

Permaculture –

Sustainable Farming

Ranching

Living ...

by Designing Ecosystems that Imitate Nature

What is Permaculture?

Permaculture, a combination of the words **permanent** and **agriculture**, offers a unique approach to the practice of sustainable farming, ranching, gardening and living.

Permaculture shows how to observe the dynamics of natural ecosystems. We can apply this knowledge in designing constructed ecosystems that serve the needs of human populations without degrading our natural environment. Permaculture sites integrate plants, animals, landscapes, structures and humans into symbiotic systems where the products of one element serve the needs of another.

Once established, a permaculture system can be maintained using a minimum of materials, energy and labor. By recycling "waste" resources back into the system, it also minimizes pollution. It serves human needs efficiently by incorporating useful, high-yielding species. A permaculture system is designed to be diverse, so that even when one element fails, the system has enough stability and resilience to thrive. This gives it greater potential than a conventional system for long term economic stability.

Permaculture was developed in Australia in the late 1970's by Bill Mollison and David Holmgren. It has since grown into an international grassroots movement. Permaculture is a unique blending of traditional practices and scientific knowledge, of ageless wisdom and innovative ideas, of time-tested strategies and useful information from around the world. Demonstration sites span the globe.

Permaculture systems have been established on every scale, from farms to apartments, from ranches to suburbs, in cities, gardens, schools and communities. They are proving successful in every climate, including the tropics, deserts, mountains and shores.

American agriculture is at a crossroads. We have achieved remarkable productivity, but have not addressed some consequences of our current agricultural practices. The costs of soil erosion, water pollution, economic uncertainty and the demise of the family farm have yet to be completely assessed. There is a growing awareness that we must profoundly shift our thinking and practices. Rather than exploiting natural resources until they are gone, we must learn to understand Nature, share in her abundance, and help to guide the process. Many people are realizing that in addition to considering short term gains, American agriculture must focus on reinvesting in the future.

A cornerstone of permaculture philosophy is to turn problems into opportunities, and apparent "wastes" into resources. Runoff from stagnant manures, for example, can be a source of ground water pollution. Feedlots and dairies can prevent this contamination and increase their revenues by composting the manure, growing worms in it, and selling both the worms and the finished compost.

This pamphlet shows how applying basic permaculture principles and specific strategies can be of benefit in farming, ranching, gardening and living sustainably.



Permaculture Design Principles

By observing natural ecosystems, we can learn to imitate Nature and create constructed ecosystems that are productive and non-polluting.

Permaculture is a system of design. Through careful observation of the natural cycles, energies and resources on a site, we can design a system that imitates Nature and takes on a life of its own. Once the design is implemented on the ground, the system can be largely self-maintaining. It can yield a variety of high quality food, fiber and energy to meet basic human needs.

The basic design principles described in this pamphlet are universal. They can be applied in designing constructed ecosystems anywhere on earth, including cities, deserts, farms, ranches and backyard gardens. The design process starts with the house and other areas of high use, and moves out to encompass the whole site. Permaculture design lends itself to an appropriate scale, making the best use of human energy and resources without over-taxing either. By intensively working with a relatively small area, we can maximize its productivity, use resources efficiently, and leave some land in its wild state.

The specific strategies illustrated below can be beneficial to some farms, ranches, gardens and homes. Each site is different, as are the humans living and working there. A good design will therefore be unique in creatively adapting to the needs and circumstances of each individual system.



Vision and Ethics

In Nature

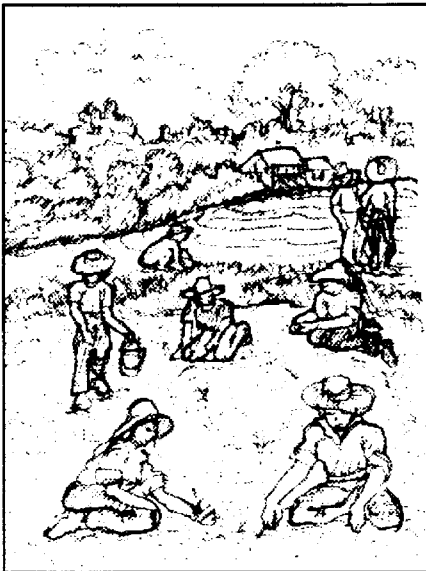
Nature is always **caring for the earth**, **caring for people**, and **reinvesting in the future**. These basic ethics form a solid foundation on which humans can build a stable and sustainable future.

In Imitating Nature

We can derive specific goals, values and intentions from the basic permaculture ethics, developing a clear **vision** of the systems we want to create.

Farmers can promote **caring for people**, for example, by converting their market gardens into **Community Supported Agriculture (CSA)** projects. On a CSA farm, local families pay a share of the annual production costs in exchange for part of the harvest each week. Members share risks and rewards with the farmer, provide extra labor when needed, and guarantee a market for everything produced. They receive a wide variety of fresh, ripe, high quality, locally grown produce throughout the year. By helping out on the farm, members also have an opportunity to connect with Nature and with other members.

The ethic of **caring for people** can thus help farmers transform an uncertain marketing situation into a stable economic enterprise and supportive community.



Site Observation and Analysis

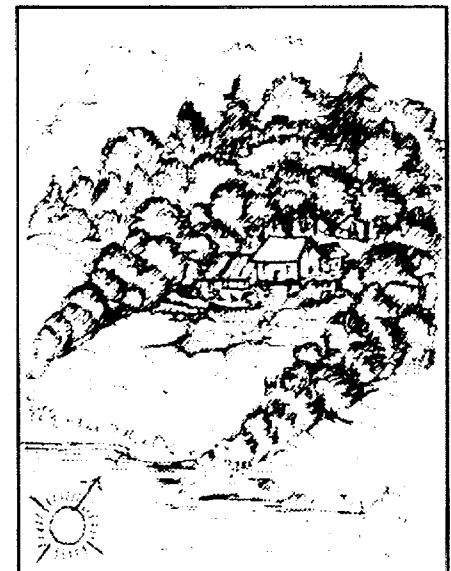
In Nature

Through patient and thoughtful observation during all seasons and climatic extremes, we can learn to cooperate with the natural processes already at work on a site. We can integrate human components into some parts of the natural environment to maximize their productivity, while leaving many areas in their wild state.

In Imitating Nature

Observing **slope**, **orientation** and **sectors** is crucial in analyzing a site. Even a slight **slope** defines the flow of energy and nutrients through an area. We can use gravity on a slope to move water and materials. **Orientation** to the sun creates differing conditions on each slope. Orientation can be used to advantage in growing a diverse selection of plants. Natural **sectors** of sun, rain, native animals, wildfire, etc. are defined by energies and nutrients moving across a site. We can maximize the use of sun and rain by collecting these resources, while deflecting native animals and wildfire to prevent problems and disasters.

After analyzing the natural influences on a south-facing homestead, for example, we can design a shelterbelt to the north of the site. In winter, trees will protect the home from harsh winds and serve as a sunscoop. In summer, they will absorb excess runoff during storms and shade the west side of the building from hot afternoon sun. The vegetation can provide bird and bee habitat, fruit, firewood and other useful products.



Relative Placement

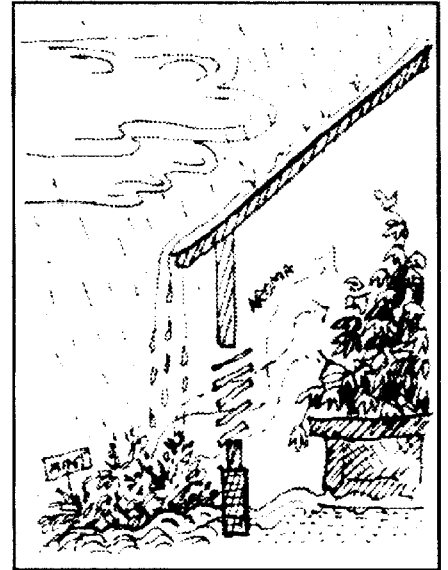
In Nature

Living creatures form beneficial relationships, where the placement of one serves the needs of another. In the arid western United States, for example, a currant bush can thrive in the partial shade of a douglas fir tree. Protection from the hot summer sun helps the bush to conserve precious moisture and produce more fruit.

In Imitating Nature

We can encourage beneficial relationships by placing elements so that they care for each other. This reduces the external inputs, including work, required to maintain the system. It also reduces unused outputs, which can otherwise result in pollution.

For example, we can plant mint outside the south wall of a solar greenhouse, under the eave. The mint, which thrives in sunny, wet conditions, will catch excess water shed by the roof and prevent erosion. Its strong insect-repelling aroma will enter the greenhouse vents by natural convection, in some cases deterring white flies and other pests.



Multiple Elements for Each Function

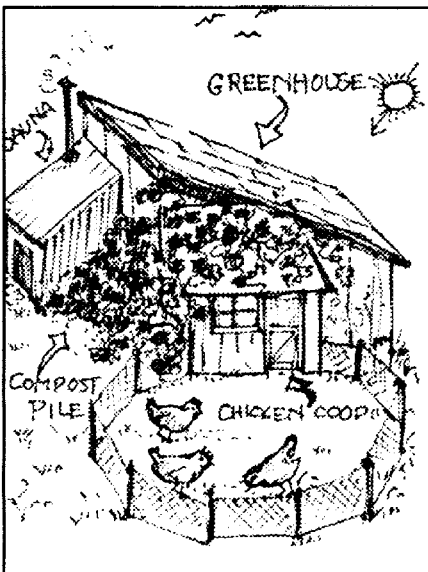
In Nature

Important functions tend to be supported by more than one component. The conversion of carbon dioxide to oxygen, for example, is a vital planetary function. It is supported by many elements, including trees, plants, soil microorganisms and ocean plankton.

In Imitating Nature

Backup components give a system the resiliency to survive even when one element fails.

In a greenhouse, for example, heating is a critical function. During the day, we can store excess heat provided by the sun in a massive substance (like rock or water) for release at night. We can also pump warm air under the growing areas, turning the beds themselves into thermal mass. We can berm the north wall into a hillside or attach it to the house for protection from the elements. Or we can insulate the north wall with a compost pile and sauna, and protect the west wall with a chicken coop. We can vent the greenhouse to accept hot air from the sauna and warm filtered air from the coop. We can maintain temperatures at night with insulated glazing and movable shutters. Each of these elements contributes to the overall function of heating the greenhouse.



Multiple Functions for Each Element

In Nature

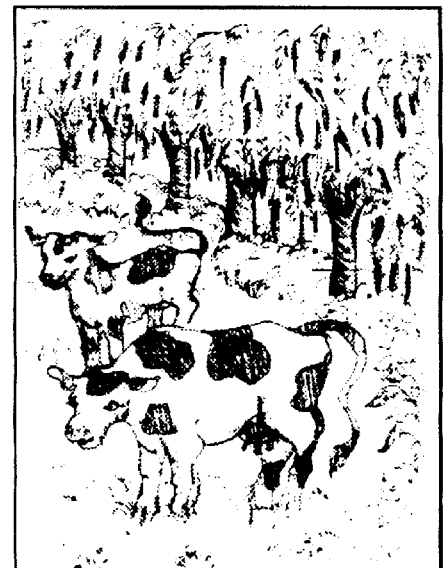
Each component of a system performs several functions, creating relationships with many other elements. Birds, for example, provide meat, eggs, manure, feathers, carbon dioxide, methane and heat for other nearby life forms. They promote vegetation by dispersing seeds, pollinating plants, eating insects and singing.

In Imitating Nature

Incorporating elements with multiple relationships helps to stabilize the web of life.

For example, the black locust tree has many useful functions in a pasture, where its thorns and gnarly branches protect it from the depredations of livestock. It establishes itself quickly in windbreaks and shelterbelts, shielding cattle from cold winds and hot sun, and thus lowering their feed requirements. We can thin a stand of black locust for fence posts, or better yet, plant it as part of a living fence. Planting trees helps to lower the water table where there is ground water salinity, thus protecting surface vegetation from excess salt.

Black locust fixes nitrogen in the soil, nourishing nearby plants. It provides habitat for birds and bees, and can buffer the toxicity of black walnut trees from other species. In Australian ranching systems, animals eat the protein-rich black locust pods when other forage is in short supply.



Using Biological Resources

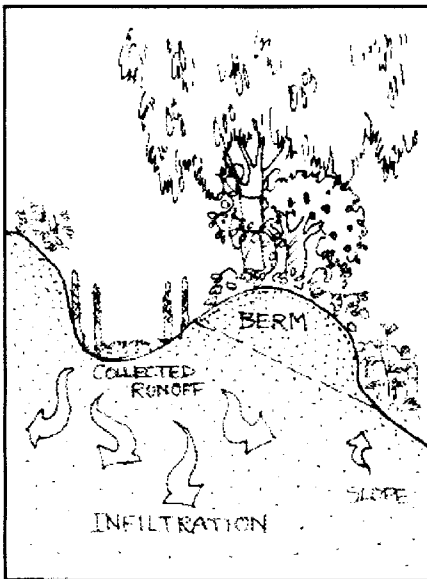
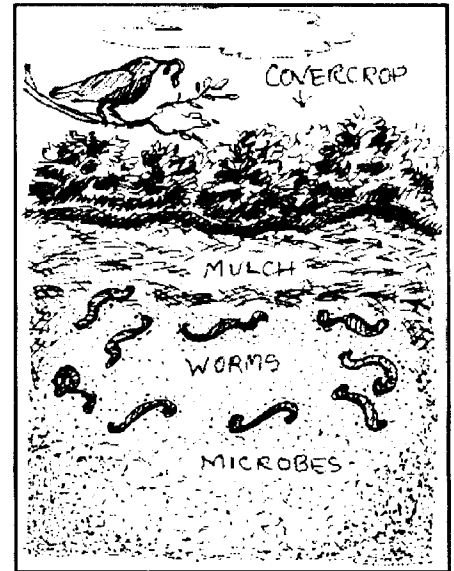
In Nature

Life builds upon itself to create more life. Things feed upon one another in the animal, insect, plant and microbial realms. The life in a system increases over time as energy from the sun is captured and stored in living tissue, and as inert minerals are converted into organic compounds.

In Imitating Nature

The use of biological resources in place of inorganic materials can increase the general health and yield of a system over time, and can decrease the need for external inputs.

We can replace expensive, toxic, non-renewable chemical fertilizers with biological resources that generate fertility on site. By feeding the soil with organic matter, we help it become a healthy, living organism which can then feed the crops. We encourage worms and microbes to multiply rapidly by using animal and green manures and by turning under crop residues. By planting leguminous cover crops, we replenish nitrogen and protect soil from sun and erosion during fallow periods. We can apply leaves or wheat straw mulch from the previous crop to protect soil, prevent weeds and increase fertility. After the harvest, we can let cows run in the stubble, supplementing their feed while manuring the field.



Recycling Energy and Nutrients

In Nature

Once captured by a local system, energy and nutrients cycle through it over and over before eventually leaving. A molecule of water, for example, may be absorbed by the soil, and then assimilated by a plant root. The plant may be eaten by a squirrel, which is eaten by a coyote, who in turn excretes the water molecule onto the forest floor. Once again in the soil, it may be taken up by a tree and transpired into the air, where it is carried away by the wind.

In Imitating Nature

Energy and nutrients tend to rush across a site quickly. The trick in capturing them is to slow down the flow, so that the system has time to absorb them.

Swales, for example, are shallow channels dug on the contour of a hillside. They slow down the flow of water during rainstorms, preventing it from eroding the landscape, and giving it time to penetrate the soil. Nutrients, in the form of leaves and seeds, are also caught in the swale, contributing mulch and organic matter to the soil. Fruit trees and other crops established in the swale or on its berm can thrive on the captured water and nutrients. The overall health of the crop and the ecosystem is enhanced.

Mimicking Natural Succession

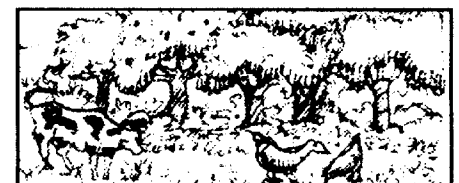
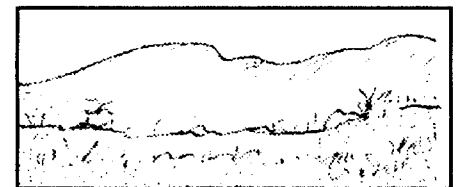
In Nature

When a forest is disturbed, Nature begins the healing process by sending in hardy plants that in other situations might be called weeds. They prevent erosion, fix nitrogen, create mulch, bring up nutrients from the subsoil, and reestablish the delicate balance of soil microorganisms. Over time, the soil begins to support herbs and flowers, perennial plants, shrubs, pioneer trees and vines. Eventually, conditions become favorable for climax trees, and a healthy forest matures. This can take a century or more.

In Imitating Nature

In restoring a landscape, we can speed up the process of natural succession by planting many useful species at once, and letting them play out their natural evolution. By carefully observing the natural progression, we can guide the system to maturity.

In an overgrazed pasture, for example, we can introduce a beneficial weevil to control thistles. We can plant annual and perennial legumes to fix nitrogen in the soil. We can establish useful species like alfalfa, comfrey and prairie coneflower, which will help speed the progression to a productive, self-reliant system. To get the regenerative process off to a good start, we can introduce beneficial pioneer trees, such as black locust, along fence lines. Although the pasture must at first be protected from cattle, in time it will support grazing, and will also produce firewood, herbs and fruit.



Maximizing Diversity

In Nature

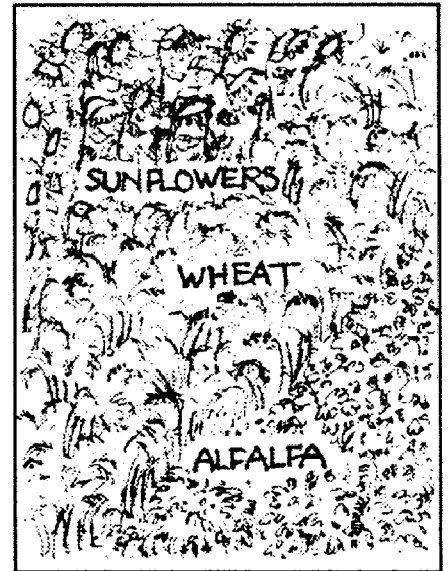
Diversity in a system is indicated not by the number of its components, but by the number of symbiotic relationships among them. Multiple associations nurture each life form, thereby increasing the stability and resilience of the whole system.

The **edge** between two ecosystems is an especially diverse area. Wetlands, for example, foster relationships between land species, water species, and specialized wetland species.

In Imitating Nature

By increasing the diversity of a system, we can increase its stability while minimizing pest problems and competition for nutrients. We can create **microclimates** to host a variety of species, and maximize the amount of **edge** between them to encourage interaction. Productivity at the edge of a field can be up to 20% higher than at the center.

In a polyculture cropping scheme, for example, we can plant strips of mutually beneficial crops such as alfalfa, wheat and sunflowers. The alfalfa fixes nitrogen for the wheat and sunflowers. The sunflowers tend to reduce evaporation and soil erosion by providing a mini-windbreak for the wheat and alfalfa. Contour planting helps to conserve the soil. The polyculture promotes a healthier system while increasing the net yield of all the crops.



Stacking in Space and in Time

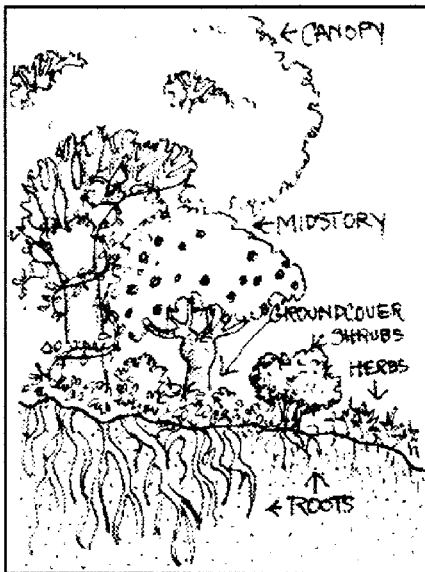
In Nature

In a vibrant system, life flourishes in every available niche. Vegetation carpets the soil, birds nest in trees, plants grow from cracks in rocks, insects burrow into the ground, moss hangs from branches, lichen cling to boulders, carnivores thrive on small rodents, and on and on. Nature also stacks living creatures in time, so that at any one moment, some are just beginning, some are reaching maturity, and some are decaying.

In Imitating Nature

A system that takes every opportunity to stack elements in space and in time can use an area to its maximum potential, yielding a multitude of useful products throughout the year.

We can, for example, construct a forest garden to imitate a natural forest. We can stack the system with productive plant polycultures, birds, bees and bats. Trees and plants can fix nitrogen to nourish the soil, extract vital nutrients from deep in the subsoil, repel insects with their fragrances, host beneficial predator insects, provide shade for tender seedlings, and serve as trellises for climbing vines. The system can yield berries, nuts, fruits, flowers, vegetables, tubers, culinary herbs, medicinal substances, honey, fuel, fiber and fodder.



Using Appropriate Technology

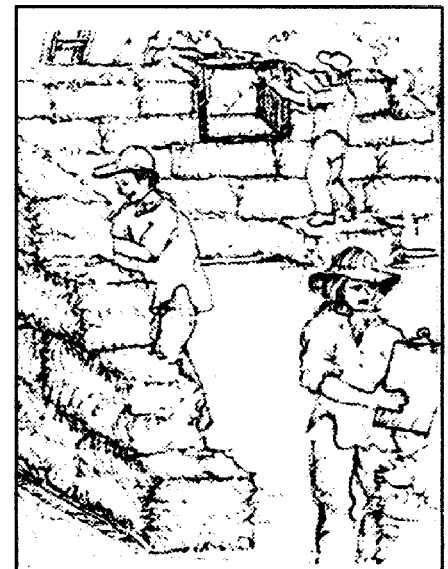
In Nature

Natural systems function quite well without human technology. A tree, for example, is an extremely efficient solar collector.

In Imitating Nature

Although technology can appear to boost the productivity of a system, manufacturing processes, transportation and ongoing maintenance often involve high energy inputs and toxic pollution. When all factors are considered, technology can actually create a net loss in energy or a net increase in work. Simple, clean technologies that rely on gravity, radiant and renewable energy, easily available natural materials, worms and microorganisms are sound investments in a sustainable future.

In areas where conventional building materials are scarce, for example, we can build homes and outbuildings from straw bales, and protect them from the elements with adobe or stucco. These local, natural materials are inexpensive, easy to work with, non-toxic and abundant. Originally developed by settlers in Nebraska, early examples of this simple technology have proven durable after nearly a century. A team of neighbors can rough out a straw bale structure on a weekend, creating the cooperation, fun and community spirit of an old-time barnraising.



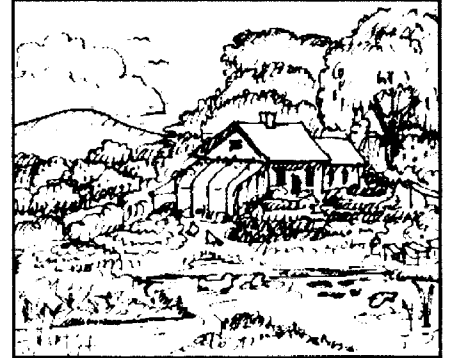
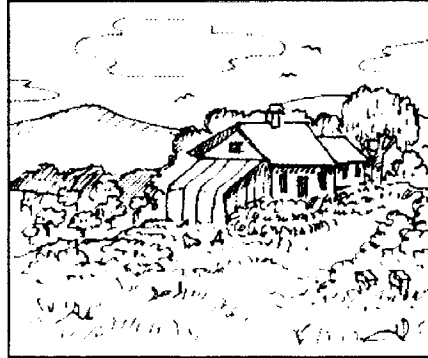
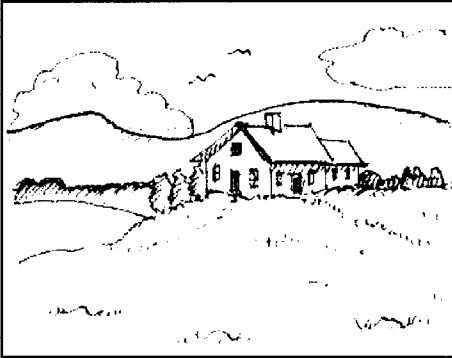
Making the Transition to Permaculture

In converting a farm, ranch or home to a sustainable system, an important permaculture strategy is to make the least change possible to yield the greatest effect. With clear **vision**, careful **observation**, thorough **analysis** and some **ingenuity**, we can design an integrated plan to be implemented in stages over the course of several years.

An audit can reveal how energy and nutrients leave a site, and what resources are brought in from external sources. The first stage often includes the capture of wasted resources, such as manure and straw, that can begin to produce income or increase fertility and biological activity on the site. Rotating crops, planting cover crops, incorporating crop residues into the soil, and using rotten hay as a mulch are simple steps that can reduce external inputs and expenses.

After the first obvious changes, we can select one project, such as building a solar greenhouse, to get the transition process moving. A solar greenhouse can provide such multiple benefits as helping to heat a home, increasing food self-reliance, and sustaining bedding plants for the garden and for sale. It can also serve as a nursery for tree seedlings to stock an orchard or reforestation project, or to provide extra income.

By making changes from the house or other center of activity outward, we can implement the system in manageable stages. The transition zone can move further out on the site as each area is stabilized. To maintain the morale and financial stability of the operation, it is helpful to start small and to build on each success as the transition process unfolds.



To Find Out More About Permaculture

Recommended Publications:

Permaculture: A Designer's Manual, by Bill Mollison, 1988
Introduction to Permaculture, by Bill Mollison and Reny Mia Slay, 1991
The Permaculture Activist, PO Box 1209, Black Mountain NC 28711

Internet (World Wide Web):

<http://sunsite.unc.edu/london/permaculture.html>

For More Information:

Jerome Osentowski, Central Rocky Mt. Permaculture Institute
PO Box 631, Basalt Colorado 81621, (970) 927-4158

Sandy Cruz, High Altitude Permaculture Institute
PO Box 238, Ward Colorado 80481, (303) 459-3494

Production Staff

Content and Writing

Sandy Cruz and Jerome Osentowski

Conceptual Design and Layout

Sandy Cruz

Illustrations

Carol Jenkins

Review Committee

Jill Auburn, Peter Bane, Steven Carcaterra, Scott Chaplin,
Jim Dyer, Richard Gibson, Al Kurki, Dan McGrath, Rhonda Miller,
Michael C. Moore, Susan Mullen, Vistara Parham, Trina Paulus,
Richard Pinkham, Philip Rasmussen, Robyn Van En

Funding

USDA Western Region SARE/ACE Program