MATUAILEOO ENVIRONMENTAL TRUST INCORPORATED (METI)

INTRODUCTION TO PERMACULTURE
A Self Instructional Manual for TAIALA

February 2015
Acknowledgements
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Overview

Introduction
Talofa! Welcome to this manual which has been prepared to help you to teach people in your community about permaculture.

The contents of this manual
Besides the overview that you are reading now, this manual is divided into 12 lessons. Each lesson contains

1. The study material from the participant’s reference manual
2. Suggestions for how you can prepare yourself to teach the lesson
   A lesson plan for you to follow (Each plan uses the lesson format from teaching life skills).
3. A copy of the handout you will give to the participants which summarises the material for that lesson from the reference manual. You will use the handouts as your speaking notes when you deliver the training.

The learning journal
Besides this manual, you will use a learning journal to help support you. Your learning journal could be an exercise book, or loose leaf paper stapled together or a hard covered book you write in.

You will use the journal for a number of reasons.

- As you work through this manual, you may be asked to write in your journal. Please make sure you do this. Sometimes you will be asked to write answers to questions in your journal.
- At other times, you will be asked to reflect on what you have learned.

Reflection refers to your thoughts, feelings, opinions and suggestions about any part of your learning and practice.

- We also suggest that you write any concerns, challenges or issues you have in your journal so that you can discuss them with the training team.

Assessment
From time to time, your journal will be collected by the training team to find out about your progress, your learning and whether you are having any difficulties and need support.

From time to time your mentor or a member of the training team will also discuss with you how well you have taught a lesson. They will complete the following checklist. After you have finished teaching a lesson, think about how you would assess yourself against the checklist. After your assessment you could record your reflections in your learning journal.
<table>
<thead>
<tr>
<th>Assessment Checklist</th>
<th>Yes</th>
<th>No</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the Taiala use simple language that participants understood?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Was their voice loud and clear?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the learners understand the materials?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the lesson activities useful?</td>
<td></td>
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<tr>
<td>Were the learners engaged in the activities?</td>
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<tr>
<td>Did the Taiala answer their questions correctly (or promise to find out the answer</td>
<td></td>
<td></td>
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<tr>
<td>if they didn’t know)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were all learning outcomes achieved?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Evaluation**

At the end of the course participants are asked to complete the following evaluation form.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Any comment?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the Taiala use simple language that you understood?</td>
<td></td>
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<td></td>
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<tr>
<td>Was their voice loud and clear?</td>
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<tr>
<td>Did you understand the materials?</td>
<td></td>
<td></td>
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<tr>
<td>Were the lesson activities useful?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the most important thing you have learnt and how will you apply it in everyday life</td>
<td></td>
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</tbody>
</table>

You are now ready to start! Good luck.
Lesson 1: What is Permaculture?

Learning outcome
By the time you have completed this section of the manual you will be able to explain what permaculture is and its importance to nature and to the people’s lives.

The material from the reference manual
Below you will find the material from Lesson 1 as it is in the reference manual. We suggest that you read it now to refresh your memory.

Lesson 1 What is permaculture?
“Permaculture is a design system used to provide for human needs in a sustainable way. Permaculture uses nature and natural patterns as the model for design. Permaculture provides a way of thinking which helps us to design highly productive systems where people can live abundantly while caring for the Earth, in harmony with the animals, plants, oceans, rivers and people around us (as well as ourselves).”

Permaculture is not just about growing vegetables. It is not just about growing fruit, farming chickens, growing pigs or timber. It is not just about forming co-operatives and valuing your community. It is not just about supplying clean water, recycling, composting, or seed saving. It is not just about researching, observing or producing medicine. Nor is it just about joining an ethical economy, or protecting the wider environment and it is not just about making information and education available to all. It is not just setting aside time for family, or spirituality, or ensuring good nutrition for your children. Permaculture is all of these things. You could think about permaculture as a box containing all of these things. The things inside the permaculture box will vary from one permaculture site to another.
Permaculture systems are sustainable because they produce more energy than they consume, with at least enough surplus to maintain and replace that system over its lifetime. It is not as hard as it might seem to live sustainably. Nature has already given us all the examples we need to learn from. In fact, permaculture literally uses natural environments like forests, as a guiding model for how to be sustainable. We also realise that it is much easier and more effective to work with the natural flows and forces of energy, rather than against them.

**Check your understanding**

Check that you have understood this lesson by answering the following questions.

1. Decide whether the following statement is true or false. If it is false, re-write it in the space provided.

   ‘There is nothing wrong with spraying chinese cabbages with chemical pesticides’.

   __________________________________________________________________________

2. Circle the word that does not belong in this sentence

   Permaculture benefits pollution, animals, plants, people, and rivers.

3. Fill in the missing word in this sentence

   Using --- reduces the quality of food and affects the health of people and the environment.

   a. Water  
   b. Compost  
   c. Chemicals  
   d. Manure

4. What could happen if western agricultural practices became widely adopted in Samoa

   a. Erosion  
   b. Pollution  
   c. Deforestation  
   d. All of the above
5. Which of the following does not help to explain permaculture
   a. Using the best of traditional agricultural practices
   b. Growing the same cultural crop permanently
   c. Working alongside nature
   d. Working sustainably

**The answers**
1. The statement was false. Spraying chinese cabbages with chemical pesticides is not a sustainable practice.
2. The word that did not belong was ‘pollution’.
3. The missing word was ‘chemicals’.
4. The correct answer was (d) all of the above.
5. ‘Growing the same cultural crop permanently’ does not help to explain permaculture.

**Preparing to teach the lesson**
1. Think of some examples that have happened recently in Samoa which illustrate the effects of poor agricultural practices and write them in the space provided.

   ________________________________________________
   ________________________________________________
   ________________________________________________

   Here is an example we thought of.
   The flooding that occurred in Vaisigano river basin during 2012 was made worse because of the trees that had been cut down along the river banks.

2. Think of a question that your participants might ask and write it below

   ________________________________________________
   ________________________________________________

   Here is a question we are often asked
   ‘Why is permaculture more sustainable than western agricultural methods?’

3. Now try writing an answer to the above question.

   ________________________________________________
   ________________________________________________

   Here is the answer we would give.
   ‘The use of chemicals is part of western agricultural methods but they will eventually destroy the soil whereas permaculture uses natural fertilisers and builds the soil up’.
What if I get a question I can’t answer?
Sometimes you will be asked a question and you won’t have a clue what the answer is. It is ok to say “I don’t know but I will try to find out”. Don’t forget to do that!

What if someone asks a question which will be answered in a later lesson?
We suggest you answer the question but not in too much detail. Explain that you will cover it in detail later.

Planning your lesson
Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable, note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

Lesson Plan 1

Goals
You should write these goals on newsprint before the session starts. Show them to the participants.

By the end of this session you will be able to:

1. Explain what permaculture is
2. Describe the importance of permaculture
3. Identify Western agricultural practices that are against the principles of permaculture

Stimulus
Tell participants that sometimes you might use words that may be unfamiliar. Tell them that there is a list of words and their meanings at the back of their reference book.

Write the word ‘permaculture’ on newsprint. Ask them to brainstorm their immediate thoughts when they see the word and write them up. Discuss participants’ initial words or immediate thoughts related to permaculture.

Objective Enquiry
Using the words of the handout for lesson 1, give a definition of permaculture and cover

- The importance of permaculture
- Western agricultural practices that are against the principles of permaculture
- How permaculture works together with nature
Return to the brainstorm and ask the group to sort out which should be in the permaculture box and which should not.

**Skills Practice**
Divide participants in 4 groups and give them each a different Western agricultural practice in use in Samoa. Tell them their task is to identify for the whole group why that practice is against the principles of permaculture and to identify ways to overcome that practice. Ask them also to talk to the main group about how some of their present practices support permaculture.

**Application**
Participants can set goals for themselves about how to practice the learning in their everyday lives.

**Evaluation**
What is one learning from today’s lesson?
Have the goals been met?

**Lesson 1: Slides**
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.

---

**Polokalame Faale-aoaoga

Faiga Faatoaga Tumau**

---

**O le a le Faiga Faatoaga Tumau?**

“O Faiga Faatoaga Tumau, o se faatulagaga/tauauga e faaaogaina, ina ia mafai ona faamalieina ma ausia manaoga, o tagata soifua i se faiga tumau ma faaauaina pea.

- O Faiga Faatoaga Tumau o le tuuafaatasiga lea o le POTO/ATAMAI faale olaga, ma le faaafaleleni, ina ia mafai ona faaia se FAATULAGAGA MAUALUGA.
- Ta ola tamoaiga ma o tagata i vaega e maau, ma ia latou faapelepele foi i le lauelele, o manu, laau, sami, vaatale ma soo se tagata soifua i lo latou siosiomaga:”

**O Faiga Faatoaga Tumau e le nao le faatinoina o vaega nei:**

- totoina o faalaau aina falsua
- totoina o laau aina tauma a mata
- faafaaogoaina o moa
- atinae puua pao laau falaupasa
- maau e le suavae mana
- faapalaga dmata pao le vasia ći ni fatu laau
- maau ai naa meaai paleni ma maloina mo lau fanau
Ae peitai:
- O Faiga Faatoaga Tumau o le pusa faataamilio lena, o loo adia una ai vaega, pai ona taua muamua
- O Faiga Faatoaga Tumau, e faailoa mai ai:
  - se esesega tele i totonu o nofoaga,
  - le anoanoai o auala ma metatia,
  - taiala, faatinga ma manatu eseese e mafai ona faatumauina ai le faatoaga.

E i ai vaega e le mafai ona ofi i totonu o le pusa o Faiga Faatoaga Tumau:
- faaogaina o valiau ona
- totoina o se ituaga laau aina se tasi
- fala o galuega e faaleagaina ai le ea
- faaogaina o ni auala le talafeaga

O nei vaega uma, e “aveeseina mai i fafo” mai le pusa, e ataila ma taiala o Faiga Faataga Tumau.

O Faiga Faatoaga Tumau, o se faatulagaga lelei ma atoatoa.
- e mafai ona maua uma ai i totonu elemeni eseese ma le anoanoai, ma o laau uoga. O nei elemeni poi vaega seesega, a oro vaega poi le fauma foi.
- O Faiga Faatoaga Tumau e faatatau i lou sogasoga, manatunatu lelei ma aga lelei ma faapepelele i totonu o lou sosiomaga.
- O se vaega e faatumauina ma atoatoa, o se tulaga e tauaia ai faatulagaga o Faiga Faatoaga Tumau o AIAIGA
- ua mafai foi ona matatūina o se auala vave lea ma telē sola aatiaga e mafai ai ona gagaula vavalalata ma vaega o le natura, poi o malosiaga ase le le tetee atu i ai.

O Faiga Faatoaga Tumau
- o loo faaogaina vaega failenatura o le sosiomaga, pei o le vaomaula.
- o se faatulagaga lelei lela pe faapēa ona co atu i se tulaga faatumauina pe faaauauina oea.

O loo faaogaina le upu Faaaauauina: “o se faasologa e matuai faamalieina ai manaoga o le taimi nei, ae le afaina ai le lelei atoatoa mo augstupulaga o le lumanai, ia faamalieina ai foi o latou manaoga:”
Lesson 2 Ethics

Learning outcome
By the time you have completed this section of the manual you will be able to explain the three ethics of permaculture and the importance of these ethics.

The material from the reference manual
Below you will find the material from Lesson 2 as it is in the reference manual. We suggest that you read it now to refresh your memory.

**Ethics**
Let’s start by talking about what ethics means. Ethics are widely held ideas about what is a good way to behave. To be ethical is to behave in ways that are in line with those ideas. A person who only looks after their own interests and who does not care about the earth or its people is not acting ethically. Ethics guides and directs permaculture projects.

The three ethics you will learn about are:

1. Take care of the earth
2. Take care of its people
3. Return what you do not need (the surplus)

Taking care of the earth
Taking care of the earth means allowing all life systems to exist. It means thinking about every action we take and asking “By doing this am I working for the benefit of the earth?” Earth is another word for soil so taking care of the earth also means caring for the soil. In permaculture all our projects should improve and enrich the soil. We must never cause harm to other living things. Realising that you yourself are part of the Earth will help you see the reason for this, the first and most important ethic.

Taking care of people
This is a part of caring for the earth. People are a part of this earth and by looking after the earth itself and our environment we are also looking after the health and richness of our families and villages. Attempting to make a profit at the expense of other people and ripping them off will never benefit us in the long run. Caring for people means we think about all the people around us and make sure that our projects benefit all those people. When a community works together everything is much easier. If a project harms or upsets people in our community it is not sustainable.

Returning the surplus
This means that we redistribute or re-use everything we do not need. If you think about it everything creates a surplus. An animal produces manure, a garden - surplus produce and organic waste, people produce sewerage, wasted food and rubbish, and a car produces fumes, dirty oil, and old tyres. Any surplus and this includes time, money and resources, which is not redistributed or re-used becomes waste and waste is pollution. However sustainable systems like a forest produce no waste because all of the surplus is re-used.
Check your understanding
Check that you have understood this lesson by answering the following questions.

Are these statements true or false? If they are false re-write them in the space provided

1. ‘It is not enough to use the earth’s resources wisely; we must also make them better’.

____________________________________________________________________

2. ‘Caring for people means only making sure they are healthy’.

____________________________________________________________________

The answers
The first statement is true.

The second statement is false. Caring for people is more than just making sure they are healthy. Caring for people means we think about all the people around us and make sure that they are helped and not harmed by permaculture projects.

Preparing to teach the lesson
1. Try to think of your own examples of the ethics in practice. Write them here.

_____________________________________________________________________________________
_____________________________________________________________________________________
____________________________________________________________________________

Here are some examples we thought of:

a. An example of caring for the earth is when village councils ban the use of chemicals.

b. An example of caring for the people is when the village council work with METI programmes.

c. An example of returning the surplus is the use of brewers waste and sawdust and glass jars for mushroom growing.
2. Think about the sort of questions your participants might ask. It might help to first think about whether there are any practices in agriculture in your village that support permaculture and whether there are any that might be against these ethics.

Write your questions down now.

_____________________________________________________________________________________
_____________________________________________________________________________________

Here are some of the questions we think you are likely to get. Were any of yours the same?

‘Does taking care of people only refer to their health?’

‘If we stop using chemicals will we be able to produce as much?’

3. Now try writing the answers to the above questions.

_____________________________________________________________________________________
_____________________________________________________________________________________

Here are the answers we would give

‘It is not only health – it is about the relationships between communities and their environment’.

‘In this course we will show you methods you can use to produce the same results without chemicals’.

**Planning your lesson**

Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

**Lesson Plan 2**

*Goals*

You should write these goals on newsprint before the session starts. Show them to the participants.

By the end of this session you will be able to:

1. Identify the 3 Ethics of Permaculture
2. Discuss the importance of these ethics
**Stimulus**
Hand out the pieces of papers with the three ethics of permaculture written on them and an example of each. Divide participants in three groups named after each ethic. Ask each group to discuss their thoughts and feelings about each topic. Ask the groups to share their responses with the whole group.

**Objective Enquiry**
You can now discuss the participants’ feelings and thoughts in the whole group. Then give a detailed explanation about the ethics of permaculture, using the text of the handout.

- Caring for the Earth
- Caring for the People
- Returning the Surplus

Share with participants the importance of these ethics.

Ask participants “do you think the Samoan people are following these ethics in the use of the land? “ Find out whether the elders see things differently from younger participants.

**Skills Practice**
Divide the group into the same groups to reflect on and discuss their village’s current agricultural practice to see whether they are currently putting any of the ethics into practice. In each group, list possible activities related to the chosen ethic in relation to permaculture.

**Application**
Ask participants to think about goals they can set for themselves about how they will apply the three ethics in their personal lives. Ask for volunteers to share their goals.

**Evaluation**
Share learnings from the lesson
Have the goals been met?

Lesson 2: Slides
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.

---

**PERMACULTURE ETHICS**

**AIAIGA /TULAFONO O FAIGAFAAATOAGA TUMAU**

The basis of Permaculture
O le faavae o Faigafaaaatoaga tumau

**1. Care of the Earth**
Faapelepele i le Laueleele

- “Do my actions benefit the oceans, rivers, mountains, insects, soil organisms, birds, trees, fish, people, bats, coral, starfish..... around me?”

- “O faamanua ma faaleleia e a'u gaioiga le sami, vaitefe, mauga, iniseti, meaola ninii i le laueleele, manulele, laau, I'a, tagata soifua, pe'a, amu, aveau.....o loo s'omia ai au?”

---
1. Care of the Earth
Faapelepele i le Laueleele

- “By doing this, am I building and enriching the soil?”
- “O o’u fausina ma faatamoaiga i le laueleele i lea faiga?”

II. Care of People
Faapelepele i Tagata Soifua

- “Am I considering my family, my neighbours, my village, my country and everyone else, as well as myself?”
- “O o’u vaavaai ea mo lo’u aiga, o o’u tuaoi, o lo’u nuu, lo’u atunuu ma isi tagata uma, faapena foi ma a’u?”

II. Care of People
Faapelepele i Tagata Soifua

- “Will this decision benefit others?”
- “E faamanuiaina isi tagata i lenei filifiliga?”

III. Return of Surplus
Faasoasoaina lelei o Vaega e Totoe

- O lou faapelepele i tagata soifua, o lou faapelepele foi lea i le laueleele. Ua iloa lelei lava, o tagata soifua o se tasi lea o vaega o le laueleele
- O le vaiaa lelei o le tatou siosiomaga, o le tatou vaiaa lelei foi lea o le ola maloloina, o aiga lima vaivai ma nuu.
- Vaaia lelei le lautele o tagata soifua uma o loo i lo tatou siosiomaga.
- Ia mautinoa o a tatou atinae e faamanuiaina ai tagata uma, ae le nao i tatou.

The system produces energy for us (money, food, other resources)
We RETURN this SURPLUS energy into the system, so it can continue to provide for us and our families.
Toe Faafoi Vaega e Totoe

- tufatufa atu pe faasoa foi vaega uma e totoe mai i vaega sa tatou manaomia.
- O mea uma lava, e maua ai vaega e totoe.

E soo se vaega totoe lava e le tufatufaina ma faasoa atu, o le a avea o se vaega maimau, ma faaegaina ai le ea, e pei o (otaota o puua, meaai pala, uga, suavai mai le gaosiina o meaai).

Faataitaiga:

- O puua latou te faamatuu maia otaota faalenatura e faalelei ai le palapala.
- O le togalaau, e maua mai ai otaota faalenatura
- O le vai mai fale o tagata, toega o meaai, otaota eseese ma isi.

• O puaa latou te faamatuu maia otaota faalenatura e faalelei ai le palapala.
• O le togalaau, e maua mai ai otaota faalenatura
• O le vai mai fale o tagata, toega o meaai, otaota eseese ma isi.

O vaega totoe uma (e aofia ai foi tupe, taimi ma vaega eseese e faaogaina) o le a faaleagaina pe a le mafai ona faasoasoa lelei.

• O vaega totoe uma (e aofia ai foi tupe, taimi ma vaega eseese e faaogaina) o le a faaleagaina pe a le mafai ona faasoasoa lelei.
• O le vaega lelei lava ma talafeagai, o le toe faafoi o vaega totoe, i le ola faalenatura o se faatulagaga lelei ma atoatoa.
Lesson 3: The Principle of Diversity

Learning Outcome
By the time you have completed this section of the manual you will be able to explain what diversity is, and the importance and advantages of diversity.

The material from the reference manual
Below you will find the material from lesson 3 as it is in the reference manual. Please read it to refresh your memory.

The principle of diversity
Diversity is a mixture of elements as in a polyculture which is planting several species of plants together. Diversity is the key to stability in a system, and is important for human health and the health of the environment.

In permaculture it is not only the number of different elements that matters, but the connections between elements. It is the connections between the elements that make a system stable, sustainable and productive with minimum input from us.

If you look at the differences between a very diverse, interconnected natural environment like a forest, and a monoculture farm environment where the aim is to grow only one productive crop, you can see how diversity benefits the environment. The picture that follows illustrates diversity:
Diversity = Stability

In a forest, why do you think one type of insect doesn’t take over and destroy the forest, like it can in a monoculture field?

A system with a very diverse range of species ensures that everything is kept in balance. When the numbers of one type of insect increase they become a food source for another creature. That creature then becomes food for another and so on. Diversity is also about creating supportive connections which keep plants and animals healthy and protected. (You will learn about supportive connections later).

Diversity = Stability (diversity of species creates stability of the systems)

In Nature

If an animal eats only one type of food, its life is not stable because the food source could be attacked by disease. Or there could be too much competition from another species for that one type of food. However, if it eats a wide range of foods, it will have many food choices, and will never starve and its life is more stable.

Diversity = Stability (a wide range of food sources gives us stability of survival)

In farming

The price of one crop is high because not much of it is being grown. So the farmer decides to plant his whole field with that crop. The problem is that every other farmer has done the same thing. Soon, there is too much on the market and so the price drops very low. If the farmer plants a variety of crops and the price fall on one crop, he can rely on income from the alternatives he has grown. A variety of crops also means the fruiting times will be spread out over the year, instead of fruiting at the same time causing an over supply.

Diversity = Stability (a diverse range of crops gives us stability of income)

Protect against disaster

If we have only one crop to rely on and something goes wrong with it, (taro leaf blight etc.) we have no other back up of income to rely on. If on the other hand we also grow coconuts with cocoa in the understorey, many different species of taro, some bananas and pineapples as well, if anything goes wrong with one product, for example the price falls or a pest or disease wipes it out, we have other crops to rely on for our family’s food and income.

Diversity = Stability (a diverse range of crops gives us stability against disaster)

By designing a diverse system we can achieve natural stability. However, it’s not just the number of diverse elements we have in the system which creates stability, but also the active relationships between them. (That means we have to consider how, when, where and why we incorporate each element into the whole system, not just what we incorporate.) This is an example of how just two elements connected together can be beneficial to each other. The more supportive connections which we can create through careful design, the more stable and productive our system will become.
An example:

On a farm we may grow papaya. If it is not picked, the fruit falls on the ground and begins to rot. This encourages pests to arrive and their numbers increase, creating a risk to the plantation. By introducing chickens into the system, they can be ranged below the papaya. The chickens will clean up the fallen fruit and eat any pest larvae which may be growing. The chickens will put on weight for market and the pest problem will have been reduced.

How to Apply the Principle of Diversity:

- Always value natural diversity in your systems.
- Look for and encourage diversity in physical systems and in community relationships.
- Pay particular attention to the connections between diverse elements.
- Have a community plan to back up major functions in case of disaster

This principle goes hand in hand with the principle of multiple functions, energy and nutrient cycling, zoning, efficient planning and placement (all of which will be covered later).

Back up Major Functions

A major function is something which we are reliant upon, such as water, irrigation, energy, income and food. If a major function fails we will be in trouble, so it is intelligent to ensure that each major function is provided for by more than one element. By backing up major functions, if one fails, the system will still be sustained.

For example if the town water supply fails, we can have a tank or buckets of water ready.

This can also be thought of as the precautionary principle. We need to determine what extremes we could encounter and design for those extremes. Have you faced any extreme events such as floods, cyclones, droughts, pest plagues, disease, or tsunami?
Check your understanding
Check that you have understood this lesson by answering the following questions.

1. Please match the words with their correct meanings by drawing a line between them.

<table>
<thead>
<tr>
<th>Words</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity</td>
<td>Growing many crops at the same time</td>
</tr>
<tr>
<td>Monoculture Farming</td>
<td>Mixture of elements that gives stability to a system</td>
</tr>
<tr>
<td>Precautionary principle</td>
<td>Growing just one crop</td>
</tr>
<tr>
<td>Polyculture Farming</td>
<td>Making sure that major functions are provided for by more than one element.</td>
</tr>
</tbody>
</table>

2. Active Relationships means:
   a. That in your farm many elements are operational or active at the same time.
   b. One elements cannot function without another element being present
   c. Several elements have to work together to create stability
   d. All of the above

3. Diversity creates stability in four different areas. What are these areas?
   i._________________________________________________________________
   ii._________________________________________________________________
   iii._________________________________________________________________
   iv._________________________________________________________________

Here are the answers.
1.
Words | Meaning
--- | ---
Diversity | Growing many crops at the same time
Monoculture Farming | Mixture of elements that gives stability to a system
Precautionary principle | Growing just one crop
Polyculture Farming | Making sure that major functions are provided for by more than one element.

2. The correct answer is C - active relationships means that several elements have to work together to create stability.

3. i Stability of system
   ii Stability of survival
   iii Stability of income
   iv Stability against disaster.

Preparing to teach the lesson

1. Think of some examples that have happened in Samoa which illustrate the dangers of monoculture farming and write them in the space provided.

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Here is an example we thought of

The widespread use of taro growing as a sole crop meant that in the mid 90’s the taro leaf blight disaster wiped out all commercial taro plantations.

2. Think of some questions that your participants might ask and write them below.
Here are questions we are often asked.

‘Can you explain why and how polyculture practices give better results?’

‘Can you give us some examples of how polyculture practices are effective?’

3. Now try writing answers to the above questions.

Here are some of the answers we would give:

‘Polyculture practices give better results because they allow many elements to work together so that everything is kept in balance. Remember diversity results in stability of systems; stability of survival; stability of income and stability against disaster’.

‘A very good example is marigold (makerita) planted in between vegetables to repel insects’.

Planning your lesson
Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

Lesson Plan 3

Goal
You should write these goals on newsprint before the session starts. Show them to the participants.

By the end of the lesson you will be able to:

1. Identify what diversity is
2. Discuss the importance and advantages of diversity
**Stimulus**
Divide the group in pairs. Handout the true or false questions which you will find in your resource folder for this lesson.

**Objective Enquiry**
Using the words of the handout, give a detailed explanation of diversity and its importance to permaculture.

With the whole group, review the various examples of diversity and how these are applied in permaculture practices. Tell the participants they can look at the reference manual while you are talking.

**Skills Practice**
Now divide the participants into 4 groups and give them newsprint. Ask them to imagine that they are in their backyard and to list down the most important plants and animals or elements like water, sunlight, soil, rocks etc... that are present. Ask them to put the elements in a circle and draw connections between them and then report back to the whole group on the connections they have made.

**Application**
Encourage the participants to set personal goals about applying diversity in their everyday lives.

**Evaluation**
Share learnings from the lesson

Have the goals been met?

**Lesson 3: Slides**
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.
Faafeifiloi = Tumau (o le feifiloi ma le esese o ituaiga e faatumauina se faatulagaga, ma se lelei e tetea atu ai i faalavelave faalen aura)

E ui i lea, o le nao le faatu aotai o le feifiloi ma le tele o elemeni esese o lo i ai i le faatulagaga, e mafai ai ona faatumauina,

Ae paitai, o le faaagaiga lelei ma le fesoataiga i le va o nei elemeni ma vaega esese.

Galuega Faatino-Vaega Faafeifiloi

- Aua foi, o le faatulagaga faafeifiloi, e paleni le ola faalenatura o vaega uma.
- Tut vaega uma nei se lo i totonu o lo to, ona lo i lea o faatulagaga faatulagaga o nei elemeni se lo.
- Tut au malie tagata uma i fesoataiga faalavelave.
- Sallif le tele e gata ai fou maifai.

Aisea e le mafai ai ona faaleagaina ma lepetiaina e se ineset se taal la vaomatua, e poe ona topu ma vaal lea tuluga i maumaga?

Aisea e leai ai ni meaola faalatua i le vaomatua?
Lesson 4: Principle of Energy and Nutrient Cycling
Learning Outcome
By the time you have completed this section of the manual you will be able to identify the various sources of energy and explain the nutrient cycle in a permaculture system.

The material from the reference manual
Below you find the material from lesson 4 as it is in the reference manual. We suggest that you read it now to refresh your memory.

What is Energy?
You might first think of energy as electricity which powers our lights and TVs. But energy is more than that. Energy is the strength required to keep active. It is the means through which everything in the universe operates, such as electricity, sunlight, food or just your physical strength. Everything that happens takes energy. If you understand that there is energy everywhere, you will find that you can use it in addition to using the energy in your own bodies. Here are some examples of how energy works in permaculture.

- Water carries energy. Moving water has a force which can produce electricity or do jobs for us, and rain water has the power to make plants grow. You can capture the energy in water by directing it to plants, and by storing it on your land. (Water stored up high has the most energy potential)
- The sun has energy, and every living thing needs the sun to function. By designing thoughtfully, you can capture the energy of the sun to grow plants, to warm (and cool) houses and buildings, even to make electricity and cook food.
- Food contains energy. The food you eat directly influences the amount of energy in your bodies. If you eat a diverse range of vegetables, beans and fruits grown naturally with lots and lots of nutrients (energy) inside, you will have much more energy inside your bodies too.

What is Nutrient Cycling
Nutrients are things that are important for life and growth. You can get them from the food you eat. Some examples are fats, proteins, carbohydrates, minerals and oxygen. They are another form of energy. Nutrients in the soil also help speed up the growth and increase the nutritional value of plants and fruits. Nutrients can be cycled within a farm to maintain a high level of diversity and abundance in the soil, in plants and in our bodies.

Here’s an example of nutrient cycling:

A tree dies and rots in a forest. Healthy fungi grow on it and are eaten by soil organisms, enriching the soil and becoming nutrient for the trees near it. These trees produce extra-tasty fruit which is eaten by birds that spread the nutrients around the forest by dropping manure, and insects breed in the fruit and become a food source for another creature, that spreads the nutrients to other trees which bear fruit etc.... If we take away the dead tree and burn it, these active relationships and the resulting products are lost. In fact if you take any element away, you lose some potential in your system. This shows the value of diversity.
You can store nutrient and energy by using a number of ways. If you understand this idea you can design different ways of cycling nutrients.

This example shows how “nutrient catchers” (deep rooted trees) have been planted at the base of the garden or hill.

When a field is planted with crops and fertilised, some of the nutrients are taken up by the plants. But when it rains heavily, some of them will wash down below the short roots of the crop. Nutrients are now unavailable to the crop and will get washed down the hill to the neighbour’s property. However, if deeper rooted plants are placed at the edge of the property, these can catch the deeper nutrients. These plants can then be chopped back and returned to the field as mulch which breaks down and becomes natural fertiliser, or it can be fed to animals who return it as manure to the crop. This is known as a nutrient cycle.

Nutrient cycling in the tropics
The top soil is where many of the nutrients are available to the plants in a forest. The topsoil is the dark organic (natural) layer and is built from fallen plant material which has been broken down by micro-organisms (small living things in the soil) and worms.

Fallen plant material is the basis of nutrient cycling in the tropics. As farmers we should be constantly building soil by allowing organic matter to decompose on our properties. This is the only way to increase the health and fertility of our land. If we are not building soil, we are slowly losing it, and soil is the most valuable resource we have.

The top soil is generally very shallow in Samoa for a reason. Because of the very heavy rain, nutrients can easily be washed away. Forests have therefore evolved to take up nutrients very quickly once they touch the ground. The plants then quickly take up the nutrients and store them in their leaves.

As a result, most of the nutrients in tropical rainforests are stored above the ground in forms of plant and animal material which cannot be washed away. By constantly dropping leaf and branch material to the forest floor where it can decompose, then ‘eating’ the nutrients, the forest is always self-fertilising.

**Mulching**

Mulch is a layer of natural material applied to the surface of an area of soil. Mulching

- provides nutrients.
- suppresses weeds
- provides home for beneficial soil life.
- protects the soil
- eliminates soil splash
- helps retain moisture
- turns into soil

Good sources of mulch include:

- Crop wastes after harvest
- Cut grass
- Leaves and branches from legume trees
- Coconut husks
- Seaweed
- Leaves that fall naturally from the trees – the tree will thank you if you leave its leaves where it left them!

**Planned nutrient cycling**

Here is an example of planned nutrient cycling.

Pigs can be allowed to free range at the bottom of a slope. At the end of the day they are fed at the top of the hill. The pigs will have a stomach full of nutrients and carry them to the top of the hill. If the pigs are penned up overnight they will drop many of these nutrients as manure.
Other examples of recycling is when water flowing onto the site is stored in dams, swales and tanks and when the energy of the sun is captured by using solar panels to make electricity. All matter can be recycled even ‘rubbish’ like old newspapers and cardboard can be used as mulch; plastic and glass containers can store seed or honey/jam/pickle pots. Metal can be melted down and use again. All weeds and animal manure and dead animals are composted. The less that leaves the system, the less that needs to be brought in from outside, and the more sustainable it becomes.
Check your understanding
Check that you have understood this lesson by answering the following questions.

1. Complete the following sentence with the correct word
   Everything in the world needs _______________ to operate.
   a. electricity  b. fuel  c. energy  d. power

2. Decide whether you think the statement below is true or false. If you think that the statement is false re-write it so that it is true.
   Nutrients are the only form of energy in the environment

3. In the space provided explain how you can prevent nutrients from being washed away.
   ____________________________________________________________________________
   ____________________________________________________________________________

4. Circle which statement below best describes mulching
   a. Mulching provides nutrients
   b. Mulching stops weeds
   c. Mulching helps keep moisture
   d. All of the above

The answers:
1. The right answer is c
2. The statement is false. Nutrients are just one form of energy but there are many more.
3. Nutrients can be prevented from being washed away by planting deep rooted trees at the bottom of a hill.
4. The answer is d

Preparing to teach the lesson
Think of some questions that your participants might ask and write them below.

_____________________________________________________________________________________
_____________________________________________________________________________________

Here are a couple of questions we are often asked:

1. ‘Why is manure a form of energy?’
2. ‘Cutting down trees to fence the farm is a common practice by farmers, which obviously can cause nutrients to wash away. Do we need to stop this practice?’
3. ‘Can you use mulch for all vegetable crops?’

Now try writing answers to those questions.

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Here are the answers we would give:

1. ‘Manure is a form of food which helps speed up the growth and adds nutritional value to plants. So it is also energy’.
2. ‘If you have to use trees for fencing we suggest that you replace the trees’.
   by replanting and use the remains for mulching.
3. ‘No, not for cabbages, lettuce and vegetables that rot easily’.

Planning your lesson

Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

Lesson Plan 4

Goals

You should write these goals on newsprint before the session starts. Show them to the participants.

By the end of this lesson you will be able to

1. Identify sources of energy in permaculture
2. Discuss the relationship between energy and nutrient cycling
3. Identify examples of sources of energy and nutrients in permaculture

Stimulus

Ask the participants to brainstorm all the forms of energy and nutrients they can think of. Write down all the words as they are called out. Discuss participants’ thoughts.

Objective Enquiry

Give a detailed explanation of energy and cycling of nutrients using the text of the handout. Talk more about the various examples of energy and nutrients in a permaculture site. Discuss how energy and nutrients are captured in the farm.
**Skills Practice**

Divide the participants into small groups (depending on the size of the group). Give them each the task of drawing a picture of how energy and nutrients are captured in a farm. This should reflect the relationship between the various sources of energy and nutrients. Ask each group to report back to the main group.

**Application**

Encourage the participants to set goals for themselves about how they will apply this principle in their farming practices.

**Evaluation**

Share learnings from the lesson

Have the goals been met?

**Lesson 4: Slides**

Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.
Malosiaga o le Vai
E manaomia e meaola uma o le laueleele:
- Tagata Soifua
- Laau
- Manu
- Maisi

Malosiaga o Meaai
Manaomia e meaola uma o le laueleele
- Tagata Soifua
- Laau
- Manu
- Maisi

Nutrient Cycling
Taamilosaga o Minerale Lelei
O le isi faataitaiga e mafai ona tatou tapu’e ai minerale lelei o le faaaogaina lea o meaola. Puaa, Anufe, faatai si ma laau toto i lalo poo totonu o vaega ia (tagai i le ata)

O le taamilosaga a minerale ma meaai lelei mai le elele i totonu o laufanua.
- Faaaga faaputuga otaota ma
- faapalaga faalelei elele, ma toe faafol atu minerale lelei i le elele!

A totôina se nofoaga i faatoaga ma faalelei ia le elele, o minerale lelei uma, o le a faaaogaina e laau.
Afai tatou te totōina laau e ola maulalo o latou aa i faatausi’usi’uga o tatou fanua, e mafai ona latou mitiaina minerale i o latou aa, ma toe faaoo atu agai i o latou ala ma lau laau.

Ofe

O lala laau, e mafai ona tatipi ma toe faafoi atu i le elele e avea ma faaputuga otaota faalelele elelele pe a oo ina pala, pe fagaina ai foi meaola, ma toe foi atu nei minerale i laau toto e ala i otaota o meaola.
Lesson 5: Trees and the Water Cycle

Learning outcome
By the time you have completed this section of the manual you will be able to explain the relationship between trees and the water cycle.

The material from the reference manual
Below you find the material from Lesson 5 as it is in the reference manual. We suggest that you read it now to refresh your memory.

Trees and the Water Cycle
Not many people these days understand the importance of trees in our environment. This chapter explains how trees relate to water, the essence of life.

Water is constantly being cycled through the environment, changing between liquid and gas or vapour. The processes involved are:

- Evaporation – when water is heated up, it forms a steam or vapor which rises into the atmosphere to form clouds.
- Transpiration – water is cycled through plants and trees. Plants suck up the water through their roots, and stems, and release it as a vapor through the pores in their leaves
- Condensation – water droplets form from the vapour in the air when the air is cooled down.
- Precipitation – from the water vapour in the air, water molecules collect together to form clouds, which eventually fall back to the earth as rain – to begin the cycle again.
This cycle is what filters all the fresh water on earth – and without it we would have no rain. This is a simple way to understand the water cycle. In nature the water cycle is very stable, but human actions can have very bad effects on the water cycle of an area – in fact, humans can quickly turn a forest into a desert if they are not aware of the natural cycles and processes going on around them.

The Relationship between Trees and Rain
Permaculture is all about interactions between elements in the environment. If we understand natural relationships we can use this in our everyday work, but if we don’t, we can produce devastating effects. Trees are some of the most important elements because they play a wide variety of functions in the environment. Many people do not understand the connections between trees (forests) and the weather. Without trees, the water cycle doesn’t work. Now we are going to find out about how trees are involved in the water cycle. Let’s look at a situation where wind blows from the ocean, over a forest.

The air contains water evaporated from the surface of the sea. About 15-20% of this water will turn into rain, and the rest 80-85% is condensed onto leaf surfaces. Condensation occurs when warm humid air is cooled down when passing over cool leaf surfaces. As the air cools, it forms droplets of water which need a surface to cling to – leaves provide this surface in a forest. This means that trees are responsible for far more of the total water content of forests than the rain.

Standing under the shelter of a great tree at dawn you might feel some cool water gently dripping down from the leaves, when it has not been recently raining. Imagine how much water drips from an entire forest each night, and how much water that is not reaching the land from when forests are ignorantly destroyed!

The upward spirals of humid air coming from forests carry pollen, leaf dust and bacteria.
These organic particles create the nuclei for rain. Without nuclei, clouds cannot form. This is a natural process whereby water molecules attach to particles, and these molecules gradually join together to make a cloud. When enough particles join together and the cloud gets ‘full’ of water (clouds appear large and dark), rain starts to fall. If there is extensive pollution in an area, clouds can form from different sources of nuclei, and either it won’t rain because particles are too small, or the rain becomes impure (ever heard of acid rain?)

Of the rain that falls, 25% again evaporates from crown leaves, and we estimate that 50% of both rainfall and condensate is transpired. Transpired means that the water has been used by the trees themselves and then release through the pores of the leaves, and returned to the air. All this water is added to clouds, which are now at least 50% ‘tree water’. These clouds travel on inland to rain again. Thus trees multiply rainfall itself by this process, which can be repeated over extensive forested areas. Air containing water, flows at a certain pressure, which varies at times. When air flows over a forest, it hits the trees and gets pushed upwards to form clouds that cause the rain.

When air flows towards a forest, about 40% of incoming air makes it inside the forest, 60% flows over the top. Think about how the environment of a forest can change air and water. The 40% which enters is shaded, cooled (or heated in cold climates), and the humidity is regulated. Without the forest, air remains hot, dry and decompressed. When rain falls, the ‘throughfall’ (water which makes it through the canopy to the ground) collects valuable nutrients as it makes its way through the trees.

These factors show a very close relationship between trees and the water cycle. By understanding this, we see how deforestation becomes a cause of major destruction. In destroying forests, we are decreasing rainfall, and the more we destroy the closer to impossible becomes the task of regenerating natural areas. This has already happened all over the world. By ignoring the relationship between trees and rain (and probably many other important relationships), people have literally turned forest into barren desert, where rain no longer falls.

In conventional farming, farmers have clear-cut forests to plant fields, immediately denying themselves of all the natural precipitation they would receive if the area was forested. Now, to keep their crop alive, they must intensively irrigate – taking massive amounts of water from other sources, and putting more pressure on the water cycle. Rivers and streams start to run dry in some times of the year, therefore more trees and plants die and do not return moisture to the air. Less precipitation is created, and farmers need more and more water from somewhere (anywhere) to irrigate monoculture crops (which need far more water than a forest does to survive). So they divert rivers, build dams; build pipelines, destroying more forests in the process.

As this cycle continues, we see the way in which conventional farming can actually change the climate of a whole area in a very short space of time, creating drought, and turning forest into desert where nothing can grow. If we could only understand (or remember) how very important trees (and all natural systems) are for life on earth, we would, as many tribes have done, respect all trees as our brothers and sisters.
Check your understanding

Check that you have understood this lesson by answering the following questions.

1. In one or two sentences try to explain the relationship between water and trees.
   __________________________________________________________________________
   __________________________________________________________________________

2. Decide whether the following statement is true or false. If it is false, re-write it so that it becomes true

   ‘The water cycle continues even if there are no trees’.
   True
   False

3. Which of the following explanations of trees and the water cycle is best?
   a. Without trees, there would be no water cycle
   b. Trees purify rain water
   c. Trees only hold 15 – 20% of moisture, the rest turns into rain.
   d. Both A and B

4. Fill in the gaps in the sentence below with the correct words from this list
   Molecules
   clouds
   rain
   forest

   Air flows over a _____________ and gets pushed upwards to form _________________. As a result ________________ starts to fall.

**The answers**

1. Water is the essence of life. Without water, trees will not grow well in a natural system. Both depend on each other’s existence.
2. The statement is false. The water cycle depends on trees.
3. The best answer is D – Both A and B
4. Forest, clouds, rain.

**Preparing to teach the lesson**

Think of some questions that your participants might ask and write them below.

_____________________________________________________________________________________
_____________________________________________________________________________________

A question we are often asked is:

‘Most of our forests have been cleared for developments like farms, cattle farming and for timber use. How can we help improve these lands?’
Now try writing an answer to that question.


Here is the answer we would give.

‘You are encouraged to limit this practice. What you would need to do is to replant’.

**Planning your lesson**

Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

**Lesson plan 5**

**Goals**
You should write this goal on newsprint before the session starts. Show it to the participants.

By the end of this session you will be able to:

Discuss the relationship between trees and the water cycle.

**Stimulus**
Ask the participants to brainstorm ideas about the relationship between trees and water. Write down all the words as they are called out. Discuss participants’ thoughts.

**Objective Enquiry**
Give a detailed explanation about trees and the water cycle using the text of the handout. Explain the importance of trees and the water cycle in permaculture.

**Skills Practice**
Ask the participants to role play the various scenarios that reflect the relationship between trees and the water cycle.

**Application**
Encourage the participants to set a goal for themselves about how they will apply this principle in their farming practices.

_Evaluation_

Ask participants to share their best learning from the lesson.

Has the goal been met?

**Lesson 5: Slides**

Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.

---

**THE WATER CYCLE**
Taamilosaga o le Vai

---

**EVAPORATION**
Mitiia e le la ma liuausa

---

**TRANSPIRATION**
Taamilosaga o le vai i totonu o le laau

---

“LIUAUSA”
O le vai i totonu o le ea e toe fo’i mai e ala i le…

“LIUSUAVAI”

PRECIPITATION TIMUGA

85% o le vai i le ea e “LIUSUAVAI” mai i luga o lau o laau.

Laau ma Timuga
E uunai agai i luga e le ea ona mau lea i pito o le vaomatua.

VAEGA NINI (PATIKALE) E FAAMATUU ATU I LE EA

E TOE MUI MA LUIAUSA LE VAI MAI LAU O LAU

E ADONI PE PIKINA FOI E LE VAI
MINEARE ESESE

E ILOA LE SUSÓ MA LE SAU I LAU O LAU

E FAALENATURA LAVA LE FAUSIANA O AO, MA LE TAIMILOSA A LE TIMU

VEVELA

MAGO / MATUTU

O LE A LEAI NI VAEGA NINI (PATIKALE) E FAAMATUU ATU I LE EA
E LE MAFAI ONA FAUSIA AO
Lesson 6: Accelerating Succession and Evolution

Learning Outcome

By the time you have completed this section of the manual you will be able to identify the process of accelerating succession and evolution and explain how it occurs in nature.

The material from the reference manual

Below you find the material from Lesson 6 as it is in the reference manual. We suggest that you read it now to refresh your memory.

Accelerating Succession and Evolution

We will first look at the process which occurs in nature.

If we picture a field which has been completely cleared of vegetation, we can imagine what would happen if the field was left alone for a long time. Eventually, the field will turn back to forest. The process by which this occurs is called succession. The first plants to grow are tough weeds, then grasses and bushes, pioneer trees, early secondary forest species, and finally, climax species (most sophisticated plants such as fruit trees or vegetables).

A Process of Natural Succession

This is how the process works:

- If the land is very degraded, the low fertility and exposure to harsh conditions means that only the hardiest weeds can survive.
• These weeds often have short lives and die back, soon to be replaced by another of these fast growing plants.
• When they die, their foliage and roots are returned to the soil and broken down by micro-organisms, which help to build up the fertility.
• These hardy weeds also begin to provide some protection for other plants on areas which were just too exposed before.
• As the level of fertility increases, the conditions develop where grass is now able to grow.
• Grass requires a higher rate of fertility than the hardy weeds mentioned above. Once this higher rate of fertility exists, the grass is able to out compete weed species and take over.
• Like the hardy weeds, this grass also grows relatively quickly and periodically dies back.
• Once again, the dead foliage and roots are broken down by the life in the soil and returned to the topsoil. This process helps to bring nutrients back to the surface and adds organic matter to the soil which holds onto the nutrients until plants require them, retains moisture and binds the soil together preventing erosion.
• After some time, the level of protection and fertility increases to the point where pioneer species can grow. Pioneer species are:
  • hardy and can survive in lower fertility environments;
  • fast growing;
  • able to compete with grasses and shade them out once adequate fertility levels exist;
  • relatively short lived with their bodies returning to the soil to help build fertility,
  • able to fix nitrogen and other nutrients to build soil fertility.

Once pioneer species have reduced the competition with the grasses by shading them, and have built the fertility in the soil further by adding their foliage and nitrogen from their roots, the conditions now exist where early secondary forest species can grow, followed by the mature forest shade species.

• Most long term forest trees need lots of protection and care for them to survive.
• If we placed these trees out on the clear area at the beginning of the succession process, they would not have survived.
• Also, if they were planted into grass, they would be smothered, out-competed and die.
• Each of the stages of succession has helped to increase the level of fertility and protection to the point where the climax species can grow.
Working with Nature - The benefit of understanding the process of succession.

Forest systems existed in one form or another on most parts of the Earth which are now inhabited by people. If we leave a piece of bare earth, no matter where or how degraded, eventually this land will go through the succession process, rebuilding its fertility and returning to a forest system. This is how nature rebuilds its own fertility. By gaining an understanding of the succession process we can begin to work with Nature, and use this to our advantage in our agricultural systems. Some examples of ways to accelerate succession include:

1. **Using compost and mulch**
   - Compost is basically a large amount of organic material which has broken down by micro-organisms to a form which is available to plants.
   - This is the same process which the hardy weeds are doing when they first begin to build the fertility in the soil.
   - By building a compost pile we are collecting plant material containing lots of nutrients, animal manure, food waste and micro-organisms from a large area of land, breaking it down in a short amount of time, and concentrating these nutrients and microbes at the base of our crop.
   - Manual labour has sped up the process which nature would have undertaken over a number of years.
   - In the tropics, a diverse application of mulch can have the same effect as compost, since organic material breaks down very fast in this climate. Application of compost tea would help the mulch to break down with lots of micro-organisms for the soil.

2. **Planting Legumes**
   - A legume is an invaluable permaculture plant. There are many different species of legume here in Samoa, from peas and beans to huge Tamaliges. Legumes can be hard to distinguish until you are familiar with them, but generally, legumes will have a pod. Many legumes are pioneer species.
   - The main reason legumes are so special is because they fix nitrogen in the soil. With the help of special bacteria, these plants actually draw nitrogen from the air and store it in little nodules attached to their roots.

For a specific example of using this principle of succession, see Practical Permaculture #5 – Establishing a Food Forest.

- Usually a legume stores most of the fixed nitrogen for its own use.
- However, if we cut back the foliage of the plant, a similar proportion of roots will die back. Nitrogen is released into the soil in a form which becomes available to other plants.


• Foliage which is cut back can also be used as a mulch, which will break down and provide further nutrients to productive plants – and almost all legumes will readily grow back from hard pruning. By placing legumes strategically next to our main elements, they can provide these functions directly for our productive species.
• We can take advantage of the succession process, right alongside our productive crop or valuable trees.

The Function of Weeds
In conventional agriculture, there is a very strong attitude towards ‘weeds’. But we should ask ourselves, why do weeds occur in the first place?

Are there any ‘weeds’ in a healthy forest system, or do all plants play an important part?

Weeds don’t inhabit a piece of land by accident. They come primarily to repair damaged land. They actually have a very noble job to do. For example, in an area that has been depleted nutritionally, nitrogen fixers (usually legumes) will move in to drop nitrogen rich mulch and nitrogenous nodules from their roots. Eventually these ‘weeds’ will restore the soil enough that other plants can grow there too. This is the principle of succession. But if we keep removing these plants before their job is done, and worse still if we pour chemicals on the land and degrade it further, the area will have a much harder time restoring its natural fertility and we will find it very hard to grow any other plant there.

It is interesting to note that in areas with other types of degradation (like compaction, fire damage or erosion) different types of restorative ‘weeds’ will move in, which have qualities that can reverse these specific problems. So often what we call weeds can actually be a hidden asset, and if nothing else we should always take advantage of the valuable nutrients contained in ‘weeds’ by mulching or composting them.

But there are certainly some non-harmful ways to remove non-productive plants if necessary.

One good one is to let animals do the work for us. Pigs, chickens, goats and some other land grazers will do an excellent job of removing certain weed species, and using this method we actually utilise the unwanted plant as animal food. (Meanwhile the animals fertilise the soil with their manure and prepare the soil for planting).
Check your understanding

1. Read the statement below and consider whether you think it is true or false. If you think that the answer is false re-write the sentence so that it is true.

   ‘Weeds have a very important role in nature’.

   ______________________________________________________________________

2. Complete the following sentence with the correct word.

   To keep the soil healthy it is helpful to use ______________________

Some weeds can be effectively removed with thick mulch. If we lay down something which is biodegradable and blocks out the sunlight, the plants will not survive and will end up decomposing back into the soil. We can plant straight into materials like cut grass or leaf mulch, and by the time our plants are established, weeds won’t have any room to grow back.

Weeds can be shaded out by productive plants. If we manually cut back an area big enough to establish some trees in the area, in time they will grow large and shade out other plants. In the meantime we can cut back the surrounding weeds and mulch our chosen trees periodically to give them a substantial head-start. This is called ‘favouring’ productive plants and ‘disfavouring’ temporary plants.

‘If you’re not happy with your work, it’s probably not worth doing.’ This means that if we are constantly attempting difficult, unenjoyable jobs that need to be done again and again, we are most likely doing something wrong. This is where we consider whether we are working with or against the pattern of nature. If we are always fighting and struggling, we are not in harmony with the environment, and need to sit down and have a good think about how we can improve our systems.
3. Circle which of the following statements best describe succession

   a. Succession is a process in which nature heals itself
   b. Succession is a process in which we use chemical to control weeds
   c. Succession is a process that will destroy the soil and decrease soil fertility.
   d. None of the above.

4. In your own words explain why succession is important:

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

**The answers**

1. The statement is true
2. The right answer is c
3. The correct answer is a
4. Succession is very important to increase the level of fertility and protection to the point where the climax species can grow.

**Preparing to teach the lesson**

Think of some questions that your participants might ask and write them below.

- ____________________________________________________________________________________
- ____________________________________________________________________________________

Here are a couple of questions we are often asked:

‘What are legume trees and what are some examples?’

‘What is the use of grass and weeds to the soil?’

Now try writing answers to those questions.

- ____________________________________________________________________________________

Here are the answers we would give:
‘Legume trees are trees that help to increase soil fertility. Some examples are gatae, vaofefe, and laupele’.

‘Grass and weeds help to keep the soil moist and healthy’.

Planning your lesson
Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

Lesson Plan 6

Goals
You should write these goals on newsprint before the session starts. Show them to the participants.

By the end of this lesson you will be able to:

1. Discuss ways of how to improve your farm using the succession principle.
2. Explain how to accelerate the succession process

Stimulus
Divide the team into 3 groups and hand out cardboard to each group. Ask each group to write down their ideas on how to make compost and mulch.

Ask each group to tell the main group about the items on their list. Staple all the lists on a sheet you have already prepared.

Objective enquiry
Give a detailed explanation of succession and how to accelerate it using the text of the handout. Discuss the topic with the participants.

Skills Practice
Divide participants into small groups and ask them to see whether they can suggest different ways to improve natural succession. Get groups to report their ideas back to the main group.

Application
Encourage the participants to set goals for themselves about how they will apply this principle in their farming practices.

Evaluation
Share learnings from the lesson
Have the goals been met?

Lesson 6: Slides
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.

AUALA VAVE MO LE
FAALELEIA O ATINAES
Faatulagaga o vaega o le natura

O le galueaina la lenei o le faasologa:
Mai elele ma fanua ua faaleagaina, agai i vaomatua lelei.

O leina faatinoga ua faaigoaina o se faiga
TUUFASOLO. O laau lava e muamua ola o :
* vao fefeu po'o vao malō
* ona faasolo ifo lea i le mutia ma le vaovao
* sosoo ai ma vao ola pe tupu tele.
* ona faasolosolo atu ai lea i vao po'o laau o le vaomatua.
* faaiu ifo lea i laau maualulua ma sosolo fe oe'i laau

Galulue faatasi ma le Ola faalenatura

* O vaomatua e mafai ona ola i soo se ituaiga fausaga, aemaise lava vaega o le laueleele o loo nofoia e tagata.

* laueleele e leai ni laau e ola ai, e faigofie lava ona toe faaleleia ma tutupu ai laau, ma toe faaleleia atili ai le palapala, pei o le ola a le vaomatua.
O ni isi faata’ita’iga o AUALA VAVE MO LE FAALELEIA O ATINAÆ e aofia ai:

- Totōina o Laau Faalelei Elele
- O Aogā o Vao
- Faaaogaina o Faalelei elele ma Faapalaga otaota

1. Faaaogaina o Faalelei elele ma Faapalaga otaota

- Tele meaola ninii e maua mai ai, e ola lelei ai laau.
- Lelei ma tamaoaiga ai le palapala
- E tutusa lava ma le tamaoaiga e maua mai i le faalelei elele, aua foi o vaega una lava e maua mai i le natura
- E vave ona faataapepeina e meaola ninii.

2. OTAOTA O MEAOLA

2. Totoina o Laau Faalelei Elele

- E faaleleiia meaai lelei mo le palapala
- E latou te taofia meaai lelei mo le toe faaaogaina lava e latou,
- O meaola ninii o loo latou aiina aa, o le a faataape atu i le palapala, ma maua ai se faapalaga mo laau toto.
4. TOTOINA O LAU FAALELEI ELEELE

faamatuuina atu minerale ma meaai lelei mo sooo se ituaiga elemeni.

3. O Aogā o Vao

• Aiseā na mafua ai ona ola nei mea o vao?
• E i ai ea ni vao o ola i se vaomatua maloloina lelei ma saogalemu?
• E i ai ni matafaioi ni ni galuega taua e faatinoina e laau uma?

7. GROUND COVER / UFIUFI O LE ELEELE

Na omai e faalelei se laulelele ua faaleagaina

Faataitaiga:

• e faamatuu mai e aa o vao ma laau le tele o le meaai lelei.
• foateleina le lelei o le palapala,
• ola lelei ai le tele o isi laau.
• o se nofoaga matuai tamaoaiga lava, tele meaai ma minerale lelei, faalelei elelele faalenatura, ma laau faalelei elelele o loo ola ai,

Faafitauli:

• vele le vao ae lei maec ona faataunuina le latou galuega faatino.

• faaaogaina o vailaau oona ma faaleagaina ai le palapala, o le a faapena loa ona matuai faigata ona toe faafoi lenei nofoaga i lona tulaga lelei sa i ai faalenatura

• faigata ai foi ona ola ai ni laau totō poa ni faatoaga.
Afai e nao le tatou vevesi, fevaevaeai ma misa
i le tele o taimi, o lona uiga:

- tatou te leo faaeteete ma faapelepele i le siosiomaga.

-e manaomia la ona tatou nonofo lelei i lalo, ma
mafaufau lelei pe faapefea ona toe faaleleia, ma alu i
Lesson 7: Using Biological Resources

Learning outcome
By the time you have completed this section of the manual you will be able to explain how biological resources are used in a permaculture site.

The material from the reference manual
Below you find the material from Lesson 7 as it is in the reference manual. We suggest that you read it now to refresh your memory.

Using biological resources
Biological resources refer to plants and animals. In a permaculture system we design in a way which allows us to use plants and animals wherever possible to provide resources and do the work of the farm.

If we can get an animal or a plant to do a job which the farmer had to do before:

• this gives the farmer more time to focus on other activities and saves energy
• this saves us money on diesel, machinery purchases, and maintenance and reduces unsustainable consumption.

Animals, plants, trees, insects, worms, micro-organisms and so on, can provide many helpful functions such as providing fuel, insect control, nutrient recycling, soil aeration, pasture improvement, fire control, erosion control, fencing, and land clearing.

Example: Taro farming

• Clearing the field – (Pigs can be penned into an area and they will clear the weeds and dig and fertilise the soil ready for planting)
• Fertiliser – (Pig manure from the clearing stage; Chicken manure if they are allowed to free range amongst the Taro; Mulch and nitrogen from intercropped legume trees; Fallow period).
Weeding – Chickens can be introduced once the crop is big enough and they will scratch some of the weeds around the Taro plants; Legume shade trees planted just before harvest will reduce weed growth during the fallow period whilst also adding fertility.

Mulch – Legumes planted in 4-6m rows can be chopped and provide mulch for the crop. Trials in Samoa have shown that taro fields farmed in this way increase their yield over the seven year trial without an extended fallow period.

Fencing – living fence (this can keep out unwanted animals during the cropping period, fence in the pigs during the clearing stage, provide mulch for the crop, provide nitrogen for the crop if they are legumes; provide feed for the animals and firewood for cooking)

Example: Papaya growing

- Clearing the field for planting – (Pigs - same as above)
- Fertiliser – (Pigs + Chickens which are free ranged to clean up fallen fruit, legume trees which provide mulch and nitrogen)
- Erosion Control – (Alley cropping systems planted across the slope, particularly if the branches are placed above the tree stumps)
- Mulch – Legume trees which are chopped back for mulch
- Weeding – Chickens, pigs, shading by legumes
- Groundcover – (creeping legumes can smother weed growth, protect and improve the soil and provide nitrogen for the trees)
- Pest Management – (Pigs or chickens to eat fallen fruit before it breeds up large numbers of pests).
- Watering (Using natural bodies of water, designing on contour to make use of natural rainfall. Water storage could be used for aquaculture which will add fertility to the water and fertilise the crops when watered).
- Cleaning up rotten fruit – (pigs, chickens will eat this)
- Fencing – (living fence – same as above)
- Wind protection – (Windbreak of trees which may also provide some animal and bee fodder, and valuable timber)

The key to the use of biological resources is management

- If they are not managed properly, they can get out of control and cause damage.
- If they are managed carefully, being introduced and removed at an appropriate time, then they can become a very helpful part of the system, saving us time and money.

The key to their management is timing. For example:

- If pigs are allowed under papaya for short time they will clean up fallen fruit, preventing pests from breeding up. If they are allowed in too long, they will start to eat roots of the trees. We need to monitor the situation to decide on the appropriate stocking rates and length of time they are introduced.
Check your understanding
Check that you have understood this lesson by answering the following questions.

1. Please say whether the statement below is true or false and give a reason for your answer.
   ‘Only animals like pigs and chickens are examples of biological resources’.
   (True / False)

   ______________________________________________________________________________________
   ______________________________________________________________________________________

2. In one or two sentences can you explain how pigs can help farmers on the farm?

   ______________________________________________________________________________________
   ______________________________________________________________________________________

3. How can we ensure that pigs and chickens do not end up spoiling our farms? Select which of the following alternatives is the best answer
   a. Keep only little chicks on the site
   b. Stay there to watch the pigs and chickens
   c. Give them enough food so they do not end up feeding on plants
   d. Don’t leave the animals on the farm for too long.

The answers
1. The statement is false. Living organisms like worms and insects are some other examples.
2. Pigs can be penned in an area and at the same time will help clear weeds and provide fertilizer for the soil before planting.
3. The best answer is d.

Preparing to teach the lesson
Think of some questions that your participants might ask and write them below.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Here is a commonly asked question

‘When is the best time to pen chickens into a taro farm so they do not end up causing damage?’

Now try writing an answer to that question.

____________________________________________________________________________________
____________________________________________________________________________________
Here is an answer we would give:

‘Management is very important when using animals and plants to help on the farm. The farmer should make sure that the chickens are not kept in too long – otherwise they will end up eating the roots and or leaves of taro. The farmer should also make sure that the taro are big enough before the chickens go in’.

Planning your lesson
Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

Lesson plan 7

Goals
You should write these goals on newsprint before the session starts. Show them to the participants.

By the end of this lesson you will be able to:

1. Explain how biological resources are used in permaculture.
2. Discuss the role animals and plants play in a permaculture site.

Stimulus
Participants are given a piece of paper with a picture of a certain plant or animal.

Participants are asked to place each picture on the chart provided.

Objective Enquiry
Give a detailed explanation of how biological resources are used in permaculture using the text of the handout. Participants share thoughts about the topic.

Talk about the different examples of how biological resources are used.

Skills Practice
Put up the chart and ask participants to check if pictures were placed in the right position on the chart.

Application
Participants set goals for themselves about how they can apply the skills learned in their farming practices.
Evaluation
Ask participants about their best learnings of the day.

Have the goals been met?

Lesson 7 Slides
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.

Faaogaina o Meaola poo Vaega ola
Faalenatura

O (laau ma manu), e mafai ona fesoasoani e faamatuu mai vaega e manaomia, ma latou faatinoina isi galuega i totonu o le faatoaga.

• maua le isi taimi tele o le fai faatoaga e faatino ai isi galuega faatino.

• sefe ai foi le malosi

A faia foi e manu poo laau isi galuega e mafai ona faia e masini, o le a:

• sefe le tele o tatou tupe e alu i le suauu, ma le faatauina mai o masini, ma le toe faaleleia

• faaitiitia ai le faaaogaina o tatou malosiaga.

2. OTAOTA O MEAOLA

Afai foi e maua mai i manu ma laau isi vaega lelei sa masani ona tatou faatauina, o le a tele tupe sefe ma faaitiitia faaaogaina o vaega e le tumau.
Manu, laau, iniseti, anufe/ilo, ma meaola ninii uma ma isi, e tele o latou aoga ma vaega e mafai ona latou faatinoa:

• faaitititia ai le tele o iniseti faalafua,
• fausiaina o minerale lelei, palapala lelei,
• faaleleia ma atinae ai le nofoaga,
• faaitititia le matutū, faaitititia le palapala tafia, pa, faamainaina o le laufanua ma isi.

AUFAIGALUEGA A LE PALAPALA

Faata´ita`iga. Maumaga Talo

• Faamainaina o le fanua:
  (E mafai ona tuu puua i se vaega fanua, ua uma ona toso ai le pa, latou te faamainaina le vao, sua ma faamalufu le palapala, tuu i ai ma faaleleia eleele, ona sauni loa lea e totō)

Pa:

• Pa i laau toto e ola (e mafai ona puipuia ai ma le sao atu ai i totonu ni manu, i le taimi e toto ai laau, pa mo puua i le taimi o loo latou faamainaina ai le fanua.
  E maua ai faaputuga otaota faaleleia eleele mo laau, maua minerale lelei mo laau, maua ai foi meaai mo manu ma fafie mo le kukaina o meaai.)

• E soo se malosiaga lava e faaaogaina i le fuafuaga poo le faatulagaga, e tatau ona sili atu le ola lelei ma tumau, ina ia mafai ona faaauauina le faatoaga tumau.
Lesson 8: Multiple Functions and Relative Location

Learning Outcome

By the time you have completed this section of the manual you will be understand why you should know the functions of the different elements in your farm and how they relate to each other.

The material from the reference manual

Below you will find the material from lesson 8 as it is in the reference manual. Please read it to refresh your memory.

Multiple Functions

An important principle of permaculture is the ability to see all the functions of elements in a system. If we can identify as many functions as possible in all elements, we can make more and more connections between elements.

Examples of multiple functions:

- Native trees and shrubs—Shelterbelt, bee fodder, native bird habitat, fruit, timber, firewood
- Dwarf Coconut – shade, breeze allowed, projectile stopper, coconuts, etc.
- Banana circle – grey water treatment, screen, groundwater infiltration, waste disposal, fruit, compost source, runoff collector, aesthetic value, fast decomposition
- Clumping Bamboo – living fence, stakes for trellis, windbreak, building material, piping, gutters, weaving material, handicrafts etc.
- Coffee plants – Hedge, screen, coffee, fodder for animals
- Shed/Fale – clothesline support, drinking water and hot-water tank above house, storage, etc.

This includes biological and structural elements, and processes. (A process is something like feeding chickens, preserving mangoes, mulching a garden, building a fale – anything that you do.) We can analyse the needs, functions and products of every element.

Let’s take a chicken as an example.

- A chicken needs food, water, shelter, nesting area, grit, dust bath, company, and predator protection.
- The functions of a chicken are scratching, eating weed seeds/fallen fruit, breeding, flying, foraging, roosting, making noise, and fighting.
- The products of a chicken are eggs, feathers, meat, manure, baby chickens, heat, CO2, and methane.

When we look at it this way, it’s clear that a chicken performs many more jobs for us than just producing eggs or meat. This should be true for all elements. Think about all the functions and products of different elements, and how they can be used to serve the needs of other elements.
Every element placed in a system should have at least 3 functions, or perform 3 jobs beneficial to the system.

<table>
<thead>
<tr>
<th>PIG</th>
<th>CLIMBING YAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs</td>
<td>Functions</td>
</tr>
<tr>
<td>Food</td>
<td>Digs</td>
</tr>
<tr>
<td>Water</td>
<td>Removes weeds</td>
</tr>
<tr>
<td>Fencing</td>
<td>Eats fallen fruit</td>
</tr>
<tr>
<td>Shade</td>
<td>Piglets</td>
</tr>
<tr>
<td>Shelter</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TREE</th>
<th>TOOL/SHELTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs</td>
<td>Functions</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>Provides shade</td>
</tr>
<tr>
<td>Pest protection</td>
<td>Wind protection</td>
</tr>
<tr>
<td>Weeding</td>
<td>Support</td>
</tr>
<tr>
<td></td>
<td>Fencing</td>
</tr>
</tbody>
</table>

This is just a very simple example, but the more parts of the system which we can connect through careful design, the more they begin to work together, and the more time, energy and money the farmer will save.

**Remember:** Although all elements will intrinsically have multiple functions, it is up to us to make use of those functions, through thoughtful design. Using other principles like relative location, energy efficient planning (zoning), nutrient cycling and functional interconnection (diversity), and using creative thinking, you can design a system where all elements are supported by other elements, reducing work and increasing productivity.

**Relative Location**
The relative location principle is about making connections. Our aim is to design our system in such a way that the waste of one part becomes a resource for another.

We had a simple example in the previous chapter of chickens integrated with a papaya plantation.

- If papaya falls on the ground and is left to rot, this can encourage pests to breed up, threatening the rest of the crop.
- If we have chickens which are penned up, we have to purchase food and hand feed them each day.
- By linking these two elements together, suddenly they are benefiting each other. We have:
  - reduced the work of the farmer
  - reduced the need to spray for pests
  - provided fertiliser for the papaya trees
  - provided food for the chickens
This is just a very simple example, but the more parts of the system which we can connect through careful design, the more they begin to work together, and the more time, energy and money the farmer will save.

<table>
<thead>
<tr>
<th>How to apply the principles of multiple function and relative location:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Make a habit of considering all the functions of every element you deal with.</td>
</tr>
<tr>
<td>• Make lists of all the functions and products and all the needs of every element on your site, and see where you can draw connections.</td>
</tr>
<tr>
<td>• Where a connection exists, place 2 elements close together where they can benefit each other.</td>
</tr>
</tbody>
</table>
Check your understanding

1. Decide whether the statement below is true or false and if you think that the answer is false re-write the sentence so that it is true.

   ‘The relative location principle is not about making connections, it is about how a system can reduce its waste’.

__________________________________________________________________________________
____________________________________________________________________________

2. Careful design can result in a number of connections working together. List three benefits to the farmer when these connections work together.
   a. 
   b. 
   c. 

3. Lists down the needs, products, and functions of the following elements.

<table>
<thead>
<tr>
<th>Pumpkin</th>
<th>Pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs</td>
<td>Products</td>
</tr>
<tr>
<td>Needs</td>
<td>Products</td>
</tr>
</tbody>
</table>

4. In your own words explain why it is important for you to understand the different functions of the elements in your farm.

__________________________________________________________________________________
__________________________________________________________________________________
The answers
1. The statement is false. The relative location principle is about making connections and designing our system in such a way that the waste of one part becomes a resource for another.
2. Money, energy and time.
3. Pumpkin  Needs  Products  Functions
   Water  Fruit  Groundcover
   Sun  Leaves  Weed control
   Pigs  Water  Pork  Pig tractor
   Shelter  Manure
   Piglets
4. If you know the different functions of the elements and understand their connections then you can ensure that one element will support the other.

Preparing to teach
1. Think about some examples on your farm of the different elements and their connections.
2. Think of some questions that your participants might ask and write them below
_____________________________________________________________________________________
_____________________________________________________________________________________
Here are a couple of questions we are often asked:
1. ‘Why it is important to know the connections of all the elements in our system?’
2. ‘What should we do if one element needs another but they are far apart from each other?’

Now try writing answers to those questions.
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
Here are the answers we would give:
1. ‘If you know the different functions of the elements and understand their connections then you can ensure that one element will support the other’.
2. ‘Place the two elements close to each other so that they will support each other’.

Planning your lesson
Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources? How would you assess what the participants have learned in the lesson?

Lesson plan 8

**Goals**
You should write these goals on newsprint before the session starts. Show them to the participants.

By the end of this lesson you will be able to:

1. Identify all functions that you can find in your system
2. Specify the importance of the different elements and their connections in nature and how the farmer can benefit from them.

**Stimulus**
Ask participants to think about the needs, functions and products that animals and plants can provide and write them down on the newsprint.

**Objective Enquiry**
Using the text of the handout, explain the importance of the different elements on a farm, and the connections between them.

**Skills Practice**
Depending upon the numbers of participants, divide them into smaller groups. Give each group 4 elements and ask them to discuss each and write down their needs, functions and products. Then get them to draw lines showing the connections between the elements.

**Application**
Encourage the participants to set goals for themselves about how they will apply this principle in their farming practices.

**Evaluation**
What have you learnt from this lesson?

Have the goals been met?
Lesson 8 Slides
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.

- **Kofe** – Toto i tulimanu fanua, maua ai le kofe, ma meaai a meaola ma manulele

- **Fale** – uaea tautau lavalava, talivai mo vai inu, potu e teu ai soo se mea faitino ma isi.

- **Laau tetele ma togavao**
  E fai ma faamoega o manulele, meaai a pi/lagomeli, fualaa aina taumafa mata, laupapa ma faie.

- **Lio mo le totoina o Fa’i /Banana circle**
  E maua ai le vai efuefu lelei ma aoga, lafoai i ai otaota pala mo le faalelei eleele, meaai, maua ai le palapala lelei, tapue ai le suavai, ma isi

  O elemeni uma e tuuina atu i totonu o le tatou faatulagaga, e tatau ona i ai ni ona aoga poo ni galuega se tolu e mafai ona fatinoina, e faamanuiaina ai le taumafaiga.
E mafai ona tatou iloiloaina manaoga, matafaioi ma vaega e maua mai i soo se elemeni.

Faataitaiga: MOA

<table>
<thead>
<tr>
<th>Manaoga</th>
<th>Matafaioi</th>
<th>Oloa</th>
</tr>
</thead>
<tbody>
<tr>
<td>-meaai</td>
<td>-save’u</td>
<td>-fuamo</td>
</tr>
<tr>
<td>-vai</td>
<td>-fanafanau</td>
<td>- otaota</td>
</tr>
<tr>
<td>-sana paaga</td>
<td>- vivini</td>
<td>- fulumo</td>
</tr>
</tbody>
</table>

**MANATUA:**

O i tatou e i ai le pule ma le faitalia e faaogaina ai galuega, e taua atu i le faia lelei o se tatou faatulagaga mautu.

Mafaufau lelei i le taua o matafaioi poo vaega foi e mafai ona maua mai i elemeni uma, ae pe faapefea foi ona faaogaina e faamalie ai manaoga o isi elemeni.

**2. Fesootaiga o Nofoaga**

- E tatau ona faia ma faafesootai vaega eseese i le faatulagaga, e mafai ai ona faaogaina vaega e le aoga i le isi itu, e avea o se vaega taua ma aoga mo le isi itu.

Faataitaiga:

- Moa i totonu o le toga esi, aiina fua toulu o esi
- Tuufaatasi vaega nei e lua, e matuai tele faamanuiaga e maua uma e i lau. E faapei o vaega nei:
  - Faaitiitia galuega a le faifaitoaga
  - Faaitiitia le manaomia ona tape ma faatamaia iniseti faalafua
  - Maua ai faalelei eleele mo esi
  - Maua meaai mo moa
  - Tele ai foi le taimi, malosiaga ma tupe a le faifaitoaga e mafai ona sefe
Lesson 9: Energy Efficient Planning

Learning outcome
By the time you have completed this section of the manual you will be able to define the six zones to efficient energy planning. You will also be able to explain what sector planning is.

The material from the reference manual
Below you find the material from Lesson 9 as it is in the reference manual. We suggest that you read it now to refresh your memory.

Lesson 9: Energy Efficient Planning
The key to efficient energy planning is the zone and sector placement of plants, animals and structures. A zone refers to a region. Sector refers to a segment or part of something.

Zone Planning
Zone planning is the simple process of placing elements like plants, animals, and other special features according to how much we use them or how often we need to check them. Areas that need to be visited every day are placed nearby. Areas visited less often are placed further away. This is simple common sense, but is often not followed in conventional farming.

Zoning is decided by:

- Number of times you need to visit these elements for harvest
- Number of times these elements need you to visit it.
- If we visit something 500 times per year and it is situated only 10m further away, this is a 20m return trip, which works out to 10km of extra walking per year.
The usual zone placement of elements in a permaculture system is a set of concentric circles radiating out from a centre of activity:

ZONE 0 – The Home

Centre of activity (house, commercial nursery, business etc)

ZONE 1 – Kitchen Garden and Utilities (visited very often if not every day)

- vegetables, cooking & medicinal herbs for home consumption
- compost heap and/or worm farms
- Seedling Nursery/Shade House
- garage/tool-shed/workshop
- fuel storage: woodshed, gas or liquid fuel tank
- clothes line
- water tanks, ponds and/or pools
- outdoor cooking area
- the lemon or lime tree (likes plenty of nitrogen {men’s toilet})

ZONE 2 - Intensive Production Areas (Require regular observation; provide surplus for sale or barter)

- Forest Gardens: multi-layered fruit trees and palms, vines, berries, herbs
- Orchards, with animals for weed and pest control (animal houses on the edge of zone 1 & 2 allow easy access)
- Plant and animals requiring care and attention
  - Houses adjoined to zone 1 for convenient monitoring
  - Poultry into orchard
  - Pigs with access to outer zone.
- Structures: terraces, hedges, trellis, ponds
- Main crop vegetables
- Windbreaks

ZONE 3 - Extensive Production Areas

- Commercial farming activities
- Unpruned and un-mulched orchards, larger pastures or ranges for meat animals, main crop
- Animals: Cows, Pigs

Possible ZONE 4 - Managed Habitat

- Semi-managed, semi-wild
- Woodlot, Forestry, Hardy Foods, swales for irrigation

ZONE 5 - Natural Habitat

Natural forests, wetlands, mangroves, reef, ocean
The idealised map is a set of concentric circles which radiate out.

In reality and practice zones can blur into each other and the landform and access to the site will have an effect – when zone planning, we consider easy access. Determine where human activity is concentrated and place elements around these areas. For example:

- Place zone 1 elements next to regular pathways. Maybe the clothesline needs to be visited regularly; by placing things such as vegetables which need regular observation beside the path to the clothesline, this means they will be observed and can be collected for dinner without any extra trip or effort.
- By creating routes to and from things we visit every day, we can get more jobs done in one go. For example a round trip which goes past the compost, the chickens, the clothesline and the vegetable garden.
- Placing fruit trees along the children’s daily path to school, this will encourage them to eat more fruit, which will improve their health.
- Place bananas in a visible spot so they are more likely to be managed.
Sector planning
This design tool helps us recognise and deal with wild energies entering our site from outside the system. We can record these energies on a map, including the direction of force etc.

Some examples of energies which may enter and affect our site are:

- Damaging winds
- Cooling Breezes
- Salt winds or dust
- Sun angles
- Hot afternoon sun
- Nutrients/pollutants flowing from uphill
- Direction and behaviour of water flow
- Shade from neighbouring plantation
- Flood zone
- Soil types (sandy, clay, rocky outcrop etc.)
- Dogs or pigs entering from next door
- Water reflection
- Wildlife corridors
- Pleasant/unpleasant views
- Public passing by
- Tsunami risk
- Cyclone risk
- Flood zone

By recognising the sectors on our site we can design in such a way that manages these incoming energies. Our aim is to:

- Block or screen out harmful ones.
- Channel for specific uses.
- Keep areas open to allow cooling breezes.

Slope
This design tool looks at the site in profile, showing the slope of the land. Gravity naturally wants to take objects downhill (mulch, nutrients, water, soil, fruit etc.). By designing with slope in mind, we can take advantage of this natural phenomenon. When we do so, we “Work with Nature Not Against”
Some examples include:

Septic tank above orchard above chickens above vegetable garden above nutrient catchers at base of hill (below on right) Infiltrating water high in the landscape.

Sheds uphill of house can provide gravity water to house.

Animal access to carry manure up hill
Check your understanding

Check that you have understood this lesson by answering the following questions.

1. The items in these columns have got muddled up. Can you match them by drawing a line between them?

   **Zone 4**  The Home Centre of activity (house, commercial nursery, business)
   **Zone 0**  Kitchen Garden and Utilities (visited very often if not every day)
   **Zone 2**  Natural Habitat (natural forests, wetlands, mangroves, reef, and ocean)
   **Zone 5**  Extensive Production Areas (commercial farming activities)
   **Zone 1**  Managed Habitat (semi-managed, semi-wild)
   **Zone 3**  Production Areas (require regular observation, provide surplus for sale or barter)

2. In a sentence or two can you explain why sector planning important in permaculture?

3. Which of the following alternatives gives the best examples of energies that may affect our farms?
   a) Tsunami and cyclone risks
   b) Cooling breezes and damaging winds
   c) A & B
   d) None of the above

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The answers

1. Zone 4  The Home Centre of activity (house, commercial nursery, business).
   Zone 0  Kitchen Garden and Utilities (visited very often if not every day)
   Zone 2  Natural Habitat (natural forests, wetlands, mangroves, reef, and ocean)
   Zone 5  Extensive Production Areas (commercial farming activities)
   Zone 1  Managed Habitat (semi-managed, semi-wild)
   Zone 3  Intensive Production Areas (need regular observation; surplus for sale or barter)

2. Sector planning helps us recognize and deal with wild energies that may affect our farms, like tsunamis, earthquakes, pigs and dogs from neighbouring families and others

3. The best answer is c

Preparing to teach

Have a look at the land on which you live. Is there any evidence of zones?

Are there farms in your village that might have zones?

Think of a question that your participants might ask and write it below

____________________________________________________________________________________
____________________________________________________________________________________

Below is a question we are often asked.

‘Our land is flat so do we need to worry about this zone planning?’

How would you answer this question? Write your answer below.

____________________________________________________________________________________
____________________________________________________________________________________

Here is an answer we would give.

‘While you cannot take advantage of gravity on flat land you can still make sure that areas you need to visit every day are placed nearby and areas you visit less often are placed further away’.

Planning your lesson
Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

Lesson Plan 9

Goals
You should write these goals on newsprint before the session starts. Show them to the participants.

By the end of this lesson you will be able to:

1. Explain the key elements to efficient energy planning
2. Define the six zones in efficient energy planning

Stimulus

Ask the participants to go outside and walk around the land. Ask them to draw a simple map of the land as they walk along. Encourage them to draw whatever they can see along the way.

Objective Enquiry

Using the text of the handout, talk about the six zones and their relationship with each other.

Skills Practice

Participants are now asked to draw a map of their own land. Ask them to label each item on the map. Ask each participant to explain why certain items are placed on his/her land.

Application

Participants can share how they can make changes in their farms/lands according to the lesson.

Participants can set goals for themselves.

Evaluation

Participants can reflect on their new learning from the lesson.

Lesson 9 Slides

Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.
Fuafuaga lelei atoatoa mo Malosiaga /Faatulagaga o Sone

O le faiga aupito sili ona lelei atoatoa mo malosiaga, o le faatulagaina lea o sone ma vaega e tuu ai laau, meaola ma le faatulagaga manino

1 FAATULAGAINA O SONE

- Faatulaga elemeni eseese, e fua i lo latou aogā, ma lo tatou faaaogaina, ae pe faafia foi ona tatou faaaogaina ma vaaia lelei.

O nofoaga e manaomia ona tatou asiasi i ai i aso uma, e tatau ona faatulaga istalata mai i o tatou nofoaga.

O vaega e seasea ona tatou asia e faatulaga mamao ese atu.

2. FILIFILIGA O SONE

- Taimi e manaomia e asiasi ai i vaega pao elemeni ma le faafagia o fua o faatulaga ma faaogā.
- Taimi e manaomia ai e elemeni bu asiasi atu i ai.
- Afai e faa 500 ona tatou asia se vaega i se tausaga se osi, ae faappea e noa le 10 mita le mamao ese atu ma ia fape, e tusa lana o le 20 mita le savaliga o le atu ma le toe foi mai, o lana uga e 10 mita ma faapopoapa i bu savaliga i le ausea.

O le faatulagaga masani o sone mo elemeni o Faiga Faatoaga Tumau, o se seti o ni lo ua faatulaga lelei, ma atagia mai ai totonuga lemu o galuega faatinou.

3. FUAFUAGA FAATAATITIA

- Ilua ma tali atu i malosiaga faalenuatu e malai ona ofi mai i le tatou faatoaga, mai i isi vagea i fafo atu.

- O lo faatulaga mai i se auvi o ni vaegaesse, e vaevaeina lelei, ma la mafai ona iloa ma atagia mai ai le auga o galuega faatino.
4. **NOFOAGA FAAIFOIFO MA MAUALALO**

- Etua tele i le faalenatura le aina o vaega lelei i itu maualalo (faalelei eleele, minerales, vai, palapala, tua o lau ma lei), pe a faatauta sa faaleiaga.
- A tatuio fai a, o lona uiga o loo tataou "Galau faalenatura, se leo le faleagaina ma faatua sa faaalaleiagia".

**FAATAITAIGA**

FAATAITAIGA fainaaga o vaega maualalalo, ina ia mafai ona faateleina le tamaoga ma le fua lelei o faaleiaga, ola faalenatura

2. Tane e faaalu i ai le otaota o fale le taua, e mafai ona faatu i luga o vaega e i ai togalau okeiti, falemoa ma togalau aina, ma vaega e tapu e ai mineral lelei, i le faatausia'i uga o se vaega maupu'epu'epu.

- Faatulaga lelei vaega e maua ai le vai, i vaega maualuluga o le laufa'anu.

3. Fale e faatu ai tane vai i le vaega pito i luga atu o le fale mautu, na te aumaia le suavai lelei mo le fale.

Faaogaina o vaega maualalu, olo le otaota o faaleiaga sa faaleiaga sa faaleiaga, olo le faga faaualalalo, olo le faaualalalo o faaleiaga sa faaleiaga.
Lesson 10 The Edge Effect

Learning outcome
By the time you have completed this section of the manual you will be able to explain the importance of the edge effect on your land.

The material from the reference manual
Below you find the material from Lesson 10 as it is in the reference manual. We suggest that you read it now to refresh your memory.

*Edge Effect*
At the edge of the forest, where forest and grassland come together, both forest-dwelling creatures and plants and grass-dwelling creatures and plants can both exist. This is just a single example of the incredible value of edges and the diversity and abundance they can create.

Let’s look at an example. If there were 5 species of birds in the forest and 5 other species of birds in the grassland, all 10 of those species could exist on the edge of the two environments. The same goes for other animals, insects, microbes and plants.
An Edge is a place for events to locate.

- An edge is the outside limit of an object or area or surface.
- It is this edge which will come in contact with other forms.
- Where these forms meet there is an interaction of some sort and an event takes place.
- This ‘interaction’ can result in many possible outcomes and some of these we can take advantage of by deliberately designing them into our systems.

Edges can:

1. Provide rich habitat

   Human settlements are often situated near river mouths. A river mouth is often a very productive edge between the ocean, forest, mangroves, and river, with access to the resources of each system close by.

2. Create a microclimate (a small area with a unique temperature, light density, moisture level, soil condition, nutrient density, etc.)

   Light colours on the outside edges of houses reflect heat and light, dark colours absorb and heat up. The edge of a body of water and area of land is cool and moist, a unique microclimate on land. The edge of a forest is also a unique microclimate, hosting a wider diversity of species. The edge of a raised garden bed will receive the more light and water than the middle, therefore creating an abundant microclimate for plants, or, if you’re not careful, weeds.

3. Trap resources

   Fences, which mark the edge of an area, will build-up windblown material. For example rubbish often collects on a school fence. We can set up barriers which trap resources which are useful to us. Hedges of bamboo can be planted in flood zones. They will trap organic matter which flows down the river. This becomes excellent fertiliser and mulch for crops. An obstruction of reeds across a stream bed will trap resources which flow down when it rains. These can be collected for fertiliser and mulch. A row of clumping grass planted on contour across the slope can prevent erosion and form a terrace. By creating a habitat for wild birds, we encourage them onto our property which imports nutrients and makes land more fertile.

4. Create barriers

   Shelterbelts of edge trees provide a wind barrier which protects crops. Clumping grass such as lemongrass can be planted closely together and will form a weed barrier which creeping grasses cannot penetrate. A hedge can be planted as a visual barrier. Mulch plants placed at the base of a slope capture nutrients as they move through the soil profile. These nutrients can then be returned to the crops in the form of mulch.
5. Encourage / Discourage turbulence
   i. When water passes an object whilst travelling down a stream, this causes the water to spiral.
   ii. When turning around, the water on the inside edge of the spiral is travelling slower than the water on the outside edge.
   iii. As the water slows, material which it is carrying is deposited.
   iv. The larger the object, the more the water will slow, and the slower the water, the smaller the material which is deposited.

   We can take advantage of this by collecting the various sized deposits from different locations along a river after strong flows (For example on the bank beside a large rock, we can collect sand for potting mix, beside smaller rocks we can collect gravel for drainage trenches)

6. Get free fertiliser

   Nitrogen fixing plants will release nitrogen when chopped back for mulch. By maximising the edge between our productive species and the nitrogen fixers we increase the availability of free fertiliser for our crops.

7. Provide trade sites

   Roadside stalls allow us to easily sell excess produce to passing traffic – this is at the edge of our property, directly where our site and the outside world meet.

8. Provide productive access

   The edges of often-used paths are good places to grow plants that need to be attended to more often. Keyhole paths allow us to maximise our growing space by minimising the area of path.
Check your understanding
Check that you have understood this lesson by answering the following questions

1. In a few words can you explain why it is important to plant big trees at the edge of the land?

2. Is this statement true or false? If it is false re-write it in the space provided.

   ‘We can only find straight lines in Nature!’

3. Which of these plants can be planted at the edge of the land?
   a) Mango
   b) Banana
   c) Taro
   d) All of the above

**The answers**
1. To capture minerals
2. False – we cannot usually find straight lines in nature
3. a

Preparing to teach:

1. Have a look at the land on which you live. Think of examples of the edge effect that you could talk to participants about.
2. Think of some questions that your participants might ask and write them below
Here is a question we are often asked.

‘What if the land isn’t square but it’s like a circle that has no edges?’

Now try writing an answer to that question.

Here is an answer we would give.

‘The important thing you should know is how to capture the minerals from being swept away, this can only be done by planting big trees at the boundaries’.

**Planning your lesson**

Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

**Lesson Plan 10**

**Goal**

You should write this goal on newsprint before the session starts. Show it to the participants.

By the end of this lesson you will be able to:

1. Discuss the importance of the edges of land.

**Stimulus**

Each member should answer True (T) or False (F) questionnaires based on their understanding of the topic.

**Objective Enquiry**

Using the text of the handout, talk about the importance of the corners and sides of a land used for constant farming and also its importance in our natural lives. Talk about a good example that everyone will understand.
**Skills Practice**
Discuss and share each part of the topic given by outline. Share each members opinion then use it to create a song or a poem based on the given topic and the words must be connected to the importance of the topic.

**Application**
Ask each participant for their opinion on how they could use what they have learned from the lesson.

**Evaluation**
Participants can reflect on their new learning from the lesson.

**Lesson 10 slides**
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.
Fausaina o vaega e malu ai le tau /savili

• O vali e vali le tau i tulimanu, faavaa poot le pito i fafo o le fafe, e ese le malu ma e tulagaese toni tau.

• E tele le malamalama e maua i pito poo tulimanu o se togalaau, o lona uiga e teie tele le faia o se tulaga faapena mo laau, ia poo le vao foi.

Tapu'eina o vaega lelei

• Pa, e sio ai pito o se nofoaga, e maua ai faaputuga o mea e telea solo i le savili ma le malagi, faata'ita'iga, duaota e ahoaaii mai i pa o felesaga.

• Faaputuga o vao e maua i vaega vaivaia, e tapu'eina vaega e tafia mai pe a tiumu.

• Totoina ni vaega o ni laau poo ni vao (pupuvao) i vaega faaofuofu:
  *nofoaga le lona uiga e teie tele le faia o se tulaga faapena mo laau, ia poo le vao foi.
  *fau siaina o vaega lelei mo apitaga
  *nofoaga malu, e oliga ai manulele ma isi meaola,
  *maua mai ai minerale le lei mo le faaleleia o le palapala.
Lesson 11 Healthy Soils and the Impact of Chemical Use

Learning outcome
By the time you have completed this section of the manual you will be able to explain what makes healthy soils, and identify chemicals that can damage the natural environment.

The material from the reference manual
Below you find the material from Lesson 11 as it is in the reference manual. We suggest that you read it now to refresh your memory.

Healthy Soils and the Impact of Chemical Use
The soil is a complex living substance and is the most important element in the environment. Healthy soils contain nutrients to feed plants. It also contains humus, broken down organic matter such as compost, mulch, manure, plant roots and plant material. Humus provides food for soil bacteria, stores nutrients and water in the soil and improves soil structure. Soils must be alive with living organisms (millions of types of fungi, bacteria, nematodes, protozoa and other creatures such as worms, ants, termites, centipedes, and lice.) These organisms break down organic matter and make nutrients available to plants. Though we never see most of these organisms, they are very important to the health of soils, and plants.

Better quality soil will give better quality produce, better nutrient supply and better taste. More diverse nutrient supply in our food means we grow stronger, more resistant to sickness, have more energy, and need less food to fill us up. In this way soil health directly affects the health of our families.

Benefits of Healthy Living Soils

- Plants are more drought resistant because the soil can store much more water and plants can send their roots much deeper into the soil to receive water and nutrients.
- Plants are more disease and pest resistant because they are healthier. An unhealthy person will become sick more often and the same is true for plants.
- The plants produced will contain more vitamins and minerals, which if consumed will improve the health of the whole family.
- Healthy soils will hold and store much more water. This will reduce the need to water plants.
- You have millions of workers in the soil that manage nutrient availability, store those nutrients, and increase the amount of air in the soil. Worms are hard workers.
- The soil becomes easier to dig and work with because it has a loose texture. This is very important because it will save a lot of time and human energy.
- It can save a lot of money if land is managed organically. Soils need little money spent on them if good techniques are used, including reusing all plant and animal wastes.
To improve soil, think about how nature takes care of the soil, for example, in forests, and try these.

- **Use organic compost and mulch regularly.** This will provide a lot of nutrients, increase soil microbes and improve soil structure without any costs
- **Use mulch to protect the soil** from direct sunlight, conserve water and increase the amount of humus in the soil
- **Recycle organic materials,** such as left over plant and animal material, to return nutrients into the soil
- **Use legumes.** There are many different types of legumes that can be planted, from seasonal to perennial. Legume plants provide nitrogen for the soil, can be used for mulch, animal feed, food for people, serve as windbreaks, help to prevent erosion, and more
- **Encourage diversity of plants and animals** to introduce diverse life and nutrients to the system.

To protect soil quality, do not:

- **Compact the soil.** Soil compaction reduces root growth, water storage and water drainage, as well as damages soil structure by killing microbes. It also means that a lot of energy is needed to dig the hard soil
- **Leave the soil open, exposed to the sun.** This kills bacteria and destroys the moist structure of soil.
- **Use anything that will kill soil bacteria.** Soil bacteria are your friends and helpers for building healthy and balanced soil. Using pesticides and herbicides will kill them.
- **Burn rubbish or organic matter.** Burning organic matter destroys future food for bacteria meaning the soil will be uncovered (exposed to the sun and rain). When you burn, you damage the soil underneath the fire, making it dry and reducing its capacity to hold water. Nutrients in organic matter are wasted if you burn it. Burning also releases harmful gases into the atmosphere, which in the long run will affect the land and soils as well as human health and air quality.
Without soils there can be no plants. The effects of soil loss are not so obvious in Samoa, and we still have lots of fertility left. In countries where commercial agriculture and unsustainable development has been harming the land for a long time, they are actually losing soil at an alarming rate. If we are not actively building soil, we are steadily losing it – and the nutrients stored in it - through erosion and nutrient leaching. On top of that, the chemical fertilisers, pesticides and herbicides used in conventional agriculture poison the soil and kill the organisms that live in it. Tilling and invasive cultivation also destroy soil structures and kill organisms (microbes).

Without microbes, plants cannot absorb nutrients in the soil. In ‘dead’ soil, even if there are many nutrients present, they are not available to plants. Because of this, plants grow weaker than usual, so farmers apply chemical fertilisers to boost their growth, in a form that plants can absorb. The problem is that while the fertilised plants do grow bigger, they are absorbing only a very small selection of nutrients – only those in the fertiliser, instead of the vast, complex nutrients usually available in nature. Less nutrients (and less diversity of nutrients) absorbed by the plant means the plant is less healthy, and needs more chemicals in order to repel pests and disease (and this becomes a vicious and costly cycle). It also means that the harvested fruit or vegetable has less nutrients for humans (and is less tasty). Chemicals are dangerous, expensive, reduce nutrition in our food, and are damaging to our environment.

Permaculture teaches many ways to deal with weeds and pests, and grow big, healthy and very productive plants without the use of chemicals, and building soil health at the same time.
Check your understanding
Check that you have understood this lesson by answering the following questions.

1. Without referring back to the material can you list four of the benefits to you of plants grown in healthy living soils?
   i.
   ii.
   iii.
   iv.

2. Decide whether you think the statement below is true or false. If you think that the statement is false, re-write it so that it is true.
   ‘Burning rubbish or organic matter damages the soil and destroys all the food for bacteria’.

3. Choose the best answer
   Healthy soils contain______________
   A. Nutrients, humus and living organisms
   B. Fertilizer and chemicals
   C. Mulch
   D. all of the above

The answers
1.
   i. The plants are more drought resistant
   ii. The plants need less water
   iii. The plants contain more vitamins and minerals
   iv. The plants are more disease and pest resistant
2. true
3. a

Preparing to teach
Go out into your garden and have a look at the soil. What is its colour? Take a shovel and dig into the soil. What organisms are there? Do you think it is healthy? How can you improve it?

Have a look around your piece of land. Are there parts of your land where the soil has been damaged? What could you do to help the soil to recover?

Now think of some questions that your participants might ask and write them below.

__________________________________________________________________________________

Here is a question we are often asked.

‘How can you know whether you have a healthy and unhealthy soil?’
Now try writing an answer to that question.

__________________________________________________________________________________
_________________________________________________________________________

Here is an answer we would give.

‘If your plants are growing fast and if they are healthy, it is likely that your soil is healthy.’

**Planning your lesson**

Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

**Lesson Plan 11:**

**Goals**

You should write this goal on newsprint before the session starts. Show it to the participants.

By the end of this lesson you will be able to:

- Explain the importance of healthy soils.
- Explain the impact of chemicals on the environment.

**Stimulus**

Participants are asked to brainstorm on ways to improve soil quality. Participants are asked to list examples of chemicals and their impact on plants and the natural environment.

**Objective Enquiry**

Using the text of the handout, explain the importance of the topic. Talk about the different ways you can make healthy soil. Briefly explain the disadvantages of using chemicals.

**Skills practice**

Ask the participants to role play various scenarios that reflect their understanding about healthy soil.

**Application**

Participants can share how they can make changes in their farms/lands according to the lesson.

Participants can set goals for themselves.

**Evaluation**

Participants can reflect on their new learning from the lesson.
Have the goals been met?

**Lesson 11 slides**
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.
A faatuputupulaia le lelei o le palapala, faatino le:
- Faaaoagaaina o faapalaga ma faaputuga otaota faalenatura faafaipaa

Mo le puipuia o le lelei o le palapala e maua, aua le:
- Faamaloina le palapala
- Tuuina le palapala e velasia i le la
- Faaaoagaaina ni vaega e tape ina pe mamate ai meaola ninii (vailaa uona)
- Susunu ina o otaota ma meaola faalenatura

A leai se palapala, ua leai fo ni laau, o le palapala e leo se vaega e mafai ona tatou faatalale i ai.

Aafiaga o Vailaau Oona
- O vailaa faalelei elele, vailaa mo inseti faafuia o loo faaaogaina i faga faaotaga, e onsai ai le palapala ma tapeina meaola ninii o loo ola ai.
- Soona elina ma soona suaina i lunga o le palapala mo atinae tetele, e faaleagaina ai le faasologa le ola ilei o le palapala ma mamate ai meaola ninii.

O le faafitauli e tulai mai, e ui lava ina ola ma tapopoa laau o loo faaaogaina ai vailaa, e faafii se lava mineare ma meaai lelei o loo olaai ma faalelei i ai, na vaega lava o loo olaai mai vailaa faalelei elele, ae le o le ilei ma le faafaitusi mineare ma meaai lelei e maua mai le ola faalenatura o le elele.

O le faafituitia o minerale ma meaai lelei eeese e maua o le a:
- le atoatoa le ola maloloina o le laau,
- matuai manaomia le tele o vailaa faalelei elele, e tetee atu ai le fafai ma inseti faafuia (o le a avea loa o sa tamilosaga faagata ma taugata telē).
- avea fua ma faaeeleleega e maua mai i nei laau, o ni laau e matuai iaitii lava ni minerale ma meaai lelei e maua ai mo le tagata sofua (le lelei iona foro).
- O vailaa e leaga ma taugata, e faafititia ai minerale ia tatou meaai, ma faaleagaina ai lo tatou siosiomaga.

E faapepea ona faatino le faaaoagaaina o le talai a o le Palapala Maloloina Lelei ma le faaaoagaaina o Vailaa Oona:
- Faatino uma vaega sa tatou talatalanoa i ai.
- Ao manatua o nei mea uma, o le tatou eepuiga faa Faalaoaga Turnau, o le puipuia lea ma faipelelei le faalauga. O le tatou lelei ma mafai sa le Faafuia Falaa le Maloaloa a laueleele, o loa heiga o le palapala.
- Cakia tumaua, ia au a lava nei faaafaaxa mai ni meaai, sa tatou ina faaaoaga i ai vailaa oana.
- Tau atu i tagata uma sa ta taoa e, o loa i ai o tatou faaaogaina, le maloaloa me lau a loa, o le ola maloloina, pe a faaaoagaaina vailau, ma faaalafua to la loa, mea meaania, la faa fituaia oceata faaaoagaaina, sa au a se xamatauxa otaota.

FAAFETAI
Lesson 12 Small Scale Intensive Systems

Learning outcome
By the time you have completed this section of the manual you will be able to explain the small scale intensive system.

The material from the reference manual
Below you find the material from Lesson 12 as it is in the reference manual. We suggest that you read it now to refresh your memory.

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Small Scale Intensive Systems
The original permaculture idea was developed because of the detrimental effects our actions were having on the Earth’s environment. Humans are completely reliant upon the health of the environment, and its destruction will eventually result in our own destruction. Permaculture design was developed “To provide for our own needs in the smallest space possible, to allow the rest to go back to nature”, therefore providing for our own needs whilst maintaining the health of the whole. The most noble human action is to leave room for all living things on this Earth.

Intensive food gardens
One example of how we can create intensive small scale systems is intensive food gardens.

One of the most beneficial elements in a permaculture system is a ‘kitchen garden’, or intensive food garden close to your house. The main reason for a kitchen garden is to provide adequate nutrition for our families. Our bodies need a broad range of vitamins and minerals, which we can only get from the food we eat. All processed foods you buy from the shop have little or no real nutrients. Foods we grow on our farms are bursting with fresh, diverse vitamins and minerals from the earth. As a rule, eating a variety of different coloured fruits and vegetables is a good way of ensuring that we are receiving the vitamins and minerals that we need.

Efficient Design Strategies
By using efficient design strategies, we are able to get as much as possible out of a small area of land, which is dedicated to growing nutritional food.

The possibilities for designing intensive food gardens are almost endless, and each design will depend entirely on the particular area of land. That is why permaculture does not aim to teach only specific techniques of gardening, but has more of an emphasis on learning how to design your garden based on natural patterns. Understanding the preceding principles means we are able to thoughtfully consider the area and resources we have available, to use our energy wisely and efficiently create our own unique gardens. This is one of the main ways that permaculture differs from conventional farming. There are no rules.
Vailele Garden Design.
To explain some basic strategies of designing a food garden, we can use the on-site garden at Vailele as an example. It is helpful to see the process of development, from very close to the beginning. In truth the development of a garden like this is never-ending, it continues to evolve. We determined that this garden was required to provide:

- Bulk food for courses
- A clear demonstration of Permaculture principles

i.) Zoning – We could not design the whole site from scratch because the houses were already built, and certain structures and fenced areas already existed. We therefore had to work with what we already had. The chosen area was already cleared, so we used this instead of clearing another and leaving the cleared space empty. Therefore our Intensive Food Garden was built in Zone 2, near to a possible nursery area, pig housing and bamboo plot (used for mulch).

ii.) Sector Analysis - We began with a sector analysis, where we look at the forces impacting on our site. We took into account such specifics as the angle of the sun, the prevailing winds, the slope and quality of the land itself, the existing plant species, existing structures, any damaging winds or shaded areas, the possibility of wild animals entering the site and any other sectors specific to this site.

iii.) Preparing the Site – After looking at the existing plants species, mostly grass which we didn’t want in our garden, we found it was necessary to clear the area first. The best way to do this was by using biological resources, in this case, pigs! To keep them in, we had to fence the area. Another way of using biological resources is to use what’s called a “chicken tractor”. Both methods keep weeds out of the beds and fertilise the soil.

iv.) Our original idea for the overall design for the garden was to use keyhole beds which maximise edge space and are a pleasing, easy to organise shape. However, since we were going for fairly large-scale production, straight beds seemed easier to plant and harvest.

We chose to place a banana circle (see Appendix 4) at the lowest point of the garden to collect and store run-off, and to provide an organic waste disposal area and in-garden compost source. Root crop ‘pits’ were designed at the highest end of the garden to infiltrate nutrients, and productive trees such as papaya are planned for that top area to hold the soil together and provide light shade. There is an existing raised rocky area, which we intend to keep as an access point (in order to maximise the higher view of the garden) and use to grow drier crops and herbs.
v.) Non-dig-gardening – Digging or tilling the soil between crops damages the soil structure because it kills the good soil microbes. If our garden beds grow a large diversity of plants, and all unused nutrient from these plants plus extra mulch is added to the garden regularly, there is no need to ever rest the soil or clear the bed seasonally. Using compost and compost tea makes this method very productive.

The main benefit of non-dig gardening is that over the years, local microbes have a chance to establish themselves in the soil, and the garden grows healthier year by year, instead of starting from scratch all the time. Because of the deep mulch and raised beds, the soil is always protected from heavy rain, wind and sun. The beds are designed to be ‘double-reach’ in width, meaning all plants can be reached without ever stepping on the bed (which, over time, damages the health of the soil). And as an added advantage, this method involves much less work.

vi.) Permaculture gardens aim to maximise space. We design to have productive plants growing on every level, with no space for weeds to flourish. That’s why there are tomatoes and vines climbing up above the garden, groundcovers and beans spreading along the floor and a range of plants with different heights and shapes, scents and colours in the middle layers. Not only does this provide more production in a small space but it helps to eliminate pest problems and soil deficiencies as well.

<table>
<thead>
<tr>
<th>How to Apply the Principle of Small Scale Intensive Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Always start small. Start with what you can manage and expand your boundary slowly, so that you always have your whole site under control.</td>
</tr>
<tr>
<td>● Remember that it is of great benefit to leave as much space as possible uncultivated, to use the smallest area possible and let the rest go back to Nature.</td>
</tr>
<tr>
<td>● Think outside the box when designing. Don’t just think about flat area, imagine productive plants growing up on trellises or down and across under water, think of ‘niches’ is space and in time.</td>
</tr>
</tbody>
</table>
Check your understanding

Check that you have understood this lesson by answering the following questions

1. Why is it in our own long term interests to adopt the principles of permaculture?
__________________________________________________________________________________

2. Is the following statement true or false? If it is false can you re-write it so that it is true?

‘Using small scale intensive gardening means that you will have to rest the soil and clear the bed’.
__________________________________________________________________________________
__________________________________________________________________________________

3. Which of the following is not an explanation of how to apply the principle of small scale intensive systems

a) Start with what you can manage and expand your boundary slowly
b) Leave as much space as possible uncultivated, and use the smallest area possible
c) Use biological resources to clear the site if you can
d) Dig the soil frequently because this will protect the microorganisms

The answers

1. Permaculture acts to protect the environment. If the environment is destroyed then we too will eventually be destroyed.

2. The statement is false. If your garden bed grow a large range of plants, and you return the unused nutrient from these plants as well as mulch to the garden regularly, there should be no need to ever rest the soil or clear the bed

3. d

Preparing to teach

Think of some questions that your participants might ask and write them below
__________________________________________________________________________________
__________________________________________________________________________________

Here is a question we thought of.

‘What are some of the benefits from permaculture’?

Try writing the answer to that question
__________________________________________________________________________________

Here is the answer we would give:

‘It will save you money as well as energy and it make your family healthier’.
Planning your lesson
Please study the lesson plan that follows. Its purpose is to help you teach each lesson effectively. If there is anything in the lesson with which you are not comfortable note this in your learning journal.

Make sure that you can answer the questions about the lesson that follow.

1. What is the goal of the lesson?
2. How are you expected to provide the stimulus for the lesson?
3. What methods would you use to teach the objective enquiry phase of the lesson?
4. What are the required resources?
5. How would you assess what the participants have learned in the lesson?

Lesson Plan

Goal
Investigate and teach how to act in arranging in order and in a good way, each different part.

- Learn the outline in its right arrangement.
- The best example is the land that is in Vailele.

Stimulus
Talk in pairs, the questions will be given out for this exercise.

Objective Enquiry
Using the handouts explain small scale intensive systems.

Get participants to share their ideas..

Skills Practice
Divide into four groups, then draw up a picture in a good order and make sure you can find every elements from permaculture, that’s already being discussed in previous lesson. You must remember above all these arrangement are our natural lives.

- Show and describe each drawings.
- Questions and answers.

Application
Participants can share how they can make changes in their farms/lands according to the lesson

Participants can set goals for themselves

Evaluation
Participants can reflect on their new learning from the lesson.

Lesson 12 Slides
Here are the handouts that you will use to speak to, during the objective enquiry phase of the lesson.
Fatulagaga Lelei Atoatoa i se Vaega Laititi

1. FAATOAGA MEATAUMAFA LELEI MA ATOATO

- O se tasi o auala e mafai ai ona tatou faaiga ona vaega laititi mo se faatulagaga mautu, o lea o se Faatooaga Meataumafa lelei ma atoatooa. O meaai o loo tatou totoina i tatou faatulagaga, e mutuai tumu i minerale lelei, vaitamini mai le elelele.

- O lona uiga la, afai tatou te taumafaina le felanulanuai o fualaaauina aina taumafa mata ma fualaaauina aina faisiau, o se auala lelei lea, e maua ai e i tatou vaitamini ma minerale o loo tatou manaomia.

1. TAIALA MO FAATULAGAGA MA 'UMUKUKA

- O le faaogaina o taiala mo faatulagaga mautu, e mafai ona tatou mautu le tele o vaega lelei, mai se nofoaga laititi, o loo mafai ona fanaatuu mai i toto ai meaai paleni ma maloloina lelei.

- E le faatuaoia le naunautaiga e faatulaga se faatoaga o meataumafa, o nei faatulagaga uma e faafua lelei faatau i le tele o le laufanua.

- E le faatuaioia le naunautaiga e faatulaga se faatoaga o meataumafa, o nei faatulagaga uma e faafua lelei faatau i le tele o le laufanua.

- O le malamalama i le faasologa o aiaiga, o lona uiga ua mafai ona tatou manatunatu pe faafefe aonu faaoga le fanua ma vaega o loo maau ai.

- Faatulaga Togalaau mo meataumafa, e mafai ona tatou faaoga ona se nofoaga se tasi e fai ma faaaoga. Fanua uia na faaaoga le fanua, ua i ai foi le faasologa o vaega ma pa ua uma na faausia).

- E tatau la ona tatou galuluve faatasi ma vaega ua i ai.

- O lona uiga ua mafai ona tatou manatunatu pe faafefe aonu faaoga le fanua ma vaega o loo maau ai.

- Faatulaga Togalaau mo meataumafa.
ii.) Iloiloina o Sone/Vaega
- amata lava le faatulagaga, i le iloiloina o vaega,
- tatu vaavaai poo a vaega e mafai ona aafia ai le
  nofoaga.
- fuafua i le vaega e susulu malosi mai ai le la
  malosi mai ai le matagi, o vaega maupuepue ma le
  ituaiga fanua o looi iai, o laau o loo ola ai, o le
  faasologa o vaega ua taatia mai ai
- vaega sa afaina i matagi, vaega paologia,
- tulaga afaina o le sao atu o ni meaola feai i le
  nofoaga poo soo se vaega lava o le fanua.

E faapefea ona faatinoina le taiala o
Faatulagaga Lelei atoatoga
i se Vaega laititi.
- Amata mai i se vaega laititi. Amata i se vaega
  e mafai ona e pulea lelei, ma faifalemu lava le
  faalauteleina, ia mafai ai ona e vaavaaia lelei
  lau faatoaga.
- Manatua, e sili atu ona lelei ma manuia le aua
  nei soona faatoaina se vaega fanua tele, ia
  faaogaina se vaega laititi, ma faamatuu atu isi
  vaega e toe foa atu i le ola faalenatura.

Ni Isi Vaega / Mataupu Autu o Faiga
Faatoaga Tumau
- Vaavaai a pulea lelei otaoata
- Tapueina o le suavai
- Faapalaga Faalelei eleele
- Ti Gaosi mai Faapalaga faalelei eleele
- Faafatoagaina o Anufe/Ilo
- Fausiaina o le Li’o mo le totoina o Fa’i
- Faatuina se vaomatua mo meataumafa
- Teumaluina o Fatu laau

TAIALA MO FAIGA FAATOAGA TUMAU
1. AIAIGA O FAIGA FAATOAGA TUMAU
2. VAEGA FAAFEILOI
3. TAAMILOSAGA O MALOSIAGA MA MINERALE LELEI
4. TAAMILOSAGA O LE VAI MA LAUU
5. AUALA VAVE MO LE FAALELEIA O ATINAE
6. FAAAOGAINA O MEAOLA/VAEGA FAALENATURA
7. GALUEGA ESEESE MA LE FESOOTAIGA O NOFOAGA
8. FUUFAUGA MAE’AE’AE/FAATULAGAGA O SONE
9. AOGA TAUA O TULIMANUIPITO FANUA
10. PALAPALA MALOLOINA /AIAIGA O VAILAU
11. FAATULAGAGA LELEI /ATOATOA I SE VAEGA LAITITI
12. PULEAINA LELEI O LE SUAVAI MA LE OTAOTA

FAAFETAI