

The Land Report

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Three Scenarios for Agriculture and Humanity

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Cover: Robert Dawson. Indian fishing platforms, Deschutes River, Oregon.

Above: Wheat seedlings for transplant in The Land Institute greenhouse and eventual breeding with wild, perennial relatives. For a description of progress in that cross-breeding, see *At the Land*, which begins on page 10.



Our Mission Statement

When people, land and community are as one, all three members prosper; when they relate not as members but as competing interests, all three are exploited. By consulting nature as the source and measure of that membership, The Land Institute seeks to develop an agriculture that will save soil from being lost or poisoned while promoting a community life at once prosperous and enduring.

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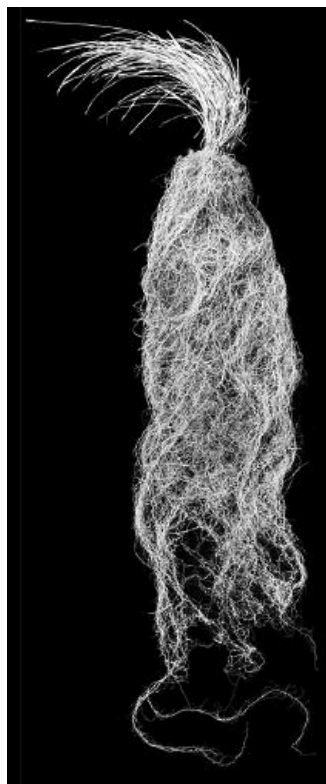
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Prairie Festival Sept. 26-28: Mark Your Calendar



Big bluestem, with roots more than 6 feet deep. This is a perennial. It holds soil year-round like no annual crop plant can. Land Institute scientists are breeding grain plants to be perennials. They'll tell about it at the Prairie Festival.

YOU'LL SEE AND HEAR NATIVE American activist Winona LaDuke, *When Corporations Rule the World* author David Korten, *Native Son* Mas Masumoto and innovative farmer Charlie Melander. You'll enjoy Kansas food prepared by a California chef. You'll get to dance. And you'll not be alone in the wilderness: People who celebrate The Land Institute's Prairie Festival share a caring about sustainable living and our land, and they say the warm people they meet are the best thing about attending. We invite you to be part of it, the 25th Prairie Festival, September 26-28.

These are confirmed speakers, along with institute scientists who will tell what they've achieved since last year's festival, and founder Wes Jackson, who will present his annual inspirational. For schedule additions, watch our web site and look in the summer *Land Report*, which will have a registration form.

The festival will open with a barn dance Friday evening, September 26. You're welcome to visit and jam afterward. If conditions permit, we'll have a bonfire. Primitive camping is free. Saturday will be an all-day happening, with talks and music, tours of plots where we're developing perennial grain plants, and supper with food grown in Kansas and prepared by Donna Prizgintas of Southern California, who has been a private chef to Hollywood celebrities. On display will be art by Salina's Priti Cox, whose work *The Invisible Hand* appeared on the back cover of the fall 2002 *Land Report*. Following a morning of talks, the festival will conclude at noon Sunday.

WE HOPE YOU'LL COME AND BRING friends. We want to make The Land Institute's audience bigger and younger. It's time to add new members to the choir.



Winona LaDuke is a leading advocate of Native American rights, was the 2002 vice presidential candidate for the Green Party, and was *Ms.* magazine's Woman of the Year. She wrote *Last Standing Woman* and *All Our Relations: Native Struggles for Land and Life*.



David Korten leads the Positive Futures Network and the People-Centered Development Forum. A leading critic of corporate influence in America, his books include *The Post-Corporate World: Life After Capitalism*. He is coming with the expressed purpose of meeting other activists.



Mas Masumoto is a California peach and grape farmer. Those who have read his *Epitaph for a Peach*, *Harvest Son* and *Four Seasons in Five Senses: Things Worth Savoring*, know the love of place that will make him a treat for the festival.



Charlie Melander works land that his family has farmed for a century. He won a conservation award for design of perennial grass terraces to replace earthen terraces on sloping ground. He advises The Land Institute and helps in its research.

Three Scenarios for Agriculture and Humanity

Feeding our growing population while preserving its requisite, the complex natural world, is the most critical challenge facing humanity in the coming century. How we currently raise most food crops, as monocultures of annual plants, fails this challenge. What we do about it will have vastly different effects on civilization's irreplaceable foundation, healthy, farmable land. Here are three strategies and their likely consequences.

These three scenarios describe likely trends. They do not predict actual acres of degraded land or the size of the human population in the coming decades. They are qualitative rather than quantitative. Such qualitative scenarios allow underlying assumptions to be clearly stated and examined. As a way of sparking healthy debate, we encourage those with different perspectives to develop differing scenarios, with references. Following are assumptions for our three scenarios.

■ Energy-intensive, industrial agriculture has rapidly degraded the land, and the changes to produce more food with this system will degrade more land even faster. Genetic engineering will not be a panacea. It will produce relatively minor changes in crop plants at great expense, and be mired in social and political complexities. (*Global Environment Outlook 3*, by the U.N. Environment Program.)

■ Returning to pre-industrial farming of annual crops is not a viable alternative to industrial agriculture. Traditional cropping still eroded and degraded soil, and when soil fertility was not maintained, harm to soils and surrounding ecosystems was more rapid than in modern industrial systems. What we need is a progressive, fundamentally different approach to farming, based on the inherent efficiencies of natural ecosystems.

■ The term “sustainable agriculture” describes technologies designed to best use existing systems. Examples include no-till practices, cover crops, buffer strips, integrated pest management, diversified rotations and integrated crops and livestock.

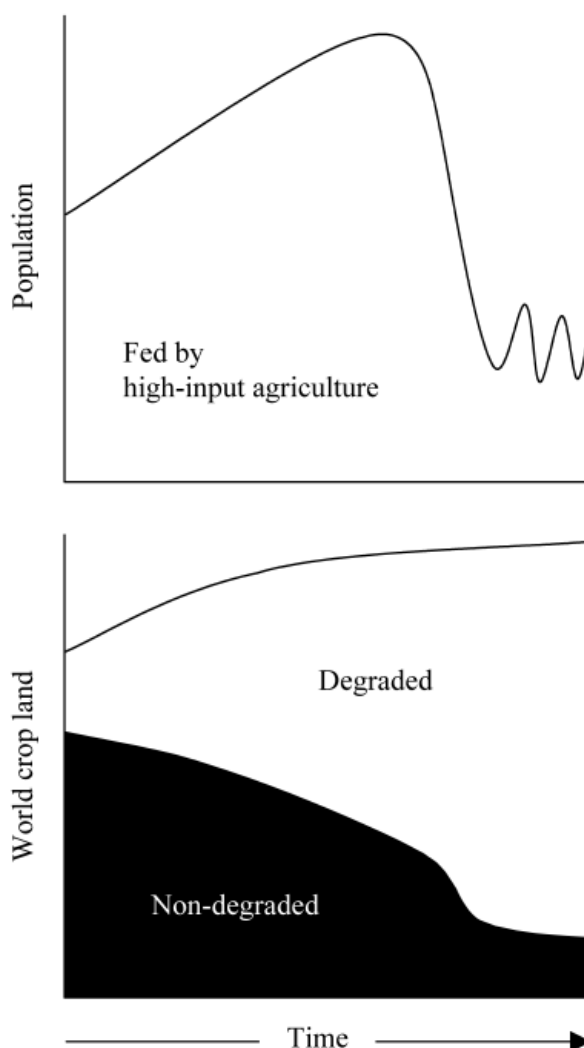
Continued on page 6

Strategy 1

Increase funding to further intensify our current agriculture of high energy subsidies and boost food production on existing farmland.

Result

This further reduces the land's inherent productivity, making the system increasingly brittle. As fossil fuels become scarce and expensive, particularly in poorer parts of the world, productivity falls rapidly, and a tragic crash in the human population follows.

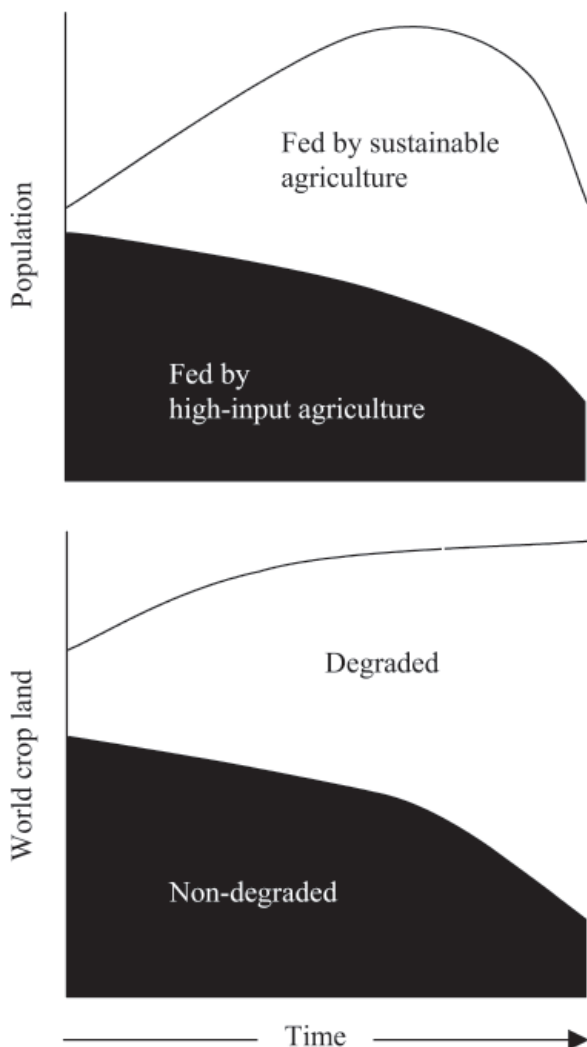


Strategy 2

Fully fund nominally sustainable agriculture research to reduce dependence on nonrenewable energy and conserve land while increasing productivity.

Result

Land degradation slows, but annual cropping remains heavily dependent on energy subsidies. As these become scarce and expensive, degradation accelerates and the human population declines steeply.

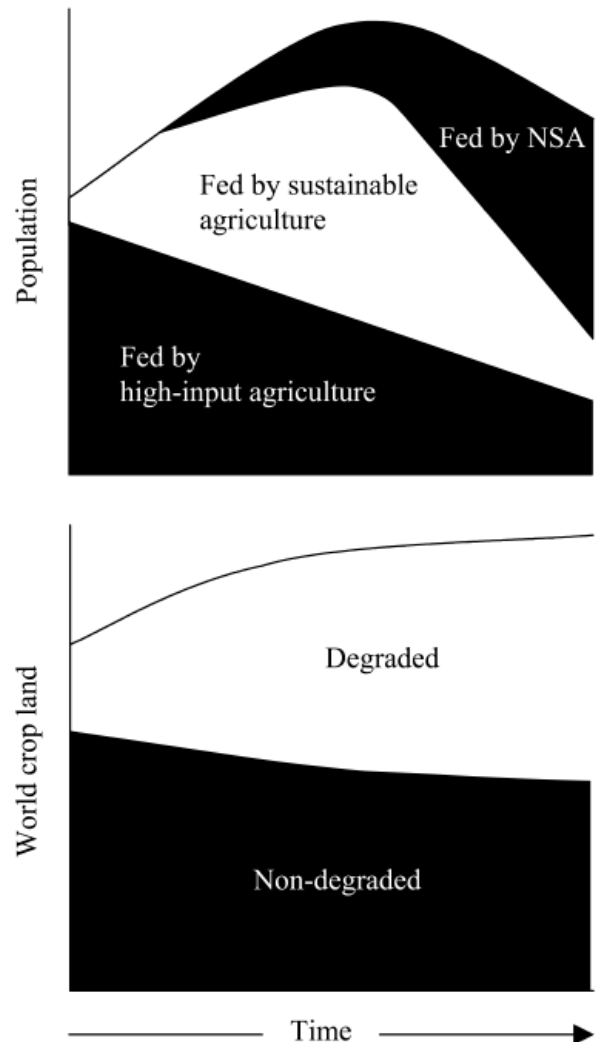


Strategy 3

Fully fund sustainable agriculture to conserve land and reduce reliance on nonrenewable energy in the short term. Fully fund development of agriculture designed to mimic natural ecosystems, Natural Systems Agriculture, to reduce energy subsidies and restore productivity of existing farmland in the medium to long term.

Result

Sustainable agriculture preserves land as well as possible in the short term, while energy subsidies remain, but is gradually displaced as farming becomes patterned after the perennial polycultures that make up most of the earth's natural vegetation. This protects and preserves soil, and enables us to be fed on sustainable resources. Human population still must decline, but an adequate food supply makes for a soft landing.





Erosion in Saline County,
Kansas, 2001.

But because annual grains dominate these systems, most are not truly sustainable. (*American Journal of Alternative Agriculture* 6:146.)

■ Humans have degraded almost 5 billion acres of soil worldwide. The proportions of degraded land shown in the graphs is based on estimates ranging from 15 to 38 percent of cropland degraded by farming over the past 50 years combined with projections of further degradation of current cropland over the next 30 years. (U.N. Environment Program, International Food Policy Research Institute and World Resources Institute.)

■ Soil degradation will ultimately limit crop yield, particularly when fertilizers are expensive or scarce. High fertilizer application currently masks soil degradation's effects.

■ Agricultural lands will expand an estimated 18 percent over the next 50 years. Most of this will be on marginal ground that will experience greater degradation when annually cropped under any kind of management. This accounts for the sharp increase in degraded lands under the scenario of sustainable

and industrial agriculture. (*Science* 292:281 and *American Journal of Alternative Agriculture* 14:129.)

■ Yields of modern cereal grains will be lower in the marginal environments than in where the varieties were developed. Yield gains for improved wheat varieties over traditional varieties on marginal land are often less than 10 percent. (*Feeding the Ten Billion* by L. T. Evans.)

■ The yield increase projections for industrial agriculture are based on increases over the past 30 years. (*Science* 292:281.)

■ The population graphs synthesize a range of study projections. (*How Many People Can the Earth Support?* by J. E. Cohen.)

■ Projections of the ability of sustainable agriculture to replace high-input agriculture are based on recent studies finding similar yields with organic, reduced-input or alternative systems. (*Soil & Tillage Research* 31:149, *American Journal of Alternative Agriculture* 10:25 and *Science* 296:1694.)



Christopher Picone. Prairie polyculture.

■ Perennial polyculture grain crops will use water and nutrients much more efficiently than the most nearly sustainable annual cropping, so they can be supplied indefinitely in most regions.

■ Public policy and the purchase of land for nature preserves will not protect refuges of biodiversity in the face of human starvation. Once current farmlands are degraded beyond producing sufficient food, additional lands will be converted to agriculture. So protecting the productivity of existing agricultural land is critical to protecting biodiversity.

■ Ecosystems are intricately tied to one another. Using large areas for production using high energy subsidies will degrade distant natural ecosystems with pesticides, nutrient overdoses and possibly genetic engineering. Water, air and nutrient cycles cannot be shut off at field boundaries. Maintaining biodiversity in pristine areas will only be possible by lowering the limiting farming's negative effects. (*Journal of Environmental Quality* 28:850, *Science* 292:281 and *Nature* 417:15.)

■ Many settlements are embedded in critical, protected natural areas. Introducing industrial strategies there would devastate biodiversity. In the Great Lakes region of central and eastern Africa, for example, nearly 50,000 square miles of farmland, an area about the size of Mississippi, are inside protected areas. (*Science* 287:1759.)

■ Continued loss of biodiversity will further degrade the ecosystem dynamics upon which human life depends. (*Nature* 405:234).

■ We make no adjustment for global climate change, although perennial mixtures will likely do better than annuals can under a wider range of climatic conditions, and be more resilient under greater climatic variation. Furthermore, intensified and expanded industrial agriculture will likely exacerbate loss of farmland to desertification and coastal flooding. (*Agriculture, Ecosystems and Environment* 67:1 and *Nature* 417:15.)

Food Security Begins and Stays at Home

Kamyar Enshayan

I was born in northern Iran, right on the “axis of evil,” and I want to tell you about a kind of true homeland security. I met Wes Jackson more than ten years ago when he visited Ohio State University’s College of Agriculture, where I was working. As we drove to the airport, he asked me about my background and my work: “Do you think farmers shy away from you because you are from Iran?” He laughed when I said, “I think it is more of a liability to be from a land grant college of agriculture than to be from Iran.”

There is much talk about bio-terrorism and how to safeguard our system of food and agriculture from terrorists. In Iowa, where I live, and in other states, agriculture bio-terror reaction teams receive large funding. But the forces systematically destroying American agriculture are almost entirely domestic: nitrogen pollution of our streams, atrazine in our drinking water, farm policies that kill independent businesses and small towns, genetic manipulation for profits and power, and the way land grant colleges of agriculture legitimize and enable a failing system of industrial agriculture.

One clear and troubling example of a domestic biological threat to our system of food and agriculture is the way the industrial meat giants raise and process livestock. Last year, snipers killed 12 people around the nation’s capital. *Listeria* bacteria suspected of coming from poultry processors killed eight people, sickened at least 54 others and caused three miscarriages or stillbirths in the Northeast, prompting a record recall of 32 million pounds of meat. I asked my students what differences there were between the two tragedies. The class had just read Eric Schlosser’s *Fast Food Nation*, which documents how packing giants repeatedly evade public health laws, leading to meat contamination and death. The only differences my class saw were that the shootings received massive news coverage but the poisoning

victims died quietly in hospitals with little media attention, and while there was an extensive search for the snipers, there were no arrests in the meat industry.

There are other ways of protecting our food and agriculture. As Mary Berry Smith said in Land Report No. 73 last summer, “Our country, through its ruinous desire for cheap food, has nearly destroyed the safest food system we could have: farmers feeding the people closest to them.” Smith’s family sells most of their farm products direct to customers: “Our customers trust us to provide delicious, healthy, safe food; we trust them to pay us a fair price.”

The people of Black Hawk County, Iowa, where I live, annually spend nearly \$240 million on groceries and another \$130 million on eating out. Under our industrialized system, most of these food dollars leave our county and state. Six years ago, with help from the Leopold Center for Sustainable Agriculture and USDA’s Sustainable Agriculture Research and Education program, I approached the dining services directors of our university, our local hospital and the owner of a locally owned restaurant about buying a greater portion of their food from nearby farms. The aim was to keep a significant part of these dollars in our community and region, as well as to build local relationships. “Value-subtracting” industrial agriculture and the resulting “value-missing” markets create insecurities for the very people who grow our food.

Ten institutions we have worked with over five years have spent nearly \$750,000 of their food purchases locally. At Rudy’s Tacos, one of our partners in Waterloo, 71 percent of the restaurant’s food budget, \$143,000, goes for fresh, locally grown ingredients. For most restaurants, that percentage would be in single digits, if any. Bartels Lutheran Home in Waverly, another partner, buys two to three cattle each month, raised

locally and processed at a local meat locker. Last year Bartels bought \$40,000 worth of locally raised beef and vegetables. Three years ago the beef came from an unknown source, and the \$40,000 left the region. The University of Northern Iowa, where I work, recently bought its first local cow!

This is “value-retained” agriculture, and we need more of it. If a handful of institutional food buyers in one small metropolitan area in Iowa can have such a significant economic effect, imagine if hospitals, schools, restaurants and retirement homes in other cities followed. We would need more farmers and businesses. If our country’s governments set a goal of retaining just 10 percent of our food dollars, that would amount to \$37 million every year. And that would be real economic development based on our best assets: our people and our land.

These institutional food buyers have come to understand that their decisions crucially affect the vitality of nearby farms and businesses. They have decided to buy their meats from farmers they know for this reason, and because they can find out what the animals were fed and how they were raised. Through local, inspected lockers, they are assured that their ground beef came from *that* cow, and not from thousands of other cattle from an unknown place.

This work has expanded the web of local relationships, which is the essence of local economy and local life. This is the kind of homeland security I think about.

Adapted from Enshayan’s talk at The Land Institute’s 2002 Prairie Festival.



Leah Wilson. Farmers market, Cedar Falls, Iowa.



Natural Systems Agriculture

As one would reap, so one must sow.

The Land Institute has taken a major step forward in developing perennial grain crops. Without a sophisticated planter, we could not achieve the scale and complexity of plant breeding needed to hit our mark, farming that mimics natural prairie. Now we have such a plot planter, made to suit our distinct needs.

We are starting expansive plots of diverse breeding lines, and we want to plant them in combination with other species. Smaller equipment like a push planter would be prohibitively slow and labor-expensive. Conventional drills for farming are too big, crude and difficult to clean seed from for the large variety of small plots we need.

The planter operator uses labeled envelopes of seed arranged according to the plot plan. This plan could amount to hundreds of plots, each as short as 5 feet and with a different plant variety or species, alone or in



Stan Cox drives the tractor, David Van Tassel feeds seed into the planter last fall.

combination with other species. The operator feeds the envelopes' contents into two cups. The push of a button at the plot edge releases the seed into a rotating mechanism that assures even seed dispersal. It empties completely to make a sharp ending edge of the plot and prevents undesired mixture with the next batch of seed. Each of the two cup arrangements can feed up to three rows a foot apart.

In addition to the cups, which are used for seeding the plant variety that will be evaluated and selected from in breeding, there are six seed boxes, one for each row. These can dispense various other plants to grow in combination with or in rows beside the breeding plants. The operator determines the mixture and pattern by what seeds go in which containers and by setting the seeding rate.

Wheat, sorghum, triticale, sunflower, Illinois bundleflower and other plants' seeds work in the planter. Hege Equipment in Colwich, Kansas, custom-made the planter for us. Hege is a leading provider of such equipment to agricultural experimenters around the country. At about 70 miles away, we happen to be nearer the company than any other customer.



The results of the planter in early March.

The Hege plot drill cost \$25,000, the most expensive piece of farm machinery at The Land Institute.

It is not just worth it, but a necessity. A slow ride behind a tractor on a long row—or, rather, lots of short ones—is needed to solve the problem of agriculture.

Plant Breeding

Last fall we used our new plot planter to establish a field study of intermediate wheatgrass mixed with various legumes. We want to identify legumes that can be readily intercropped with intermediate wheatgrass, or perennial wheat derived from crosses between wheat and wheatgrass. The best species for intercropping will be used to suppress weeds and fix nitrogen in future perennial wheat breeding plots. Some of the legumes we are evaluating are purple prairie clover, birdsfoot trefoil, cicer milkvetch, Illinois bundleflower, prostrate alfalfa, common alfalfa, sainfoin and white clover.

In late winter, activity in the greenhouse was at a high. Three bays are now fully operational with heating and kept plants alive through nights near zero.

We added automatic drip irrigation in the greenhouse to save water and enable work on other matters.

The perennial sorghum project moved inside for the winter. We have hundreds of plants that are beginning to set seed. The plants and the seeds will be used for breeding plots in summer.

Annual and perennial sunflowers also are growing in the greenhouse. They will be crossed again in hopes of creating more hybrid perennials.

More than a thousand first-generation hybrids between wheat and its wild perennial relatives are growing in the greenhouse. Because these first-generation plants are male-sterile, we are pollinating them with wheat and perennial intermediate wheatgrass. We have been rewarded with several hundred seeds derived from this process of backcrossing, and expect hundreds more by spring. Many of these precious backcross seeds have been planted, so our breeding program will be well into the next generation come the new season. With more backcrossing and selection we will restore the fertility required for grain production.

Wheat can be crossed with a wide array of perennial grasses. We want to play the field with that variety's potential. Last year we focused on crossing wheat with the wheatgrasses of the genus *Thinopyrum*. Those crosses were relatively easy. This year, we are trying to achieve more difficult crosses between Kansas winter wheat varieties and wild plants such as mammoth wild rye (*Leymus racemosus*), with the desirable trait of a large seed head, and quack grass (*Elytrigia repens*), a strong producer of rhizomes, by which a perennial can spread beneath the soil surface.

NSA Graduate Research Fellowships

We received 37 applications for our Graduate Research Fellowship Program. The applicants this year were outstanding, so we are at the difficult work of deciding which to accept for 2003.

New Faces

Board of Directors

We welcome two new board members, Dan Glickman and Jan Flora.

Glickman, former U.S. secretary of agriculture (1995-2001), is director of the Institute of Politics at the John F. Kennedy School of Government at Harvard University. Glickman represented Kansas' 4th Congressional District in Congress for 18 years. He was a member of the House Agriculture Committee, including six years as chairman of the subcommittee dealing with federal farm policy issues.

Flora is a sociology professor at Iowa State University and a faculty member in the graduate program in sustainable agriculture. His work involves Latino immigrants in rural Iowa. He is studying the relationship of community and sustainable development in the United States and Latin America. He was program officer for agriculture and rural development in South America for the Ford Foundation.

Advisory Council

Richard Lamm, the longest-serving governor in Colorado's history (1975-87), joined our Advisory Council. Lamm is Director of the Center for Public Policy and Contemporary Issues at the University of Denver. He has been in the forefront of political change and was an early leader in the environmental movement.

On-Site Help

Two young women helped our scientists with plant breeding work in the greenhouse this winter: Rachel Chapman, who studies at Bethany College in Lindsborg, Kansas, and Ingrid Britt Hogle, who recently earned a master's degree in ecology from the University of California at Davis.

Prairie Writers Circle

We were sorry to say goodbye to Prairie Writers Circle co-director George Pyle in October. Pyle, who came to us after serving as a columnist for the *Salina Journal*, could not resist a job writing editorials for the *Salt Lake Tribune*. The Prairie Writers Circle continues under the leadership of Harris Rayl.

It continues to release an op-ed essay about once a week. Monthly circulation has reached as high as 2.5 million, according to our news clip service.

The March-April *Orion* magazine published Wendell Berry's essay on the National Security Strategy and war with Iraq. A shortened version appeared as a full-page ad in the *New York Times*, and an abridgement of that was distributed as a Prairie Writers Circle op-ed piece. That and the midlength version are on our web site, www.landinstitute.org. The site carries all Prairie Writers Circle essays.

Public Notices

Presentations

Staff members traveled to the University of Guelph, the Chicago Openlands Project annual luncheon, Dordt College, the University of Northern Iowa, Luther College, the New Mexico Farming and Garden Expo, St. Bonaventure University, the University of Florida and a local class of third-graders.

Publication

Plant breeder Lee DeHaan's doctorate research on the genetic diversity of Illinois bundleflower appeared in the January/February issue of *Crop Science*. This productive legume fixes nitrogen in prairie and pasture, and is a promising perennial grain crop. DeHaan's findings are on our web site, www.landinstitute.org.

The Bible and Our Topsoil

Ellen F. Davis

In what could accurately be termed a disaster of biblical style and proportion, industrial agriculture in this country is taking away soil faster than it is producing food.

We lose 2.5 tons of topsoil for every ton of grain or hay harvested, according to the U.S. Department of Agriculture. I say this is a disaster of biblical style because the Bible shows that from the beginning of human history, poor choices about eating have damaged the fundamental link between humankind and fertile soil.

The first human story shows both the linkage and the damage. God uses fertile soil—in Hebrew, “adamah”—to form the human creature, and even to come up with an appropriate name: adam, with a lower case “a” because the word designates not just one individual but the whole species. But when the first couple decide to eat against the rules that God has established, they get kicked out of the garden, and the soil turns against them. The once pleasant work of producing food becomes a bitter struggle against thorns and briars. The first 11 chapters of Genesis, that quick and dirty history of early humankind, is in fact the story of adam’s progressive alienation from God and fertile soil.

In the next generation, the farmer Cain makes the soil drink the blood of his brother the herdsman. This is a short reflection on human cultural history. The Bible doesn’t shy away from the recognition that the practice of agriculture, which began in the Middle East, had from the beginning a potential for violence. Cain himself wanders away from the land, and tellingly, his offspring become the founders of cities—another Middle Eastern invention.

The story of the tower of Babel mocks the great urban culture of Babylon rising out of the Tigris and Euphrates flood plains, plains that were disastrously overirrigated even in ancient times. So the centers of Mesopotamian civilization moved steadily farther north through the centuries, to escape the creeping salinization that destroyed the soil near the old capitals on the Persian Gulf. The Israelite story makes fun of a people so deluded that they take their eyes off the ground and build a tower “with its head in the heavens.” “The heavens are the Lord’s heavens, but the earth he gave to human beings,” says Psalm 115:16. Forgetting their own proper domain, the Babel-onians laid it waste.

Against this background, God’s assurance to Abraham acquires fresh urgency. Genesis 12:3: “In you



all the families of the fertile soil shall be blessed.” Abraham represents those around the world who understand that God’s blessing is ineluctably connected with topsoil; it is the indispensable medium for communication of God’s goodness to all the peoples of the world.

When you think about it, this is a striking account of the world’s history, one that could be produced only by a people like the ancient Israelites, an agrarian people who occupied an ecological niche they knew to be precarious. Israel-Palestine is semiarid, habitable over the long term only when water is harvested and used sparingly. The highlands around Jerusalem are steep, and a growing population quickly deforested them. Erosion and desertification were the enemies against which the Israelite farmer fought steadily. It is no wonder that the Bible’s writers, blessed with that fragile land, cite the condition of the soil as the best index of the health—or the erosion—of the relationship between Israel and its God.

All this is to say that the Bible could never have been written in America. Having a large margin for error, we have always had trouble seeing fertile soil as a blessing whose continuance depends on our observing and accepting the way God set things up, observing what we call “nature.” Abundantly fertile soil seems to us a birthright, and we have treated it the same way Esau treated his. Heedless of the future, we have sold it for what meets our immediate hunger: cheap food.

We could never have written the Bible, yet a lot of us read or hear or even quote it with regularity. What if we started listening for what it says about our relationship to the earth’s topsoil? We would quickly discover that almost every page of the Old Testament sheds light on that relationship, and that Jesus’ agrarian parables are something more than local color. Who knows? Maybe today’s sad statistics on soil loss would become a religious issue.

With the Prairie Writers Circle, The Land Institute invites, edits and distributes essays to newspapers. We appreciate receiving clippings of published pieces, or e-mail about them. Our address is theland@landinstitute.org. For all essays as they are released, see our web site, www.landinstitute.org

The Farmer as Conservationist

Catherine Badgley

The industrial system of food production, through its damaging effects on local and regional ecosystems, has pitted modern farming against the conservation of native biodiversity. Indeed, the potential conflict between food production and biodiversity preservation is acute, since agricultural areas, from tropical forests to northern prairies, are home to most of the world's biodiversity. But outside the industrial mindset, there is fertile ground for the farmer as conservationist.

Aldo Leopold considered these issues seventy years ago, as exemplified by his essay, *The Farmer as a Conservationist*, written in 1939. Leopold's ideas are a rich source of inspiration today. I find it ironic as well as hopeful that Leopold, who understood well the importance of "working landscapes," became the patron saint of wilderness conservationists, who wish to preserve more non-working landscapes as parks and reserves. Today it is more important than ever to reconcile the goals and visions of agriculture and conservation.

I offer five ecological reasons that it is so important for farmers to be conservationists and for conservationists to be deeply concerned about farming.

First, agriculture involves fundamental ecological processes: energy flow, nutrient cycling, pollination, seed dispersal, climate moderation and flood control. These processes are among the "ecological services" of healthy ecosystems. Industrial agriculture has developed substitutes for some of these services, including synthetic fertilizers and biocides. These shortcuts often disrupt both local and distant ecosystems—locally, as in the high rate of soil erosion on most farmland, and distantly, as in the Gulf of Mexico's dead zone. Ecological services depend on many species interacting with each other, with inorganic nutrient sources, with water, and with the atmosphere. Farmers benefit from, indeed, depend upon, the ecological services mediated by diverse organisms, from soil fungi to mammal and bird predators.

Second, agroecosystems with multiple species, thereby more similar to natural ecosystems, tend to sponsor more of their own fertility and have fewer biological disruptions than do monocultures. Well-chosen mixtures of agricultural species often use moisture and soil nutrients more efficiently than single species do. Polycultures may yield more biomass than do the same species grown in monoculture, and reduce weeds and diseases. In addition, polycultures may promote various biological-control strategies. For example, one plant species may host the beneficial insect predators for another plant's pests. Biological diversity should allow

farmers to be more reliant on their ecological knowledge and less reliant on synthetic inputs.

For conservationists, the rationale is equally great. First, the sheer amount of land involved in farming and grazing is so great that the fate of many species and ecosystems depends on farming practices. Leopold wrote, "It is the individual farmer who must weave the greater part of the rug on which America stands." In the United States, 65 percent of the area in the lower 48 states is agricultural land, including private farmlands, private pasture and rangeland, and public lands where grazing is allowed. Globally, 54 percent of ecologically productive land (37 percent of the total land area) is farmed or grazed. In contrast, protected areas occupy just 6.4 percent of the world's land area. The quality and management of land between protected areas are critical to the well-being of the biodiversity within them.

Reserves themselves cannot safeguard all of a region's biodiversity. They are too small and too isolated from other reserves. Fragmented, patchy habitats lose species over time because small populations are vulnerable to extinction by random events. Isolated habitats often cannot be naturally recolonized by extirpated species. The intervening habitat may harbor viable populations of species found in the reserve. Or it may be so inhospitable as to form an ecological moat around isolated reserves. Agricultural lands and processes are fundamental to conservation, because they determine whether native species can persist over large areas. Yet many in both agriculture and conservation treat the vast farmlands, from the Midwest corn belt to tropical banana plantations, as "ecological sacrifice areas" forfeited to industrial production and off limits to conservation.

Finally, agriculture is the major threat to most endangered and threatened species and ecosystems. The Nature Conservancy cites habitat degradation as the leading cause of imperilment or federal listing of animal and plant species in the United States. Habitat degradation affects 85 percent of such species, and agriculture is the main part of habitat degradation. Introduction of alien species, pollution, overkill and disease are the other major threats to biodiversity, and some of these result from agriculture.

Farmers and conservationists have widely unappreciated, vested interests in each other's practices. They also have a common enemy: the abuses of land and local economies by industrial agriculture. As Aldo Leopold, Wendell Berry and now the contributors to *Fatal*

Harvest have argued in response to these abuses, restoring working lands and safeguarding biodiversity are intertwined goals.

Every decision that farmers make about land use, plants, and animals has repercussions for conservation. The crop and livestock varieties, the rotation schedule, the tillage method, the weed and fertility management, the plowing pattern and the amount of native habitat interspersed among fields and pastures determine the capacity of the land to provide ecological services and maintain native biodiversity. Many decisions on the farm affect distant regions of the continent, especially for river ecosystems and migratory species. Leopold wrote, "Conservation implies self-expression in [the agricultural] landscape rather than blind compliance with economic dogma." Following are three examples of farming that exemplify this statement.

Rotational grazing

In 1988, the Land Stewardship Project and the Sustainable Farming Association of Minnesota began a farmer-to-farmer information exchange, as described by J. F. Nerbonne and R. Lentz in a forthcoming article in the journal *Agriculture and Human Values*. Six farmers embarked on a change to rotational grazing, letting their cattle graze only a small portion of the total pasture at one time, and moving the herd to a different place every few days. When restricted, the livestock eat more of all the plant types. Weedy plants do not proliferate and there are long times for regrowth. Working with scientists at the University of Minnesota, Iowa State University and the Minnesota Department of Natural Resource, these farmers also developed a program to monitor the effects of rotational grazing on their pastures and streams. They gathered data over three summers.

As B. DeVore relates in *The Farm as Natural Habitat*, Ralph Lentz fenced off a section of his stream from grazing 30 years ago. That area is now heavily forested. There, the stream is wide and shallow, with eroded banks and a mucky bottom. The forest has shaded out the ground layer of vegetation so that it no longer holds the soil. Where cattle grazed the streamside for a few days at a time in rotation, the bank slopes gently and is fully vegetated, and the stream runs deep and clear with a fine gravel bottom. In that stretch live aquatic insects that are sensitive to stream pollution and diverse fishes, including trout, that require premium stream habitat.

The teams of farmers and scientists documented the effects of rotational grazing, compared with conventional grazing, on pastures, soils, streams, and local plant and animal diversity. This collaboration resulted in several published reports and numerous presentations. It also changed the participants' views of each other and

themselves. In a survey reported by Nerbonne and Lentz, one farmer wrote, "I literally bet my livelihood on (switching to rotational grazing). Forming this team gave me the confidence to go forward." Another wrote, "Being part of this (team) broadened my perspective on whole systems and reinforced my beliefs about what I observed. I was trained (at the university) to believe that streams and cattle were incompatible, but this project absolutely gave me the confidence that what I was doing might have some truth in it."

Also, the farmers became more interested observers of their land. One said, "I used to always take my four-wheeler out to shut the gate. Now I walk out because there's so many things I'm afraid I'll miss."

The scientists changed their views, and some their research. One said that he "came into the project thinking that he would help farmers see what was out there by building baseline information." Instead, he learned from farmers that "the whole was more than its parts and that we must build on the farmers' strong instincts for the land." Another said, "The team really changed the direction of research that I do. I used to study fish; now I have an ecosystem restoration focus."

The change to rotational grazing improved the ecosystems on the farms and benefited the standing of the farmers among themselves and the scientists. Also, the farmers received premium prices for their grass-fed beef.

Predator-friendly ranching

"Predator-friendly" ranching involves warding off native predators without killing them. This approach departs substantially from the typical rancher's attitude toward predators: get rid of them by any means possible. Historically, farming in the East and ranching in the West have been the major force behind predator-control programs, which have eliminated many mammalian and bird predators from their original ranges. Ranchers are also the major opponents of reintroducing large native predators, such as the wolf and the grizzly bear.

But some ecologically minded ranchers have taken a fresh approach. They keep their livestock safe by their own vigilance and with guard animals, including llamas, burros and dogs. Certification lets these ranchers sell meat, wool and wool garments as Predator-Friendly.

At Thirteen Mile Ranch, in Belgrade, Montana, sheep and cattle are raised organically and llamas protect the herds from coyotes, wolves, bears and mountain lions. (See www.lambandwool.com). Becky Weed, a Thirteen Mile rancher, argues that such methods are more effective, less expensive and more ecologically appropriate than shooting or poisoning local predators.

This system has several benefits. Ranchers receive premium prices and have the satisfaction of practicing and leading a conservation-oriented agriculture.

Ecosystems enjoy the persistence of wide-ranging predators that control populations of prey species and smaller predators. Consequently, forest and rangeland are less severely grazed by wild herbivores, and native bird and small-mammal populations are higher because the populations of “mesopredators,” such as foxes and raccoons, are lower. Conservationists gain the persistence or revival of species long on endangered-species lists and the restoration of ecosystem processes severely diminished over the past 200 years.

Shade-grown coffee

In Central America, Colombia and Brazil, coffee farming has great potential to harbor or reduce native biodiversity, as documented by Ivette Perfecto and Inge Ambrecht, a Land Institute graduate fellow, in the new book *Tropical Agroecosystems*. This region grows about one-third of the world’s coffee. Mexico, Colombia and Brazil are recognized as megadiverse by Conservation

International, and coffee is an important crop in all three countries. Much of the coffee is grown at montane middle elevations, where high levels of biodiversity and deforestation both occur.

Coffee farming ranges from rustic coffee, in which shrubs are planted in the understory of native forest, to sun coffee, in which monocultures are grown with synthetic fertilizers and pesticides in fields stripped of the original vegetation. An intermediate method, shaded coffee, in which shrubs grow under a planted forest canopy, often looks and behaves ecologically like a native forest. In parts of northern Latin America, shaded coffee farms provide most of the remaining forest habitat. For example, El Salvador has lost more than 90 percent of its original forests, and 80 percent of its remaining forests are shaded coffee farms.

Perfecto and Ambrecht report that more kinds of resident and migratory birds, bats, ground mammals and



arthropods live in shaded coffee plantations than in other agricultural habitats, often at levels similar to those in undisturbed forests. In contrast, most animal groups studied so far decrease in species number and are more uniformly distributed in sun-coffee monocultures. The higher levels of native biodiversity in shaded coffee farms support the control of insect pests on coffee plants by birds and other insects. Insectivorous birds remove more herbivorous insects, including those that feed on coffee plants, in shaded coffee than in sun-coffee plantations. In Colombia, leaf-litter ants prey more heavily on the coffee berry borer in shaded coffee settings than in sun-coffee farms.

Also important is the role of these farms in connecting scattered forest reserves. The quality of the land surrounding fragments of tropical forest affects migration and persistence of native species. The maintenance of rustic- and shaded coffee farms is quite important for

conservation, as economic pressures push more farmers toward sun-coffee production.

The tradeoff is that yields are lower in shaded coffee farms than in sun-coffee monocultures. Shaded coffee farmers need a price premium in order to remain economically viable. Recently, some conservation organizations, including the Smithsonian Institution's Migratory Bird Center and the Rainforest Alliance, have begun certifying shade-grown coffee. To gain wider acceptance among farmers, such programs need to respond to growers' economic concerns, which are acute now because global overproduction has sent wholesale prices to a 30-year low and forced many small coffee farmers out of business.

With fair compensation, shaded coffee and rustic coffee farms sustain farm families not only economically, but also with shade, fruit, wood and the ecological services of a moderately to fully intact forest. For con-

William Campbell. Cyrus the llama guards sheep from native predators, mainly coyotes, at Thirteen Mile Ranch in Montana.



servationists, the benefits are a high-quality landscape with high levels of native biodiversity. In fact, shaded coffee farms are critical for international plans to establish a Mesoamerican corridor for protection of the jaguar and other vulnerable species.

In each of these examples, the farmers raise non-native species in sufficient amounts to support a decent living, and adopt local species or ecological processes for their needs. The farmers receive a price premium through certification. The results work for the farmer, the ecosystem, the landscape, the consumer, and the conservationist. These examples illustrate what Richard Levins describes as “less capital-intensive and more thought-intensive” farming.

A vision of ecologically sustainable agriculture

Ecologically minded farmers and their supporters are often criticized as romantics wanting to re-create Victorian, medieval or even hunting-and-gathering times. This reaction is ridiculous. Ecologically minded farmers are crafting a future that contributes to the well-being of society and the environment, in contrast with the genetic engineers, who are benefiting mainly agribusiness. Following, I present elements of my vision of farms, land and society in which the dominant agriculture is ecological and economical.

At the scale of the farm, planning is guided by knowledge about local biological diversity and ecosystems. Farms feature diverse plants and animals raised to reflect the structure and processes of the native ecosystem. The quality of life of all species is respected. Fields are polycultures, including tree crops where appropriate. Livestock range over abundant, healthy pasture instead of standing in confinement.

Agricultural technologies take the form of breeds well suited to local ecosystems, pest management by ecological interactions as well as sprays or powders, and suitably sized planting and harvesting equipment. New methods are evaluated not only for their immediate utility, but for their local and distant ecological effects.

Farmers are trained not only in farming but also in ecology and natural history. Farmers acquire detailed knowledge of their fields and pastures by walking and working them rather than by using precision-agriculture machines. Farmers preserve areas of native habitat, such as wetlands, woods, streams and native grassland, and are rewarded for their preservation and knowledge of these areas. Farms are known both for their products and their distinctive natural features, such as particular wetland orchids, several species of frogs calling or a high number of butterfly species. Farmers lead field trips to experience these native features for students and interest groups.

Such a system would be viable only if farmers receive a fair price for their products and if their com-

munities value farmland and natural habitats enough to safeguard them from urban development. This system would attract young people to farming.

At a larger scale, farms and ranches lie in a landscape retaining substantial areas of native ecosystem. A land shared by natural systems agriculture and native ecosystems should harbor high levels of native biodiversity. Farmers have economic and aesthetic incentives to sustain their working lands. Since farmers are knowledgeable about local biodiversity, they help in the development of habitat-conservation plans. Farmers and ranchers help to restore extirpated native predators. More species are taken off than are added to state and federal lists of endangered and threatened species. Rural areas increase in popularity as destinations for vacations and ecotourism, adding to the economic growth of rural communities.

At the scale of society, farmers and consumers interact through farmers markets, community-supported agriculture, urban gardens, and food stores and restaurants that feature locally grown food. Farmers are regularly elected as heads of conservation organizations, because of their knowledge of healthy local ecosystems and working lands. Governmental and non-governmental organizations foster programs for farmers to travel to other regions to see the distant effects of their farming practices. Consumers rely heavily on locally grown food. The economy values food at its worth, not at prices driven well below its value.

This vision is ambitious in scope and incomplete in many elements. But each idea is based on examples in progress already in the United States and elsewhere. All involved—farmers, conservationists, the public and biodiversity—would benefit from the alliances of knowledge, goals and political power.

On a personal note, I grew up as a conservationist first and only in the past 12 years have also become a farmer. Although I do not gain my income from farming, I have experienced the issues that preoccupy farmers and conservationists from both sides. It is a false dichotomy that farmers and conservationists have opposing interests. Farmers can benefit from conservationists as advocates for farming practices that raise the quality of the land for farmers and biodiversity. Conservationists can benefit from farmers who enhance the ecological value of working landscapes for more native species. The rest of us need to support both groups in our purchases and our political activism. This vision requires a revolution in agriculture and society, one that is already under way all over the world.

Adapted from a presentation at The Land Institute's Prairie Festival 2002.

Lives of Two Pioneers

Daniel B. Luten

Daniel B. Luten, who raised red flags about environmental issues long before they became topics of public discussion, died Jan. 18 in Berkeley, California, following an earlier stroke. He was 94.

Luten joined the University of California geography department in 1962 after 26 years as a chemist for Shell Development Co.

“When I was in his class in the 1970s, he was already talking about the connection between fossil fuels and national security,” said David Larson, now dean of the College of Arts, Letters and Social Sciences at California State University at Hayward. “He was 30 years ahead of his time in calling attention to such matters as global warming, California’s overuse of the Colorado River water, the invasion of national parks by snowmobiles and other off-road vehicles, the irreversible loss of plant and animal species, and especially the threat of continued population growth, which he saw as the root of all environmental problems.”



David Hooson, a retired UC Berkeley professor of geography, said Luten was an entertaining lecturer, who, in the days before computers, always kept his slide rule up his sleeve for spur-of-the-moment calculations.

“Give him a couple of numbers to start with and he’d be able in 15 seconds to estimate the number of piranhas in the Amazon basin and their rate of reproduction,” said Theodore Oberlander, another colleague.

Luten’s concern with population growth took hold when he served in the civil administration of occupied Japan. He helped prepare a 1950 report demonstrating that Japan’s growing population was too much for its limited natural resources. The report set off a firestorm of controversy. Within eight years the birth rate had fallen 50 percent, an unprecedented voluntary decline.

In his 1986 book, *Progress Against Growth*, Luten warned about the potentially catastrophic consequences of global overpopulation: “We, all of us, must know one thing. The growth in numbers, so familiar to us, cannot continue; some day it must cease—it will cease either by a decrease in birth rates or an increase in death rates.”

Luten was also an environmental activist who served the Sierra Club. David Brower, the club’s former executive director, called Luten his “coach on population.” Luten later served as president of Friends of the Earth.

Robert Swann

Robert Swann, 84, a peace activist who believed that war could be avoided by strengthening rural communities with land trusts and alternative monetary systems, died of lung cancer Jan. 13 in his home in South Egremont, Massachusetts.

He was raised in Cleveland Heights, Ohio. His sense of community was heightened by growing up on a street where block parties were common and movies were sometimes screened as part of the festivities.

Under Lutheran minister Joseph Sitler’s tutelage, young Swann read such German philosophers as Hegel, Nietzsche and Spengler, as well as novels by Dostoyevsky and Tolstoy.

Swann attended Ohio University, paying his way by working in restaurants for meals and selling mops door-to-door.

During World War II, he spent two years in prison for not only opposing the war, but the draft. He went to solitary confinement for refusing to participate in prison segregationist policy. He eventually joined in a study group with other conscientious objectors.

“Prison was his monastery and his university,” said his companion, Susan Witt. “He went in a young man and he came out educated about what he felt were solutions to the problems of war: building strong local economies, land reform, local currency—and those are the causes to which he devoted the rest of his life.”

Swann co-wrote *Building Sustainable Communities*, and contributed essays to *Rooted in the Land and Action and Knowledge: Breaking the Monopoly with Participatory Action-Research*.

He founded the E. F. Schumacher Society, a group advocating the theories of the economist who wrote *Small is Beautiful: Economics As If People Mattered*.

Swann was instrumental forming many community land trusts and helped develop alternative money sources, such as Deli Dollars, issued by a delicatessen owner. Each “dollar” was worth \$8 and could be redeemed for \$10 if the holder waited six months to redeem it, in effect allowing the owner a six-month loan.

“He was shy and didn’t enjoy being the center of attention,” Witt said, “but he had a passion for ideas and an eagerness to discuss them that drew people to his world.”

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The Importance of Being Nowhere

Charles Bowden

The day felt like rain and smelled like rain. The sky held the soft gray of a winter storm, the kind of weather Mexicans describe as *equipatas*, equal steps, to capture that idle way the rain on a December day can slowly drizzle across the land. It was 1957, and I was your basic 12-year-old, out of the Southside of Chicago, riding in the back seat of a '55 Chevy down the Ruby Road, that section where you climb across the flank of the Atacosas and then slide along a ridge above Bear Valley near Montana Peak. I looked out at a landscape of dry grass and green oaks, the trees evenly spaced like in a model railroad layout, and was struck dumb by the ground, that moment they now call imprinting, where some things make an impression that can neither be explained nor removed. I remember imagining living down there, a sane thought for a kid who'd spent most of his life in an apartment. And that was it, no bolt of lightning from the heavens, no roll of celestial drums, no voice thundering a revelation.

Since then, I have, like most of my fellow citizens, wandered far afield and squandered generous blocks of my life, but always that day and that stretch of road and that landscape came back to me, riding the El in a Chicago rush hour, commuting to work in the Bay Area or doing dim toil on the East Coast. I can still feel the light, taste the air and smell the soil of that day. The rocks brood under the gray clouds and the trees, the scrubby oaks dotting hills, the trees glow with an eerie green.

Luckily, I seem to have imprinted with a patch of earth almost beneath notice. Along the border from the Huachucas to the Altar Valley is a swatch of oak woodland that is tucked away in the national forest and forgotten, a place without coffee-table book vistas and major landmarks. This has been my sanctuary from a world that demands the special effects of the red rocks of Sedona or the monotonous pines of the Mogollon Rim or the fleshpots and villas of Carefree, Paradise Valley and Scottsdale. This oak grassland lacks the pizzazz for American mansion builders or campers. It is, God be praised, too nondescript for the global scenery consumers.

I keep coming back to it, and each time I kind of worry that it will have been sacked by golf course junkies, destination resort vandals and other chamber-of-commerce vermin. And so far I've always been wrong. In part, I think what has spared it is the lack of water. Water is a kind of lethal toxin in Arizona that always manifests itself in tumorlike eruptions of golf courses and country clubs. The other thing that has

spared this swatch of ground is Mexico, always nearby, and on a calm night you can hear the gnashing of teeth as a nation of poverty brushes against the American fences. And finally, what has saved this place are the inhabitants, a varied lot who seem genetically favored with some kind of deep immunity to the blandishments of the Republic's malls and economists. For 40 years this tract has been the playing field of my fantasy life, the place where there is space, silence and hills no one has yet broken to a name. And within its core, say from the Atacosas to Arivaca to Amado, is a kind of Bermuda Triangle, where all development plans seem to vanish without a trace. Naturally, this history has made outsiders look at this ground as a place of failure. I remember once seeing a newspaper clip from the late 1940s, in which some leading Tucsonians said they were ready to develop Arivaca and make it the next Santa Fe, a vicious threat that would stop anyone's heart.

I like the light, the white light bouncing off the burned grass in June, the soft light touching the face in December. And I like the big events that never make the papers. I remember once in October watching fifty or a hundred ravens roosting on Oro Blanco wash, a kind of biker gang of 2-year-olds having a fling before they mated and bonded for life, and it was a dark and noisy run that went on for weeks. I've killed a lot of time in this border forest, finished up a book on Charlie Keating at Jim Chilton's ranch, wrote another book or two at Chris Clarke's ranch. One evening I watched a deer twirl and make its bed and then go to sleep. Another evening I drank until 2 a.m., listening to Miles Davis. There was a morning when I saw ravens chase an eagle away. Another time a great blue heron and a redtail had a knock-down-drag-out at the pond. By June the well pretty much went dry, with late July came the rains, and by the end of November the last hummingbird had fled and did not return until February, when the Arizona holly bloomed. The snow came in the night but left by noon. When it got real dry, a rattlesnake moved onto the porch, but it left with the rains. I saw a red bolt of lightning split an oak and savored the smell lingering in the air. Once, two DEA agents asked me what I was doing and I said watching birds. Usually in the morning, someone standing next to a government vehicle would be staring at me with binoculars. I took a long walk in the hills New Year's Day.

I once had a friend go to Nigeria, and he saw a message painted on the back of a bus: NO EVENT NO HISTORY. That sounds about fine to me. It's not that nothing happens, it is that what happens is not news. If



you walk up Cedar Canyon from Arivaca Lake, you'll find huge cedar stumps, stumps that announce trees the likes of which are now nowhere to be seen. And you realize that there is a ghost forest out there that will not come back from the dead for another century. If you look at early photographs of Ruby, the hills are all but empty of oak, the trees having vanished into the lusty appetite of the mine. So things do happen, if you watch for them.

The places worth clinging to are the places nobody quite knows what to do with. That's where the life is. That's why we should feel lucky. What we want and what we need seems to have the power to last. We can count on it, even if most other people can't even notice that it exists. God, in his infinite wisdom, has created place like Sedona and Santa Fe as sacrifice areas. Out here in nowhere, we are lucky. Nothing happens. Progress seems nil. We have a future.

Reprinted from the Arivaca Connection.

Robert Dawson. Uranium Drive In, Naturita, Colorado.

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S1	<i>Natural Systems Agriculture Round Robin</i>	Stan Cox, Moderator; Marty Bender, Lee DeHaan and Jerry Glover
S2	<i>Pharmaceutical Plants and the Threat They Represent</i>	Margaret Mellon
S3	<i>Getting Over Pesticides: What Does It Really Take?</i>	Monica Moore
S4	<i>Future Harvests: Fatal or Otherwise?</i>	Wes Jackson
Sunday, September 22		
SU1	<i>Join the Home Team</i>	Kamyar Enshayan
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Robert Dawson. Scientists discuss the demise and restoration of salmon near the Sacramento River in California.

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