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Soil Fertility

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CONTENTS

DEPARTMENTS

Permaculture Activist welcomes your articles, news items, photos, and other materials of interest. Please contact the Editor in advance of your submissions (editor@permacultureactivist.net) to request writers guidelines and present your ideas.

Upcoming Issues, Themes & Deadlines

#77	**Eco-nomics**	**June 1**
#78	**Water**	**September 1**
#79	**The Urban Frontier**	**December 1**

Permaculture is a holistic system of DESIGN, based on direct observation of nature, learning from traditional knowledge, and the findings of modern science. Embodying a philosophy of positive action and grassroots education, Permaculture aims to restructure society by returning control of resources for living: food, water, shelter, and the means of livelihood, to ordinary people in their communities, as the only antidote to centralized power. For 30 years Pc has combined top-down thinking with bottom-up action to make a world of difference in over 100 countries.
We are everywhere.

Editor's Edge

Floating Remnants of a Fertile Past

Scott Horton

ONE OF MY MOST VIVID TRAVEL MEMORIes is visiting a place that, at least historically, owes its existence, beauty, and sustenance to a human-designed and maintained balance between soil and water fertility: the Xochimilco district of Mexico City.

At 49 square miles, about the same size as San Francisco, Xochimilco remains a place out of time in the middle of one of the ten most populous cities in the world. Yet if you parachuted into it blindfolded, you might find it hard to believe that you were surrounded by nearly twenty-nine million people and the resultant waste, noise, bustle, and chaos. Amidst the canals, small farm holdings, market gardens, flowers, boats, and birdsong, the misnamed "floating gardens" of Xochimilco are a reminder of centuries of fertile connections between water and soil, people and natural cycles.

The islands or *chinampas* of Xochimilco—actually small farm plots—don't actually float. They are solidly built up from lakebed muck, mats of reeds and other organic matter, and living plants from the floor of a shallow lake to make arable a vast area of natural lakes and interconnected waterways. They are anchored by *sauce* trees, a native species of willow, which are planted as saplings when the chinampas are first built. The trees then grow to an immense size, holding the plots in place between the canals.

The Mexica people (called Aztecs in Western history) migrated to the valley of Mexico long before the Spanish arrived in the early 16th century. The valley, encircled by volcanoes, has no outlet, so water melting from the snow-capped peaks created a vast area of swamps and shallow lakes. The Mexica built their capital Tenochtitlan on piles driven into the lakes, and they surrounded and penetrated the city with the immensely productive chinampas. To this day, waste and fertility constantly cycle back and forth in a dynamic balance between terrestrial horticulture and aquaculture. In addition to the *milpas,* or polyculture plots, the islands supported small livestock. The canals were brimming with useful aquatic plants, fish, and crustaceans, and the skies were alive with migratory and native birds and insects. This elegant design remains unsurpassed for productivity; it harnassed ease of transportation to virtually limitless fertility. The chinampas fairly define our concept of edge or ecotone: water life meets farm life meets city life meets the airborne.

All this began to end when Hernán Cortéz and his small band of conquistadores overthrew the Mexica rulers in 1521 to claim the city as their own. Over time, they remade Tenochtitlan, filling in canals, toppling buildings, and systematically supplanting Mexica culture with Spanish ways. The water gardens of Xochimilco are the only remnant of one of the largest pre-Columbian cities in Meso-America.

Though the Spaniards, in their journals and letters home, marveled at the beauty and abundance of Xochimilco ("place of flowers and fields" in the Nahuatl language), they seem not to have understood the efficient productivity of the chinampas. These survive to this day because the new colonial capital of Mexico needed food for its tables, and the original expanse ran into the hundred of square kilometers. But in a death by a thousand cuts, this vision of an abundant world has gradually been sacrificed on the altar of European superiority. As the city grew, most of the broadscale canals were filled in, although one remained in use until the 1940s, connecting Xochimilco to the main plaza miles away. Farm products were still carried the distance in hand-punted boats amidst the flurry of city life. But eventually, even this

With the deterioration of the once healthy and fertile system have inevitably come problems—pollution, poverty, and health hazards are now sad hallmarks of Xochimilco.

Continued next page —>

Basics of Biology and Practice

The Permaculture Way of Soil

Andrew Goodheart Brown

WALT WHITMAN WROTE "I am a part of everything I've met." As a permaculturist, I would say, "I am a part of everything I've eaten." I am also a part of the complex dance of all the organisms and energies involved in growing my food. Likewise, permaculturists transform the idea of a "food chain" into a "food circle," because in nature food becomes waste becomes food becomes waste. Permaculture reminds us that we can design our way back into this circle of life. We are not apart from it, though our culture pretends to be. Besides being a cool thing to do, placing ourselves in the circle of life is energy-efficient and productive. After all, life has evolved over several hundred million years, an exquisite complexity that produces abundance and wastes nothing, cycles nutrients, and slows the flow of energy through all ecosystems. All natural systems have evolved to live from—and contribute to—this surplus.

What allowed our industrial cultures to turn its back on the circle of life was the discovery, extraction, and use of cheap, abundantly available fossil fuel. Fossil fuel is by definition limited. Almost all of it was laid down under extraordinary conditions 150 and 90 million years ago, "cooked" under the earth's crust for very long periods at just the right temperatures and pressures, and is not being replaced. (1) Once it is gone, we will have to have turned our economies and our cultures fully back into the circle of life energy driven by the sun, soil, plants, and microbes. Though much more is implied than soil, food, and economy, this is "The Great Turning" to which Joanna Macy and others refer.

It has begun. Fossil fuel extraction appears to have peaked and discoveries are in permanent and irreversible decline. As demand continues to surge, the rapid depletion of all the long-ago-discovered, high-quality, easily available sources means that less fossil fuel will be produced each year, and what remains will come at higher cost. It is time to sit up and take notice.

Photo by Chiwa.

The author builds a torus shaped compost pile on the edge of his forest garden from horse manure, grape skins and seeds from wine making, and straw. The torus shape is said to broadcast energies into the surrounding area, so he placed water (following several years of drought), kelp, and vermicompost into the center.

No way out

Since the industrial discovery of oil, the U.S., which was for many decades the world's leading and swing producer, has been top dog economically, politically, and militarily—and has taken the lion's share of resources as a result. From 1970 onward, with the decline of its domestic oil production, the U.S. made deliberate efforts to expand global trade and manipulate financial flows, making oil a commodity to be bought and sold in the global marketplace. 'They who have the money get the oil,' became the new rule. But the OPEC embargoes of 1973 and 1979 put paid to that game, and the U.S. was forced to embrace a foreign policy that committed it to intervene militarily in the Middle East to regulate the flow of oil—the Carter Doctrine. As North Sea

Permaculture Way of Soil continued next page —>

Floating Remnants, cont'd.

was buried to make way for a grand boulevard and the burgeoning fleet of cars that came with progress.

Though Xochmilco today is still a farming area, it is best known as a sublimely bucolic place where families and tourists flock, especially on weekends, to hire colorful boats for picnics and parties, and to hang out amidst a fading relic of Mexica glory.

With the deterioration of the once healthy and fertile system have come problems—pollution, poverty, and health hazards are now sad hallmarks of the area. With increasing modernization in the 20th century, the water table of Mexico City dropped and the land subsided. As population grew, the canals became a dumping ground for sewage and garbage. A farmers association and other NGOs are working to remediate the area but there is much work to be done to restore the dynamic balance of soil and aquatic fertility and health to the chinampas.

For all its human-created problems, the potential of the immensely creative system in Xochimilco still reminds us that if we maintain the cycles of waste, fertility, and growth, we can provide for large numbers of people and the rest of the natural world in a mutually beneficial web.

Xochimilco's fertility and its decline provide us food for thought. It remains eerily relevant for us today. Δ

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and North Slope oil came online in the 1980s, the world price of oil collapsed, buying the U.S. a few years of continued bluster. Nevertheless steadily increasing imports eroded the U.S. position as the world's creditor and flipped this country into permanent debtor status. The North American wake-up call has now clearly sounded: we are no longer the ones with the money. Other world powers are pushing their way up to the bar and jockeying for position: wars large and small attest to that.

The implications are staggering for a culture addicted to cheap food, energy, comfort, import-based hyper-consumerism, and lavishly wasteful transportation. We've had a fun ride on this rollercoaster, while the infrastructure has developed severe cracks. It's not a matter of "if" the track will drop out from under us, but rather how soon and how drastically.

Fortunately, we do not have to wait for the teetering carnival ride we are on to collapse beneath us to get down to earth. We can step off now and put our feet on solid ground.

A new economy of sun and soil

Permaculture teaches us to identify our primary needs and design resilient systems to meet those needs. People around the world share the same basic needs: clean air and water, healthy food, shelter, meaningful livelihood, security, and community.

All terrestrial life is completely dependent on the magic of soil.

In a world independent of fossil fuels, or where they play a minor role—the future we can now clearly see coming toward us—we must put our focus on creating and enhancing soils and ecosystems to produce healthy, vital, and abundant food and other goods and services from living nature. Healthy soils are the foundation of a healthy world.

Back to our roots

When we eat food, we take in some of everything that has gone into that food: sacred, life-giving water, the sun's energy, and microbial/plant interactions. Without all of these, there can be no life. Microbial activity breaks down and releases stored nutrients from the dead bodies of plants and animals, making these building blocks available in a form easily assimilated by growing plants. Plants link earth and sky, transmuting their forces into roots, tubers, leaves, flowers, and fruit. From the tiniest bacteria to the most ferocious carnivore, all reap the life-giving, nutritional benefits of microbe/plant interactions. And all partake of and benefit from all parts of the process. With each mouthful of food we consumers also eat air, sun, water, earth, once-living plants and animals, and…manure.

Soil micro-organisms make it all possible and, in fact, keep the sphere of life rolling along!

In permaculture, we learn to look for points of intervention. Another way to say this is, we seek places to intervene in the system that will give the biggest bang for the buck, or achieve the desired goals with the least expenditure of energy. Improving soil becomes a basic strategy for best use of energy. If we want healthy bodies, we need adequate amounts of healthy food. We do not find these in industrial markets, where an apparent abundance of product belies a diminishing quality of nutrition. What we do find there reflects the rising costs of energy since industrial food production has an extremely high petroleum cost. Writing *In Defense of Food: An Eater's Manifesto*, Michael Pollan reminds us that in supermarkets, real food is generally limited to

Without soil microbes, life would have run out of the nutrients and minerals necessary to build all physical bodies hundreds of millions of years ago.

the perimeter of the store: the many interior aisles through which one must pass to reach the real food, contain mostly "food-like substances," designed for profit, not for health.

Soil is not dirt

All terrestrial life is completely dependent on the magic of soil. Modern ecological studies give us an in-depth understanding and appreciation of the complexities of this material beneath our feet. No longer can we believe it to be lifeless and inert. Soil is a matrix of bedrock weathered over thousands or even millions of years. Broken down into minerals and organic matter, it holds the decomposed bodies of everything that has lived before, as well as parts (leaves, hair, skin, excrement) of living organisms. Nature's crown jewels are the soil micro-organisms. We've called them decomposers, and among them we count the fungi, bacteria, nematodes, actinomycetes, and numerous other microorganisms. The term "decomposers," however, doesn't do them justice! They really are "enablers" because their metabolic activities break down all organic matter. These tireless workers free up the nutrients and minerals making up the bodies of all life forms (plant, animal, and microbial) to provide absolutely necessary cell building blocks to plants.

Plants incorporate these nutrients into their own tissues, and everyone else (all of us!) eat either the plants or the animals that feed on the plants. All living beings shed cells constantly, defecate or discharge wastes, and eventually die. Those nutrients in our bodies rejoin the circle of life. In so doing, they pass through endless cycles. They are broken down by the enablers and either stored in the soil—bound to particles of clay and organic matter, or, as is the case most often in the tropics, are passed directly to plants through their roots. Since Earth is a finite system, everything is in limited supply. Phosphorus, for example, is so essential and so scarce, that every atom of it not bound up in rocks is exchanged 46 times a year, moving constantly from one body to another. (2) Without soil microbes, life would have run out of the nutrients and minerals necessary to build all physical bodies millions of years ago.

> **Organic matter is the fuel that runs soil systems, and carbon is the key ingredient.**

Soil is an ecosystem teeming with microbes constantly breaking organic matter apart. In a teaspoon of healthy topsoil are hundreds of millions of bacteria, fungi, protozoa, nematodes, and other organisms. Plants growing in a healthy soil ecosystem are chock full of vital nutrients and minerals. Organisms that consume these plants bio-accumulate the building blocks of life. By actively managing healthy soil ecosystems, we can grow vibrantly healthy plants. Food is energy, and the quality of food determines the quality of health and well-being. (Americans take note!) Healthy, nutrient-dense food supports health in all animals (people, too).

As permaculturists, we design for a vibrantly healthy, nutrient-rich, and regenerative soil system. As we begin to understand soil and its importance, strategic management steps become clear. Everything we do, everything we choose to consume, and each individual action has an impact on soil ecosystems, either positive or negative. We are responsible to act in a way that benefits the soil. We must avoid choices and actions that will cause harm to this foundation of life itself. Fortunately, soil, which is extremely complex, can be cared for and enhanced by simple means: Feed soil with organic matter and keep it covered.

Feed me!

Organic matter is the fuel that runs soil systems, and carbon is its key ingredient. Soils deficient in organic matter are poor soils with minimal complexity and low numbers of organisms. Correcting almost any soil condition requires the addition of organic matter. Soil acidic? Add organic matter. Soil alkaline? Add organic matter. Our first order of business in soil system management is to feed the soil. A more appropriate way of saying this is: Feed the carbon cycle. From a chemistry perspective, soil life has evolved to break apart carbon bonds. In the process, carbon as well as other elements necessary for life are released and made available for plant uptake. This is a beautifully intricate and complex process without which there is no life.

The elements and techniques I outline in this article include composting, vermiculture, fertility crops or green manure plantings, mulching, soil amendments (such as kelp and phosphate), foliar sprays (such as compost tea), and animal manures (including humanure).

Compost happens

Composting doesn't require the purchase or building of a bin to be successful. Nature composts everything without any of the above. For our convenience we can accumulate organic materials in a pile, keep things tidy with a bin, perhaps pleasing our neighbors, and by so doing, produce a finished product more quickly. A certain mass of materials (a cube roughly four feet on a side) that brings together manures (nitrogen-rich) and dried plant materials such as straw or leaves (carbon-rich) at a very general ratio of one part nitrogen to 20-30 parts carbon, sets the stage for a speedy decomposition. When these conditions are met, bacteria will reproduce and consume organic matter furiously, pushing the pile to temperatures that destroy pathogens and the seeds of most plants. Some people turn the pile several times, moving the outside of the pile to the inside, for even speedier finished compost. I do not, being in no hurry, and knowing that compost happens, thanks to our life enhancers—the soil organisms that break apart the chemical bonds and release nutrients.

After the pile temperature spikes (reaching 140°–160°F) and falls again toward ambient temperature, microbial activity slows down and macroorganisms enter the picture. These include compost worms, insect larvae, beetles, and other crawlies and wigglers. This begins the process of finishing the compost—much like a wine needs a finishing period for its flavors to develop.

What happens in the compost process is a speedy breakdown of organic matter into resins, gums and other substances, and humus that can persist in the soil for many decades. Humus acts as a nutrient and water reservoir to enhance long-term soil fertility. The measurement of soil organic matter (SOM) is the measure of humus in a soil. When early Europeans arrived on the North American continent, SOM measurements were as high as 14%. After decades of plowing followed by industrial agriculture's war on natural soil, the average SOM may now be as low as 2%. (One percent SOM or less is considered dead soil). Even this degree of degradation can be amended with the addition of organic matter. However, it takes as much as 20 tons of organic matter per acre to increase SOM by 1% on the broad scale.

Putting weeds to work

Weeds are self-sown plants that grow (often quickly) where we want crops or gardens instead. My weed management has evolved from quick removal—yank them out of the soil, roots and all, and move them to the compost pile—to deliberate exploitation: I now wait until they have flowered, cut them at the base just before they set seed, and lay them down in place as mulch. Each time above-ground plant parts are cut, a corresponding mass of roots dies off. The root die-off becomes food for the soil. The mulch on top breaks down more slowly. Rather than upset the soil system around the weed by yanking out the entire plant and its roots, I create an immediate and ongoing source of soil food, and turn a problem into a solution!

Let worms do the digging

Vermiculture is the use of compost worms to create a natural product called vermicompost. When evaluating organic matter to enhance the soil, we can say that manure is great, compost is better, and vermicompost is the best. Since the initial heat generated by microbes in the compost pile is high enough to kill macroorganisms, compost worms show up only after temperatures drop. They consume partially decomposed organic matter, further digesting it and concentrating nutrients to levels several times higher than in the surrounding material. They then excrete these super nutrient packets ("casts" or egesta) in their wake as they move through the soil. The magic of vermicompost goes beyond the nutrient value of these packets, which is very high. Inside the worm, the casts are inoculated with microbial spores, ensuring the wide dissemination and propagation of healthy microbial populations throughout the organic layers of the soil. This natural stacking of functions produces a truly value-added product.

The gardener's goal is to concentrate the compost worms by building a suitable bin or heap, thereby concentrating the vermicompost. One worm, under worm-pleasing environmental conditions—including adequate soil moisture, plentiful organic matter (on the soil surface), and pleasant temperatures—can produce half its body weight in casts every day. This is heroic, yet the weight of one worm's poop is truly minuscule. Our permaculture point of intervention is to concentrate the worms. One pound of worms, under optimal conditions, can produce one-half pound of vermicompost daily. But vermicompost is worm manure—too strong to be used as a sole medium for growing plants. Rather, it should be mixed into planting soil at a general rate of 1:10.

Fertility crops

Green manure plants are herbaceous fertility crops grown for the sole purpose of soil improvement. These may be bulky materials such as grasses, rich in cellulosic carbon, or nitrogen-fixing plants such as clovers, alfalfa, vetch, peas, etc. Sometimes dynamic accumulators such as buckwheat (which builds calcium and phosphorus in its tissues) or soil pest-suppressing plants such as mustard are grown. At some stage in their growth cycle, and in accord with the scale and available tools of the agricultural enterprise, they are either cut, flailed, scythed, disked, dug into, or just laid down on the soil surface as food for the soil ecosystem. The healthier the soil system, the quicker the organic matter will break down, and the sooner the system will be ready for planting.

In healthy forests, soil systems act like a huge mouth just beneath the duff-covered forest floor. Nature has worked out all the moves.

At Barefoot Permaculture, my homestead in Asheville, North Carolina, I use inexpensive, low-tech solutions available and affordable to anyone. I use mostly hand tools. Since I early on succumbed to Bill Mollison's idea of the importance of hammock time on a permaculture site, I simply scythe my green manure plants and lay them down as top mulch. I spare myself the hard work of digging them into the soil. Time will handle that. There are, of course, other layers of complexity behind my practice. Digging into the soil disturbs the microbes and the earthworms.

Nature has evolved top-down feeding

A look in the forest reveals leaves on its floor and a gradient of decomposition that begins just under the leaf cover and extends a few inches into the topsoil. Almost all soil activity occurs in the top two inches: this is the zone of maximum air penetration and organic matter deposition. Dave Jacke calls this A- Horizon the "zone of Accumulation." Vertical-dwelling earthworms will rise out of their burrows, grab mouthfuls of surface organic materials and drag them down many inches into the earth, yet the vast bulk of soil organisms accomplish their work at or very near the surface (a wooden post in the ground decomposes only at the surface edge, not two feet down). In healthy forests, soil systems act like a huge mouth just beneath the duff-covered forest floor. Nature has worked out all the moves. Following her example by designing and using top-down mulching systems allows us to work less and achieve more. We cannot improve on this time-tested system. This is truly the old-time religion, and it's good enough for me.

This is compost making instruction at a training center in northern Bangladesh, using animal manures, straw from rice and wheat, and other plant materials. Note the use of bamboo sections for air entry into the pile.

Succession leads to complexity

In permaculture, we model the best of nature. The only time we see bare soil in natural systems is following a severe disturbance such as fire, flood, landslide, or glacial scouring, or from the much more confined scratching and burrowing of animals. Immediately, nature begins to close off any disturbance, heal the wound, and revegetate the site. A predictable array of plants appears. These comprise an initial response team of wind-blown and animal-carried seeds, whose job is to put roots down and green leaves up, anchor the soil, halt further degradation of the soil, pump in organic matter, and buffer extremes of soil temperature and moisture, thereby improving conditions on the site. Less harsh already after a season, the improved site attracts and supports a suite of second responders—longer-lived annual and perennial plants. Each stage, or sere, is marked by a distinctive plant community with its own evolving microbial and animal counterparts. In a sequence we call succession, each stage further ameliorates the site until a healthy, stable, mature ecosystem is in place.

Bare soil is an abomination in the garden as in nature. Either a vegetable cover or a mulch is needed to buffer extremes of moisture and temperature. Without cover, the soil surface bakes under sun, freezes under cold skies, erodes under rain, and the soil-building organisms are driven away. Both high and low temperatures as well as drought are limiting factors in ecosystem health and, therefore, manipulating conditions to moderate soil temperatures and moisture levels provides us a critical point of intervention. Using mulches allows us to stack our functions, for they both protect soil from extreme conditions and feed it through top-down application of carbon-rich material.

May the broken bowl be mended

Most soils worldwide are deficient in phosphate, an element necessary for successful flowering and fruit development. Other elements are also missing from agricultural soils, in both the industrial and home landscapes. Plants use some 40 minerals, many of them in trace amounts, and though some soils are deficient because of their parent material, many mineral deficiencies are a result of human practices. Commercial farming has learned to supply chemical NPK (nitrogen, phosphorus, and potassium), which are the Big Three elements, but ignores many of the remaining three dozen minor elements. Plants, however, know the difference, and will be weak if they lack for anything they require. Export agriculture, where crops are sold into distant markets and not replaced with a comparable volume and quality of fertilizing elements, results over time in the loss of minerals and nutrients. This impoverishes the soil and the ecosystem, and steadily degrades the nutritional quality of the food produced. Until we start employing practices in our agriculture that regenerate soil health, most of us will continue to be poorly nourished. Much of the epidemic of degenerative diseases experienced by modern people is a direct result of degraded farm soils producing nutrient-deficient food.

To repair degraded soils we can use our brief window of fossil fuel availability to import needed soil additives. Kelp is a sea vegetable that makes a good addition to diet as a condiment. It also contains a full spectrum of trace elements (all of which are present in seawater), and so should be added regularly to garden soils and livestock diets. Almost all soils too can benefit from the addition of phosphate. Slow-release rock phosphate is a good choice for a soil amendment. We can also let our phosphate fly or walk in. Attracting wild birds is beneficial, as is the use of poultry manure, because birds eat large quantities of insects and seeds, thus concentrating this essential nutrient in their manures.

Once a site is remineralized and its ecosystem is working well, minerals are recycled and the need for soil amendment diminishes. One strategy is to let nothing organic leave your site: recycle everything back into the circle of food through the soil. Nutrients are like a bowl of money: if we are always taking money out of the bowl without replacing it, at some point we run out. A sound agricultural practice is to ensure that whenever we take some out, we put some back in. This way the bowl is always full and we have created a regenerative system.

The finished pile, made from grapes (post-fermentation), horse manure, and straw, as well as Biodynamic Compost Prep. In the background is the author's food forest, chicken tractor, native bee nest box, and zone of inspiration and relaxation.

Feeding through foliage

One of the most exciting and powerful garden practices to come into public awareness in the last few decades is foliar feeding. Science long ago discovered mouth-shaped cells (stoma) that open and close on the underside of leaves, acting to "breathe" gases in and out. The stoma open and close according to temperature and time of day. Foliar feeding has evolved beyond the gross application of fertilizer to include "teas" made from compost or vermicompost. These may include herbaceous material, seaweeds, and other natural substances. Elaine Ingham of Soil Foodweb, Inc. has researched methods of making and using compost teas to optimize the presence of beneficial soil microorganisms. These teas can be sprayed directly onto plants and onto soils.

Further studies show that some beneficial microbes, sprayed on leaves, will occupy sites on the plant and act as a living guard against disease organisms: a true bio-control. The use of a bubbler to create an oxygen-rich solution is key. The addition of a small amount of natural sweetener, such as molasses, benefits the plants. Microorganisms like the sugar, and in the presence of oxygen they boost their populations big time.

Animals build fertility

Animal manures are a good source of organic matter, carbon, nitrogen, and other nutrients for the soil ecosystem. By eating and digesting plant matter and other organisms, livestock quicken the cycling of nutrients within ecosystems. Smaller animals are especially valuable. Manures should be well aged or preferably composted prior to application. Otherwise, they may leach nitrogen to groundwater, and can be damaging if applied in high concentrations. Twelve inches of manure on top of your soil is likely too much. Most of us would be unable to achieve these levels for practical reasons, but you can see the problem in confined animal feedlots.

Cattle manure comes out of the animal already well-digested and doesn't need much aging. Horse manure is also valuable depending on the type of bedding material used. Some materials, such chips of black walnut and red cedar wood can suppress plant growth. Sheep, goat, and llama manure is only slightly richer than that of horses and cattle. Pig and chicken manures, however, must be composted prior to use since both are very rich in phosphorus and nitrogen, and can burn plants. Both of these animals are omnivores and eat a diet higher in protein than ruminants and other grazers. Keep in mind that light applications of any manure seldom generate much heat (though a four-foot pile would do so). Rabbit manure is ready to use right out of the animal. You can create a simple, productive polyculture by housing your rabbits over a vermiculture bin.

An animal polyculture for the home garden

In 2001, I was preparing for a project in Rwanda teaching village women to design productive systems for very small plots of land given to them following the genocide. Rwanda is the most densely populated nation in Africa and at about a thousand people per square mile, one of the most densely populated in the world, near the levels of Bangladesh or Holland. It is widely believed that land pressure contributed to the ferocity of the genocide that erupted there in 1994. After getting some examples of effective small animal polycultures from ECHO (Educational Concerns for Hunger) in south Florida, I designed a productive, four-tiered, small-footprint, stacked animal polyculture with rabbits on top, then chickens over ducks, with compost worms at the bottom. This intensive polyculture was required by the size of the plots of land. The women, often with several children, were given a plot roughly 35 by 35 feet on which to build a wattle-and-daub home and a latrine. Around the house would also be a primary location for gardens and fruit plantings. Protein was scarce, so the animals would enhance the diet, while the concentrated manures would give the families a source of fertilizer as well as a small bit of income from selling the excess to neighbors. The cash income would allow the children to attend school. These "protein high-rises" had a footprint of 10 feet by 3 feet by 5 feet.

Keeping humanure at home

The easiest manure for us to harvest, compost, and use is our own. Currently most of us flush it away in drinking water, removing our share of ingested nutrients from the local circle of life and concentrating them with the feces of others as well as industrial waste in municipal sewage systems. These systems periodically release untreated sewage containing heavy metals, toxic chemicals, antibiotics, and other pharmaceuticals into local waterways causing untold ecological problems. We can rejoin the circle of life by responsibly adding our share of nutrients back into our local ecosystem. Since reading Joe Jenkins's *Humanure Handbook* in 1994, I have flushed my home toilets a total of 21 times. All the rest of my many tons of humanure has gone through compost piles into the soil. In the absence of flushing, I celebrate a happy new holiday: June 22 is when I harvest my finished humanure compost from the year before, and wheelbarrow it up to the garden and orchard. And the first harvest surprised me with an upwelling of tender tears as I realized the implications of this act: I am now deeply connected to the life processes of my land!

Become a true radical

In this article, I've covered the very basics of complex soil ecosystems, centering on soil microorganisms. We've learned the basics of soil care and enhancement through descriptions of compost, vermicompost, green manures, soil amendments, foliar feeds, and manures. When we combine information with our own experience we gain knowledge. By practicing the application of that knowledge of over time and sharing it with others, we come into wisdom.

After being introduced to these concepts, I encourage you to take a personal pledge: Become a friend and champion of soil. Realize that all of our actions and choices impact the soil community, for better or for worse. Since all life depends on the health, vitality, and complexity of soil ecosystems, how can we not honor this most important life-enhancing process?

To be conscious of soil, and then to become a friend, champion, and enhancer of soil is a true and radical (to the root) path of holism. You can walk it silently, proclaim it on a tee shirt, or keep it in the closet: just do it. In whatever way you follow it, that path leads fully into the circle of life! Δ

Andrew Goodheart Brown wears many hats: permaculture teacher and practitioner, international consultant for small-scale agricultural projects, and field biologist, organic gardener and home orchardist; natural food chef and teacher, home brewer and artisanal bread baker, fermenter, and broom maker.

Notes

1. Campbell, Colin, quoted in *Crude Awakening*. 2006.
2. Volk, Tyler. *Gaia's Body*. 2004.

New Hope from an Ancient Technology
Biochar and Agriculture

James Bruges

"The main danger to the soil, and therewith not only to agriculture but to civilisation as a whole, stems from the townsman's determination to apply to agriculture the principles of industry."

—Fritz Schumacher, Small is Beautiful*, 1973*

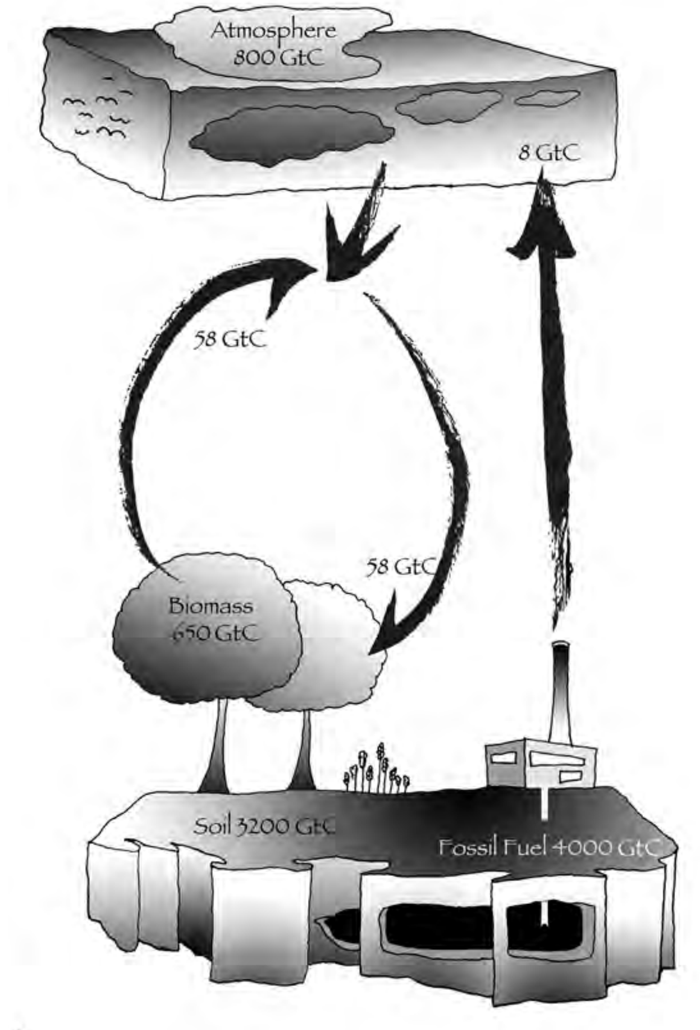
ONE OF MY FAVORITE STATEMENTS is by Herb Stein, an adviser to President Nixon who either thought there is no point in taking action to avert the inevitable or, alternatively, had a rather low opinion of politicians' intelligence. "If something can't go on forever," he said, "it will probably stop." Industrial farming falls into this category, yet the government and its advisers seem desperate to extend present policies into the future as if nothing will change.

We are entering a period of immense changes. Some are obvious, some are possible but uncertain, and some, particularly those relating to climate, may fall into Donald Rumsfeld's famous category of "unknown unknowns." When thinking about the introduction of biochar into farming we should concentrate on farming practices that will last rather than on those that will need to be abandoned.

Global warming, in addition to its other dangers, is now acknowledged as a serious threat to the production of food. And the production of food is one of its greatest causes. "Agriculture, forestry, and other changes in land use are responsible for 30% of human-caused greenhouse gas emissions," says a *Worldwatch Report* in 2009. "Changing how we grow crops, raise livestock, and use land can reduce greenhouse gas emissions and increase carbon sequestration and storage." In order to achieve a stable climate, these emissions don't just need to be reduced to zero; the land needs to become a net sink for carbon dioxide. The IPCC says that better agricultural practice could extract at least 4.4 billion tons of carbon dioxide equivalent from the atmosphere annually by 2030.

Soil is the largest carbon sink over which we have control.

Much can be done with an understanding of how carbon is retained in the soil through good land management. Biochar would be a further bonus: it extracts yet more carbon from the atmosphere; it results in carbon being retained more permanently; it increases fertility; it is effective in reviving degraded soil; and is of particular value in the tropics, where temperatures above 250˚C (77ºF) increase the rate at which soil organic matter is oxidized.



The Carbon Cycle

Much of the literature on biochar applies the new technology to existing farming practice. I present here reasons why many aspects of industrial farming cannot be regarded as permanent. Organic farming, at the other extreme, is often considered a matter of opinion, prejudice, or lifestyle choice. But we are facing both a climate crisis and a food crisis. The discussion should not be polarized. We need analysis of how all agriculture can be made sustainable and how biochar can contribute to this.

The transition to sustainable cultivation will make profound changes to our lives. It will affect how and by whom food is grown. It will affect distribution: where and from whom we buy our food. And it will open up new possibilities for where we live and what occupations we pursue. On the psychological side, the transition will lead to new ideas about how we relate to each other, what we mean by security, and where we look for satisfactions. Integrated into these changes will be the use of biochar to reduce greenhouse gases and increase yield. Some communities are already looking for ways to adjust to the changing situation through the Transition movement, as described in Rob Hopkins' book, *The Transition Handbook*.

Biochar should be regarded as a natural component of sustainable farming. The book *Biochar for Environmental Management* gives evidence that most soils contain some char that was left by forest fires during the last few thousand years. In some places there are significant quantities. Biochar, therefore, is not an alien introduction like synthetic chemicals, but can be thought of as "natural," to run alongside compost, green manure, and crop rotation. Soil that has been degraded by synthetic chemicals, however, is "unnatural." The addition of biochar may benefit almost any soil if used intelligently, but it is particularly useful where the land has been compacted or lost its fertility. The book also gives evidence that biochar worked into the soil can increase soil carbon in a way that is more stable than can be achieved with ordinary compost and manures, and to support this it mentions specific studies carried out in Australia, the US, Germany, Russia, and Kenya.

The development of agriculture is partly influenced by government and partly by economics. Government and modern economics take food for granted, since, financially speaking the agricultural sector in wealthy countries is such a small part of the overall economy. This is short-sighted. Previous generations have managed without cars, central heating, television, mobile phones, and most of those things by which we measure the wealth of a nation. But they never managed without food. Now, globally, there are more people hungry than ever before. Between 2005 and 2008 the global price of wheat and corn tripled, and the carry-over stocks fell to just 61 days of global consumption, a record low. Ocean fish are being pursued to extinction. Global warming is beginning to cause droughts and floods that affect food production. Aid to poor countries is being withheld due to the recession. On top of all this comes the most immediate threat to food supplies—peak oil—and the even more serious longer-term threat of peak phosphorus. Politicians and economists will be forced to recognize the centrality of sustainable farming in the economy of the real world.

Biochar should be regarded as a natural component of sustainable farming.

For example, the attempt to keep Britain self-sufficient in food was abandoned by the free-market policies of Margaret Thatcher and New Labour. Apples from New Zealand are cheaper than home-grown apples, so orchards were pulled up. Britain now imports 90 percent of its fruit and 47 percent of its vegetables. The uncertainty of fuel for transport and the vagaries of international finance put our imports at risk.

Threats from the agricultural base of society are not new phenomena. Classic examples, among many, are the Indus civilization and those of the Fertile Crescent, which rose and collapsed due to dependence on irrigation that brought salts to the surface. Their once-rich land has remained infertile through the centuries. Modern farming has found ways to damage the land more thoroughly and more extensively than ever before, through replacing natural nutrition with synthetic chemicals. The fate of

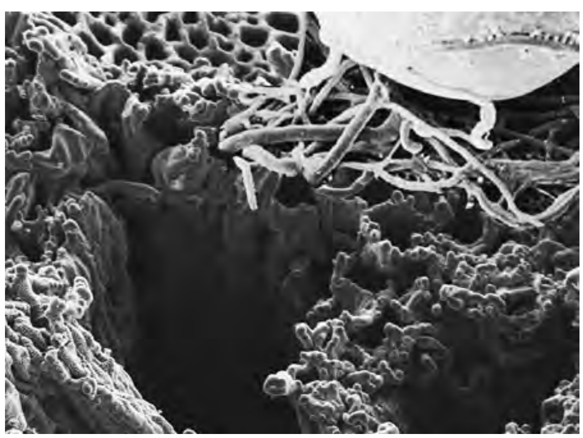
…it is particularly useful where the land has been compacted or lost its fertility.

those civilisations could be ours, not due to conflict or economic collapse, but due to failure of the agricultural base.

Soil realities

"Among material resources, the greatest, unquestionably, is the land." This is how Fritz Schumacher opened a chapter entitled "The Proper Use of the Land" in *Small is Beautiful*. He continued: "Study how a society uses the land and you can come to pretty reliable conclusions as to what its future will be. The land carries the topsoil and the topsoil carries an immense variety of living beings including man."

Under most conditions it takes between 3,000 and 12,000 years to build enough soil to form productive land. Soil that is richest in minerals originated from glaciers scraping the surface off rocks, and from ash and lava that have come out of volcanoes. Like most natural things, soil can recover from damage, overgrazing, or too widespread use. But it can also be lost. Degradation, compaction, erosion and salination are widespread due to bad farming practice. Soil is the largest carbon sink over which we have control.



Fungi growing into the pore structure of biochar.

Modern agriculture uses land as if it were an inert material on which we provide all the fertility the plants need. Artificial fertilizers were introduced in 1909 when the Haber-Bosch process produced ammonia (NH_3). This is regarded as one of the great achievements of modern science. To start with, the process just required masses of energy to extract nitrogen from air, then ways were found to get it from natural gas, and China is now using coal to produce it. But the manufacture of these fertilizers alone still uses more than one percent of global energy, so the process itself has significance for climate change.

But the use of nitrogen fertilizer produced by this process is of greater concern because it results in emissions of nitrous oxide (N_2O) that have a greenhouse effect 300 times as strong as carbon dioxide. Worldwide, the emission of nitrous oxide caused by nitrogen fertilizers is equivalent to seven percent of all emissions from burning fossil fuels. Since industrial farming "can't go on forever" without nitrogen fertilizer, "it will probably stop."

But emissions are not the only problem. Plants don't take up all the nitrogen. Some of it gets into the groundwater or runs off the surface to pollute rivers. "Diffuse nitrate pollution puts a question mark over the future compatibility of UK food production and public water supplies," said Professor Bradley

...biochar could be useful (in preventing erosion and maintaining soil structure) due to its moisture-retention properties and its affinity with the roots of plants.

of the environmental agency ADAS in 2006. "What's more, this problem isn't limited to the UK but applies across much of Europe. The only way to safeguard the future of our water resource is to convert much of our arable land into unfertilised, restorative grassland or forest." In other words, we can either have industrially farmed food or drinking water, but not both.

Fungicides, insecticides, and herbicides now maintain the productivity of crops. They are made from fossil fuels. These -cides (dictionary definition: a thing that kills) have a disturbing origin. Chemical companies that developed poison gases for the two world wars and for Vietnam needed to have something to sell in peacetime, so they modified their chemicals to kill insects and microbes rather than people and forests. Rachel Carson wrote *Silent Spring* in 1962 to warn of the consequences, which (we now see) are contributing to the fifth mass extinction: a "microbial" extinction with similarities to four of the other ones. But the attack on the land has only intensified. The companies are now developing herbicide- and insecticide-tolerant genetically modified (GM) plants so that more poisons can be sprayed onto food crops right up to the time of harvest, which is hardly reassuring for the consumer. The companies are, in effect, carrying out a massive experiment on us and on the land with virtually no research into the long-term consequences. In Britain the Food Standards Agency seems to be running an aggressive campaign to denigrate organic farming and support the use of synthetic chemicals and GM crops.

Livestock corporations find it more efficient—in terms of profit—to separate animals from crops, depriving animals of a natural environment. This makes two problems out of one solution. The solution was to mix straw and dung to fertilize the fields. The two problems are how to dispose of the excrement and what to do with the straw. One fears that biochar may be introduced into the process to justify the status quo.

The Green Revolution, which resulted from the development of a few thirsty hybrid plants dependent on artificial chemicals, was immensely successful. These crops had minimum contact with the soil through diminished roots, and put all their energy into the grain. As a result modern agriculture enabled the population to increase exponentially. The recommendation for birth control that Rev. Thomas Malthus made in 1798, and for which he was stigmatized, was ignored until recently.

But this approach to farming destroyed the natural factory of the soil: without biological structure to hold it together, it drifts into the oceans or blows away in the wind. It has been estimated that the US has lost half its topsoil during the last 100 years. The arid cornfields of northern France and East Anglia have probably suffered in the same way. This is an aspect of cultivation where biochar could be useful due to its moisture-retention properties and its affinity with the roots of plants.

Industrial farming in many locations relies on irrigation fed by deep-bore wells that drain ancient "fossil" aquifers. Some, like the Ogallala under America's wheat belt or the one under Arizona, have only a decade or two left.

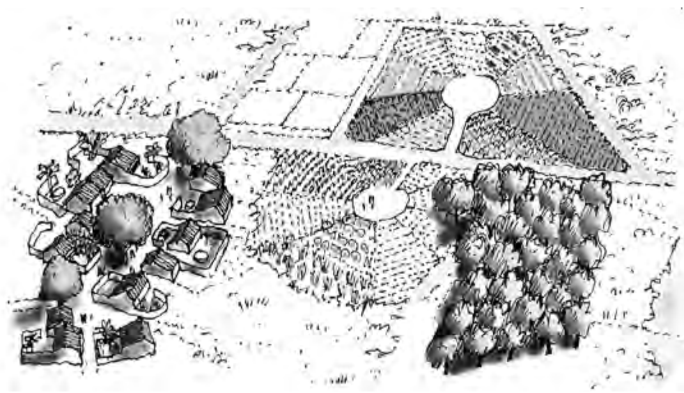
There is widespread concern over the future of bees for pollinating crops. A third of our food is dependent on their services. Colony Collapse Disorder (CCD) is now widely

Academic and practical research into biochar needs to focus primarily on sustainable farming methods.

reported. In the UK a third of beehives have been lost over the last two years. No single reason has been identified, but it must be at least partly related to monoculture crops and our use of synthetic chemicals throughout the countryside.

It has been known for the last ten years that a particularly nasty group of insecticides called neonicotinoids has been directly responsible for the loss of hives. They work by blocking specific neural pathways in the insects' central nervous system, and this prevents forager bees from imparting precise directions to the others. Neonicotinoids were banned in France, Germany and Italy, though the US, Canada, and the UK still allow them. The UK has carried out no research, and uses the lack of proof as a reason not to resist pressure from corporate lobbies. We will, of course, be saved the cost of research when there are no bees left on which to do research. But we will be hungry.

The plow has been with us since the dawn of agriculture, so one can't blame industrial farming for all its faults. However, it turns soil upside down, suffocates aerobic microbes and exposes anaerobic microbes to oxygen. Soil carbon, also exposed, oxidizes into carbon dioxide. The soil becomes less fertile and greenhouse gases are released. It is more damaging in temperatures over 25˚C (77ºF). Loss of carbon—often referred



Smallholdings play an important part in our future.

to as loss of soil organic matter (SOM)—is the reason why it has been essential to regenerate the land with manure, compost, green manure, and crop rotation. The deterioration could be contained when plows were pulled by horses, but 100 horse-power tractors have massively accelerated the damage, and are one of the reasons why chemical fertilizers have become essential. Think of the postcards of idyllic rural scenes with birds flocking behind the horse-drawn plow, then watch a modern plow in action: not a bird in sight. The birds know that the soil is dead.

Nearly 250 million acres, seven percent of the world's arable land, is under no-till management. The amount is growing rapidly as rising fossil fuel prices increase the cost of tillage and also to reduce topsoil losses. The practice sometimes uses nitrogen fertilizer drilled in with genetically modified seed that allow herbicides to control the weeds. In Parana, Brazil, however, farmers have developed no-till organic systems. The farmers have found that the yield of wheat and soybeans is a third more than conventionally plowed plots. The practice is spreading, and researchers around the U.S., including at the Rodale Institute in Pennsylvania, are also developing organic no-till tools and methods.

Sustainable farming and gardening methods are being tried, but as yet they are regarded as marginal, incidental to the serious business of industrial farming. However, when industrial farming collapses we will be left with chemical-free methods such as organic cultivation, permaculture, forest gardens, allotments, and backyard gardens to provide the bulk of our food. Academic and practical research into biochar needs to focus primarily on these sustainable farming methods. ∆

This excerpt from The Biochar Debate: Charcoal's Potential to Reverse Climate Change and Build Soil Fertility *reprinted with permission. (http://www.chelseagreen.com/bookstore/item/the_biochar_debate:paperback)*

A Miracle of Mulch

From Rocky Mountains to Rich Soil

Jerome Osentowski

FOR ANY AGRICULTURAL ENDEAVOR, soil building is an ongoing life process which reflects the health of the food production system. When we began the Central Rocky Mountain Permaculture Institute (CRMPI) more than 20 years ago, we aimed to demonstrate sustainability and self-reliance, which meant food production among many other things. Since we are located at 7,200 feet above sea level on the western slope of the Rockies, we faced more than a few adverse factors. Our climate is cold and dry. The Institute gardens hang onto a narrow ridge between very steep slopes halfway up Basalt Mountain. There was very little organic matter present and under typical conditions, plant growth is slow and diversity is low. The only abundant resource is sunshine. Starting with shallow, iron-rich, alkaline soils and few onsite resources, we have had to overcome steep slopes, poor water retention, and compaction. That we can grow anything here at all seems something of a miracle.

Phoenix in early July 2009. Foot-deep sheet mulch with a thin layer of topsoil. The summer crop nursery is on the right, with the tropical nursery behind it, waiting to be planted. The culverts in the middle are air intakes for the active solar subterranean soil heating system. The barrels against the south wall catch roof water, which is then pumped to larger tanks on the northern wall.

By employing the methods of sheet mulching, mycorrhizal management, and promoting a diverse population of beneficial insects and worms, we have turned an unlikely spot into an agricultural paradise.

The success of our integrated system here is founded in the permaculture approach to problem solving and creative design. By employing the methods of sheet mulching, mycorrhizal management, and promoting a diverse population of beneficial insects and worms, we have turned an unlikely spot into an agricultural paradise. I will try to explain how we have used the principles of permaculture to create diverse, living soils in our growing spaces.

Sheet mulch in the greenhouse

Sheet mulching is often the most effective way to turn local biomass into rich, fertile soils. The process I describe here is calibrated for sheet mulching a 72’ x 26’ greenhouse, but can be replicated on any scale (such as a single garden bed) using diverse resources.

Our process at CRMPI started in the mid-90s in a free-standing greenhouse named Pele, when raised beds that had been used for annual market crops were converted into perennial polycultures. By alternating layers of straw, rotten hay, leaves, wood chips, and manure, we laid our foundation of organic material about a foot deep. We then introduced worms, mycelia (beneficial soil fungi), and water and let the digestion process flourish through the winter.

The following spring we planted a tropical food forest and a Mediterranean forest garden into the layered mulch, with basil, eggplant, peppers, and tomatoes filling the growing space in between perennials. Instead of adding compost as we had when growing annual market crops, we added a generous helping of mulch to the new plantings, and relied on our natural allies—mycelia, worms, microorganisms, and bacteria—to break down the organic matter. We added extra worms with each mulching, and season-by-season, this has evolved to be the only soil treatment we need. By continuously adding mulch, we ensure that the worms, mycelia, and pillbugs have something to break down and turn into rich topsoil, full of humus. The market crops we raised in there before needed annual applications of compost to maintain the organic content of the soil. By using the sheet mulch method, in conjunction with the beneficial ecological effects of the perennial polyculture, we have been able to nourish and build our soil through the creation of habitat in mulch.

This process of adding mulch to build soil evolved over ten years, until Pele unfortunately burned down in the autumn of 2007. The fire destroyed most of the plants, and a lot of the soil had to be removed during the cleanup process. When we rebuilt our new greenhouse (named Phoenix), we once again began the soil building process. In the new design, we made an addition to our passive solar heating system: a layer of subterranean soil-heating pipes, called the “Climate Battery.” This now keeps our greenhouse soils consistently at around 62°F (17°C).

On what was left of the existing topsoil in Phoenix, we added a foot of sheet mulch. This time it was of a different mix—coppiced Siberian pea shrub, comfrey, straw, llama manure, wood chips, and ashes from our wood stove. There is no one recipe for sheet mulching, other than the creative use of onsite and local resources. Where we had used local straw, hay, and manure in the past, we applied comfrey and Siberian pea shrub trimmings from the garden (essentially a green manure) to the new mulch. The range of materials you can use for sheet mulch is seemingly limitless. Regardless of what you use, the forces of nature combined with the power of microorganisms will render your unique blend into fertile soil. Be encouraged, because every site and microclimate can use different materials to create the same result: fertile, living soil.

Regardless of what you use, the forces of nature combined with the power of microorganisms will likely render your unique blend into fertile soil.

In the spring of 2009, when our perennial Mediterranean and tropical plants for the indoor forest garden arrived, we planted them in a nursery to let them get established. In April and May, we sheet mulched the entire Phoenix greenhouse, then newly enclosed. In early July we planted out these freshly mulched beds with tomatoes, eggplants, peppers, basil, and beneficial flowers. After a continuous six months of growth and harvest, it was time to plant the warm-climate perennials and add another layer of mulch with yet another combination of materials. This is a good example of stacking time; growing out one crop of plants in a nursery while harvesting another from the sheet-mulched greenhouse. This provided us with an extra yield and time for the tropical perennials to mature. In January when production slowed, we took out our annual crop and planted the perennial food forest in its place. Because we did not yet have enough depth in our mulch to accommodate the 15-gallon plants, we placed them in shallow holes and sheet mulched up around their bases. In between the perennials, we planted a variety of brassicas, peas, and beans which will provide a large yield in the spring. After harvesting the spring vegetables, we will add another layer of mulch to start our summer crop of melons, cucumbers, squash, and nightshades around the tropical and Mediterranean perennials. Eventually the understory of this tropical food forest will have perennial ground covers and tubers of those warm climates—Bolivian sunroot, sweet potato, yam, pineapple, artichoke, and lemongrass, some of which have already been planted.

Phoenix with the annual summer crops thriving in the sheet mulch. The bulk of this crop was harvested for six or seven months before being replaced. Some of the plants were left to be continuously harvested.

Sheet mulch in the forest garden

In the outdoor forest garden, we use a similar sheet mulch technique. In a newly terraced bed, we lay down a combination of the usual—straw, rotten hay, manure, wood chips, comfrey, green weeds, horseradish leaves, coppiced Siberian pea shrub, etc. Our design is first to plant perennial trees and shrubs and mulch heavily, then plant annual vegetables and herbaceous perennials into pockets of the mulch.

In this way we take advantage of the opportunities in ecological succession. Succession is the natural maturation process of any ecosystem—the evolution of microclimate, soil character, and biotic composition of a given area. There are many ways to benefit from niches in this process.

Rather than planting a forest guild (a group of plants that provide each other with mutual ecological benefits) at a specific spacing, and then leaving the mostly open area alone as the woody perennials mature to their productive stage, we take advantage of the potential productivity of the area right away. When expanding our garden in a new terrace, we plant the trees and shrubs, add mulch, and then add the annuals and herbaceous perennials. By interplanting annuals in the forest garden—even sun-loving annuals—we find that we can often reap a few years' worth of harvests before the understory gets too shady. At that point, we continue to mulch, and put in perennial flowers, medicinal plants, and culinary herbs which can flourish amidst the trees. After several years, we are no longer disturbing the soil, but adding whatever materials come to the farm through the seasons.

Annuals as a catch crop

Through this evolving and cyclical process, we have developed a rewarding no-till, no-dig method of growing annual vegetables in newly created beds. Beginning in clay subsoils, we add three to four inches of sheet mulch and worms, and spread a half-inch or so of topsoil. Next, we broadcast our salad greens and other vegetable seeds, lightly brushing the top of the soil with our hands to get the seeds more firmly into the soil, and finally cover the bed with Reemay (a row cover fabric) to prevent the young seedlings from drying out. We harvest many cuttings of salad and vegetables from these beds.

After our final harvest in late fall, we pull up everything that remains and leave it in the bed to use as a green manure. On top of that we add three to four inches of sheet mulch plus worms and mycelia, and just before the snow, another two to three inches of leaves to help the bed winter over. When the snow melts in the spring, we will spread a half-inch of topsoil on the leaves, and broadcast our seeds, starting the cycle again. Over the past four years, we have created nearly five inches of fertile topsoil on top of the clay subsoil we began with.

Deanna and Jack Heimsoth firming the broadcast seeds into the thin layer of soil on top of the sheet mulch.

The crops we've found to do particularly well here are salad greens, kale, chard, beets, peas, turnips, purslane, lambsquarters, and pigweed, a kind of amaranth. Some of these are commonly recognized as "weeds," but we intentionally plant and harvest them as extra crops for our animals and ourselves. The beauty is that each year, we grow wonderfully healthy crops with minimal labor, digging, and weeding. When our perennial food forest shades out the current annual production, we will simply take our sheet mulch method to other parts of the site to build soil and continue the annual production.

Phoenix in February 2010—Tropical perennials planted into sheet mulch with pulse crop of brassicas plus fava, pole, bush, and scarlet runner beans to climb up the papayas. Dragon fruit in the left-hand corner is climbing up to the sleeping platform. Bolivian sunroot and sweet potatoes as a perennial ground cover.

We are worm farmers

This discussion of the ease of soil building and sheet mulch is misleading without a description of the very hard work we rely on from our friends, the worms. Here at CRMPI, they are our draft animals, so to speak, with a pretty appealing job description: eat as much as you can.

Worms are an integral component in the success of our sheet mulches. In order to ensure an abundant vermicular labor force, we are constantly building worm farms—either in 15-gallon nursery pots, in outdoor worm piles, or in indoor or outdoor worm bins. This practice helps us to achieve fertile soils, provides another revenue stream from selling the worms, and ensures that no possible food scrap goes to waste.

We farm worms in several ways:

1) In 15-gallon nursery pots. We take three pots, fill them up with organic material (kitchen scraps, straw, leaves, etc.), then add some worms and water as a starter. Then we stack the three pots one on top of another, keep them moist, and wait for a month-and-a-half. After the digestion process, we can take one of the pots, divide the worms of that pot into three new pots and

begin the process again.

2) In an outdoor pile. In the summertime, we keep a pile of organic matter full of worms where we bury our kitchen scraps. We keep the pile covered with a tarp to prevent the chickens from eating it and to keep it from drying out. In the fall we cover the pile with a thick layer of leaves to winter over. Remember that worms do not need specially built bins made in the cabinet shop or some contraption ordered over the Internet. Keep it simple.

3) In our greenhouse beds. In actuality, the bed of annuals along the south wall of the greenhouse is really a worm farm that gets planted twice a year. The entire bed is a 3-foot deep sheet mulch of worm food that will, over time, become rich soil. In the fall, to facilitate the germination of our direct-seeded winter crop, we spread a thin layer of topsoil. In the spring, we transplant seedling basil from four-inch pots into this same bed as a cash crop. Over time, through decomposition, this area will lose volume. However, as the worms multiply, we will continue to layer in materials and be left with fertile soil—black gold.

Our design is to plant perennial trees and shrubs, and mulch heavily, then plant annual vegetables and herbaceous perennials into pockets of the mulch.

This is a great example of stacking functions: first, we are growing a crop and achieving a yield; second, we are multiplying livestock to use and sell; third, we are creating rich fertile soil; and fourth, we are having fun doing it. Everything we do serves multiple functions, makes beneficial connections between elements, and it all cycles energy and materials through the different parts of the farm. By mulching and building soil in our growing spaces, we are allowing nature's processes to flourish and work for us, which is fundamentally what permaculture is all about. Δ

A first-year forest garden bed with grafted fruit trees as an over-story, berries as a mid-story, and brassicas, salad greens, fava beans, and peas planted as a summer pulse crop, ensuring an abundant inaugural year.

Jerome Osentowski is the founder and director of the Central Rocky Mountain Permaculture Institute (CRMPI), one of the oldest continually operating permaculture facilities in the United States. His half-acre demonstration site began as a successful commercial market garden. It has evolved into a series of greenhouses and a permanent forest garden, characterized by a complex integration of perennial edibles, fruit and nitrogen-fixing trees, medicinal herbs, and annual vegetables.

Tropical Systems

Hawai'ian Farm Builds Soil with Worms

Sarah Straley

FROM THE DEPTHS OF AN OHIO WINTER, I set myself on a course for some fun in the sun, but I couldn't leave my curiosity behind. I had to learn something about farming in the tropics on my way to a suntan. Which of us has never wandered in an exotic biome and and wanted to learn, "How are folks growing food here?" I know many permaculturists seek out gardens and farms when they travel.

Dropping out of the stratosphere onto Oahu, the third largest and most populated island of Hawaii's archipelago, I explored a five-acre farm that is putting the typical red clay soils there to good use. Olomana Gardens, a commercial farm which invites the curious and the hungry to discover the magic of integrated design, is home to many ducks, chickens, horses, goats, rabbits, koi, thousands of plants, and millions of worms. Glenn and Liz Martinez, who carved Olomana out of the Hawaiian forest in 1996, are dedicated permaculturists, hosting daily tours, school workshops, and sustainability gatherings.

Located just a few miles off the Kalanianaole Highway over the Ko'olau range from Honolulu on the island's windward side, this modern garden boasts cutting-edge aquaponics systems, fruit orchards, pallet gardening, composting, and vermicomposting that smells happy and loamy. It's a wonder that Glenn or Liz have time to do anything other than manage their plants and animals, but with an important nod to working hard and the symbiosis that Mother Nature naturally deploys, Glenn casually remarks, "We work 8 am to noon, and then the rest of the day is open."

Chickens grasing for worms at Olomana Gardens.

For folks concerned with growing plants, tropical soils are typically acidic. A popular way to make them more balanced is biochar remediation.

Tropical soils

All a person needs to do to meet the soil of the tropics is to get there—by plane, train, or astral projection, then lift up the first layer of detritus. The soil should look red or like *lepo* (Hawaiian for clay or soil). You may notice the absence of humus. This is due to such factors as the high temperatures, rapid decomposition, and elevated rainfall.

For folks concerned with growing plants, tropical soils are typically acidic. A popular way to make them more balanced is through biochar remediation. Biochar is made by pyrolysis, or the slow heating of organic wastes in a kiln. Volatile gases are driven off and what remains is charcoal with a rich pore structure that can hold water and nutrients. Called dark earth, or *terra preta* as it is known in Portuguese, biochar is durable even in the hot, rainy tropics, and was first discovered more than 30 years ago to have been used by pre-Columbian people of the Amazon to create remarkably fertile soils that have persisted to this day. Of late, biochar is gaining attention due to its potential to reverse climate change by pulling carbon from the atmosphere and storing it stably in the soil. It's a simple technology that is potentially available to small farmers around the planet. Another reason to use biochar is because, as Glenn says, "It's miracle stuff." And who doesn't need a miracle, especially industrious farmers working to make agriculture more sustainable.

At Olomana Gardens, they make the biochar in a nested, double drum to "char" coconut shells. Basically high heat in the outer drum cooks the biomass in the inner drum, turning it into charcoal. It's then mixed with biodynamic preparations and voilà, beautiful soil.

Another soil amendment practice that Olomana Gardens uses with good results is sheet mulching. Three horses live on the farm, and their manure is mixed with wood chips and put into a large compost pile. Glenn turns the pile with a tractor every week and monitors its temperature to assure that it reaches 131˚F, which is the temperature needed to kill all pathogens. It is then used on the food crops or sold for a $1/lb.

Tropical clay soils present a challenge to obtaining a yield, yet increased fertility has been realized through different methods—most notably aquaponics systems, and the use of Indian blue worms and animal manure.

Making the clay pay

Tropical clay soils present a challenge to obtaining a yield. Yet Olomana has increased fertility through different methods—most notably aquaponics systems, and the use of Indian blue worms and animal manure.

When I first arrived at the farm, one of the first objects to catch my attention was a demonstration aquaponics system: it was covered with bright orange, blue, and yellow fake flowers. Glenn and Liz take their demo model all over Oahu, especially to schools, to train people about basic aquaponics. By way of introducing the system, Glenn quickly shares his mantra, "One country, one God, one pump," and proudly shows that his systems do indeed only have one pump.

One of the most interesting things about the system is that it is eight times more productive and twice as fast to grow plants as regular garden beds. Once I got past the demonstration exhibit and the fake flowers, I found fifteen 100-gallon garden beds connected to a 1,500-gallon tilapia tank. Lava rocks or cinder, taken from the Big Island, support the plants in the beds, while the pump circulates water from the fish tank through the lava rocks. The fish tank water must not be allowed to pool on top of the cinders, as mold and fungus might then develop in the plants. To accomplish this, the upper two inches of the lava rocks are kept dry by the use of a siphoning system. This avoids damping off and other fungal problems common to top-down misting systems.

The crop plants, including tomatoes, chard, herbs, taro, tapioca, and strawberries, are started in small blocks (like soil blocks) made of worm castings (no soil), and the roots shoot out from there to anchor themselves among the cinders. Most of the food is harvested within 30 days. This garden feeds about 20 families each week. Olomana also sells the tilapia at a market price of about $6/lb.

One god, one country, one pump…

Tilapia are a favored warm-weather aquaculture species because they tolerate crowding and turbid, nutrient-rich water, and thus can be more easily managed in tanks. But as a life preserver for the fish, there is a "living machine" connected to the fish tank. This biofilter uses wetland plants, living in cinder, in a 350-gallon tank. A $100 pond pump lifts water continuously from the fish tank to the biofilter tank. Power to run it costs about $6/month. Once the filter tank fills with water, it will trip a siphon's flush point, causing the water to drain by gravity back into the fish tank. The filter acts as a living machine with the pump as the heart and the plants as the lungs. All this with a car battery and a 12-volt pump!

So if God and Glenn only want permaculturists to use one pump, then how many worms? Millions, yes, millions. They're industrious little friends and they work for scraps—even papaya scraps. Glenn makes an important point, noting that he can earn around $6/lb. for his tilapia, but for his worms, he can bring in $40/lb. It may help that Olomana is one of only three farms licensed to raise and sell worms in the state.

At Olomana Gardens, it's all about the worms. They are a

Aquaponics systems can be extremely producive.

Worm casting blocks ready to nourish seedlings for the garden.

valued renewable resource offering lots of services. They're everywhere, and their castings have led to some bountiful yields. The tropical climate allows the worms to work in the topsoil all year round. As Glenn leads tours around his farm he asks, "Notice the smell?"…"That's my barnyard." Indeed, there's not much of an odor thanks to the worms and their penchant for scat.

The worm castings are used for the aquaponics growing blocks. The worms also wriggle through the barnyard to keep the manure down. Plastic mats with holes are kept over the hen house floor so that manure can drop down to the soil below, where the worms can safely come up and do their thing. When it's time for a snack, Glenn just moves a couple mats and the birds come a runnin'. His eggs sell for $6/dozen. They are pretty delicious considering the birds eat a diet of papaya, worms, and azolla, a floating, nitrogen-fixing plant that lives in the fish- and filter tanks.

Another high yielding function of worm love is Glenn's papaya grove. The plants are typically tall and skinny, even fragile. They are not really trees but large herbs with woody stems that can reach 25 feet. It would be difficult to put a ladder against a typical papaya without causing some stress. Here, the trees are grown in three feet of worm castings and sprayed with worm casting tea. The use of worm castings results in heavy yields, so much so that the papaya limbs droop downward under a heavy load of fruit. Another benefit of worm castings in the orchard is that the soil is kept well aerated and doesn't get compacted. Sweet potato and comfrey are grown as companions to retain moisture and provide mulch. It's a sweet orchard.

Simplicity in diversity

As David Holmgren writes in his book *Permaculture: Principles and Pathways Beyond Sustainability,* "In soil ecology, a vast diversity of organisms and microorganisms contribute to the recycling of organic matter. Earthworms are the most easily observed; they digest organic matter and turn it into soil humus. In healthy soil, a dynamic and complementary balance

One of the most interesting things about his whole system is that it is eight times more productive and twice as fast to grow plants as regular garden beds.

Comfrey and sweet potato provide ground cover in the papaya grove, as well as mulch, edible tubers, and greens.

of fungi and bacteria complements the macro-scale activities of the worms." At Olomana Gardens, the ducks, chickens, horses, goats, rabbits, koi, plants and worms support the many elements which create the whole of a sustainable, commercial farm, found somewhere near the Tropic of Cancer, on a remote island in paradise. Δ

Sarah Straley trained in permaculture in 2008 while working with Simply Living. A mother of one, she lives near Columbus, Ohio.

The Poop on Composting Toilets

Demystifying Human Waste

Joe Jenkins

People around the world have followed the logic of reconnecting themselves to the natural world not only by growing their own food, but by rendering their wastes into compost for the garden thanks to the passionate advocacy of Joe Jenkins, author of The Humanure Handbook*—now in its 3rd edition. For more insight into the process and norms around human waste, we offer the following excerpt.*

TECHNICALLY, A "COMPOSTING TOILET" is a toilet in which composting takes place. Usually, the composting chamber is located under the toilet. Other toilets are simply collection devices in which humanure is deposited, then removed to a separate composting location away from the toilet area. These toilets are components of "composting toilet systems," rather than composting toilets, per se. They can also be called "compost toilets."

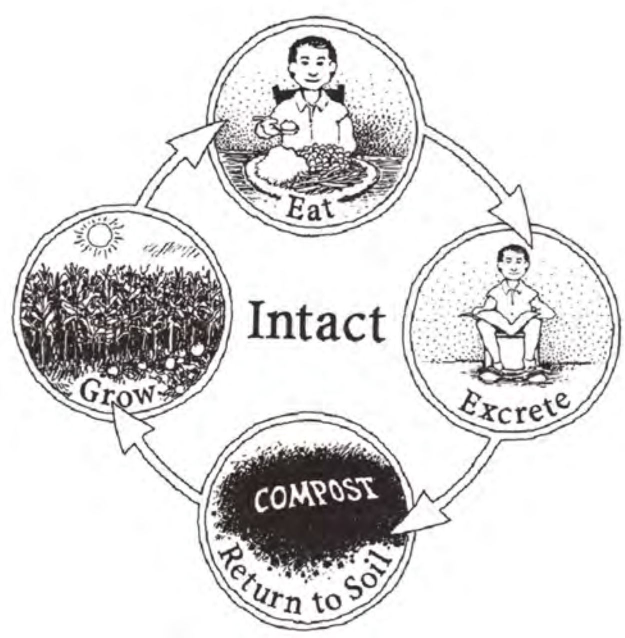
Humanure composting toilets and systems can be divided into two categories based on the composting temperatures they generate.

Humanure composting toilets and systems can generally be divided into two categories based on the composting temperatures they generate. Some toilet systems produce thermophilic (hot) compost; others produce low-temperature compost. Most commercial and homemade composting toilets are low-temperature composting toilets, sometimes called "mouldering toilets."

The most basic way to compost humanure is simply to collect it in a toilet receptacle and add it to a compost pile. The toilet acts only as a collection device, while the composting takes place at a separate location. Such a toilet requires little, if any, expense and can be constructed and operated by people of simple means in a wide range of cultures around the world. It is easy to create thermophilic (hot) compost with such a collecting toilet.

The toilets of the future will also be collection devices rather than waste disposal devices. The collected organic material will be hauled away from homes, just as garbage is today, and composted under the responsibility of municipal authorities, perhaps under contract with private sector composting facilities. Currently, other recyclable materials such as bottles and cans are collected from homes by municipalities; in some areas organic food wasts are also collected and composted at centralized composting facilities.

The day will come when the collected organic materials will include toilet materials. In the meantime, homeowners who want to make compost rather than sewage must do so independently



by either constructing a composting toilet of their own, buying a commercial composting toilet, or using a simple collection toilet with a separate composting bin. The option one chooses depends upon how much money one wants to spend, where one lives, and how much involvement one wants in the compost-making process.

A simple collection toilet with a separate compost bin is the least expensive, but tends to be limited to homes where an outdoor compost bin can be utilized. Such a toilet is only attractive to people who don't mind the regular job of emptying containers of compost onto a compost pile, and who are willing to manage the compost responsibly to prevent odor and to ensure appropriate composting conditions.

Homemade composting toilets, on the other hand, generally include a compost bin beneath the toilet and do not involve transporting humanure to a separate composting area. They may be less expensive than commercial composting toilets, and they can be built to whatever capacity a household requires, allowing for some creativity in their design. They are usually permanent structures located under the dwelling in a crawl space or basement, but they can also be free-standing. The walls are typically made of a concrete material, and the toilets are most successful when properly managed. Such management includes the regular addition to the toilet contents of sufficient carbon-based material, such as sawdust, peat moss, straw, hay, etc. Homemade composting toilets do not require water or electricity.

Commercial composting toilets come in all shapes, types, sizes, and price ranges. They're usually made of fiberglass or plastic and consist of a composting chamber below the toilet seat. Some of them use water and some of them require electricity. Some require neither.

Composting toilets must be managed

We have used flush toilets for so long that after we defecate we expect to pull a handle and simply walk away. Some think that composting toilets should behave in the same manner. However, flush toilets are disposal devices that create pollution and squander soil fertility.

Composting toilets are recycling devices that should create no pollution and should recover the soil nutrients in human manure and urine. When you push a handle on a flush toilet, you're paying someone to dispose of your waste for you. Not only are you paying for the water, for the electricity, and for the wastewater treatment costs; but you are also contributing to the environmental problems inherent in waste disposal. When you use a composting toilet, you are getting paid for the small amount of effort you expend in recycling your organic material. Your payment is in the form of compost. Composting toilets, therefore, require some management. You have to do something besides just pushing a handle and walking away.

The degree of your involvement will depend on the type of toilet you are using. In most cases, this means simply adding some clean organic cover material such as peat moss, sawdust, rice hulls, or leaf mould to the toilet after each use. Instead of

flushing, you cover.

Nevertheless, someone must take responsibility for the overall management of the toilet. This is usually the homeowner or someone else who has volunteered for the task. Their job is simply to make sure sufficient cover materials are available and being used in the toilet.

They must also add bulking materials to the toilet contents when needed and make sure the toilet is not being used beyond its capacity, not becoming waterlogged, and not breeding flies. Remember that a composting toilet houses an organic mass with a high level of microbial diversity. The contents must be watched over and managed to ensure greatest success.

Fecophobia and the pathogen issue

The belief that humanure is unsafe for agricultural use is called fecophobia. People who are fecophobic can suffer from severe fecophobia or a relatively mild fecophobia. The mildest form is little more than a healthy concern about personal hygiene. Severe fecophobics do not want to use humanure for food growing, composted or not. They believe that it's dangerous and unwise to use such a material in their garden. Milder fecophobics may, however, compost humanure and use the finished compost in horticultural applications. People who are not fecophobic may compost humanure and utilize it in their food garden.

It is well known that humanure contains the potential to harbor disease-causing microorganisms or pathogens. This potential is directly related to the state of health of the population which is producing the excrement. If a family is composting its own humanure, for example, and it is a healthy family, the danger in the production and use of the compost will be very low. If one is composting the humanure from orphanages in Haiti where intestinal parasites are endemic, then extra precautions must be taken to ensure maximum pathogen death. Compost temperatures must rise significantly above the temperature of the human body (37°C or 98.6°F) in order to begin eliminating disease-causing organisms, since human pathogens thrive at temperatures similar to that of their hosts. On the other hand, most pathogens only have a limited viability outside the human body, and given enough time, will die even in low-temperature compost.

We have used flush toilets for so long that after we defecate we expect to simply pull a handle and walk away.

Humanure is best rendered hygienically safe by thermophilic composting. To achieve this, humanure can simply be collected and deposited on an outdoor compost pile like any other compost material. Open-air, outdoor compost piles with good access are easily managed and offer a no-cost, odorless method to achieve the thermophilic composting of humanure. However, such a system does require the regular collection and cartage of the organic material to the compost pile. This makes it relatively labor-intensive when compared to low-temperature, stationary, homemade and commercial composting toilets.

Many people will use a composting toilet only if they do not have to do anything in any way related to the toilet contents. Therefore, most homemade and commercial composting toilets are comprised of large composting chambers under the toilet seat. The organic material is deposited directly into a composting chamber, and the contents are emptied only very occasionally.

Thermophilic conditions do not seem to be common in these toilets, for several reasons. For one, many commercial composting toilets are designed to dehydrate the organic material deposited in them. This dehydration is achieved by electrical fans which rob the organic mass of moisture and heat. Commercial toilets also often strive to reduce the volume of material collecting in the composting chamber (mostly by dehydration), in order to limit the frequency of emptying for the sake of the convenience of the user. Bulky air-entrapping additions to the compost are not encouraged, although these additions will encourage thermophilic composting. Yet, even passive, low-temperature composting will eventually yield a relatively pathogen-free compost after a period of time.

Low-temperature composting toilets include most commercial and many homemade units. According to current scientific evidence, a few months retention time in just about any composting toilet will result in the deaths of nearly all human pathogens. The most persistent pathogen seems to be the roundworm *(Ascaris lumbricoides)* and particularly the egg of the roundworm, which is protected by an outer covering which resists chemicals and adverse environmental conditions. Estimates of the survival time of Ascaris eggs in certain soil types under certain conditions are as high as ten years. Although the Ascaris eggs are readily destroyed by thermophilic composting, they may survive in conditions generated by a low-temperature toilet. This is why the compost resulting from such toilets is generally not recommended for garden use if it comes in contact with food crops.

People can become rather obsessive about this issue. One man who published a book on this topic wrote to me to say that a two-year retention time in a low-temperature composting toilet is generally considered adequate for the destruction of Ascaris ova (eggs). He indicated that he would never consider using his own low-temperature compost until it had aged at least two years.

The degree of your involvement will depend on the type of toilet you are using.

I asked him if he was infected with roundworms. He said no. I asked him if anyone else was using his toilet. No. I asked him why he would think there could be roundworm eggs in his compost when he knew he didn't have roundworms in the first place? Sometimes common sense is not so common when issues of humanure are involved. This is similar to the phobic person who would never go to a movie theater because there might be someone in the theater who has tuberculosis and who might sneeze. Although this is a risk we all take, it's not likely to be a problem.

Owner-built composting toilets

Owner-built composting toilets are in widespread use throughout the world since many people do not have the financial resources required to purchase commercially-produced toilets. Owner-built devices tend to be low-temperature composting toilets, although they can conceivably be thermophilic toilet systems if properly managed.

The objectives of any composting toilet should be to achieve safe and sanitary treatment of fecal material, to conserve water, to function with a minimum of maintenance and energy consumption, to operate without unpleasant odors, and to recycle humanure back to the soil.

The primary advantage of low-temperature toilets is the passive involvement of the user. The toilet collection area need not be entered into very often unless, perhaps, to rake the pile flat. The pile that collects in the chamber must be raked somewhat every few months, which can be done through a floor access door. The chamber is emptied only after nothing has been deposited in it for at least a year or two, although this time period may vary depending on the individual system used.

In order for this system to work well, each toilet must have a minimum of two chambers. Fecal material and urine are deposited into the first chamber until it's full, then the second chamber is used while the first ages. By the time the second side is full, the first should be ready to empty. It may take several years to fill a side, depending on its capacity and the number of users. In addition to feces, carbonaceous organic matter such as sawdust, as well as bulky vegetable matter such as straw and weeds, are regu-

larly added to the chamber in use. A clean cover of such material is maintained over the compost at all times for odor prevention.

Some composting toilets involve the separation of urine from feces. This is done by urinating into a separate container or into a diversion device which causes the urine to collect separately from the feces. The reason for separating urine from feces is that the urine/feces blend contains too much nitrogen to allow for effective composting and the collected material can get too wet and odorous. Therefore, the urine is collected separately, reducing the nitrogen, the liquid content and the odor of the collected material.

An alternative method of achieving the same result which does not require the separation of urine from feces does exist. Organic material with too much nitrogen for effective composting (such as a urine/feces mixture) can be balanced by adding more carbon material such as sawdust, rather than by removing the urine. The added carbon material absorbs the excess liquid and will cover the refuse sufficiently to eliminate odor completely. This also sets the stage for thermophilic composting because of the carbon/nitrogen balancing.

One should first prime a composting toilet chamber before use by creating a "biological sponge," a thick layer of absorbent organic material in the bottom of the compost chamber to a depth of up to 50% of its capacity. Some suggest that the toilet can be filled to 100% of its capacity before beginning to be used, because if the material is loose (such as loose hay), it will compress under the weight of the added humanure. A bottom sponge may even consist of bales of hay or straw buried in sawdust. These materials absorb the excess urine as it is added to the toilet. Fecal material is covered after each use with materials such as sawdust, peat, leaf mould, or rice hulls. A drain into a five gallon bucket (perhaps pre-filled with sawdust) will collect any leachate, which can simply be deposited back on the compost pile. Extra bulking materials such as straw, weeds, hay, and food scraps are regularly added to the compost chamber to help oxygenate and feed the growing organic mass in order to promote thermophilic decomposition. Ventilation can be enhanced by utilizing a vertical pipe installed like a chimney, which will allow air to circulate passively into and out of the compost chamber.

Such systems will need to be custom-managed according to the circumstances of the individuals using them. Someone needs to keep an eye on the toilet chambers to make sure they're receiving enough bulking material. The deposits need to be flattened regularly so that they remain covered and odorless. Chutes that channel humanure from the toilet seat to the compost chamber must be cleaned regularly in order to prevent odors. When one compost chamber is filled, it must be rested while the other is filled. A close eye on the toilet contents will prevent waterlogging. Any leachate system must be monitored.

In short, any composting toilet will require some management.

Remember that you are actively recycling organic material, and that means you are doing something constructive. When you consider the value of the finished compost, you can also realize that every time you deposit into a composting toilet, it's as if you're putting money in the bank.

Homemade low-temperature composting toilets offer a method of composting humanure that is attractive to persons wanting a low-maintenance, low-cost, fairly passive approach to excrement recycling. Any effort which constructively returns organic refuse to the soil without polluting water or the environment certainly demands a high level of commendation.

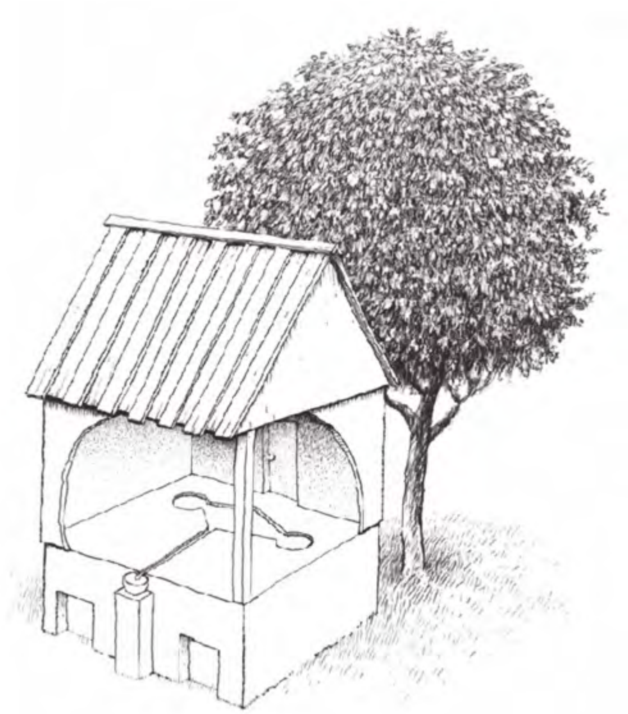
Asian composting

It is well known that Asians have recycled humanure for centuries, possibly millennia. How did they do it? Historical information concerning the composting of humanure in Asia seems difficult to find. Rybczynski et al. state that composting was only introduced to China in a systematic way in the 1930s and that it wasn't until 1956 that composting toilets were used on a wide scale in Vietnam. On the other hand, Franceys, et al tell us that composting "has been practiced by farmers and gardeners throughout the world for many centuries."

They add that, "In China, the practice of composting [humanure] with crop residues has enabled the soil to support high population densities without loss of fertility for more than 4000 years." However, a book published in 1978 and translated directly from the original Chinese indicates that composting has not been a cultural practice in China until recently. An agricultural report from the Province of Hopei, for example, states that the standardized management and hygienic disposal (i.e., composting) of excreta and urine was only initiated there in 1964. The composting techniques being developed at that time included the segregation of feces and urine, which were later "poured into a mixing tank and mixed well to form a dense fecal liquid" before piling on a compost heap. The compost was made of 25% human feces and urine, 25% livestock manure, 25% miscellaneous organic refuse and 25% soil.

Two aerobic methods of composting were reported to be in widespread use in China, according to the 1978 report. The two methods are described as: 1) surface aerobic continuous composting; and 2) pit aerobic continuous composting. The surface method involves constructing a compost pile around an internal framework of bamboo, approximately ten feet by ten feet by three feet high (3m x 3m x 1m). Compost ingredients include fecal material (both human and non-human), organic refuse, and soil. The bamboo poles are removed after the compost pile has been constructed—the resultant holes allowing for the penetration of air into this rather large pile of refuse. The pile is then covered with earth or an earth/horse manure mix and left to decompose for 20 to 30 days, after which the composted material is used in agriculture.

The pit method involves constructing compost pits five feet



Schematic of Vietnamese Double Vault composting toilet.

wide and four feet deep by various lengths, and digging channels in the floor of the pits. The channels (one lengthwise and two widthwise) are covered with coarse organic material such as millet stalks. A bamboo pole is then placed vertically along the walls of the pit at the end of each channel. The pit is then filled with organic refuse and covered with earth, and the bamboo poles are removed to allow for air circulation.

A report from a hygienic committee of the Province of Shantung provides us with additional information on Chinese composting. The report lists three traditional methods used in that province for the recycling of humanure:

1) Drying—"Drying has been the most common method of treating human excrement and urine for years." It is a method that causes a significant loss of nitrogen;

2) Using it raw, a method that is known to allow pathogen transmission; and

3) "Connecting the household pit privy to the pig pen . . . a method that has been used for centuries." This is an unsanitary method in which the excrement was simply eaten by a pig.

No mention is made whatsoever of composting being a traditional method used by the Chinese for recycling humanure. On the contrary, all indications were that the Chinese government in the 1960s was, at that time, attempting to establish composting as preferable to the three traditional recycling methods listed above, mainly because the three methods were hygienically unsafe,

Homemade low-temperature composting toilets offer a method that is attractive to persons wanting a low-maintenance, low-cost, approach to excrement recycling.

while composting—when properly managed—would destroy pathogens in humanure while preserving agriculturally valuable nutrients. This report also indicated that soil was being used as an ingredient in the compost, or, to quote directly, “Generally, it is adequate to combine 40-50% of excreta and urine with 50-60% of polluted soil and weeds.”

For further information on Asian composting, I must defer to Rybczynski et al, whose World Bank research on low-cost options for sanitation considered over 20,000 references and reviewed approximately 1,200 documents. Their review of Asian composting is brief, but includes the following information, which I have condensed:

There are no reports of composting privys or toilets being used on a wide scale until the 1950s, when the Democratic Republic of Vietnam initiated a five-year plan of rural hygiene and a large number of anaerobic composting toilets were built. These toilets, known as the Vietnamese Double Vault, consisted of two above ground water-tight tanks, or vaults, for the collection of humanure.

For a family of five to ten people, each vault was required to be 1.2 m wide, 0.7 m high, and 1.7 m long (approximately 4 feet wide by 28 inches high and 5 feet, 7 inches long). One tank is used until full and left to decompose while the other tank is used. The use of this sort of composting toilet requires the segregation of urine, which is diverted to a separate receptacle through a groove on the floor of the toilet.

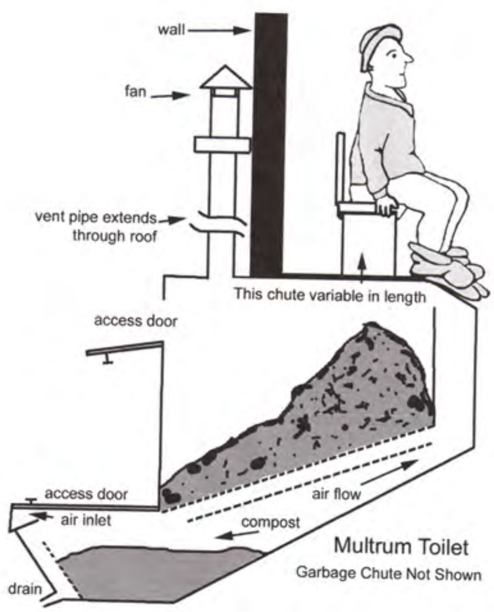
Fecal material is collected in the tank and covered with soil, where it decomposes anaerobically. Kitchen ashes are added to the fecal material for the purpose of reducing odor. Eighty-five percent of intestinal worm eggs, one of the most persistently viable forms of human pathogens, were found to be destroyed after a two-month composting period in this system. However, according to Vietnamese health authorities, 45 days in a sealed vault is adequate for the complete destruction of all bacteria and intestinal parasites (presumably they mean pathogenic bacteria).

Compost from such latrines is reported to increase crop yields by 10-25% in comparison to the use of raw humanure. The success of the Vietnamese Double Vault required “long and persistent health education programs.”

When the Vietnamese Double Vault composting toilet system was exported to Mexico and Central America, the result was “overwhelmingly positive,” according to one source, who adds, “Properly managed, there is no smell and no fly breeding in these toilets. They seem to work particularly well in the dry climate of the Mexican highlands. Where the system has failed because of wetness in the processing chamber, odors, or fly breeding, it was usually due to non-existent, weak, or bungled information, training, and follow-up." A lack of training and a poor understanding of the composting processes can cause any humanure composting system to become problematic. Conversely, complete information and an educated interest can ensure the success of humanure composting systems.

Another anaerobic double-vault composting toilet used in Vietnam combines fecal material and urine. In this system, the bottoms of the vaults are perforated to allow drainage, and the urine is filtered through limestone to neutralize its acidity. Other organic refuse is also added to the vaults, and ventilation is provided via a pipe.

In India, the composting of organic refuse and humanure is advocated by the government. A study of such compost prepared in pits in the 1950s showed that intestinal worm parasites and pathogenic bacteria were completely eliminated in three months. The destruction of pathogens in the compost was attributed to the maintenance of a temperature of about 40°C (104°F) for a period of 10–15 days. However, it was also concluded that the compost pits had to be properly constructed and managed, and the compost not removed until fully "ripe," in order to achieve the satisfactory destruction of human pathogens. If done properly, it is reported that "there is very little hygienic risk involved in the use and handling of [humanure] compost for agricultural purposes."



Commercial composting toilets

Commercial composting toilets have been popular in Scandinavia for some time; at least 21 different composting toilets were on the market in Norway alone in 1975. One of the most popular types of commercially available composting toilets in the United States today is the multrum toilet, invented by a Swedish engineer and first put into production in 1964.

The decomposition takes place over a period of years, and the finished compost gradually falls down to the very bottom of the toilet chamber where it can be removed. Again, the decomposition temperatures remain cool, not usually climbing above 32°C (90°F). Therefore, it is recommended that the finished compost be buried under one foot of soil or used in an ornamental garden.

Because no water is used or required during the operation of this toilet, human excrement is kept out of water supplies. According to one report, a single person using a Clivus (pronounced Clee-vus) Multrum will produce 40 kg (88 lbs) of compost per year while refraining from polluting 25,000 liters (6,604 gallons) of water annually. The finished compost can be used as a soil additive where the compost will not come in contact with food crops.

A 1977 report, issued by Clivus Multrum USA, analyzed the nutrient content in finished compost from seven Clivus Multrum toilets which had been in use for 4 to 14 years. The compost averaged 58% organic matter, with 2.4% nitrogen, 3.6% phosphorus, and 3.9% potassium, reportedly higher than composted sewage sludge, municipal compost or ordinary garden compost. Suitable concentrations of trace nutrients were also found. Toxic metals were found to exist in concentrations far below recommended safe levels.

If a multrum toilet is managed properly, it should be odor and worry-free. As always, a good understanding of the basic concepts of composting helps anyone who wishes to use a composting toilet. Nevertheless, the multrum toilets, when used properly, should provide a suitable alternative to flush toilets for people who want to stop defecating in their drinking water. You can probably grow a heck of a rose garden with the compost, too.

Inexpensive versions of multrum toilets were introduced in the Philippines, Argentina, Botswana, and Tanzania, but were not successful. According to one source, "Compost units I inspected in Africa were the most unpleasant and foul-smelling household latrines I have experienced. The trouble was that the mixture of excreta and vegetable matter was too wet, and insufficient vegetable matter was added, especially during the dry season." Poor management and a lack of understanding of how composting works may create problems with any compost toilet. Too much liquid will create anaerobic conditions with consequent odors. The aerobic nature of the organic mass can be improved by the regular addition of carbonaceous bulking materials. Compost toilets are not pit latrines. You cannot just defecate in a hole and walk away. If you do, your nose will soon let you know that you're doing something wrong.

Besides the Scandinavian multrum toilets, a variety of other composting toilets are available on the market today. Some cost upwards of $10,000 or more and can be equipped with insulated tanks, conveyers, motor-driven agitators, pumps, sprayers, and exhaust fans. According to a composting toilet manufacturer, waterless composting toilets can reduce household water consumption by 40,000 gallons (151,423 liters) per year. This is significant when one considers that only 3% of the Earth's water is not salt water, and two-thirds of the freshwater is locked up in ice. That means that less than one percent of the Earth's water is available as drinking water. Why shit in it? Δ

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Diverting Urine to Fertilize Soil

A Golden Opportunity

Carol Steinfeld

SETH WILKINSON AND ALISON FLYNN enjoy explaining their unusual toilet to visitors. With its trim tapered tank and unique two-button flush knob (one is pushed and one is pulled), it could pass for one of the new dual-flush toilets. But lift the lid and the key difference is apparent: inside, a small drained basin is cast like a shelf in the front of the toilet bowl, so that urine is caught and flushed with a tablespoon of water to a tank. Solids are flushed away via a standard 1.2-gallon flush to a conventional septic system.

Catching up with the world leaders

This urine-diverting toilet, the Ekologen DS by Wost-Man of Sweden, is one of only a handful in North America, but they are far more common in Scandinavia, Mexico, China, and Germany. In some installations, such as in multi-unit buildings, the urine drains to tanks in the ground or under the building which are periodically pumped. Others drain directly to evapo-transpiration trenches, sometimes lined. In some instances, the pumped urine is applied as a fertilizer to fodder crops.

Every day in the US, Americans excrete about 90 million gallons of urine. Most of it is flushed away.

Wilkinson and Flynn live in Orleans, Massachusetts, on Cape Cod, a region grappling with nitrogen pollution affecting lakes, seashores, and groundwater. With the blessing of their local public health agency, they chose the urine-diverting toilet to reduce their environmental impact. Urine drains to a 250-gallon in-ground tank. A float switch turns on a light when it's full, about once a year. Flynn hoses the urine-water mixture on piles of composting leaves and well-mulched gardens. It has no major odor, she reports.

Growing away pollution

As federal regulations increasingly require tertiary treatment, and regulators work to mandate expensive advanced denitrification systems—most with powered aeration to convert nitrogen to ammonia gas which is vented away—some are asking if there might be a better way to manage nitrogen. After all, they reason, it's a valuable fertilizer when applied to crops and landscapes, and only a pollutant when discharged to surface and ground waters.

Porcelain urine-diverting toilets were developed in Sweden in the past decade in response to nutrient pollution and eutrophication evident in that country's many lakes and along the Baltic and Atlantic coastlines. Large "dead zones" of eutrophication are also appearing in the sea. The Swedes isolated the source of the nutrients: urine—from humans as well as farms. Several authorities and research institutions investigated and proved the viability of diverting this nitrogen source and using it in place of farm fertilizer—another source of nitrogen pollution via runoff.

Urine is kept separate and drained from its own drain cast in the front of the toilet bowl. Urine needs very little water to flush.

Human urine accounts for about 90% of nitrogen in human excreta. What points to opportunities is that urine is usually pathogen-free in a healthy population (feces are the main source of potential pathogens). In essence, we flush away free pathogen-free urea fertilizer in the form of urine. (The amount of nitrogen is determined by how much protein one eats.)

A resource in the wrong place

Every day in the US, Americans excrete about 90 million gallons of urine. Most of it is flushed away. That day's urine contains an estimated 7 million pounds of nutrients in the form of nitrogen. By one estimate, that's enough nitrogen to fertilize up to 31,962 acres of corn for one year. And one year of US urine could fertilize 11.5 million acres of corn. Instead, manufactured and animal-derived urea fertilizer is imported—sometimes at great cost.

When we flush urine to septic systems, it can leach into ground and surface waters—often with much of the nitrogen intact.

In lakes and other surface waters, aquatic plants and algae consume the nitrogen, resulting in a great bloom of growth. When this growth dies and decomposes, it pulls oxygen from—or eutrophies—the water, which can suffocate fish and other aquatic life. Underground, nitrogen can seep into drinking water, posing a potential health hazard. At the same time this is happening, farmers worldwide purchase millions of tons of nitrogen fertilizer, much of it from industrial factories running on imported fuel.

Urine-diverting toilets are still rare in the US and not yet listed in plumbing codes. Another method to divert urine is waterless and low-water urinals, which are working their way into codes. (However, since these are designed for use by males, this only addresses half of the nitrogen load.)

Health risk parameters

Beneficial use of urine, which we might term "nutrient reclamation," differs from land application of septage and treated sludge. Urine offers low risk of pathogens, high-nutrient content, and the ability to drain itself away. Combined septage and sewer sludge potentially contains disease-causing organisms carried by the feces and household chemicals.

Denitrification with urine diversion can be an easy way to complement existing septic systems without installing expensive biofilters.

By not mixing urine with these sources of potential health risks, we isolate the high-value constituent—nitrogen—and put it to use.

Safe methods for using urine to nourish plants are now well documented, particularly in Sweden, where several research institutions and Stockholm's water authority studied the sociology, bacteriology, and viability of collecting urine and using it to fertilize grain crops.

According to sanitation researcher Caroline Schönning of the Swedish Institute of Infectious Disease Control, humans rarely excrete disease-causing organisms, or pathogens, in urine. Also, most pathogens die when they leave their hosts, either immediately or shortly thereafter. The only significant urine-transmitted diseases are leptospirosis (usually transmitted by infected animals), schistosomiasis, and salmonella. The first two are rare—usually found only in tropical aquatic environments—and the last is typically inactivated shortly after excretion.

The urine and flushwater dosing chamber. This assures the "yellow water" from the toilet has time to get absorbed into the grey-and-yellow water system before another pulse drains into it. The chamber also assures there is some velocity for every dose.

The more likely health risk is urine contaminated by feces that were misplaced in a urine-diverting toilet.

Ways to inactivate pathogens include time (waiting them out), composting; heat; and adding high-alkaline additives, such as lime and wood ash. Following are some general guidelines for use:

• To deactivate most pathogens that may be present, especially if urine from outside of one's household has been collected to fertilize food crops, store it for six months before use. This period can be shortened if the ambient temperature is at or above 65°F. For lowest risk, apply it to crops that do not touch the earth, such as orchard fruit, vines, and berry bushes. Or use it only for crops that will be cooked or fed to animals. When in doubt, it should not be used.

• For personal and household urine used for growing food, Schönning deems it an acceptable health risk to harvest raw-eaten crops one month after urine-fertilization.

• Urine is best worked into the soil or applied under the soil to reduce exposure, allow soil organisms to deactivate pathogens, and preserve its nutrient value.

Onsite possibilities

Collecting urine for farm fertilizer may be on the very far horizon for the regulated mainstream in the US, but we can thank the Swedes for pointing the way.

Denitrification with urine diversion can be an easy way to complement existing septic systems without installing expensive biofilters. To treat urine for plant use, it must be oxidized to a nitrate form that plants can use. Or it can be diluted and mixed into well-aerated soil, where the soil's aerobic microbes complete the oxidation (nitrification) process.

Methods for diverting and managing urine

• Drain urine to planted greywater system beds. For planted systems, urine's nitrogen is a good addition to greywater, which is a lot of water and a little carbon (BOD) but nearly no nutrients. Direct this combination to a planted evapo-transpiration bed. This can take the form of a lined or unlined trench no deeper than 2 feet and filled with 0.75-inch to 3-inch gravel. These beds can double as landscape features.

• Constructed wetlands created to treat only greywater often suffer for lack of nitrogen. Because the wetland environment is more anaerobic than aerobic, nitrogen in a wetland is largely lost to the atmosphere, providing cheap denitrification.

• Drain urine to a tank that is periodically pumped like a septic system. The collected urine can be contained, tested for pathogens, and applied to well drained forests, tree farms, or pasture lands high in the landscape. Or it can be discharged to a tertiary treatment plant.

• Municipal composting facilities that handle woody landscape waste and shredded paper often have a nitrogen deficit. Urine provides a low-risk nitrogen match.

• Urine can be slightly acidic and salty. It should not be distributed with drip-irrigation tubing unless it is diluted; otherwise emitters may clog.

The world needs all the nutrients we are flushing away each day in our urine. Given the high cost of onsite denitrification systems and the far-reaching costs of using manufactured fertilizers, using this valuable and usually pathogen-free resource deserves more consideration.

Beneficial use of urine, which we might term "nutrient reclamation," differs from land application of septage and treated sludge.

Diverting and using urine may seem on the "lunatic fringe" now, but the benefits are so great that it will be a common-sense practice in the future. ∆

Carol Steinfeld is the author of Liquid Gold: The Lore & Logic of Using Urine to Grow Plants *(Ecowaters Books), from which parts of this article were excerpted.*

Building Soil with Crop Rotations

Eric and Beth Ardapple Kindberg

LEGUME-BASED CROP ROTATIONS are essential to production of fertility on the farm. Crop rotation is a systematic alternating between cash crops and soil building crops on the same soil.

Humus, which is decayed organic matter, is the basis of all fertile soils. As early as 1915, the Virginia Truck Experiment Station demonstrated that a crop of cowpeas plowed under green in the fall produced as large a yield of cabbage to the acre as 20 tons of stable manure. In general, there are three ways to add organic matter to the soil:

- incorporation of crop residues
- applying animal manures or other organic residues
- incorporation of green manure crops.

Rotation of soil bulding green manure crops with cash crops is the most economical way of adding organic matter, and results in side benefits unavailable from other methods.

Among the many benefits it offers to the organic farmer, crop rotation:

1. Improves soil tilth, drainage, and water-holding capacity.
2. Produces organic matter for making humus.
3. Brings up plant food from subsoil to topsoil and holds it there. This reverses leaching, and prevents nutrients like nitrogen and sulfur from escaping into the air.
4. Lessens weed, disease, and insect attack.
5. Checks erosion.
6. Adds nitrogen fixed by bacteria associated with the legumes.
7. Allows the farmer to make money while building soil. Annual green manure crops can be grazed. Perennial green manure crops can be grazed and sometimes hayed.
8. Integrates livestock and cash crop production efficiently.

Growing legumes for nitrogen

One of the most economical sources of nitrogen fertilizer available to the organic farmer comes from nitrogen fixation on legume plants. Legumes can be part of a crop rotation or a permanent pasture.

Covers, alfalfa, cowpeas, beans, peas, vetches, sesbania, and other legumes form a partnership with certain bacteria on their roots. (1) The plant supplies the bacteria with energy in the form of carbohydrates while the bacteria take nitrogen directly from the air in the soil and supply it to the plant.

Excess nitrogen is also made available to other nearby non-legume plants, such as grasses. Soil life consumes excess nitrogen as it goes about the work of decomposing organic matter into humus. When the field is eventually disked down for green manure, a flush of nitrogen, along with other nutrients, is released from the dying plants into the soil to be used by the next cash crop. On permanent pasture, the flush of nitrogen and other nutrients is released when the top growth is mowed or grazed.

Strip crops tilled into the field can boost productivity through the years.

Guidelines for planting legumes

1. Legumes grow better when they are inoculated with fresh bacteria, found at seed stores. The bacteria are specific to the kind of legume used. Though sometimes naturally present in soil, it is cheap insurance to add more bacteria.
2. Two or more kinds of legumes growing together seem to do better than one.
3. Most legumes need a pH of 6.2 to 7.0 for optimum performance. Soil testing for pH is available from the Extension Service in most areas.
4. Good air movement and moisture in the soil are necessary for legumes to grow well.
5. Choose legumes suited to the region and for the length of time available to grow them.
6. Solid stands of 10-15 seedlings per square foot are desirable.

Building soil with legumes

1. Legumes, with their associated bacteria, will produce more nitrogen if kept in a vegetative (before flowering) state.
2. Legumes will add more net nitrogen to the soil from the air if they are not fertilized.
3. If legumes mature to early blooming, the maximum amount of nitrogen will have been added to the soil, between 50 and 200

pounds per acre. If legumes are allowed to mature further, more organic matter will be added but not more nitrogen.

The transition to organic farming

When making the transition from conventional to organic farming, it is helpful to build soil by growing green manure crops for several months before planting a cash crop. Better yet, two or three years of alfalfa or clover pasture should be grown before row cropping. The pasture can be used for managed grazing, but taking off hay without returning manure is detrimental.

Planning crop rotations

To simplify planning rotations, crops may be divided into four types. Grain and cultivated crops such as vegetables deplete soil and should alternate with Sod (pasture, hay) or Green Manure crops which build soil. Green manures are used in short rotations, Sod crops in long-term rotations. In orchards or vineyards, either short- or long-term rotations may be used between the rows. Permanent pastures are simply sod crops that are not rotated with other crops.

Managing green manure crops

There are three basic ways to increase soil fertility with green manure crops:

1. Incorporate them into the top two or three inches of soil when the leaves and stems are tender and succulent.
2. Keep them in a vegetative (before blooming) stage of growth by repeatedly mowing, grazing, or disking with the blades set straight. Incorporate when you are ready.
3. Let them get coarser and older, then incorporate into the soil.

Each method presents a number of principles and factors to consider when choosing which way to manage the crop. Each option is considered below.

1. For quickest release of nutrients from the green manure to the next crop, incorporate the green manure when it is tender and succulent, thus causing rapid decomposition.

However, when the green manure crop is a mixture of different plants, as it should be, this can get complicated. The legumes, which fix nitrogen, should ideally grow to early bloom stage, when they will have produced their maximum amount of nitrogen. By this time, the rye, sudan, or other non-legume plants may be past the tender, succulent stage.

So, how do you incorporate the green manure crop while it's still tender and get maximum nitrogen, too? The answer is to make legumes the dominant plant in the planting. Most legumes will still be tender and succulent at early bloom stage. By having a majority of legumes in the field, the non-legumes will not effectively slow down decomposition, even if they are past the tender stage.

2. To improve soil structure and build up nutrients in the soil, the green manure crop can be grown longer but still be kept in a tender vegetative stage by repeatedly setting

Humus: The Basis of Organic Farming

What is humus? Organic farming means building fertile soil. Fertile soil is a soil rich in humus. Humus is formed from decomposing organic matter. Under favorable conditions, organic matter is literally consumed, eaten up by soil life such as bacteria, fungi, soil insects, and larger animals like the earthworm. The soil changes its appearance, becoming a dark absorbent residue called humus.

Why do we need it? Humus feeds. It also:

- improves the physical condition of the soil, making it more open, allowing better air, water, and heat movement.
- improves both the drainage and water holding capacity of soil.
- improves the amount and diversity of available nutrients for plant growth.
- reduces erosion and leaching of minerals and nutrients from the topsoil.
- helps prevent insect and disease attack.

The process of humus development is an unbroken circle of life, death, and rebirth in the soil. Plants grow, die, and are decomposed into humus by soil life. The humus then feeds the next cycle of plant growth. For maximum fertility, humus must develop rapidly in large quantities. Organic farmers must create conditions that will support high populations of soil life (bacteria, fungi, earthworms, etc.) that turn organic matter into humus.

Those conditions are:

1. High moisture
2. Good aeration and drainage
3. Near neutral soil (about pH 6.5)
4. Warm temperatures
5. Abundant organic matter
6. Growing plants
7. Animal by-products (manure, urine, blood meal, etc.)

Δ

it back. Setback can be achieved by mowing, controlled grazing, or disking with the disk blades set straight. The best time to cause setback is just before the legumes reach early bloom, when they will have almost finished producing nitrogen. The growing plants will continue to add organic matter. When it is time to incorporate, they will still be in a vegetative state, so the nutrient will be released quickly.

Tillage: Less Work for Greater Results

All tillage tends to decrease organic matter and compact soil. It is important to do the minimum amount of tillage necessary to grow the crop.

Compacted soil lacks air and cannot absorb water well. Compaction happens in two ways: (1) tractors and implements compact soil through sheer weight; and (2) particles of soil which have been tilled too fine will drain through the soil layer. At tillage depth, the fine particles will accumulate and solidify, acting like a plugged filter. This is also called 'hardpan' or 'plowpan.'

To prevent compaction, soil should be worked when it is moist, but not sticky, and not bone dry. if you already have hardpan, subsoiling, use of a chisel plow to create furrows below grade, will break hardpan. Determine the depth by digging a hole with a hand shovel. Then subsoil just below the hardpan. It is a waste of horsepower to go any deeper. Plant root systems will break up hardpan over a period of years if tillage is discontinued.

Tillage tools

Most tillage implements used for organic farming are the same as those used for conventional farming. The moldboard plow, however, creates special problems in organic farming because it tends to work against the soil life by turning over the soil layers, disrupting the life cycle. If you must use a moldboard plow, minimize the mixing of soil layers by shallow plowing. For each ten percent of subsoil mixed into the topsoil, yields decline by 15 percent.

It is better to use an implement, such as a chisel plow, field cultivator, or rototiller, which stirs the soil, rather than disrupting the natural layering, although a rototiller tends to create hardpan.

A disk harrow works well for chopping up top growth before doing primary tillage, but when used after plowing, it also compacts.

Tillage guidelines for maintaining soil fertility

1. Crop residues, manures, green manure crops, etc. should be mowed, grazed, rolled, or tilled into just the top two or three inches of soil. Partial covering of the residues will cause better humus development than full covering. Small soil life found at 4 inches depth will not live if fully exposed.

2. Loosened soil is extremely prone to recompaction from traffic immediately after subsoiling. Recompaction will be worse than the original problem. It is best to subsoil when no other tillage will follow. When that is impossible, controlled traffic patterns for seedbed preparation, bedding, or planting on the subsoiled field will reduce damage.

3. Subsoil just before a period of good moisture and rising temperatures. Warmth and air admitted to the soil by subsoiling will stimulate population explosions of soil life. Δ

Cattle, though not as effective at building soil as green manures, are an important part of rotation programs.

3. For maximum improvement of soil structure, let the green manure crop get old and coarse. However, decomposition will be slowed down, and nutrients will not be released quickly. Mature crops are slow to decompose because there is little available nitrogen in them compared to carbon.

The soil organisms need nitrogen for their life cycle. If you plant crops too soon, the soil life will have all the available nitrogen temporarily tied up for its own use, and the new crop will probably suffer a nitrogen deficiency. If a nitrogen fertilizer, like blood, feather meal, or composted manure is added to the soil, the soil organisms will multiply and decomposition will speed up, releasing nutrients sooner for the next crop. As an alternative to adding nitrogen, you can delay planting the next crop two to six weeks or more, depending on soil temperature, while decomposition slowly progresses.

Note: To achieve self-seeding, simply wait until a significant number of plants have formed seed, then incorporate. The seeds will be planted by the tillage. Do not use a moldboard plow, as it will cover the seeds too deeply, preventing germination.

A cultural guide to green manures

1. Every green manures crop should be a mixture of legumes and non-legumes. A mixture will cover the ground better and smother weeds, while making better use of soil and climate resources. Two different legumes will grow better together than each would growing alone, and a mixture of plants will help to protect each other from harsh weather.

2. Soil life needs nitrogen to decompose organic matter into humus. Legumes carry enough nitrogen for their own decay, plus enough to decay other non-legume plants as well. If legumes dominate the green manure planting, they will provide enough nitrogen for the next growing crop.

3. There is a great advantage to include non-legumes into the green manure crop. Grass and grain crops will "sop up" any available nitrogen and use it to grow massive amounts of organic matter quickly. The growing plants hold the nitrogen

until it is freed later when the plants die and the organic matter decomposes. By grabbing up all the free nitrogen, the non-legumes also encourage the legumes to fix more. If grasses and grains are not present, the excessive nitrogen thrown off by the growing legumes will be lost into the air or leach through the topsoil.

4. Legumes should only be left out of the green manure crop when it is too late in the fall to get them started. If a very late (December) green manure crop is seeded, rye is the most reliable producer.

5. Decay of a green manure crop should occur at the time it will best serve as fertilizer for the crop it is to benefit. This timing is especially applicable with green manures grown among perennials—orchards, berries, etc. The grower's problem is to supply adequate amounts of suitable organic matter so that decomposition may progressively release available nutrients in accordance with the needs of the developing crop as the growing season advances.

6. If weeds are left to grow for green manure, be sure they are incorporated before they go to seed. The same applies if weeds come up in a green manure crop.

7. If you are using crop rotation to eradicate a certain disease or pest, such as clubroot in cabbage, it is wise to check your green manure selection to make sure it does not include plants that are host to the same disease. For example, to get rid of club root, it is recommended that no crucifer family plants (mustard, radish, turnip) be grown in the diseased field for two years, as cabbage is a crucifer family plant. Also avoid growing mustard, radishes, or turnips as either a cash or green manure crop.

8. Like other crops, green manures have specific fertility needs, but fertilizing the soil for each green manure crop can get overly complicated and costly. Even if the initial green manures do poorly, the very act of growing and incorporating them will create better conditions for future crops. The single most important soil amendment needed is usually lime, to raise the pH

A subsoil plow with ring roller and seedbox. The chisel (or Yeomans plow).

Seed Mixture Examples for Soil Building Crops:

A seed mixture should include at least two legumes and one non-legume.

Short-Term Rotations (1 year or less)		Long-Term Rotations (2-5 or more years)	
Cool Season Green Manures	Warm Season Green Manures	Cool Season Sod	Warm Season Sod
◊ Hairy vetch *(Vicia villosa)* ◊† Crimson clover *(Trifolium incarnatum)* ◊ Austrian winter peas *(Pisum arvense)* ◊ Fenugreek ◊ Lupine Mustard Daikon Radish Rye Wheat Oats Other grains Seeds primarily for overseeding cool season crops (those listed above can also be used). ◊ Red Clover *(T. pratense)* ◊† Arrowleaf Clover *(T. vesiculosum)* ◊† Subterranean Clover *(T. subterraneum)* ◊ Ladino Clover *(T. repens var. latum)* ◊ Dutch White Clover *(T. repens)*	◊ Soybean (forage-type) ◊ Cowpea (forage-type) *(Vigna sinensis)* ◊ Crotolaria ◊ Velvetbean *(Stizolobium deeringianum)* ◊† Sesbania *(S. macrocarpa)* ◊ Sweetclovers *(Melilotus spp)* Sudan grass Buckwheat Millets Seeds primarily for overseeding warm season crops (those listed above can also be used. ◊ Annual Lespedeza ◊ Sweetclover ◊ Red Clover ◊ Ladino Clover	◊ Red Clover ◊ Ladino Clover ◊ Hop Clovers *(T. dubium, T procumbens, T. agrarium)* ◊† Subterranean ◊† Arrowleaf Grasses: Fescue *(Festuca eliator, F. arundinacea)* Timothy *(Phleum pratense)* Orchardgrass *(Dactylis glomerata)* Kentucky bluegrass *(Poa pratensis)* Native grasses	◊ Annual Lespedeza ◊ Red Clover ◊ Ladino Clover ◊ Alsike Clover *(T. hybridum)* ◊ Alfalfa *(Medicago sativa)* Grasses: Brome Bluestem *(Andropogon gerardi, A. scoparius)* Redtop *(Agrostis alba)* Reed canary *(Phalaris arundinacea)* Native grasses

Any plant, including weeds, can be a green manure. Note: ◊ = legume † = hard-seeded (for self-seeding)

Planning Crop Rotations

	Short-Term Rotations 1 year or less	**Long-Term Rotations 2,3,4,5 or more years**
Potential Cash Crops	Annual vegetables, row crops, small grains, etc.; orchards and vineyards, when short-term rotations take place between the rows.	Pasture and hayland, plus all the short-term cash crops, can also be part of the long-term rotation. Orchards and vineyards, when the rotation takes place between the rows.
Rotations of Cash and Soil-Building Crops	Cultivated cash crops are alternated with green manure crops. Example #1: A spring broccoli crop, then a warm season green manure crop, then fall mustard. Then a cool season green manure crop, a summer tomato crop, a cool season green manure, etc. Example #2: A fall-planted grain crop is overseeded in early spring with a clover. The grain is harvested in July, while the clover comes on and grows until fall, when it is incorporated into the soil and another grain crop planted.	Two, 3, 4, or 5 years of sod pasture/ hayland are alternated with 1, 2 or 3 years of a cultivated crop. Example: A fescue/ orchardgrass/ brome grass/ red clover/ ladino clover pasture is grazed and hayed for three years, then put into vegetables for 2 years, then back into sod pasture for another 3 years, etc. By dividing the farm into several production areas, the number of acres in cultivated crops can remain the same every year.
Three Ways to Seed Soil-Building Crops 	1. Planting in a prepared seedbed: A green manure crop is planted after a cash crop is harvested, a. For large seeds such as rye, drill with a grain drill, or broadcast, then disc lightly or harrow. b. For small seeds like clover, broadcast, cover lightly, and roll, or broadcast and roll with a cultipacker (ring roller). 2. Overseeding: A green manure crop is broadcast or drilled into the cash crop before harvest, perhaps at the last cultivation. 3. Self-seeding: Some plants, such as clovers, are hard-seeded. If they are allowed to form seed before incorporating them for green manure, the seed will lie in the ground for several months or years, then germinate. This can be manipulated to advantage in certain rotations.	All pasture crops need a firm seedbed. 1. Planting: A seedbed is prepared, and the seed is planted with a cultipacker/ drill, or the bed is rolled, the seed broadcast, and the bed is rolled again. 2. Overseeding: Seed is broadcast over existing pasture, or drilled with a pasture drill. The pasture is grazed heavily to cut back competition for the new seedlings. 3. Renovation: The sod is partly torn up or loosened with a disc or pasture cultivator, the seed broadcast, then rolled.
When to Seed Soil-Building Crops	At 36°N latitude (mid-Ozarks or Tenn./Ky line), plant fall green manure crops by Sept. 15 for maximum growth. If they must be planted later, plant more seed to achieve a thicker stand. These planting guidelines will vary with climate zone. Overseeding should be done after the last cultivation of crops like vegetables. For small grains, determine when to overseed by calculating whether the grain will be mature before the green manure crop gets big enough to compete for water and nutrients.	Cool-season sod crops can be planted either fall or spring. There is some advantage to fall planting, because the crop has both fall and spring to grow before hot, dry weather begins. Try to plant by Sept. 15. In spring, plant as early as possible; however, a late hard frost will sometimes kill young seelings. A later planting (up to early May) is safer if there is good soil moisture. A warm-season crop must be spring planted. Remember: have a firm seedbed and good seed-to-soil contact. ∆

and add calcium for the legumes. Some green manure crops, especially buckwheat, will grow well on poorer soils.

9. Some minerals exist in the soil, but are unavailable to plants. Certain plants take up unavailable minerals, and make them available for the next crop. For example, mustard increases the availability of calcium; buckwheat and sweetclover increase the availability of phosphorus.

10. During both cool and warm growing seasons, the ground should be covered with growing plants. Exceptions: when crops must be clean cultivated to reduce competition, and right after green manures are incorporated. Δ

Notes

1. Editor: Tree and shrub legumes, black and honey locust, the acacias, leucaena, tagastaste, and hundreds more, as well as non-legumes such as Eleagnus spp, caragana, ceanothus, and alder may also be used to fix atmospheric nitrogen on the farm. When rows of such perennial nitrogen-fixers are grown with cultivated crops interplanted, the system is known as alleycropping, a technique used with great success in tropical countries, but little known in the North.

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This article, copyright by the authors, is reprinted from Permaculture Activist *#26. At the time of publication the authors were farming in the Ozark Mountains and consulting about whole farm fertility systems based on Keyline soil development.*

Fungus Among Us

Mushrooms Convert "Waste" Into Nutrient-Rich Soil

Alice Beetz and Michael Kustudia

SMALL-SCALE MUSHROOM PRODUCTION represents an opportunity for farmers interested in an additional enterprise and is a specialty option for farmers without much land. This publication is designed for market gardeners who want to incorporate mushrooms into their systems and for those farmers who want to use mushroom cultivation as a way to extract value from woodlot thinnings and other "waste" materials. Mushroom production can play an important role in managing farm organic wastes when agricultural and food processing by-products are used as growing media for edible fungi. The spent substrate can then be composted and applied directly back to the soil. This publication includes resources for entrepreneurs who wish to do further research.

Many people are intrigued by mushrooms' nutritional and medicinal properties, in addition to their culinary appeal. Mushrooms contain many essential amino acids; white button mushrooms, for example, contain more protein than kidney beans. Shiitake mushrooms are less nutritious, but are still a good source of protein. (Royse and Schisler, 1980) As a group, mushrooms also contain some unsaturated fatty acids, several of the B vitamins, and vitamin D. Some even contain significant vitamin C, as well as the minerals potassium, phosphorus, calcium, and magnesium. (Park, 2001)

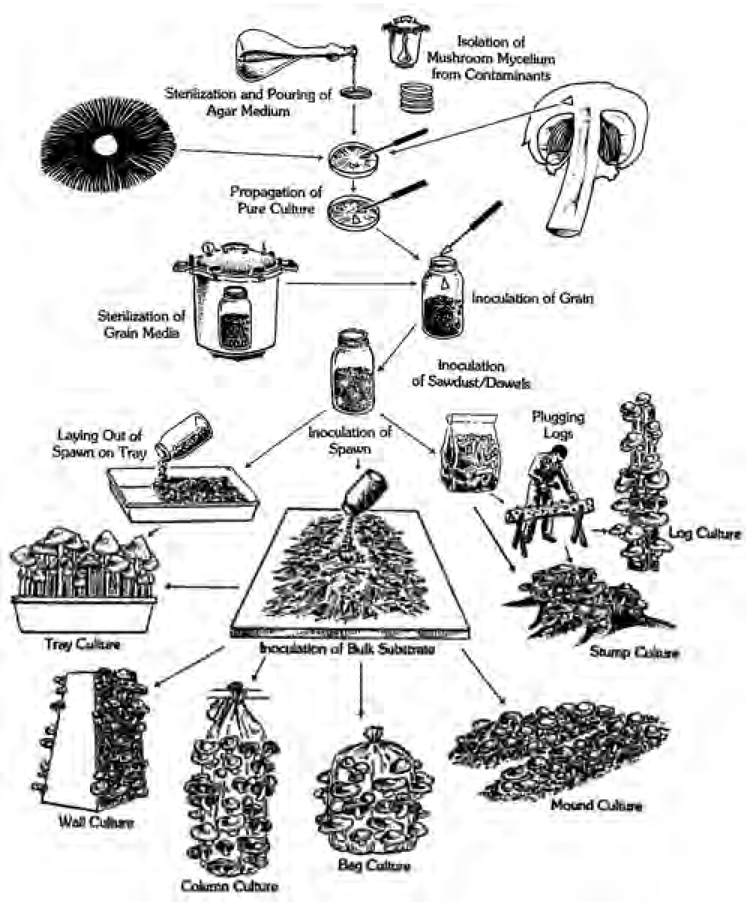
Asian traditions maintain that some specialty mushrooms provide health benefits. Chinese doctors use at least 50 species. Two recent books, *Medicinal Mushrooms: An Exploration of Tradition, Healing, and Culture* and *Medicinal Mushrooms You Can Grow*, detail existing research on the health benefits of mushrooms.

Producing nutritious food at a profit, while using materials that would otherwise be considered "waste," constitutes a valuable service in the self-sustaining community we might envision for the future.

Mushroom production is labor- and management-intensive. Specialty mushrooms are not a "get rich quick" enterprise. On the contrary, it takes a considerable amount of knowledge, research, planning, and capital investment to set up a production system. You must also be prepared to face sporadic fruiting, invasions of "weed" fungi, insect pests, and unreliable market prices.

Growing mushrooms

Mushroom production is completely different from growing green plants. Mushrooms do not contain chlorophyll and therefore depend on other plant material (the "substrate") for their food. The part of the organism that we see and call a mushroom is really just the fruiting body. Unseen is the mycelium—tiny threads that grow throughout the substrate and collect nutrients by breaking down the organic material. This is the main body of the mushroom. Generally, each mushroom species prefers a particular growing medium, although some species can grow on a wide range of materials.



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If you are considering mushroom production, become thoroughly familiar with the life cycles of fungi. A very general description is included below. A plant pathology textbook is a good resource for learning more about their complex life cycles.

Once you are familiar with the various fungi life cycles, learn the growth requirements of each of the species you are considering. Two basic references are *The Mushroom Cultivator,* by Stamets and Chilton, and the aforementioned *Growing Gourmet and Medicinal Mushrooms* by Stamets.

Growing mushrooms outdoors as a part of a market garden involves little effort after you have inoculated the logs or other substrate with the mushroom spawn. Your duties are mainly to maintain humidity and monitor for fruiting. When mushrooms appear, you add them to your other garden products and sell them. (See sidebar, page 37)

Most available markets, however, require more mushrooms than occasional fruiting provides. Indoor production can fill the gaps when outside fruiting lags. The entire operation can also be conducted inside. However, indoor mushroom production demands a much higher level of knowledge, continuous monitoring, and timely manipulation of environmental conditions.

These are the steps in mushroom production—a cycle that takes about 15 weeks (time varies by species) from start to finish

- Choose a growing medium.
- Pasteurize or sterilize the medium
- Seed the beds with spawn (material from mature mushrooms grown on sterile media)
- Maintain optimal temperature, moisture, and other conditions for mycelium growth and the conditions that favor fruiting (This is the most challenging step.)
- Harvest, package, and sell the mushrooms
- Clean the facility and begin again (Cooner, 2001)

The substrate on which the mushrooms will fruit must be sterilized or pasteurized in order to destroy any fungal or bacterial competitors. Low-tech substrate preparation methods are described in the books by Paul Stamets and by Peter Oei.

To produce spawn, you inoculate a pasteurized medium, usually grain, with the sterile culture of a particular mushroom species. After the culture has grown throughout the medium, it is called spawn. Producing spawn requires exacting laboratory procedures. Terri Marie Beauséjour, cultivation chair for the Mycological Society of San Francisco, has written an excellent article that can help the beginner who is put off by the technical aspects of mushroom cultivation. Titled "Getting Started with Mushroom Cultivation: The Wisdom of Simplicity," it is available on the Web at mykoweb.com/articles/cultivation.html.

Many mushroom suppliers sell several kinds of spawn, and the beginning mushroom farmer should take advantage of this selection in early trials to determine which species grow best on available materials. Eventually, learning to produce spawn might reduce your cost of production. Evaluate this possibility only after you have mastered the later stages of cultivation.

While the mycelium is growing—and until it fully occupies the substrate—the mushroom farmer typically manipulates the growing environment to favor mycelial growth. The atmospheric conditions are then changed to initiate "pinheads," and then to complete fruiting. For example, in oyster mushroom production under closely controlled conditions, the grower lowers the temperature and the CO_2 in the grow room to initiate fruiting. Each species has specific requirements for its stages of development. *The Mushroom Cultivator* provides detailed information on the requirements for 16 species. (Stamets & Chilton, 1983)

When you can cut the time between harvests, annual production increases. Short cycles are what the large-scale commercial producers aim for, constantly looking for ways to increase efficiency. This is the competition you face if you plan to sell your product on the wholesale market.

Paul Stamets of Fungi Perfecti, an educational and mushroom supply company, has spent most of his life studying the growth and cultivation of fungi. His book, *Growing Gourmet & Medicinal Mushrooms* is an invaluable resource for anyone considering the cultivation of any mushroom species. He describes several alternative methods of producing mushrooms, including growing them outdoors on logs, on stumps, and in the garden, as well as indoors in bags or on columns.

Peter Oei, in *Manual on Mushroom Cultivation*, describes in some detail how alternative mushroom production systems have been used successfully in developing countries. Many ideas for low-input systems are included. In practice, it is unlikely that the beginner can successfully compete in the wholesale market against highly capitalized and efficient mushroom companies. A better choice is to develop a niche market for high-quality fresh mushrooms, then sell them at retail, or to produce a value-added mushroom product, such as a soup mix or sauce.

Mushrooms on the farm and in the garden

Fungi cycle nutrients that nourish new life in the soil. Recognizing this essential function, inventive gardeners integrate mushrooms into farm, garden, and permaculture systems.

Mushrooms in Permaculture Design

Paul Stamets was an early advocate of integrating a variety of mushrooms into a permaculture system. (Stamets, 1994) In his design, agricultural wastes like cornstalks, wheat straw, or rice straw can be used as growing media for oyster mushrooms. After harvest, the spent substrate can be recycled as fodder or mulch for garden soils.

Shaggy manes *(Coprinus comatus),* Stamets notes, do well on manured soils and near compost piles. The King stropharia or wine cap mushroom *(Stropharia rugoso-annulata)* grows best outdoors and plays a key role as a recycler of woody debris. Bees, attracted to the sweet mycelium, help pollinate the green garden plants. The mushrooms are good to eat when small. Large, mature mushrooms attract fly larvae that make excellent fish or poultry food. These can supplement feed for other on-farm enterprises or be sold to pet stores.

Stamets also uses King stropharia mushrooms for their ecological benefits. He found that, when established along waterways, they acted as microfilters of fecal coliform bacteria generated by his small herd of cattle. He also planted them along greywater runoff areas. Stamets believes mushrooms can play a large role in mycofiltration. (Stamets, 2000-2001)

Stamets grows shiitakes, namekos *(Pholiota nameko),* and Lion's mane *(Hericium erinaceus)* mushrooms on inoculated logs set in a fence row, while other species like maitake *(Grifola frondosa),* reishi *(Ganoderma lucidum),* and clustered wood-lovers are cultivated on stumps as part of a hardwood forest management system. He introduces mycorrhizal species such as chanterelles, King boletes, and others to new areas by "satellite planting," in which seedlings are planted near trees that have a desired mushroom species growing around them. After several years, the seedlings and their mycorhizal associates are transplanted, creating new patches of mushrooms. Morels are more difficult to propagate, but some types can be encouraged through the use of small burns.

Mushroom Cultivation Media

Growing Medium	Mushroom Species
Rice straw	Straw *(Volvariella)* Oyster *(Pleurotus)* Common *(Agaricus)*
Wheat straw	Oyster *(Pleurotus)* Common *(Agaricus)* Stropharia Straw *(Volvariella)*
Coffee pulp	Oyster *(Pleurotus)* Shiitake *(Lentinus)*
Sawdust	Shiitake *(Lentinus)* Oyster *(Pleurotus)* Lion's Head or Pom Pom *(Hericium)* Ear *(Auricularis)* Reishi *(Ganoderma)* Maitake *(Grifola frondosa)* Winter *(Flammulina)*
Sawdust-straw	Oyster *(Pleurotus)* Stropharia
Cotton waste from textile industry	Oyster *(Pleurotus)* Straw *(Volvariella)*
Cotton seed hulls	Oyster *(Pleurotus)* Shiitake *(Lentinus)*
Logs	Nameko *(Pholiota)* Shiitake *(Lentinus)* White jelly *(Tremella)*
Sawdust-rice bran	Nameko *(Pholiota)* Ear *(Auricularis)* Shaggy Mane *(Coprinus)* Winter *(Flammulina)* Shiitake *(Lentinus)*
Corncobs	Oyster *(Pleurotus)* Lion's Head or Pom Pom *(Hericium)* Shiitake *(Lentinus)*
Paper	Oyster *(Pleurotus)* Stropharia
Horse manure (fresh or composted)	Common *(Agaricus)*
Crushed bagesse and molasses wastes from sugar industry	Oyster *(Pleurotus)*
Water hyacinth/Water lily	Oyster *(Pleurotus)* Straw *(Volvariella)*
Oil palm pericarp waste	Straw *(Volvariella)*
Bean straw	Oyster *(Pleurotus)*
Cotton straw	Oyster *(Pleurotus)*
Cocoa shell waste	Oyster *(Pleurotus)*
Coir	Oyster *(Pleurotus)*
Banana	Straw *(Volvariella)*
Distillers grain waste	Lion's Head or Pom Pom *(Hericium)*

Mushrooms can also be grown in lawns, polytunnels, vegetable gardens, and woodlands. (Edwards, 2000)

Terri Marie Beauséjour, a writer for *Mushroom the Journal,* encourages creativity and imagination when planting mushrooms in a garden. Look at the "fungamentals," she writes, the necessities such as available substrates, microhabitats, sun, shade, wind, and humidity conditions. Gardens offer ample substrates—organic waste materials—while plants provide shade and humidity. Plug-inoculated blocks buried among plantings work well for oyster and Stropharia rugoso-annulata mushrooms. Beauséjour suggests using a misting sprinkler for mushrooms in gardens. (Beauséjour, 1999)

Grower and author Ken Litchfield notes that mulching, a standard gardening practice, not only regulates soil temperature and humidity but also nourishes fungi. He also suggests surrounding raised beds with partially buried logs to create mushroom habitats. Inside the beds, vegetables, flowers, and shrubs offer the requisite shade and humidity for mushroom cultivation. In weedy areas, Litchfield suggests putting down organic material and covering it with wet cardboard and wood chips, an ideal substrate for fungi. (Litchfield, 2002)

These methods of production are not likely to yield huge numbers of mushrooms. However, they can provide an attractive addition to directly marketed produce.

Choosing a mushroom species

A mushroom cultivation kit is a handy way to begin to understand the fungal life cycle. Once you successfully use the kit, you can begin to learn the steps that precede that final fruiting stage of the mushroom life cycle. Purchase spawn that will grow on materials you have available. Then design and test a system that duplicates the conditions favorable to all stages of growth. You can use this experience to learn how to create sterile cultures and spawn for the species you are growing.

Choose the species to grow by thinking about:

- What waste materials are available to use as a substrate?
- What kind of facility or environment is available?
- How much will the necessary equipment cost?
- What level of skill is required to manage the life cycle of the fungus?
- What is market demand for this species?

According to these criteria, oyster *(Pleurotus spp)* and shiitake *(Lentinus edodes)* mushrooms are probably best for most novices, although the maitake *(Grifola frondosa)* is also a possibility. The former two are relatively easy to grow, and there is already a market for them, largely because commercial producers of white button *(Agaricus bisporus)* mushrooms have been diversifying into specialty mushrooms. If you intend to grow mushrooms commercially, shiitake or oyster mushrooms are your best choices.

The chart at left lists other common species and the materials on which they can be cultivated. Test each species you are considering against each of the questions listed above. Δ

Alice Beetz grew up and later worked seasonally on a grain and cattle farm in northern Illinois. Most of her NCAT work has been with the ATTRA project, handling topics such as mushroom cultivation, forages and grazing management, worms, and *agroforestry.*

This article first appeared on the ATTRA website (attra.ncat.org/attra-pub/mushroom.html) and is reproduced here with permission. ATTRA is a free information service for US farmers and ranchers and those who work directly with them, focusing on commercial sustainable agriculture. Individuals and home gardeners are welcome to the website and are encouraged to use the search function to access all information on specific topics.

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From the Regions

Permaculture Takes Hold in Konso, Ethiopia

Alex McCausland

AS THE HEAD of the Konso Woreda Education Bureau stood in front of the crowd, his fumbling speech soon gathered momentum. "We now want to see this program expanded to all the schools in Konso, making us an example to the whole society and the rest of Ethiopia. Permaculture shows us how to achieve food security and environmental preservation, how to improve our nutrition and benefit our ecology, all through direct community action." We all clapped and cheered heartily. It was a moment of fulfillment for us at Strawberry Fields Eco-Lodge (SFEL).

Gathered around the training room were teachers, parents, and children from the three schools where the Permaculture in Konso Schools Project (PKSP) pilot project had been underway since May 2009. It began with training of teachers at SFEL, in a permaculture design course that was funded in part by a former volunteer and good friend of ours—Sarah Davis from Austin, Texas, and also by Save the Children Finland (STCF).

Our lead trainer, Tichafa Makovere, who had led the pilot project, now stood before people from all over Konso and repeated The Parable of the Sparrows, his own way of confronting the mentality of aid-dependence, which has become so deeply ingrained in southern Ethiopia that it seems as much an obstacle to the development of food sovereignty as climate change or population growth.

"Empowering communities is about getting them to provide for their own needs, not just giving them whatever they ask you for so they become dependent on you."

"God feeds the birds of the air!," he intoned, "But he does not let them sit in their nests while he comes and puts food into their mouths. Unless they fly out of their nests to scratch the ground in search of food, they will go hungry." This sums up Tichafa's approach to development in Africa. He has seen too much of well-intentioned Westerners splashing around hand-outs to "the poor starving Ethiopians." A Zimbabwean of the Shona ethnic group, Tichafa knows what will benefit Africans in the long-run. "Empowering communities is about getting them to provide for their own needs, not just giving them whatever they ask you for so they become dependent on you."

We are not beggars!

He first visited a Konso school in early 2009, accompanied by the director of an Italian NGO. The school principal had been complaining to the Italian that he had not delivered the furniture he had promised. Not delivering on promises was apparently habitual with this gentleman, but Tichafa stepped in to his rescue, upbraiding the principal: "Don't embarrass me! I am an African like you. We are not beggars! Look at all these Eucalyptus trees you have here, they are destroying your soils. You should cut these down and sell them, then use the money to buy your own furniture. And plant better trees at the same time!" At this the Italian pricked up his ears. "Oh, I need Eucalyptus for building my new conference hall!"

Such is the mentality of self-reliance that permaculture instills. While many NGOs are throwing around thousands and even millions of dollars for white-elephant projects (such as superfluous conference halls), the chronic needs of communities on the ground could be better met if they were able to make more effective use of the resources they already have. This is the key aim of the Permaculture in Konso Schools Project (PKSP) the pilot phase of which culminated with last Saturday's speech.

From teachers to students to parents

The format of the PKSP is similar to that of the ReSCOPE and SCOPE programs, which Tichafa has led in a number of countries in southern Africa over the past 15 years with great success. It works this way. Two key teachers from a school are given the 72-hour permaculture design course, during which they produce designs for "retrofitting" their school grounds. The follow-up then brings in the kids and parents to implement those designs (with input from Tichafa, where necessary). The whole community gets involved. They haul in manure from their animals, mucking in together and singing in great spirits as they do. Soil and water harvesting infrastructure, intensive gardens, and tree nurseries are all laid out on the ground. Channels are dug to run rainwater from roofs into keyholes where banana suckers soon explode into lush thickets. Moringa, papaya, and mango (the first 70 seedlings provided by SFEL) will soon close a canopy over the flourishing vegetable beds. Permaculture is included on the school curriculum, with resource materials designed for the purpose, so kids gain theoretical insight as well as being involved practically. Within a year the school can supplement its children's diet with fresh fruit and greens and gain income from sales of vegetables and tree seedlings to the community. The bare schoolyard soon becomes a lush and fascinating jungle for exploration by the young mind. The kids also take their skills home, strengthening community for the long run.

These people are taking control of their own destiny, no longer sitting by the roadside waiting for UN grain convoys to roll in with hybrid wheat over-produced on the other side of the planet—the solutions lie right here, in their own back yard.

The bare school yard soon becomes a lush and fascinating jungle for exploration by the young mind.

A pedagogy of permanence

A program of monitoring and evaluation continues over the following 24 months, with exchange visits between the schools, bi-annual refresher courses for the teachers at SFEL, visits to our model farm to promote new ideas and improve motivation. The culmination of Phase I (the pilot) was the competition between the schools which came in February 2010 with SFEL's most recent international design course, the participants of which were asked to judge between the schools for the best implementation, as part of their own training.

The permaculture design course had a multinational complexion with the U.S. Peace Corps sending two Ethiopian-American officers, an Ethiopian estate owner from Norway, two freelance American volunteers, a Swedish SFEL volunteer, an Italian couple, a British volunteer on a mission to develop a windmill for SFEL, a Welsh woman working with the Karrayou tribe from the rift valley in East Shoa, and a Welsh veterinary surgeon also working with the Karrayou tribe. Criteria for the participants' appraisal of the schools, included:

- The presence of the design map on the wall
- The presence of a tree nursery
- Effective intercropping of species to reduce disease and promote companion relationships
- Evidence of innovation in water harvesting
- Evidence of eating the vegetables produced in the gardens
- Evidence of gaining an income for the school from sales of produce

Overall it was decided that Sawgume (the same school where Tichafa had first embarrassed the teachers with the parable of the sparrows a year ago) deserved to win the competition, but all three schools were given prizes as an encouragement. The prizes were donated by local businessmen, such as Mr. Samuel, the owner of Bela Abyssinia Tours, a customer of SFEL, who agreed to contribute 3000 Birr for exercise books, pens, watering cans, spades, and hoes, awarded to the teachers and to the most industrious parents and kids of the three schools.

And the PKSP pilot phase has been proclaimed a resounding success! The Konso Education Bureau are keen to see its expansion to all the schools in Konso. STC Finland have agreed to include two more schools in their program in 2010, however, we at SFEL are keen to go beyond that. If more NGOs, governments, or individuals will involve themselves, by adopting or sponsoring schools in various ways, we can keep permaculture growing actively in Ethiopia in the coming years. We are ready to work with you.

You can also support our activities by joining the next international permaculture design course at SFEL in Konso: Permaculture for the Rural African Environment—oriented towards food security development for rural communities lead by Tichafa Makovere Shumba, at Strawberry Fields Eco-Lodge. ∆

For more information please contact info@permalodge.org also visit our website www.permalodge.org.

Forests and Water

A Firm Resolve in Trinidad and Tobago

Bunty O’Connor

EVERYONE WOULD AGREE that Trinidad is a very small island, only 40 miles by 50 miles and supporting a population of a million and a half inhabitants, billions if we include the birds, insects, beasts and reptiles. This makes it easy to despoil and we have been burning, hacking, littering, and quarrying as if tomorrow would never come. Over the past 50 years, there have been warnings a-plenty from our own biologists and ecologists about the effect of fire on our hillsides and lowlands, mining and quarrying and the destruction of forested lands. Denuding the hills has resulted in our streams drying up—take a drive to Asa Wright and see how the hundreds of “leaks” in the mountain side have disappeared.

This year has arrived with a vengeance, bringing our first sampling of what happens when we ignore the earth we live on and do nothing to repair it. Global warming is blamed for our present situation of drought and intense daytime temperatures are caused, we are told, by the “burning of fossil fuel”. We are somehow left with the impression that this evil is carried out by “industrialized nations” somewhere out there. Intellectuals pontificate and leave us feeling that there is nothing we can do to help the situation.

But there is.

We can plant trees.

Trees do any number of useful things. They provide shade in the dry season, providing they are the right sort of tree. Have you ever wondered why the grass is always greener and the air cooler where there is shade? In Trinidad, we have lots of trees to choose from - over 300 different species that grow here naturally. Roots of trees dive deeply down into the earth, holding it up in areas prone to landslide, allowing rain to percolate deep down to replenish water supplies. Roots die too and are replaced on an ongoing basis. Their remains and the leaf litter that accumulates, provide nourishment for organisms that build up the soil. Roots of some trees like the immortelle and the pois doux, harbour bacteria which make their own fertilizer and share with the surrounding plant community as is seen in a cocoa plantation.

Plant trees to bring the rain

A tree is not a creature that remains static; its pattern of growth is slower than ours and it may require three or more human generations to care for the same tree, so we need to look upon our living trees as savings or money in the bank. Scientists have recently declared that trees give off chemicals that create rainclouds. Giants of the rainforest create their own rainfall patterns by transpiration and the interaction of leaves and insects. If this is so, then we should be planting hundreds of groves of trees to win some of this holy water. Trees absorb pollution and they give off oxygen. The atmosphere in which our brains evolved held more oxygen than it does today, so perhaps this is why we are suffering from the ignorance and inertia that prevents us from getting out and repairing our communities and countryside. The outlook is dismal, no water, no rain, no shade, no trees and to make it worse no action. Trees and water go together; trees circulate water up and down their trunks and branches. They transpire water vapour through their leaves into the atmosphere which has the effect of cooling the surrounding air. Water shortages will become more and more critical until we begin to understand the relationship between forests and water.

The bare lands of Central Trinidad, once under forest, cleared for sugar and now baked hard by fire and sun. A river used to run in the valley between the hills. This landscape is extremely difficult to repair and will require daily vigilance in the dry season over many years to prevent illegal burning if it is to be restored.

A recent project being carried out in south Trinidad promises to be a successful example of collaboration between teachers, children, big business and agriculture. Funded by one of our multinationals, the project educates primary and secondary schoolchildren about the importance of permaculture or agro forestry. The children collect their own seeds and germinate them at school. When they are big enough, the plants are sold or exchanged with other schools for planting. Because of the diversity of environments where these schools are located, there is a tremendous variety of trees, shrubs and herbs to collect.

The students are also expected to research their finds and keep a record. After planting, which is done at the beginning of the rainy season, the stem of the plant is protected from the weedwackers with split PVC pipe, the trees are watered and maintained and a note is keep in a small record book. It is hard work and everyone gets such enjoyment from the day spent planting and watering, that one cannot imagine why children all over the island can't do the same, especially as so many schools stand in bare tracts of land with only a lonely neem or manila palm tree. Orchards of "old fashioned" fruits have been established in some of these schools, and playgrounds surrounded with shade trees. Maintenance is an issue but the children know that they have to look after their trees. How educational is this? The children learn about the earth they live on, observe and collect her bounty and then proceed to grow something essential to their own health, wealth and happiness.

Every boy and girl plants a tree or three!

The dry season is the time of year when trees make seed pods and fruit. Why not go out and collect some? Go to the market and find fruit that is on sale: sapodilla, sugar apple, chenette, guava, cashew, coconut, cherry, chataigne, pommerac, paw paw and mango. Look for poui and immortelle seeds drifting down on the breeze. Get some plastic containers. Cut off the tops, punch them full of holes at the bottom, put some soil in them, place them in a cool shady spot, put your seeds into the soil and water them. Soon you should be rewarded with nice healthy trees. Grow the trees on, show them to your neighbours, and talk about what you are doing. Don't be disappointed by scornful remarks. Tell everyone you are saving T & T. Get the children to help. It will be a struggle to change people's minds and habits, but persevere. Ask them for help in planting your tree around the recreation field. You will be the flag bearer for the new Green movement because ordinary people are at the foundation of the remedy to restore shade and balance to our communities. Those who hack, burn and bulldoze are the criminals who threaten the rights of all of us to enjoy the beauty of nature, to be able to shelter from the sun, smell the flowers, pick fruit and above all to breathe clean air. Δ

Bunty O'Connor trained in permaculture in 2007 during the first-ever course in Trinidad. She can be reached at bunty@ajoupa-pottery.com.

The riverside before cutting and burning. These areas need to be preserved for their water and restoration of our well being.

Permaculture and Empowerment in Palestine

Building Wealth from the Ground Up

Alice Gray

"Nations and peoples are largely the stories they tell themselves. If their stories are lies, they will suffer the future consequences of those lies. If they tell stories that face their own truths, they will free their histories for future flowerings."
—Ben Okri

THE MIDDLE EAST has long been a place for beginnings. Here people first practiced agriculture some 12,000 years ago; here the first cities grew, and here three world religions were born. This is a place for asking questions and for seeking answers. So perhaps it is appropriate that we should have chosen a small farm in Palestine to start our own search for answers to what may be the most important question of our time: How can we live sustainably?

Such a simple question. It seems the answer, too, should be simple. And yet, in the world we know today, where global climate change, loss of biodiversity, and poisoning of the environment stare us in the face each day, it is clear that we do not have that answer. It is also clear that the "status quo" for human life on this planet, particularly in our so-called "developed" nations, is one of environmental destruction.

To live in Palestine is to live under a magnifying glass…it presents a microcosm of global problems where everything is exaggerated and condensed.

A rudimentary examination of global resource flows or ecological footprints can tell us that developed nations are consuming the vast bulk of the world's ecological wealth. It is now cliché that if everyone lived like Americans we would need several planets to support us. Equally obvious, though less often admitted, that demand for resources is being enforced by military coercion. Resource wars, like climate change, are not a bleak portent of tomorrow, but the harrowing truth of today. In the Middle East, where Iraq lies smouldering in ruins and the brutal summers get longer and dryer each year, both calamities are already much in evidence.

Palestine is a special place, the Occupied Territories now made up of two remnants of war: Gaza is a tiny strip of land between the Mediterranean and the Naqab Desert. The West Bank is squeezed between a brief flush of mountains near the bulwark of Israel on one side and the Judean desert on the other. This is a land of ancient stone terraces and olive groves, of almond blossoms and minarets, but also of military occupation and active colonization, where the call to prayer mingles with the roar of fighter jets overhead, and wildflowers grow between the razorwire and the watchtowers of the occupation.

Palestinian village.

To live in Palestine is to live under a magnifying glass. It is an area about half the size of Connecticut (6,200 km^2 or 2500 sq. miles), where two worlds meet and clash. Here the control of resources plays very directly into the politics of dominance and oppression. A country of extremes and of extreme contrasts, it presents a microcosm of global problems where everything is exaggerated and condensed.

Contrasts in privilege

A red-roofed Israeli settlement perches on a West Bank hilltop: the epitome of modernity. Sprinklers play across well-watered lawns, swimming pools shimmer in the ever-present sun, and air-conditioning units hum beside neat brick houses. The well-to-do residents receive numerous tax-breaks and government utility subsidies for participating in this colonization project. Connected to Israel by well-surfaced roads, they zoom back and forth unimpeded, barely seeing another world that hovers nearby.

At the foot of the hill, a stone's throw away, a Palestinian village nestles in the valley. Caught between the Israeli settlement on one side and its access road on the other (which is out-of bounds to Palestinians), the village is practically encircled by a razorwire fence. The narrow streets that wind between the old stone houses are potholed and choked with rubbish and dust; the gardens are wilted and dry. Water supply in the summer is intermittent at best; it often fails altogether. People scratch a living however they can; the farmland from which they used to support themselves is either rendered inaccessible by the encircling fence or has been ruined by untreated sewage pouring down the hill from the settlement above or from the village itself.

House and valley in the spring.

This spectacle is familiar to anybody who has spent time in the West Bank and could refer to literally hundreds of villages, from Jenin governorate in the north to Hebron in the south. These marked contrasts are not just the product of culture (which may explain differences in dress, language, and architecture), but of a carefully orchestrated and brutally enforced program of colonisation and control that is designed to create and reinforce privilege and power. The Israeli settler movement in the West Bank is motivated by a religious-nationalist agenda, but once you start to understand the pattern, you begin to see it operating everywhere and at every scale.

While systemic change is clearly desirable, action at the individual and community level is more immediate and will have more tangible consequences in our lives.

Breaking it down, we see that it rests on two main pillars: appropriation of resources and control over their production and distribution to benefit an "elite," and the disenfranchisement and subjugation of an "underclass" to create a dynamic of dependency and control. Both are backed by military might.

A war over water

Looking again at the Israeli settlement and the Palestinian village and the great gulf in privilege between them, we can see this pattern in action. The issue of access to water, that most vital of life-giving resources, makes clear the disparities. Why do the settlers have access to more water than the Palestinians? Is it a lack of organisation on the part of the Arabs? Is there not enough water for all?

Water Resources of	Israel and Palestine
Total population of Israel and the OPT	About 10 million
Sustainable annual yield of main natural water resources in Israel and the OPT	1,800 MM^3 (MM^3=million m^3=1 billion liters)
Total annual water needed to provide 100 liters/person/day (MM^3/yr)	(10,000,000 x 100 liters/ day x 365 days=365 billion liters=365 million MM^3
Remainder	1,435 MM^3/yr

On examination, it becomes apparent that the answer to both questions is no. Despite the aridity of the Middle East in general, there is enough water in naturally occurring aquifers inside Israel and the Palestinian Territories for everyone to get the minimum of 100 liters per person per day to cover basic needs recommended by the World Health Organisation. That would still leave a substantial amount for agricultural and industrial purposes (see Sidebar 1 for the basic sums).

In spite of this, the average water supply to Palestinians in the West Bank is a scanty 50 liters per person per day (just half of the WHO minimum) while Israeli settlers living in the same area have a practically unlimited supply. Across the board (including industrial and agricultural use), on a per capita basis, Israelis have access to four times as much water as Palestinians, according to the World Bank's most recent water development report.

This inequity is no coincidence. It is well-documented that Israel has maintained a strangle-hold on Palestinian water development: first under the Israeli Civil Administration from 1967–1995, and then under the terms of the Oslo Interim Agreement, in force from 1995 until the present. Organisations working in the sector, from Amnesty International to Oxfam to the World Bank have drawn the same conclusion. A similar story applies to other development sectors such as wastewater and solid waste management.

The upshot of this monopolisation of resources and strangulation of development is one of both human suffering and environmental destruction. Shortages of food and water, as well as a general economic insecurity are commonplace in Palestinian communities. The air is thick with the fumes of burning garbage, while 90% of the sewage goes untreated, choking the wadis and contaminating the soil. In the West Bank, Israel controls 60% of the land and 80% of the water. In Gaza, where 1.5 million people are crammed into a mere 365 km^2 (93,000 acres) of land, resources are insufficient to support the population, so the incessant border closures (not to mention bombings) have created real and widespread hardship.

The gap between "haves" and "have-nots" is wide and widening. In 2005, Israel's Gross National Income (GNI) per capita was almost 18 times the Palestinian GNI per capita. Militarily and economically, the power dynamics are clear. Does this pattern seem familiar yet? Looking around the world at the global trade system, the issue of Third World debt, the interventionist foreign policies of Western nations, and over a long history of Western imperialism and colonialism, it is hard not to see the parallels. Both within and between countries, this culture of exploitation deeply permeates our societies, ensuring that the world is arranged to benefit powerful elites at the expense of the majority of humanity and the life of the planet.

How can we overcome these dynamics of oppression and destruction? Systemic change is clearly desirable, but action at the individual and community level is more immediate and will have more tangible consequences in our lives. Permaculture is one route to effect such change, essentially taking back control over our patterns of consumption and disposal, and placing ourselves at the center of a conscious interaction with the world. Permaculture is about re-imagining our relationship with the rest of nature, and finding within ourselves the creativity to live in a way that enhances the world.

Reclaiming the wasteland

This brings us to Bustan Qaraaqa: a four-acre permaculture farm on the edge of the Judean desert in the West Bank town of Beit Sahour close to the city of Bethlehem. Bustan Qaraaqa is an experiment in sustainable living and food production, seeking to support and empower Palestinians to obtain the resources they need from the environment around them, whilst also managing their environmental impacts. Bustan Qaraaqa is demonstrating what individuals and communities can do, even under military occupation, to take control of their situation and to create a healthy life in the midst of destruction.

We are using techniques such as rainwater harvesting and greywater recycling to augment water supplies. Composting toilets save water and prevent sewage pollution. Food waste and cardboard are composted to support growing food, while disposing of a good deal of household waste. We make cheap structures using tires stuffed with rubbish, laying them up as bricks. This also helps to clean up the countryside.

Beit Sahour is one of the hottest and driest towns in the West Bank, which offers us the perfect testing ground for drought-tolerant food production. Using a combination of drip irrigation and mulch, we are attempting to minimize water input whilst maximizing soil moisture content. We are also experimenting with companion planting and agroforestry to develop robust ecosystems that can supply a variety of goods and services, from building materials to food and medicines. We have managed to develop the only native tree nursery in the Palestinian Territories, and are making its products freely available to the surrounding community for agroforestry, ecosystem restoration, and community gardens..

The founders of the farm are of British origin, yet we are finding a warm welcome in the Palestinian community around us. We are building strong partnerships with Palestinian farmers and organisations at the same time as we are finding friends across the border. In the 'green' community in Israel, many are keen to support Palestinians to obtain their environmental rights and to resist the Israeli occupation. Working alongside Israelis and Palestinians, we are realising more and more the truth of the statement by Bill Mollison, one of the fathers of the permaculture

Palestinian students planting and tending the soil.

concept that: "A person of courage today is a person of peace. The courage we need is to refuse authority and accept only personally responsible decisions." ∆

Alice Gray (MPhil, BSc) is an ecologist and environmental researcher who has worked for four years in the Palestinian environmental development sector. She is the co-founder of Bustan Qaraaqa (www.bustanqaraaqa.org) and LifeSource (www.lifesource.ps).

Movement Musings

Participatory Permaculture Research

Carbon Farming Data Needed to Make Smallholder Case

Ethan Roland

Carbon Farming Tennessee is launching a research initiative, in collaboration with Appleseed Permaculture, Australia Felix Permaculture, Nemawashi Permaculture, and individual farmers, to help quantify the effects of Holistic Management and Keyline Techniques for soil building.

This article offers information on broadacre soil health, fertility, and carbon sequestration.

Carbon in the wrong place

The economic project of humanity is seriously out of balance with the planetary ecosystem. The climate is in chaos, two-thirds of all species are threatened with extinction, and the effects of too many people consuming too much stuff are causing massive suffering for humans and other species. Worse is in store if we don't change course. The most urgent problems are linked: climate is being disrupted by the rapid increase in carbon dioxide and other greenhouse gases into the atmosphere. This movement of carbon into the atmosphere is mirrored by a loss of carbon in our soils and a diminishing of both forest cover and the ability of forests to hold carbon. The burning of fossil fuels drives this process faster and faster. Human work, organized to a considerable degree by the industrial economy, is causing this shift of carbon out of soils and biomass and stored hydrocarbons, and into the air.

Of the three main sources for carbon entering the atmosphere, soil, forests, and fossil fuels, the last has gotten most of the press in recent years. Much of the brouhaha about climate politics up to this time has been about how to put a throttle on the burning of hydrocarbons, who will have a hand on that throttle, how to throttle back without stalling the engine of economic growth, and who will give up opportunities to profit from continuation of the current systems. Very little attention has gone to the question most permaculture designers would immediately ask: How do we get the carbon out of the atmosphere and back into the ground where it can do good instead of harm? Proposals by the coal industry to sequester CO_2 from power plants in deep underground reservoirs are untested and fraught with enormous costs and dangers.

Permaculture researchers believe that we have gained the ecological understanding and technology to capture carbon from the atmosphere quickly and economically and to store it broadly around the planet in stable molecular forms that will improve the productivity of our farming and forestry. We intend to mobilize a massive army of microbes, earthworms, ants, termites, and much smaller but still impressive brigades of smart farmers and tree planters to pay down a ten-thousand-year-old debt which is now coming due. We are hopeful that we can bring our economic systems back into harmony with the earth.

This is potentially very good news, and it should be worth a great deal of money because it could help protect multi-trillion dollar investments of infrastructure, not to mention supporting the stability of civilization itself. Combined applications of keyline design and plowing, rotational grazing, water-harvesting earthworks, regenerative food forestry, and aerated compost tea have the potential to sequester massive amounts of carbon in the soil and biomass of our cultivated systems, increasing fertility and productive yields, and at the same time stabilizing climate.

But we lack some key data to show the global scientific community that these simple, locally-available tools will do the job if deployed on a broad scale. Specifically, we wish to establish how much carbon can be sequestered in soils through the use of these techniques, both independently and in various combinations. A group of us, identified as Carbon Farming Tennessee, have twice applied for federal funds through the Sustainable Agriculture Research and Education program (SARE) to run and monitor trials of combined techniques, and twice have been turned down. We are now appealing to farmers, graziers, gardeners, ecological engineers, green architects, permaculture designers, and others to help make this research happen.

Soil degradation and repair

Over the past century, agricultural soils in North America have been subject to heavy abuse due to mechanization of farming and the widespread effects of livestock, tillage, and agrochemicals. As a result, many of these soils are severely compacted. They have low levels of organic matter and soil life, and their moisture-holding capacity is compromised. The continuation of our agriculture and our society require healthy and fertile soils. Restoring them to this condition demands the careful study and promotion of the best land management practices.

Impacts of climate change

On a wider scale, erratic weather patterns and rapidly growing levels of atmospheric CO_2 and other greenhouse gases are combining to compromise the relative climatic stability we have come to know in many regions of the planet. In 2007, extended drought conditions affected significant parts of the Northeast, while the nation's Southeast and Southwest zones are currently suffering greatly due to extreme drought. These conditions affect agricultural productivity but also threaten livelihoods in these regions. Farmers throughout the country, and indeed everywhere, need to explore and adopt management practices that catch and store water in their agricultural landscapes—especially in soil—the cheapest and most effective means of holding moisture.

Increased atmospheric greenhouse gas concentrations, measured in CO_2 equivalents, are believed to be a primary cause of growing climatic instability and rising global temperatures, which are in turn altering local weather patterns. Dr. Rattan Lal, Professor of Soil Science at Ohio State University, has calculated that 476 Gigatons (Gt) of carbon have been oxidized from farmland soils due to inappropriate farming and grazing practices (Christine Jones, PhD, www.amazingcarbon.com). In contrast, 270 Gt have been burnt over the past 150 years of fossil fuel use (Jones, *op cit).* In their study, "Carbon Sequestration: Potential Estimates with Changes in Land Use and Tillage Practices in Ohio, USA," Zhengxi Tan and Rattan Lal explain that the conversion of natural ecosystems to agriculture can reduce the soil organic carbon pool by up to 50% in the top 8"(20 cm) of the soil and 25–30% in the top 40"(100 cm) after 30–50 years of cultivation (Tan, Lal, 2005). There is a great need to reduce carbon emissions, while at the same time instituting large-scale initiatives to sequester atmospheric carbon already accumulated.

A multifunctional solution

We believe that the widespread application of Keyline design and subsoiling, as pioneered by Australian engineer P.A. Yeomans, would address the issues of climatic instability and erratic weather at both the local farming level (by drought-proofing landscape through soil water storage) and the global atmospheric level (by massive sequestration of carbon through increased soil humus levels). The bulk of the earth's vegetated area is classified as grasslands (56.3 million km^2 out of 117 million km^2), some of which are permanent pastures in humid regions, and most of which are not suitable for arable cultivation because they exist in arid or semi-arid regions. They are undergoing severe degradation worldwide (www.windstream.net/bsundquist1/og1.html). We propose to apply Keyline subsoiling to compacted pasturelands using the Yeomans keyline plow™, and to document the changes in soil carbon levels that result over a three-year period in treated (keylined) and untreated (control) plots on seven farms in the Northeast. Since rotational grazing techniques have advanced grassland productivity dramatically since Yeomans' work was first implemented, and additional soil life enhancing methods are available today that were unknown when Yeomans began his Keyline developments in the 1940s, we think that further synergies are possible. Similar controlled studies could be conducted to assess the impact of management intensive rotational grazing, Soil Foodweb Techniques, and other practices to form a baseline understanding of regenerative farming and its potential to address the climate crisis.

Our research strategy is to:

1. Collect baseline data about different sites prior to applying these regenerative agricultural techniques.
2. Create and spread a simple methodology for farmers to test their own soil and report results to add to the knowledge commons.
3. Review "best practices" for regenerative agriculture to help capture atmospheric carbon in soil while boosting crop yields.
4. Disseminate the results of our study through our website. See: www.carbonfarming.wordpress.com for updates.

Welcome to community supported research

This project is a direct response to the pressing needs of farmers around the world. Carbon Farming Tennessee is a small community-owned, for-profit business; we are part of the farming and permaculture communities. The aim of these studies is to empower communities and farmers to understand the science of carbon sequestration and soil improvement, and to do their own research. If we are able to document, as we expect to do, the capture of significant amounts of atmospheric carbon by soil building processes, the implications for the interlinked global crises of climate and food are immeasurably large.

For more information about this proposal or to collaborate with an independent test plot following this methodology please email carbonfarmingtennessee@gmail.com. Δ

We are hopeful that we can bring our economic systems back into harmony with the earth.

Mark Krawczyk, Mary Johnson, Gregory Landua, and Peter Bane contributed to this article. Ethan Roland is the president of AppleSeed Permaculture LLC, Gaia Northeast (A Regional Center of Gaia University), and CFO of Carbon Farming Tennessee. Mark Krawczyk runs Keyline Vermont and helps to organize the Burlington Permaculture Guild. Gregory Landua is a founding partner of Carbon Farming Tennessee, and works with Gaia University International, and, along with Mary Johnson of Watershed Resource Consultants (and others), is founding an international carbon farming consultancy.

Tree Tax Funds Awarded to S. Dakota Coppice Demonstration

Peter Bane

GLACIAL LAKES PERMACULTURE OF ESTELLINE, South Dakota has been awarded $500 from Permaculture Activist Tree Tax funds to plant a one-acre coppice woodland demonstration site for the northern Plains. South Dakota was never heavily wooded in the post-glacial era, but much of its original vegetation has now been altered. Short-grass prairie dissected by riparian forests in the eastern part of the state stretches into more and more arid steppe zones in the west. The massif of the Black Hills, wooded at higher elevations, represents an exception to the geographic trend.

Estelline, located at the eastern edge of the state, receives from 22-25 inches (560-635mm) of precipitation per year on average, and it is expected that, once established, the coppice woodland will do well. Species have been selected for their hardiness to zone 4 and semi-arid conditions, as well as suitability for multiple uses. Eastern South Dakota is agriculturally and geographically similar to the sections of Minnesota, Iowa, and Nebraska which it borders. The region around Estelline is an elevated plateau north of the Missouri River known as the Coteau des Prairies, lying between 1200' and 1500' (360-450m) elevation.

Dr. Karl J. Schmidt, Director of International Studies and Professor of History at South Dakota State University–Brookings, and the project's designer, explains that the purpose of the coppice demonstration is to show local farmers how a portion of their land, now almostly exclusively under corn and soy monocultures, could sustainably provide firewood, poles, craft material, fodder, and food both for on-farm use and for income while creating perennial plantings of great value to wildlife. The project will emphasize scalability so that its species and its findings can be transferred to a farm or property of any size.

Modeling traditional European practices but with native species, Schmidt, who also directs the Glacial Lakes Permaculture organization, intends to establish standards (main overstory trees) of Bur Oak *(Quercus macrocarpa),* a fire-adapted prairie tree with very large and edible acorns, over a mixed understory of smaller trees and shrubs. The understory species will be coppiced. Most of the selected species are native to the state and will be obtained from a local conservation nursery.

The 326 trees of ten species and 261 shrubs of six species will be planted starting in the spring of 2010 by volunteers. Results of the project will be shared through site tours and findings reported via the web at www.glaciallakespermaculture.org.

In 2008, Dr. Schmidt was recognized by the regional Plain Green conference with an award in the category of Plain Action for his design of a forest garden. With funds from that small cash prize he purchased and planted 22 fruit trees that will eventually form the tall canopy layer of this edible ecosystem. His work in South Dakota follows a parallel design and planting of a forest garden at the ICPPC-Ecocenter in Stryszów, Poland where he has academic ties. Dr. Schmidt received his permaculture training from Bill Mollison and Geoff Lawton in Australia in 2007, and took further training with Andres Soares and Lucy Legan in Brazil in 2009. He was the featured speaker on permaculture at the Northern Plains Sustainable Agriculture Society Winter Conference this past February. ∆

South Dakota Coppice Trial Species

Trees

Bur Oak *(Quercus macrocarpa)*
Silver Maple *(Acer saccharinum)*
Common Honeylocust *(Gleditsia triacanthos)*
Peach Leaf Willow *(Salix amygdaloides)*
Northern Catalpa *(Catalpa speciosa)*
Boxelder *(Acer negundo)*
Common Hackberry *(Celtis occidentalis)*
Green Ash *(Fraxinus pennsylvanica)*
American Linden *(Tilia americana)*
Eastern Cottonwood *(Populus deltoides)*

Shrubs

Black Chokeberry *(Aronia melanocarpa)*
Common Elderberry *(Sambucus canadensis)*
False Indigo *(Amorpha fruticosa)* – N-fixer
Red Osier Dogwood *(Cornus sericea)*
Nannyberry *(Viburnum lentago)*
Willows *(Salix spp)*

Celebrating a Life of Service
American Permaculture Pioneer Scott Pittman Turns 70

Sarah Wright

IN MARCH, Scott and many of his former students, friends, and fellow permaculturists celebrated his 70th birthday. We took a moment to reflect on the life and career of a man who has been living and teaching permaculture for a quarter century.

An actor finds an audience

It was on the stage Scott first felt he could reach people. In 1960 at the age of 20, he moved to New York City with dreams of becoming a professional actor, but after a few months he became disillusioned and returned to school at the University of Texas. In Austin, he felt a calling back to the natural world and a strong desire to delve into man's relationship to it. During his time at university, he became involved with the SDS (Students for a Democratic Society). He continued activist work for several years.

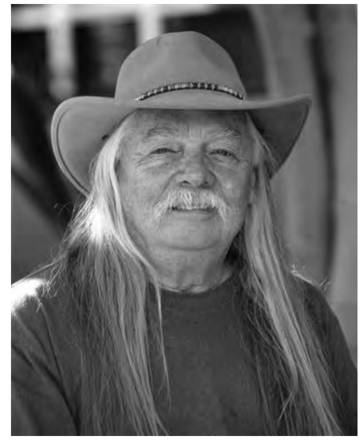
After establishing a business and a home in Santa Fe, Scott traveled to Kathmandu, Nepal in 1984 to study permaculture with Bill Mollison. The two hit it off. Scott continued traveling and studying with Mollison, and around 1986 taught his first design course. According to Scott's wife, Arina, "he always jokes that it was a near disaster, as he didn't realize how much he needed to know. But he had forgiving students who were hungry for information, and he pulled it through to become a teacher." At about the same time Scott started Permaculture Drylands Institute (PDI). The Institute sponsored permaculture trainings in the Southwest and launched *Permaculture Drylands Journal.* PDI also helped secure grant funding for Scott to travel.

Adventures in the South

Besides working in countries of the former Soviet Union in the early 90s, Scott and Bill Mollison found themselves teaching permaculture in the Ecuadorian rain forest in most unusual circumstances. The big tent in the jungle brought together native shamans and Ecuadorian military officers, plus students from around the world speaking five languages.

In this same period, Scott traveled and taught in Columbia and worked with Permacultura America Latina (PAL). He was invited to Guatemala and Brazil where, among other things, he taught at Instituto de Permacultura Mesoamericano (IMAP) in San Lucas Toliman, Guatemala; Instituto Permaculture e Ecovilas de Cerrado (IPEC) in Pirenopolis, Brazil; and Instituto Permaculture e Ecovilas de Pampa (IPEP) in the town of Bage, in the state of Rio Grande do Sul in southern Brazil. Scott also worked in communities settled by Brazil's landless workers movement (Movimiento Sem Terra). To add to the list, Scott traveled to Haiti multiple times. Since 1986, he has taught, and reached people, in 18 countries on four continents.

Helping in New Mexico


Scott Pittman

At his home near Pojoaque, Scott has served as Treasurer for Acequia Larga, an irrigation cooperative, for three years. For Scott, an Anglo, to hold such a title, in a land and time wrought with a history of ethnic turmoil, speaks of his ability to transcend barriers and to build and maintain a bridge that connects people to place.

Scott has also worked with different Pueblos in New Mexico. In June, 2009, he taught a class at Hamaatsa entitled "Permaculture through the Lens of Indigenous Land Wisdom."

Serving the national community

The first article in the Winter 96/97 issue of *Permaculture Drylands Journal* was titled "Taking Control of our Money: Creating a Permaculture Credit Union" by Bill Mollison. In collaboration with Manuel Abascal, a former student and friend, and an organizing committee, Scott Pittman set about contacting thousands of former students nationwide to enroll in the Permaculture Credit Union (PCU) and to pledge money to create a lending pool. From its home-base in Santa Fe, the PCU serves all states, is over 10 years old, and remains a thriving, "meaningful alternative to traditional banks…" (Mollison)

At home in the garden

Scott Pittman has dedicated his life to listening and learning from the land and the communities of life buzzing incessantly around him. His home near Pojoaque, New Mexico, home also to chickens, goats, guineas, geese, turkeys, trees of mulberry, cherry, apple, peach, plum, and quince, vegetable and herb gardens, wetlands of willow, cattail, and ducks, is a place one can walk through and feel hope. In the midst of everything growing here on the farm, it is hope—that promise of something succulent and delicious—that Scott and his family have truly planted. They continue to share the harvest. ∆

Sarah Wright studied permaculture with Scott Pittman, and now works at the Permaculture Institute. She plans to return to Albuquerque in the Spring to initiate/participate in a women's art collective and urban homestead.

Reviews

At Home in the Wild

Review by Peter Bane

SAMUEL THAYER
Nature's Garden
A guide to identifying, harvesting, and preparing edible wild plants
Forager's Harvest Press.
Birchwood, WI. 2010.
512 pp. paper. full color illus. $24.95.

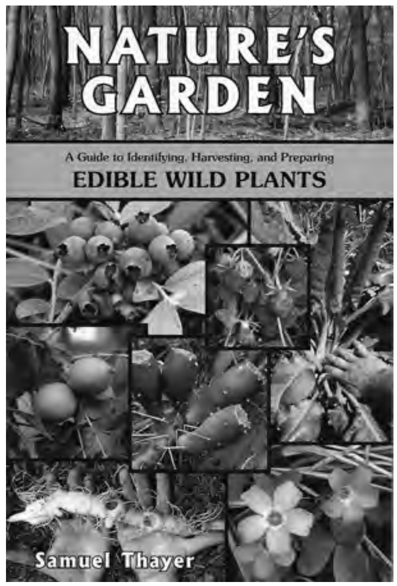
IN HIS FIRST BOOK, *The Forager's Harvest*, Sam Thayer emerged as a strong writer and an authentic man of wild places as he highlighted 32 North American food plants. The book sold well, won three awards, and guaranteed him a place in the literature of wild edibles. In *Nature's Garden* he gives us profiles and stories about 41 more noteworthy wild food plants. His passion for nature and wild foods carries this book, as it did the earlier one, deep into the hearts and minds of his readers.

Thayer writes from lived experience. He knows these plants and has eaten and enjoyed the foods they provide. The directness of his approach along with his craft as a writer make the book a fascinating journey. We vicariously find ourselves crawling through the underbrush, poling across the lake, or hiking the forest trail, enjoying all the delight of full-color photographs and succulent descriptions on every page but without the annoying bug bites, scrapes, and sore muscles. Many too, are the kitchen tales as we sit down to a breakfast of hickory nuts and lotus mush with maple syrup, or a glass of deep purple aronia juice or a bowl of ripe plums.

Though he describes preparing, cooking, and preserving the foods in each chapter, Thayer makes no attempt to give recipes per se. His aim is to help you identify, locate in the wild, come to know and appreciate, and then safely and efficiently harvest, prepare, store, and eat the foods he himself regales. Oh, he'll tell you how much sugar to use in preparing plum preserves, but this is not a recipe book. Nor is it a field guide. If you think you know where to find one of the plants described herein, this book will tell you how and when to harvest it, and what to do with the edible part.

Nature's Garden devotes considerable page space to correct plant identification. In the case of wild carrot and elderberry, the author is especially thorough in making sure the reader does not confuse these fine edibles with water hemlock, a carrot relative which is deadly poisonous. Using the descriptions and photos Thayer provides, the serious food forager will not have any difficulty distinguishing these superficially similar plants.

"The Myth of the Deadly Wild Plant" commands a significant chapter near the front of the book as Thayer takes popular author Jon Krakauer (*Into the Wild*) to task for intellectual dishonesty in characterizing Chris McCandless's death in the Alaskan bush as related to ingestion (from misidentification) of wild plants. Chris, a young and idealistic Georgia man who walked into the Alaskan wild intending to forage all his food, was hungry, ill-prepared, and poorly informed, but he didn't eat poisonous plants. He starved to death, as the coroner's examination of his emaciated body confirmed. Thayer uses this widely popular book and the film made from it to draw important lessons for his own readers.



Our culture is afraid of wild foods (and of nature generally), and so it's willing to tolerate slipshod journalism about wild food that would be unacceptable in any other context. (Krakauer floated three separate and fallacious explanations of McCandless's death in three editions of his book, changing the story but refusing each time to accept the simple and unarguable conclusion that he starved. The film was no better: it showed a counterfeit mock-up of a plant I.D. book with an illiterate entry that maligns one of the wild plants McCandless supposedly ate (it was not actually poisonous.) Also, Thayer points out that most people have very little sense of what it takes to eat from the wild. Cultivated foods are amazingly energy rich, and we're somewhat spoiled to live with the legacy of 10,000 years of agricultural development, plant breeding, and on top of that, the miracles of fossil-fuel driven food distribution. Foraging in the wild takes six times as much effort as buying the same number of calories in the store—and that's if you are proficient and knowledgeable, and if you live where wild foods are nutrient rich. In Alaska, excepting animals difficult to hunt, the wild food is not.

To punctuate these points—which I take to be some of the more important philosophical aspects of this book—Thayer describes a challenge he and his wife undertook: to eat only wild foods for a month. He actually went 40 days and she 36, including a time when she, working as a nurse, did multiple 12-hour shifts in quick succession, and when he was traveling. Neither modern condition, which we take for granted, is easily compatible with the diet restrictions they undertook, limits that required them to eat from home-stored food they had harvested, or to spend numerous hours in

His aim is to help you identify, locate in the wild, come to know and appreciate, and then safely and efficiently harvest, prepare, store, and eat the foods he himself regales.

the day (it was summer) collecting food, and then to cook and process it.

The effort was fun and informative, but not strictly a controlled experiment. The author confesses that after four days he stopped noting in his journal every food he was eating. Most days the wild food was repetitive, though perhaps not as much as people eating a store-bought diet would experience. The Thayers recorded eating at least 104 species during their long month—quite a feat. As he points out, pizza and hamburgers may appear to be significantly different, but they consist of two species: cattle and wheat, if you ignore the minor amount of calories contributed by tomatoes.

During his 40 days in the wilderness of nature's garden, Thayer and his wife ate many of their home preserved and canned wild foods, some wild food provided by others, and some foods they foraged "to order," so to speak. They ate well, stayed healthy, may have a dropped a pound or two, farted less, and slept better. And he found himself craving fat and sugar occasionally, though they both had good access to maple syrup (which they harvest and sell). He describes trading a friend berries for bear fat, then frying smelt in the fat and licking the fat off the plate. It's easy to overlook that there's more energy in a stick of butter than in two quarts of blueberries or six pounds of broccoli, and we're quite accustomed to an unusually rich and abundant diet.

The upshot? Foraging is serious work. You can learn to do it well and will benefit from including wild foods in your diet. There's an enormous amount of food available in the wild, but it takes skill, time, and practice to find it, gather it, and process it.

The chapters of this beautifully written and illustrated book are numerous but not equal in length. Most are similar and short (6-10 pages) but Thayer devotes over 50 pages to acorns, a major staple. A group of six Aster family plants including dandelion, lettuce, and salsify, also gets expansive coverage.

Responding to critiques of his first book, the author has included a wider range of plants this time so that the book may be more useful to people living in most parts of the US and Canada. As he explains, the literature of ethnobotany in North America is highly skewed toward the West and the Far North, while the horticultural, agricultural, and wild food centers of diversity are primarily in the territory from New York to Minnesota south to Oklahoma and east to the Carolinas—the heart of the eastern deciduous forest. This is the territory and these are the plants he knows from harvesting. His two books are a generous gesture toward filling that gap.

He offers a chart of the 50 U.S. states and 13 Canadian provinces and territories showing the percentage of the book's plants which grow in each. The center of the range is a territory stretching from Delaware across West Virginia, Ohio, Indiana, and Illinois to Iowa where all of them grow. Ontario and Quebec both host more than 90% as did all of New England, the Mid-Atlantic and the Midwest. Westward, the numbers drop gradually to under half in Hawaii, Nevada, and Alaska.

If permaculture were to become widespread, most of us would be doing something rather like Sam Thayer...

Sam Thayer is a careful, skillful, and intelligent writer—sometimes funny, always frank and thorough. He repeats in this book his concerns about the poor state of the literature in his field (misidentified plants, poor scholarship, unsubstantiated claims), and in this way underlines his own commitment to a high standard. It's easy to see and taste in his words and photos. He shakes his head metaphorically and not a few times at the relative ignorance of people approaching the subject of wild foods, not just the ones who insist on confusing chokecherries and chokeberries, but those who insist that this or that perfectly delicious plant is deadly poison. And he underscores his commitment to education and his passion for his work by opening the book with a "Claimer," not a disclaimer: He stands by his words; he advocates the use of the plants he names, and he thinks people should do what he has done. But, sensibly, he's not responsible for your mistakes or mine.

Thayer works an interesting cultural edge, anchored as he is in a genuine love of the wild. He's a scientist, but he's also out in the wild rice swamps and wapato fields gathering food to make his living, much as native Americans would have done in his region 500 years ago, and as some still do. He writes (very well) and he teaches about what he does to augment his income, but he also practices subsistence. His house is full of buckets of nuts, gallons of dried fruits, sacks of wild rice, and barrels of maple syrup. He displays mastery of the tools that have shaped the modern world (empirical science), and also of the skills that enabled aboriginal peoples to live in the world that came before it, and that with luck may endure beyond it. He's critical of the culture, while offering an authentic and approachable alternative. If permaculture were to become widespread, most of us would be doing something rather like Sam Thayer: cultivating and living from nature's garden.

I don't think I can praise or recommend this book highly enough. It also appears to be exceptionally good value. And it's wonderfully fun to read. Δ

Putting Carbon in its Place

Review by Peter Bane

JAMES BRUGES

The Biochar Debate

Charcoal's potential to reverse climate change and build soil fertility

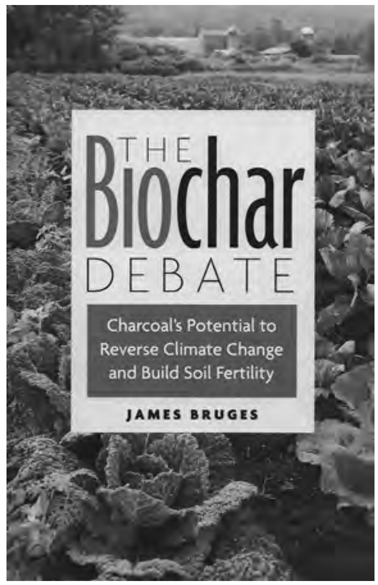
Chelsea Green Publishing Co.
White River Jct. VT. 2009.
120 pp. paper. illustrated. $14.95

THERE IS LITTLE INFORMATION in book form about the agricultural use of charcoal—called biochar, so this slender and well-written volume is a welcome introduction to a subject of great promise and some controversy. The author, James Bruges, grew up in Kashmir and worked as an architect in London, the Sudan, and India. He has retired to Bristol, England, if getting involved in local sustainability initiatives (The Bristol Urban Village) and continuing to write books can be called retirement. He is probably near 80 and we are lucky to have him.

My first conscious encounter with the idea of biochar came in 2005 at a workshop at the 7th Intl. Permaculture Convergence where German designer Harald Wedig presented an overview to about 20 of us. He referred to biochar through its historical discovery in Brazil. Areas of dark earth, *terra preta do indio* in Portuguese, apparently created by native peoples of the Amazon centuries ago, have persisted and were known locally to be of remarkable fertility.

Dark and durably fertile soils are exceptional if not unknown in the tropics, where high rainfall and constant warmth cause rapid oxidation of organic material when it is not literally carried away and eaten by insects within hours of falling to the forest floor. Tropical ecosystems store fertility (carbon and organic matter) in living biomass because there is no need for a soil reservoir to endure a season of cold dormancy, and because that fertility would be oxidized and leached were it not actively bound into organisms. High rates of bioactivity also consume everything not tightly defended by toxins, chemicals, ferocity, or stealth. Thus, the paradox of dark, fertile soils in the rain forest.

Brazilian researchers have known for decades that *terra preta* contained charcoal, and that the deep deposits (many feet) in which it was found suggested that large piles of crop wastes, along with pottery shards, manures, and wood scrap had been deliberately pyrolyzed or charred in place by low-temperature combustion in the absence of oxygen. This process, similar to the way charcoal is made traditionally, drives off volatile compounds from smoldering organic materials, leaving behind almost pure carbon in the form of charcoal. The biochar, as it is now widely termed, is especially valuable as it retains the cellular structure of the original material, a carbonized matrix with enormous pore space.



If practiced by enough farmers, it could actually bring down CO_2 concentrations in the atmosphere, not merely slow their increase.

It seems the Amerindians had stumbled across and grasped the potential of charcoal to hold both water and soil microorganisms, though they would probably not have understood the invisible components of soil life as we do today. Understood scientifically or merely used empirically, biochar improves soil fertility and the growth of plants for very long periods—centuries or even longer. It is this enormous capacity to hold the basis of soil fertility that makes biochar such a promising agricultural amendment, for both tropical and temperate soils.

This alone would be a discovery of startling significance today, as the world faces severe problems of soil erosion and massive loss of fertility due to the cumulative impacts of agriculture. But biochar has ignited a storm of excitement among climate researchers and activists as well because it is a simple, low-cost, and immediately accessible technology that can pull carbon from the atmosphere and lock it up in a stable form for centuries. If practiced by enough farmers, it could actually bring down CO_2 concentrations in the atmosphere, not merely slow their increase.

How does "burning" charcoal reduce CO_2? It doesn't directly, but when plants grow and photosynthesize, they capture carbon dioxide and convert it into biomass. Normally, as the plant dies, or its leaves and branches drop, that carbon is reoxidized and returned to the atmosphere by digestive organisms—fungi and other microbes. But when the carbon in biomass is charred before it can decompose, it becomes stable for centuries. The gases released in pyrolysis do contribute to carbon emissions—and they are of concern both for their toxicity and their potential value as industrial feedstocks, resins, oils, etc., but they are only a small portion of the total carbon in the plant. Charcoal doesn't oxidize in soil. It will only oxidize by burning at high temperatures. In the soil it remains to darken and enrich the earth.

Bruges explores the various aspects of the emerging debate over this potentially game-changing technology. The book sets out a brisk overview of the problems of climate and agriculture. One of his matter-of-fact assertions warms my heart, "The most productive use of land is a carefully managed vegetable garden or allotment feeding a family and neighbours. As the size goes up, to market gardens and small mixed farms that supply shops, the amount of waste goes up and the productivity per acre goes down." Perhaps no more succinct argument for permaculture has ever been made.

The author makes a nod to the surfacing

of biochar through *terra preta,* and then surveys a range of biochar pilot projects from south India to Ghana to Belize to West Virginia and Cameroon to see how they are working and what technical innovations are emerging. He briefly speculates about the potential of biochar to ameliorate soil conditions in the south of France, which is keenly interesting to me because Jean Pain—an early contributor to permaculture's global conversation—had a not dissimilar vision in the 70s when he wrote about gasification of wood waste using compost heat in these same regions. Bruges quotes James Lovelock, co-author of the Gaia hypothesis and extreme climate pessimist, as saying of biochar on farms, "…this scheme would need no subsidy, the farmer would make a profit."

Therein lies the potential and the controversy over biochar. Should it be subsidized and how so? Should it be linked to markets in carbon? What will happen if (or when) corporations and governments get involved. Much of the power of biochar is its simplicity and accessibility to hundreds of millions of small farmers and land managers the world around. It could be a salvation for peasant farmers and for the climate, or it could become part of the next investment bubble. Bruges is clear that biochar should be treated separately from other schemes to reduce carbon emissions. There can be no substitute for greater conservation and efficiency in the use of industrial fuels. This must proceed with urgency. Government programs may be needed to support tree planting and soil building, but these efforts are fundamentally different from smokestack recovery, industrial efficiency, and renewable energies in the form of solar and wind generation, and the regulation and support for the two sectors should not be mixed.

There are also real dangers in folding biochar into formal international agreements, among them being that the required research, quantification, and procedures for verification could impede actual movement toward the use of biochar for a decade or more—just the period when its nimbleness and potential for rapid deployment could actually make a real difference for the planet and for farmers faced with acute stresses from climate shift and market dislocations.

The author points to recent efforts, initiated in New Zealand, to use satellite sensing backed up by soil and forest sampling to monitor carbon levels as a promising approach that could bring the biological capture of carbon into the Kyoto framework or other international agreements. The technology, despite its increasing sophistication, is not susceptible to use on individual properties. Its best application would be on a country-wide basis, with each nation's carbon pool evaluated and changes to that baseline leading to potential payments (or debits) under a international funding facility.

It could be a salvation for peasant farmers and for the climate, or it could become part of the next investment bubble.

Along the way to this assessment of carbon politics, Bruges gives us a very crisp and clear look at the science of biochar, of agriculture, and of climate emissions: which gases count for what; where is the carbon held; how quickly is it being released? As a primer on climate science alone, this little handbook is quite respectable. We learn about peak phosphorus, soil degradation and other pressing problems, and see how biochar might be useful in addressing these persistent limitations of farming. Biochar is not a fertilizer, but a soil amendment that allows the soil to be "charged" with water and nutrients in a way that builds fertility over the long-term. Biochar holds tremendous promise for repairing damaged agricultural and even urban soils.

What is needed now are many and varied investigations of appropriate biochar technology so that agricultural and other biomass waste can be effectively turned into charcoal with the least emissions and lowest cost. Small-scale kilns, handbooks of practice, and chemical analyses of flue gases and their potential uses would be of immense value. Grassroots researchers can contribute a great deal here, but university chemists and engineers also need to get involved, quickly. Damn the "free energy" machines and all their pitiful illusions. We need to reclaim and re-energize this most ancient of industrial technologies.

As an internationally accomplished and well-networked professional and a citizen of both the global North and South, Bruges is well-placed to shed light on this exciting new phenomenon. That he happens to be a fine writer is a boon. His claims are sober and balanced, he's no hothead or invested promoter with a cause to inflate, but rather seems to be taking his role as an elder with profound seriousness. I highly recommend the book and think that despite the many unknowns in this newly emerging field, that *The Biochar Debate* will prove to be of enduring value over the next decade as the climate dilemma heats up. Δ

Briefly Noted – New Permaculture Books

Received just as we were going to press, new books by Martin Crawford, *Creating a Forest Garden: Working with nature to grow edible crops* ($49.95 cloth, 384 pp), and Patrick Whitefield, *The Living Landscape: How to read and understand it* ($37.95 paper, 331 pp), make tremendous additions to the permaculture literature. Deep into Whitefield's masterful text, I'm in awe of the extent to which he understands the British countryside, an artifact of both natural and cultural processes. Though confined to UK examples, the book is a brilliant display of what is required to read landscape, something every designer must learn. Patrick is a great teacher, the book intimate and fascinating, and much of its information widely applicable to temperate climates the world around.

Martin's long-awaited and exhaustively researched book will be candy to the dedicated plant people among us, and not just eye candy, though its all-color format is delicious. It has the immediacy of a good cookbook. The explanatory sections are short and to-the-point; then you're on to the recipes. Bold color blocks, strong subheads, and a profusion of data in short lists, bullet points, and plant profiles show just how to do it.

We'll have more complete reviews of these and other new books in August. Δ

The Architect Has No Clothes

Review by Peter Bane

PAT MURPHY

The Green Tragedy: LEED's Lost Decade

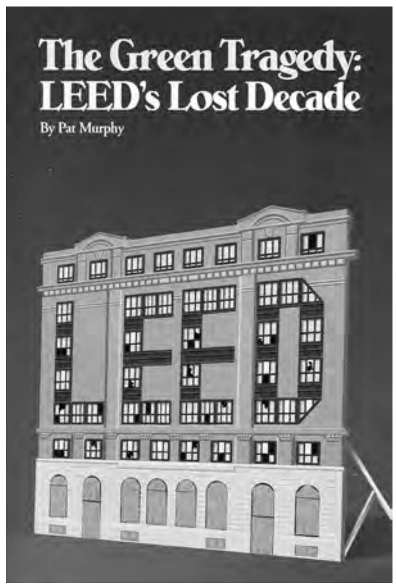
Arthur Morgan Institute for Community Solutions. Yellow Spgs. OH. 2009. 86 pp. paper. charts. $12.95.

I APPRECIATE SHORT BOOKS, especially those with a potent message. Pat Murphy is the author of *Plan C: Community and Curtailment,* in which he laid out the basic case for a dramatic curtailment of consumption and energy use as the most humane and effective way to address shrinking supplies of fossil fuels and the rampant climate crisis. The Community Solutions organization for which he works has put its attention on the household sector (about 70% of the economy and energy use) in three main areas: food, housing, and transportation. In *LEED's Lost Decade* he focuses in on buildings, a sector of the economy responsible for 48% of energy use and an area in which he has considerable experience.

In the 70s, Murphy was a construction and software engineer who put much attention to the design of energy-efficient buildings. Today he is the Executive Director of the Arthur Morgan Institute in Yellow Springs. The Institute has brought national attention to the issue of Peak Oil and its implications over the past six years, a clear example of a small group of committed people making a difference. Thank you Margaret Mead.

The argument here is straightforward: LEED, a much vaunted standard developed by the architectural profession, does far too little to save energy. Worse, it is costly to implement, obscures the importance of energy savings, and has occupied center stage in the industry for over a decade while doing very little to address real problems. Murphy has confided that the head of the Green Building Council accepts the fairness of this book's critique, but USGBC has no intention of changing its message.

The worst aspect of this typical American farce is that moves are underway on many fronts to enshrine LEED's weak energy protocol as the nationwide threshold for supposedly "green" building. Better LEED should be abandoned than propagated. It has been a colossal failure, along the same lines as the government's Energy Star program, with perhaps even less effect. Too few buildings have been built under LEED despite its 15-year history; the program is too costly, and energy savings, when there are any, rarely exceed 15%. Only the rarely built Gold and Platinum standards actually gain any energy traction. The "certified" and Silver standards of LEED are little more than greenwash.



I feel embarassed for the many public officials and building professionals whom I hear advancing the virtues of LEED buildings. They usually are somewhat tentative and not a little timid about trumpeting the accomplishments implied by authorizing or designing a LEED building, though usually, I think, for the wrong reasons. They don't have a clue that this is a phony and ineffectual standard. Instead, they seem to think it too wonkish to put before public audiences, or perhaps they are simply embarassed that it has taken their city, county, or firm so long to "get on the bandwagon." I don't want to offend them—public officials in particular almost all want to be liked—but I want to let them know that the green train left the station years before LEED got on the track, and that by boarding this milk run, they will be a long time getting nowhere.

Murphy has got me concerned now that we will fossilize this farce in code standards across the country. How pitiful that professionals with ample economic resources, access to government, and high public status have done such a poor job of saving energy. On my own, at home, working season by season using the best guesses and simple approaches, I have reduced the energy consumption of my home by over 50% in four years, retrofitting two 50-year old buildings. Our fossil fuel use has dropped even more in this period. The house was an ugly duckling when we began, and will never be a glorious swan. How much easier it would be to achieve 90% or greater energy savings in a new building where one didn't have to live with poor solar alignments, sloppy detailing, and inferior materials.

Murphy offers the German Passive House standard as a superior alternative to LEED. Originating with US work in the 70s on superinsulated houses, this program has already proven its ability to all but eliminate active heating and cooling of structures. Some 15,000 units have been built worldwide in recent years, most of them in Germany and Scandanavia. For an estimated increase in construction cost of 5-10%, energy savings of over 90% are achieved. The house design is based on a very thick insulated envelope (R-60 or more), careful elimination of thermal bridges to prevent conduction of heat, detailing to eliminate almost all infiltration, special heat-exchanging ventilation units to maintain air quality, and a radical reduction in heating and cooling equipment to a tiny heater. Owners report that a few candles or a couple of friends are usually enough to warm the building in winter. Only a program of this thoroughness, argues Murphy, can hope to achieve the required 80-90% reduction in energy use that we must achieve across the board by 2050 or sooner.

Since the Passive House technology is proven, and its energy savings will more than pay for the small increment in added construction cost, we would be better off to invest our public and private dollars in this approach, and sweep LEED into the dustbin of history.

Pulling no punches, this well-documented broadside deserves a wide audience. Δ

EVENTS

Permaculture Design Course
Baja, Mexico

Dates: December 6-19
Location: Baha Sur de California, Mexico
Description: Please join us at Buena Fortuna Botanical Garden, a dry, tropical plant paradise featuring rare species gathered from around the world by renowned botanist, Seeds of Change co-founder, Gabriel Howearth. We will cover the 72-hour curriculum applicable to all climate zones, while experiencing and enriching systems for the dry, tropical region. This course is fully bilingual Spanish-English and uses a variety of teaching formats in a beautiful outdoor classroom setting. Our site is within walking distance to a beautiful beach, with nearby hot springs and waterfalls!

Our highly experienced teachers bring a wealth of knowledge gleaned from an array of settings: disaster relief scenarios, working with NGOs, homestead and community garden, educational center and ecovillage design and implementation, as well as involvement in multiple international projects.

Instructors: Andrew Jones, Bruce Horowitz, Stefan Hetz, Kitzia Danel, with special guets.
Cost: $1,300 if registered by Sept. 30. Includes camping and garden fresh meals.
Contact: rawpermaculture@yahoo.com
www.rawpermaculture.org

Permaculture Design Course
Interior Northwest

Dates: July 12-25
Location: Methow Valley, WA
Description: This course will be held at the Skalitude Retreat Center in Methow Valley in north central Washington. The main focus is learning permaculture principles and design methodology. These, once learned, can be applied and adapted to any site, bearing in mind that each site and each client is unique. No cookie-cutter solutions will be found here!

The course covers the traditional Mollison permaculture curriculum as well as lots of local knowledge. The species and techniques will be oriented to the interior Pacific Northwest which includes Washington east of the Cascades, eastern Oregon, Idaho, western Montana, and southern interior British Columbia.

Instructors: Michael Pilarski and guests.
Cost: Contact for details.
Contact: Michael Pilarski
509-486-2672
michael@friendsofthetrees.net
www.friendsofthetrees.net

Permaculture Design Course
British Columbia

Dates: May 30-June 12,
Location: Winlaw, BC
Description: This is a traditional design course. This intensive course combines theory with practical hands-on learning. Topics include: techniques and principles, site analysis, soil fertility, organic gardening techniques, herbs and medicinal plants, fruit and nut trees, water uses, and ecological buildings.
Instructors: Gregoire Lamoureux and guests
Cost: Cdn. $975
Contact: Gregoire Lamoureux
Kootenay Permaculture Inst.
spiralfarm@yahoo.com
www3.telus.net/permaculture

Permaculture Design Course
Western Washington

Dates: July 3-17
Location: Bellingham, WA
Description: Two weeks that can change your life and change the world! Earth Activist Training with a special emphasis on social permaculture. This is a design course with a grounding in earth-based spirituality, and a focus on organizing, activism, and social permaculture as well as urban and rural land-based systems.

Learn how to heal soil and cleanse water, how to design human systems that mimic natural systems, using a minimum of energy and resources and creating real abundance and social justice.

Explore the strategies and organizing tools we need to make our visions real, and the daily practice, magic, and rituals that can sustain our spirits. Participatory, hands-on teaching with lots of ritual, games, projects, songs, and laughs along with an intensive curriculum in ecological design.

Instructors: Co-taught by Starhawk and friends, with guest teachers Bill Aal and Margo Adair of Tools for Change.
Cost: $1,400-$1,800, sliding scale. Work trade and scholarships available, apply early!
Contact: 800-381-7940
earthactivisttraining@gmail.com
www.earthactivisttraining.org

Permaculture Design Course
Kootenay Mountains, BC

Dates: August 15-28
Location: Winlaw, BC
Description: This intensive traditional design course combines theory with practical, hands-on learning. Topics include principles of design, site analysis, soil fertility, organic gardening techniques, growing, gathering & use of herbs and medicinal plants, fruit and nut trees, water uses, and ecological buildings.
Instructors: Gregoire Lamoureux & guests
Cost: Cdn. $900 by July 8.
Cdn. $975 after July 8.
Contact: Gregoire Lamoureux
Kootenay Permaculture Inst.
spiralfarm@yahoo.com
www3.telus.net/permaculture

Permaculture Design Course
Alaska

Dates: August 9-22
Location: Homer, AK
Description: Join us for Alaska's first design course led by Rick Valley of Lost Valley Educational Center in Oregon. It promises to be an informative and exciting course located on a beautiful 160-acre Wilderness School site. The 72-hour course will include hands-on activities and field trips to working sustainable farms so you can experience theory in action.

Additional evening workshops are planned to further your knowledge on permaucltrue related topics. Homer is studded with world-class scenery, kayaking, hiking, and other outdoor opportunities.

The venue offers newly constructed facilities including a classroom, dining room with a professional kitchen, and fully-furnished yurts and wall tents.

Instructors: Rick Valley, Lisa DePiano, and guests.
Cost: $1,250 after July 15.
Contact: Terri Brown
terrib@artlover.com
907-344-0935
http://akpermaculture.wordpress.com

Send Event and Calendar Listings for Issue #77

Eco-nomics

for the June 1st deadline to:

Address: pcaeditor@comcast.net

Permaculture Design Course
Northern Oregon

Dates: June 13-26
Location: Ashland, OR
Description: Held on Restoration Farm, a working permaculture farm. This course is for those who are committed to permaculture and farming as a career. Based on Bill Mollison's curriculum it covers meta systems, natural systems, and cultivated systems.
Instructors: Chuck Burr, Larry Korn, and Tom Ward
Cost: $1,300 before 5/15; $1400 after. Camping and three veg etarian meals per day are included.
Contact: 541-941-9711
courses@restorationfarm.org
www.restorationfarm.org

Advanced Design Course
Central Oregon

Dates: September 7-24
Location: Corvallis, OR
Description: This course is open to both enrolled Oregon State University students earning credits and to the general public. We will dive deeper into permaculture with an intensive design and implementation project, an extended field trip to southern Oregon to meet with advanced teachers and see some of the most developed permaculture sites in the state, and array of other guest presenters from the best that our region has to offer.

Some topics we will cover in depth from the permaculture perspective are agroforestry and social forestry, seed breeding and production, farm-scale water catchment and distribution, natural building and village design, perennial polyculture and forest garden design, and more.

Our design project will be broad scale: the western agricultural portion of the Oregon State University campus, and we will utilize the planning and mapping resources of the University wherever possible.

Permaculture Design Certificate or comparable introductory course is prerequisite. Field trips to Mountain Homestead, Cob Cottage Company and others.
Instructors: Andrew Millison with guests Tom Ward, Larry Korn, and others.
Cost: $900 Students provide their own food and housing while in Corvallis. Housing provided during field trips.
Contact: 541-752-9118
amillison@gmail.com
www.beaverstatepermaculture.com

Permaculture Design Course
Central Oregon

Dates: July 19-August 6
Location: Corvallis, OR
Description: This course is open to both enrolled Oregon State University stduetns earning credits and to the general public. We will cover the internationally recognized curriculum with classroom work, field trips, hands-on projects, experiential exercises, amazing guest speakers, and a great design project.
Instructors: Andrew Millison with guests Larry Korn, Mark Lakeman, Rick Valley, Leonard Barrett, Heiko Koester, Tao Orion and others.
Cost: $750. Students provide their own food and housing. Hous ing assistance provided to out-of-towners.
Contact: 541-752-9118
amillison@gmail.com
www.beaverstatepermaculture.com

Permaculture Design Course
California

Dates: Second Weekend June-November
Location: Los Angeles, CA
Description: Join us for EarthFlow Design Works' annual Sustainable Solutions series (PDC) in LA and Orange County tought by leaders in the worldwide sustainability movement. Learn the fundamental principles of sustainable design embodied in all of the natural world and how to apply them to your own real-world projects.
Instructors: Larry Santoyo, Toby Hemen way, Scott Pittman, John Valen zuela and others.
Contact: permaculture@earthflow.com
www.earthflow.com

Permaculture Design Course
California

Dates: May 16-29
Location: Los Angeles, CA
Description: Join us for EarthFlow Design Works' annual design course in LA and Orange County tought by leaders in the worldwide sustainability movement. Learn the fundamental principles of sustainable design embodied in all of the natural world and how to apply them to your own real-world projects.
Instructors: Larry Santoyo and others.
Contact: permaculture@earthflow.com
www.earthflow.com

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Instructors: Andrew Millison with guests Larry Korn, Mark Lakeman, Rick Valley, Leonard Barrett, Heiko Koester, Tao Orion and others.
Cost: $750. Students provide their own food and housing. Hous ing assistance provided to out-of-towners.
Contact: 541-752-9118
amillison@gmail.com
www.beaverstatepermaculture.com

Permaculture Design Course
California

Dates: July 17-30
Location: Occidental, CA
Description: Whether you currently own property or dream of it, this two-week intensive course will immerse you in information, ideas and inspiration for how to design sustainable, regenerative systems in balance with your home ecosystem. You will learn the ethics, principles and practice of "permanent culture," by exploring topics such as organic gardening, mulching, natural building techniques, forest farming, water retention and regeneration, erosion control, community processes, and much more.

Using a combination of lecture, discussion, hands-on activities at OAEC's 80-acre site, visits to local permaculture examples, and a group design project, you will have the chance to integrate and apply the concepts of permaculture during almost 100 hours of course time.
Instructors: Brock Dolman, Kendall Dun nigan, and guests.
Cost: $1,500, $1,400 if registered two weeks in advance. Includes lodging and meals.
Contact: 707-874-1557
oaec@oaec.org

Upcoming Issues:
#77 Eco-nomics
#78 Water
#79 The Urban Frontier

Permaculture Design Courses
California

Dates: June 11-26; Sept. 3-18; October 2010 to Sept. 2011
Location: Bolinas, CA
Description: Permaculture design courses at the Regenerative Design Institute weave together the principles and practices of permaculture with wilderness awareness--learning bird language, tracking and participation in activities that deepen your awareness and intimacy with the rest of the natural world. The programs are founded on the reality that we are nature and have an amazing role in our watershed ecosystems. You will learn how to observe and use the same principles that make ecological systems self-sustaining and apply them to integrate homes and gardens.

In addition, you will learn how to apply these principles to energy systems and water supplies, healthy communities, meaningful and fulfilling work, ecological economics, and global political movements for change.
Instructors: Penny Livingston-Stark, Lydia Neilson, Lauren Dalberth, David Hage, and speical guests.
Cost: $1,500, four-season course is $1,100.
Contact: 415-868-9681
info@regenerativedesign.org
www.regenerativedesign.org

24th Annual

Permaculture Design Course
Central Rocky Mountains

Dates: September 12-25
Location: Basalt, CO
Description: The CRMPI course provides participants with an understanding of the essential principles and elements of permaculture, enabling them to better design and engineer systems including forest gardens, appropriate buildings, greenhouses, and more. During the first week we'll cover the essential elements of permaculture, followed in the second week by a full-spectrum design project. The curriculum includes a variety of classes and workshops essential to every permaculturist's development : from soil structure to the invisible structures of our economy and society.
Instructors: Peter Bane, Jerome Osentowki, Adam Brock, Sarah Montgom ery, and Kelly Simmons.
Cost: $1,295 includes camping, materials, and organic meals. Discount for couples.
Contact: Jerome Osentowski
970-927-4158
jerome@crmpi.org
www.crmpi.org

Permaculture Design Course
Northern Colorado

Dates: Weekends: May 29-July 18
Location: Fort Collins, CO
Description: This full course, led by seasoned permaculture instructors, is offered in six summer weekends in beautiful northern Colorado. Like a rainbow that spans the breadth between earth and sky, the curriculum will cover topics from soil and water to economics and community, including permaculture design elements, techniques, and ethics. Design sites include urban and more rural properties. The course offers numerous hands-on practical how-to's. Engage your heads, hands, and hearts with this course. Help in locating weekend accommodations can be provided.
Instructors: Sandy Cruz, Becky Elder, Kelly Simmons, and guests.
Cost: $1,280 after May 1.
Contact: Lisa Olivas
970-672-4722
lisaregina@frii.com
frontrangepermaculture.org

Permaculture Design Course
Colorado Front Range

Dates: July 30-August 12
Location: Sedalia, CO
Description: Join us for a two-week intensive certificate course in the foothills of the Rocky Mtns. Learn how to design sustainable and regenerative systems in balance with the natural world. Based on the traditional permaculture Design Course curriculum, this residential course will include permaculture ethics and principles, patterns and design, soil building, food forests, water harvesting, natural building, zero waste systems, community design, aquaculture, medicinal plants, mycology, alternative economics, watershed management, sustainable forestry, and more.

The course will use diverse formats, including lecture, discussions, hands-on activities, field trips, and team design projects. Incorporating Woodbine's commitment to indigenous values and sustainable communities plan for sessions on traditional ecological knowledge, social and enviornmental justice, and indigenous permaculture. Students may choose to stay for the first Indigenous Permaculture convergence.
Instructors: Andrew Goodheart Borwn, Shannon Francis, Pavlos Stavropoulos & guests.
Cost: $1,200 registered by June 30th; $1,300 after July 1. Limited scholarship and work exchange opportunities available.
Contact: Woodbine Ecology Center,
PO Box 1253, Littleton, CO
pdc @woodbinecenter.org,
www.woodbinecenter.org/pdc2010

Advanced Design Course
Central Colorado

Dates: 10 Thursday evenings, Sept. 16th-November 18th, plus September 18th, Oct. 2nd
Location: Boulder, CO
Description: A unique, locally-based certificate course offered by seasoned instructors. Opportunities for in-depth design of physical sites and invisible structures. Case studies and design charettes bring course material to life. Projects range from broad conceptual design to nitty gritty detail, as students work individually and on teams. Local natture of the course will facilitate implementation of designs, as well as evolution of teams over time. Participants are asked to commit four hours per week outside of class for readings, site observation, research, design work and other assignments.
Instructors: Sandy Cruz, Marco Chung-Shu Lam, and Alison Peck.
Cost: $700 if paid in full by 8/16; $800 after 8/16
Contact: Sandy Cruz
303-459-3494
hialtpc.org

Permaculture Design Course
Southern Colorado

Dates: July 26-August 7, 2010
Location: Westcliffe, CO
Description: This is a two week residential course that covers the core topics of permaculture and sustainable design. Topics covered will include: food forest design, full loop waste systems, soil building techniques, water harvesting strategies, plant propagation, medicinal herb preparation, and more. This group of instructors brings decades of experience of practicing permaculture in mountain environments and brings their passion for mountain permaculture to you!
Instructors: Marco Chung-Shu Lam, Sandy Cruz, Becky Elder, Jerome Osentowski, guests.
Cost: $1,200 by June 30; $1,250 after
Contact: Ayesha McDaneld
719-783-0188
ayeshamcd@gmail.com

Permaculture Design Course
Southwestern Colorado

Dates: July 16-August 8, weekends
Location: Telluride, CO
Description: Join us for four weekends in beautiful southwestern Colorado. This course is offered through the University Centers of the San Miguel which serves the San Miguel watershed through sustainability education.
Cost: $900 before 6/1; $1,000 after. Camping included, lodging available.
Contact: 970-369-5255
www.ucsanmiguel.org

Permaculture Design Course
Central Iowa

Dates: May 29-June 12 or July 24-August 7
Location: Fairfield, IA
Description: Classes are held in a sun- and wind-powered strawbale building with rainwater catchment on the 12-acre SLC Fairfield Eco-Design Center Campus. The course is enriched by many sustainable living initiatives in greater Jefferson County, including Radiance Organic Dairy, Abundance Ecovillage, Cypress Village, Abundance Permaculture Nursery, examples of urban permaculture, and Maharishi University of Management's Sustainable Living program. Leave equipped to implement permaculture in your home and community.
Instructors: Doug Bullock, Lonnie Gamble, Grover Stock & local experts.
Cost: $1,300-1,700 sliding scale incl. camping and local, organic meals. Internships available.
Contact: Briggs Shore, 641-430-1089
briggs@sustainablelivingcoalition.org
www.sustainablelivingcoalition.org

Permaculture Design Course
Lower Ohio Valley

Dates: October 15-17, 29-31, November 12-14, February 18-20, 2011, March 4-6
Location: Bloomington, IN
Description: Join with us as we roll up our sleeves and get our hands in the soil; as we explore the patterns that shape and move our natural, built, and cultural sytems into sync; and as we celebrate the paradox that embraces the challenges of our times.

With good humor, great conversation, and engaging lecture we will cover the traditional curriculum from new perspectives. A passionate teaching team drawing on experience in environmental and social justice, botany, natural building, ecovillage design, and community organizing provides a rich depth of insight into the course content.

Guest lectures, field trips, and movie nights round out your educational experience. Prepare for hands-on activities in class and for readings and applied homework between weekends. Collaborate with classmates on projects that expand permaculture in the local community.
Instructors: Peter Bane, Rhonda Baird, Keith Johnson, and guests.
Cost: $700 if paid in full by 8/1; $750 after 8/1. This includes course materials and Saturday lunches.
Contact: Rhonda Baird
812-323-1058
rk.baird@yahoo.com

Permaculture Design Course
Midwest

Dates: June 22-July 3
Location: Stelle, IL
Description: In this Permaculture Design Certificate (PDC) Course, we hope students will not only learn but will experience how we as humans have moved from a quiet connection to the earth to a vibrant but often times destructive relationship to our planet.

Through this understanding we can move ourselves and our culture toward a creative and caring relationship to each other and the earth.

The course is incorporates a five-day experience in natural skills based on Wayne Weiseman's study and practice incorporating these traditional skills with permaculture.
Instructors: Wayne Weiseman, Bill Wilson Milton Dixon, and guests.
Cost: $1,495
Contact: Becky Wilson
815-256-2215
info@midwestpermaculture.com
www.midwestpermaculture.com

8th Annual
Permaculture Design Course
Lower Ohio Valley

Dates: June 6-20, 2010
Location: Paoli, IN
Description: This certificate course, enriched by social design, is offered in conjunction with Indiana University (undergraduate credit available), and takes place in the Hoosier Natl. Forest, surrounded by rural and eclectic sensibilities and scenes on a 200-acre farm and retreat center. Passionate, experienced teachers combining decades of design practice, social justice organizing, and comunity building animate a liberating curriculum.

From wildlife to wild life, the experience is steeped in a rich community soup flavored with permaculture builders, farmers, and other practitioners who have percolated throughout the Hoosier Hills region and into the Bluegrass Country.
Instructors: Peter Bane, Keith Johnson, Rhonda Baird, and guests.
Cost: $1,200, incl. camping & meals
Contact: Andy Mahler
812-723-2430
andy@blueriver.net

Permaculture Design Course
Eastern Pennsylvania

Dates: August 19-29, 2010
Location: Wallingford, PA
Description: Pendle Hill, a Quaker retreat center in Wallingford, Pennsylvania, just thirty minutes southwest of Philadelphia, will host its first permaculture design course. This course includes field trops to local organic farms, teachings in nearby Swarthmore Woods, and guest speakers such as Phil Forsythe of the Philadelphia Orchard Project.

This course is co-sponsored by Greener Partners, a Philadelphia area non-profit dedicated to jump-starting local agriculture in the region.
Instructors: Andrew Goodheart Brown, Benjamin Weiss, and Joel Fath.
Cost: $1,500 for commuters (includes breakfast and lunch), $2,000 for a shared room, $2,500 for a private suite.
Contact: bazzrad@yahoo.com
www.pendlehill.org

Permaculture Design Course
Bluegrass State

Dates: June 18-July 2, 2010
Location: Prospect, KY
Description: Held on a working organic farm in the beautiful bluegrass state of Kentucky, this two-week permaculture course includes all fundamental elements of design as well as hands-on projects. Cost includes camping, meals prepared by experienced chefs using local foods, and all course materials-including an extensive playbook.
Instructors: Patricia Allison, Dylan Ryals-Hamilton, Penryn Craig, and guests.
Cost: $950 before 5/15; $1,000 after. Friend and work trade discounts available.
Contact: Penryn Craig
502-396-5721
penrync@aol.com
kypermaculture.com

Fundamentals of Permaculture
Niagara Escarpment

Dates: July 17-24
Location: Orangeville, ON
Description: This traditional design course is located at the Ecology Retreat Centre. This intensive course combines theory with practical hands-on learning. Topics include: techniques and principles, site analysis, soil fertility, organic gardening techniques, herbs and medicinal plants, fruit and nut trees, water uses, and ecological buildings.
Instructors: Gregoire Lamoureux, Richard Griffith, and guests
Cost: Cdn. $975
Contact: Russell Scott
True Source Seminars
519-942-8339
info@truesourceseminars.com
www.truesourceseminars.com

Permaculture Practicum
Southern Ontario

Dates: July 25-August 1
Location: Orangeville, ON
Description: This course presents the second half of the permaculture curriculum, focusing on design exercises while integrating hands-on activities. Taken with a Fundamentals course, this completes the requirements for a design certificate. Pre-requisite: Fundamentals of Permaculture. Located one hour north of the Toronto airport on the Niagara Escarpment, the Ecology Retreat Centre offers high-quality accommodations in a wooded rural setting.
Instructors: Gregoire Lamoureux and guests
Contact: Russell Scott
True Source Seminars
519-942-8339
info@truesourceseminars.com
www.truesourceseminars.com

Permaculture Design Course
Upstate New York

Dates: August 8-20
Location: Paul Smiths, NY
Description: Set in beautiful upstate New York, near Lake Placid, this course covers the traditional curriculum and includes the innovative teaching styles and practical skills of a very experienced teaching team. Theory and practical work are balanced with field trips to a farm and nursery to see practice in action. The course is taught through Paul Smiths College and course credit is available.
Instructors: Peter Bane, Mark Krawczyk, and Keith Morris
Cost: $1,190 includes text, course materials, field trip, and local food lunch. Housing, camping options, and meal plans also available by request.
Contact: Tom Huber
518-327-6330
thuber@paulsmiths.edu

Back Issues of *The Permaculture Activist*

I,1 July '85 **Permaculture in Oz**
I,2 Nov. '85 **Fruit & Nut Trees**
II,1 Feb. '86 **Garden Design**
II,2 May '86 **IPC-2** & Pc Courses
II,3 Aug. '86 **2nd Int'l Pc Conference**
II,4 Nov. '86 Fukuoka, Keyline, Genetic Conservation, City Farms, Oceanic Pc
III,1 Feb. '87 Networking, Natural Farming, D-Q Univ., Children's Permaculture
III,2 May '87 **Wild Land Restoration**
III,3 Aug. '87 **Annual Planting Cycle**
III,4 Nov. '87 **Trees for Life**
IV,1 Feb. '88 **Marketing Pc Products**
IV,2 May. '88 **Urban-Rural Links,** Economics & Community Development
IV,3 Aug. '88 **Social Forestry,** Gabions, Jap. Org. Ag., Producer/Consum. Coops
IV,4 Nov. '88 **Multi-Story Tree Crops,** Greening Dominican Repb., Runoff Gdns
V,1 Feb. '89 *Permaculture: A Designers Manual,* Tree Bank, Water in Pc
V,2 May. '89 **Plant Guilds,** Roof Gardens, Small Livestock
V,3 Aug. '89 **Rainforest Conservation** in Ecuador, Gaia, Weed Gardens
V,4 Nov. '89 **Earthworks** & Water Conservation: Small Dams, Ponds, Keyline
VI,1 Feb. '90 **Household Greywater** Systems, Soil Imprinting ($5 each to here)
VI,2 May. '90 **Insectary Plants,** more Greywater, Land Use for people "
VI,3 Aug. '90 **Water:** Forests & Atmosphere, Catchment, Pond Design
VI,4 Nov. '90 **Urban Permaculture:** EcoCity Conf., Soil Detox, Suburbs & Pc
#23 May '91 **Politics of Diversity,** Greenhouse Market Gdn, Pc in Nepal
#24 Oct. '91 **Creativity in Design:** Case Studies; **Index to Issues #1-23**
#25 Dec. '91 **Design for Community:** CSAs Restoring Forests; Garden Ecology
#26*May '92 **Soil:** Our Past, Our Future; Fertility, Worms, Cover Crops
#27*Aug '92 **Integrating Pc:** Deconstructing Utopia, Grassroots Organizing, Garden Polyculture, Pattern Learning, Living Fences
#28*Feb. '93 **Structures:** Comm'ty Dsgn, LETS, Industry, Strawbale/Timber-frame Bldgs.
#29/30* Jul.'93 **Networks:** Media Revw, Rural Reconstruction, Leaf Concentrate, Comm'ty Food Inits, Palestine Pc, Do-Nothing Educ, Feng Shui, Pc Academy
#31*May '94 **Forest Gdng:** Energy & Pc, Mushrm Cultvn, Robt.Hart's F.G., Spp for No. Cal., Alders, Agroforestry in Belize & China, Honeylocust, N-fixers
#32*Apr. '95 **Animals & Aquaculture:** Animal Polyculture, Small-scale Cattle, Goat Dairy, Keyline, Feral chickens, Bee Plants, Constructed Wetlands
#33 Dec. '95 **Cities & Their Regions:** Green Cities, L.A. Ecovillage, MAGIC Gdns, CoHousing, Micro-Enterprise Lending, Suburban Conversion
#34 June '96 **Useful Plants:** Bamboo Polyculture, Medicinals, Pest Control, Root Crops, Oaks, R. Hart's F.G., Russian Plants, Regl. Plants, Sources
#35 Nov. '96 **Village Design:** Pattern Language, Consensus Democracy, Conflict, Historic & New Villages, Planning for Tribe, Village Economics
#36*Mar. '97 **Climate & Microclimate:** Climate Change, Windbreaks, Low-Tech Sun Locator, Drylands, Cool Slopes, Straw-Clay Bldg. Round Beehive, Water Catch.
#37 Sept. '97 **Tools & Appropriate Technology:** Dowsing, Workbikes, Scythes, Japanese Saws, Nursery, Ferrocement, Greywater, A-frame & Bunyip Levels, Ram Pump, Solar Toilet, Log Yoke, Cookstoves
#38*Feb. '98 **Economic Transformation:** Speculation, No Middle Class, Coops WWOOF, Global Warm'g, Hol. Fin. Plan'g. Land Use, Adopt-a-Hive
#39 Jul. '98 **Knowledge, Pattern & Design:** Pc Way of Seeing; Native Consvn Sand Dunes, Language-Worldview-Gender, Patterning Process, Land-Use Planning, Teaching Pc, Vietnam, Holmgren on Pc
#40*Dec. '98 **New Forestry:** Regl. Devl., Horselogging, Menominee Reservation, Forest Investing, Restoration, Old Growth, Homestead Tenure, Forest Soils, Forest Farming, Woody Agric., Rainforests, Windbreaks, Coppice
#41*May '99 **Natural Building:** Oregon Cob, Cordwood, Bamboo, Thatch, Ethics, High Winds, Origins of Conflict, Greenhouses, Ponds, Adobe, Road Bldg, MicroHydro, Bldgs. That Live, Under $20K Houses, Dreams
#42 Dec. '99 **Self-Reliance & Community Cooperation:** Co-Intelligence & Self-Orgn., Archetype Design, Sovereignty, Samoa, Mondragon, Natural Hous'g, Comm. Gdns., Zone Zero, Solar Electric Tractor, Beekeeping
#43*June '00 **Food & Fiber:** Hunger, Ferments, Seasonal Salad, Heirlooms, Fencing Self-Fertile Gdns, Rice Revolt'n, Cold-Climate Food, Edible Insects, Chilies, Food Origins, Garlic, Ethnobotany, Wild Food, Bamboo, Hemp
#44 Nov. '00 **Earthworks & Energy:** Spreader Drain, Horse Swales, Earth Dams, Machinery, Carpet-lined Ponds, Constr. Wetlands, Biogas, Windmills
#45 Mar. '01 **Medicine & Health:** World & Self, Healthy Home, Designing Care, Ayurveda, Agents of Decay, Comn. Health Centres, Women Trad. Med. 4th World Apothecary, Healing Weeds, Medicinal Crops, Hawaiian Bot'ls
#46 July '01 **Good Work & Right Livelihood:** Pc Golf Course, Downsize Cost of Living, New Forest Economy, Energy Currency, Buddhist Mktg, End Wage Slavery, What's Surplus?, Urban Community, Enterprise Facil'n
#47 June '02 **Watersheds:** Water4Sale, Basins o'Relations, Watershed Devl, Gabions, Urban Runoff, Beavers, Skywater Ctr, Consvn. Investmt, Peat Bogs, Rabbits
#48*Sept '02 **Making Changes:** Co-Intelligent Activism, Webs of Power, Urban Food, How to Change, Teaching for Change, Global Transform'n, City Repair, Escaping Job Trap, Argentine Recovery, Costa Rica Pc
#49 Dec. '02 **Where is Permaculture?** Land-Rent Reform, 10 N. Amer. Sites, Cuban Ag, Rainbow Vall. NZ, Cacti/Succulents, Animal Self-Meds, Challenge to Pc
#50 May '03 **Ecosystems:** Holmgren on Pc Mvmt, Hazelip & Syng. Ag, Chestnuts/ Pigeons, Oak Savannas, Root Crop Polycultures, Alders, Fungal Ecosys. Humans & Wilderness, Indoor Ecosystems, Humid Tropics
#51 Jan '04 **Trad'l. Knowledge & Regeneration:** Cataclysm & Collective Memory Genome Wisdom, *Waru Waru,* Biosculpture, Inuit Medc, Ferment'd Stimulants
#52 May '04 **Aquaculture:** EcoAquac, Fish4Health, Dowsing, Pond Design, Greywater Biotreatment, N. Amer. Polyculture, Manage for Native Spp, Integrated Village Fisheries, Vietnam
#53 Aug. '04 **Education:** Lifelong Learning, Edge-ucation, Albany Free School, Indigenous Ed. & Ecology, Ecocentric Pedagogy, School Gardens

Permaculture Design Course
Northern New England

Dates: July 25-August 8
Location: Marshfield, VT
Description: This is a design course with a grounding in earth-based spirituality, and a focus on organizing, activism, and social permaculture as well as urban and rural land-based systems. Learn how to heal soil and cleanse water, how to design human systems that mimic natural systems, using a minimum of energy and resources and creating real abundance and social justice. Explore the strategies and organizing tools we need to make our visions real, and the daily practice of magic and ritual that can sustain our spirits. Participatory, hands-on teaching with lots of games, projects, songs, and laughs along with an intensive curriculum in ecological design.
Instructors: Starhawk and Charles Williams
Cost: $1,500-$1,900, sliding scale. Workshops and scholarships available, apply early! Childcare option available.
Contact: 800-381-7940
earthactivisttraining@gmail.com
www.earthactivisttraining.org

Permaculture Design Course
Finger Lakes Region

Dates: July 23-August 8
Location: Ithaca, NY
Description: We train people of all backgrounds to mimic natural patterns and principles in their yards, on their land, and in their homes and businesses.

This affordable course highlights hands-on learning in the beautiful rural Cayuta Lake Valley. The class equips students with the knowledge of whole systems and the principles, techniques, and challenges of permaculture as a system of sustainable design. Our off-grid learning community explores topics such as soil regeneration, water conservation, building ponds and swales, managing woodlots, building natural and efficient homes, utilizing renewable energy, and designing gardens.

We teach these topics through presentations, case studies, and student design projects and exercises. Instruction is augmented by presentations from local experts, field trips, and games.
Cost: $1,200.
Contact: Finger Lakes Permaculture Institute
info@fingerlakespermaculture.org

Permaculture Design Course
New York City

Dates: Six weekends July to October
Location: New York City
Description: A hands on learning opportunity in the city at the historic Old Stone House in Park Slope. The site has substantial gardens, a model compost system, and a garden education partnership with an adjacent middle school. This urban permaculture program will offer you the tools to design an integrated environmental lifestyle. All of the traditional topics of permaculture will be covered. Plus, special curriculum for urban dwellers: with an emphasis on community connection, business networking, and the use of public space. Some classes will be held in community gardens in Manhattan. This course is designed to direct you scientifically and psychologically into beneficial relationships with our fundamental support systems.
Instructors: Claudia Joseph with Jono Neiger, Phil Forsythe, Ariane Burgess and guests.
Cost: $1,000 by 6/1; $1,150 after.
Contact: The Old Stone House
718-768-3195
oldstonehouse@verizon.net

Back Issues of *The Permaculture Activist* (continued)

& Dances, Ecology of Learning, Brain Gym
#54 Nov. ‘04 **Fire & Catastrophe:** Design Beyond Disaster; New Opportunities; Globalization; Invasion Biology; Street Orchards; Community Food Security, Floodwaters Rising, Disrupted Climates
#55 Feb. ‘05 **Learning from Our Mistakes:** Petrol Dependcy, Village Design, Austral. Lessons, RTFM!, Trial&Error, Forestry Expmts, Owner-Bldr, 10 Mistaken Ideas in Pc
#56 May ‘05 **Tree Crops & Guilds:** Pine Nuts, Tree Vege, Acorns, Am. Chestnut, Honeylocust Silvopasture, Broadscale AgroFor, Bamboo, Willow, Socl. For.
#57 Aug. ‘05 **20th Anniv.:** Challenges & Changes, USA Pc, Hawai’i Retrospect; Permatecture; Pc’s Soft Edge; Gaia U; PINC; Oil Depl; IPC-7; Retrofit Suburbs
#58 Nov. ‘05 **Urban Pc:** Urban/Rural Futures; City Zones & Sectors; Growing Food; Detroit Visionaries; Rebldg. New Orleans & Everywhere; Transforming a Military Base; Workers Co-op; Energy Descent.
#59 Feb. ‘06 **Peak Oil:** Eco-Collapse & Trauma; Thom Hartmann; Pathways for Energy Descent; How Cuba Survived; Oil & Food; Biofuels; Algae for Fuel; Relocalize!
#60 May ‘06 **Land Use Past & Present:** Sust.Ag an Oxymoron?, Negev Bedouin, East. Woodlands AgroForestry, Pc Heals in India, Arocsanti Land Plan, Pop. Growth/Land Hunger, Mex. Reforestation, Rocky Mtns.
#61 Aug. ‘06 **Unseen Kin-doms:** Observation as Design Tool; Soil Food Web, Bees, Mycelial Internet, D-I-Y Mycorrhizal Inoculum, Cover Crops as Bee Forage, Earth Energies, Local Currencies, Dead Zones, Birds at Risk
#62 Nov. ‘06 **Art of Permaculture:** Painting, Writing & Pc; Ecoartists; Art, Activism & Cmty; Street Theatre; Art & Bioremediation; Living Willow, Body as Zone 0; Art of the Found; Water Magic; Pc in Pop Culture
#63 Feb. ‘07 **Building & Technology:** How to Dwell? Natural Bldg & the Law, Bldg Code, Strawbale in China, Cob in Armenia, Integrated Solar Heating, Cooking, Pumping; Self-Build, Nation-Scale Pc in Brazil
#64 May ‘07 **Waste = Food:** Throwaway Econ, Strategy of Salvage, Peak Soil, Pigs & Waste Mgmt; Bikes, Soil & Garbage; Farm as Organism, Opportunistic Plants? Simple Biodigester, Waters of Spain, Vermiculture
#65 Aug. ‘07 **Climate Change:** Shrinking Seas, Forests’ Role in Climate, Urban Forests, Making Trees Pay, Rainwater Harvst’g, Indoor Gdns, Water Filtration, Changing Human Climate, De-Stabilizing Climate
#66 Nov. ‘07 **Animals in Design:** Jumbo Shrimp, Pawpaw Patch, Alpaca, Insects as Food, Bees, Integrated NH Farm, Pastured Poultry & Rabbits, Urban Livestock, Predator Restoration, Complementary Animals, Agrichar
#67 Feb. ‘08 **Kids in Pc:** School as Ecosystem, Pc Education, Pc to H.S. Students, Tlaxcalan Kids Make Seedballs, Gardening Kids, Fostering Research Skills, Bottled Water Boycotts, Feeding 8 Billion
#68 May ‘08 **Plants on the Move:** Rethinking Non-Natives, Forest Migration, Black Walnuts, Saving Seed Savers, Grow a Cmty. Gdn, Neighborhood Greening, Healthy Honeybees, Biofuels & High Food Prices
#69 Aug. ‘08 **Permaculture at Home:** Hawai’ian Cmty; London Forest Gdn; Suburban Renaissance; Calif. Campus; Phila. Orchards; Drinking Roofwater; Floating Island Bioremed.; Bike Transport; Mississippi Pc
#70 Nov. ‘08 **Ethics at Work:** BAU is the Enemy; 13 Princ. of People Care; Pc in Business; Ecovillages; White Man in India; Uganda Boarding School, No Waste Principle; Qual. Control; City Farming w/Runoff; Amaranth
#71 Feb. ‘09 **Working w/Earth:** Hopewell Mound Water Mgmt, Belize, Road & Dam Bldg, Keyline, NW AgroFor, Pc&Landscape Arch, Earthbag Bldg, Low-Watt Fridge
#72 May ‘09 **The View from Abroad:** War, Oil & Snails in Nigeria; Green Tech Future, Ethiopian Water Mgmt.; Shrinking Forests; Food Exploration in Caucasus; Maya Agroforestry/Biochar; Pc to Trinidad; Bridging Cultures in Brazil & India, Pc Schools in Africa; BuggerBug in Liberia
#73 Aug. ‘09 **Bioregionalism:** New Paradigm; Rocky Mtn. Wildlands; Wild Elephants; Organizing Houston; Heirloom Seeds; L.A. Gdns; Reclaiming Commons; Transition Hohenwald, Tenn.; BioCongress Saga; Diversity at Home
#74 Nov. ‘09 **Energy Descent**: In the Home; Transition Communities; Pc in Mexico; Biochar; US Consumption Dropping; Making Fuel Alcohol No More Throwaway Economy; EcoTechnic Future
#75 Feb. ‘10 **Local Food:** A City & Regl. Food System; Working Family on 5Ac; CSAs & Wild Foraging, City Backyd Gdng.; Food Bank Gardens & Orchards; Salt Collecting; Growing Regional Staples; City Grains.

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Permaculture Design Course
Mid-Atlantic

Dates: August 13-29
Location: Freeland, MD
Description: Earn your permaculture design certificate with Dancing Green during our summer residential immersive! Dancing Green offers the whole permaculture design course curriculum as an immersion in educational experiences of integration, collaboration, consensus, and self-empowerment within the context of permaculture land-use design. The 17-day residential immersive allows you two levels of enhanced focus: the routines of daily life are set aside-freeing and enhancing your attention; the process is predominantly collaborative. Dancing Green can be found at www.sustianableagriculture.org.
Instructors: Dawn Shiner, Patty Ceglia, Karen Stupski
Cost: $1,750 including room and board. Financial aid is avail able.
Contact: Karen Stupski
410-357-9523
education@heathcote.org
www.livingmandala.com

Permaculture Design Course
Southeast US

Dates: September 18-30
Location: Americus, GA
Description: This course is located at Koinonia Farm, a 67-year-old intentional Christian community. In addition to being a working farm, our members are also active in peace and social justice work, carrying on the legacy of the early members' historic role in the Civil Rights Movement. Koinonia is in its third year of designing and implementing permaculture systems on our 570-acre farm. Current projects include transitioning conventional pecan groves to organic, rotational grazing, organic gardens, large-scale swaling and other water harvesting, future construction of a permaculture demonstration village, and more. Students will have the opportunity to observe and interact with existing systems, including hands-on projects that are a part of the community's current goals. Koinonia has several thousand visitors every year, and we are working to spread the word and grow the network of permaculture through the deep south. Come join us and become a part of history in the making!
Instructors: Wayne Wesiman, Bill Wilson, Bob Burns, and guests.
Cost: $900 including dorm-style rooms and meals. Work trades and scholarships available.
Contact: Sarah Prendergast
877-738-1741
sarah@koinoniapartners.org
www.koinoniapartners.org

Permaculture Design Course
Blue Ridge

Dates: August 21-September 4
Location: Gerton, NC
Description: The permaculture curriculum includes over 30 topics including: ethics, design process, ecosystems, microclimates, aquaculture, site analysis, cultural sustainability, ecovillage design, natural/green building, urban permaculture, earthworks, and many more. The course is offered at Laughing Waters, an eco-designed and constructed retreat center located in the beautiful Hickory Nut Gorge.
Instructor: Patricia Allison
Cost: TBA
Contact: Marcia Ghidina
marcia.ghidina@gmail.com

Permaculture Design Course
New England

Dates: July 16-August 4
Location: Shutesbury, MA
Description: Held at Sirius EcoVillage and and sponsored by Living Routes, this course will visit urban farms, permaculture sites, ecohomesteads, CSAs, and micro-organic food and medicine cottage industries. The venue provides the opportunity for immersion in the life of this intentional community. College credit (4 hours) is available through the University of Massachusetts at Amherst for "Natural Resources Conservation (NRC) 298P–Section 2. (May also be combined with the summer intensive in Green Building and Sustainable Design for a total of 8 credits.) The three-week course covers the certicate material in permaculture and more. Seventeen hours of hands-on projects, plus 25 hours of design projects make this an especially rich experience.
Instructors: Dave Jacke, Eric Toensmeier, Kay Cafasso, Mark Krawczyk, Jono Neiger, John Gerber, and guests.
Cost: $1800 tuition. Room and board ranges from $330-$1030 for commuter, camping, or shared indoor room.
Contact: Living Routes
888-515-7333, 413-259-0025
413-259-1113 fax
284 N. Pleasant Ln, Ste. 1
Amherst, MA 01002
www.livingroutes.org

Calendar

May 1-June 15. Maricopa, CA. Living Craft Project Natural Building Intensive. www.quailsprings.org/programs.

May 12-20. Portland, OR. Gaia University Orientation. Kirsten Liegmann. 888-316-2092x4. kirsten@gaiauniversity.org.

May 15-26. Lens St. Remy, FRANCE. Cours de design 72hrs. Permaculture en Belgique francophone. upp@permaculturefrance.org

May 16-29. Los Angeles, CA. Permaculture Design Course. permaculture@earthflow.com.

May 28-30. High Falls, NY. Forest Garden Immersion, Tend and Caretake. ethan@appleseedpermaculture.com. www.appleseed-permaculture.com.

May 28-30 Occidental, CA. Woodshop for Women. Occidental Arts and Ecology Ctr. 707-874-1557x201. oaec@oaec.org.

May 28-Jun. 6. Portland, OR. Village Building Design Course & Village Building Convergence. Mia Van Meter. vbdc@cityrepair.org.

May 29, 30, June 5,6,12,13,26,27, July 10,11,17,18. Fort Collins, CO. Permaculture Design Course. Front Range Permaculture Institute. 970-672-4722.

May 29-June 12. Fairfield, IA. Permaculture Design Course. Briggs Shore. 641-430-1089. briggsshore@gmail.com.

May 29-30, folowing weekends in June & July. Fort Collins, CO. Permaculture Design Course. Lisa Olivas. 970-672-4722. lisaregina@frii.com.

May 30-June 12. Winlaw, BC, Canada. Permaculture Design Course. spiralfarm@yahoo.com.

June 5-6. Laytonville, CA. Primitive Technology Overview. 707-972-1364. www.polcumsprings.net.

June 6-20. Paoli, IN. Permaculture Design Course. Andy Mahler. 812-723-2430. andy@blueriver.net.

June 11-26. Bolinas, CA. Permaculture Design Course. 415-868-9681. info@regenerativedesign.org.

June 13-26. Ashland, OR. Permaculture Design Course. 541-941-9711. courses@restorationfarm.org.

June 18-20. High Falls, NY. Forest Garden Immersion, Food & Medicine. ethan@appleseedpermaculture.com. www.appleseed-permaculture.com.

June 18-July 2. Prospect, KY. Permaculture Design Course. Penryn Craig, 502-396-5721. penrync@aol.com.

June 21-July 11. Maricopa, CA. Permaculture Design Course/Sustainable Vocations. www.sustainablevocations.org.

June 22-July 3. Stelle, IL Permaculture Design Course. Becky Wilson. 815-256-2215.

info@midwestpermaculture.com.

June 26-July 7. Plufur, FRANCE. Permaculture Design Course. upp@permaculture-france.org.

June 26-July 10. Bellingham, WA. Earth Activist Training. 800-381-7940. earthactivisttraining@gmail.com. www.earthactivisttraining.org.

July 3-17. Bellingham, WA. Earth Activist Training. 800-381-7940. earthactivisttraining@gmail.com.

July 12-25. Methow Valley, WA. Permaculture Design Course. Michael Pilarski. 509-486-2672. michael@friendsofthetrees.net.

July 15-27. Earthhaven Ecovillage, NC. Comprehensive Lifeskills Training. 888-822-8199.

July 16-August 4. Shutesbury, MA. Permaculture Design Course. Living Routes, 888-515-7333 or 413-259-0025. www.livingroutes.org.

July 16-August 8. Telluride, CO. Permaculture Design Course. 970-369-5255. www.ucsanmiguel.org.

July 17-24. Orangeville, ON. Fundamentals of Permaculture. Russell Scott. 519-942-8339. info@truesourceseminars.com.

July 17-30. Occidental, CA. Permaculture Design Course. Philip Tymon. 707-874-1557. oaec@oaec.org.

July 17-31. Marshfield, VT. Earth Activist Training. 800-381-7940. earthactivisttraining@gmail.com. www.earthactivisttraining.org.

July 17,18,31, Aug. 1, Sept. 25,26, Oct. 2,3,16,23,30. New York City. Permaculture Design Course. 718-768-3195. oldstonehouse@verizon.net.

July 19-August 6. Corvallis, OR. Permaculture Design Course. 541-752-9118. amillison@gmail.com.

July 23-August 8. Ithaca, NY. Permaculture Design Course. info@fingerlakespermaculture.org.

July 24-August 7. Fairfield, IA. Permaculture Design Course. Briggs Shore. 641-430-1089. briggsshore@gmail.com.

July 25-August 1. Orangeville, ON. Permaculture Practicum. Russell Scott. 519-942-8339. info@truesourceseminars.com.

July 25-August 8. Marshfield, VT. Earth Activist Training. 800-381-7940. earthactivisttraining@gmail.com.

July 26-August 7. Westcliffe, CO. Permaculture Design Course. Ayesha McDaneld. 719-783-0188. ayeshamcd@gmail.com.

July 30-August 12. Sedalia, CO. Permaculture Design Course. Woodbine Ecology Center. pdc@woodbinecenter.org. www.woodbinecenter.org/pdc2010.

August 1-6 Bolinas, CA. Ecology of Leadership. Regenerative Design Institute. 415-868-9681. info@regenerativedesign.org.

August 8-20. Paul Smiths, NY. Permaculture Design Course. Tom Huber. 518-327-6330. thuber@paulsmiths.edu.

August 9-22. Homer, AK. Permaculture Design Course. Terri Brown. 907-344-0935. terrib@artlover.com.

August 13-15. Sedalia, CO. Indigenous Permaculture Convergence. Woodbine Ecology Center. ipc@woodbinecenter.org. www.woodbinecenter.org/ipc2010.

August 13-29. Freeland, MD. Permaculture Design Course. Karen Stupski. 410-357-9523. education@heathcote.org.

August 15-28. Winlaw, BC. Permaculture Design Course. Kootenay Permaculture. Institute. spiralfarm@yahoo.com. www3.telus.net/permaculture.

August 17-19. Nethen, BELGIUM. European Permaculture Convergence. maraethe.holzer@utanet.at.

August 19-21. Lafayette, IN. North American Fruit Explorers Annual Meeting. Ed Fackler, cefackler@gmail.com.

August 21-September 4. Gerton, NC. Permaculture Design Course. Marcia Ghidina, marcia.ghidina@gmail.com.

August 19-29. Wallingford, PA. Permaculture Design Course. bazzrad@yahoo.com. www.pendlehill.org.

August 22. Boulder, CO. Permaculture Convergence. Sandy Cruz. 303-459-3494. hialtpc.org.

August 23-28. Seoul, KOREA. Intl. Union of Forest Research Organizations. XXIII World Congress. www.iufro2010.com.

September 3-18. Bolinas, CA. Permaculture Design Course. Regenerative Design Institute. 415-868-9681. info@regenerativedesign.org.

September 4-10. Hohenwald, TN. Gaia University Orientation program. Valerie Seitz. 931-442-1770. valerie@gaiauniversity.org.

September 7-24. Corvallis, OR. Advanced Permaculture Design Course. 541-752-9118. amillison@gmail.com.

September 12-25. CRMPI, Basalt, CO. Permaculture Design Course. Jerome Osentowski. 970-927-4158. jerome@crmpi.org.

September 14-25. British Columbia, CANADA. Permaculture Design Course. Suuz, 250-366-4395.

September 16,18,23,30, Oct. 2,7,14,21,28, Nov. 4,11,18. Boulder, CO. Advanced Permaculture Design Course. Sandy Cruz, 303-459-3494. hialtpc.org.

September 17-25. Hohenwald, TN. Gaia University Financial Permaculture Course. Valerie Seitz. 931-442-1770. valerie@gaiauniversity.org.

September 18-30. Americus, GA. Permaculture Design Course. Sarah Prendergast. 877-738-1741, sarah@koinoniapartners.org. www.koinoniapartners.org.

September 18-October 1. Occidental, CA. Permaculture Design Course. Philip Tymon. 707-874-1557. oaec@oaec.org.

September 23-26. Bloomington, IN. Midwest Permaculture Convergence. Rhoonda Baird. 812-323-1058. rk.baird@yahoo.com

October 14-16, 29-31, Nov. 12-16, 2010; Feb. 18-20, Mar. 6-8, 2011. Bloomington, IN. Permaculture Design Course. Rhonda Baird. 812-323-1058. rk.baird@yahoo.com.

October 23-Sept. 2011. Bolinas, CA. Permaculture Design Course. Regenerative Design Institute. 415-868-9681. info@regenerativedesign.org.

November 8-12. Occidental, CA. Intentional Communities Course. Philip Tymon. 707-874-1557. phil@oaec.org.

December 6-19. La Ribera, MEXICO. Bilingual Permaculture Design Course. rawpermaculture@yahoo.com.

January 8-22, 2011. Cazadera, CA. Earth Activist Training. 800-381-7940. earthactivisttraining@gmail.com

LETTERBOX

Boulder, Colorado Holds 2nd Food Summit

Dear *Permaculture Activist*,

Thanks for the great issue on food security, with Peter Bane's article providing a community blue-print for creating a food security plan. I LOVE hearing what other communities are doing on this. It is so heartening!

I'm working with Everbody Eats here in Boulder on these issues. FYI, here's the Prezi site for the first Food Summit (http://prezi.com/2mhxamjxks5b), which happened two years ago. Our latest summit was March 20, where we brought together about 30 organizations that work with food and are interested in a food secruity plan.

Zia Parker
Boulder, CO

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Housing/Community

Forming a cohousing community on 70 acres near Athens, Ohio. Contact Bruce Sabel, besabel_88@hotmail.com. www.permaculture-synergies.com.

Seeking folk to discuss forming bi-/poly-intentional 'family' for older (post- or non-children) people using permaculture principles for our 'organic farm,' 'tent & breakfast,' 'ropes course,' etc. I'm 53, former science teacher, currently incarcerated (you are compassionate, non-judgmental, I hope). DenzialTittle@gmail.com.

Situations Offered

For permaculture-based family farm/homestead start-up on 30 acres rich cove forest w/ barn, cabin, creek, innovative forest agriculture plans; 1 hour from Asheville, NC. Individual or couple. Write for details: don@donsilver.net.

HELP NEEDED IN EDEN! Live-in gardening, orchard, food preservation, maintenance, caretaking of small, sustaining paradise sanctuary in N central WA at wilderness edge. http://www.medicineeagle.com. 509-223-3093.

APPRENTICE tree and vegetable farmer on Ohio Valley permaculture smallholding. Varied duties from greenhouse propagation and transplant, pruning, mulching, forestry, to construction and system installation. Design orientation and PDC required. An opportunity to work toward a diploma. Room, board, stipend. Nonsmoker, omnivore, emotionally mature, serious interest only. Minimum commitment of six months. Email letter of intent and references to pcactivist@comcast.net.

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Issue #76

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