or stock feed from a store and their manure then helps the garden grow well.

Legumes as food for people

Dry legume seeds should be cooked to allow people to really benefit from the protein in the seeds.

Some people allow the legume seeds to sprout- (start to grow) before eating them. This also helps to make the protein easy to digest for people. It is a good way to eat legume seeds. Once sprouted they can be eaten raw or cooked.

Learning from International Experiences

- **Thousands of farmers in other places are using short rotations of legumes as fallow- to reduce weeds and to increase yield of next crop.**
- **Let's try this together and see for ourselves if it is helpful.**

Tumbuna pasin bilong yumi

- Remember that in taim bipo there was plenty of land for everyone and fallow periods were long, allowing trees to naturally regenerate. Now, there is less land and we have to put some effort into making each fallow period a really useful fertility building time.
- Learning from our ancestors is always worthwhile.

Working together

- In half of a garden that is almost finished- ready for taim bilong malolo- plant seed of plants like velvet bean, Dolichos, snake bean, cowpea under the old food crop (photos starting on page 47).
- Leave the other half of the garden to rest in whatever grows there- weeds, grass etc.
- Leave both parts of the garden for about 6 months.

Later

- After 6 months, plant corn in both areas, to see what effect the legume has had.

Discussion

- List good and bad points relating to adding legumes to your garden system
- What stops us from planting legumes under a maturing crop?
- How can you make use of legumes and animals to help your food security?

Case studies of Green Manure legumes

1. Tomatoes at Vudal, ENB - cowpea or weeds planted.

These two photos were part of one garden at Vudal- growing tomatoes. The farmer left the left hand side as we normally do, to let weeds grow during the rest or fallow period. On the right, the farmer planted some cowpea seeds at the base of the dying tomato plants. They grew really well.

?

- **Which is the best system?**
- **Why?**
- **What stops you doing this on your land?**

Dispela samting em i samting bilong yu. Your choice!

2. Rice and Calopo- PNG, Western Province

The photo on the next page shows how a green manure legume can help the next crop of corn.

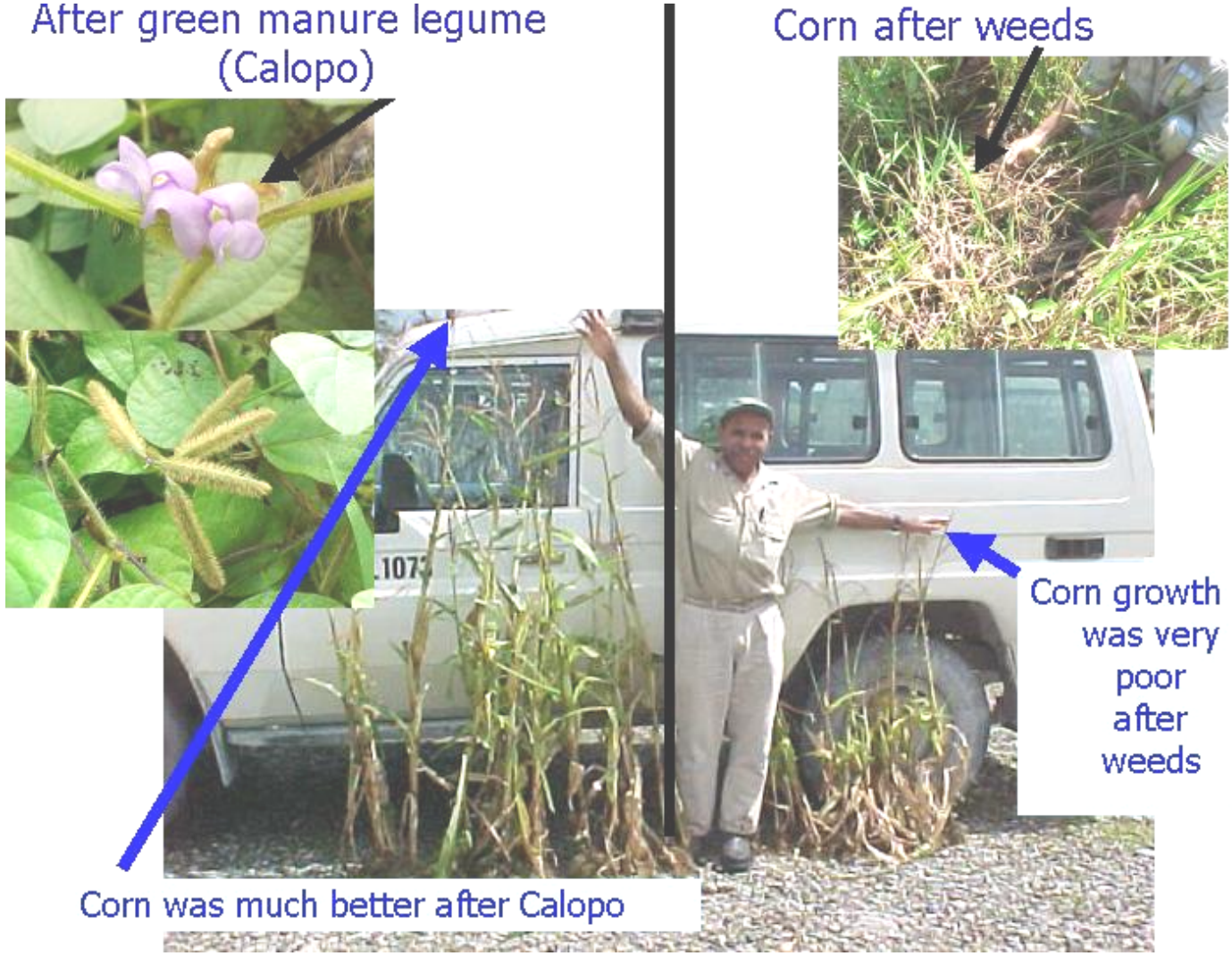


Photo was taken at Tabubil, Western Province. Corn plants were grown either after a short fallow of legume (Calopo) or after a normal weed fallow.

NARI researchers are continuing to test these systems.

You can try this on your own land.

3.4. Improving long term fallows

Background Information

- Rainforests are the best ways we have of re-building soil fertility after a gardening cycle.
- If we have a long fallow planned, then we can plant our last food crops and young tree seedlings together. This allows us to care for the tree seedlings as our food crops grow.

Tumbuna pasin bilong yumi

- Remember that in 'taim bipo' there was plenty of land for everyone and fallow periods were long, allowing trees to naturally regenerate. (They established by themselves).
- Our ancestors knew the value of trees in rebuilding soil fertility. We all know this.
- However, our garden fallows are becoming shorter.
- Now, there are more people. We have to plan our land use, so there will be good soil and good timber for our next generations.

Wokabaut long ples

Take a walk around the village looking for gardens that farmers know will be in fallow for more than 2-3 years.

- How long will this garden rest before it is planted to a new crop?
- What will happen to this land during the time it is in fallow?
- Can we improve this fallow- so that the next crop grows better, with fewer weeds to bother the person doing the weeding?

Learning from International Experiences

- In other places, both in PNG and elsewhere, farmers actively establish trees for various reasons. Many of us already plant trees. This exercise is designed to help us think about planting lots more trees for our needs and the needs of our children.

Working together

- Go to a garden that has recently been planted in food crops. The new garden should be the last garden in this area for some years.
- Plant many seedlings of trees you know will be good – for the purposes you know are important to you. Firewood, timber, poles, soil fertility building and so on.

Background Information- Trees and Crops?

- Trees and food crops can mix, so long as your land is going to rest in a few months.
- Break or prune side branches off the trees if they start to grow too strongly.
- When the food crop is finished, the trees will be able to grow above the grasses and weeds, shading them out. This will mean that fire won't kill the trees, because there won't be much grass to make a hot fire.

Discussion in your group

Many people say that our land is full of trees. There is no need to plant more trees.

- What do you think about this?
- What do you think your children are going to say about this, when they are older, looking for timber to build their houses?

Later

- Over the next few years, keep visiting the site of these trees and see how quickly they grow.
- Do weeds grow well under the trees, or are weeds being slowed down by the shade?
- Note that taro can cope with quite a lot of shade, and can be grown under some of these trees.
- If taro is grown under trees, in some shade, there will be less work in weeding the taro.

Teak. High value timber. An opportunity for many villagers, to grow this for their own needs or for sale.

4. Planting low growing ground covers under permanent trees

Background Information

- Many perennial tree crops are grown in East New Britain. When you first plant these, it is a good idea to think about how to reduce erosion, and protect your soil, as well as those living down river. They don't want lots of your soil dumped on their land, during a flood.

Wokabaut long ples

Look at perennial tree crops (cocoa, coconut, balsa, vanilla, teak, etc) and the plants growing under them.

- In these shady conditions forage peanut (refer pg 47) may do well- protecting soil, reducing weeding and even providing some good forage for animals.

Working together

- Go to a garden where perennial crops are being planted. They might be cocoa or maybe vanilla plants.
- With the owner, plant half of the garden, or just one area, in some legume ground cover, like forage peanut.
- Leave other areas, so that later on a comparison can be made.

Later

- Come back to the site and see how the perennial tree crop and ground cover is growing.
- Look in drainage ditches- and see how much soil is being carried away. Compare with areas that have been planted with low growing ground covers, like forage peanut and those which just have weeds.

5. Controlling Erosion

5.1. Managing rain water

Tumbuna pasin bilong yumi

- There are many traditional practises in Papua New Guinea that aid in controlling erosion, and we should always remember to learn from our ancestors.

Floods and Excess Water

- Beware. Once your land and soil has been carried away by erosion, you may have lost it forever.
- Houses and roofs can be the start of an erosion problem.

Working together

- Look at ditches that carry lots of water during heavy rain.
- In the ditch, or along the sides of the ditch, plant some erosion controlling plants- like vetiver or lemon grass. (Photo of Vetiver- refer page 47)
- Plant some forage peanut or other grass or legumes to slow down the water and protect the soil. These can be planted along the length of the ditch and right in the ditch.

5.2. Strip gardening on slopes

Wokabaut long ples

See if you can find some gardens where strip gardening is either;

- **being used by farmers or**
- **could be used by farmers**

Working together

- **If some people are starting a new garden, you could help them for a while, discussing the possibility of leaving some land – in a strip - to protect the soil from erosion.**
- **You could set up a small experiment, on a piece of sloping ground, so that later on you can see the benefit of strip gardening.**

Discussion

- **List good and bad points relating to strip gardening.**
- **What stops us from using strip gardening?**

- **Could strip gardening have been used in this garden?**
- **What stops us from taking practical steps to control soil erosion?**

5.3. Using an A-Frame and Trashlines

This exercise is designed to help you control erosion on your land, while growing some useful plants, like pitpit, valangur, pineapple, sugarcane, aibika, vetiver or lemon grass. (refer to page 47 for photos of these plants).

Look at the photos below to give you an idea of what you are going to achieve.

They come from ENB at Rapolo.

Case Study- From Rapolo Village, Rabaul District

Feb-

A-frame to help in establishing contour lines. Note the bottom row of vetiver and valangur is at Mr Bomai's feet. He is holding the A-Frame. .

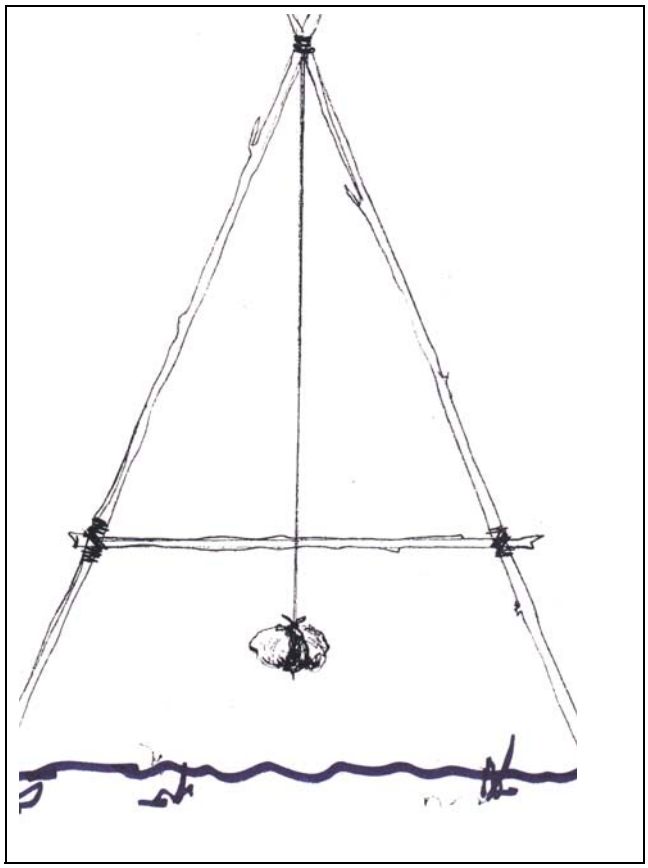
Planted in Feb

Vetiver grass

Growing in May

Lemon grass and Valangur

Making an A-Frame for planting on contour lines



1. Take two poles, the same length, about the height of a person. Tie them with a short cross stick (approx 1 m) using rubber or vines as shown.
2. Tie a weight to a piece of string and make sure the weight can hang down beyond the horizontal bar, but will not touch the ground.
3. Now, on a flat surface let the weight settle and mark the horizontal bar where the string touches the bar.
4. Pick up the A-Frame and turn it around so that the legs are in the same two places as before. Now mark the horizontal bar again where the string touches the horizontal bar.
5. Half way between these two marks, is horizontal. Make a big mark or cut at that (halfway) point. When the legs are placed on a hill side so that the string hangs on the half way point, the legs will be following the contour. This is where you are going to plant vetiver, or lemon grass or pit pit etc.
6. By walking the A-frame across a hill side it is possible to mark out where the horizontal contour is. This is the line where you can plant soil erosion controlling plants, or throw away all kinds of rubbish to help control erosion.

Wokabaut long ples

- **Go to a garden which is on some sloping land, looking at the traditional ways in which erosion has been managed- eg Trash-lines.**
- **Are traditional ways of controlling erosion present in every sloping garden, or only some?**

Working together

- **Make an A-frame**
- **Collect range of plants, cuttings.**
- **Using the A-Frame, mark out lines across the slope. Each contour line should be about twice the height of a person apart.**
- **Plant lines using plants that local farmers are happy with- those that give food may be best.**

Discussion

In a group, you may like to do a SWOT analysis relating to the methods you are using to control erosion in the gardens you worked in. You can fill it out on page 35.

Farmers work together to learn about ways of controlling erosion. May 04, ENB.

5.4. Planting Singapore taro without cultivation

Working together

- Slash with bush knives the vegetation under some large trees.
- Plant some Singapore taro

Tumbuna pasin bilong yumi

- Did you know that there are quite a few tribes in PNG who plant their taro in this way, with minimal work, so that the soil is not disturbed and doesn't erode?
- Learning from our ancestors is always good.

Knives are dangerous

- Be careful with knives. Always work a safe distance away (at least 5 m) from others.

Later

- Look in ditches- and see how much soil is being carried away. Compare different systems in terms of soil loss..

Discussion

During discussion think about these issues

- What are the good and the bad things that come about when a farmer plants their taro in this way?
- Would you be willing to try this technique with some of your planting? Remember that a small trial costs nothing, but lets you test a new way of gardening, to see if it might work well for you.

	A family have planted Singapore taro without cultivating the soil.
	A few weeks later, the taro crop looks like this. Note that the soil is always covered so erosion is minimised.

Some farmers plant taro directly into trash in the bush, without any burning.

Discussion in your group

Look at the photos above. Now discuss together your thoughts regarding-

- **Why don't we do more to reduce erosion?**

?

Discussion about Erosion

- **Discuss together the good and bad points relating to erosion control in your gardens- see below.**

Good things that happen if we reduce erosion?

5.5. Using SWOT Analysis on various ways of controlling or reducing erosion.

	Strengths	Weaknesses	Opportunities	Threats
Trashlines				
Using A-Frames				
Minimal cultivation- eg planting Singapore taro without digging.				
Other ways that you use to control erosion- list here				

6. Roads and Erosion

Background Information

- **Often roads are the cause of erosion- as they stop natural water ways from working**
- **Often roads suffer serious damage from heavy rain and floods.**
- **Roads only remain good so long as water is managed well. Culverts/ditches must be kept open and this takes regular maintenance.**
- **Once a culvert is full of soil, water has to flow over the road, causing expensive damage.**

Working together

- **Plant some road cuttings with some contour lines- using vetiver and lemon grass, valangur, marmar, kalava, balbal.**
- **Use legumes like Pueraria and Calopo to help to stabilise the steep banks, with vetiver grass.**

Maintenance is the key to good roads

- **Keeping ditches clear, so that they can carry water away properly is a key issue for good roads.**

Every place that carries water needs to be protected. See next page.

Cuttings in roads need protection using vines, and trees and grasses.

	Karavi, ENB, needs many more plants to control the erosion that will happen with heavy rain.
	Don’t let a road near you become like this- use plants to control water flow. Karavi, ENB.

7. Swampy areas

Tumbuna pasin bilong yumi

- **Our ancestors had plenty of ground, so they didn't need to make gardens in swampy land. Now some of us have to work in ground that isn't really good- it may be quite swampy.**

Drains and Flood risk

Here are some key things to ask and do-

- **Learn from people who know the area of land- how badly does it flood? How often does it flood?**
- **Drainage is the key to managing swampy land. You may need to work in with others living close by so all of your drains work properly.**
- **Plant food crops that can cope with lots of water. Things like taro, wara cress, kangkung are good.**

8. Gaden long Atol o Ailan[1]

As toktok- Ol giraon long ailan	
Hevi	**Bai yumi wokim wonem long daonim hevi**
Wait san – ol diwai na kaikai long wait san i save dari hariap	**Wait san ino save holim passim wara.** ➢ **Putim o yusim ol sting na dai pipia lip, gras na diwai insait long graon bilong holim pasim wara** ➢ **Noken kukim pipia – em i gutpela long halvim gaden**
Sapos giraon i gat Ph antap long 8 – ol gris olsem Ion, Manganese, Copper na Zinc bai i liklik o nogat olgeta long graon	**Yumi mas** ➢ **Putim planti mals long graon bai i halvim ol plants o kaikai bai i kamap gut long gaden.** ➢ **Putim planti orgenik meta na planim ol legium diwai olsem ol kainkain bin long hap we yu kamautim kaikai bai em i givim gris long graon** ➢ **Noken kukim ol pipia na ol drai lip na gras. Larim i stap long gaden.**
Graon i wait san ino gat strong tumas long holim passim gris bilong graon bai ol kaikai long gaden i ken kamap gut.	➢ **Yusim planti pekpek bilong ol enamel – pig, kakaruk na ol goat sapos i gat.** ➢ **Yusim planti mals na ol ogenik meta bai halivim long givim gris long graon.**
Win i kam long solwara i save karim sol na taim i pundaon em i nap long bagarapim sampela kaikai long gaden.	➢ **Planim ol diwai sol ino nap bagarapim olsem – Kokonas bai i banisim narapela samting sol i ken bagarapim.** ➢ **Ol casuarina diwai i ken halivim long was long sol na tu em i ken putim gris long graon long ol lip bilong en.**

[1] East New Britain has an atoll project, based with NARI. Contact them for more information and results of research.

Wokabaut long ples

- **Wokabaot insait long atolls gaden na glasim gut giraon.**
- **Digim hul long graon na lukim gut i gat wet san. Tingim tu olsem wet san i save holim pas liklik wara tasol bihain long ren i pundaon. Tingim tu ol wok ogenik meta i save mekim bilong halivim long givim gris long graon.**
- **Lukim ol hap bilong olgeta gaden (falo) na tingim long painim planti oganik meta (olsem ol diwai na ol bin – cowpea, snek bin – bai i ken halivim taim yu planim ol kaikai klostu long haus bilong yu.**

Wok bung wantaim

- **Mals em i wanpela wei bilong halvim na lukautim giraon bai ol kaikai i kamap gut long Atol o wait san ailan.**

9. Using Fertilizers bought from stores

Background Information- Using chemical fertilisers	
Issue	**What can we do?**
Fertiliser is expensive and the phosphorous particularly may be held tight by clay particles in our soil	**We need to:-** ➢ **feed our plants through the mulch/compost,** ➢ **Fertiliser added should be added in the mulch (litter, rotting leaves) layer, so that the fertiliser is mostly available to our plants.**
Fires concentrate nutrients in ash, a bit like chemical fertiliser	➢ **When we burn organic material, most of the nitrogen is lost in the fire. The ash is rich in P and K and other nutrients, but like chemical fertiliser it is easy for it to get washed away by rain.**
Fertiliser from stores may be hard to get in our village	➢ **Think about sharing costs with some other farmers** ➢ **Remember that there are other kinds of fertiliser- animal manures, mulches and green manures.**
Sometimes we have a particular deficiency that is best overcome with fertiliser.	➢ **This is particularly the case with trace elements like Boron which is often needed for good tree growth. Only small amounts of fertiliser will be needed in these instances. You will need to seek advice of extension officers and scientists with organisations like NARI.**

Our best fertiliser is always mulch and manure.

Wokabaut long ples

- In your village- take a walk looking for gardens that may benefit from fertiliser- especially crops that are going to be sold- things like capsicum, tomato, watermelon, corn etc.

Learning from International Experiences

- Many people are finding that mulch and animal manure is better than chemical fertiliser.

Working together – Yumi traim

- Set up a small experiment with a food crop-
- half of the plants receive one matchbox full of fertiliser (see next page) – suggest you try with NPK fertiliser.
- and the other half of the plants get no fertiliser.

It is best to test fertiliser on high value crops like capsicum, watermelon, aibika, tomatoes, corn etc. We suggest you don't try fertiliser on kaukau as that may not need the fertiliser.

Timing and Applying fertiliser

- For vegetable crops, you can apply half the fertiliser at planting, and then another half once the crop has established.
- Apply fertiliser on some leaf litter, and cover with either soil or more organic waste.
- If nitrogen fertiliser is not covered, much N will be lost, as ammonia gas when hot sun hits the fertiliser.

Write down what you did so you can remember what areas were given some fertiliser.-

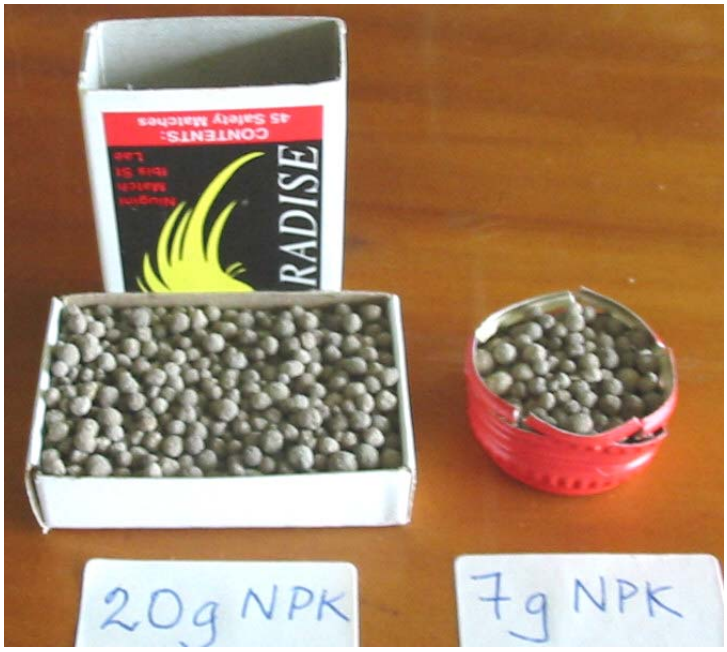
Later

- Come back to the garden and see how the fertilised and unfertilised crops are growing.
- Can you see a difference?

Was it worth spending the 6 toea buying the fertiliser for each of the plants you used a matchbox weight of fertiliser on? See next page for costs.

How much fertilizer should I use?

If you are going to apply fertilizer to your tomatoes, capsicums etc, you need to answer some more questions- what kind and how much?



If 40 kg of fertiliser cost	A **matchbox** (20g) of fertiliser would cost the farmer	A **lid** of fertiliser (7 g) would cost
K60	3 toea	1.1 toea per lid
K80	4 toea	1.4
K100	5 toea	1.8
K120	6 toea	2.1 toea per lid

If four farmers each bought ¼ of a bag of fertiliser which weighed 40 kg and cost K120 by the time it was transported to their village then-

- **They would have to pay K30 each for their 10 kg.**
- **They would have enough to put 20 g of fertiliser on 500 plants.**
- **That means each of the 500 plants receive 6 toea of fertiliser, weighing 20g in a matchbox container.**

Remember- Make a trial garden

For cocoa, farmers often use about 1 tin fish can (approx 400g of fertiliser) and from the table above, if the bag of fertiliser cost K100, then that tin fish can would cost the farmer about K1 for each cocoa tree.

Fertiliser and organic farming

Many farmers want to farm in an organic manner- not using fertilisers or sprays. This is good.

However, remember that when a plant takes up Phosphorous (P) into its roots, it doesn't really care if the P came from rotting plant material or from a fertiliser bag.

You may also like to think of the ash from a fire being a little like a fertiliser from a store. Both are concentrated forms of plant nutrients (except the store fertiliser will normally have lots of nitrogen and the ash has lost most of its nitrogen in the fire). Both can easily be washed away in heavy rain. It is best to rely on organic forms of fertiliser- green manures, composts, animal manure.

10. Action Plan

This is a summary exercise. There are different ways you can do this. You may break into groups and have each group summarise parts of the training, for the President of the LLG or other visitors.

You may like to do the exercise below, or if the weather is fine, you could all take a walk outside and identify in each garden, the kinds of things that can be done, to improve management of soils.

?

Discussion

During the training and village activities you have seen and talked about many different kinds of gardens, and ways of managing your land.

- **In groups, list the ways you can improve land-use practises on your land. Write all these good ideas on cards (about 10 cm x 5 cm).**
- **Now draw a large map of the village on a very large sheet of paper, and tape the cards to the places where they fit.**
- **This becomes a plan – a village plan to improve land-use and help to provide for future needs of people in the village.**
- **It is now over to you.**

11. Photos of less well known plants useful to farmers

Note this section only provides photos of plants that are not common in ENB, or that may be unknown by some of the readers. Plants like snake bean are not shown as they are common and can be learned from people in most villages of Papua New Guinea.

Photos are listed alphabetically, by common name.

Name and comments[2]	Photo
Calopo (*Calopogonium muconoides*) Green manure crop, not very palatable to animals, see how hairy it is.	

Casuarina- diwai Yar Useful especially in atolls, to provide firewood, timber and organic matter from the fallen leaves.

[2] Order based on common, English name.

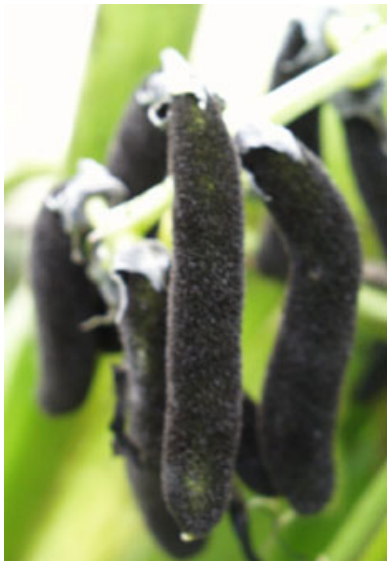
Cowpea, *Vigna sinensis*	
Dolichos (*Dolichos lablab*)	
Erythrina- BalBal	

Forage peanut (*Arachis spp*) Low growing creeping ground cover, tolerates lowland heat and rain.	
Flemingia (*Flemingia macrophylla*) Shrub legume, used elsewhere as contour plant, reducing erosion on slopes	
Kalava Shrub, useful as food for people, forage for animals and erosion control.	
Lamtoro (*Leucaena leucocephala*) Nitrogen fixing, fertility building tree, producing useful poles.	

MarMar- Gliricidia – Quick stick.	
Peuraria (*Peuraria phaseoloides*) Twining legume, common in waste ground, and under balsa May not be wise to plant this as it is a vigorous climber, and spreads rapidly. However farmers need to know it is useful and can be used for animal forage.	

Pigeon Pea (*Cajanus cajan*) Shrub, food for people and animals	

Snake bean Useful lowland feed for people, animals, and short rotation green manure, no need for photo.	
Valangur Live fence, food for people, forage for animals?	

Velvet Bean (*Mucuna pruriens*) Short lived climbing bean, has toxins in mature seed- beware.		

Vetiver grass- your DPI or NARI or private trainer can help you get some of this grass. It can be used for thatching houses, and some people believe its roots can help to repel insects like bed bugs or cockroaches.	
White clover (*Trifolium repens*) High quality forage, erosion control, grows in cold areas of highlands.	
Kenyan White clover (*Trifolium semipilosum*) as above, but can tolerate more heat, and has purple flowers.	
Winged Bean, also called ‘as bin’. (*Phosocarpus tetragonolobus*)	