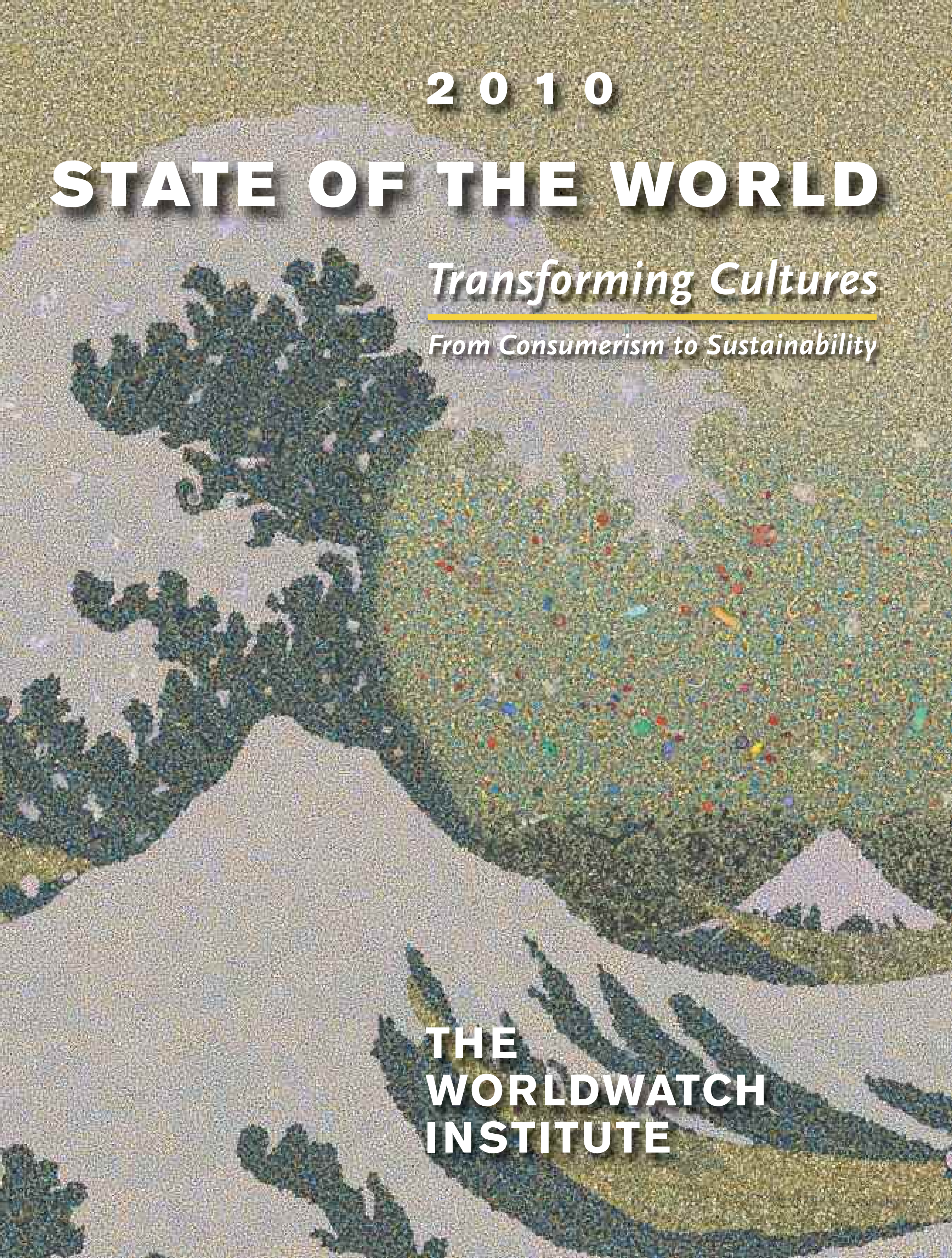
2010

STATE OF THE WORLD

Transforming Cultures

From Consumerism to Sustainability



THE WORLDWATCH INSTITUTE

SCIENCE/ENVIRONMENT

2010

STATE OF THE WORLD

Transforming Cultures

From Consumerism to Sustainability

Advance Praise for *State of the World 2010*:

"If we continue to think of ourselves mostly as consumers, it's going to be very hard to bring our environmental troubles under control. But it's also going to be very hard to live the rounded and joyful lives that could be ours. This is a subversive volume in all the best ways!"

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"Worldwatch has taken on an ambitious agenda in this volume. No generation in history has achieved a cultural transformation as sweeping as the one called for here...it is hard not to be impressed with the book's boldness."

—***Muhammad Yunus, founder of the Grameen Bank***

"This year's *State of the World* report is a cultural mindbomb exploding with devastating force. I hope it wakes a few people up."

—***Kalle Lasn, Editor of*** **Adbusters magazine**

Like a tsunami, consumerism has engulfed human cultures and Earth's ecosystems. Left unaddressed, we risk global disaster. But if we channel this wave, intentionally transforming our cultures to center on sustainability, we will not only prevent catastrophe but may usher in an era of sustainability—one that allows all people to thrive while protecting, even restoring, Earth.

In this year's *State of the World* report, 50+ renowned researchers and practitioners describe how we can harness the world's leading institutions—education, the media, business, governments, traditions, and social movements—to reorient cultures toward sustainability.

full image

extreme close-up

Several million pounds of plastic enter the world's oceans every hour, portrayed on the cover by the 2.4 million bits of plastic that make up *Gyre*, Chris Jordan's 8- by 11-foot reincarnation of the famous 1820s woodblock print, *The Great Wave Off Kanagawa*, by the Japanese artist Katsushika Hokusai.

For discussion questions, additional essays, video presentations, and event calendar, visit **blogs.worldwatch.org/transformingcultures**.

Cover image: *Gyre* by Chris Jordan
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From Agriculture to Permaculture

Albert Bates and Toby Hemenway

Above the door lintels of the cultural museum of Tlaxcala, Mexico's oldest state capital, are murals depicting the rise of civilization. First there appear the hunters, clad in furs, with bows and spears. A woman discovers a small grassy plant and begins to cultivate it. After a time, everyone is planting it, and the newly domesticated plants grow as tall as a person. Special tools appear to prepare the ground, plant, harvest, and process the grain. In the wall panels that follow, civilization arrives, in all its complexity.

Something similar to this story is told in most, if not all, cultures. In the Fertile Crescent of the upper Tigris and Euphrates Rivers there are ancient coins bearing images of a plow drawn by oxen. Images of planters and plows appear on pottery from Egypt and Anatolia and on rice paper from Japan and China, some of it more than 14,000 years old.[1]

As the ice retreated and the climate warmed 20,000 years ago, the area of fertile soil and suitable growing seasons expanded, even as wild game retreated and mammoths and other large animals went extinct. About 8,000 years ago, animal husbandry began to be augmented by the domestication of emmer wheat, einkorn, barley, flax, chick pea, pea, lentil, and bitter vetch. Humans had begun to alter their landscapes in profound ways, clearing forests for fields, building larger villages and cities, and redirecting rivers for irrigation and flood control. By 7,000 years ago, many, if not most, people in the world were farmers.[2]

This might have continued until humanity entered the next Ice Age—a world of cold deserts, land bridges, and massive mountains of ice. But civilization changed that trajectory by harnessing the coal, gas, and oil that fueled the Industrial Revolution. Once more, people altered the planet's rhythms in ways they could not fully grasp.

In the span of a single century—the present one—Earth's climate may warm more rapidly and to a greater degree than in the previous 20,000 years. Agricultural systems will be profoundly challenged, beset by a perfect storm of diminishing fuel supply for tractors, fertilizer, and transportation; by crop-destroying heat waves, expanding pestilences, and declining water supplies for irrigation; by growing and migrating populations clamoring for food,

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especially for meat and processed foods (see Box 5); and by the financial instability borne of exceeding Earth's limits and having to retrench to an earlier stage of industrial development.[3]

Before the mid-twentieth century, most crops were produced largely without the use of chemicals. Insect pests and weeds were controlled by crop rotations, destruction of crop refuse, timing of planting to avoid high pest population periods, mechanical weed control, and other time-tested and regionally specific farming practices. While these are still in use, changes in technology, prices, cultural norms, and government policies have led to today's industrially intensive agriculture. The dominant system of agriculture now practiced throughout the world, referred to as "conventional agriculture," is characterized by mechanization, monocultures, the use of synthetic chemical fertilizers and pesticides, and an emphasis on maximizing productivity and profitability.

This type of agriculture is unsustainable because it destroys the resources it depends on. Soil fertility is declining due to erosion, compaction, and destruction of organic matter; water supplies are being depleted and polluted; finite fossil energy supplies are being exhausted; and the economies of rural communities are left in shambles as agricultural outputs are shipped to distant markets. The shortage of productive cropland, decreasing soil fertility, and the enormous waste and imprecise management associated with industrial-scale food economics are responsible for the world's recurrent and accelerating food and water shortages, malnutrition, mass starvation, and loss of biodiversity. In addition, agriculture accounts for about 14 percent of greenhouse gas emissions, and from 1990 to 2005 global agricultural emissions increased by 14 percent.[4]

Humanity now confronts a critical challenge: to develop methods of agriculture that sequester carbon, enhance soil fertility, preserve ecosystem services, use less water, and hold more water in the landscape—all while productively using a steadily compounding supply of human labor. In short, a sustainable agriculture.

Defining Sustainable Agriculture

Fortunately, for the past half-century some pioneers have been preparing the agriculture of the future, and their ideas are now moving to center stage. Organic no-till, permaculture, agroforestry, perennial polycultures, aquaponics, and biointensive and biodynamic farming—long considered fringe ideas—are now converging as serious components of a sustainable agriculture.[5]

One of the foundation stones was laid early in the twentieth century, when Franklin Hiram King journeyed to China, Korea, and Japan to learn how farms there had been worked for thousands of years without destroying fertility or applying artificial fertilizer. In 1911 King published *Farmers of Forty Centuries: or Permanent Agriculture in China, Korea and Japan*, which described composting, crop rotation, green manuring, intertillage, irrigation, drought-resistant crops, aquaculture and wetlands farming, and the transport of human manure from cities to rural farms.[6]

King's work was inspiration for many, including Sir Albert Howard. In 1943 he published *An Agricultural Testament,* which described building compost piles, recycling waste materials, and creating soil humus as a "living bridge" between soil life, such as mycorrhizae and bacteria, and healthy crops, livestock, and people. At the heart of Howard's work was the idea that soils, nutritious crops, and organisms in general are not just arrays of minerals but are parts of a complex ecology of cycling organic matter, and that these life-supporting cycles are critical for a self-regenerative agriculture.[7]

Howard became embroiled in a mid-twentieth century conflict. On one side were disciples of chemists such as Carl Sprengel and

Box 5. Dietary Norms That Heal People and the Planet

While many different combinations of foods will meet a person's dietary needs, dietary norms are for the most part shaped by the individual's culture, typically very early in life. Traditionally, these preferences were in large part shaped by the foods that were available to people in their bioregion.

In today's globalized world, however, more people can choose from a wide array of foods. While increased choice is theoretically a good thing—giving people variety and the opportunity to choose diets that are healthy and have little ecological impact—dietary norms have been reshaped in an increasingly unhealthy and unsustainable manner. Easy access to high-fat, high-sugar foods combined with billions of dollars spent annually on marketing have dramatically shifted what is considered a "normal" diet—from the number of calories per meal to the amount of meat, sugar, and refined flour consumed. All of these in turn have contributed to rising obesity levels and have had significant ecological impacts.

Today 1.6 billion people are either overweight or obese, and 18 percent of greenhouse gases are produced by livestock that are raised to feed humanity's growing demand for meat. In 2007, people ate 275 million tons of meat, about 42 kilograms per person worldwide and 82 kilograms in industrial countries (2.7 servings every day).

By cultivating new dietary norms, food can contribute to good health and possibly even help heal the planet. A study of several of the longest-lived peoples in the world found that they ate just 1,800–1,900 calories a day, no processed foods, and minimal amounts of animal products. By comparison, the average American consumes 3,830 calories a day.

Food writer Michael Pollan explains succinctly what a healthy, restorative diet could look like: "Eat food, not too much, mostly plants." By food, Pollan means that people should avoid food-like products with so many additives, preservatives, flavors, and fillers that their nutritional value may be compromised.

And by eating fewer calories (while ensuring those calories are high in nutrients), overall health and longevity can be increased—a finding that has been borne out in several different animal species, including humans. Moreover, eating fewer calories means having a smaller ecological impact. For example, if a person starts adhering to an 1,800-calorie-a-day diet at age 30, he could live to the age of 81 before consuming the same amount of calories as a person who follows the typically recommended 2,600-calorie diet would by the age of 65.

Eating "mostly plants"—not necessarily completely vegetarian but, as in many cultures throughout history, eating meat infrequently or perhaps even just ritually—will have significant ecological benefits. According to agricultural researcher David Pimentel, a vegetarian diet needs one third fewer fossil fuels than a meat-based diet. Another study found that producing just 1 kilogram of beef involves as much carbon dioxide emissions as the average European car being driven 250 kilometers.

Unfortunately, today the dietary norm that is spreading around much of the world—driven by the media, government subsidies, advertising, and even by parents—is the consumer diet of high quantities of meat, processed foods, refined flours, and sugar.

What is needed is the intentional cultivation of sustainable dietary norms—an effort that is getting started, thanks to books like *In Defense of Food*, documentaries like *Food Inc.*, government programs that promote healthier eating, social enterprises selling healthier food, and movements like "Slow Food" that enourage people to consider carefully what they eat.

—Erik Assadourian and Eddie Kasner

Source: See endnote 3.

Justus von Liebig, who advocated fertilizing principally with nitrogen, phosphorus, and potassium minerals and promoted a mechanical approach, arguing that plant growth is boosted by adding the scarcest, or limiting, mineral. This soon became a widely accepted agronomic principle and the basis for the Green Revolution. On the other side were the organic advocates, adhering to Howard's view that crop health depends on maintaining soil ecology by returning to the soil not just the minerals lost in farming but also the organic matter that supports the nutrient cycles of soil life. Howard's position was, in the words of biologist Janine Benyus, that it is life that best creates the conditions conducive to life.[8]

Courtesy Maya Mountain Reasearch Farm

The face of agroforestry at the Maya Mountain Research Farm, Belize.

Howard lost that battle but may yet have won the war, as it becomes apparent that many aspects of industrial agriculture are unsustainable, from the topsoil loss that approaches 75 billion tons annually to the looming depletion of the critical fertilizer phosphorus and the negative returns typified by crops that use 10 calories of fuel energy to produce one calorie of food energy.[9]

Twentieth-century agriculture has badly degraded nearly every ecosystem it has encountered while consuming roughly 20 percent of world energy production. The style called "conventional" depends for nearly all of its workings on a dwindling and increasingly expensive supply of fossil fuels.[10]

Sustainable agriculture, in contrast, can be pursued indefinitely because it does not degrade or deplete the resources that it needs to continue. Since most of Earth's arable land is already under cultivation and human populations are continuing to expand, an even better goal would be to actually improve the capacity of the land to produce.

Some net gain approaches are coming into view, but they are not magic elixirs. While optimized farming practices can increase the capacity of the land to produce over the long term, they cannot be considered in isolation; a robust solution to humanity's continued existence on this planet must include adopting sustainable lifestyles and maintaining human population at sustainable numbers.

Organic Agriculture: An Overview

Key features of organic agriculture are the use of biologically produced fertilizers such as carbon-enhanced manures instead of manufactured inorganic nitrates and phosphates, infrequent use of biologically derived pesticides rather than routine application of synthetic and systemically toxic compounds, and—most critically—maintenance of soil ecology and organic matter through cover crops, green manures, crop rotation, and composting.[11]

A long-term comparison done by the Rodale Institute from 1981 to 2002 found that organic systems provided crop yields equivalent to those of conventional methods. The trials showed that when rainfall was 30 percent less than normal—typical drought levels—organic methods yielded 24–34 percent more than standard methods. The researchers attribute the increased yields to better water retention due to higher soil carbon levels.[12]

Data gathered from the trial have revealed that soil under organic agriculture management can accumulate about 1,000 pounds of carbon per acre-foot each year. This is equal to about 3,667 pounds of carbon dioxide per acre (4,118 kilograms per hectare per year) taken from the air and sequestered into soil organic matter. Also, organic methods used 28–32 percent less energy and were more profitable than industrial methods. These results suggest that organic methods offer great promise for reducing fossil fuel use and greenhouse gas emissions. The study suggested that converting the 64 million hectares of U.S. cropland currently planted in corn and soybeans to organic methods would sequester 264 million tons of carbon dioxide; this is the equivalent of shutting down 207 (225-megawatt) coal-fired power plants, about 14 percent of the installed coal electric capacity in either the United States or China.[13]

Perennial Polycultures

Wes Jackson and his colleagues at The Land Institute in Salina, Kansas, have been developing new perennial crops to replace annual grains that must be replanted every year. These grains are grown in polycultures, mixed with other perennial species that fix nitrogen for fertility, and produce seed oil for food, fuel, and lubricants. These polycultures mimic the plant communities that make up wild prairie.[14]

"Here's where we have to be thinking deeply," Jackson says. "Agriculture had its beginning 10,000 years ago. What were the ecosystems like 10,000 years ago, after the retreat of the ice? Those ecosystems featured material recycling and they ran on contemporary sunlight. Humans have yet to build societies like that. Is it possible that embedded in nature's economy are suggestions for a human economy in which conservation is a consequence of production?" Ecological wealth, Jackson argues, is a more reliable sponsor of human food systems than fossil fuels, bank loans, or government subsidies are.[15]

Land Institute research shows that compared with annuals, perennial food plants provide more protection against soil erosion, manage water and nutrients more effectively, sequester more carbon, are more resilient to pests and stresses, and require less energy, labor, and fertilizer. Yields are currently low compared with annual crops, but they are rising. Studies performed in Africa suggest that many grains, fruits, and vegetables now farmed in annual monocultures will produce similar results when farmed in perennial polycultures.[16]

Agroforestry

Agroforestry combines trees and shrubs with annual crops and livestock in ways that amplify and integrate the yields and benefits beyond what each component offers separately. Like other methods of sustainable agriculture, it is based on observing productive natural ecosystems and mimicking the processes and relationships that make them more resilient and regenerative.

In one form of agroforestry, called alley cropping, grains or other non-woody crops are planted in strips between rows of nut, fruit, timber, or fodder trees. Cattle, poultry, or other livestock can be pastured in the alleys or fed from the crop yields.

Near the town of San Pedro Columbia, in Southern Belize, Christopher Nesbitt has been growing food crops in this traditional forest style at his Mayan Mountain Research Farm for the past 20 years. He mixes some fast-growing native tree species, some annual crops, and some intermediate and long-term tree crops to build soil and produce continuous harvests. Some of his trees are leguminous and hold nitrogen by the microbial attraction of their roots. Some are pollinator-friendly and attract bees and hummingbirds to transfer the fertile pollen of important food plants. Understory trees like coffee, cacao, cassava, allspice, noni, ginger, and papaya benefit from intercropping with high canopy trees like breadfruit, açai and coconut palm, cashew, and mango. Fast-yielding crops such as avocado, citrus, banana, bamboo, yams, vanilla, and climbing squashes provide an income for the farm while waiting for the slower harvest of samwood, cedar, teak, chestnut, and mahogany to mature.[17]

The World Agroforestry Centre reports that methods like these can double or triple crop yields while reducing the need for commercial fertilizers. A U.N. Environment Programme report estimates that if best management practices were widely used, by 2030 up to 6 gigatons of CO_2 equivalent could be sequestered each year using agroforestry, which equals the current emissions from agriculture as a whole.[18]

No-till and Low-till

Some of the nutrient-accumulating and -conserving features that allow natural ecosystems to build and sustain soil fertility include minimum soil disturbance, the presence of a protective layer of plant residues covering the soil surface with no large bare areas for any length of time, and a constant covering of living plants to take up and store any nutrients that become available through decomposition. These nutrient-building and -conserving features can be incorporated into cropping systems by converting to no-till or low-till methods, such as reducing the period of bare fallow, planting cover crops, reincorporating stubble and plant residues, keyline plowing, and reducing aeration of the soil.[19]

On his 2,000-hectare farm near Wellington, New South Wales, in Australia, Angus Maurice is convinced that permanent pasture and what he calls "no kill" cropping systems will be the future of grain production. "We have seen significant recruitment of perennial grasses in the past five years, which is encouraging," he says, "but we realize to reach the system's full potential we would have to eliminate the use of herbicides altogether, which is something we can achieve through fine-tuning and successful recruitment of the right grasses."[20]

Long-term research studies reveal average losses of 328 pounds of organic matter per acre per year with plowing, whereas no-till studies report an average increase of 956 pounds of organic matter per acre per year. Erosion from a conventionally tilled watershed has been found to be 700 times greater than that from a no-till watershed. No-till systems that use high-residue cover crops build soil organic matter content and slow the movement of water over the soil surface, allowing more of it to penetrate. In New South Wales, Maurice reports his most interesting finding: soil carbon levels were significantly higher in areas of perennial grass in the remnant vegetation—about 4 percent, compared with 1.5 percent in paddocks coming out of the old continuous-cropping system.[21]

Permaculture

The term permaculture, a contraction of "permanent agriculture," was coined by Australians Bill Mollison and David Holmgren and refers to a systems approach for designing human ecologies, from farms to houses to cities, that mimics the relationships found in natural biomes. It integrates concepts from organic farming, sustainable forestry, no-till management, and the village-design techniques of indigenous peoples. It applies ecological theory to understand the characteristics of and potential relationships among different design elements.[22]

The discipline uses a set of principles adopted from ecosystems science. One principle is to use the cradle-to-cradle model of recycling all resources and producing no waste. Another is to promote interactions between components so that needs and yields are integrated within the design. For example, a chicken needs food, water, safe habitat, and other chickens, and it produces eggs, feathers, meat, and manure, as well as services such as weed-eating and insect control. A design that integrates chickens would meet their needs from on-farm resources and allow the chickens' outputs to meet the needs of other elements in the design, such as crops or an aquaculture system.

Once set in motion, permaculture designs evolve naturally, capture synergies, and produce a high density of food and other products with diminishing labor and energy inputs over time. One example of a permacultural strategy is the combining of crops in synergistic alliances called guilds, such as the traditional blending of corn, beans, and squash. Researchers have found that these combinations can increase total yields two- to threefold over monocultures of single crops.[23]

One of the better known examples of successful permaculture is found in one of the least hospitable places on Earth for farming. In the Kafrin area of the Jordan valley, 10 kilometers from the Dead Sea, the nearly flat desert receives only two or three light rainfalls in winter. The fine-grained silt is salty, and even the wells in the area are too saline to be used for irrigation.

It was there that Geoff Lawton and his team of permaculturists set up a small, 5-hectare farm and in 2001 began digging swales—2-meter-wide mounds and shallow trenches that crossed the farm in wavy lines on contour. They planted leguminous forest trees in the mounds to fix nitrogen and make leaf fodder. Each tree was given a drip-node from an irrigation line coming from a water dam built to capture road runoff; the lake formed by the dam was stocked with tilapia and geese, which contributed organic fertilizers for the trees.[24]

In the moist trenches, they planted olive, fig, guava, date palm, pomegranate, grape, citrus, carob, mulberry, cactus, and a wide range of vegetables. Barley and alfalfa were planted as legumes and forages for farm animals between the swales. Tree and vegetable plantings were mulched with old newspapers and cotton rags, and animal manure was added before and after planting. Animals raised on the farm included chickens, pigeons, turkey, geese, ducks, rabbits, sheep, and a dairy cow. They were fed from the farm once there were enough trees and plants growing to harvest regularly without overtaxing the system.

Within the first year the soil and well-water began showing a marked decline in salinity, and the garden areas had significant increases in growth. Pests were minor and largely controlled by the farm animals. The combining of plants and animals brought about the integration of farm inputs and outputs into a managed ecosystem of continuous production, water conservation, and soil improvement. In less than a decade a permacultural balance had been achieved, with lessening inputs and improving outputs.

Transitional Agriculture

The early corn-growers depicted in the murals in Tlaxcala would not have imagined they were transforming humans' relationship with Earth's ecology. Although it might be inspiring to have a grand mission like restoring the balance of nature, most farmers who venture into sustainable agriculture are simply interested in improving crop yields or saving labor or money. While tradable credits for sequestering carbon could soon provide another farm revenue stream, many farmers will likely go into sustainable agriculture simply because gas-and-oil-dependant agriculture is becoming more expensive.[25]

As Angus Maurice's family farm in Australia demonstrates, sustainable agriculture is not an either/or proposition, and there will necessarily be a period of transition from the current system to a more sustainable one. Even if most farmers do not go all-organic or apply permaculture principles, they can still improve their fortunes—and that of the planet—by adopting bits and pieces, a little at a time.

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