Permaculture as a Design Modality for Healing and Regeneration: Design with a Deeper Agenda

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Synopsis

This paper describes the discipline of Permaculture with particular emphasis on healing and regeneration of the land. Permaculture is a design system for creating sustainable human environments. Traditional site design concerns itself with placement of elements to achieve aesthetic or economic effects or both. Permaculture extends this effort to create environments that are healthful and nurturing for the humans and other species inhabiting the site and that are sustainable in their use of natural resources.

The practice of Permaculture involves observation of healthy natural systems and the design of human systems on the basis of the patterns observed in the natural systems. Its fundamental approach is to conserve what is on the site and stop the loss of resources; to heal and repair the damage that has been done; and then to create systems of abundance so the site will support well-being for all its inhabitants and its surroundings.

The paper describes the basic steps in good Permaculture design, describes a number of tools and design principles, and concludes that the designer can have a much more profound and holistic impact than has been generally assumed.

Introduction

In nature there are patches in every landscape where things are healthy – plant and animal life is more abundant, and the place seems more vibrant than other areas. Many things contribute to such patches: micro-climate, balance and diversity of plants and animals that provide different services, geology (mineralization), the quality of natural litter on the ground (mulch), the fertility of the different layers of soil, the availability of water, sunlight and air, etc. The goal of Permaculture design is to study these patches and emulate them in our landscape designs.

Permaculture is a design system for creating sustainable human environments.[1] The term was coined in 1978 by Australian ecologist Bill Mollison and his student David Holmgren as a contraction for Permanent Agriculture. The term has been expanded to mean Permanent Culture, for food production is only one of many activities needed for healthy, sustainable environments for humans. Permaculture is an interdisciplinary practice focusing on sustainable food production, energy-efficient building, recycling, waste-water treatment, land stewardship, and just and workable social structures and economies. This paper focuses on landscape and site design.

Permaculture's fundamental principle is to design with nature. Mollison says

> *In designing with nature, rather than against it, we can create landscapes that operate like healthy natural systems, where energy is conserved, wastes are recycled and resources are abundant.*[2]

The Design Process

The basic approach of a Permaculture designer, when looking at a new site, is (1) to conserve what is on the site and stop the loss of resources; (2) to heal and repair the damage that has been done; and then (3) to create systems of abundance so the site will support well-being for all its inhabitants and its surroundings.

The groundwork for the design is the result of a process of interaction with the site and with the clients who want to do something with or on the site. The process consists of a series of steps:

- Careful observation of the site.
- Thorough research of things about the site that are not directly observable, such as its history, applicable legal codes, etc.
- Gaining a deep understanding of the clients' wants and needs through interviews and discussions.
- Educating the client about the planning and design process and about possibilities that the client may not have considered.

[1] Mollison, Bill, with Slay, Rita Mia: Introduction to Permaculture, New Edition (Tyalgum, Australia: Tagari Publications, 1994), p. 1.
[2] Idem., p. 72.

These steps usually occur in a spiral fashion – talking to the clients, observing and researching the site, talking to the clients some more, observing some more, etc. The designer gathers a lot of information, and records it in a series of maps and reports. The designer gains knowledge about the site's climate, history, geology, soil characteristics, water, plants, animals, economics, surrounding region, legal restrictions, and much more. At this point, we have enough knowledge to begin making some design decisions.

Sometimes the designer-client relationship only goes this far because it becomes evident that what the client wants cannot be done economically or practically or ethically. But if the site is appropriate for the intended uses, then the design process continues.

A Whole-Systems Approach

In order to create a successful design – one that will increase the overall health of the site as well as satisfy and delight the client – the Permaculture designer needs to use a whole-systems approach. This includes the following:

- Base the design on observation of how healthy, natural systems work.
- Be locally appropriate by creating designs in harmony with the nature of the biological region we are designing for.
- Understand the services of pattern. Different patterns do different things. For instance a scatter pattern slows down and disperses flows, and a branching pattern either disperses or concentrates material, depending on the direction of the flow.
- Create useful connections between elements through judicious use of placement, scale, edge dynamics and flows.
- Mitigate the climate to enhance the seasonal experience. There are a number of techniques for doing this, such as placement of buildings to absorb sunlight in winter, planting wind breaks to slow down cold winds, etc.
- Select organically-grown, non-genetically engineered and non-polluting elements.
- Emphasize integrated pest management.
- Schedule the timing of the installation and construction to use the seasons to save time and money and increase growth.
- Disaster-proof the design by identifying potential hazards, both natural and human-caused, and designing in prevention and the ability to respond.
- Introducing specific techniques for cleaning an unhealthy site.

There are many other aspects, too many for a short paper. The rest of this paper concentrates on techniques for cleaning the site and making it more healthy.

Permaculture as a Healing Discipline

The most important factor in design for healing is one's intention. What we think and say has a profound effect on the actual physical world. Fascinating research by the Japanese scientist Masaru Emoto suggests that merely by directing positive thoughts toward stored water one can improve its quality.[3] Accordingly, the Permaculture designer talks and thinks about solutions rather than problems. In our reports and the language we use with the clients, we stay as positive as possible.

Following are some examples of how a site may be healed.

> Note – The application of these techniques will vary depending on where the site is located. Different bioregions have different vegetation, different animal species, different water characteristics, different climates, etc. The specific characteristics of the site and its surroundings will determine how these techniques apply.

Retaining and Cleaning Water

You can provide clean water in a number of ways:

- Collect and store as much water on the site as possible. Use cisterns and ponds as surface storage and infiltration swales and basins for storing water in the ground. You can use plants such as daikon radish (Raphansus Sativus Daikon), comfrey (Sumphytum) and other root crops to infiltrate water into the ground.

- Introduce oxygen by splashing the water, bubbling air through it, filtering it through soil or rocks with helpful organisms, and introducing oxygenating plants, animals or micro-organisms. Some useful oxygenating plants are cyperus, water iris, water hyachinthus, duckweed (Lemna), bullrush (Scirpus), cattails (Typha), Pistia Stratiotes, Elodes Canadensis, and Cabomba Caroliniana.

- Expose the water to sunlight. "When a stream flows through the direct sunlight of an open meadow, its waters are cleansed of some chemicals by light rays that trigger photolytic chemical reactions."[4] You can remove shadow by removing shade trees from a pond or stream, and you can store the water in transparent containers.

- Change the water's pH. There are a number of ways to do this. You can expose it to rocks that have the balancing pH by putting rocks in the cistern or storage tank or by running the water over the rocks. For example limestone causes water to become more alkaline. You can expose it to plants that create the desired pH. Pond edge plants such as bullrush (Typha Latifolia) increase alkalinity.

- Change its temperature. Most human pathogens live in colder water[5]; heating the water helps remove them. Water that is stored deep and still tends to be cool. You can warm the water by running it over a long, shallow whitewater course, exposing

[3] Emoto, Masaru: *The Message from Water* (Tokyo: HADO Kyoikusha, 1999).
[4] Lyle, John Tillman, *Regenerative Design for Sustainable Development* (New York: John Wiley & Sons, 1994), p. 254.
[5] Britton, Gabriel, *Wastewater Microbiology* (New York: Wiley-Liss, 1994), p. 116.

it to sunlight or heat from thermal storage (e.g. hot rocks). You can use passive solar energy: store water above ground in containers painted black to absorb heat and shaped so a lot of surface is exposed to full sunlight.

- Filter it. Run it over or through something that will absorb impurities, such as sand or crushed rock. Varying the size and kind of material in the filter changes how the filter works. Filters remove material from the water and provide habitat for animals and microorganisms that consume impurities from the water (e.g. bacteria eat viruses). You can filter water through living material such as plant roots and stems by building soil dams in the water course and creating marshes with lots of plants. You can also use human-made filters such as charcoal, which takes out chlorine, or reverse osmosis which removes a number of harmful minerals.
  Constructed wetlands – artificial marshes – have proven to be very effective for treating wastewater. "Constructed wetlands offer an economical, largely self-maintaining, and therefore preferred alternative to conventional treatment of a variety of types of contaminated water. … Constructed wetlands are capable of moderating, removing, or transforming a variety of water pollutants while also providing wildlife and recreational benefits commonly associated with natural wetlands systems."[6]

- Expose the water to plants. Plants change the water chemically. They take up some minerals as nutrients and release chemicals. For instance, some plants found to be helpful in cleaning contamination from mining are bristly locust (Gleditsia Aquatica), darling pea (Swainsona Galegifolia), thick spike wheatgrass (Agropyron), four-wing saltbush (Atriplex) and autumn olive (Elaeagnus Umbrellata). Plants that clean xylene include areca palm (Chrysalidocarpus Areca Lutescuns), dwarf date palm (Phoenix Roebelenii), dumb cane (Dieffenbachia) and dragon tree (Oracaena Draco). Plants that clean up ammonia include lily turf (Ophiopogon), Chrysanthemum, and lady palm (Rhapis). Plants that eat benzene include Chrysanthemum, English ivy (Hedera Helix), and snake plant (Sansevieria). For general decontamination try peace lily (Spathiphyllum 'Mauna Loa'), weeping fig (Ficus Benjamina), tulips (Tulipa) and English ivy (Hedera Helix).
  Plants can also prevent contamination. You can plant austrian winter pea (Pisum Arvense) and hairy vetch (Vicia Villosa) to help suppress woody invaders in rights of way, thereby reducing the need to use chemical herbicides.

- Gather fresh water from the air in desert regions, where surface water may be salty or mineralized, through dew-harvesting plants or structures.

- Introduce trace minerals by exposing the water to rocks of desired types, such as volcanic rock, granite sand, and other igneous rocks.

- Remove or reduce dissolved solids by putting it through plants that take up dissolved solids as nutrients such as Water Hyacinthus or duckweed (Lemna).

[6] Hammer, Donald A., and Bastian, Robert K., "Wetlands Ecosystems: Natural Water Purifiers?", in Hammer, Donald, ed. *Constructed Wetlands for Wastewater Treatment* (Chelsea, Michigan USA: Lewis Publishers, 1989), pp. 16, 18.

Cleaning Air

Air quality is as important as water quality for the health of humans and other species on the land.

- Plants. You can use plants to clean the air. All plants take up carbon dioxide and release oxygen; most release other chemicals as well, often detectable as fragrences. Indoor plants such as spider plants (Chlorophytum Comosum), peace lily (Spathiphyllum 'Mauna Loa') and mother-in-law's tongue (Sanseveria Trifasciata), etc., oxygenate the air and provide visual beauty. Outdoor plants do the same, but may also add irritants such as pollen. The designer must pay attention to the direction of the wind during pollen season. Windbreak plants such as vertical yaupon (Ilex Vomitoria), pine (Pinus) and poplar (Populus) can create favorable microclimates where wind is reduced. In the city you can plant vines on trellises around windows.
  Researcher Carol Smyser observes, "Leaf surfaces, especially hairy ones, can trap dust and soot. Atmospheric dust has been reduced by as much as 75% with a 200-yard-wide planting. Studies have shown that ragweed pollen was reduced by 80% over a distance of 100 yards by a dense evergreen forest. … Plants also control air-polluting gases by introducing oxygen into the atmosphere and diluting the polluted air."[7]

- Filters. An effective, low-maintenance air filter for indoor spaces is made of charcoal. Construct a wall or part of a wall out of two screens a few centimeters apart and fill the space with charcoal. As air flows in from the outside, dust and other irritants are trapped in the charcoal. Left dry, the charcoal dehumidifies the air. To make the air moister and cooler, you can drip water on the charcoal.

- Plant trees for transpiration. Moisture released from the trees cleans dust and pollen from the air.

Climate

There is a great number of ways you can create a more comfortable climate on a site through use of placement of buildings and plants.

- Wind deflectors. Build walls of masonry, stone, wood, metal or any hard surface shaped to deflect wind from the site. Vertical walls tend to cool the downwind side and preserve moisture. Walls slanted 45 degrees tend to warm and dry the downwind side.

- Wind breaks. Place combinations of trees and shrubs upwind of dwellings, gardens or fields that both deflect the wind and consume it (slow it down).

- Wind funnels. You can increase the velocity of the wind by placing plants and structures in a V shape so the wind is funneled through a narrow opening. This technique can be used to increase the chill on fruit trees, preventing them from blooming too early in the season.

[7] Smyser, Carol A., *Nature's Design: A Practical Guide to Natural Landscaping* (Emmaus, Pennsylvania, USA: Rodale Press, 1982), p. 214

- Wind jumps. Any hill, wall or building causes wind to go over it and curl back down behind it. To reduce the scouring effect of the wind behind the building, you can plant trees or shrubs leeward of it.

- Sun traps. Especially in colder climates you often want to increase the amount of sunlight absorbed by a site to warm it for comfort and to provide a longer growing season. You can place buildings so they face the direction of dominant sun in the winter and are free of shadow. An example is a courtyard with the sun-facing wall open or reduced (south-facing in the Northern hemisphere; north-facing in the Southern hemisphere). You can trap sun in conjunction with wind control, for instance by planting a wind break in the direction away from the sun and opening the sun-facing side.

- Light. You can increase or decrease light as desired. To increase it, include things on the site that reflect light, for instance shiny surfaces such as water and light colors such as birch bark. To decrease light, plant shade trees and include textured or dull surfaces and dark colors. As important as the amount of light is the pattern of its distribution. Dappled light promotes more growth for many species of plants and animals than constant full sunlight.

- Heating and cooling. You can cool or heat the site or portions of it. Use thermal mass such as rock or concrete to absorb heat during the day and give it off at night. Reflective surfaces and light colors reduce heat absorption, and dark, rough surfaces increase it.

  An important tool for cooling a site is the use of evaporation and transpiration. Trees that transpire (give off moisture) a lot can make an area cool; a grove of orange trees can be fifteen degrees Fahrenheit (8.3 degrees Celcius) cooler than surrounding areas in the middle of summer.

  You can cool dwellings by placing water upwind of them so the wind picks up moisture. An effective way of cooling living areas in hot climates is to place water sprinklers high above them, on the roof or at tree-top level. Turning on the water a for a few minutes at the end of the day can cool the area significantly.

  You can plant vines on walls to cool them in the summer (they shield the wall from sunlight) and warm them in the winter (they shield the wall from cold winds).

Retaining and Cleaning Soil

The health of the soil is crucial for growing healthy crops. There are lots of ways to clean the soil; here are some of them.

- Erosion Control. Build check dams to prevent soil from being washed away. Plant ground cover to prevent soil from being washed or blown away. Place swales and berms on contour to capture water and sediment on the land. All of these techniques build soil depth and health.

- Plants. Plants are dynamic accumulators. Different plants take up and release different chemicals, trace minerals and nutrients. They also host different animals,

micro-organisms and soil organisms. Fungi, for instance, have been found to have great restorative powers.
Important things to look at when choosing plants for a site are their root types, the composition of the leaves and twigs that fall from them, their size, shape, texture, color and pattern. Also consider their services (what they are good for), whether they are evergreen or deciduous, what substances they take in and give out, and what kind of animals they provide habitat for. Following is a partial list of some useful plants:

Nitrogen-fixing trees	**Fertilizing plants**	**Insect and Pest Control**	**Fire-break**
▪ Wattle (Acacia) ▪ Silk tree (Albizia) ▪ Sensitive tree (Mimosa)	▪ Most legumes ▪ Rye (Lolium) ▪ Spring oats (Avena) ▪ Barley (Hordeum Vulgare) ▪ Clover (Trifolium) ▪ Vetch (Vicia Villosa)	▪ Thorn apple (Datura Metel) ▪ Tobacco (Nicotiana) ▪ Pyrethrum (Tanacetum Cinerariifolium) ▪ Garlic (Allium Sativum) ▪ Lavender (Lavandula)	▪ Thyme (Thymus) ▪ Ice plant (Carpobrotus) ▪ Sedum (Rhodiola) ▪ Comfrey (Symphytum) ▪ Saltbush (Atriplex) ▪ Ivy (Hedera Helix) ▪ Yarrow (Achillea Millefolium)

Other ways to control pests are through predatory insects such as lady bugs, green lacewings and trichagramma wasps, and through growing food in nutrient-rich soil so they it will have more resources to fight off pests.

- Rocks can influence the pH of soil just as they can influence the pH of water.

- Mulch, known to many gardeners, is a most important technique. Mulch is a layer of material, such as straw, peat moss or pine needles, on top of the soil. Mulch protects the micro-organisms in the soil by placing a roof over them. It mitigates the climate and conserves water. When it rains, the mulch absorbs water. Then it releases the water slowly, nourishing the soil and the plants it surrounds. Mulch supplies a constant supply of food for the soil organisms, mitigating seasonal variations and provides shelter so they do not bake or freeze to death. By shielding the ground from sunlight, mulch helps prevent the growth of unwanted plants. Mulch can change the pH of the soil.

- Tree litter acts like mulch to protect the soil. According to Smyser,

  > Leaves, and in some cases stems, of plants have a beneficial effect on soil composition and structure. The dead plant material, or litter, that covers the ground in natural landscapes breaks the impact of rain, retards runoff and

filters the water into the soil without disturbing the soil structure. During dry weather, the litter reduces surface evaporation, and as the litter decays, it becomes the basis of the humus horizon, which provides mineral elements for plant growth. Humus also provides a sheltered environment for microbiotic life, which breaks down the many complex substances in the soil. It provides shelter for earthworms, which help keep the soil granulated. In extremely cold weather, the litter insulates the ground and in the event of freezing it tends to honeycomb, allowing early spring rains to soak in. Litter also provides a major source of nutrients for the soil. Some trees, like dogwoods, have very high nutrient levels and their leaves decompose rapidly, thus quickly replenishing the soil.[8]

- Add carbon by composting plant leaves or waste paper that decompose easily.

- Add protein to the soil by introducing organisms such as worms and grubs and feeding them compost or garden waste. You can also plant environments for animals that will come and deposit nutrients on the site.

- Add air. You can aerate the soil in many ways. Increase the number of aerobic soil organisms. Introduce worms to tunnel through the soil and break it up. Funnel air to the site as mentioned above under Air. Add nitrogen by planting nitrogen-fixing species such as legumes that harvest nitrogen from the air and store it in root nodules. Add water, which carries oxygen.

- Break up the soil by planting crops whose roots dig through it. Root vegetables such as radishes, carrots, beets, onions and garlic make tunnels down into the ground, which allow water and air to infiltrate. The leaves of these plants funnel water to their roots.
  Some plants mine the minerals in the soil by sending roots very deep. The deep roots bring minerals up the plant and enhance the top soil through falling leaves and twigs. Also, organisms travel up and down the outsides of the roots. Examples are pecan trees (Carya Illnoensis)) and any tree with a deep tap root.
  Plants with lots of surface roots, such as grass, stabilize the soil and keep it from blowing or washing away.
  Some plants, such as mountain laurel (Sophra Secundiflora)), split rocks and create niches for soil.

- If needed, introduce soil organisms that clean the soil, such as bacteria that reduce sulfate or oxidize the soil. Certain strains of mustard (Brassica Juncea) accumulate heavy metals, including lead. Certain kinds of fungus degrade tetrachlorethylene and chlorinated solvents. Thorn apple (Datura Metel) takes up radiation.

Promoting Growth

You can increase or slow down the rate of growth of plants and animals on the site through careful selection, placement and pattern and through timing of plant succession through the seasons and over the years.

[8] Smyser, *Nature's Design*, p. 214.

- Select groups of species that complement each other. Permaculture emphasizes the use of guilds, beneficial assortments of plants and animals, usually clustered around a central element. For example, "Almost all cultivated fruit trees thrive in herbal ground covers, not grasses. Comfrey (Symphytum), for example, allows tree roots to feed at the surface and produces mulch and worm food when it dies down in winter, while spring bulbs … die down in the summer and do not compete with trees for water during summer dry periods."[9]
  The author created a remarkably dense thicket in a very short time by planting a number of species all at the same time and in the same area: daikon radishes (Raphanus Sativus Daikon) to create channels in the ground for water infiltration; Indian bean (Catalpa Speciosa) to provide early shade, fix nitrogen and harvest dew; crepe myrtle (Lagerstroemia Indica) to acidify the soil and attract birds; chaste tree (Vitex) for fertilizer and to attract beneficial birds and insects; pecans (Carya Illnoensis) to bring minerals to the surface from far below; sumac (Rhus Aromatica Sumac), which is native to the area, to attract native soil organisms and birds; hairy vetch (Vicia Villosa) to fix nitrogen; and afghan pines (Pinus Afghanis) for windbreak and habitat for beneficial insects through the winter.

- Plant things close together so plants competing for height get taller faster.

- Plant first succession "nurse plants" to provide nutrients and shelter for later plants.

- Plant evergreens to provide habitat for beneficial insects through the winter

- Plant bird attractors to provide phosphates to the land from bird excrement.

- Plant plants with large shiny leaves to harvest night-time dew.

- Plant a very fast-growing tree to provide spotted flickering shade to the whole system.

- Plant low-growing plants such as hairy vetch for living mulch.

- Plant deciduous trees to provide leaf-fall and litter to nourish and protect the ground.

Conclusion

This paper has presented a few techniques for healing and regenerating the land from the perspective of Permaculture design. There are many more. We hope to have demonstrated that the designer, if allowed to come in early on a project, can have a much more profound and holistic impact than has been generally assumed. He or she can enhance the health and well-being of the site and the local region as well as create beautiful, abundant sites that are economically viable and ecologically sound.

[9] Mollison, *Introduction to Permaculture*, p. 25.

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