What is Land Design ?

Permaculture designer Govinda Sharma in his kitchen garden

Farming is part of the body of rural communities. Everybody wants to make these communities more sustainable. **Permaculture** is the direct application of the principles of nature in the design of sustainable human habitats. Design can make a farming system which relies on the observation of nature and the adaptation of nature's stability, fertility and resilience to create a sustainability which benefits not only people, but the whole earth. Permaculture is a way of designing which uses mainly local resources to help individuals and communities be self reliant and abundant. It is also a design system which helps us to run our lives and cultures in a sustainable way .

Permaculture combines the best of natural systems, traditional skill and wisdom, community values, and modern technology. In this chapter we give an introduction to Permaculture and its principles, and how it is used in design. This chapter also combines all the other chapters of the Farmers' Handbook to help make households more sustainable.

Benefits of using Permaculture design

- To repair degraded land and make it productive again
- to produce more benefits from less land
- to protect basic natural resources of soil, water, biodiversity, etc.
- to reduce the cost of farm production
- to create sustainable life systems
- to design a sustainable agriculture.

What is "Sustainable" ?

Nowadays the word "sustainable" is widely used, like "sustainable development", "sustainable economics", and so on. But we must only use this word when we understand it. What is a sustainable place like ? What do we gain from it ?

A "sustainable" system is permanent, stable, resilient and self sustaining, never breaking down and always meeting the needs of its populations of plants and animals.

Actually, in modern times people have never made a truly sustainable system, so where do we get our "sustainable" vision from ?

If we wish to be truly sustainable, where can we go to learn how, when we have never done it ourselves ? Modern developement has given us billions of dollars and thousands of politicians and scientists, but still we are not sustainable.

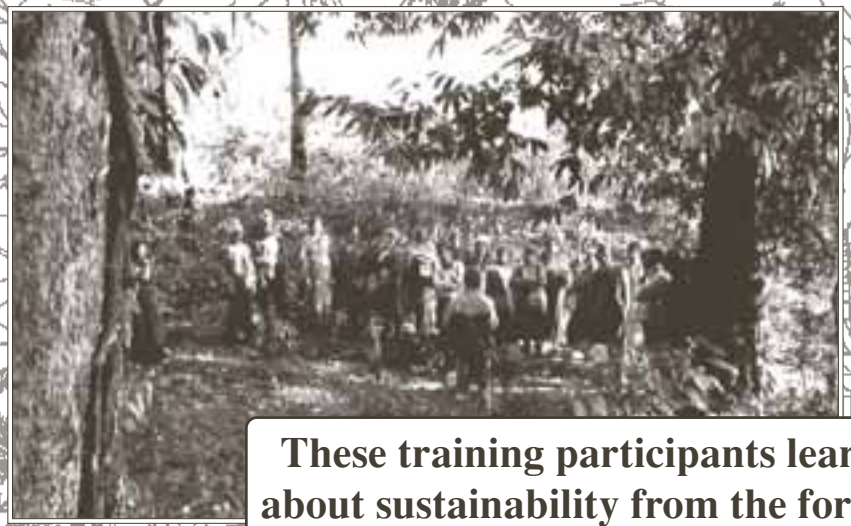
So where to go and what to do, to be sustainable ?

Where can we see sustainability ?

If we really want to create a sustainable lifestyle for ourselves, and for future generations, we must learn from places where systems *are* sustainable. These are the self-reliant, self sustaining, resilient, stable and productive natural systems of the world.

An example of a sustainable natural system can be seen in a natural forest. But traditionally the forest is a dark, forbidding place, where crops can't be grown and tigers hide to take our livestock. That's why we are more accustomed to clearing forest in order to grow crops. But at the same time, most people understand that without the forest there is no life, because so much of what we need in life comes from the forest.

But have we ever thought how the forest is a teacher of sustainability ?



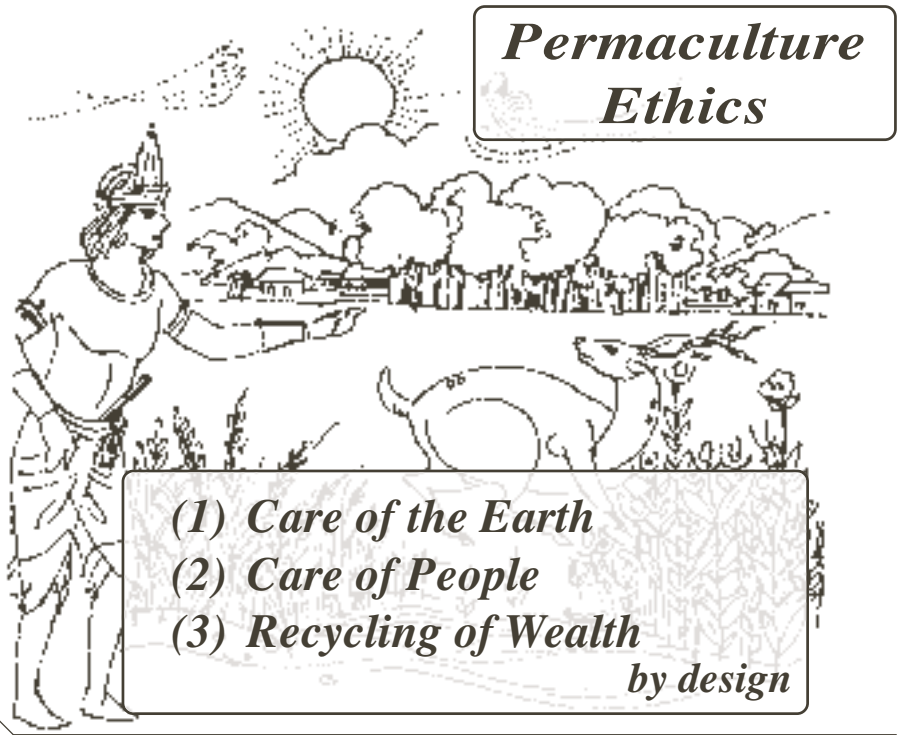
These training participants learn about sustainability from the forest

Go to the forest and see !

- **The Forest** needs no work but is always productive.
- **The Forest** never degrades itself, and is always growing.
- **The Forest** does not need fertilizing or irrigating, but it is always fertile and moist.
- **The Forest** is warm when it's cold, and cool when it's hot.
- **The Forest** is permanent, resilient, and self reliable.

And the forest is sustainable !

So how would it be if we could make our homes, communities and economies as sustainable as the forests ? To make our homesteads as sustainable as nature, we need to understand the importance of natural systems, and use that understanding in our lives. Permaculture is a way of designing the land using this knowledge.



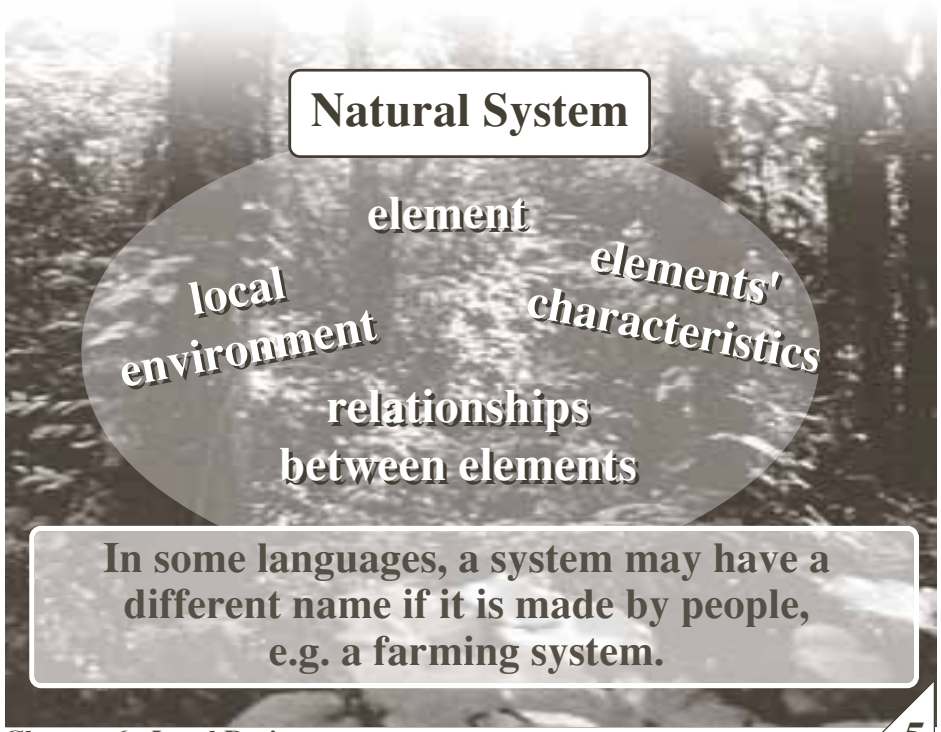
Natural Systems and Permaculture Design

How is a Natural System Sustainable ?

What is a Natural System ?

A Natural system is made up of living and non-living elements.

In a natural system there are various elements, such as trees, shrubs, insects, ponds, rocks, birds, etc. These elements have their own different characteristics, habits and qualities. Some trees are short, some tall. Some are thick, some thin. Some need full sunlight, some grow in the shade. All the elements, with their own habits, live in a functional relationship to the other elements around them in any place. That is called a natural system.



Principles of Natural Systems

Natural Systems follow a group of principles which enable them to be sustainable. By using the same principles in the design of farming systems, the objective is to work towards a sustainable agriculture. Permaculture is used as a design system to enable this.

Principles of Natural Systems and Permaculture Design

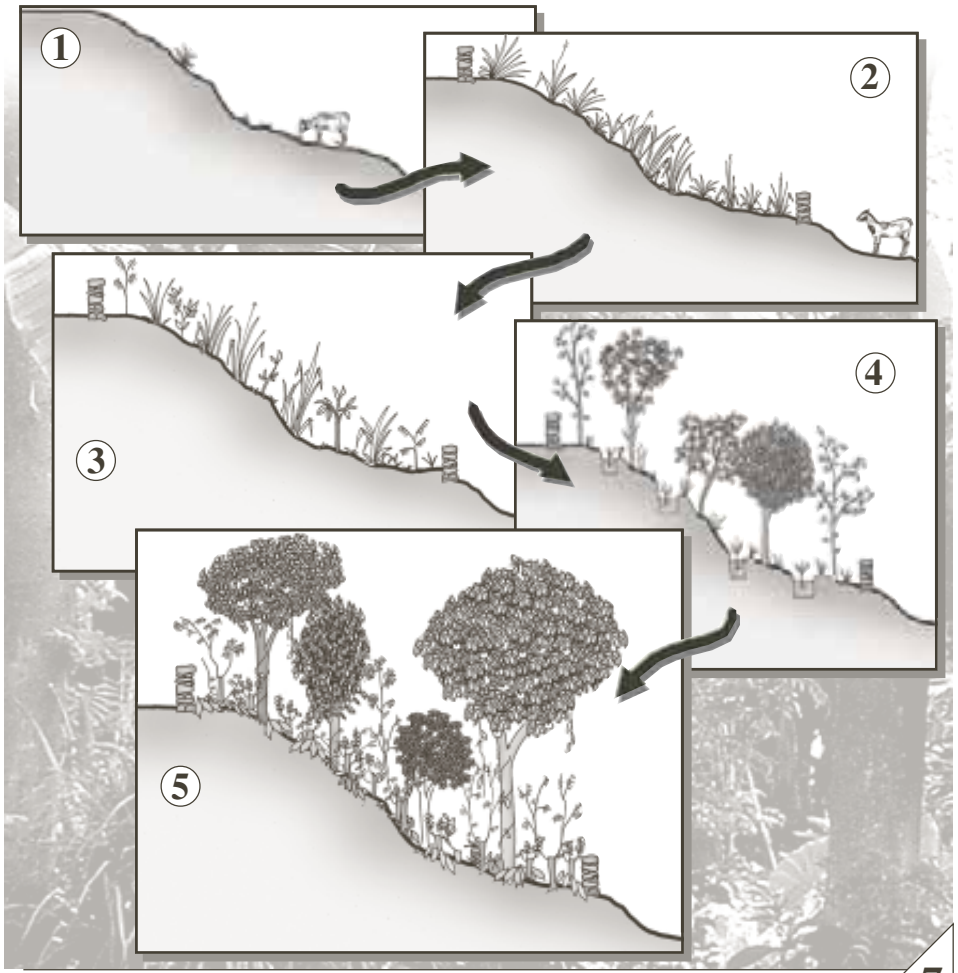
There is information about the history and founders of Permaculture at the end of this fifth volume.

- ❁ Succession
- ✳ Beneficial, functional relationships between elements
- ✻ Diversity
- ❁ Cycles and Re-cycling
- ✳ Use of local resources
- ✻ Each element performs multiple functions
- ❁ Each function is supported by multiple elements
- ✳ Stacking for efficient use of space
- ✻ Use of biological (living) resources
- ❁ Use of microclimate
- ✳ Energy efficient planning

Permaculture design uses these principles to make agriculture more productive and sustainable. That's why the principles are the same for permaculture as for natural systems.

❁ Succession

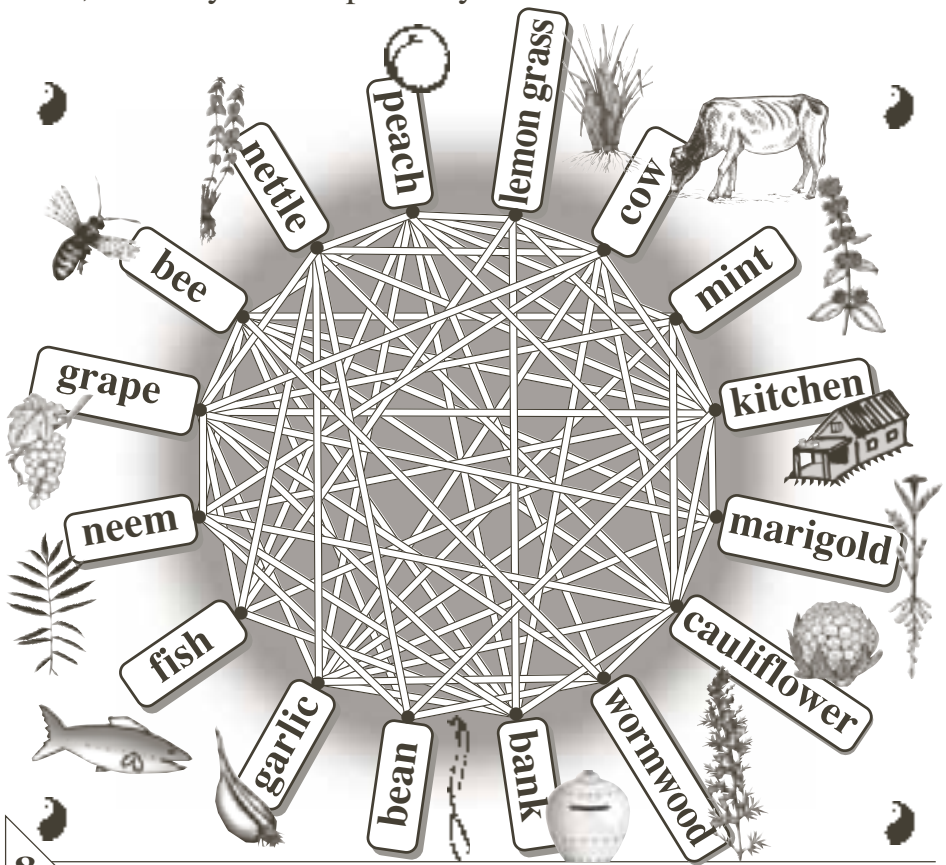
Bare, degraded land will improve itself naturally. This process of regeneration is called **succession**. For example, when any bare land is protected, special ground cover plants called ***pioneers*** will grow first. They will start the soil improvement process. Then, larger shrubs and trees will grow. Eventually, a mature forest will develop, and the soil will have a new life. This principle is used to regenerate unproductive land into productive systems quickly, successfully, and at low cost. We can also use species that follow this principle, but are more useful for human needs.



❋ Beneficial, functional relationships

In nature, living and non-living elements are connected to each other. This is a relationship of cooperation, not competition. For example, birds eat seed and disperse it elsewhere in their manure. Also, bees take nectar from flowers, so helping pollination.

In farming systems also, different elements can be related to each other. Anything that any one element needs can be provided by another element, and the outputs of that are used by something else. In the diagram below are examples of sixteen elements in a homestead. There are various connections linking the needs of one element to the outputs of another, in a way that helps the system to be sustainable.



For example, the bee takes nectar from the peach flower, and the peach can produce better fruit from the pollination. Wormwood and nettle can help the bean, garlic, cauliflower in the kitchen garden by being used for mulch. Newly sprouting shoots of the peach can be rubbed on the cow to prevent skin parasites, while the cow provides manure to many elements in the system. Garlic, wormwood, nettle, marigold, etc. are all useful in the vegetable garden and orchard for companion planting, liquid manure and pest control.

Design looks to put the right elements together in the right place, so that needs and outputs are met within the system. This reduces work and waste, and the need for external inputs, while increasing production. The right elements in the right place will create their own beneficial connections.

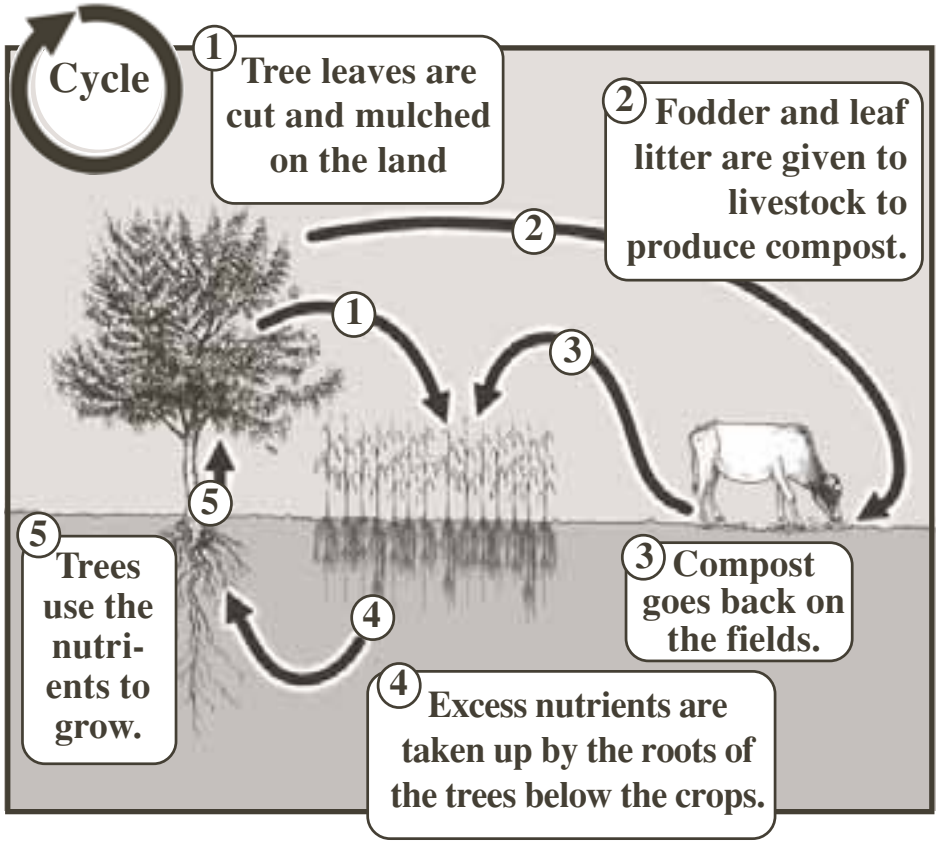
❋ Diversity

Nature is diverse, with many types of plants, animals and habitats. For example, though Nepal is a small country it has a huge diversity of climates and wildlife. The more diversity there is, the more beneficial relationships there are between the various elements in the system. This helps the system to be sustainable.

An example of using diversity in farming is with mixed vegetable gardening, the integrated orchard, and agroforestry.

❁ Cycles and Re-cycling

In nature, living things die and rot down. The nutrients they are made of are released back into the system for use by the plants. This cycle always runs, so elements which the forest needs, such as water and soil nutrients, are always made available, and never run out. In farming systems, the cycle of nutrients in agroforestry is shown below.



Another example can be seen in the kitchen garden. Waste water from washing can be used for irrigating the vegetables, and sweepings from the house and yard can be recycled as compost for the kitchen garden. Without cycles like this, it is very difficult to be sustainable.

❋ Use of local resources

The forest doesn't need to travel anywhere to find its basic resources. There are no transport costs to bring in its needs. The more a farming system relies on external inputs, the more are its costs of production, and the less sustainable the system is. This is a very important principle in achieving sustainability.

✻ Each element performs multiple functions

In nature, each element perfoms several functions. A single tree will provide leaf litter, habitats for birds and insects to live in, a support for climbing plants, protects the soil, and so on. Trees planted on the farm can also provide many benefits according to their characteristics, such as fodder, mulch, medicine, etc. Extra benefits come by planting them in the right place and in relation to other elements, such as giving shade. In design, each element should produce at least 3 different benefits or functions within the system.

Trees can meet all our needs

❁ Each function is supported by multiple elements

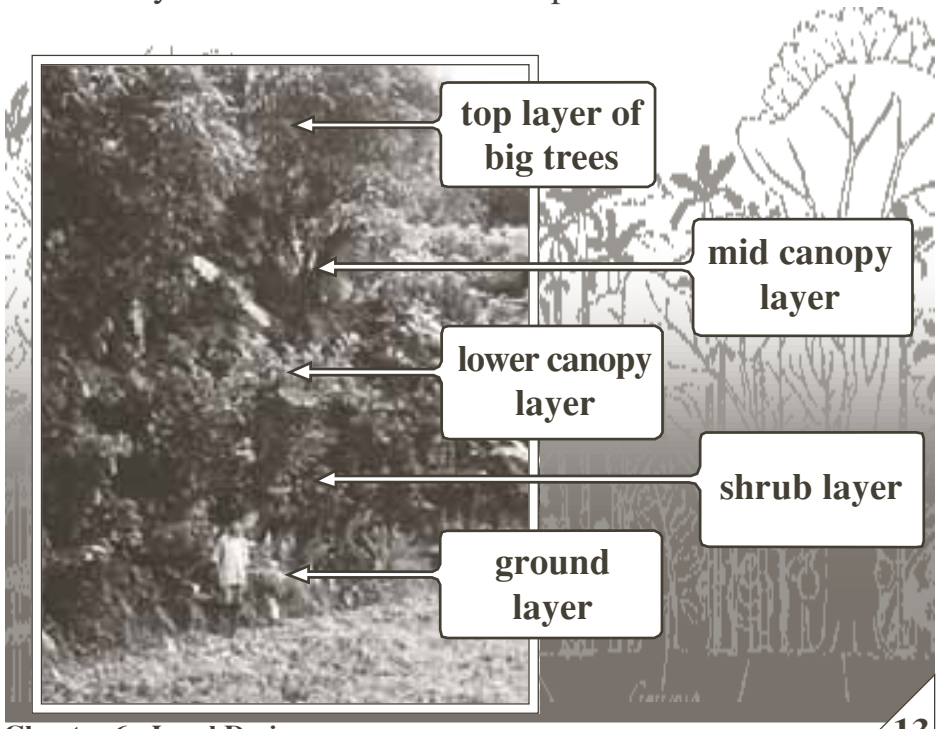
In nature, many elements combine to support any one function. For example, the function of maintaining soil fertility in the forest is provided by the leaves of trees, by soil bacteria, earthworms, bird droppings, dead animals, fungus, the wind blowing dust, etc. This principle is also related to diversity.

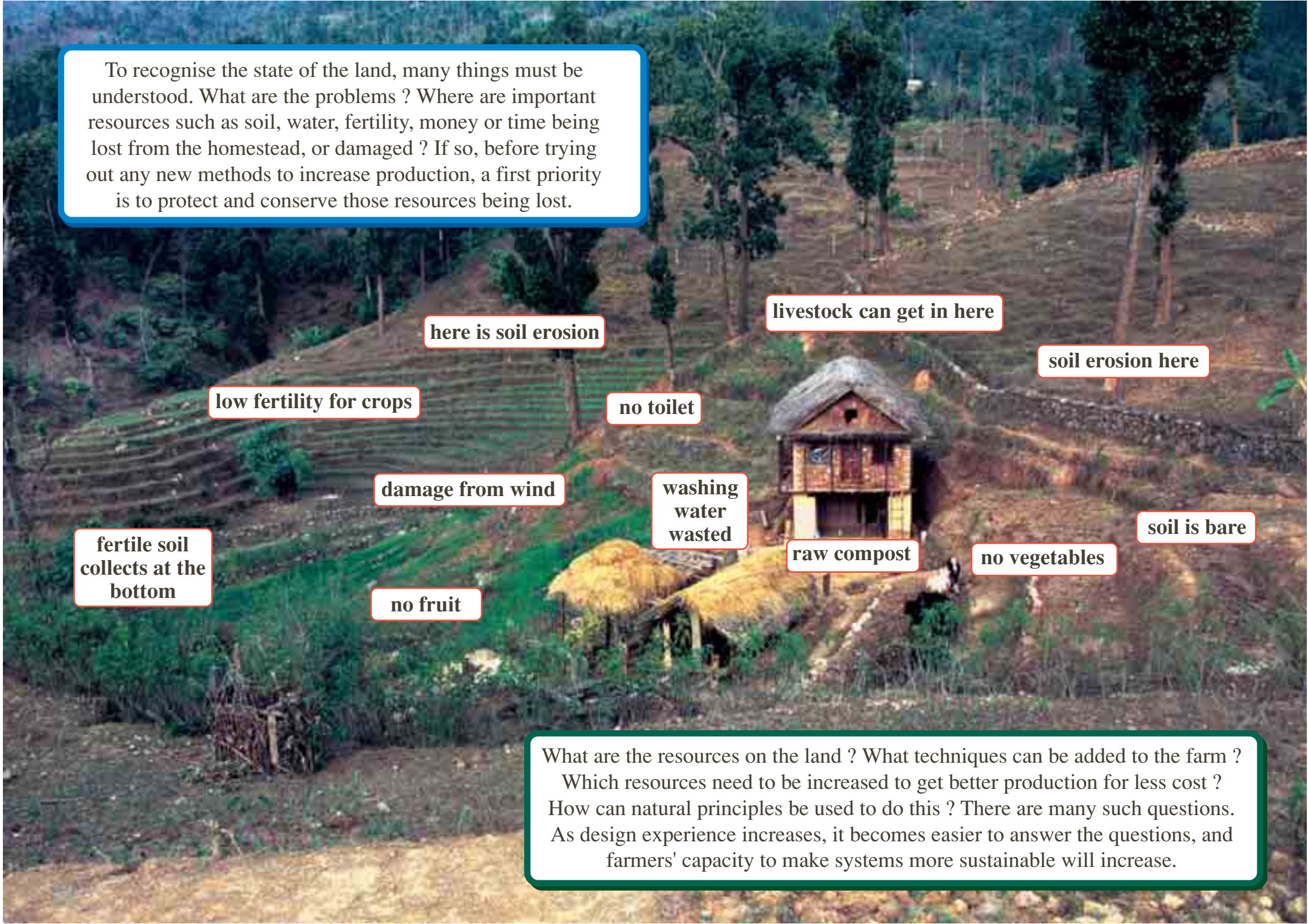
In farming, this principle can be seen in the **living fence**, or hedge. The single function is for protection, and this is made up of many species of trees and shrubs (elements). So if one species of the fence is unsuccessful for any reason, other species will continue the function, so the protection is not lost. In mixed vegetable gardening, there are many varieties of vegetable growing together which all provide food. If insects attack one type, there will always be others to provide food, so production is not lost. This principle is used to reduce risk in the system.

❋ Stacking for efficient use of space

In nature one reason why there is such great production with such small input is that space is used very efficiently, and there are many elements in a small space. By stacking one species on top of another, more species can grow. In one forest, up to 7 layers can be seen :- a ground or weed layer, shrub layer, lower, mid and upper canopy layers, a climbing plant layer, and a root layer. Different species are stacked into this system, giving production from 10-20 metres below the ground to 30-40 metres above the ground. No space is wasted.

Planting layers of trees and shrubs in farming systems is very productive. In the living fence, agroforestry and the integrated orchard, species are planted according to their size and shape, and whether they need shade or sun, to make many levels and produce many more benefits than a field of grain, which only uses a metre of vertical space.




To recognise the state of the land, many things must be understood. What are the problems ? Where are important resources such as soil, water, fertility, money or time being lost from the homestead, or damaged ? If so, before trying out any new methods to increase production, a first priority is to protect and conserve those resources being lost.
here is soil erosion
livestock can get in here
soil erosion here
low fertility for crops
no toilet
damage from wind
washing water wasted
soil is bare
fertile soil collects at the bottom
raw compost
no vegetables
no fruit
What are the resources on the land ? What techniques can be added to the farm ? Which resources need to be increased to get better production for less cost ? How can natural principles be used to do this ? There are many such questions. As design experience increases, it becomes easier to answer the questions, and farmers' capacity to make systems more sustainable will increase.

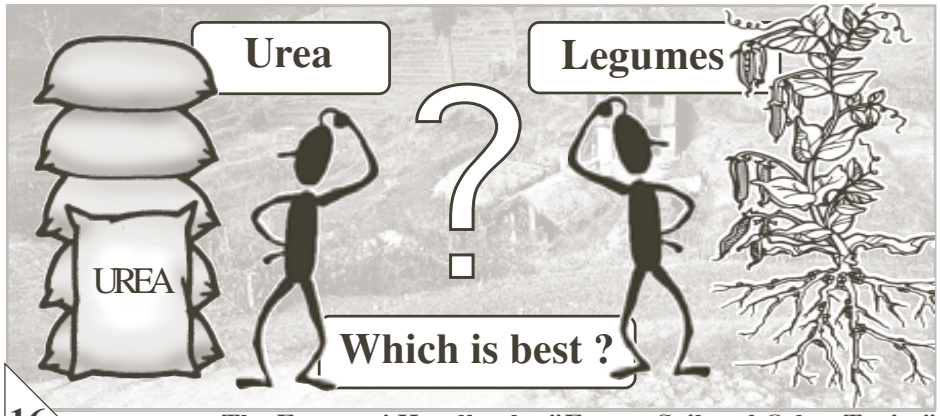
Examples of fruit and multi-purpose species for lowland and highland, suitable for different stacked layers

Big trees :- mango, jackfruit, avocado, walnut, neem, chestnut, soapnut, oak, etc. **Mid-canopy trees :-** apple, pear, peach, plum, apricot, persimmon, etc. **Low-canopy trees :-** orange, lime, banana, custard apple, guava, coffee, sea buckthorn, papaya, *Gliricidia*, mulberry, hazel, *Lucaena*, elder, etc. **Bush layer :-** cardamon, pineapple, napier grass, lemon grass, tumeric, broom grass, *Crotalaria, Sesbania*, etc. **Ground layer :-** sweet potato, taro, bean, groundnut, clover, comfrey, wormwood, chamomile, etc.

✻ Use of biological (living) resources

In nature, it is the living, organic resources which are responsible for running the system. Important functions such as making the soil fertile, distributing seed, conserving moisture, etc. are all served by living things. Trees, birds, worms and bacteria all work for the development of the system.

For fertility and crop protection in sustainable agriculture, benefits from green manures, liquid manure, legumes, predator insects and companion planting are greater than chemical fertilisers and pesticides.

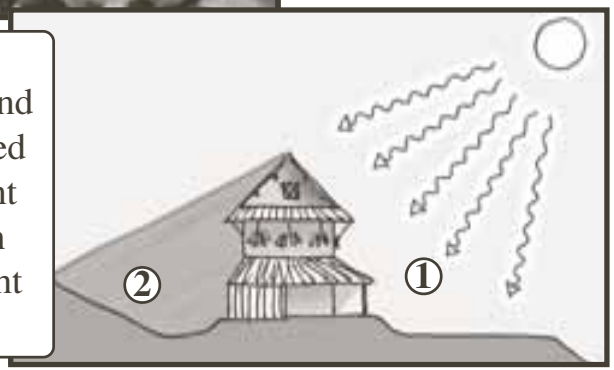


❁ Use of microclimate

The climate inside and around the forest is different to the surrounding climate. There are areas of different moisture, temperature, and light levels. These small areas of diverse temperature, light and moisture are called **microclimates.** In farming, use can be made of microclimates by growing the type of plant that grows best in that particular place. Microclimates can also be created, for example by planting windbreaks or making ponds. Species are then selected according to their site needs. This also brings **diversity** onto the farm.

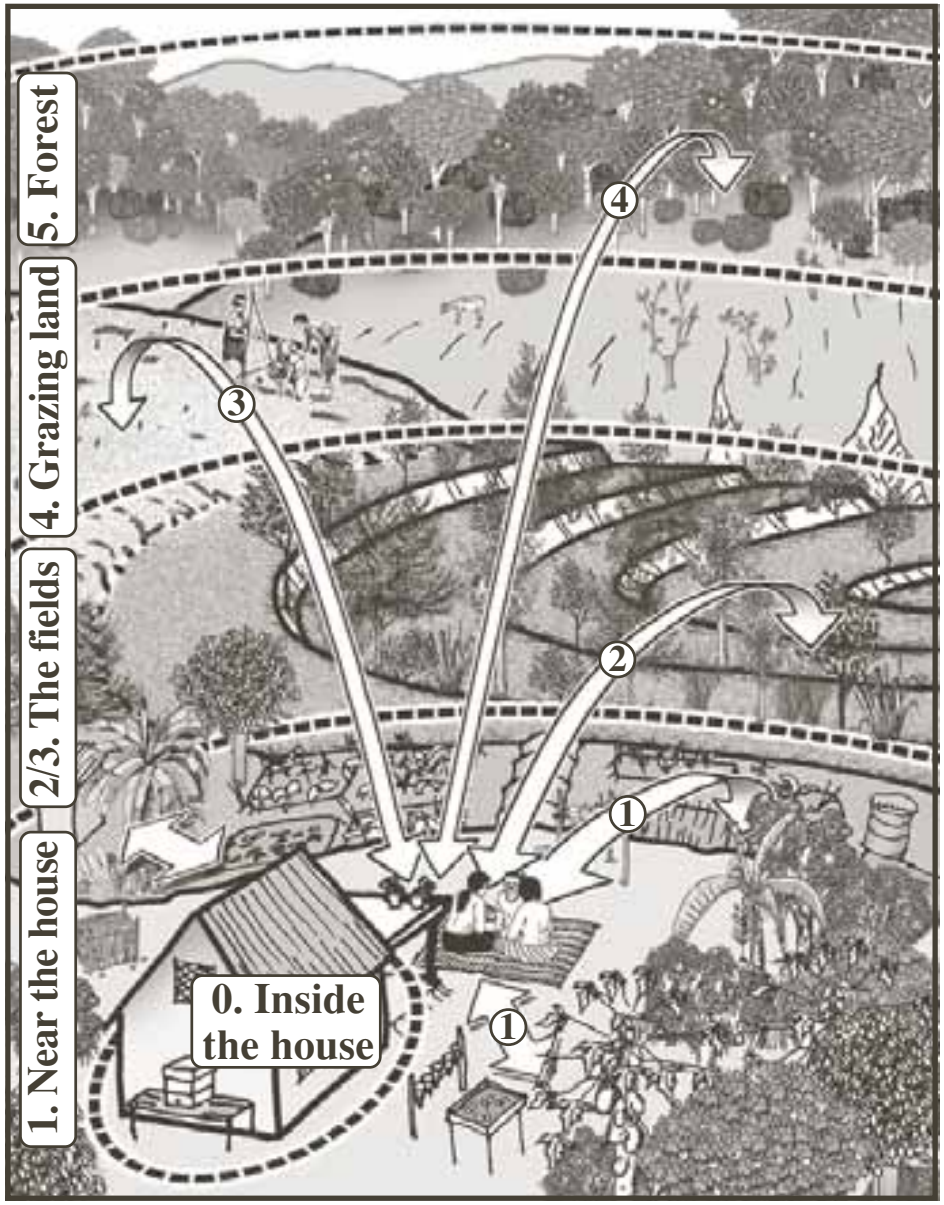
Inside a mixed vegetable bed. Because plants are densely planted the temperature at the ground ① is cooler than at the top ②. This is an example of a microclimate.

The sun side of the house ① is hotter and dryer than the shaded side ②. So, different plants can be grown having different light and water needs.



There's nothing new about using microclimates. The terraces in front of houses are traditionally kept on the sunny side. That makes them ideal for drying seed and vegetables, making pickles, etc. The sun gives free energy in this place. The shade side is good for shade-loving crops, or a nursery can be made.

❋ Energy-efficient planning



In this diagram, the relationship of the house to other parts of a well designed farm is shown by the different thickness of the arrows. A thick arrow shows a frequent connection, and thinner arrow shows where less visits are needed.

Areas of the farm are divided by zone. Inside the house is zone 0 and close to the house is zone 1. Zone 1 has techniques and systems that need more maintenance, such as the kitchen garden, which is visited 2-3 times a day for maintenance and harvesting. Various nurseries also belong in zone 1, because they need extra care, such as daily watering. By placing them near the house, less time and energy are used for harvesting or maintaining these systems. Below are more examples :-

zone	number of visits	suitable technologies and systems
1 - near the house	① many	kitchen garden, nurseries, waste water, sweepings pit, toilet, bees, etc.
2 & 3 - the fields	② fewer	agroforestry (fodder, firewood, timber production, fruit trees, mixed with field crops, orchard, green manures, etc.
4 - grazing area	③ less still	soil erosion control, soil improvement, plantation, integrated orchard, etc.
5- forest	④ very rarely	forest management, wild and cultivated herbs, education, etc.

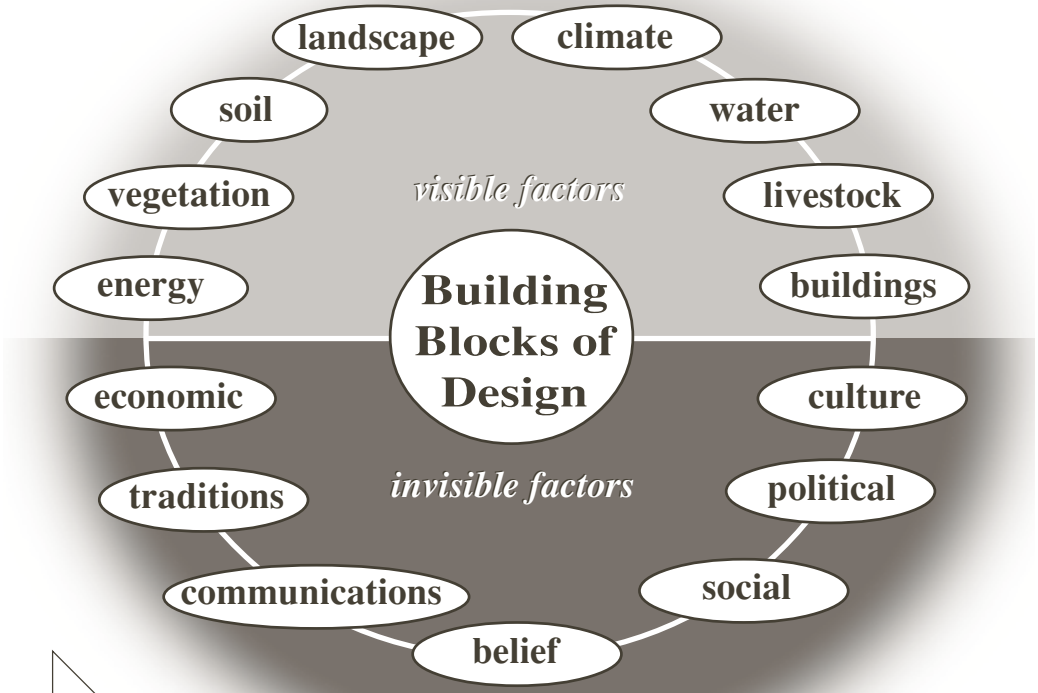
Having the right Attitude

The principles descibed above are necessary to design a sustainable system, but most important is the attitude of the designer and user. As long as people don't have a deep desire to achieve the goals of sustainability within ethical guidelines, then no type of design can help to reach these goals. Some people feel that they can't make a difference by themselves, or are scared of making a change, or of losing resources.

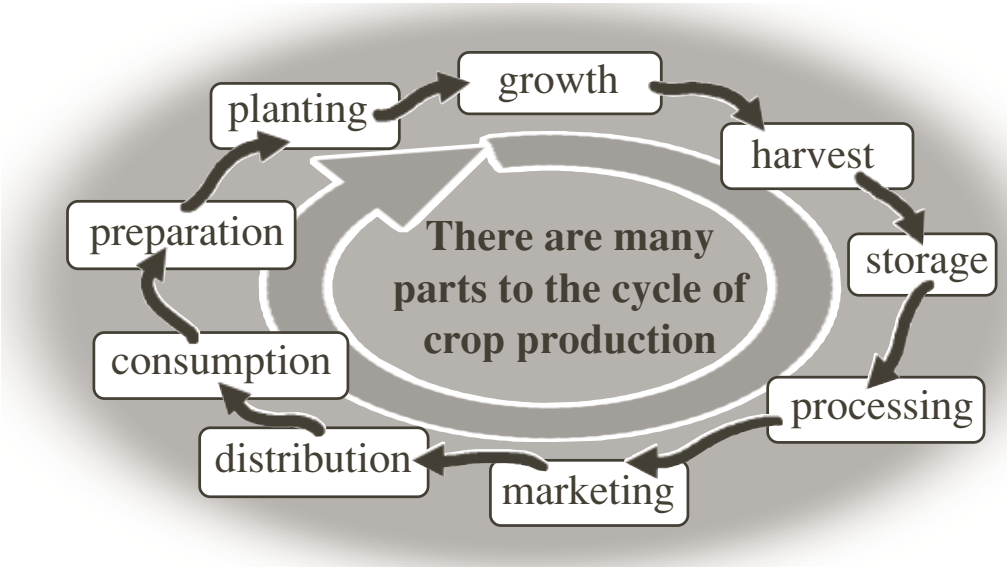
But good design can solve many problems. With the right attitude, problems can become solutions, and a progressive design will develop. We can also design to learn. People need to work together to find the right techniques and resources to solve their own problems and meet their own needs, as well as those of nature.

Building Blocks of Design

When designing land to be more productive and sustainable, it is very important to understand the factors which can both limit, or aid, the progress of the design. Then the design can be adapted and changed in the early stages, so that no mistakes will prevent the objectives of sustainability being reached. Factors which can affect the design are divided into 2 groups - those which are visible, and those which are invisible. This is shown below :-



The effects of some of these factors are illustrated below in the farming system's cycle of rice production.



Many of the visible and invisible factors shown on the previous page will affect the crop production, and so they will determine the strategy which needs to be used in design. In the monsoon, there is more heat and water, and so sickness is more common. Yet this is the time when most human labour is required, and also when there are more pest problems. If communal oxen are not available, ploughing, planting and weeding work is delayed. When all these issues are sorted out, there may be a good crop, but then rats can destroy the crop in storage, or the price in the bazaar may be low, and all the work can again be wasted.

So when making a design, all these factors must be considered. Which factors, at what stage, and where they may cause problems for production should be considered at the very start of the design process. Whether the solution to that problem can be solved with local resources or not, should also be considered early on.

The Design Process

The process of creating the design, and then implementing it, is a step by step approach which enables the design to reach its goals more easily. Following the design process helps with many decisions :- what to do first, which areas are most important, how to use the available technologies and any other resources, how the design grows in a natural way, and so on. A summary of the main steps in the design process is given below :-

1. Gathering information about the people and the land involved in the design.

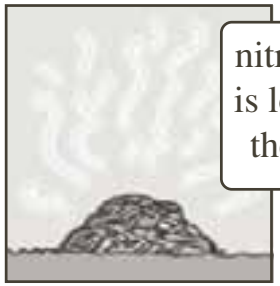
• Collect information about the people's vision and goals, their resources, needs, constraints, capacity, costs, problems, skills, income, etc.

• In the same way, collect information about the site - the soil, water, climate, aspect, slope, vegetation, microclimate, livestock, pests and diseases, erosion, exposure to wind, and any other relevant information about problems and resources.

When creating and implementing a design, it is a priority to repair damaged systems, and stop loss of resources from the existing system - this will give immediate results. Below are examples of how we can lose resources from farming :-

Farm losses

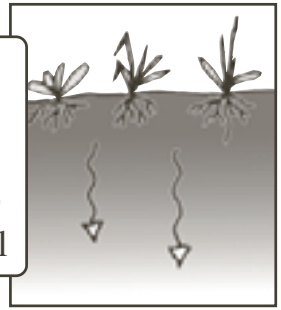
• compost dries out in the sun



nitrogen is lost to the air

• nutrients in the soil are lost if not used (leaching)

all types of nutrients are lost deep in the soil



• nutrients leak from compost

all types of nutrients can be lost

• much time is wasted gathering from the far away forest

• waste water is not used at home

• soil is washed away by rain

• fire destroys nutrients in the soil

• wind dries out moisture in the soil

• nutrients in sweepings are lost

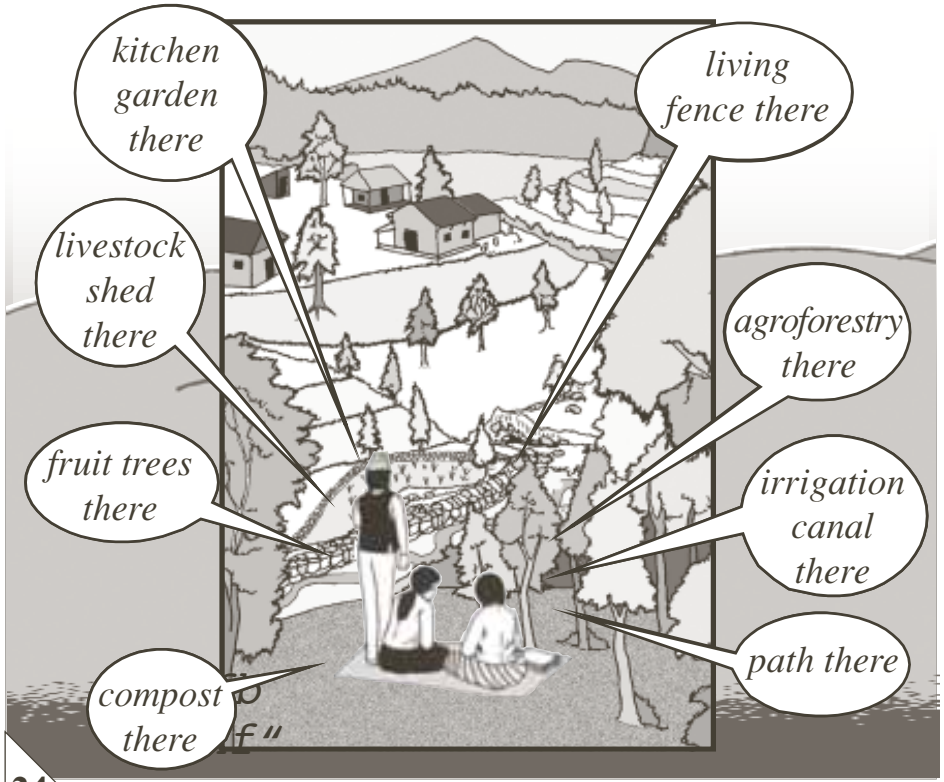
So we should discover leaks to the system early in the design process. Then, it can be decided what techniques are needed, when and where, to find the solutions and prevent valuable resources being lost.

2. Deciding which functions are needed

According to what we have found out about the people and the site, what are the needs of the design ? For example, increasing fodder and firewood production, growing more nutritious food, protecting from livestock, preventing soil erosion, protecting from wind, increasing fertility, earning more cash, etc. are all examples of the types of functions needed.

3. Selecting techniques

To carry out the functions identified in 2, what methods are needed ? For example, agroforestry, living fence, bee-keeping, fruit production, kitchen garden, compost making, mulching, home nursery, improvement in livestock management, seed production, green manures, etc. are all methods of providing for the identified needs of the farmer and the site.



4. Placement

Where should the systems be placed for them to give maximum benefit ? They should be placed in beneficial relationship to each other, so that the needs of one are met by the outputs of another, instead of competing. The principles of nature can be used to help with this. For example, the nursery should be placed where there is shelter, water is near, and it is easy to care for the site. In the same way, the best places are selected for the compost, fruit orchard, fodder trees, etc.

5. Species' selection

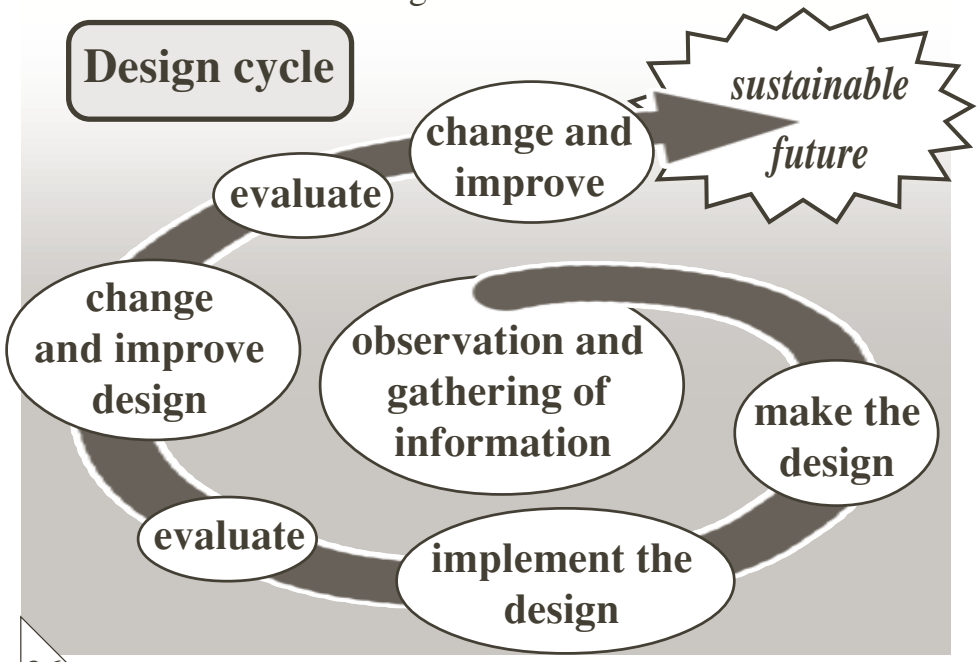
Finally, the best species to fulfil the needs of the site and the functions required are selected and placed, understanding their characteristics, yields and needs. For example, when selecting trees for the orchard, ask the following questions :-

6. Timetable

This work of implementing the design can't all be done at the same time. So it's good to arrange the work according to **priority**. Some systems can wait until later to establish. This will make the design much easier to implement. The most important systems to design and implement first are usually for site protection, access, water and soil improvement, as they all allow other parts of the design to develop.

Evaluation

As the design is being created and implemented, time should be spent evaluating progress against the aims and needs of the people and site. The design can be changed and adapted as necessary. Are the principles being applied ? What has changed ? What problems have been solved ? Will more problems be created ? Will the design help the people to reach their goals ? Questions like this should constantly be evaluated, and all stakeholders in the design should be consulted.



There are 2 types of place to implement a design :-

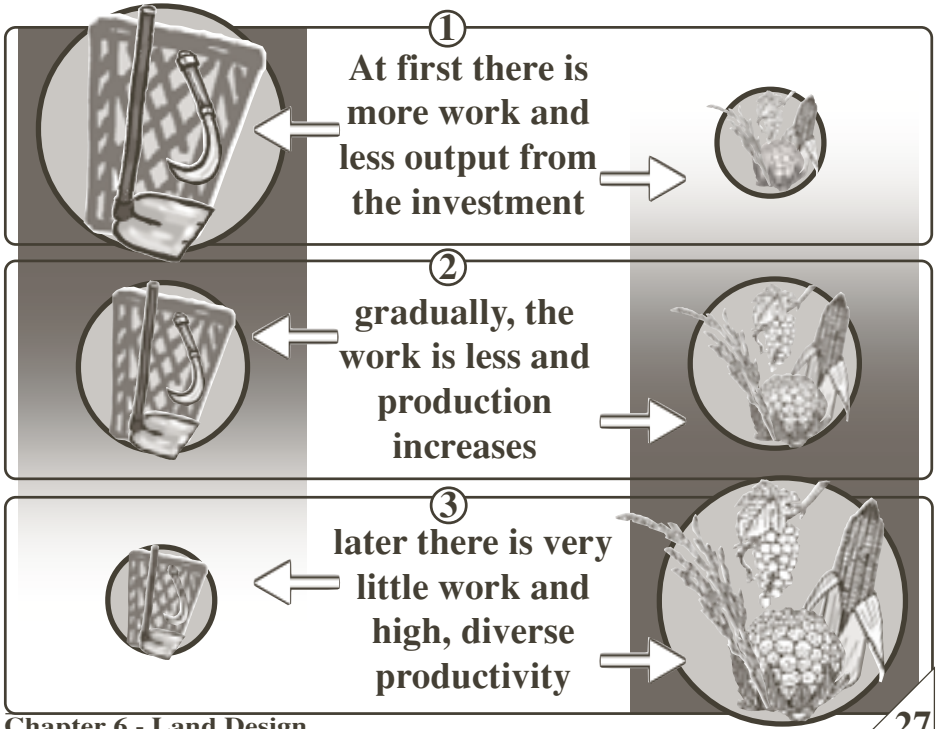
1. Where there is no production - like a degraded, bare site.

2. Where there is on-going production - e.g. a working farm.

1. Where there has been no production (such as degraded land), the design will definitely create productivity on that site. The design will help to create the best regeneration and production, in the shortest time. There are more details about this in the ***Soil Conservation and Improvement*** chapter.

2. Where there is on-going production (such as a working farm), that existing production should not decrease as the design is implemented and other types of production begin. Otherwise, the farmer or the community may have problems meeting basic needs in the short term. The design will help to improve and increase resources, reduce costs, and diversify production.

How to tell if the design is working ?



Farmers' Experience

Mr Govinda Sharma

From Nepal, Kavrepalanchowk district, Patlekhet VDC, Mr Govinda Sharma has used permaculture design on his own farm. Now let's read about his experiences.

Govinda Sharma

“ I took a Permaculture design course in 1991. After that I started to learn from friends, then started to put all that experience into practice. Now, I also help other organisations to make and implement designs. A farming system which is planned using this method is very productive, and easy to use. Instead of having just one crop, many diverse crops can be grown. Instead of just growing corn, I find it's better to mix beans, pumpkins, and plant fodder around the edges to give a higher total yield. At first, the other local farmers didn't accept what I was doing, but when they saw the crops I was growing, with only small extra inputs and mainly local resources after the start, they became interested, and have started copying some of the methods. They are understanding that you can reap the fruits of your investment, and that investment isn't just strength and sweat, it's also design. ”