

Title page

Waiting on Samuel for graphic here

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1. You – as trainer?

What do you need to bring to any training so that effective training leads to the right kind of change in villager's lives?

This manual provides you, a trainer with resources to assist you in training villagers in core topics relating to sustainability – being able to cope with climate change challenges along with increased pressure on the land from population growth. The manual provides you with resources, examples and new ideas. You bring your experience and your attitudes to the training... and what you bring is crucial to successful learning and change.

It provides you with suggested daily topics for the training – and activities. Those are suggestions. As you gain experience you will find you change things to suit the situation. Great. Remember trainers are primarily doers. Don't just be a talker. You will be so much 'MORE' if your training is coming from your own actions and garden experiences.

Humility is perhaps the most important – a willingness to learn from villagers AND a willingness to leave a cherished belief and change your mind. This is at the heart of science and learning. We do experiments, we read from others and we learn and change.

Climate change is pushing us to change many aspects of what we do in our gardens and lives more generally. We must change and assist others to change. Without the needed changes, our future looks bleak.

Please read the other resources we have for you. A key is your own attitude towards village training. Are you content to just share book knowledge?

I'm not.

I want to share with people my practical experience of doing what I teach. So, practice with your own gardens, your own livestock. Doing is critical. Training is a big responsibility.

Be a life-long learner. Learn from whoever, wherever. Be open to changing your mind as you see things working well, or not working well.

One way of continuing to learn is by reading. We have lots of resources for you – in an online library, that is freely available. Help yourself. There's training manuals and the search feature will find anything with the word you type. The library is small but has great resources.

<https://gutpela-png-gaden.net/library/record/list>

Please don't start a training without reading –

Training villagers in PNG!

You can download a copy here-

<http://gutpela-png-gaden.net/library/record/view/id/43>

Muntwiler and Askin, 2004. Training villagers in PNG - a manual for trainers.

Remember, training is much more than giving technical information. The Muntwiler and Askin manual will provide lots of useful information to assist the process of your training.

Be a life-long learner. Learn from whoever, wherever. Be open to changing your mind as you see things working well, or not working well.

A good example is the way Vetiver grass was promoted as a core erosion control strategy for hill side farmers. Simbu province was viewed as a model province with lots of Vetiver planted in the 1990's. That has changed dramatically. Almost no vetiver is used. Why? I suspect it was viewed as being useful in erosion control BUT it reduced fertility and water for



desired food plants. So, we as extension officers must adapt to farmer experience and desires. Farmers want to look after soil but will require plants that slow erosion AND provide benefits to their gardens. Look for local plants that can do the job vetiver had to do, but in a more appropriate way.

This is where partnership between you and the villagers is crucial. They know their local plants and situation.

2. Trainers' manual and Farmer manuals?

There are two manuals in each of the topics developed by the EU funded Climate Change Action, managed by NARI.

This is the trainer manual for an introduction to sustainability and living well in a village where gardens provide most food. There is another in the same topic area produced as a Farmer manual (written in Tok Pisin and in English).

The series will be available in a website where other resources are also ready for you – normally freely available to anyone.

There's extras at the end of the manual, starting on page 49 – ideas for specific situations and photos of some key plants.

3. Resources

There are two key things to keep in mind – how to run excellent training and technical resources to provide extra information for this training.

3.1. How to run excellent training?

Here are three key resources that will guide you – as well as notes throughout this manual. Reading is important. Really important. As a trainer you are guiding villagers. They trust you to have wise advice, tested advice.

So, learn from others.

Training villagers in PNG – a manual for trainers – Markus MUntwiler and David Askin. <https://gutpela-png-gaden.net/library/record/view/id/43>

Conducting effective training workshops – Robert Songan and Laurie Fooks. <https://gutpela-png-gaden.net/library/record/view/id/64>

Duck farmer training of trainers manual – Markus Muntwiler. Markus provides lots of useful 'hints' around running a training. <https://gutpela-png-gaden.net/library/record/view/id/40>

3.2. Extra technical resources

These will be added to as they are found. Meanwhile there are some extras at the end of this manual. The library at <https://gutpela-png-gaden.net/library/> has further resources and a Pacific Agriculture Information System is also coming on line.

4. Objectives

In each training for village families we provide you with some key objectives, broken down into

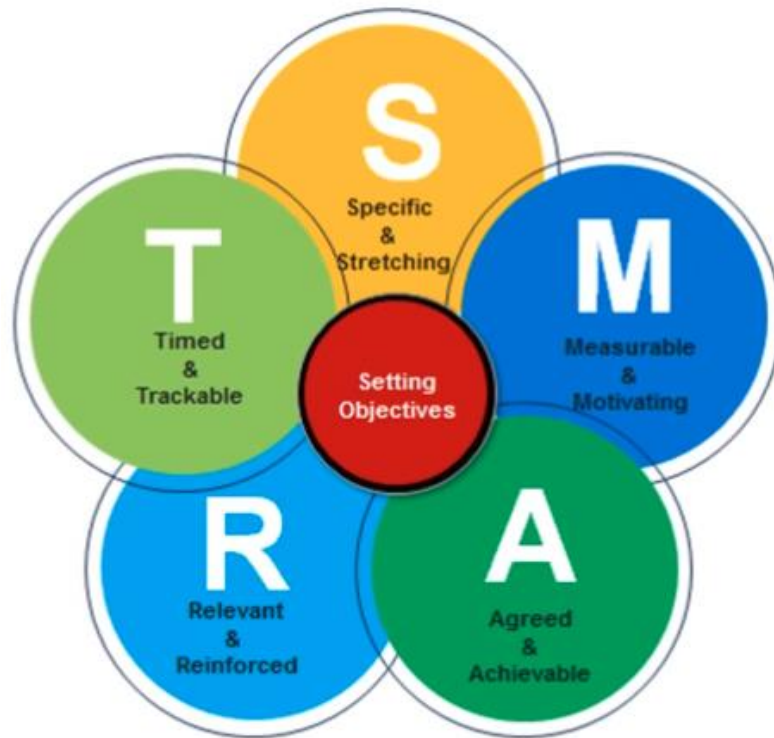
- New knowledge for men and women to discuss and understand,



- Behaviour (Attitudes) and
- New skills they learn by doing, not just watching.

We often refer to these as SMART Objectives. What we have in mind is that your training will seek to result in changes that are →

Specific, Measurable, Achievable, Relevant (also realistic) / and Timebound / Trackable.



From - <https://www.youtube.com/watch?v=1T3o-ruJ8uA>

As a trainer, keep in mind the diagram above. Turn each topic into question and discussion starters. Questions at this level may be best shared among trainers during preparation.

You may like to watch the video (link provided above) where the topic is explained in more detail.

Markus Muntwiler who worked with Salvation Army as an Agricultural Extension Officer has this to say about training –

‘How often have you heard Agricultural Extension workers say *‘those farmers are stupid because they did not do what I told them to do’*? They tried, but because they did not involve the farmers fully in the process of adapting the new ideas to fit the farmers’ particular needs the farmers did not understand the ideas and therefore did not use them. The training course outline in this manual aims to help you to enable farmers to work out what they want to do, how they should implement the lessons and techniques they learn and how to make sure they will continue to use them in the future.

If you take the time now to read the manual carefully and see how straight forward the approach is and follow the instructions it will save you a lot of time and failures in the future.’¹

¹ From Duck farmer training of trainers manual available here –

<https://gutpela-png-gaden.net/library/record/view/id/40>



5. Training Day 1 - What is happening in our villages?

5.1. Getting started – a Reminder

You need the Training villagers in Papua New Guinea manual in your hands and mind! (and if possible the Conducting effective training workshops – Robert Songan and Laurie Fooks).

This day is about reflection – thinking together about what is happening in both village and gardens. Big picture issues are in our minds today – beyond the local village.

Make sure you allow village men and women to share their thoughts and experiences.

The activities are designed to help them reflect on what is important to them.

5.2. Objectives

Farmers will →



1. Start to get to know each other and start to trust the leadership of the training event.
2. Farmers will enjoy interacting with each other, listen respectfully to both men and women.
3. Learn new insights regarding climate change and population pressure.
4. Think together about changes occurring and the challenges those changes bring and
5. Develop strategies to overcome the challenges of increasing population pressure on their village lands.

5.3. Population is growing very rapidly

Talking about population is really challenging, because we quickly come to family planning, family size and these are important topics. Some people tell us that our planet has way more people than it can cope with. Fertiliser – especially nitrogen fertiliser has been used globally to grow lots of traded food. That has helped population increase dramatically across the world.

So, how to talk about population and the damage over-population does to each village across PNG and beyond? That will take cultural sensitivity. Raising issues is fine. Raising them in an arrogant, I told you so manner is not.

Keep in mind that population pressure is a core issue, something we must not ignore.

If a Mum and a Dad have a family of 4 boys and 4 girls and each of them have the same. In two generations land that used to provide for just 2 people is now needing to provide for ... how many? How do we make more land? Is God making more land? Is sea level rise reducing land available?

There is plenty here to help us change our attitude to family planning.

5.4. Climate and weather is changing

Villagers should be encouraged to remember that although weather is always changing, there **are** signs in PNG and around the world that our climate is changing because of what we as humans do.



Trainer Handbook – Day 1 – Past, present future



Discussion – what does climate change mean?

Discuss with villagers what they think of when someone says climate change. The list below is for you to help the discussion. Don't provide these items – rather allow villagers to raise them as part of discussion.

We humans →



1. Cut and then burn down forests to make gardens
2. Large companies enter agreements with villagers – then remove forests and plant monocultures. What are the key differences between a monoculture (eg oil palm) and a natural forest ecosystem? What do villagers gain in this? What do they lose?
3. We burn fossil fuels – oil, gas and of course diesel and petrol. How does Carbon dioxide that is released when we burn fossil fuel harm the planet? (It acts just like a big blanket, warming the planet). If the planet warms too much, ice in Antarctica and the Arctic melts. That causes sea levels to rise. Has your village got first hand experience of king tides and flooding? Maybe wells are becoming salty?
4. We all want families that have plenty of children and so our population size continues to grow very fast. Is there a problem with large families? We sometimes fight over garden land. We might find it hard to make gardens for each family member.
5. We clear land to grow gardens on steep land that erodes easily in heavy rain. The top soil washing away is a loss to our gardens and maybe pollution to fishing beds as silt in coastal areas.
6. Others?

Now is the time to find out what the villagers are experiencing. Villagers experience? →

1. Are the patterns of rainfall – wet season and dry season changing in ways that hurt villagers food gardens?
2. Are villagers having to change what they eat from their gardens?
3. Are villagers finding that land hasn't got time to rest in a long fallow that builds large trees?
4. Are crops that used to grow only in lowland areas starting to grow successfully in highlands?
5. In a recent (2015/16) drought insect pests – especially sweet potato weevils² caused very severe problems for many villagers. What were the key issues that villagers experienced where you are based for the training?
6. Are fires getting out of control more often, doing more harm than in the past?

² Strategies to reduce Sweet potato weevil damage are given here - <https://gutpela-png-gaden.net/library/record/view/id/12>



Trainer Handbook – Day 1 – Past, present future



7. Are some people tenant farmers in the village – renting land from a traditional land owner? In some places landlords – the owners – don't want tenants to plant trees. What effect does this have on the land and on both landlord and tenant?
8. Anything else that villagers want to talk about?



Sweet potato weevil damage during drought of 2015/16.

These discussions are crucial. They set a scene for a broad willingness and desire to change – to learn new things that will help with a challenging future where top soil has been lost, where garden fertility is not easily replaced and where each area needs to be producing lots of food.

5.5. Added information on climate change

There are many resources on you tube to help you increase your understanding of climate change. A blogger who does his best to review high quality – peer reviewed science- is potholer54.

Eg. <https://www.youtube.com/watch?v=8pa8duiMiS0>

Beware there is a lot of nonsense produced in you tube and on the internet.

What is clear is that various scientific teams have analysed 3,000,000 mm (3 km deep) of ice cores from the Antarctic and they believe that allows us to look back over 800,000 years. Air is trapped in the ice as it falls as snow. The ice cores contain tiny bubbles that allow us to look at what was in the air many thousands of years ago. The key gas we are interested in is carbon dioxide (CO₂) and it is important as it helps act like a blanket on our planet – warming it. At no time over the last 800,000 years has the concentration of CO₂ in our atmosphere gone above 300 ppm in the atmosphere. Until now. Our use of fossil fuels – oil, gas, coal is releasing millions of tonnes of CO₂ into the atmosphere. Now we are at 400 ppm CO₂ and scientists believe this is warming our planet, causing increasingly severe storms, melting ice in glaciers and polar caps. This is causing sea level rise and many coastal communities in PNG are starting to experience this challenge.

Scientists expect increasingly severe droughts with fires caused by the dry conditions, and more severe storms and floods.

Have the village people you are working with experienced any of these challenges?

5.6. Don't treat soils like dirt!

Just a reminder. PNG has very diverse environments and soil types. Some big picture generalisations maybe helpful.

Many **inland valleys**, but not all, are highly productive, allowing high population densities to develop. Why? This is primarily about favourable temperatures with limited malaria challenges AND wonderful volcanic ash as a base for many soils. Where the volcanic ash is missing soils will be less productive.

Inland valleys can be infertile also – and that is often a result of steepness and lack of volcanic ash remaining. Think parts of Simbu province.

Where soils are the result of **long term erosion and high temperatures, coupled with high rainfall** – eg Western province and Sandaun for example – soils can appear to be fertile. This is because



Trainer Handbook – Day 1 – Past, present future



of healthy forests. But those soils are often very low fertility and removal (and burning) of forest can rapidly lead to poor yields of crops.

East New Britain – Kokopo and other areas with highly fertile soil are a result of volcano's that have delivered excellent material for growing crops.

The areas of greatest challenge for much of PNG are those areas away from coconut and beach resources, but not high enough to be in great climates and volcanic enriched soils.

It isn't all about soil... There's also climate and the length and severity of dry season – Central province has a long dry season with severe fire issues and challenges around crop production.

Knowing your soil is a crucial starting point. Seek advice regarding your unique situation.

5.7. Village walk and Village mapping exercise

Prepare well

Discuss your planned walk with village leaders – include women in this discussion. If possible do the walk prior to the training, so both you and farmers you will visit are well prepared for discussions that may arise during the actual walk.

This first walk is an opportunity for you as trainer to encourage lots of question and discussion, without feeling the need to be a TRAINER.

*Relax. Listen, question
– be a learner.*

You may well visit gardens that women do most of the work in. This means you want to be careful about the comments you make – be sensitive that you are talking about a person's work and effort. They take pride in their gardens – as you know.

There may be comments made during the walk. Now is not the key training time. Now is time to listen and learn. Learn why things are done the way they are. Seek to understand challenges village families are facing. Think about food supply through the year, market surplus, water quality and supply, shortages of timber? Are insect pests and diseases a problem? Have some new crops been planted recently? Maybe African yam is a new crop? Maybe in the past cassava was for pigs and now people are planting to eat? Are new banana diseases causing fear and challenge?

Drawing three maps – past, present and future

So, we suggest three maps are drawn by the villagers.

Remember – do the walk first – it will help to clarify the mapping exercise, especially if during the walk, you discuss the mapping that will be done.

Get started on maps straight away, only if it is raining too hard to go outside for a village walk about.



What is needed for drawing maps together?

- Felt pens – white board markers work well for this exercise.
- Large A3 paper is the smallest you can use. A2 is better or cut from a roll of brown paper.
- Blue tack, Sellotape – to hold finished maps on wall? What is going to be acceptable?
- Groups of about 5 people works well.



Trainer Handbook – Day 1 – Past, present future



A map of time before

A map of when the oldest men and women were young. Clean water, birds and animals in forest that had many high-quality timber trees of many species and food producing trees. What else did the forest provide the villagers with?

Villagers may not remember to consider how the healthy forest helps to hold moisture during rain and allow that moisture to replenish creeks and rivers giving people adequate water for many months.

A map of now

Include all the elements described in the villager handbook. Make sure that men and women, young and old are all contributing to this process.

Lots of trees have gone. Rain comes and falls on almost bare ground, or ground with some grass and weeds and food crops. It is easy for much of this water to run off carrying good soil with it.



A map of a future the villagers hope to create

This is where it gets interesting. Villagers are encouraged to draw this map... but it could be drawn at the very end of the training. Or they might draw a map of their desires at the start of training and come back and modify when the training is finished. Encourage detail. The map could become a Village Plan. An Action plan. Remember this training is meant to encourage change in villagers lives.

Needs a map that has been drawn...??



Summary discussion / presentation – how is land used

	<h3>How is land used?</h3> <ol style="list-style-type: none">1. Each village community will have different approaches to land.2. Encourage discussion as villagers think about what they have described in their maps. They may have current food gardens, old food gardens in a weed fallow, areas pigs are allowed in, cash crops of pineapple, cocoa or coffee and cash crops that are short term like onion, aibika, tomato, kaukau (sweet potato) or corn etc.3. How much of their land is always producing food? This kind of garden is right at home. Some people don't have this kind of garden.4. Most Melanesian gardens are very complex with fruit trees like mango, soursop, guava mixed in with various food plants. That complexity is a wonderful strength of gardens. Why? (Think shared fertility, timing of harvest, insect pest burden reduced, varied food crops that cope with various environmental challenges).
	<h3>Discussion</h3> <p>The farmer workbook provides questions.</p> <p>Encourage farmers to consider the maps they have drawn so that the discussion looks at past, present and future.</p> <p>What has been happening? Good and bad? What trends can be and need to be stopped? Plastic rubbish? Loss of trees?</p> <p>What new directions might the village community agree on? Maybe they might agree that planting trees for firewood and building needs can happen much closer to their village in a 5-10 year fallow?</p> <p>Encourage farmers to discuss these issues together – making sure men and women, young and old are heard.</p> <p>Capture key answers on paper that can be put on the walls of the hall or school you are using to gather in.</p>

Choices – which way next? Is change needed?





6. Training Day 2 - Water shed management

This is a 'big picture' or 'big idea' day. The big picture of how 'our' village fits into the bigger picture of rivers and mountains, gardens and forest, people, housing, schools, churches, roads and businesses.

Globally water is easily as important as oil (diesel and petrol). Water is crucial to life. Today we think about the good and bad of water.

Here's a list of key objectives for your training.

6.1. Objectives

Farmers will →



1. Know what a water shed is – and how their village fits into the watershed.
2. Understand the crucial role of forest in water sheds and water management.
3. Be aware of their precious resource – water and the need to look after it.
4. Know how to reduce erosion in gardens AND take steps to reduce erosion (of precious top soil) that occurs during heavy rain – in their own gardens.
5. Understand how important organic matter is – and how organic matter is both lost and improved in their gardens' soil- AND take steps to manage and improve organic matter in their own gardens.
6. Realise that fire needs very careful management it is both good and bad. They will establish discussions leading to community agreements around fire management – especially during dry or drought periods.
7. Know the steps to improving fallows – when garden land is recovering fertility
Short term with green manure legumes and
Long term with trees. They will have planting material and establish improved fallows in their own gardens – as examples for others.
8. Understand the crucial roles livestock play in sustainable gardens.
9. Understand the good and bad of nitrogen – a key nutrient, but a toxic challenge when used as fertiliser in an unwise manner.

Healthy land is one of the fundamentals to living well. Villagers know this. But villagers are often following gardening practices that worked fine with a small population. With far more people needing to garden on scarce land we must think of necessary changes to gardening techniques. There are also new pests and diseases that challenge our farmers.

This next section covers the biggest topics in coping with climate change and managing to live well. The objectives above lists the key topics.



Create a map of the watershed

- This takes time before the training starts. You need a (good) map. Google Earth is your best starting point.
- You need to look at the mountains and rivers that contribute forest and water resources for the villagers.
- Create and / or print out a big map, **before** the training. This will be of the watershed that the villagers are part of.
- For coastal villagers, the water shed is potentially very large, and they will have no control over pollution added to rivers that start many miles away.
- Bring this to the training as a resource for discussion.
- Villagers may be surprised at how big their watershed is.

Beware. These topics are meant to be taught by people who are doing what they are talking about. Don't pretend. If some of this is new to you – go back to your land and put these things to the test. Do the work in the garden. You'll love the results!

Maybe you were not able to visit a forest. We are making videos and photos available for you to use, to help farmers remember and think about forest.

Don't pretend with farmers. If it is new to you, say so. Then you are all on the same side - learning together. That's fine

And... don't pretend with farmers. If it is new to you, say so. Then you are all on the same side – learning together. That's fine.

These next sections are treating the watershed as a series of inter-related elements. Organic matter, livestock, erosion control, mulch – all are important.

At the end of this section the big picture of watershed management is considered in a way that village men and women can discuss - with their village maps in mind.

6.2. Forests are crucial

Forests play several crucial roles in our watersheds. They are like guardians for our villages, providing protection from floods, providing food and much more. Encourage farmers to think about forests as much more than somewhere to go and hunt and find timber for a house or church or school.



Let's go walking!



Take a couple of hours to visit forest land.

1. How healthy is the forest?
2. What are the temperatures like under the trees, compared with out on the open road?
3. What differences do your villagers see and feel between their garden soil and the soil in the forest land?
4. How can their garden soil become more like this forest soil?
5. What other comments or questions do you have – do farmers have?
6. Make sure men and women are participating in the discussion.
7. What factors are leading to a decline in forest and availability of forest products – vines, cane, fruit, hunting animals etc?

What did you see that surprised you?

Forests protect villages and gardens from flood and drought

Forests protect soil in our gardens from floods and from droughts – by managing heavy rain. A healthy forest can trap great amounts of water in the soil and litter above the soil and in the moss and lichens that grow.

Healthy forests release water slowly – reducing the intensity of floods and helps to keep small creeks flowing, even when rain stops falling during drought.

But the opposite is true also. When forests are cleared for gardens, there is often very little to keep the water in the ground. Heavy rain washes away fertile top soil exposing sub-soil that has few nutrients AND is not good at holding water.

Later we will look at making a simple experiment – showing the value of topsoil AND animal manure.



Forests store nutrients

David Kulimbao remembers going to school where birds of paradise flew and large forest trees grew. Now the land is degraded, eroded and topsoil is gone. Yellow, infertile subsoil clay is left.

Kunai grass is the main plant.

What a desecration! What challenges! How to repair this hurt landscape?

Villagers face challenges like this in their own land.

Many tropical forests look so healthy and rich that people can believe the soil they are growing in is very fertile. Sadly looks sometimes deceive. Often tropical forests are growing on leached and weathered soils. The fertility is in the forest and litter. So, when a village community clear land and burn for new gardens the fertility is lost to the atmosphere in fire AND the remaining fertility is stored in ash. Heavy rain can quickly wash away lots of that ash. There can be a massive loss of nutrients.

Yes, fire does a good job of creating a new garden, but the soil after a few short years is often impoverished. In the past this system of shifting agriculture worked well when the forest recuperation / fallow phase was long enough for forest to re-grow.

This isn't the case now. Often gardens only rest for a few months or year or two. This means soils are depleted and erosion may add to topsoil loss.

Forests provide a home (habitat) for birds and animals

Habitat is a small word with a big meaning. It involves protection and food.

Animals are enjoyed for their beauty and at times because they provide meat and skins. There's much to be lost when a village fails to protect and manage forest.

Provides fruit, nuts, timber, vines and more

Forests also provide medicinal plants and cool spaces to enjoy. Forests filter water and clean air for us to breathe.



6.3. Managing heavy rain – reducing erosion

Grow fifteen corn plants –

- 5 in a bucket with just sub-soil;
- 5 in a bucket filled with fertile top soil and
- 5 more in a bucket with top soil plus some animal manure.

Use photos of these to help show farmers the importance of caring for top soil.

Top soil is crucial to healthy crops. Whatever a farmer chooses to grow – it will always grow best in a deep top soil. Protecting top soil is very important.

Top soil holds nutrients and moisture. Subsoil is not good at either task.

Protect top soil. This is a key message for your farmers and they need to hear your own experiences of managing and protecting soil in your garden.

Talking is not good enough. Make trash barriers to slow soil loss. Then discuss what stops villagers doing these things in their own garden?

If you are not a gardener – you should not be running this training! Find someone else who can speak from their experiences...

Establish a simple experiment or trial with corn plants to show how important top soil is, and how hard it is to grow good crops when top soil is lost and sub-soil is all that is left.

You know you have a problem when... topsoil is washed away





Trainer Handbook – Day 2 – Water and Erosion



The photos tell an awful story of heavy rain and soil being washed away. Your farmers will have their own examples.

Here's a sweet potato (kaukau) garden with no topsoil left. Corn, if planted into soil like this will try and set corn cobs when less than 30 cm tall. A useless crop is the result. Topsoil matters!



Topsoil matters!

Video

Show a video of heavy rain and soil moving in the water. Show the way soil is lost and transported in ditches. Show how some farmers are creating simple barriers in their gardens to slow soil loss.

Barriers in drainage ditches

Most PNG gardens have periods where the soil is too wet and vertical drainage ditches are commonly dug, to get rid of excess water. Great. BUT, when heavy rain comes lots (and lots) of fertile top soil is carried away during heavy rain. That precious top soil is given to people you have never met... or worse still it is carried all the way out to sea. There, it falls as sediments harming fish breeding areas – and causing pollution.

How can farmers keep that top soil in their gardens?

Barriers are the key as described in the farmer manual.

You as a trainer must not just go to a village and (just) talk about this. Divide people into groups and make drainage barriers, then discuss. Why don't people do this? Is tidiness a good enough value to accept soil loss? No, it is better for a garden to look a bit untidy AND hold soil during heavy rain.

After heavy rain, look at the soil that has collected upstream of the barrier. Dig that out. Collect in a bucket. Think about how much soil is lost. The corn demonstration discussed should help people realise how important top soil is.

Create simple barriers to slow down soil erosion with your farmers.
Don't just talk.



What else can farmers do to reduce soil loss?

Barriers between sweet potato (kaukau) mounds.

Some people in PNG make large kaukau mounds and the intermound area becomes a place where a lot of soil is lost as water runs freely during heavy rain.

Remember, fast flowing water carries soil. Slow it down!



Make some barriers

- Collect some trash, and some sticks to hold the trash
- Make barriers between mounds or
- Make barriers in ditches.
- Encourage farmers to assess how helpful the barriers are after heavy rain has fallen.

Remember, don't visit gardens and talk. Make some erosion control barriers with the famers gathered. Then discuss. Remember that there are many traditional understandings underpinning garden practice. Beauty is one of them. Trash slowing soil loss isn't beautiful. What do people make of this?



Trash between large (Engan) mounds, ready to collect soil that is being lost from this sloping garden.

Trashlines, Contour planting and using A-frames

Some trainers will have heard of Vetiver grass as an erosion control plant, used with an A-frame.

What are the local plants that farmers can use to plant on contours that will help slow soil erosion AND may provide them and livestock with food?

Here's a resource freely available. <https://gutpela-png-gaden.net/library/record/view/id/45> - it describes farmers in ENB using A-frames. An A-frame is used – you may have worked with one – to allow a strict contour line to be planted. Try this technique with a farmer or two who are particularly interested. Some farmers really understand the importance of slowing down soil loss. Top soil is precious.

In Enga farmers are learning to use a local plant called Muku as a food plant AND erosion control plant- which can be planted with the help of A-frames.

Make use of plants that have multiple uses.



Trainer Handbook – Day 2 – Water and Erosion



This is a great opportunity to present to the local farmers the challenge of and need to control erosion. Now allow them to discuss and think about plants they use that could be used as live fence barriers for erosion control. Try them in a garden. There's a good chance the plants they suggest don't need to be started from seeds.

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 54 for photos of these plants).

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

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

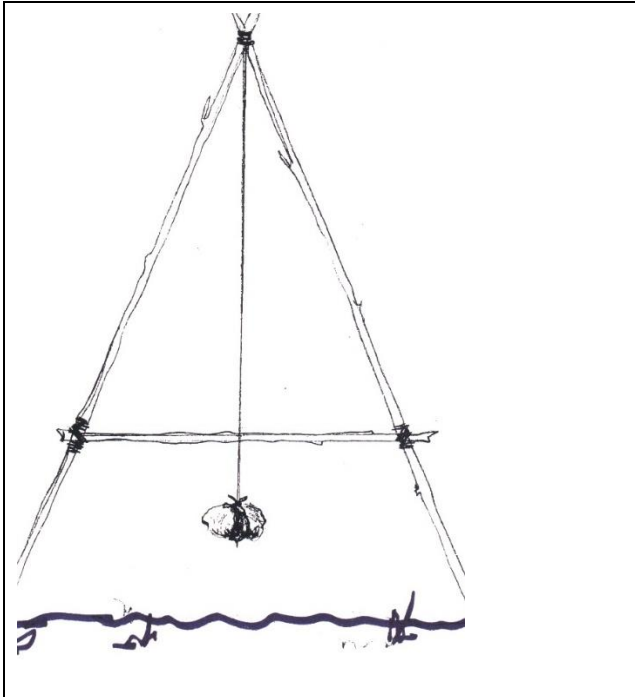
Growing in May
Lemon grass and valangur



The soil in photos above isn't normal garden soil. These slopes were covered a few years before in a thick coating of volcanic ash, that grows plants well... but erodes very easily. Controlling erosion was a priority.



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.



Wokabout 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?
- What else can be done?



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.

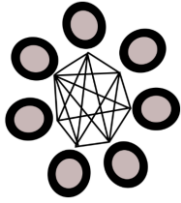


Farmers work together to learn about ways of controlling erosion – East New Britain





Trainer Handbook – Day 2 – Water and Erosion



Discussion in groups

Look at the photos above.

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



Discussion about Erosion

- Either complete a SWOT analysis (page 21) or the question below-
- Discuss together the good and bad points relating to erosion control in your gardens- see below.

Good things that happen if we reduce erosion?

Are there bad things that happen with controlling erosion? Yes, maybe the land will slump if it gets too wet...



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

	Strengths	Weaknesses	Opportunities	Threats
Barriers in drainage ditches				
Using plants like white or Kenyan clover and forage peanut to slow water				
Trashlines across the contour				
Using A-Frames and live fences on the contour				
Other ways that you use to control erosion- list here				



Live fences

This is like the topic above. There are many options. You will know some. Farmers will know some that are specific to their area.

What are the characteristics you are looking for when discussing options with farmers?

Live fences maybe useful as a way of reducing kaukau weevil in new gardens.

The best live fences



Try to find live fences that are →

- Planted from stakes,
- Nitrogen fixers – legumes,
- Produce edible leaves or fruit for farmers to enjoy and sell,

You won't find all these characteristics in one live fence plant. But it is good fun and very affirming of villager knowledge to ask them to consider options.³

Instead of vetiver, consider (smel kumu) – lemon grass as it has uses in the kitchen.

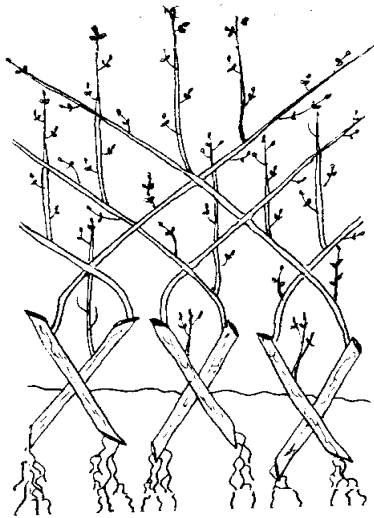
You may have multiple species in a live fence. Right at ground level, white clover (cold areas), Kenyan white clover (cool areas) and forage peanut (hot areas) maybe useful as ground covering plants slowing erosion by slowing water.



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 54)

³ Video, powerpoint resource required...



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.



Remember, caring for topsoil matters!


These photos are from hills in the Philippines. On the left, 400 t/ha of soil were lost each year in a traditional garden. On the right less than 2 t/ha of soil were lost each year, by planting rows of legumes on contour lines.


Strip gardening on slopes

What is strip gardening? This is a technique used in other countries to slow down top soil loss. Instead of contour rows, part of the hill side is left in fallow plants. As heavy rain falls, this 3-5 m wide (un-gardened/uncleaned) area of fallow plants captures and holds precious top soil.

Villagers are unlikely to be keen to do this. Why? This is where discussion is helpful. Walking onto sloping ground and looking at new and old gardens, looking at soil characteristics is crucial. In a new garden where soil is in good condition, there will be plenty of top soil, lots of fine material. However, when the garden has been exposed to a few years of heavy rain, it is very likely that fine material is gone, and only coarse material is left. Soil loss is long term, permanent damage to the garden and soil. It won't feed the family well, when top soil is lost.



	<h3>Make a simple experiment</h3> <p>Maybe villagers can agree to try this technique?</p> <ul style="list-style-type: none">• 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 on the contour- ie across the hill side - to protect the soil from erosion
	<h3>Discussion together -</h3> <ul style="list-style-type: none">• List good and bad points relating to strip gardening.• What stops villagers from using strip gardening- or any of the other techniques to protect top soil from erosion?

	<ul style="list-style-type: none">• Could strip gardening have been used in this garden?
--	--

Look at the photo below – it shows a garden that has had two or three years of cultivation. Most fine topsoil has been washed away. Only coarse, sub-soil portions are left. How productive is this garden?





Discussion questions

Relate the discussion of water resources in a water shed back to the changes that have occurred over the last 50 or so years – using memories of those in the room.

- Review the maps villagers have drawn.
- How far has the forest receded from the village in last 40 years?
- What are the key issues learned today – about water and how to manage it well?
- Encourage farmers to discuss issues together – making sure men and women, young and old are heard.
- Capture key answers on paper that can be put on the walls of the hall or school you are using to gather in.



7. Training Day 3 - Organic matter – crucial to healthy soil

7.1. Objectives



Farmers will →

1. Know what organic material and organic matter (humus) is and why it is so important.
2. Be able to manage organic material to benefit their soil and garden produce.
3. Have changed attitudes to fire – knowing how good and how bad it can be.

This topic is crucial. Plenty of organic matter is the foundation on which we build healthy crops. Healthy soils can provide the right environment for food plants to grow and villagers and livestock rely on these for life and growth.



Wasting organic matter. Wasting mulch. How else might this be used? Why do we burn? What are the consequences of burning? These are questions at the heart of today's discussions.



Trainer Handbook – Day 3

Organic matter, mulch and fire



Your training started (Day 1) by encouraging men and women to think together about their village and the ways the village has been changing. They have considered the way the climate is changing and how this is affected by what people all over the world are doing. (Burning of fossil fuels causing increases in CO₂, with increased temperatures causing bigger storms, droughts / fires and sea level rise.

On our second day together, we thought about and discussed the big picture of water sheds and the importance of top soil and reducing erosion.

Today on our third day, we 'dig' into a whole new topic – how to care for the soil we live from. This requires us to think about and discuss the importance of organic matter.

Back when there were few people and lots of forest to cut and burn villagers didn't have to plan or think too much about garden fertility – the forest fallow built fertility for them to use with their fires and ash.

Now with lots of people and very few villagers able to cut and burn old forest, each village family needs to learn →

1. what organic matter is,
2. the importance of organic matter,
3. how organic matter is lost and gained,
4. special roles for mulch, and
5. fire – the good and the bad.

7.2. What is organic matter?

Put simply organic matter is anything that was alive, is now dead and starting to decompose. Leaves, kitchen waste, dying roots from plants. Anything that can rot.

The layer under a forest is rich in organic matter.

We have two components to consider. Organic material are the leaves, twigs, sweet potato peelings, banana skins we throw on our gardens- or make compost with. Organic matter is this organic material that has been decomposed into relatively stable humus.



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.

•	
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7.3. Why is organic matter important?

In addition to providing nutrients and a place for small and tiny organisms to live in the **soil**, **organic matter** also binds **soil** particles into aggregates (small chunks) and improves the water holding capacity of **soil**. Most **soils** contain 2-10 percent **organic matter**. However, even in small amounts, **organic matter** is very **important**.



Organic matter –critical issues

- ✓ Holds water in our soils - this is critically important when rain stops and drought sets in.
- ✓ Having mulch (organic material) on the soil surface protecting soils from sun AND lots of organic matter in the soil helps to keep soils moist.
- ✓ Organic matter holds nutrients needed for crop growth. They are provided as slow release nutrients. Wonderful.
- ✓ Just by being there and helping to bind soil together, organic matter helps reduce erosion during heavy rain. Great!

Without organic matter farmers tend to have to rely on chemical fertilisers for their crop growth. Chemical fertilisers are great – but only if used wisely – little and often is a reasonable way of operating.

But we are much better to rely on organic matter and sustainable garden systems with fallow plants and animal manures providing most nutrients.



Trainer Handbook – Day 3

Organic matter, mulch and fire



Nitrogen fixing plants are a much better way of getting Nitrogen into our gardens – but... wait, we are getting ahead of ourselves. More on this later.

Over cultivated soil, then heavy rain forms crust



Do your farmers ever see soil that is so cultivated that when it rains it forms a hard crust on top. This soil from Wetar Island in Indonesia desperately needs organic matter and mulching.

7.4. How is organic matter lost and gained?

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. We must continually add organic matter to keep soils healthy.

How else do we lose organic matter from our soils? We lose organic matter when we cultivate the soil for a garden. Then add hot tropical temperatures PLUS moisture and we have an oven that literally cooks up organic matter. It is gone quite quickly. So, we need strategies with our farmers to maintain and look after organic matter.

7.5. Special roles for mulch

I believe mulch and mulching are absolute keys to improving food resilience and food security in challenging times.

How do you as a trainer learn the value of mulch?

You make your own simple with mulch and without mulch experiments to show the effect of mulch.

Let's recap. We have many people. We have few areas of forest left to make gardens in. We must learn from rain forest ecosystems. By this I mean – we must learn from key features of how rainforests work.

One key feature is they protect the soil from heavy rain and hot sun – with leaves above and litter or mulch on the soil – protecting it.



Trainer Handbook – Day 3

Organic matter, mulch and fire



Let's see. Can we protect soil in the same way with our crops above and LOTS of mulch on our soil? The answer is yes indeed!

But how will you as trainer really believe in the value of mulch? You make your own simple 'mulch and without mulch experiments.





Trainer Handbook – Day 3

Organic matter, mulch and fire



The leaves used as ground cover were from *Gliricidia* – quickstick. The crop was shallots – like onion/garlic.

The leaves did a great job of reducing weeding. Without light weed seed germination was greatly reduced.

(Pulau Wetar, Indonesian gardens at sea level).



Trainer Handbook – Day 3

Organic matter, mulch and fire



Look at the photos below→

Cut grass, collected ready for what? This grass was thrown into a smelly pit to rot and pollute ground water with nutrients that make water unhealthy to drink. Not good. But it gets worse! It was a total waste of needed organic matter in gardens. Where might this grass be put?

Each farmer has a choice... What do they do with mulch?



Where to put mulch?

This is a question for your farmers during training. Under bananas, taro, around corn plants. Almost anywhere is good! Farmers can test with and without mulch.

Here's a photo of organic matter/mulch material which has been used well. That same mulch was put on top of nut grass in Vudal's University gardens (back when it was called Vudal).



Without mulch

- cabbage doesn't grow well
- many big weeds

With mulch –

- cabbage grew bigger
- weeds are only small

7.6. Fire – good and bad

In tropical gardens one of the biggest challenges is fire. Matches. People sweep leaves and instead of putting them in a hole to plant African yam for example... they burn them. Burning leaves is bad for smoke and air quality – but also a silly loss of organic matter.

Organic matter is simply too precious to just toss away and burn.



Trainer Handbook – Day 3

Organic matter, mulch and fire



Make two lists together – the good and the bad of fire in villager's gardens.

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

Beware – thinking about fire



- ❖ 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, destroying gardens and houses.
- ❖ When drought starts, then is a crucial time to manage fire very carefully.



7.7. Compost and kitchen gardens

African yam!



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:-

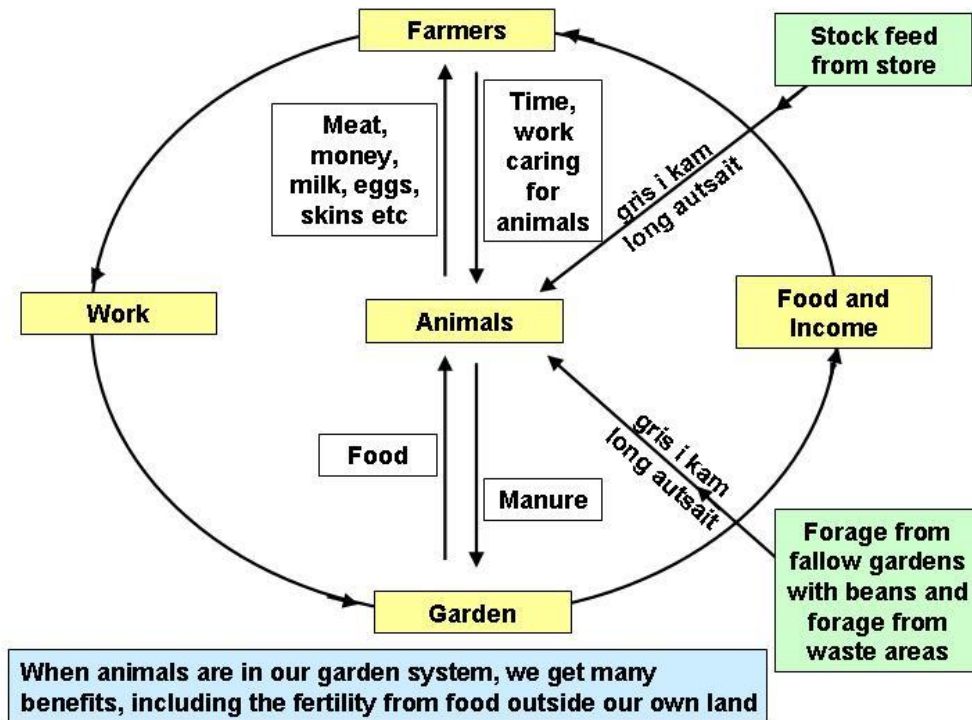
Mix 7 spades of green leaf material, 2 spades of good soil, 1 spade of banana trunk material that is chopped up, and 1 spade of dry leaves. After mixing, put these all into a compost heap and keep adding material in a similar ratio. The amounts are not too important. Make sure that the material is moist- 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.



7.8. Role of animals in soil fertility and family well-being



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.

This topic maybe a step too far for this training course. Keep it in mind! Animals can be powerful and helpful in food resilience.



Chinese cabbage, with manure and without manure



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



8. Training Day 4 Improving fallow

8.1. Objectives

Farmers will →



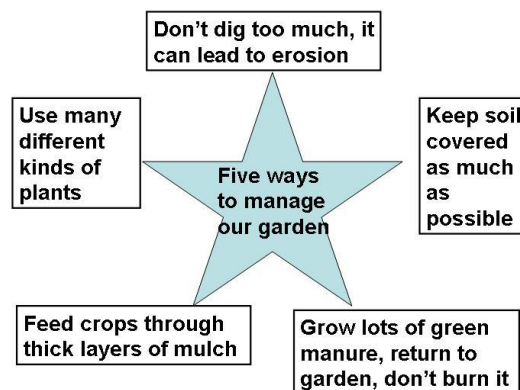
1. Understand the changes that have been occurring due to population pressure with gardens and fallow land management.
2. Understand how to and take actions to care for soil that is resting – in fallow.
3. Go home and plant legumes under their maturing corn to see the value of crop rotation.
4. Take every opportunity to improve the value of their fallow land so that it produces well, in next cropping phase.

Gardens always need rest periods. Years ago, many gardens rested for years. Tall forest trees grew during fallows. Times have changed! There are still parts of PNG on very weathered, nutrient poor soils, with few people (eg Fly River catchment in Western Province) where villages still shift, and new gardens are made from old growth forest. But those people are often gaining most of their food from hunting, sago and bush foods.

For **most of the people you work with**, they are challenged by inadequate ground for long fallows. Our job as trainers and extension officers is to encourage best use of the ground villagers have and that happens with fallow legumes and wise integration with animals. These are issues for learning and understanding options. People won't use fallow legumes if they have never experienced them... There is a role for teaching here... BUT have you as trainer used them? If not, work with resources you have to run a small trial with farmers. More on that below.

One of the problems of a natural fallow of weeds and grasses is the amount of weed seed that causes problems in the new garden. A fallow of legumes can dramatically reduce the weed seed problem.

8.2. Five ways to care for garden land -




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



Most of the star items above copy the way forest covers, protects and cares for the soil. Interesting!

8.3. Managing fallow land



	<h4>How is land used?</h4> <ol style="list-style-type: none">1. Each village community will have different approaches to land.2. Encourage discussion as villagers think about what they have described in their maps on day one. They may have current food gardens, old food gardens in a weed fallow, areas pigs are allowed in, cash crops of pineapple, cocoa or coffee and cash crops that are short term like onion, aibika, tomato, kaukau (sweet potato) or corn etc.3. How much of their land is always producing food? This kind of garden is right at home. Some people don't have this kind of garden.4. Most Melanesian gardens are very complex with fruit trees like mango, soursop, guava mixed in with various food plants. That complexity is a wonderful strength of gardens. Why? (Think shared fertility, timing of harvest, insect pest burden reduced, varied food crops that cope with various environmental challenges).
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Many fallow gardens grow lots of weeds. These weeds produce seeds that cost gardeners lots of time in weeding. So, this isn't just about fertility. It is about the work of those who weed – and often this is women.

Strategies we as trainers help farmers put in place that reduce work are really important.



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.



8.4. 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 54 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 59- 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 54).
- 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?**

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.



Trainer Handbook – Day 4

Improving fallows



After green manure legume
(Calopo)



Corn after weeds



Corn was much better after Calopo

Corn growth
was very
poor
after
weeds

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.



8.5. Improving long term fallows

Long term fallows normally involve trees – forest trees. In many areas close to towns in PNG, tenant farmers are not allowed to plant trees because of potential problems when the trees are mature. Who planted this tree becomes an important statement of ownership... so landlords say to tenants – no tree planting.

	<h3>Background Information</h3> <ul style="list-style-type: none"> ☛ 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.
	<h3>Tumbuna pasin bilong yumi</h3> <ul style="list-style-type: none"> ☛ 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.
	<h3>Wokabout long ples</h3> <p>Take a walk around the village looking for gardens that farmers know will be in fallow for more than 2-3 years.</p> <ul style="list-style-type: none"> ☛ 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?
	<h3>Learning from International Experiences</h3> <ul style="list-style-type: none"> ☛ In other places, both in PNG and elsewhere, farmers actively establish trees for various reasons. Many of us



Improving fallows

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

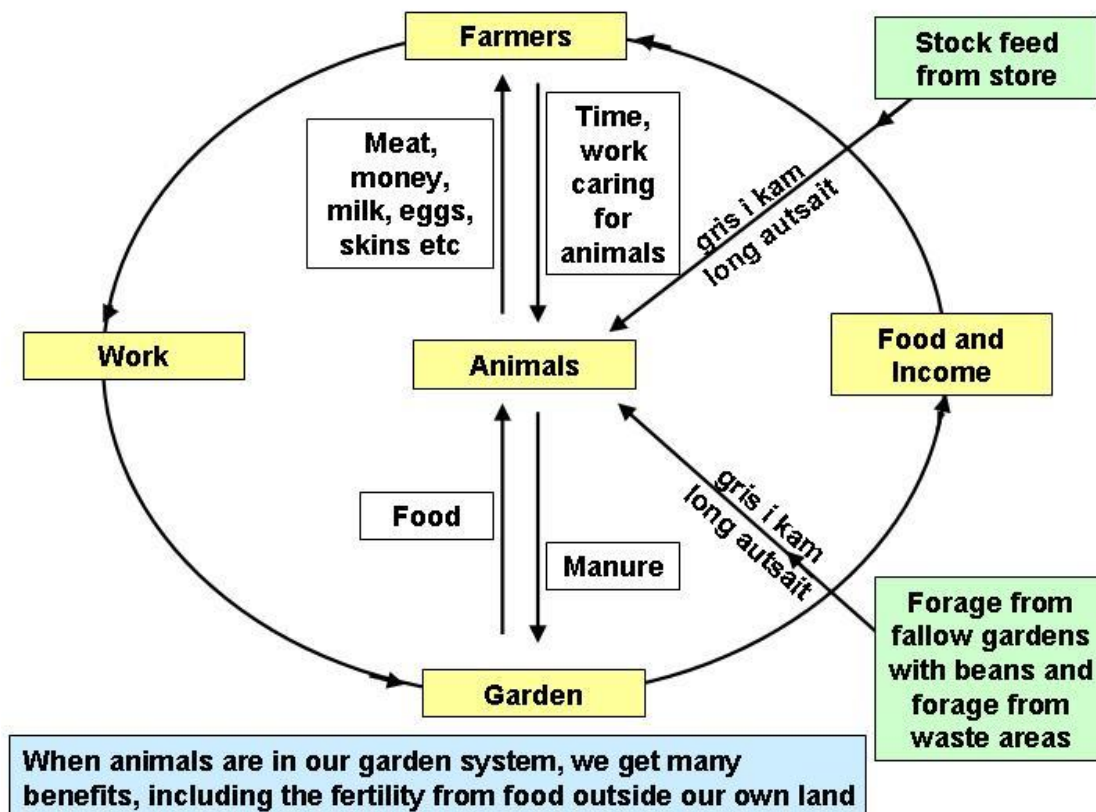


- Over the next few years, keep visiting the site of these trees and see how quickly they grow.
- Do weeds grow well under the trees, or are weeds being slowed down by the shade?
- Note that taro can cope with quite a lot of shade, and can be grown under some of these trees.



- ☛ If taro is grown under trees, in some shade, there will be less work in weeding the taro.

8.6. 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.



Trainer Handbook – Day 4

Improving fallows



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

Chinese cabbage, with manure and without manure



9. Extra resources for you

9.1. Making sense of claims people make – Doing Field Research!

When you are training villagers, you will hear people say... *'if only farmers used this or that (magic) product farmers yields would rise dramatically'*.

Today I watched on Facebook as people were told that chicken manure bought from Singapore is so much better than the chicken manure from your own chickens... It has been treated with something special. It costs ten times as much as your own... but it is magic and wonderful. Is this true? (What do you think?).

So, how do you encourage farmers to think like good scientists? How do you as a trainer think well?

How do you make sense of these amazing claims?

Mostly, it is simple and a little time consuming. Let's stay with the example above – a special, organic chicken manure, imported from Singapore.

Firstly, ask the seller to show you test results of the Singapore manure when compared with chicken manure from local chickens as well as compared with a control. A control is a plot of corn say, that got no fertiliser.

So in the simplest possible trial you would have 3 treatments.

1. Control – corn with no added fertiliser.
2. Corn with a weighed amount or standard volume of local chicken manure/plot
3. Corn with a weighed amount or standard volume of special Singapore chicken manure/plot
4. (You could add more to this experiment... eg fertiliser from store or other animal manure).

Measure the yields and do the analysis of cost:benefit. ie Perhaps the Fertiliser was best, but how much did it cost to get the extra growth?

Want to learn more about Doing Field Research – there's heaps of resources in the library here - <https://gutpela-png-gaden.net/library/>



9.2. 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	<p>We need to:-</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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-
It's organic and natural AND
Feeds the soil more than just chemical nutrients**



Wokabout 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 train

- 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?

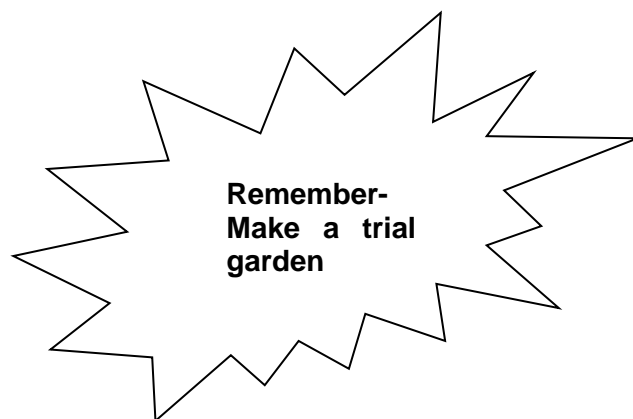
If you are going to apply fertilizer to your tomatoes, capsicums etc, you need to answer some more questions- what kind and how much?



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 $\frac{1}{4}$ 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.





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 organic 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 and animal manure.





9.3. 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.

<p>Calopo (<i>Calopogonium muconoides</i>) Green manure crop, not very palatable to animals, see how hairy it is.</p>	<p>Cowpea, <i>Vigna sinensis</i> This is one of the best cover crop, fallow plants. Refer photos and text page Using Green manure legumes on page 41</p>
	
<p>Casuarina- Diwai Yar Useful especially in atolls, to provide firewood, timber and organic matter from the fallen leaves.</p>	
<p>Dolichos (<i>Dolichos lablab</i>) The almost mature pods are picked, boiled and seeds enjoyed once boiled. Sort of like peanuts.</p>	<p>Erythrina- BalBal Tree, edible leaves, legume, can be used as live fence, but remember this grows large. Some short to very short thorniness.</p>
	



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



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.









<p>Pigeon Pea (<i>Cajanus cajan</i>)</p> <p>Shrub, food for people and animals</p>	
<p>Rosewood <i>Pterocarpus indicus</i></p> <p>A most wonderful legume tree, rabbits love eating it, can be grown from sticks, useful live fence tree. Glorious timber when milled.</p>	

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



<p>Velvet Bean (<i>Mucuna pruriens</i>)</p> <p>Short lived climbing bean, has toxins in mature seed-beware.</p>		
<p>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.</p>		
<p>White clover (<i>Trifolium repens</i>) High quality forage, erosion control, grows in cold areas of highlands.</p>		
<p>Kenyan White clover (<i>Trifolium semipilosum</i>) as above, but can tolerate more heat, and has purple flowers.</p>		
<p>Winged Bean, also called 'as bin'. (<i>Phosocarpus tetragonolobus</i>)</p>		



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



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.

