The Principles of Permaculture Design

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ABSTRACT

The word "permaculture" is a contraction of "permanent agriculture" or "permanent culture". Permaculture principles are designed to support (or ensure) the survival of humanity, the earth and all on it, and, to improve our standard of living. Permaculture can be defined as : a design system for creating sustainable human environments that can be (relatively) easily constructed and maintained. The principles of permaculture designs are : relative location every element (such as house, rice paddy, road, *etc*) is placed in relation to each other such that each assists the other ; each element performs multiple functions ; each function is supported by many elements ; energy efficient planning ; using biological resources rather than fossil fuels ; energy cycling on site

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(both fuel and human energy) ; Using and accelerating natural plant succession to establish favourable sites and soils ; poly-culture and diversity of beneficial species for a productive, interactive system ; use of edge and natural patterns for best effect. These principles can be used for any permaculture design, in any climate, and at any scale. There has been very little scientific examination of Permaculture, and as such, it must be viewed as a design philosophy.

Keyword : permaculture, environment, humanity, energy efficient planning, biological resources, fossil fuels, energy cycling, permaculture design.

I. INTRODUCTION

Permaculture began with Messers Bill Mollison and David Holmgren in 1974. Both individuals were working at the University of Tasmania (Hobart, Australia) and had a desire to evolve a framework for sustainable agriculture based on multi-crop farming. First, a framework of ethics was decided. Permaculture ethics are simple. They are :

1) Care of the Earth - This includes all living and non-living things plants, animals, land, water, and air ;
2) Care of People We need to ensure that we have our basic needs for food, shelter, education, satisfying employment, and convivial human contact ; and,
3) Return of surplus to the earth-care and people-care systems - Any unused resource (be it surplus time, labor, money, information, or energy) is a form of pollution. They should be returned to the system to develop earth-care and people-care systems.

Although based on natural ecological models, Permaculture is a cultivated ecology, designed to produce more human and animal food than is generally found in nature. The principles of Permaculture can be used for any permaculture design, in any climate, and at any scale.

Educational courses have been organized to educate all interested people (city and country dwellers alike) about environmental problems facing the world, and about solutions ordinary people can implement. MANY thousands of people in many countries around the world have completed Permaculture courses, with many of them practicing

its principles.

The word Permaculture is subject to copywrite, and may not be used by unauthorized individuals.

II. THE PRINCIPLES OF PERMACULTURE DESIGN

1. Relative Location

To enable a design component (be it a house, rice paddy, road, dam wall, chickens, ducks, vegetable garden) to function efficiently, we must put each in the right place. For example, ducks should be close to the pond to provide them easy access. Dams and water tanks should be above the garden so gravity (and not a pump) is used to direct flow.

Consider a chicken. Proper examination of its attributes allows us to place it near the vegetable garden, herb garden, for ease of manure dispersal ; close to the house for collection of eggs ; close to the orchard for foraging and scratching ; and with other chickens for protection.

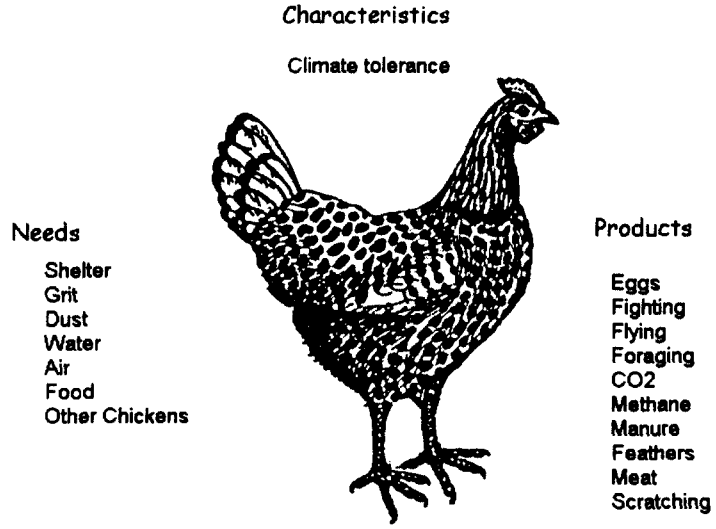

Figure 1

For every design element we should ask :

1) Of what use are the products of this element to the needs of the other elements?
2) What needs of this element are supplied by other elements?
3) Where is the element incompatible with other elements?
4) Where does this element benefit other parts of the system?

The inputs of one element should be supplied by the outputs of another element, and, the outputs of any element will supply the inputs of other elements.

2. Each Element performs many functions

Elements should be chosen and placed so they perform as many functions as possible. For example, in addition to producing rice, a paddy can function as a duckling feeding area. The ducklings can provide nutrients for the rice, eat weeds and rice pests, and, provide meat and feathers. A paddy wall can function as more than a barrier to water flow it can have vegetation planted along it which may provide : windbreak, privacy, trellis, mulch, food, animal forage, fuel, erosion control, wildlife habitat, climactic buffer, and/or soil conditioner. A species chosen for a windbreak can provide flowers for honeybees and insects, nitrogen for the soil, and mulch to drop into the paddy. If a windbreak consists of many species, it can provide MANY more functions.

3. Each important function is supported by many elements

Important basic needs (such as water, energy, and food) should be served on more than one way. For instance, a farm should have both pasture and fodder trees for domestic stock. A house should have a solar water-heating system plus a wood heating system. Water can be collected by dams, tanks, chisel ploughing, and swales. Minerals and nutrients should cycled though more than one cycle. Income should be derived from more than one source (i.e. by growing more than one crop and, perhaps, organizing tours of a property).

4. Efficient energy Planning

Permaculture uses zone and sector placement for plants, animal ranges, and structures. Placement can be modified by local factors.

1) Zone Planning

Elements must be placed according to how often they may be visited or serviced. Areas requiring frequent observation, constant visits, high work input, or complex management techniques should be located close to the main area of activity, and areas visited less frequently should be visited farther away. Figure two shows a small property divided into four zones. The vegetable and herb gardens are close to the house because they are visited daily. Beside them are the chickens, making it easy to throw the chicken manure onto the vegetable and herb gardens. The chickens are also in close proximity to the intensive fruit and nut system, and can be let into it to scratch, eat fallen fruit and insects, and, manure the trees. Sites visited less often are situated further from the house.

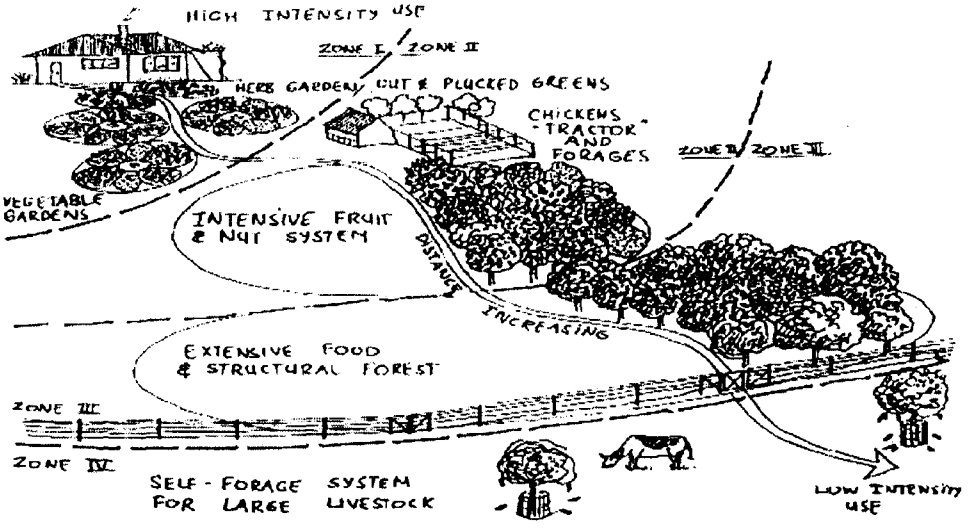

Figure 2

2) Sector Planning

Sectors deal with wild energies, sun, light, wind rain wildfire, and water flow (including flood). These energies come from outside our system and pass through it. For this we arrange a sector diagram based on the real sight, with the center of activity and the center of the diagram. Factors to include on a diagram include : cold, hot, salty, dusty, and damaging winds ; winter and summer sun angles ; reflection from

ponds ; flood-prone areas ; and, screening unwanted views. Figure three shows a sector diagram for a hypothetical property. Understanding of the direction from which outside forces will come assists in determining where to situate structures and vegetation.

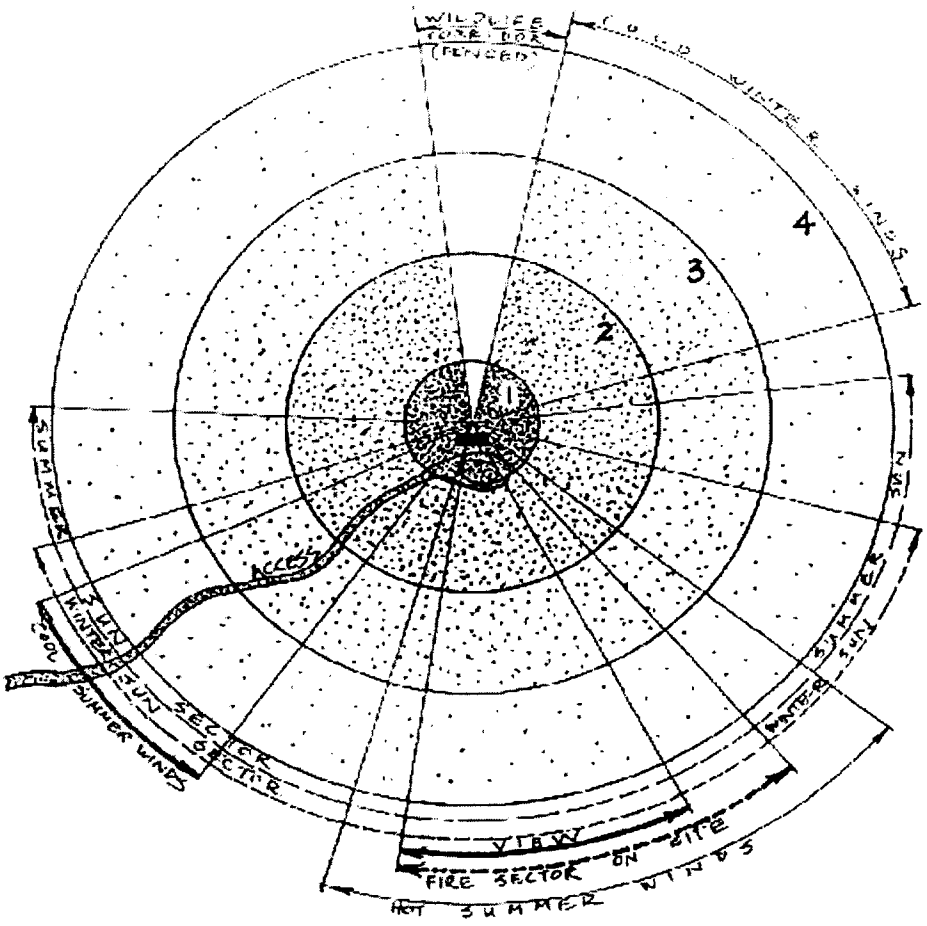

Figure 3

3) Slope

The site should be examined in profile to decide on the placements of dams, water tanks, wells ; to plan access roads, drains, flood or flow diversions ; to place wastewater or biogas units ; to see what effect slope has on the natural elements, and so on. Figure four shows the slope profile of a hypothetical property. Proper analysis

has allowed us to place trees on the ridge to provide stability, increase condensation, and to warm descending cool (or frigid) air. The house (and, accompanying vegetable and herb gardens) has been placed above the winter frost line. Trees are much less affected by frost, so the productive forest is sited below the winter frost line.

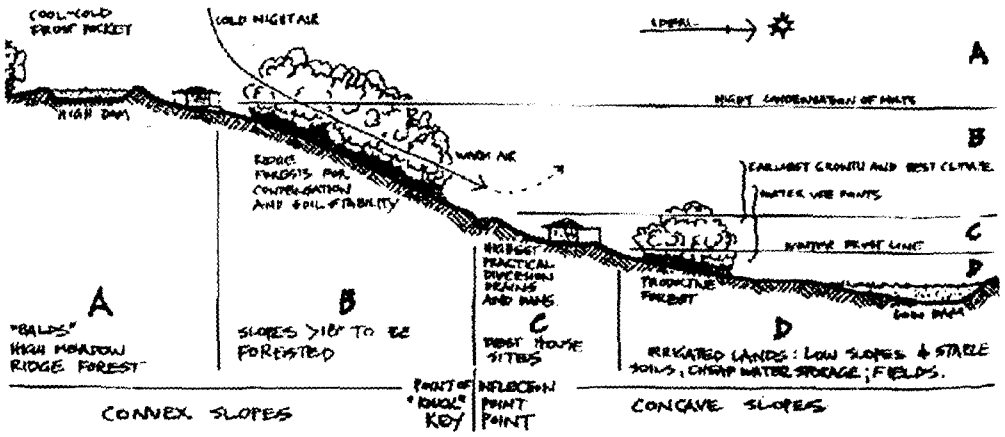

Figure 4

5. Using Biological Resources

Wherever possible biological resources should be used to save energy and to work the farm. For example ; we use green manures and leguminous trees instead of nitrogen fertilizer ; weeding geese or short herbs rather than a mower ; biological pest control rather than pesticides ; and animals such as pigs and chickens rather than rotary hoes, weedicides, and artificial fertilizer.

Non-biological systems can be used if they are used to create long-term sustainable biological systems, and an enduring physical infrastructure. Examples of this would b e : the use of photovoltaic cells, solar water heaters, and black plastic piping to create a lasting energy production site ; and, the use of heavy machinery to build dams, roads, swales, and diversion dams.

6. Energy Cycling

Energy (and nutrients) should be put through as many cycles as possible prior to them being lost to the system. The designer's work is to set up useful energy storages

in a landscape or building (going from State A to State B). Such storages become resources for increased yield. Figure five shows a hypothetical valley. State A is a natural state : water flows down the hill, unimpeded. A few hours after the cessation of rain, the slope will have shed most of its water. State B is the same hill with additional infrastructure. The many dams, tree roots, and diversion channels impede the flow of water down the hill, significantly. Some months after the cessation of rain, water will still be on the hillside. This will increase the basil flow inside the hill ; increase the amount of evapotranspiration within the valley and therefore increase the amount of nighttime condensation. Permaculture should not only recycle energy (and nutrients), but it should also catch, store, and use everything before it has totally downgraded and been lost to us forever.

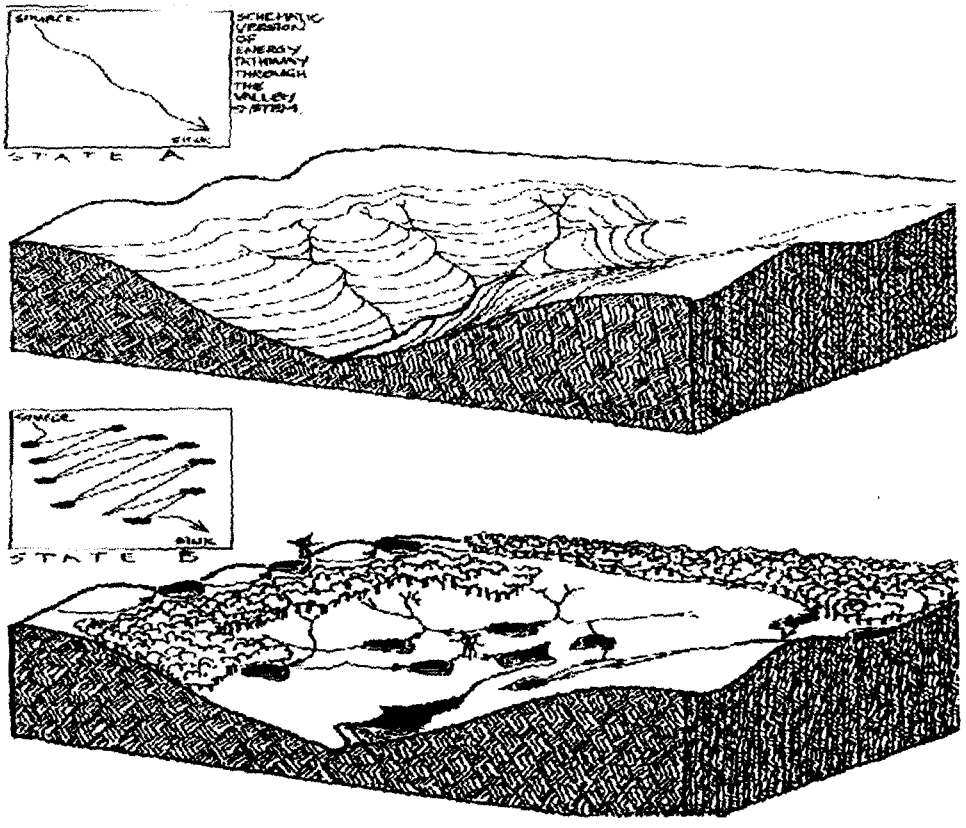

Figure 5

7. Intensive Systems

In intensive systems much of the land can be used efficiently, and, the site is under control. Stacking crops can increase productivity. Figure six illustrates hypothetical plant stacking in a rich soil and water environment, sharing light and nutrients in canopy, mid-level, and herb strata. Not all plants need be for human consumption : some may be efficient miners of minerals, provide mulch for the soil, or provide protection for other plant species. This stacking is an imitation of a forest community.

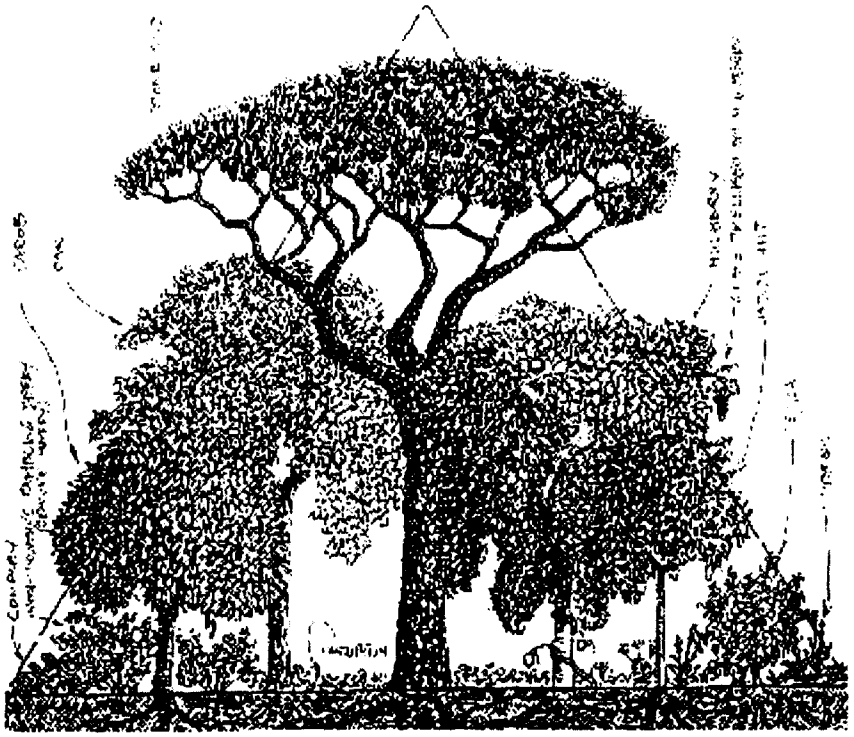

Figure 6

Stacking can also occur over time. A farmer might start his second crop before harvesting his first crop. The first crop may provide nutrients or protection for the second.

8. Accelerating Succession and Evolution

Natural ecosystems are not static. They change over time. Permaculture systems

should copy and accelerate this phenomenon. Many farmers spend their lives (and much energy and money) maintaining a herb or grain system. Instead of fighting nature to maintain this system we should use nature, and accelerate it to build or own climax guild of species. Figures six, seven and eight show a hypothetical pasture succession system. Figure seven shows the system being established. The area requiring rehabilitation is fenced and a mixture of hardy species is planted and protected from grazers. The climax crop may be planted at a later date, when soil conditions are more suitable. Only ducks, geese, and some annual crops are harvested.

Figure 7

Figure eight illustrates the system in a semi hardy stage. Chickens may be introduced on an occasional basis.

Figure 8

Figure nine shows an evolved system. It provides forage, firewood, and animal products, and produces its own mulch and fertilizers. The mature system requires management rather than energy input, and has a variety of marketable yields.

Figure 9

9. Diversity

Permaculture systems should aim to be as diverse as possible because diversity can encourage stability and increase productivity.

Diversity can provide stability by :

1) Dispersing yield over time so products are available during most seasons ;
2) Minimizing market downturns or severe losses in one crop due to pest, bad weather ;
3) Allowing (or promoting) cooperative relationships between elements within the system.

Productivity can be increased if elements within the design are cooperative with each other and work as a guild. It is the relationships between elements that promote stability, not merely species numbers alone. Benefits of a well-designed guild can include :

1) Reduced root competition ;
2) Provision of physical shelter for smaller plants ;
3) Provision of nutrients from legumes and other species ; and,
4) Assisting in pest control.

10. Edge Effects

The interface between two mediums is an edge. Productivity increases between the boarders of two ecologies. By increasing the amount of boarder, we can increase the productivity of our system.

In figure ten we have two four-hectare fields, each with a one-hectare pond. By altering the shape of the pond in field B, we can increase the number of edge plants.

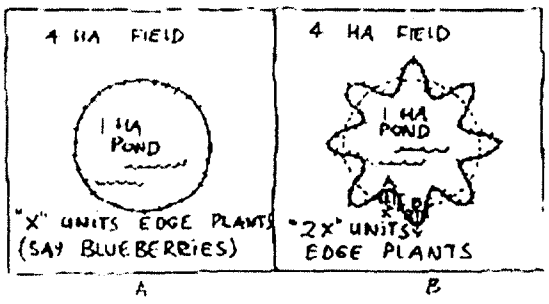

Figure 10

Edge effect can also exist between two differing ecologies, for instance between a woodland and a savanna because many organisms need the two ecologies to exist. Permaculture postulates that we can increase the productivity of our property by imitating such interfaces. Figure eleven illustrates how this may possibly be done.

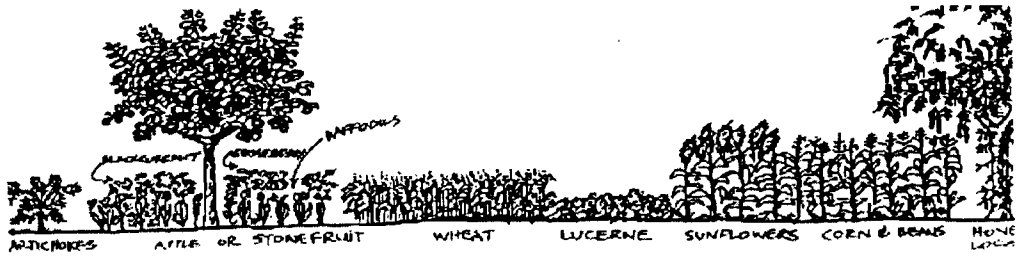

Figure 11

If we lay out crops in figure eleven in swirled rows (see figure twelve), not straight lines, we can increase the amount edge (and possibly the number of plants, too).

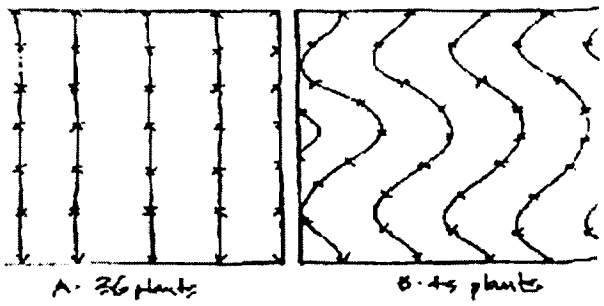

Figure 12

11. Attitudinal Principles

Everything has a benefit or a cost, depending on how it is viewed. For example, a strong prevailing wind might not be good for an orchard, but it can be ideal for a wind -generator, and we can place our crops behind shelter windbreaks or in greenhouses.

Permaculture is information and imagination intensive. It is the quality of thought that determines yield from any particular site. High quality thought will improve how effectively we use a particular niche, and will also increase the number of niches we design into our system.

12. Some Simple Examples of Permaculture

An example of imagination is the recent upsurge of the native Australian food industry. Australians are intensely proud of their unique flora and fauna and believe that it should be preserved. Unfortunately, most existing means of preserving Australia's unique wildlife incurs considerable cost to the community. People with considerable imagination have chosen to make Australia's wildlife safe by making it economic to maintain, by having the wildlife return a profit. By enabling a farmer to make a profit from native wildlife, he has greater incentive to ensure its preservation. A variety of spreads, jams, and preserves, which utilize native Australian plants, can be found on the shelves of very many of Australia's supermarkets. *Red Ochre* is a restaurant chain that specializes in Australian native foods including kangaroo dishes. Perhaps we should consider a kangaroo to be a source of meat instead of a tourist attraction. If you are ever offered kangaroo stew, or a crocodile steak, you will be doing the earth (and, the kangaroo and crocodile) a favor if you accept.

The standard suburban house allotment in Australia is one quarter of an acre. It was determined in the late nineteenth century that this was the minimum amount of land required for a man to feed his family. During the twentieth century, Australian families replaced their vegetable gardens with high maintenance, low yield gardens similar to the hypothetical plan in diagram thirteen.

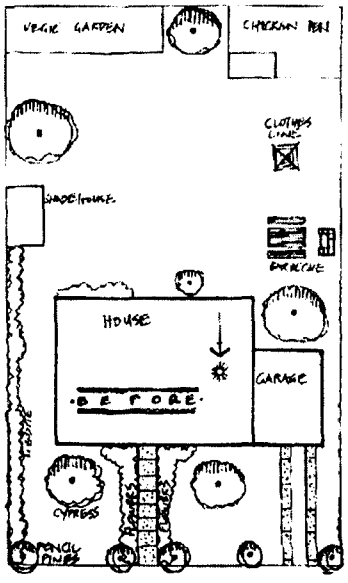

Figure 13

Many some Permaculture graduates have restored their gardens to their original purpose, to feed their family. A typical design is illustrated in figure fourteen. It includes : chickens, vegetable and herb gardens, fruit and nut trees, and, shade plants.

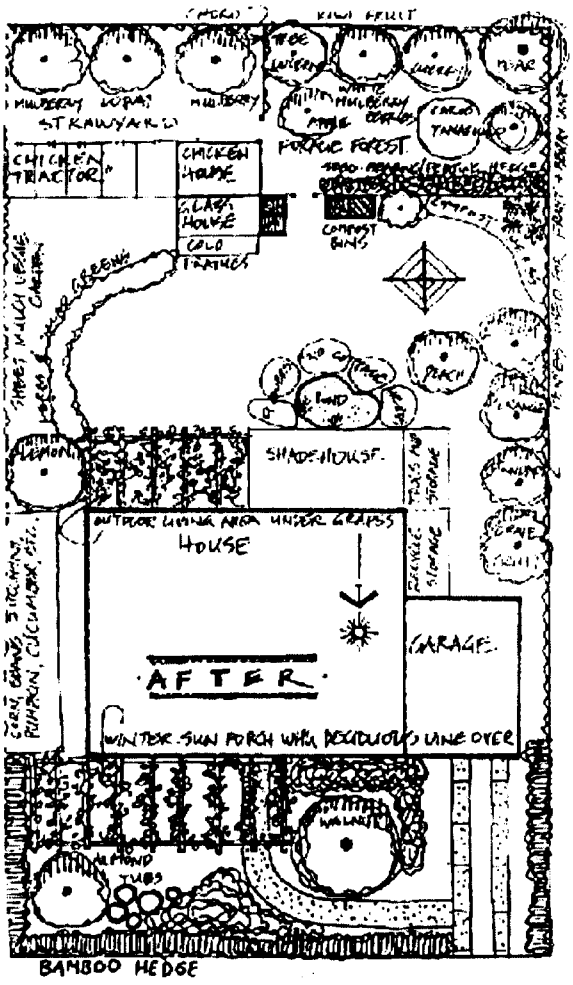

Figure 14

Permaculture can also be practiced in a financial manner. In 1980 Bill Mollison proposed that concerned people should use their money to create their own ethical financial institutions that would direct funds towards sustainable, environmentally friendly investments. This inspired Mr. Damien Lynch to pioneer the ethical investment industry in Australia by creating August Investments (now Australian Ethical Investments Ltd.). They seek out investments that provide for and support :

1) The development of worker participation in the ownership and control of their work organizations and places ;
2) The production of high quality and properly presented products and services ;
3) The development of locally based ventures ;
4) The development of appropriate technological systems ;
5) The amelioration of wasteful or polluting practices ;
6) The development of sustainable land use and food production ;
7) The preservation of endangered ecosystems ;
8) Activities which contribute to human happiness, dignity and education ;
9) The dignity and well being of non-human animals ;
10) The efficient use of human waste ;
11) The alleviation of poverty in all its forms ;
12) The development and preservation of appropriate human buildings and landscapes.

They avoid any investment that is considered to unnecessarily :
1) Pollute land, air or waters ;
2) Destroy or waste non-recurring resources ;
3) Extract, create, produce, manufacture, or market materials, products, goods or services which have a harmful effect on humans, non-human animals or the environment ;
4) Market, promote or advertise, products or services in a misleading or deceitful manner ;
5) Create markets by the promotion or advertising of unwanted products or services ;
6) Acquire land or commodities primarily for the purpose speculative gain ;
7) Create, encourage or perpetuate militarism or engage in the manufacture of armaments ;
8) Entice people into financial over-commitment ;
9) Exploit people through the payment of low wages or the provision of poor or unsafe working conditions ;
10) Discriminate by way of race, religion or sex in employment, marketing, or advertising practices ;
11) Contribute to the inhibition of human rights generally.

The company now handles in excess of one hundred million Australian dollars.

People living in apartments who are unable to grow their own food or produce their own heating/cooling systems are able to practice Permaculture by purchasing goods and services that are consistent with Permaculture ethics. These goods or services will often bare the Permaculture copywrite. Goods might include, buying organic herbs, foods, household cleansers, fibers, and clothes. Services might include depositing funds with an ethical investment fund.

Korean farmers wanting to adopt a Permaculture approach might consider planting a mixture of flowers, fruit trees, leguminous shrubs, or olive trees along their rice paddy bunds. The flowers will attract insects and provide nectar for bees. The flowers can also be sold to florist shops for additional income. The flowering fruit trees will provide much, fruit, flowers for insects and bees, and additional income. Leguminous shrubs will provide nitrogen, mulch, and, flowers for insects and bees. The insects and flowers will attract birds, which will in turn provide additional nitrates. The bees will produce honey (a VERY expensive commodity in Korea), which will produce additional income. Olives and olive oil are also expensive in Korea. The edge effect created by the above plants may also increase the amount of rice grown by the farmer.

More than half of all certified organic land in the world is in Australia (Stehnli 2001). The Australian organic farming industry is export based. Australian governments offer their farmers very little (or no) protection or financial assistance. In effect the market has demanded that Australian farmers make their businesses both profitable and environmentally friendly. This bears stark contrast to farming in all other economically developed cultures which are heavily protected and/or massively subsidized by their respective governments yet have much smaller areas of certified organic farmland. The behavior of the Australian organic farmers is consistent with the Permaculture ethos one should be resolve problems oneself through imagination and careful analysis of available information. The riotous success of the Australian farmers may indicate governments might be major contributors to lack of environmental (and economic) progress, rather than a source of protection, as most politicians would have us believe.

III. CONCLUSION

Permaculture has been studied and developed over a period of twenty-seven years. Thousands of people around the globe have undertaken Permaculture courses. These

courses involve a considerable investment in both time (two weeks full time study) and money. These people are all hungry for Permaculture products and services. Organizing Permaculture courses can generate considerable additional farm and household income. Such courses will also increase the market for Permaculture products.

There has been very little scientific examination of Permaculture, and as such, it must be viewed as a design philosophy. Considerable opportunity exists for the scientific community to examine it. It may be that Permaculture also lends itself to examination by geographers.

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