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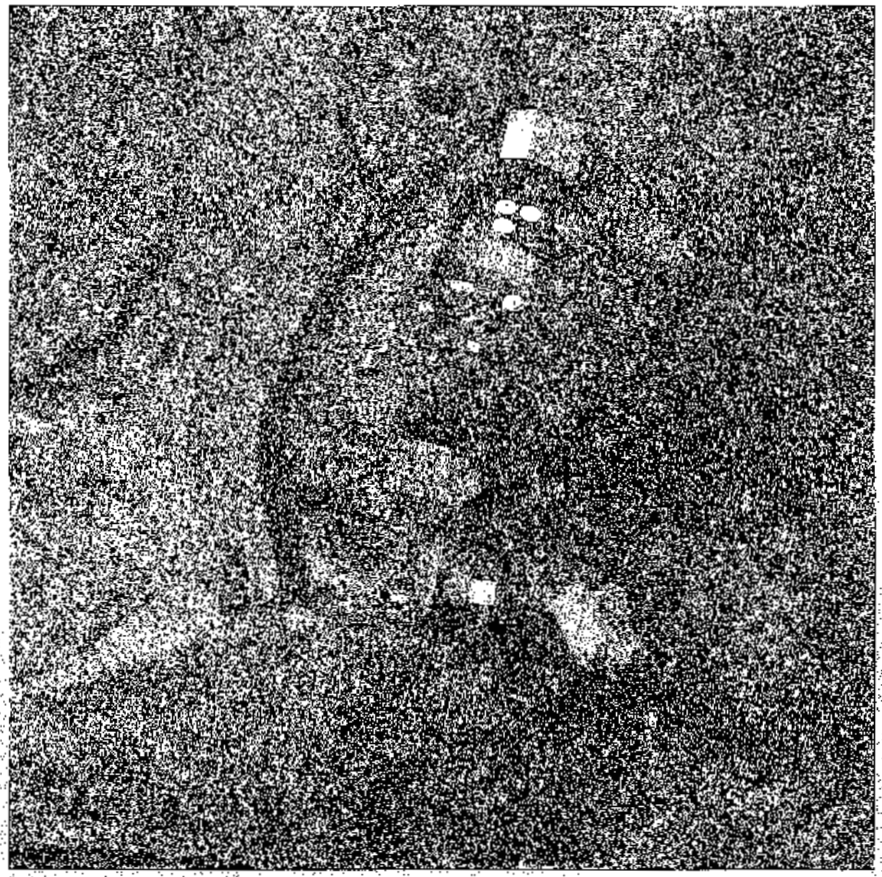

The Land Report: 20 Years

A publication of The Land Institute *Number 55/56 Summer 1996*

20 Years

Prairie Festival 1996

At The Land

Land Institute Research Report

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. To become a Friend of the Land and support the work of The Land Institute, please turn to page 79.

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Introduction

Brian Donahue

Here is the "Summer" 1996 *Land Report.* We discovered we needed an 80 page double issue and a few extra months to do justice to twenty years of Land Institute history and 54 previous *Land Reports.* Excerpts have been taken from more than 50 articles.

In putting this history together we have followed five interwoven themes. First is the tradition from which the Land Institute sprang; our mentors such as E.F. Schumacher, Paul Sears, Hans Jenny and Aldo Leopold. Another is our place in the national community of environmental thinkers, activists and organizations that grew up in the 1970s including Amory and Hunter Lovins of the Rocky Mountain Institute, John and Nancy Jack Todd of the New Alchemy Institute, Donald Worster and Wendell Berry to name a few. A third is the connection of The Land Institute to related efforts within Kansas. A fourth is the immeasurably important firing of the minds and spirits of nearly 200 interns and research associates. We do not claim credit for their accomplishments, but we are proud of what they do.

The central theme, of course, is the development of thinking and research at The Land Institute itself. Here you will notice continuity of ideas along with change and elaboration. Over the first ten years of the organization the focus tightened on what we now call "natural systems agriculture," and alternative shelter, energy and community concerns moved to the periphery. This was symbolized by prairie roots replacing the wind machine on our logo in 1986. But, these early concerns have reappeared in the Sunshine Farm and Matfield Green projects.

I want to extend special thanks to Dana Jackson for her suggestions of articles to reprint, many of which I took. Of course the final choices were mine and she cannot be held responsible for my slant on the Land's story. She *can* be held responsible for the consistently high quality of the material I had to work with. These articles were well-written and tightly edited to begin with. It was a real pleasure reading through all the issues that Dana (as well as Jake Vail and Laura Sayre) put together. In more ways than one it is her work that is reflected here, too.

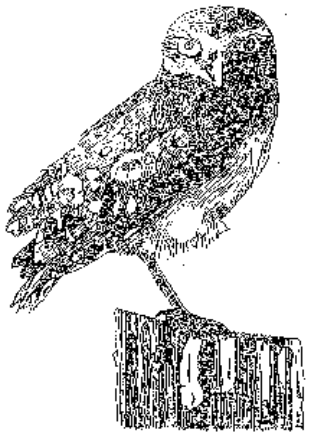
I apologize to both the readers and especially the writers of these fine essays for cutting them so ruthlessly. They were all much better in their original form. I had to do it to include the widest possible range of voices and ideas. Only Wes' "Living Nets" and Dana's "Lost in the Garden," along with one or two shorter pieces survived intact. In most cases I was able to contact the authors for their acquiescence. Where I failed to do so, I hope I have given no offense. After consulting with several of the writers I decided not to use the grating ... symbol except in a few cases.

Finally, I apologize to the many deserving interns and staff who have not been pictured or mentioned by name, and to the photographers whose work has been reprinted without attribution. Where I could identify the photographers I have credited them. I assume many of the uncredited pictures were taken by Dana. Of course Terry Evans' work is found throughout, and her photos grace both covers, as is only fitting.

Mind-Mulch in the Fall Session

Jake Vail

Number 39, Fall 1990



Jake Vail—Intern, Research Fellow, Acting Education Director and Land Report Editor, Illustrator, 1989-1992

"Is it always so windy here?" first-time visitors to The Land Institute often ask. Over the gusts we shout, "Yes!" Kansas, from the aboriginal "konza," in fact means "spirit of the south wind," and throughout the summer winds blow from the south. As the seasons change so too do the winds, and winter winds come from the north. This fall the changing winds assembled colorful visitors at The Land Institute like autumn leaves collecting in a garden bucket.

Each told a different story, which mixed unpredictably with class discussions. Add to the visitors and discussions a sprinkle of extra-curricular activities and the pile of leaves is transformed to compost, mind-mulch out of which amazing new ideas and actions grow.

Wes started fall classes with his vision of integrating ecology and economics. Reading from Herman Daly and John Cobb's important new book, *For the Common Good,* essays of historian Donald Worster, and some of his own speeches, Wes argued against the growth economy associated with industrialism and for an economic system that recognizes biological and physical limits and works creatively within them.

1990 intern Kathy Collmer

Ecologist Jack Ewel visited from the University of Florida and presented a slide show of his work, which like our research uses nature as a model. ...He has found that agricultural systems which resemble an area's natural ecosystem (in this case a tropical forest) can produce high yields while cycling nutrients and resisting outbreaks of pests and diseases as the natural system does.

Plant breeder Peter Kulakow led class discussions of William Ophuls from his book *Ecology and the Politics of Scarcity.* [The thesis is] simple: we must pay attention to the consequences of our extractive economy. In the book *Economics, Ecology, Ethics,* Herman Daly declares: "Growth chestnuts have to be placed on the unyielding anvil of biophysical realities and then crushed with the hammer of moral argument."

And if the nuts of growth-mania aren't crushed? Adam Smith's invisible hand broadcasts pollution, acid rain, ozone depletion, global warming, loss of biological diversity, fostering megalopolises.... It takes a nimble mind to bounce over the bad news and get to some concrete proposals for positive action: enter David Orr. ...[A]s part of Kansas State University's Lou Douglas Lecture Series, ...he posited that re-ruralization is inevitable, and presented suggestions to help make the transition a smooth one. A "discourse on methods" followed at The Land Institute, and David's political science background and familiarity with history emerged as he sparked discussion about community and the individual, language and values, new-Luddites, strategy, and praxis.

From New England came Robin Grossinger and Dick Backus. This past summer Robin worked with Ocean Arks, John and Nancy Jack Todd's solar aquatics firm that builds sewage treatment facilities using plants, animals, and sunlight as natural filters. Through "ecological engineering" Ocean Arks has expanded from its roots in the New Alchemy Institute to a successful firm in a few short years. Dick Backus is on the board of New Alchemy and a retired scientist formerly with the Woods Hole Oceanographic Institute, and regaled us with tales of his ocean-going days studying bioluminescent fishes of the Atlantic.

Bernie Jilka—Intern, Research Fellow, Groundskeeper, 1989-1992

Operations manager John Craft seems to have taken William Blake's dictum that "Energy is Eternal Delight" as his motto, and led a week of classes on energy basics that would delight the old poet. John explained electricity and solar and wind energy, and put the lessons in a context of living sustainably.

John's classes were a fitting preamble to hearing Hunter Lovins. Hunter is president and co-founder of The Rocky Mountain Institute (RMI), and followed David Orr in the Lou Douglas Lecture Series this fall. RMI is known around the world for its work in energy efficiency and national security. Hunter stopped at The Land on her way back west to Colorado, and as geese flew overhead we sat on the grass and talked about efficiency vs. sufficiency and the unpredictable behavior of complex systems—technological as well as social.

With her new photographs from the Water and the West Project, Land Institute Arts Associate and board member Terry Evans spent a morning exploring the theme of art and the environment with the interns, wondering what the place of art and artists in a sustainable society might be.

Dana led classes covering the 1980 U.S. Department of

May 31-June 2, 1991. The 13th Prairie Festival, "The Value of Nature," features Lewis Hyde, Baird Callicott, and Stephanie Mills.

June, 1991. A feasibility study for the Sunshine Farm begins. Marty Bender returns to The Land Institute and spends a year in Lawrence, Kansas carrying out this study.

Agriculture study on organic agriculture chaired by Garth Youngberg. ...Interns spent another day discussing the landmark report, *Alternative Agriculture,* published last year by the National Research Council of the National Academy of Science. After reading the study of Dick and Sharon Thompson's farm in Boone, Iowa, interns then had the opportunity to hear the Thompsons at the Kansas Sustainable Agriculture conference.

Classes ceased two weeks around Thanksgiving as interns concentrated on summarizing the results of their experiments and preparing oral presentations to be given at Kansas State University on December 6 and written papers to be published in *The Land Institute Research Report.*

Food was the topic for two of the last warm-ups of the term. 1989 intern Ray Epp visited on December 7 and told about the new bakery he helped open in Winnipeg, Manitoba, that buys organically-grown wheat directly from farmers at higher-than-market prices and mills flour right in the bakery. On December 11, the day after the board meeting, Alice Waters, proprietress of Chez Panisse Restaurant in Berkeley, California, discussed her philosophy of cooking and emphasized the importance of using fresh, locally grown produce as much as possible.

Mangroves and Monocrops

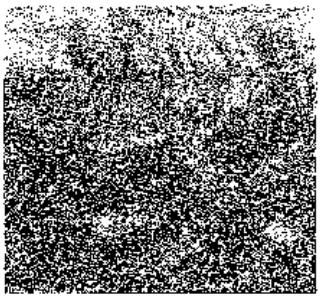
Laura Sayre

Number 40, Spring 1991

Laura Sayre—Intern, Research Fellow, Groundskeeper, Land Report Editor, 1991-1993

Angus Wright's recent book concerning agricultural use of pesticides in Mexico, *The Death of Ramon Gonzalez: The Modern Agricultural Dilemma* is the final product of ten years of research. When Angus came to class on February 22, he immediately asserted his unwillingness to discuss any topic relating to pesticides. Having seen the book in print, he is on to other projects. A native Salinan and a long-time friend of The Land, Angus was nevertheless a new acquaintance for the 1991 interns, and on Friday of our first week at The Land he provided both a welcome respite from a numbing series of tours and introductions and a thought-provoking presentation of a few of the issues confronting contemporary agriculture on an international level.

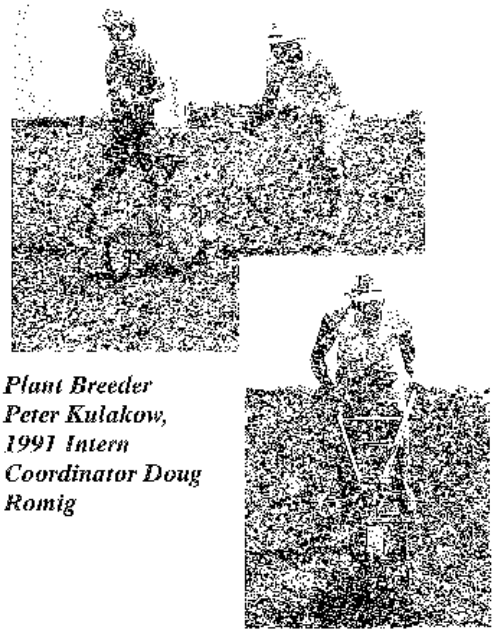
Angus's current project, which he described to us in part, is an effort to create a book that highlights the political syndromes surrounding issues of land control in general by providing detailed examples from contemporary agricultural situations in several countries. By bringing together



Angus Wright

analyses of both good and bad examples of land use in Brazil, Mexico, and the United States, Angus hopes to address fundamental questions concerning the social manipulation of agricultural resources and, in so doing, to promote wiser and more just forms of agriculture. In his presentation, entitled "Mangroves and Monocrops," Angus described two such examples, both pertaining to the production of luxury monocrops in Brazil.

The production of sugar cane and cacao, like the production of luxury monoculture crops in general, is highly destructive of the surrounding natural and human environment. Sugar cane production demands dangerous working conditions and has historically been oppressive to workers. In Brazil, land wars and assassinations of labor leaders have led to the deaths of thousands; cacao production has been only slightly better. The demise of the cacao industry, according to Angus, cannot be lamented, in spite of the loss of employment it will entail for many. Angus hopes it can be turned to greater good through conversion of some plantation areas into nature preserves. In light of the fate of the cacao industry, the ethanol fuels program can be recognized as a desperate measure to rescue the sugar cane industry from its inability to compete with high fructose corn syrup as a sweetener. Not only does ethanol allow Brazil to avoid implementation of a fuel-saving mass transit system, but is also places automobile use by relatively wealthy urban populations in direct competition with food for rural populations—a struggle whose disastrous outcome is easily predicted. Perhaps, Angus suggested, Brazil's situation contains a cautionary tale for ethanol programs in the United States.



Plant Breeder Peter Kulakow, 1991 Intern Coordinator Doug Romig

July, 1991. Dana Jackson takes a one-year leave of absence to earn a Masters degree in the mid-career program in public administration at the Kennedy School of Government, Harvard University.

Fall, 1991. *Farming in Nature's Image: An Ecological Approach to Agriculture,* by Land Institute ecologists Judy Soule and Jon Piper is published.

Collaborating in Nature's Image

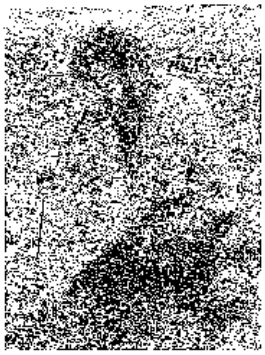
Tom Mulhern

Number 42, Fall 1991

Judy Soule, Land Institute Ecologist, 1984-1985.

Farming in Nature's Image: An Ecological Approach to Agriculture is a new book by Judy Soule and Jon Piper, published by Island Press. Jon Piper has been staff ecologist at The Land Institute since late 1985. Judy Soule preceded him as ecologist at The Land in 1984 and 1985...: Jon and Judy worked together at the Land for four months in 1985, but their book collaboration didn't develop until 1988.

According to Jon, *Farming in Nature's Image* is an attempt to bring together a number of agricultural problems such as environmental destruction, disintegration of rural communities, and fossil fuel dependence, and to present the ecological and social underpinnings of these problems. "Soil erosion is an ecological result of till agriculture," says Jon. "In our book we look at what ecology has to teach us about a different way of doing agriculture, an agriculture that is grounded in ecology."



Jon Piper, Land Institute Ecologist, 1985 to date.

Judy describes the book as both an extended argument and a strategy for a new approach to agriculture. She says the critical solution offered in the book is that of "modeling agriculture on local natural ecosystems, systems that are already in place and working in a permanent way."

Those familiar with the work of The Land Institute will recognize this as the idea that underlies our perennial polyculture research program, where we have been working since the early 1980s on a long-term program to model agriculture on the prairie ecosystem. However, Judy and Jon have produced a book with a much broader focus than The Land Institute.

"We make the case that using nature as the standard for agriculture is a general principle," says Judy, "and we give examples from several different ecosystems where agriculture has worked that way—not only the prairie ecosystem, but also forest and desert ecosystems." Jon states that "The Land Institute gets an entire chapter because it is the most comprehensive example of an alternative ecological approach, but we also describe other research that relates to various aspects of this approach."

Judy Soule and Jon Piper represent an emerging generation of scientists who have come of age during a period of unprecedented environmental destruction and growing environmental consciousness. They propose an ecological approach to agriculture that goes beyond the conventional reductionist strategies of either agronomy or ecology.

Stunned 1991 interns at the "Garden of Eden," Lucas, Kansas.

Wes demonstrates the right way to use transition fuel in the garden.

1992

May 31-June 2, 1992. The 14th Prairie Festival, "Learning From the Land," features David Orr, Arnold Schultz, and John McCutcheon.

June, 1992. Wes Jackson receives a five-year MacArthur fellowship.

In Memory of Hans Jenny

Arnold Schultz

Number 43, Spring 1992

Arnold Schultz

A memorial service was held for Hans Jenny on the University of California campus. Everyone who attended that March day in Berkeley perceived that Hans had not really died. Had he not turned soil science and ecosystem study into dynamic fields that are going to live on and on? His two books, *Factors of Soil Formation* and *The Soil Resource,* are already classics and will never go out of date. The wealth of new ideas he contributed to soil and colloid chemistry will be incorporated in experimental research on plant nutrition and pedology for a long time to come. And the many fine natural reserves that he helped to establish are living laboratories for never-ending long-term study and demonstration. Because Hans Jenny continues to live, I shall hereforth use the past tense sparingly.

Not many scientists will express the association they have with their field as one of friendship. That is precisely how Hans thinks about soil and how, later, he expresses it in his paper, "My friend, the Soil." He sees in the soil the beauty that artists see and talk about with their paints. He sees in soil great complexity and diversity which yet is completely describable with the simple organizing equation: Soil=f(Cl,o,r,p,t...). He also sees ions dancing about as rocks and other parent materials break up and reform into solid horizons and hardpans. He sees in soil a resource that sustains the life of myriads of organisms, including humans, when used with scientific care and human compassion. All these insights comprise the friendship pact that Hans has signed with the soil.

I first met Hans in person in 1949 when I was hired by the Forestry Department of the University of California, Berkeley. But I knew him well even before then; I had purchased *Factors of Soil Formation* while a graduate student at the University of Nebraska, studying ecology with Professor J.E. Weaver. I read the book several times in Lincoln, and thought of it as my ecology text. Later, in Berkeley, after I had the opportunity to work with him, I once said, "Hans, I've always thought of you purely as a soil scientist, but now I realize you really are an ecologist." "No,no," he answered, "I don't know much about ecology at all, but of ecosystems I know a lot." That statement emphasized to me that the study of ecosystems was much more than the study of ecology. Thereafter I coined the term Ecosystemology and started to teach both a graduate and undergraduate course by that name. Although we were colleagues in ecosystem research and thinking for over forty years, I remain forever his student.

Of all of Hans's many achievements—papers, books, lectures, and research---the crown is the Pygmy Forest. His efforts, with the help of his wife, Jean, have preserved large chunks of this pygmy forest for education and for long-term research. With his graduate student, Bob Gardner, he documented the evolution of a landscape sculpted through a series of marine terraces which were formed during the million-year period of the Pleistocene on the Mendocino coast of California. The study of this chronosequence is actually a reification of the state factor approach which Hans had developed in..., *Factors of Soil Formation*, written before the pygmy forest phenomena had been observed or heard of. Perhaps the most earth-shaking of all is what this has done to our textbook soil and ecological theory. The soils and plant communities of the Middle West developed to maturity after the recent Wisconsin glaciation, a period of 50,000 years, and to soil scientists and ecologist they appear to be in a steady state. The million-year period of the Mendocino chronosequence, however, has witnessed drastic changes in soils—form mollisol to altisol to podsol—and drastic changes in vegetation---from prairie to rich redwood forest to poor pygmy forest—with no changes in climate, species pool, topography, or parent material, only time. Hans Jenny has written only one line about this fallacy in Midwest theorizing. It appears in *The Soil Resource* as: "Some of the imagined Clementsian and Marbutian sequences last millions of years...."

Sharon Thelander and Linda Okeson are among the office and accounting staff who have kept The Land Institute running over the years. Others include Pam Ellinghausen, Louise Sorenson, Stephanie Krug and Alice Sutton.

Summer, 1992. A 3.5 KW photovaltaic array is installed near the Krehbiel house office.

June 12, 1992. Interns plant "The Prairie in the Park" at Salina's Oakdale Park as part of the annual Smoky Hill River Festival, educating local children about prairie by planting native prairie species.

A Contagious Influence

Orville W. Bidwell

Number 43, Spring 1992

One of my most valued mementos is a *San Francisco Chronicle* editorial that describes the Kansas state soil drive, entitled "Digging the Dirt the Kansas Way," to which is attached a handwritten note: "Best regards, Hans. P.S. I didn't write it."

Those aware of Professor Hans Jenny's unexcelled affection for the soil readily understand his declination. Had he been in my shoes, the internationally acclaimed pedologist and "soil art" promulgator would have responded rhetorically to the print media's overuse of the colloquial "dirt" for the more precise "soil" in countless headlines: "Senate moves dirty issue," "Soil lobbyist

Orville Bidwell at the 1986 Prairie Festival

tackles dirty job," and "Lawmakers face dirty issues," to name a few. Professor Jenny would have seized the opportunity to use soil color and profile sculpture to impress us with the soil's personality, history, and age.

Soil art came to him naturally on his parents farm, ...and was nurtured by his woodcarver grandfather and periodic visits to art exhibits in high school. Hans ...emphasized that soil profile art, unlike classical paintings with themes, is abstract, and those who customarily think of soil only as dirt rarely find beauty in it.

Having experienced Professor Jenny's field agility in eastern San Joaquin valley in November 1977, I was struck by Boyd Gibbon's description of him in *National Geographic:* "Believing that soils highest in organic matter would exist at high altitude near the Equator, he recently climbed Mount Kilimanjaro and filled his plastic bags with black soil. The Tanzanians were astonished to see this wisp of a man at 14,000 feet. Hans Jenny was 82."

Francis Hole and a friend at the 1986 Prairie Festival

A Friend of the Soil

Francis D. Hole

Number 43, Spring 1992

Dr. Hans Jenny was a professor of soil science at the University of California-Berkeley from 1936 to 1967, and a pedologist (soil scientist and ecologist) of international stature. He was enthusiastic about the work that Wes and Dana Jackson and associates are doing at The Land Institute. Whereas most people go through life careless of the soil that supports them, Professor Jenny, in common with the members of The Land Institute community, was mindful of the earth beneath our feet. He asked questions about the "soil-plant contract" and the soil-plant-people contract.

Dr. Jenny thought of soil erosion as a form of destruction of the soil resource that is cumulative, just as radiation, however slight at a given moment, is cumulative in its damage to living cells. To him, no human-accelerated loss of soil by erosion was tolerable. He was alarmed that soil losses by wind and water are belittled. The work at The Land Institute in developing herbaceous perennial polycultures addresses the need to stop accelerated soil erosion that is rampant on cropped and grazed landscapes.

Hans Jenny [was] an inspired person who was happily at home on this planet. He became interested in soil in his youth in Switzerland and he turned to soil science in order "to comprehend it." He came to love the beauty of soil as known through the senses of sight, touch, and smell. His rigorous research methods, including mathematical treatment of data, are impressive. He published in an astonishing variety of scientific journals, enjoyed the friendship of many people in different disciplines, and integrated much that he learned from them into the planet Earth-soil view that he developed over a lifetime. He recently wrote, "As this century is ending people are becoming aware of resource limitations, and they will want to know more about soils and their response to environmental change." (*The Soil Resource,* 1980) He showed not only how to do soil science, but also how to live as a vital truth-seeker and practitioner. Because success in proper management and protection of ecosystems in the future depends on people being similarly oriented, disciplined and in love with the earth beneath our feet, we do well to enjoy, share, and promote the generous legacy left to us by this delightful friend of the soil.

October 4, 1992. Perennial grains are used in baked goods served at the Fall Visitors Day. "For the first time ever, guests at The Land were invited to sample baked goods featuring the fruits of our research work."

"We may want to look into that..."

Wes Jackson

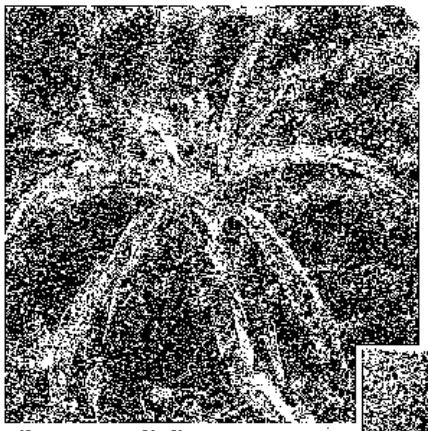
Number 43, Spring 1992

For many a scientist, there is the memorable field trip, the one that sticks out from all the rest. Mine lasted three days in September of 1985 near Comptche in Mendocino County, California. Hans Jenny and his friend Arnold Schultz, a forestry professor at the University of California, Berkeley, led Saskatchewan ecologist J. Stan Rowe and me up and down the ecological staircase of Mendocino. It was a trip in which any penchant toward eco-fundamentalism was sure to suffer. At least mine did.

Before I started up the staircase with its five, 100,000-year-old treads, I was a firm believer that any natural ecosystem was sure to improve, and by that I mean add top soil, increase in stability, maybe diversity, or if not improve, at least stay good indefinitely. By the time we headed back toward Berkeley in the car, the pillars of my ecological understanding had been shaken.

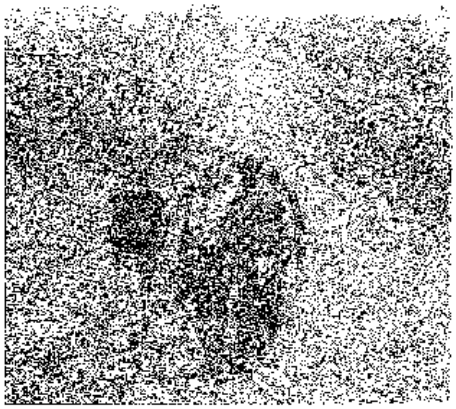
[A]bout four months after the field trip there came a letter from Hans saying that he was not aware that there was a concept of steadily improving ecosystems. He said that such a "sunshiney belief rests on a neglect to appreciate the soil as a dynamic—either improving or degrading—vital component of land ecosystems." There was little comfort in the fact that I had been half right.

Fundamentalism of any variety tends to die hard. Staring into a soil pit dug into the fourth terrace, I could sympathize with the churchmen who refused to look through Galileo's telescope. Even there, with the evidence before me, I protested, saying that good farming can improve the soil. "Yes," Hans said, but "the extent depends on what kind of soil, virgin or depleted, the farmer begins with." He thought it would be difficult to improve a good virgin Iowa prairie soil by soil management techniques, except perhaps by applying nitrogen, phosphorus, and potassium.



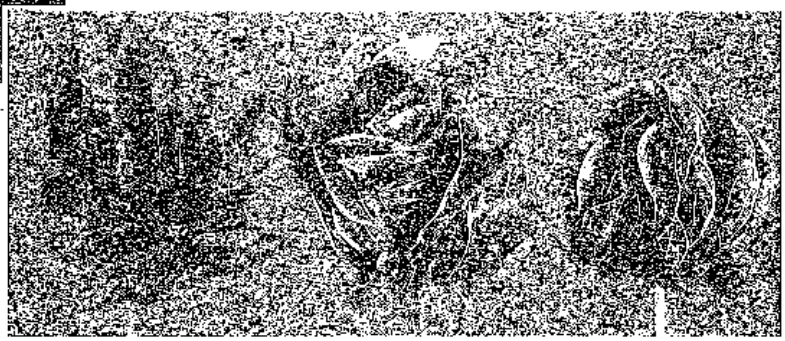
Illinois Bundleflower

It was the beginning of an important lesson to me, and from then on I have burdened myself and my students with the question: Why should a look to nature, as we work out our relationship to the Earth, provide us with easy absolutes? There is nature, which may or may not have human interests. It is we who choose to make nature our standard or measure for agriculture instead of trying to understand agriculture on its own terms. It is also ourselves, not nature, who are loaded with our notions of good and bad. Few humans, in comparing the luxuriant redwood-fir forest to the pygmy forests, would not think that the latter represents a deterioration or a decline. But Hans insisted that "nature might call it a biological improvement, an adaptation of vegetation to a changing substrate."



1992 interns after a prairie burn

We're talking about more than soil here, though it is fitting that a discussion on soil formation is the means for doing so. It is not just a question of how the soil is made. Are there any firm laws about its formation that are not trivial? Nature seems to be saying, "No." Hans said it well in the final paragraph of the same letter. "The picture of natural decline of native ecosystems, more dramatically displayed by bare laterite crusts, has broad philosophical implications. (Many) popular writers contend that if our society were to adhere to ecological laws we would have paradise on earth, a simplistic view. The laws they cite, for example, that diversity creates stability, may not be broad laws, and maybe there aren't any, unless they are trivial. We may want to look into that."

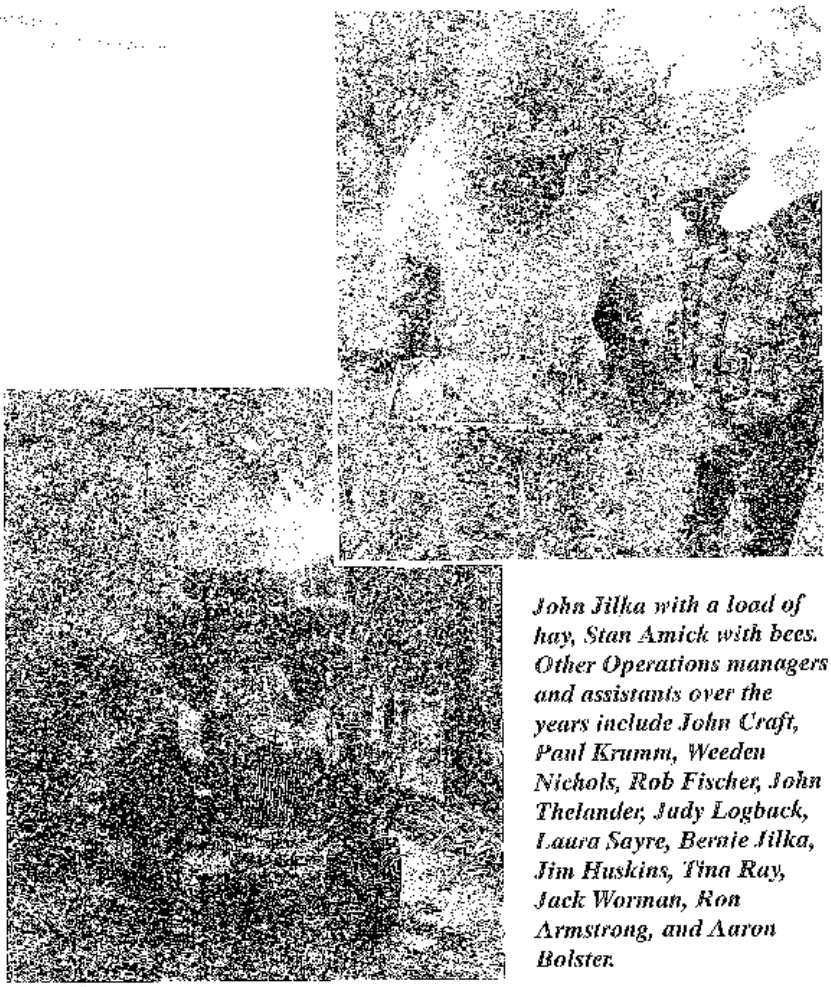


December, 1992. Dana Jackson leaves The Land Institute to work with the Minnesota Food Association. Currently, Dana is Associate Director of the Land Stewardship Project in Minnesota.

The Sunshine Farm

Marty Bender

Number 44, Summer 1992



John Jilka with a load of hay, Stan Amick with bees. Other Operations managers and assistants over the years include John Craft, Paul Krumm, Weeden Nichols, Rob Fischer, John Thelander, Judy Logback, Laura Sayre, Bernie Jilka, Jim Huskins, Tina Ray, Jack Worman, Ron Armstrong, and Aaron Bolster.

The Land Institute has just completed a one-year feasibility study of the proposed Sunshine Farm, funded by the Austin Memorial Foundation. In the Sunshine Farm, we have combined traditional farming methods with recent scientific findings and technology to design a sunlight-powered farm that will be compelling to conventional farmers seeking alternatives. During this ten-year project, ongoing research and innovation will determining practices that will be incorporated into the Sunshine Farm.

In designing the Sunshine Farm we have made several assumptions. Our first is that with eventual government rationing fossil fuel supplies for agriculture will become unpredictable and will come at a cost of energy subsidies from taxpayers and other sectors of the economy. Thus, a central question in our study is how much agricultural productivity can be maintained while sunlight-powered farms sponsor their own inputs without fossil fuels. The Sunshine Farm will grow some of its own inputs, such as fuel and nitrogen fertility, thus exchanging energy that is directly or indirectly renewable for the embodied energy in conventional fertilizers, fuel, and machinery.

Since cereal grains and livestock are staples of the American diet and are the basis of agriculture on the Great Plains, the primary focus of the Sunshine Farm will be grain and livestock production. Vegetarian diets would allow cropland to support more people than meat-based diets because they avoid the energy and protein losses that occur as animals convert feed to products we consume. However, much meat could be produced on the rangeland that occupies 46% of the agricultural land in six of the Great Plains states (ND to TX) and is unsuitable for till agriculture. ...With the extra forage resulting from crop rotations, the amount of grain fed to animals could easily be reduced so that more grains could be grown for human consumption.

With these assumptions, we have designed the Sunshine Farm as follows. Located on Land Institute property, the Sunshine Farm will occupy 150 acres, with 50 acres of tillable bottomland and 100 acres of upland native pasture. In 1920, when fossil fuel input was relatively small compared to now, the typical farm size ranged from 160 to 200 acres in central Kansas and Nebraska. Roughly a third of Kansas farms are still between 50 and 259 acres.

The animals on the Sunshine Farm will be cattle, hogs, chickens, and draft horses. Twenty cattle and perhaps 100 free-ranging chickens (with a moveable chicken pen and a portable electric fence) will range the 100-acre pasture. ...We will have two draft horses that will have access to pasture at night and in the winter. The 50 acres of cropland will produce more than enough winter feed for these animals.

Fertility will be provided in the primary crop rotation by symbiotic nitrogen fixation in the soybeans and alfalfa. ...[A]lfalfa [aftermath and some legume cover crops] in the rotation will not be harvested but will be plowed down as green manure.

The Sunshine Farm will sponsor its own traction

1992. The Land Institute and several Friends of the Land begin acquiring and restoring property in Matfield Green, in the Kansas Flint Hills.

needs. On the Sunshine Farm, heavy-duty field operations such as plowing, discing, and combining will be done with a small diesel-engine tractor running on vegetable oil. [Several other on-farm energy sources for traction] were rejected either because of immaturity of the technology or fuel process, or because of a negative energy balance (where the energy value of the fuel is less than the energy required to grow and process the fuel, including credit for any by-product).

We chose soybeans as the initial candidate for vegetable oil fuel because this crop is a nitrogen-fixing legume which could be used in the primary crop rotation to provide nitrogen. However, in the Great Plains, [dryland] soybeans can be grown only about as far west as central Kansas. Since sunflowers, rapeseed, safflower, and peanuts were the vegetable oils with the most positive energy balances (including soybeans), they will be investigated in trial plots.

A team of draft horses will be used to spread manure and perform light-duty field operations. We view the inclusion of draft animals in the Sunshine Farm as part of the necessary and desirable mix of energy sources that provides security through diversity. Since most farms have a small parcel of land that is usable only as pasture, we have assumed that the horses have access to pasture.

Extensive calculations suggest that the portion of the cropland on draft-horse farms devoted to horse feed would be roughly the same as the portion of cropland on tractor farms devoted to oil crops for vegetable oil fuel. Thus, draft animals will not divert more cropland from food production than oil-fueled tractors would.

...In addition to demonstrating sunlight-powered farming, the Sunshine Farm will provide a farm background into which the research and results of The Land Institute's perennial polyculture program can gradually be introduced. The effects of grazing, soil fertility management, and other farming practices on perennial polycultures and plant breeding could be studied on the Sunshine Farm.

Ted Schuur, Laura Sayre, Tom Mulhern, Stan Amick and John Jilka after a prairie burn

Darryl Short and Marty Bender 1992—still planting research plots

First Prairie Festival attendees (from p.11):

Kneeling: Sister Jeanne McKenna, Hunter (Sheldon) Lovins. Standing: Dana, John Simpson, Chuck Washburn, Amory Lovins, Wes, Gov. John Carlin, Sister Monica Schneider, David Brower. Extra credit: Sparky.

1993

January 6-8, 1993. A symposium on common problems in medicine and agriculture is held at The Land Institute with Charles Sing and colleagues from the University of Michigan.

Spring, 1993. The Sunshine Farm begins its first field season.

Research at the Micro Edge

Mary Handley

Number 44, Summer 1992

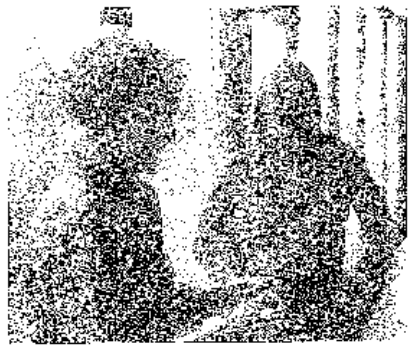
Monoculture is not possible, you know. "Monoculture" is just a shorthand way to say, "in this area I intend for only one plant species to grow and I choose to ignore everything else." As The Land Institute's plant pathologist, I can't ignore the "everything else," because that's where my realm begins. Below the level of crop and weed are all the microorganisma and even smaller things that are the domain of pathologists.

I am continually amazed at the complexity of even our simplest "monoculture" research plots. We are working with plants derived directly from nature, complete with all the co-evolved diseases and pests. Germplasm plantings of Illinois Bundleflower and eastern gamagrass have been established from seed collected directly from hundreds of sites. Each of our plants is unique. Each individual plant in our field is a distinct genetic individual—no genetically-engineered tissue-cultured, advanced inbred breeding lines or uniform varieties here. That means that they have a distinct set of genes that makes them as different as two people. Add to that healthy soil, with an intact community of microorganisms, and no insecticide or fungicide use to reduce aboveground insects and pathogens. Our plots thus contain an almost incomprehensible amount of diversity.

[One] plant I am studying is Illinois bundleflower. This plant is a legume, capable of gathering nitrogen from the air and converting it to a form usable by plants. The mechanism that allows this is complex, mediated by a bacterium (Rhizobium) which is a symbiont inside small nodules that form on the plant's roots.

Superimpose on this at least one, perhaps two major additional interactions and you begin to sense the complexity present underground. Illinois bundleflower has at least one root pathogen that kills small and large roots and can kill whole plants.

...Illinois bundleflower has also been reported to be mycorrhizal. That means that it develops an association with a fungus which aids the plant in nutrient and perhaps water acquisition in exchange for supplying the fungus with some nutrients. There are thus three microorganisma competing for space and nutrients on Illinois bundleflower roots in our plots. And those are just the major associations. Every plant has a community of epiphytes on its roots leaves, stems, flowers, and fruit—fungi and bacteria and others that use the plant surface as their base but do not appear to interact directly with the plant. They are a lot of the "everything else" that is so easy to ignore.



Mary Handley with Senator Kassebaum

Not easy, perhaps essential. The complexity becomes impossible to comprehend. For me, it is important to know it is there. The invisible "everything else" may be the key to a puzzle that appears unsolvable. I like to teach students about the layers on layers on layers that exist in "simple monocultures," and to help them understand that ecosystems teem with things invisible. That each of these things is interesting, perhaps useful, possibly crucial. That one must keep an open mind and seek out the minutiae that hide beneath the surface. Too few of us, even when we know a lot about ecology, can imagine these "microsystems."

What is different about research at The Land Institute may be this imagining. Because we want to find new ways to design agriculture, and because we are looking to the native ecosystem for ideas to incorporate into these designs, we are alert for the invisible or subtle interactions. Because we are trying to change business as usual we are willing to consider that "everything else" has a voice to be heard. I can only hope that we are listening well.

1992 interns harvest Eastern gamagrass research plot

May 28-30, 1993. The 15th Prairie Festival, "Becoming Native: Our Paleolithic Past, Modern Hunter Gatherers, Subsistence Farmers," features Dave Foreman, Richard Lee, Helena Norberg-Hodge, Doug Peacock, and the Paul Winter Consort.

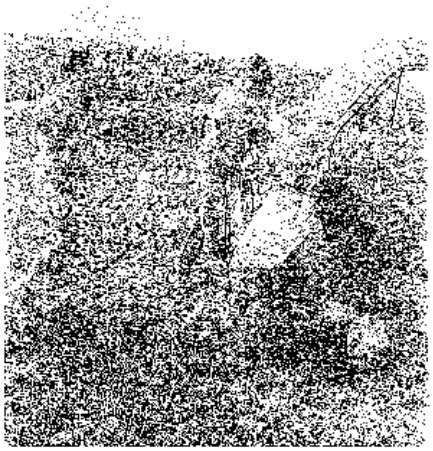
Visiting Scholars Show Complexity In a Natural Light

Corey Samuels

Number 48, Fall 1993

Our series of visiting scholars sparked class discussions at The Land Institute in the fall of 1993. The series began ... with William C. Wimsatt, a professor of philosophy at the University of Chicago. Wimsatt was accompanied by two colleagues from the program in Conceptual Foundations of Science, Jeff Schank and Greg Mikkelson. The three spent a whirlwind week lecturing about their brand of holistic research and advising Land research staff on how we might use these ideas.

Wimsatt's lectures centered on his critique of classic reductionistic science. Although he acknowledged that it is fundamentally necessary to simplify problems—because it is impossible to evaluate all possibilities—he repudiated determinism, the idea that all happenings in the world can be predetermined infinitely into the future. Next, Wimsatt introduced his own preferred method for problem-solving, the heuristic. Heuristics are rules of thumb that work in certain situations. The trick is to define the conditions under which a given heuristic will always work, and then to use the places it doesn't work to find new rules. When a rule works dependably within its defined parameters, it is said to be robust.



Corey Samuels—Intern, Research Fellow, Acting Education Director, 1992-1994—with 1993 intern Christian Anders Petrovich and Swedish exchange student Göran Bergkvist on the road.

Our second visitor at The Land Institute ... was Arthur Zajonc, a physicist at Amherst College. Zajonc is unique in his field in that he makes use of historical and spiritual explanations to understand physics. His recent book, *Catching the Light: The Entwined History of Light and Mind,* traces popular and scientific views of light through the ages. Zajonc spoke on topics from his book and on his study of Goethe's writings about light. He also suggested ways in which this history can inform our views of agriculture and nature.

Zajonc's work emphasizes the idea that our way of seeing is not absolute, but rather is fundamentally influenced by context and expectation. He demonstrated this by showing slides of images that are deceiving to the eye (for instance, the drawing in which one can see either an old woman in one position or a young woman in another) and by discussing studies that have been done of individuals who were born blind, had their sight restored by surgery in adulthood, but who then still didn't see in the way most people do. Zajonc also shared fascinating stories of early scientists' ideas about the nature of light. These served as further proof that there might be ways of seeing in science besides the reductionism we are accustomed to.

Followers of The Land's research may see some of these ideas reflected in our projects in 1994. Both scholars discussed how their research might be of use in the three parts of The Land's research program: perennial polyculture, the Sunshine Farm, and Matfield Green. In addition to getting feedback on ongoing research projects, Land staff held follow-up classes to entertain ideas for future work.

In addition to their daytime classes, Zajonc and Wimsatt each delivered an evening public lecture in The Land's classroom building. These events attracted people from across the state, and the discussions generated by the audience provided further food for thought on the implications of the emerging science of complexity for all our lives.

Kansas garden women: Corey Samuels, Tonya Haigh, Emily Pullins, Beth Gibans, 1992.

Bobbins, Honorary Intern.

Fall, 1993. Visiting Scholars in complexity studies William Wimsatt and Arthur Zajonc shape the fall curriculum.

September, 1993. The Matfield Cafe opens at the former hardware store in Matfield Green, owned by The Land Institute. Currently, this building houses Land Institute staff, and is no longer functioning as a cafe.

The remodeled "Lumberyard Cafe" in Matfield Green

Welcome to the Matfield Green Cafe

Sara Wilson

Number 48, Fall 1993

"Now that's where the scale used to be, right where that piano is," Jewell Swift points out as he walks into the Matfield Cafe, just days after its first opening. "Well, this place sure has changed. I haven't been in this building since it was the hardware store," he comments. Jewell Swift Jr. is with him, his son visiting from western Kansas. As coffee and tea are served to the Swifts, Ken and Gladdys Brent, aged 87 and 82 respectively, pull up in their tan pickup. Gladdys was born and raised on a ranch just outside Matfield Green, and her husband has been in the area the duration of their married life. As the morning progresses in the Matfield Cafe, five other locals will come and go.

The Matfield Cafe officially opened its doors in early September, 1993.... Staffed and supplied by Land Institute interns, it is one part of The Land Institute's ecological community accounting project underway in Matfield Green, Kansas, a small town situated in rural Chase County, deep in the Flint Hills. Ecological community accounting, in its most basic form, is best explained by a blackboard that sits behind the coffee mugs in the cafe. It reads, "MENU: coffee—Peru, sugar—Hawaii, cream—Betty and Charlie Swift [farmers two miles south of Matfield], Lead Plant tea—gathered off the prairie 1 mile east of Matfield Green."

1993 interns pay their respects at a monument to the industrial age at Carhenge, Nebraska

As Jewell Swift observed, the Cafe is housed in the downstairs of what was once Matfield's lumber yard office, a two-story frame building purchased and renovated by The Land Institute with a special grant from a foundation. The upstairs of this building has individual sleeping rooms for interns, visiting scholars, and guests. Classes and meeting have been held around the large tables in the main room. As part of the renovations, a large wood-fired brick oven was build extending out from one wall of the cafe, and Sara Wilson and Caroline Mahon have been baking bread and an occasional pizza for the cafe clientele.

Matfield is typical of many small towns on the border of the Midwest and Great Plains: it had its heyday over a generation ago when more people were required to work on the land. It is now a town of around fifty, most of whom are older retirees. There are only four young families to take the place of the passing generation. At one time, there were a number of establishments in Matfield Green, including three grocery stores, two gas stations, the hardware store and lumber yard, a barbershop, and a cream and egg station. Today, Matfield has a half-time post office that is under threat of closure, a bar, a church, and now a small cafe. It is nine miles to the nearest gas station and fourteen miles to the nearest grocery store.

Sara Wilson and Corey Samuels at the Farm Show

In order to be more than a passing fad, sustainable agriculture can not simply orbit the extractive economy, as Wes Jackson would say; instead, it needs to develop as an integral part of local communities with local, more sustainable economies. The Matfield Cafe is designed to draw attention to the ecological patterns of local life, to encourage development and maintenance of these smaller loops within these patterns, and last but not least, to provide a place for the local and visiting people of Matfield Green to stop and talk.

1994

January 5-8, 1994. A conference on "Complexity in Ecology, Agriculture and Medicine" is held at The Land Institute, featuring Donald Worster, Stuart Pimm, James Drake, John Todd, Stuart Kaufmann, Charles Sing, and Land Institute staff.

Update: Great Plains Research Project

Christian Anders Petrovich

Number 49, Spring 1994

November 31, 1994: telluric and cosmic forces collide, a space/time vortex ensues, and Christian Petrovich finds himself wearing Jack Worman's clothes

"Pick up that plant." I picked it up, but I didn't know why I was holding a potted aloe as Tim Miller described his organic farm.

Tim and I had just finished planting the first perennial polyculture research plot outside of The Land Institute's Salina, KS, property. Tim's farm is in Kyle, TX, on the western edge of the Blackland Prairie. It is the southern-most site location of the 1994 Great Plains Research Project, a region-wide study of The Land Institute's main research plants.

After 20 minutes of wildly inspiring conversation about Tim's farm and natural reseeding of his annual vegetable crops, he said, "you can keep that," pointing to the aloe in my grasp.

This has been the nature of the Great Plains Research Project so far—blooming with kind generosity and powerful inspiration.

The 1979 Ford F-100 "Official" Land Institute Research Vehicle has carried that house plant through four states (Texas, Oklahoma, Missouri, and Kansas) and 28 plantings to date. It is April 2nd as I write. The aloe has a place between the box of files on prairie ecology and the spare tire, below the shelf with the red box for clean clothes and the blue box for dirty clothes. Then there are the seeds, packed away in the soft, tight bundles of cotton seed bags—each labeled by species with a pen that bleeds into cotton fiber.

1994 intern Antonio Serrano and a friend plant a small prairie in Oakdale Park, Salina

The rakes and hoes hang along the side and roof of the pickup topper, leaving enough space for a fold-out foam sleeping pad in the center of the truck bed. I've taken to calling this old blue pickup "Henry," for the times when I'm driving alone between plot plantings. Talking to Henry somehow seems much better than talking to myself.

For most of the first third of this research planting, I have avoided the lone mumbling that makes passers-by nervous. This is because I am fortunate to have 1993 intern alumna Jen Tressler helping me with the project. Together we have met the remarkable people who agreed to become collaborative researchers in this Great Plains-scale research project. All together there are 78 individuals, families, groups and schools collaborating with The Land Institute's research across 14 states. The response I received to this study has been truly phenomenal.

In addition to the 78 study participants, I had to turn down over 40 other people who wanted to collaborate with The Land Institute's research. Unfortunately I simply could not plant with them for lack of seeds and time. I cannot express how inspiring this response has been to all of us here at The Land Institute. It is heartening to know that so many people want to participate in this grassroots level research project. I wish I could plant with all of you.

1994 intern Victor Rabinovich leads a tour at Fall Visitor's Day

It has been a joy and an honor to meet all the people who have decided to dedicate effort to this study: the lawyers who save seed and gather wild edibles; the sociology professors who plant gardens and graft walnut trees; the cable company workers who became farmers because their gardens get out of control; the rotational grazers whose electric fences draw more curiosity than current; the postal workers who deliver lambs, calves and colts as well as mail; the school teachers who shear sheep; the fifth graders who help compress the soil on our plots by doing the bunny hop; the research scientists who find spaces for us on university farms; the extended families that live and work together; the realtors who raise pigeons; and the ad writers who also run organic farms.

There is one characteristic that all the above participants and I imagine all of you who receive this *Land Report* embody: an individual dedication to creating a soil-building and community-building daily reality worthy of this prairie place we live in. That has been the greatest inspiration to me—observing the silent dedication taking place in people's back yards.

Prairie soils took millennia to build, particle upon particle, root entwined with decomposing root. It is by the accumulation of your often unacknowledged efforts that we find the hope and inspiration to continue in our quiet quest.

Spring, 1994. New experiments in community assembly of perennial polyculture species begin in collaboration with ecologist Stuart Pimm of the University of Tennessee.

Spring, 1994. The Great Plains Research project begins with Christian Petrovich's planting of seventy-seven polyculture plots through fourteen states from the Rockies to Lake Michigan.

Both horses and machines are fitted to appropriate tasks, and their energy use accounted, on the Sunshine Farm.

The Sunshine Farm Takes Shape

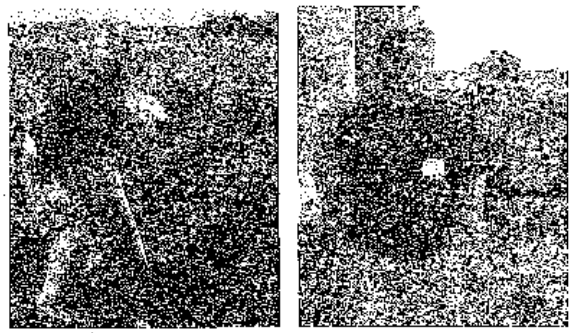
Marty Bender

Number 51, Fall 1994

The Sunshine Farm project began with a one-year feasibility study to select the mix of crops and animals, and to choose renewable energy strategies with the greatest likelihood of success. ...During the past two field seasons, staff and interns have built a five-wire high-tensile fence for draft horses, horse stalls, a six-strand barb-wire fence with a portable holding pen for cattle, several water lines and automatic waterers, a portable hen house and a portable broiler pen, a granary for storing horse feed, soybeans and sunflowers, and a double-barreled wood stove for heating the workshop. Most of the farm infrastructure is now in place.

Intern research projects to develop and analyze sustainable agricultural practices on the Sunshine Farm have begun. Innovative components on the Sunshine Farm include long-term crop rotations, narrow strip-cropping, close monitoring of soil quality, portable hen house and broiler pen, controlled cattle grazing, and exploratory incorporation of candidates from The Land Institute's research on perennial polycultures. The projects are set up as multi-year experiments that require graduate-level statistical analyses, which will lead to publication in peer-reviewed journals.

Two five-year crop rotations have been set up: 1) grain sorghum, soybeans, oats, sunflowers and sweetclover; and 2) grain sorghum, soybeans, oats, alfalfa and alfalfa again. Sometimes wheat is substituted for oats. The crops are grown in 120 thirteen-foot wide strips of four rows each, which progress through these rotations over the years. The purpose of strip-cropping is to provide many edges between different crops, which might lead to higher yields as a result of polyculture effects. However, we did not see these effects in the few strips we examined in 1994. Yields were not higher in edge rows than interior rows. This may have been because it was difficult to find field implements wide enough to control weeds in the edges, and yet not so wide that they sometimes inadvertently drift into adjacent strips. We expect these problems to be ironed out over time.



Marty Bender planting an experimental plot and leading a tour on the Sunshine Farm, 1995.

Electricity for drying grain, pumping water, running fence chargers and workshop tools and other needs will be provided by photovoltaic cells and wind-electric turbines on the Sunshine Farm. Western Resources, the regional public electric utility, has donated the components for a system of photovoltaic cells and storage batteries.... This system has been sized to meet the projected annual electric demand of the farm. By using automatic waterers that keep from freezing by being set in the ground, we eliminated the need for electric livestock water tank heaters in the winter, which can account for one-fourth to one-half of the electric load on a typical farm, not counting the house. The photovoltaic system will be connected to the utility grid because there may be times of the year when the power demand is greater than what is produced. The future inter-dependence of sunlight-powered farms with local fuel co-operatives and regional utility grids demonstrates that the aim of renewable energy technologies is not complete farm self-sufficiency, but reducing the use of fossil fuels as much as possible across society as a whole.

One of the central goals of the Sunshine Farm is to carefully account for all of the energy, materials and labor that actually goes into running the farm. To make this data accessible for analysis in a computer

Spring, 1994. The repaired Matfield Green school hosts community functions and meetings. Renovations are essentially completed by 1995.

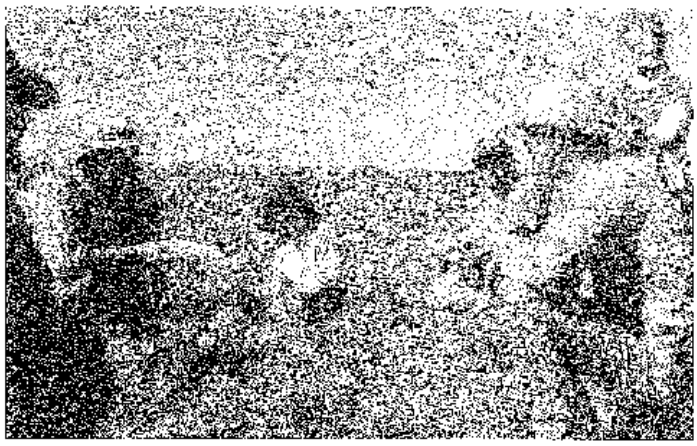
Spring, 1994. *Becoming Native to This Place*, by Wes Jackson is published.

John Jilka and Jack Worman

database, a taxonomy was developed to define the various farm tasks, projects, enterprises, objects, inputs, and other categories. To control the entry of the data into the computer database so that the stored information is in a uniform format for analysis, former Land Institute intern Chad Hellwinckel (now a graduate student in agricultural economics at the University of Tennessee) designed a user-friendly input screen. This screen handles complex entries, such as prorating the fuel and labor devoted to each crop in a field operation that covers more than one strip. Or, as another example, it prorates the fuel and labor for a trip into town to pick up various items that are charged to more than one farm enterprise.

Determining how to run a profitable farm in today's economic environment of cheap fossil fuel-based inputs is not an important consideration at the Sunshine Farm. Economics will be the biggest wild card in the future because relative prices among goods and services are likely to shift dramatically when fossil fuel becomes scarce or expensive, and for many other unforseeable reasons. This means that current economic analysis will have little long-term applicability. ...The Sunshine Farm Project concentrates on basic energetic and nutrient constraints in farming, which will ultimately interact with the social structure of agriculture to determine what is profitable in the future.

The cost of our food is currently the product of a national policy of cheap food and fuel. The data derived from these studies will allow us to make a more complete ecological accounting for farming, which may suggest a more accurate long-term cost for what we eat. The production of annual grains using renewable energy technologies and low-input practices on the Sunshine Farm will also provide a standard for comparing the productivity of conventional grains with that of perennial grain polycultures. Thus, we hope the studies undertaken at the Sunshine Farm will lead us to a better understanding of both the opportunities and the limitations of "conventional" organic tillage and livestock farming on the Great Plains in a solar-powered future.



1994 interns visit Pete Ferrell on his ranch. Intern coordinator Audrey Barker, center. Others over the years (not previously pictured) include Mark Gernes and Michelle Mack.

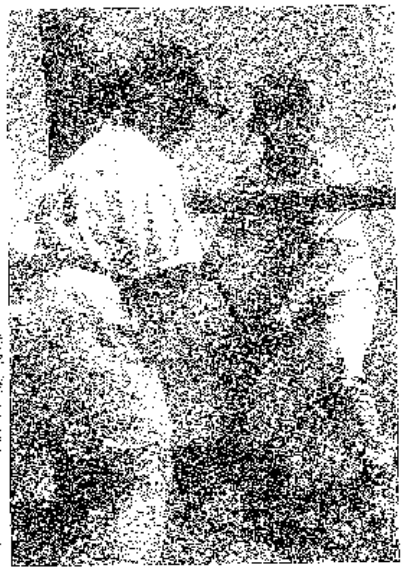
May 27 - 29, 1994. The 16th Prairie Festival, "The Pattern Which Connects," features Stuart Pimm, Steve Marglin, Frederique Apfell-Marglin, Charles Sing, and Alice Waters.

September 17, 1994. Michael Ableman, Alice Waters and Wes Jackson are featured at the "From the Good Earth" celebration in Lawrence, KS.

Cattle on the Prairie

David Tepfer

Number 51, Winter 1994



1994 interns Joel Gerwin, Antonio Serrano, Portia Blume and Kathy Holm build fence

At the end of a day in late October, Land Institute staff and interns watched as their major work task of the year was christened: eight Texas Longhorn cows were turned into our newly fenced pasture. ...The pasture is on the 160 acres north of Water Well Road, northeast of The Land Institute's office. The cattle fill the role that animals do in any ecosystem, helping to cycle nutrients.

Grazers were a large component of the native tallgrass prairie, our model here. The hilly uplands, even the more gently sloping parts, are subject to erosion and should remain as prairie. Someday our perennial polycultures may have some place here but for now maintaining a functioning prairie ecosystem is our goal. Properly managed grazing can accomplish this goal and also allow the animals to be part of a larger farming system.

Just as bison grazed the tallgrass prairie, cattle will graze our prairie. Cattle do not graze exactly the same as bison, but they are easier to manage... We are using the Texas Longhorn breed because they do better on a forage diet than other breeds, a very important trait since we intend to produce primarily grass-fed beef. Their natural disease resistance, acquired through centuries of evolving in a semi-wild state, makes them well suited to organic production practices.

Dave Tepfer—Intern, Research Assistant, 1994-1996

This production system draws on traditional practices of grazing cows and yearlings along with feeding them some harvested crops and crop residue. ...As much as possible, we are using crops and livestock and production practices that are familiar and proven in this region over time. While many farms today are moving away from integration of crops and livestock, we seek to return to and build on traditional practices, modifying them as necessary based on ecological standards, and combining them with new energy efficient technologies.

With the fence done and the cows out there, the grazing management begins. ...This first year we will graze ten cows in a system of paddocks fenced by electric polywire. This light movable wire will allow us to be flexible in our paddock size and configuration and gain some of the benefits of controlling where the cattle graze. We will ...move the cows every few days [through] eight or ten separate grazing areas, [so that] each area will get about a month to rest before it is grazed again. After this year we will also be grazing yearling calves.... We will need to adjust the number of cattle and their supplemental feed as we learn what the prairie can sustainably produce.

Through the remaining years of this project we will closely monitor species diversity and forage production on the grazed prairie. For comparison we have eighteen small exclosure areas fenced off within the area that is grazed, as well as 60 acres of unplowed prairie right across the fence that will not be grazed. These areas will serve as standards which will help us understand the effects of grazing on the prairie.

1995

Fall, 1994. Longhorn cattle begin grazing 100 acres of native and restored prairie on the quarter section as part of the Sunshine Farm project.

Notes from the Intern Garden

John Curtis

Number 53, Summer 1995

"THE ARRANGEMENT WILL ONLY BE CORRECT IF IT LOOKS AS IF THE FLOWERS HAVE BEEN GROWN IN THE POT."
SHEN FU.

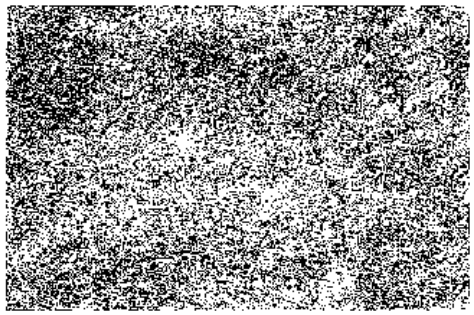
The intern garden at The Land Institute is a place where this year's group of interns has the opportunity to experiment with landscape management and to test ecological principles on the land. As landscape managers we have to keep three major factors in mind. First, we depend on the garden to produce most of our food for the summer and fall months. Second, we have a responsibility to leave the soil in at least as good a condition as we found it for future intern groups. Third, as students of natural systems, we ask what we can learn from the prairie and how to apply these principles to the garden.

John Curtis in the garden

Applying ecological principles to the garden isn't as elusive or impractical as it may sound, and the prairie provides some useful models. Let's take ground litter for example. Say you're a well-established clump of big bluestem and your local ecosystem hasn't seen a good prairie fire in a year or two. The soil around your roots will be covered by a thick mat of dead plant material which protects the soil from erosion, helps retain precious water and all but eliminates any invading annuals. Apply this principle to the garden and that dead plant material (usually hay, straw or pulled weeds) is called mulch. Mulch improves the soil, reduces watering and weeding, and creates an ideal medium for young transplants out of the greenhouse.

1995 intern Doug Walton with Honorary intern Olivia

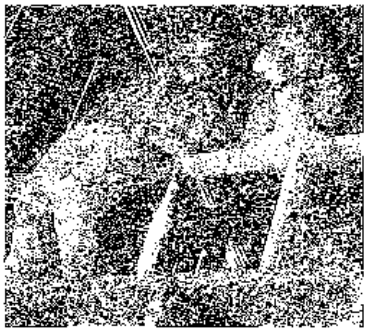
On the prairie you won't find rows of course (unless you're at the Land Institute and accidentally venture into a former research plot), but neither do you often find isolated individual species. The careful observer is more likely to see a grouping of one species over here and of another over there with some overlap between the two. In the north beds of the garden we've mimicked this pattern with patches of vegetables overlapping one another. Additionally, we try to arrange plants so that they tend to complement rather than compete with each other; for example planting onions with the brassicas deters cabbage worms, corn benefits from nitrogen fixed by beans and so on.



Raised bed

The prairie often exhibits several species of what we commonly think of as a single plant. There are half a dozen milkweeds for example, and many more sunflowers. Certain sunflower species seed earlier than others and in given years some flourish while others decline. Again, we've tried to adopt this principle to the intern garden. We have over a dozen varieties of tomatoes, and nearly as many types of potatoes, peppers, beans, sweet corn, melons and so on. Like nature, we're hedging our bets and extending the harvest by not relying on just one or two types.

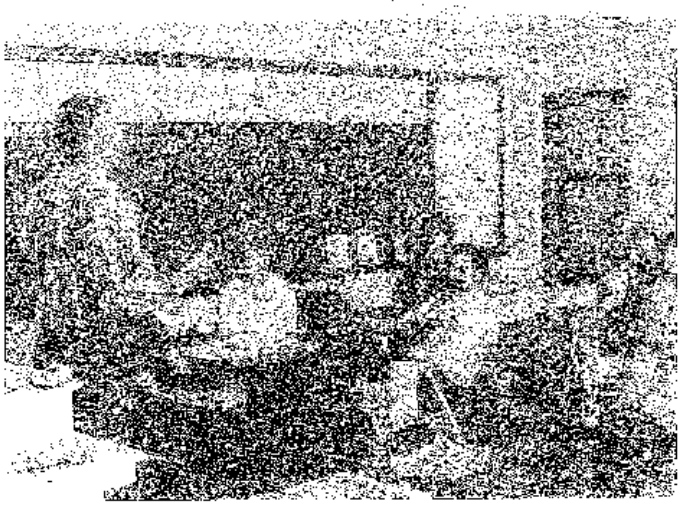
Likewise, we look to the prairie for other models to follow in landscape management such as perennialism, principles of succession, evolution and so on. ...The bottom line is that as we learn to apply the complexity of natural principles to the garden and to the landscape as a whole, beauty, diversity, fertility and productivity will naturally follow. ...By using nature as measure in the intern garden, we're entering into a more intimate relationship with the natural world, ensuring that both will endure.



1995 interns Karen Andersen and Todd Wetzel

January, 1995. The Land Institute signs a cooperative mission statement with Kansas State University to encourage USDA research in "Natural Systems Agriculture."

Spring, 1995. A 4.5 KW photovoltaic array is installed at the Sunshine Farm. Meanwhile, the old wind generator poles on the rise by the classroom building are taken down.



Pete Ferrell meets with Tallgrass Prairie Producers at the school

The Land Institute in Matfield Green

Brian Donahue, Wes Jackson and Nancy Scott

Number 54, Fall 1995

Matfield Green is typical of America's small rural places. Its current economy is heavily dependent upon the extraction of non-renewable resources, both locally and around the world. Much of the productive land in the region is absentee-owned, so both the produce from the land and the profits from local enterprises tend to be exported. The population of Matfield Green and the surrounding countryside has been dropping steadily for decades, and is aging. But like many rural places, the Matfield Green area is still home to a group of dedicated families and individuals who wish to make a living there in a sustainable way.

Fossil fuel energy subsidizes farming in the Flint Hills and the larger economy of which local agriculture is a part. Most farmers in the Matfield Green area, as elsewhere, depend on petroleum products for traction, synthetic fertilizers, pesticides and herbicides to grow their crops. Transient graziers truck cattle from southern winter pastures to the Flint Hills in the spring, then from Flint Hills pastures to feedlots outside the region in the fall. These feedlots concentrate the grain produced by petroleum-subsidized farming over a wide region. Given the limited supply of fossil fuels and the environmental impact of their rapid consumption, these practices are not ecologically sustainable. Neither is the economy which treats the countryside as a pool of resources from which grain and beef are to be extracted as efficiently as possible, with no regard to the future of places like Matfield Green.

Conference Coordinator Emily Hunter

The Land Institute's program in Matfield Green seeks to employ the insights of ecology as better organizing principles for human communities. Our goal is to develop conceptual tools which will help minimize dependence upon non-renewable resources, and maximize possibilities for local cultural innovation and adaptation. We are beginning by studying the ecological history of Matfield Green and a representative portion of the surrounding creek bottoms and upland range. We will identify a succession of "ecological regimes" and evaluate the degree to which each was sustainable, and determine what forces drove evolution from one stage to the next. We hope to draw on the experience of local residents throughout our work. This will give all of us a deeper sense of how Matfield Green came to be the way it is, and will suggest options to pursue for a sustainable future.

Ecological history will help us draw meaningful boundaries and better understand the interplay of parts for making an

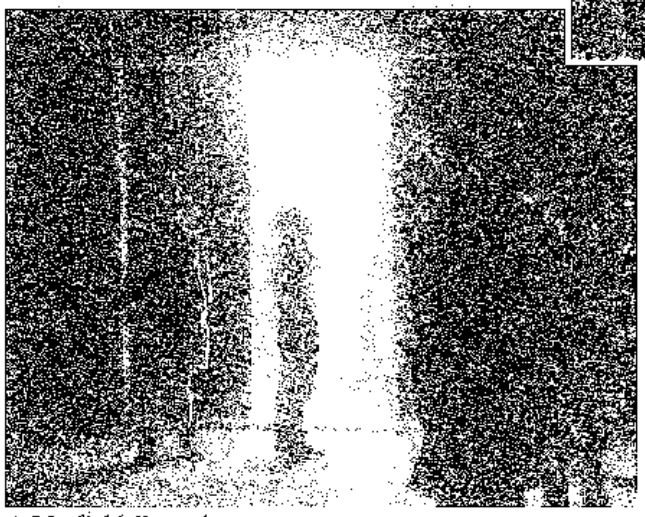
Matfield Green school

May 27-28, 1995. The 17th Prairie Festival, "Becoming Native to this Place," is held in a sea of mud. Alice Waters and friends prepare the food. The featured speakers include Mary Catherine Bateson, Cathrine Sneed, and Angus Wright.

1995 intern Lisa Mosca

"ecological community accounting," the next stage in our research. We propose to study Matfield Green and the surrounding landscape as an ecologist would study an ecosystem. We will measure the flow of energy, materials and nutrients into and out of the system, and examine the dynamics within. Communities are endowed with ecological capital such as minerals, deep soil, timber, and rich prairie grasses. Such assets are protected by healthy ecosystems. The erosion of this capital through export, destruction or ecological over-simplification must eventually be accounted and paid.

This sort of accounting will identify shortfalls and surpluses that might be redirected to meet long-term local needs. We believe balanced ecological books—characterized by relatively equivalent inputs and outputs, based primarily on renewable resources like sunlight, water and muscle power—cannot be separated from a prosperous and enduring community life.



A Matfield Green barn

As our research evolves, our educational program will develop alongside it. We will create a program of workshops to introduce teachers to our research and methods. Our projects and facilities will be available to teachers from institutions throughout the region for field trips and special classes. This educational model is exemplified by Terry Evans, The Land Institute's Art Associate and a nationally recognized photographer. Terry has her darkroom in the school basement and spends about one week every month working in Matfield Green, photographing townspeople and the surrounding landscape. But beyond her own work, Terry has run workshops and classes on photography and land use with community members, and with teachers and students in the Chase County schools. Operating in this way, artists and scholars can pursue their own specialties, teach, and learn from the people who know Matfield Green best.

We would like to see places like Matfield Green remain viable, places where the young are raised in a healthy and productive way and are able to return to live if they desire. But we cannot promote a return to these places with the same set of assumptions with which they were originally settled—the assumption that resources are infinite and that it makes no difference how or where we extract them, so long as it is cheap and efficient. Those assumptions have led to the decline of thousands of places like Matfield Green, in spite of the best efforts of those who have cherished them. We hope to discover, in one such place, how the costs imposed by the industrial economy have remained hidden for so long. The Land Institute would like to help put rural communities on a more secure economic footing, by inventing a new, ecological form of accounting that recognizes the value of places like Matfield Green.

Wes Jackson is President of The Land Institute, Brian Donahue is Director of Education, and Nancy Scott assisted our endowment effort in 1995.

October, 1995. President Clinton signs agricultural appropriations legislation expecting the Secretary of Agriculture to "make an analysis of the feasibility, productive potential, and economic and environmental benefits of long-term natural systems agriculture and to identify associated near-term research needs."

Natural Systems Agriculture

Wes Jackson

Number 55/56, Summer 1996

In 1978, I published a paper entitled "Toward a Sustainable Agriculture" which first appeared in *The Land Report,* and then in the Friends of the Earth publication *Not Man Apart.* I argued for an agriculture based on the way the prairie works. I later expanded the argument in a small volume entitled *New Roots for Agriculture* (1980). Over the years researchers at The Land have built on that "nature as standard" notion. Our thinking about an ecological agriculture has gone far beyond the 70's. Not only have we rephrased and sharpened the relevant scientific questions, we have broken those questions down to more manageable proportions and begun to answer them.

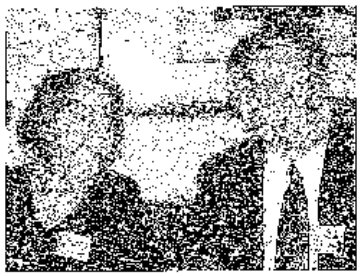
It may sound like the "nature as standard" idea began with my publications. Nothing could be further from the truth. In a memorable speech delivered at the dedication of our new greenhouse in 1988, Wendell Berry traced the literary and scientific history of our work. First he cited Job, who said "speak to the earth, and it shall teach thee." Next he mentioned Virgil, who, at the beginning of the *Georgics* (36-29 BCE) advised that "before we plow an unfamiliar patch it is well to be informed about the winds." He moved on to quote Spenser and Shakespeare who cast nature as the instructor of creatures and the ultimate earthly judge of their behavior. Milton, in *Comus*, had the lady say "she, good cateress, means her provision only to the good that live according to her sober laws." Finally, Wendell drew on Alexander Pope who in his *Epistle to Burlington* counseled gardeners to "let Nature never be forgot" and to "Consult the Genius of the Place in all."

Later in his speech, Wendell pointed out that the Romantic poets lost interest in a *practical* harmony between people and land. This idea surfaced again among agricultural writers with a scientific bent. In *The Holy Earth* (1915), Liberty Hyde Bailey advanced the notion that "a good part of agriculture is to learn how to adapt one's work to nature." In *Tree Crops* (1929), J. Russell Smith argued that "farming should fit the land." Smith was disturbed with the destruction that occurred because "man has carried to the hills the agriculture of the flat plain." He believed that an agriculture modeled on the forest and featuring trees was required for hilly regions. Sir Albert Howard also thought we should farm like the forest, for nature is the "supreme farmer." In *An Agricultural Testament* (1940) he wrote:

> Mother earth never attempts to farm without livestock; she always raises mixed crops; great pains are taken to preserve the soil and to prevent erosion; the mixed vegetable and animal wastes are converted into humus; there is no waste; ...

More recently, Judy Soule and Jon Piper have outlined a detailed science of Natural Systems Agriculture in *Farming in Nature's Image.* Such an agronomy would begin by consulting nature as these writers have all advised. An agriculture modeled on the prairie, featuring perennials, would finally make hillside harvest of mixed grains sustainable.

It may appear that what we have done at The Land Institute follows from a long succession of thinkers in a literary and scientific tradition. But as Wendell Berry said about the agricultural writers of our century, these expressions probably arose from a succession in the "familial and communal handing down of the agrarian common culture, rather than in any succession of teachers and students in the literary culture or in the schools." For the most part these writers did not build on other writers who had gone before. Therefore, as Wendell said, they form a series, not a succession.



Alice Waters and Wes Jackson in Lawrence, Kansas, 1994

What we hope at The Land Institute is that Natural Systems Agriculture marks the beginning of a succession in the formal culture running parallel with the succession underway in the common culture over the millennia. The agrarian culture which time and again grasped the necessity of consulting nature now faces industrial agriculture, which has completely disowned the ancient tradition of humility and restraint, and rests on the assumption that nature can be dominated or ignored. We believe we have shown the possibility of a better solution to the "problem of agriculture" with a research agenda based on a marriage of agriculture and ecology.

What new insights does acceptance of the Darwinian evolutionary ecological world view bring to agricultural research? Most agronomists utilize evolutionary theory well enough at the level of *tactics*, as in breeding high-yielding crop varieties. But a thorough understanding of Darwin would force agricultural research to expand the boundaries of consideration beyond short-term production to a *strategy* of long-term, sustainable production that does not mar the rest of Creation.

Let us consult Darwin. From his unedited notebook comes this crucial passage:

> One may say there is a force like a hundred thousand wedges trying force into every kind of adapted structure into the gaps in the economy of Nature, or rather forming gaps by thrusting out weaker ones. The final cause of all this wedgings, must be to sort out proper structure and adapt it to change.

To say this evolutionary change was due to wedges creating pressure from the outside inward would be as wrong as to say it was pressure from inside out. Darwin's realm of consideration was the entire ecology. The creative force for change is a very large context, a much larger context than nearly all agricultural researchers consider. Furthermore, parts affect wholes and wholes affect parts. The dynamic

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1996

April, 1996. Wes Jackson submits a report entitled "Natural Systems Agriculture: The Solution to the Problem of Agriculture" to the USDA. The report outlines a methodology for integrating natural systems agriculture research into the USDA Agricultural Research Service.

May 24 - 26, 1996. The 18th Prairie Festival, "The Marriage of Ecology and Agriculture, the Next 20 Years," features Conn Nugent, Kathleen Merrigan, José Lutzenberger, Donald Worster, and Wendell Berry.

involves interpenetration amongst living things and between the living and non-living world. Evolution is not due to the simple working out of immutable parts in a hierarchy, as is proposed by Cartesian reductionism.

The largest boundary we humans consider at any one moment defines a certain slab of space/time. Within that boundary comes the *strategy* for any who seek to manipulate the world. Subsets within the boundary are sources of *tactics*. If the boundary is reduced to a subset, then what was once a tactic becomes strategy and the larger goal may be missed.

In football the strategy to win has nested considerations called tactics. Theoretically, a team could ignore the opponent's ground game and concentrate entirely on their stronger passing attack. What might have been a tactic to stop the pass becomes strategy. The coaches could elect to "bottle up" the opponent's two best receivers by placing five men on one and six on the other. But now the undefended quarterback could throw to another receiver, or simply run down the field and score a touchdown every time the ball is snapped. Leave other possibilities outside the realm of consideration and you lose.

Absurdity always enters when the boundary of consideration is too narrow. But what we see clearly when we think of a football game often escapes us when it comes to agricultural research. Spraying to eliminate a particular bug opens up a niche for other kinds of bugs or causes other forms of damage. Health care is in the same fix, because pathogenic agents adapt and change as their environment changes. Both industrialized agriculture and modern medicine (including public health) have suffered from narrow strategic thinking, thinking that should have been in the realm of tactics, not strategy.

Professor Richard Levins at Harvard's School of Public Health has pointed out that this is why both agriculture and medicine have been confronted by surprises in recent years, with more surprises coming. Antibiotics give rise to new pathogens. Pesticides increase pest problems. Introduction of high-yielding crops increase food supply, but can also increase human inequality and thus *decrease* access to food for many. Infectious diseases once in decline now expand including tuberculosis, cholera, malaria, and rabies. Levins has described the present cholera epidemic as residing "in a much larger whole than usually considered by microbiologists or clinicians whose paradigm is more limiting." This whole includes (besides the bacterium itself) plankton blooms related to coastal pollution, increased international shipping of ballast water, and dismantling of Third World social services under pressure from the World Bank.

The need to expand the boundary of consideration in agriculture can be illustrated by a recent study promoting the use of some of America's agricultural land for alcohol fuel production. A scientist in the plains advocates planting marginal cropland to switchgrass as a fuel source, saying that a mere 1.5 acre tract would yield 770 gallons of ethanol—enough to drive the average family vehicle 10,000 miles each year. But as this *Land Report* recalls, perennial enthusiasm for land-based fuels is usually the consequence of considering gross energy harvest only. This proposal specifies that 100 pounds of nitrogen per acre be applied annually. To account for the fossil fuel energy cost to *produce* that fertilizer, one has to include manufacturing, packaging, and distributing it. When the boundary of consideration is broadened, and the entire balance considered, the end result of the analysis is that for each BTU of gross ethanol output, 0.77 to 0.90 BTUs of what we might call cultural energy input must be subtracted. Much as we may approve the idea of returning erodable cropland to perennial grass, turning around and asking that land to fuel automobiles will never get us very far.

By expanding the boundary of consideration we see that the cholera bacterium is not the "cause" of disease but rather an "agent," and that the energy and material inputs to agriculture are as important as the outputs. Narrowing the boundary, on the other hand, forces dualism. Annual monocultures that over-emphasize production make resource conservation a problem. Thus, we have a USDA Agricultural Research Service dedicated to increasing yields and we have a USDA Natural Resources Conservation Service dedicated to mitigating the consequences. The stated mission of the NRCS is to help people *conserve, improve and sustain* our natural resources and environment. This is necessary because of the fundamental split between production and conservation.

The two oldest chestnuts in agriculture, and the hardest to crack, are how to obtain a bountiful harvest and how to assure that future bountiful harvests are not jeopardized. The first question requires us to explore ways to maximize sun-sponsored fertility through ample supplies of moisture and how to provide protection from insects, pathogens and weeds. The second question causes us to consider how to minimize soil erosion and other losses of ecological capital. These two chestnuts must be cracked not in artificially imposed isolation from each other, but as falling from the same tree, within the same realm of consideration.

The Land Institute's approach to sustainability in agriculture is predicated on an evolutionary-ecological view of the world in which the essentials for sustainable living have been sorted out and tested in nature's ecosystems over millions of years. Evolutionary biologists have learned a great deal as to how ecological bills are paid by the systems which build soil and minimize epidemics. A primary feature of Natural Systems Agriculture is to mimic the structure of a natural ecosystem enough to be granted the function, even though we may have improved some of the components for human purposes--for example, perennial species bred for high seed yield. Following Virgil, we have begun to inquire into "the native traits and habits of the place, what each locale permits, and what denies." Given twenty-five years or less of properly bounded research, our country could make soil conservation a *consequence* of grain production.

August, 1996. The number of Friends of The Land Institute reaches 2300, from 16 countries on five continents. We are actively seeking Friends in Africa and Antartica.

September, 1996. The Land Institute celebrates its 20th anniversary.

Prairie Festival 1996

Like this *Land Report*, the 1996 Prairie Festival celebrated the Land Institute's twentieth birthday. In keeping with Prairie Festival tradition, torrential thunderstorms passed through on Friday night, Saturday night, and Sunday afternoon, creating the proper dramatic atmosphere. An all-star cast of speakers looked at the challenges ahead—you may refer to the tape order form that follows for their names. On Sunday morning, nine poets swapped poems for two hours before a packed barn. Two new films about farming in America were shown, *Troublesome Creek* and *My Father's Garden*. Music was provided by Scottish songwriter Frieda Morrison, along with prairie perennials Ruby Tilton, Ann Zimmerman, and caller Mike Rundle and the barn dance band. Charlie Rascoll of Wheatfields Bakery in Lawrence and the Prairieland Food Coop prepared great meals. We have been helped in featuring Kansas organic food the past two years by a grant from the Kellogg Foundation (administered by the Kansas Rural Center) to encourage sustainable agriculture in Kansas.

John Simpson

Wes Jackson presented Terry Evans photographs to John Simpson, a founding board member and long-time treasurer who was instrumental in getting The Land Institute organized; and to Edith Muma, who headed the Noyes Foundation when it gave us our first grant in 1978, before we had so much as a letterhead to submit the proposal on.

Among the many thinkers and doers who have spoken at the Prairie Festival over the years, there are two who have had a particularly important influence on many of us here at The Land Institute. Donald Worster and Wendell Berry spoke at the 1982 Prairie Festival, and excerpts from their talks ran side-by-side in the *Land Report*. After the 1989 symposium on the Marriage of Ecology and Agriculture, the same thing occurred. Both again gave fine talks at this year's Prairie Festival. Don Worster's is excerpted here; Wendell Berry's could not be printed yet because of a publication conflict. We have substituted portions of another speech of his. The conversation continues.

Private Property and the Commonwealth

Wendell Berry

Excerpted from Another Turn of the Crank, Counterpoint, 1995. Reprinted by permission.

This essay owes its existence to anxiety. I write, as I must, from the point of view of a country person, a member of a small rural community that has been dwindling, perhaps for most of this century and rapidly since the end of World War II. Only the most fantastical optimism could ignore the possibility that my community is doomed—that it was doomed by the overwhelming victory of industrialism over agrarianism (both North and South) in the Civil War and the history both subsequent and consequent to it. It may be that my community—its economy, its faith, its local knowledge, its affection for itself and its place—will dwindle on for another generation or two and then disappear or be replaced by a commuters' suburb. If it is doomed, then I have no doubt that much else is doomed also, for I cannot see how a nation, a society, or a civilization can live while its communities die.

Wendell Berry

If that were all my thought, then I might find some comfort in despair. I might resign myself and at least sleep better. But I am convinced that the death of my community is not necessary and not inevitable. I believe that such remnant communities as my own, fallen to the ground as they are, might still become the seeds of a better civilization than we now have—better economy, better faith, better knowledge and affection. That is what keeps me awake, that difficult hope.

In my own politics and economics I am a Jeffersonian—or, I might more accurately say, I am a democrat and an agrarian. I believe that land that is to be used should be divided into small parcels among a lot of small owners; I believe therefore in the right of private property. I believe that given our history and tradition, a large population of small property holders offers the best available chance for local cultural adaptation and good stewardship of the land—provided that the property holders are secure, legally and economically, in their properties.

To say that the right of private property has often been used to protect individuals and even global corporations in their greed is not to say that it cannot secure individuals in an appropriate economic share in their country and in a consequent economic and political independence, just as Thomas Jefferson thought it could. That is the political justification of the right of private property. There is also, I believe, an ecological justification. If landed properties are democratically divided and properly scaled, and if family security in these properties can be preserved over a number of generations, then we will greatly increase the possibility of authentic cultural adaptation to local homelands. Not only will we make more apparent to successive generations the necessary identity between the health of human

continued on page 65

Walking the Back Forty

Donald Worster

Excerpted from a talk given at Prairie Festival 1996

In the midst of confusion and uncertainty, when signs of the times are discouraging or hard to read, one turns back to holy word. I don't mean the bible, as useful as it may be. For most conservationists, the holy word still comes from Aldo Leopold, the prophetic voice of the modern conservation movement, author of *A Sand County Almanac.* He was, it is important to remember, himself uncertain about the overall direction of history, and for good reason. He lived in even more troubled times than our own: the 1930s, the era of the Great Depression, and the 1940s, an era of world war and atomic bombs, of fascism's rise and defeat. Faced with so much global tumult, Leopold stayed focused on the fate of conservation, particularly in rural areas of the Midwest, far from the centers of world conflict, power, and concern. What he saw there was not encouraging. "Despite nearly a century of propaganda," he wrote, "conservation still proceeds at a snail's pace... On the back forty we still slip two steps backward for each forward stride." Most Americans of his day were not interested in the back forty, the uncharismatic lands just down the road, but for him it was where the long-term struggle for conservation must be won or lost. And it was being lost, he feared, more or less.

Donald Worster

Yet Leopold was, on the whole, an optimist who found in the long course of evolution a reason to hope. Evolution is more than biological, he believed; it is also cultural and ethical. People do learn from their past, and they do acquire, however slowly, new knowledge and new attitudes. Even on the back forty, we may expect cultural change to go on, and some of that change may be enlightenment. Hope in that potentiality of human evolution can counterbalance feelings of despair over the pace of change, or darker premonitions of doom.

Leopold went on to give us as clear a way to evaluate progress as anyone has done. When we have "quit thinking about decent land-use as solely an economic problem," he wrote, when we have begun to examine our relations with nature in terms of "what is ethically and esthetically right, as well as what is economically expedient," we will be succeeding. And then he added that famous, often quoted line, the best standard we have ever had for evaluating our behavior: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community." He called that standard a "land ethic" and added that it is an ecological necessity and an evolutionary possibility.

Marty, David Brower, Amory Lovins, Wes—PF 79

The biggest obstacle standing in the way of a land ethic is not our scientific knowledge but our economic values. We still think about the land as a commodity rather than a community.... No ethic, social or environmental, can ever flourish in a climate of unrestrained economic self-interest. A land ethic comes at a cost. Are we willing to pay it?

An ethic, Leopold wrote, is a "limitation on freedom of action in the struggle for existence." Freedom of *economic* action may be taken as his meaning. A land ethic takes away some of our economic freedom. Are we willing to give it up?

Land, Leopold observed, "is still property. The land-relation is still strictly economic, entailing privileges but not obligations." We have to begin putting some obligations into place.

Now I realize that I am picking at some highly sensitive nerves. The idea of private property is, in the eyes of many citizens, a sacred truth, first inscribed in that other tablet of stone that Moses brought down from Mount Sinai, the one that reads, "Thou shalt not interfere with my rights. Thou shalt not even speak harshly to me, the property owner. Thou must pay me, and pay me well, for any obligation I am expected to meet." The institution of private property in land, however, did not come down to us from Moses or from any other religious authority. It is a modern secular invention, not much older than the steam engine, and it was invented for one compelling reason: money. Privatizing property was supposed to increase the incentive of people to produce wealth from the land. It was not invented for the conservation or the protection of nature. It was invented as part of an economic revolution that was completely modern and fundamentally materialistic. Make no mistake about that. Turning the earth into private property was done to promote the wealth of individuals and of nations.

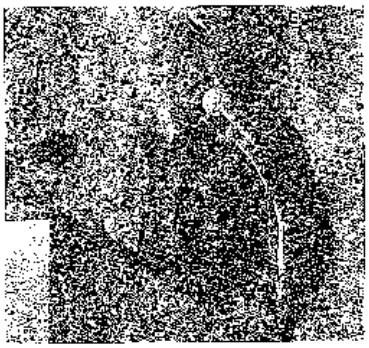
John Todd—PF 80

Over the past few years the institution of private property has been more stridently defended than ever, as various private property groups have organized to fight regulations imposed on them for environmental protection. They insist that almost any kind of restraint is morally wrong. Nowhere is this argument made more fiercely than here in Kansas, where certain agriculturists and land developers have made common cause. They do not want a land ethic imposed on them. In fact, they do not want a land ethic.

Sixty percent of the nation's land is owned privately; ninety-eight percent of Kansas is. But only a very small group of people own that land. They are a minority but different from all other minorities. They either have had enough money to buy land or they have inherited it. Many have bought out their neighbors—enthusiastic winners in the "free enterprise" system. Put another way, little of our land heritage these days is in the hands of small-scale, traditional rural farmers, nor even in the hands of ex-urbanites looking for solitude. The vast portion of the land is held by

those who seek, with varying intensity, to use property to improve their wealth.

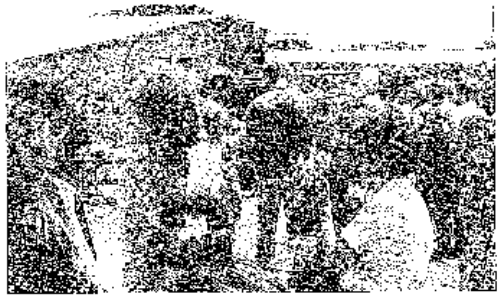
The inescapable fact is that a land ethic must either emerge spontaneously among such owners, which is highly unlikely, or it must be taught, encouraged, and enforced by others, by non-landowners. Finally, when methods of persuasion fall short, and at some point they will, a land ethic must be imposed by law. Progress toward conservation, in other words, requires nothing less than a reinvention of the institution of private property. Property must be seen as a social as well as an individual good, a community concern rather than simply private. Before I turn to how we might do that, I want to look at a couple of alternatives and show why they are not practical or sufficient.



Marty Strange—PF 90

First, there is the alternative of complete and final termination of all private property in the United States. That would be our equivalent to emancipating all the slaves of the Old South. Nothing like that is going to happen in our lifetime or our children's lifetime. The only way would be for government to buy up the entire sixty percent of America that is not already in its hands, which for obvious political or financial reasons is not possible. If we cannot find enough money to fund a handful of artists through a national endowment or to pay for Medicare, then we are unlikely to find enough money to buy up nearly a billion and a half acres of private land.

The second alternative is the back-to-the-land ideal, redistributing land among more individual owners. Rather than a mere two or three percent of the population, some say, we should have five or ten or even twenty percent of the people living on the land, owning their own property. How exactly that is to happen remains a mystery. The market has been working precisely in the opposite direction for most of our history. If government now steps in to try to change that pattern, then what is it supposed to do? Take land away from the biggest owners and give it to the little people? Fat chance.



Kelly Kindscher, Sandy Strand, Terry Evans

Even if we managed some redistribution of land, so that only 90 percent instead of 97 percent of us were left living in cities and suburbs, we would not necessarily have attained Leopold's ideal of a land ethic. We could very easily go on thinking about land as property, entailing privileges but not responsibilities. To move beyond that attitude we would still have to reinvent the idea of property. We would still have to move seriously toward a limitation on freedom of action on the back forty.

The only effective way to do that, and our only plausible hope at this point in our nation's history, is to mobilize the majority of Americans, which is to say urban Americans, into a movement that will change the package of rights and responsibilities pertaining to property. Such a mobilization would bring together people who may not own land but want to see it used in an ecologically sensitive manner. That is to say, it would rely on the engine of politics.

Deborah and Frank Popper—PF 90

Here is what mobilizing public opinion to limit freedom of action on the land would mean. The public would begin to say to the property owner, you cannot drain that wetland; we forbid it. You cannot destroy the habitat of a threatened species. You cannot let chlordane or atrazine run off your crops and into the river. You cannot allow the soil to wash or blow away. As you use land, you must try to preserve the integrity, stability, and beauty of the biotic community. Failure to do so will bring penalties. You may have to pay higher taxes or heavy fines. You may even lose your title.

Put this way, it is clear that the burdens of an ecological conscience would fall disproportionately on those few Americans who are the owners of private property. There is no other way. They would have to bear costs and obligations that the average citizen does not. They would have to forego profit in many cases, or they would have to incur costs that they may not want to pay. Most of these costs can and will be passed on to the consumer; in the end, the whole public is going to have to pay more for food and fiber if we are going to achieve a land ethic.

Where owners are not able to pass on the costs, and cannot afford to pay them themselves, they will have to have direct help from the taxpayer. Incentives and subsidies can make change less painful. But make no mistake about it; a land ethic is going to be an expense that in most cases the holders of private property will have to pay and, in some instances, pay severely. They may lose by taking land out of production, by harvesting forests differently, by giving up prospective rents and gains from putting in a golf course or mall. Either that, or we will never achieve a more ethical relation to nature in this nation or any other.

So here is what conservation is going to have to mean in the future: applying ecological knowledge to the use, and to the nonuse, of land through the democratic political process. I have talked about costs; here is an important gain: a reinvention of property can, if we work it right, involve people in land decisions who have never been much involved before. More women can be included as well as men.

People of color can be there along with whites, poor folks along with the rich. When that happens, and only when that happens, will land truly become a community possession and a community responsibility.

The federal government will have to enact legislation that will make land ownership more of a public responsibility. On the other hand, a new ethic toward land can also come through organized political action on state and local levels. In fact, the best chance we have for a truly effective, sensitive, and informed land ethic is on those lower levels of governance, in the halls of the state legislature or in the meeting rooms of the county commission. It is there in particular that we must get people together to rewrite the rules.

I have indicated that it is necessary for a land ethic to grow and spread across America. Are we gaining or losing ground? Read the daily newspapers, and you will see lots of bad news as more and more of our best farm land goes under concrete, as legislators try to strip away whatever small protection the land has. But there is some good news here, too. We have created a political and cultural movement that is unprecedented in American history, and that movement is still gathering momentum. It is not finished nor is it defeated. Increasingly, it is spreading beyond the national scene and the big public land and health issues

Faith Rand teaches spinning—PF 96

down to the local and the near at hand. It is changing the conversation over all this country about land and nature. It is bringing committed scientists, humanists, and artists into the halls of policy makers to contest the rule of outmoded economics. It is putting traditional property attitudes under scrutiny and challenge. Slowly, in the teeth of much resistance, it has begun changing the ethics that govern our relation with the natural world.

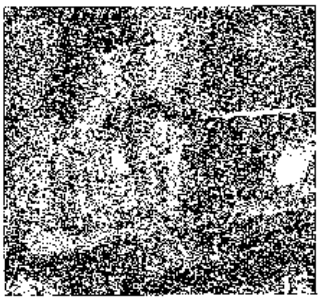
Can we say that we are doing better than Leopold thought? I think we can. We are taking at least one and a half steps forward for every step back. That is not much to claim. But that, after all, is exactly how evolution works.

Wendell Berry

(continued from page 62)

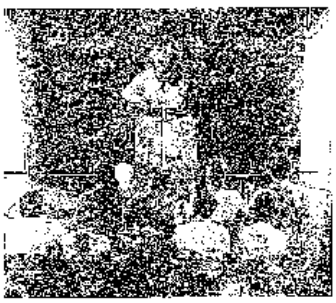
communities and the health of local ecosystems, but we will also give people the best motives for caretaking and we will call into service the necessary local intelligence and imagination. Such an arrangement would give us the fullest possible assurance that our forests and farmlands would be used by people who know them best and care the most about them.

My interest here is in preserving the possibility of intimacy in the use of the land. Some of us still understand the elaborate care necessary to preserve marital and familial and social intimacy. The possibility of intimacy between worker and place is virtually identical with the possibility of good work. True intimacy in work, as in love, means lifelong commitment; it means knowing what you are doing. The industrial consumer and the industrial producer believe that after any encounter between people or between people and the world there will be no consequences. The consumptive society is interested in sterile or inconsequential intimacy, which is a fantasy. But suppose, on the contrary, that we try to serve the cultural forms and imperatives that prepare adequately for the convergence of need with fertility, of human life with the natural world. Then we must think of consequences; we must think of the children.



Ann Zimmerman—PF 88

I am an uneasy believer in the right of private property because I am aware that this right can be understood as the right to destroy property, which is to say the natural or the given world. I do not believe that such a right exists, even though its presumed existence has covered the destruction of a lot of land. A considerable amount of this destruction has been allowed by our granting to corporations the status of "persons" capable of holding "private property." Most corporate abuse or destruction of land must be classified, I think, as either willing or intentional. The willingness to use land on a large scale implies inevitably at least a willingness to damage it. But because we have had, alongside our history of land abuse, a tradition or at least a persistent hope of agrarian economy and settled community life, the damage to the land that has been done by individual owners is more likely to be attributable to ignorance or to economic constraint. To speak sensibly of property and of the rights and uses of property, we must always observe this fundamental distinction between corporate property and property that is truly private—that is, property of modest or appropriate size owned by an individual.



Francis Hole—PF 86

Our history, obviously, gives us no hope that in our present lack of a general culture of land stewardship, the

weaknesses in our idea of private property can be corrected by the idea of public property.

There is some hope, I think, in the idea of the commonwealth, which seems to acknowledge that we all have a common interest or share in the land, an interest that precedes our interest in private property. The best evidence of this precedence of our share in the common wealth is that we share also a common health; the two, in fact, are inseparable. If we have the "right to life," as we have always supposed, then that fact must stand upon the further right to air, water, food, clothing, and shelter.

It follows that every person exercising the right to hold private property has an obligation to secure to the rest of us the right to live from that property. He or she has an obligation to use it in such a way as not to impair or diminish our rightful interest in it.

But—and here is the catch—that obligation on the part of the landowner implies a concurrent obligation on the part of society as a whole. If we give our proxy to the landowner to use—and, as is always implied, to take care of—the land on our behalf, then we are obligated to make the landowner able to afford not only to use the land, but to care properly for it. This is where the grossest error of our civilization shows itself.

In giving a few farmers our proxies to produce food in the public behalf for very little economic return, we have also given them our proxies to care for the land in the public behalf for no economic return at all. This is our so-called cheap-food policy, which is in fact an antifarming policy, an antifarmer policy, and an anti-land policy. We have also a cheap-timber policy, which is similarly calamitous.

Helena Norberg-Hodge—PF 93

We hold the land under a doctrine of private property that in practice acknowledges no commonwealth. By allowing or forcing the owners and users of productive land to share in the commonwealth so minimally that they are poorly paid for their work and not paid at all for their stewardship, we have stood an ancient pyramid on its tip. We now have an enormous population of urban consumers dependent on a tiny population of rural producers. And this involves a number of problems that are not merely quantitative or practical. ...[A]s farming families dwindle away, we lose not just essential and perhaps irreplaceable knowledge but also an old appreciation and affection that may be even more valuable.

Conservationists have now begun to acknowledge that the health and productivity of the land constitute a commonwealth. I say they have *begun* to acknowledge this because at present they tend to acknowledge it only so far as it pertains to forested or otherwise "wild land," the land that most conservationists understand as "natural." They wish to protect the common wealth of the forested land by some such doctrine as "the forest commons." But the danger is that this will accomplish only one more anomalous inversion; from a doctrine of private landownership that acknowledges no commonwealth, we might go to a doctrine of commonwealth in which there are no private shares. "The forest commons," I am afraid, may become an idea that will separate forestry and forest conservation from the rural economy, just as industrial agriculture is an idea that has separated farming and soil conservation from the rural economy.

Piper Eugene Lamm

To insist that our public forests should be cared for and used as a commonwealth already strains belief for it raises immediately the question of where we are to find the people who know how and are adequately motivated to care for it. Our history—which is the history of a colonial economy—has not produced, because it could not produce, an adequate number of people adequately prepared to be good stewards of the public lands any more than of lands "privately" owned. Colonial economies place no value on stewardship, and do not teach, encourage, reward, or even protect it.

To remedy this failure, we will have to realize that not just forest land, but all land, private and public, farmed or forested, is "natural." All land is natural and nature is a common wealth. Wherever we live, we live in nature and by using nature, and this use everywhere implies the requirement of good stewardship. But we will have to do more than merely change our minds. We will have to implement a different kind of education and a different kind of economy.

If we want the land to be cared for, then we must have people living on and from the land who are able and willing to care for it. If—as the idea of commonwealth clearly implies—landowners and land users are accountable to their fellow citizens for their work, their products, and their stewardship, then these landowners and land users must be granted an equitable membership in the economy.

In Kentucky we have 12,700,000 acres of forest, more than 90% of which is privately owned. We must assume, I think, that many of the 440,000 owners of this land would fiercely oppose any public appropriation of their modest properties or any diminution of their rights therein. Although I know very well the dangers to the common wealth and health inherent in private property rights, I would be one of those fierce opposers.

The first of my reasons is my too little faith in the long-

term efficacy of public stewardship. Perhaps the public will prove equal to the task of wilderness preservation, though that is by no means certain. But it is not easy to imagine the conditions under which highly competent and responsible stewardship of land that is in use might be maintained for many generations and through the inevitable changes of politics and economics.

My second reason is that I do have some faith in the long-term efficacy of private stewardship, again provided that the connection between the people and the land can be made secure. To be preserved in use, even our public lands must come to be intimately connected to their local communities by means of strong local economies.

Conservationists wishing to establish good forestry practices in our state will immediately see the hopelessness of conventional economics and of conventional conservation if only they will consider that many of the owners of Kentucky's forests are farmers, and therefore that one of the greatest threats to our forests is the continuing stress within our agricultural economy. We would-be conservers of the state's forests must see that the interests of producers and consumers, of landowners and conservationists, are not divided but only the two sides of a mutuality of interest that waits to be defined. Conservation clearly cannot advance much farther here unless conservationists can make common cause with small landowners and land users. And our state's small farmers and other small landowners desperately need the understanding and help of conservationists.

Prairie Festival 1996

I would beg my fellow conservationists, as I would beg my fellow farmers, to realize that we must quit thinking of our countryside piecemeal, in terms of separate products or enterprises: tobacco, timber, livestock, vegetables, feed grains, recreation, and so on. We must begin to think of the human use of each of our regions or localities as one economy, both rural and urban, involving all the local products. We must learn to see such local economies as the best and perhaps the only means we have of preserving that system of ecological and cultural connections that is, inescapably, our commonwealth.

If conservationists are serious about conservation, they will have to realize that the best conserver of land in use will always be the small owner or operator, farmer or forester or both, who lives within a securely placed family and community, who knows how to use the land in the best way, and who can afford to do so. Conservationists who are also farmers or foresters already feel the tension between the demands of ecology and the demands of our present economy; they already feel the urgency of our need for a better economy and better work.

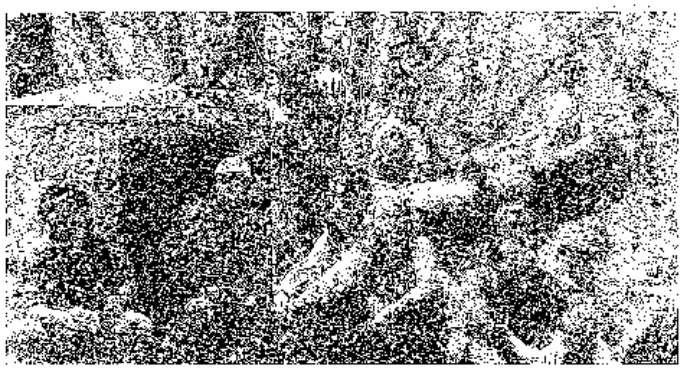
Now consumer-conservationists must begin to feel these strains and stresses also. They will have to acquaint themselves with the requirements of good agriculture. They will have to see that a good food economy does not enrich the agribusiness and grocery corporations at the expense of everything and everybody else but pays to the real producers the real costs of good food production in capital, labor, skill, and care. They will have to become active and knowledgeable participants in their local food economies. They will have to see that their local Sierra Club chapter is no more important to conservation than their local food-marketing co-op.

Similarly, they will have to understand the value of and give their support and patronage to the formation of good local forest economies, permanently in place, scaled so as to use the local forests in the best way, and able to pay a price for timber that will encourage the best forestry and logging practices. These three issues of local economy, scale, and price will determine the quality of use. Our present economy pretty well dictates that a farmer's woodlot or forested hillside will be roughly logged once in a generation or once in a lifetime, and otherwise ignored or used for grazing. A good local forest economy would both protect the forest from abuse and make it a continuing source of income to the landowner and the local community.

Let us think of the thousands of farm woodlands in Kentucky not just as the possible basis of a system of good regional forest economies but as parts of family farms that include, in addition to their woodlands, some land that is arable and some that is in permanent pasture. Such farms in Kentucky are capable of producing an astonishing variety of marketable products: forest products, livestock, row crops, herbs and mushrooms, fruits and vegetables. They can produce these good and necessary things in great abundance indefinitely, protecting in the process the commonwealth of air, water, forests, and soils, granted only the one condition: vigorous local economies capable of sustaining a stable and capable rural population, rewarding them appropriately both for their products and their stewardship. The development of such economies ought to be the primary aim of our conservation effort. Such development is not only desirable; it is increasingly necessary and increasingly urgent.

1996 Interns

Sheri Walz



1996 Interns. Front: Jerry Glover, Jim Boyd, Sheri Walz, Tammy Hinman, Aron Gannon, Jon Richardson. Back: Brian Donahue, Dave Tepfer, Thomas Ruppert, Robin Mittenthal

Community is integral to The Land Institute's mission—be it human community or the larger ecological community. The Land Institute is concerned with healthy communities, how to maintain them, how to integrate them with the landscape. For ten months, interns are a part of this community-building research. We participate as passers-through, but gain valuable insights for the time when we return to our own places. Study of literature, work on the farm, research, field trips, and visitors provide a barrage of experiences and ideas. In time we will digest what has happened to discover the lessons we will take home.

The year began with an introduction to The Land Institute and its research, followed by a spring schedule of classroom and field work. Interns discussed readings regarding the relationship between nature and culture, and explored this relationship within Saline County. We took a break from class during summer field-work, but are back in the classroom now two mornings a week. Interns are leading discussions on topics such as farm crisis, ecological economics, community and social dynamics, alternative farming systems, and sustainable communities. All these topics are relevant to our work in community building: what is the crisis; what are the historical causes; how can we effect positive change?

Maintaining a healthy community requires work. Interns have participated in all aspects of upkeep at The Land Institute: planting, weeding, harvesting, gathering and analyzing data, painting the Sunshine Farm house, moving the Longhorn cattle, mowing, preparing for Prairie Festival and Fall Visitors' Day. We also have swathed, raked, and baled hay three times, so our animal community has food for winter. The perennial staff has provided guidance and continuity for annual interns.

In addition to joining The Land Institute community, we have become members—albeit temporary—of the Salina and Kansas community. Most of us have joined the Prairieland food coop. Interns have also been working with various organizations such as Habitat for Humanity and Salina's Compost Demonstration site. Nearly all of us have enjoyed attending barn dances in Manhattan and Lawrence. Interns have also spent much time working on The Land Institute garden—many Friday evenings have become after-work "garden parties."

Field trips have provided a pleasant break from work and class, allowing us to become acquainted with Kansas and its residents. These trips provide the opportunity to visit existing communities, and see how local people are working to effect change. Jim Scharplaz and former intern Kathy Collmer hosted us at their ranch in Minneapolis, where they are working on raising and marketing residue-free beef cattle. Another trip took us to the Konza Prairie in Manhattan, for a tour of research projects at this Long Term Ecological Research site. Pete Ferrell, a Land Institute board member and rancher in southeastern Kansas, invited interns to inspect his rotational grazing operation and have lunch at his sister's cafe. We visited another Land Institute board member, Charles Francis, at the University of Nebraska in Lincoln, for a tour of Agricultural Interns' micro-farms, and of five local farmers' operations. Some interesting work-weekends have also been spent at Matfield Green, where interns helped with and were able to sit in on several conferences.

Our study of community is aided by the sundry people who come to The Land Institute as visitors. The interns have met with passers-through who conversed with us about diverse topics ranging from Danish environmental history to the Natural Step Movement in Switzerland. David and Elsie Kline, Amish farmers from Ohio, talked with us about the dynamics of their community. All these people share the goal of nurturing their home places, yet they are going about it in unique ways—through the study of environmental history, through the implementation of shared environmental goals, through adhering to traditional and religious beliefs in the context of the modern world.

When we end our stay at The Land Institute the interns will all be moving in different directions: other internships, school, their own farm. We have been exposed to a vast array of concepts, potentials, and problems in the fields of community building and natural systems agriculture. The Land Institute's intern program provides a satisfying balance of practical farm experience mixed with research. These experiences will undoubtedly affect how we conduct our next endeavors. We return to our own communities full of ideas to share about the project of reviving, building, and maintaining ecological community.

Development Officer Position Open

The Development Officer will be responsible for all areas of fundraising including direct mail solicitations, foundation and corporate grant writing, and personal fundraising with major donors. Other responsibilities include involvement with budget preparation, contacts with media, and special event coordination. Position requires BA/BS, three to five years experience in development or related field, computer proficiency, excellent verbal communication, and demonstrated writing excellence. Position is open until filled. Send resume, letter of interest, and list of fundraising achievements to Ken Warren, Managing Director.

Director of Education

The Land Institute is also looking for a new Director of Education, beginning in January, 1997. The Director of Education is responsible for developing and conducting Land Institute education programs, for carrying out research in land use history and ecological economy, and for editing *The Land Report*. The Education Director will have responsibilities in both Salina and Matfield Green, Kansas.

Responsibilities

I. Education

In Matfield Green, The Land Institute studies the relationship of a small farming and ranching community to the surrounding landscape. The Education Director will develop an educational program in Matfield Green. This will include summer teachers workshops on understanding local places (using Matfield Green as a model) and developing methods for "learning in place," and working on educational projects with Chase County schools and communities.

In Salina, the Education Director will lead spring and fall courses for interns on ecological thought, prairie ecology, environmental and agricultural history, and sustainable land use and communities, focusing on the prairie region and Kansas. The Director will work with Ecologist Jon Piper to modify this curriculum so that it is more tightly focused on Natural Systems Agriculture. This will include incorporating presentations from Land Institute staff on the fundamental concepts underlying our research, and bringing in visiting scholars in fields relevant to that research.

II. Research

In Matfield Green, carry on a research program in land use history and ecological economics. This investigation into the past, present and potential ecological structure of a human and natural community will go hand-in-hand with the Matfield Green educational program. In Salina, work with the Natural Systems Agricultural research team in clarifying issues of ecological history in the prairie region.

III. Land Report

Solicit and edit articles for *The Land Report* and see it through layout and publication.

Qualifications

I. Masters in environmental history, geography, anthropology, or related field. Ph.D. preferred.
II. Research experience in human ecology and land use. GIS mapping experience preferred.
III. Teaching experience and aptitude.
IV. Strong writing skills. Editorial experience preferred.
V. Demonstrated commitment to caring for communities and land.
VI. Leadership skills to develop a new program, together with the flexibility to work with a small group of colleagues toward a larger goal.

Please send resume and references to Ken Warren, Managing Director. Open until filled.

Land Institute News

Intern Coordinator and Research Assistant Dave Tepfer headed off after the Prairie Festival. Dave was an intern in 1994 before joining the staff to help get the cattle grazing project underway and to do a slew of historical mapping and land use analysis on the Matfield Green project, among many other tasks. Dave is now working on a farm in Concord, Massachusetts, and looking toward more graduate school in ecological economics.

Two 1995 interns stayed on. Heather Brummer is a Research Assistant working with Jon Piper on Natural Systems Agriculture. Tina Ray is Operations Assistant, assigned primarily to Jack Worman on the Sunshine Farm. Tina takes the place of John Jilka, who had become a Land institution since joining the staff in 1990. John retired at the end of 1995.

Miranda Weiss spent several weeks as a summer intern, helping out with soil research. Miranda is a senior at Brown University. Local high school students Hannah Applequist and Mandy Chase also volunteered from time to time this summer. My wife, Faith Rand joined the staff for a few weeks to coordinate a special collaborative project between The Land Institute, the Salina Art Center, and Lakewood Natural Area Discovery Center called "Art in the Environment." This summer elementary education project was funded by a Horizons 50 grant from the Salina Arts and Humanities Commission.

Miranda Weiss

In other news, Arts Associate Terry Evans continues to collect honors for her work. Her appointment to the National Council on the Arts was approved by the Senate, and she was awarded a 1996 Guggenheim Fellowship. The Guggenheim supports her continuing photographic study of ranching in the Flint Hills, along with an aerial survey of mixed grass prairie from Canada to Texas. She is somewhere low over Saskatchewan as we go to press, zigzagging slowly toward the Gulf of Mexico. Friends of the Land can truthfully say they saw it all coming a long time ago.

New New Farm in the Works

A group called the "Committee for Sustainable Farm Publishing" is working to launch a solid replacement for *The New Farm,* the well-known sustainable farming magazine retired by the Rodale Institute last year. The group includes former *New Farm* editorial director Craig Cramer and contributing editor Christopher Shirley. They hope to begin publication under a new title and new management in 1997. You can get on their mailing list of potential subscribers by contacting Christopher Shirley, Committee for Sustainable Farm Publishing, 609 S. Front St., Allentown, PA 18103; or e-mail CDShirley@aol.com

Along similar lines, Friend of the Land Tom Shay is setting up an electronic database of people involved in work to make local communities more sustainable. If you are involved in such work and would like to stay in touch with others of a similar bent, you may send your e-mail address to Tom at 75360.1621@CompuServe.COM

Memorial Gifts and Intern Sponsorships

Robin Mittenthal

Raising funds to keep The Land Institute's programs running is a constant effort. Unsolicited donations are therefore always a pleasant surprise. Gifts to our Memorial and Tribute Fund are particularly nice because of the special consideration they imply.

I myself have a personal connection to Dr. Charles Jorgensen of Minneapolis, Minnesota, who recently donated $5,000 in memory of his father, Caleb L. Jorgensen. Caleb Jorgensen was an agronomist who received his bachelor's degree from the University of Nebraska and his master's from Kansas State. He spent most of his professional life with the Soil Conservation Service. Other recent gifts to the Memorial and Tribute Fund came from Molly O'Reilly of Sandpoint, Idaho in memory of her father, Daniel Patrick O'Reilly; and from Rebecca Hofkamp for her husband Mike.

Dr. Jorgensen's donation is being used to sponsor my internship, and as a small thank you I write occasional letters to try to convey the flavor of daily life at The Land Institute. Two other interns have similar relationships, Aron Gannon with the Global Environment Project Institute and Tammy Hinman with the Leighty Foundation. We are grateful for the learning experience these donations are helping to provide us.

Jerry Glover

The Land Institute greatly appreciates all donations, whether earmarked for a certain area such as the intern program or given without restrictions. Ms. O'Reilly urges us to "Keep planting!" and to do so is the most sincere thank you we can offer.

Saucer Eyes: A Story of Becoming in Hard Rock Mining Country

by Eulah Croson Laucks

Santa Barbara, California: Fithian Press, 1996

Reviewed by Sheri Walz

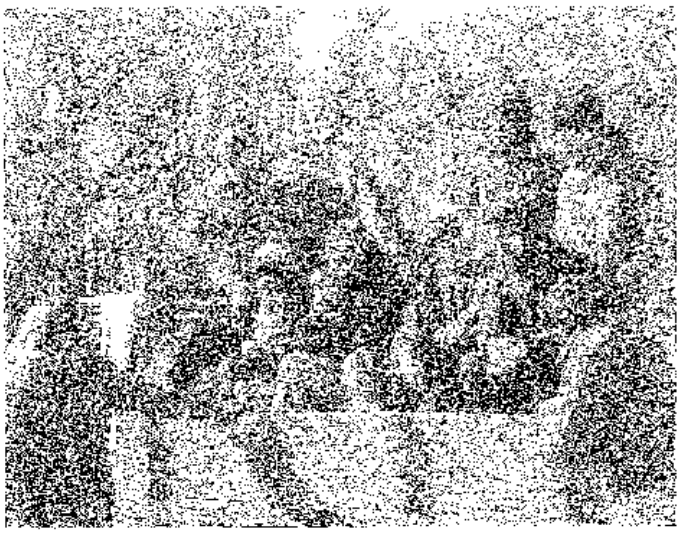
I was given to this exaggerated widening of eyes when I was concentrating on not losing the slightest detail of something happening around me ... for many indelible years, I was Saucer Eyes to a lot of people.

Eulah Laucks

Some seventy years later, Eulah Croson Laucks' eyes are still wide-open to the world around her. She is President and CEO of the Laucks Foundation, founded with her husband in 1969 to promote world peace and equity, to try to clarify the relation between technology and human values, and to encourage environmental responsibility. Ms. Laucks also serves on the board of The Land Institute.

Her early, keen attention to the world has yielded a memoir about Laucks' youth in the mining towns of the American West called *Saucer Eyes: A Story of Becoming in Hard Rock Mining Country.* The brief book chronicles Laucks' family life over seven years. It begins with her first recollections at the age of five in Gold Hill, Nevada, and ends with her first date at the age of twelve—a classic misadventure involving a white dress, a muddy dog, and a rowboat. In between, we are treated to anecdotes of a child's experiences growing up during the fleeting time of the mining boom.

Each compact chapter relates a memory. She recalls how immigrant miners, who had left their own families at home, would watch out for the children as they wandered the camp. The tired miners always found time to pull a child's snow sled up hills, and shared their limited food with the children. She remembers a Paiute woman who helped her mother with laundry, and the woman's children with whom Laucks enjoyed playing. She remembers how the Paiute were regarded as "gypsies" at that time, and how the society misunderstood them. Laucks captures the feel of life in that World War I era as a time of simple pleasures such as Saturday night dances and rodeos, and of dangers such as rattlesnakes, coyotes, and influenza epidemics.



Tour of the Scharplaz/Collmer ranch in Minneapolis. On ground: Jim Scharplaz, Jim Boyd. Seated: Sheri Walz, Jon Piper, Kathy Collmer, Brian Donahue. Back row Jerry Glover, Tammy Hinman, Jon Richardson, Robin Mittenthal.

Saucer Eyes is a pleasant evening read. Laucks details her childhood memories in a pleasingly simple, forthright style. Her many escapades are fresh yet familiar. They are adventures that generations of children have shared—the first haircut, the first day of school, being teased by a sibling, attending a dance. However, their setting during the mining boom lends an eye-opening perspective. Encounters with Native Americans, runaway horse-carriages, and Longhorn cattle are parts of Laucks' childhood landscape not many are familiar with. She has written a book that will touch memories for some, and for others will spark ideas about a time unknown.

By the time Laucks entered high-school, she was "full of dreams of becoming somebody in the world. Not a great somebody, maybe only a small somebody, but somebody." And so she has. In *Saucer Eyes* we can see her developing the clear view of the world that she still brings to the work of the Laucks foundation. She is "somebody" The Land Institute is lucky to know.

Tammy and Jim in the garden

Small Mammal Survey in Polyculture Plots, Restored Prairies, and Virgin Prairie at The Land Institute

Brian Ford, Carla Kjellander, Janet Paper, and Charles F. Newlon, Biology Department, William Jewell College, Liberty, MO 64068

Abstract

Small mammals were trapped between 14-18 August 1995 in polyculture plots, two restored prairies, and a virgin prairie located at The Land Institute, Salina, Kansas. The dominant species at all sites was the cotton rat *(Sigmodon hispidus),* representing 80% of 159 individuals. The northern grasshopper mouse *(Onychomys leucogaster)* had the second highest percentage for all areas (8% of 159 individuals), but it was captured at only one of the four sites, a restored prairie. The western harvest mouse *(Reithrodontomys megalotis)* occurred in all areas, but represented only 4 % of all captures. Five additional species, the house mouse *(Mus musculus),* thirteen-lined ground squirrel *(Spermophilus tridecemlineatus),* prairie vole *(Microtus ochrogaster),* hispid pocket mouse *(Chaetodipus hispidus),* and deer mouse *(Peromyscus maniculatus)* each represented 1-3% of captures. Six of eight species were trapped in one of the restored prairies and five species were captured at the polyculture site. However, only 25% of the mammals caught at the polyculture site were trapped within one of the polyculture plots. The rest were trapped in the grassy borders surrounding the plots. Future trapping efforts will clarify population trends and patterns.

Introduction

The Land Institute is conducting research to develop a grain agriculture modeled on the native prairie ecosystem. The rationale for this research is that today's monoculture agricultural practices can result in soil loss, contamination of water supplies, and loss of genetic diversity in crops. Polyculture plots have been developed at The Land Institute using perennial plants that may some day produce seeds suitable for animal and human consumption. In addition to providing edible products, polyculture plots may display such beneficial characteristics of native prairie as reduction of energy expenditures for tillage, decreased soil erosion, and more efficient nutrient cycling (Piper 1993).

Within the last 125 years, the extent of native prairie in Kansas has decreased significantly due to conversion to agricultural lands. With increased human concern for preserving wildlife habitats, biologists need to understand better the requirements for native animals and how farming practices affect animal populations. Recent studies have looked at the effect on small mammal populations when native prairies have been converted to agricultural fields, specifically wheat. One such study (Kaufman and Kaufman 1990) showed a shift in abundance and composition of small mammal populations. Some species increased in abundance and numerical dominance while other species declined. The Land Institute is focused on growing combinations of perennial plants that will mimic a natural prairie ecosystem and still be capable of edible seed production. To date, no preliminary research has been done to determine how these land practices affect the diversity of small mammals. The project will survey over a 3 to 5 year period the small mammal populations in a virgin prairie, two restored prairies, and a series of polyculture plots to reveal overall population trends within an area as well as differences among the areas. This report focuses on the results of an initial survey in each area. Future reports will look at emerging trends and patterns and how they affect the agricultural studies.

Figure 1

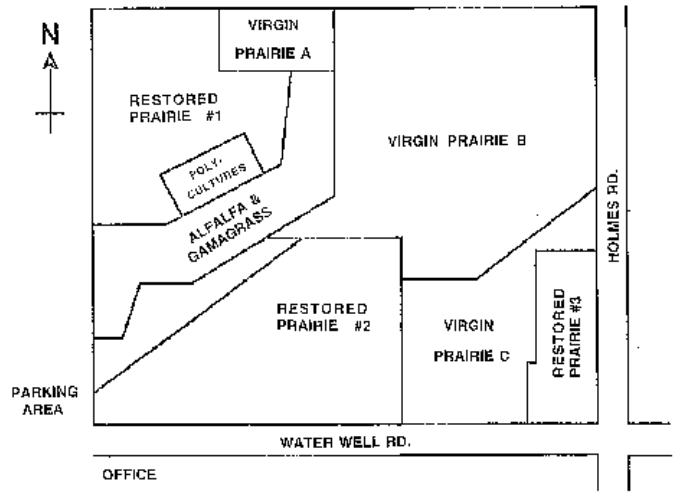


Figure 1. Map of small mammal study area. Trapping occurred at four sites, the polyculture plot, restored prairies #1 and 2, and virgin prairie B. A grid of 50 traps was used in each field except the polyculture plot where 48 traps were used. Trapping occurred from 14-18 August, 1995.

Materials and Methods

Small mammals were surveyed at The Land Institute at two pairs of sites between 14-18 August 1995. One pair of sites was a series of polyculture plots and the adjacent restored prairie #1 whereas the other pair was virgin prairie B and an adjacent restored prairie #2 (Figure 1). A grid using fifty Sherman Live Traps, baited with rolled oats and peanut butter and placed 10 m apart, was established at each site with the exception of the polyculture plots where 48 traps were used due to the configuration of the plots. Each grid was approximately 90 m x 40 m.

The polyculture site is a fenced in enclosure consisting of 18 plots, each 9 m x 7.3 m, with 4 m grassy strips between the plots and between the outside plots and the adjacent prairie. Eastern gamagrass, Illinois bundleflower, and wildrye are planted alone or in various combinations in the plots. Of the 18 plots, three contain all three perennials, three are eastern gamagrass/Illinois bundleflower mixtures, and three are eastern gamagrass/wildrye mixtures. The remaining nine plots are monocultures of each perennial species.

A total of 198 traps, representing 990 trapnights, were used throughout the study. Traps were checked once per day in the morning. All captures were identified (Bee et al. 1981), weighed, sexed, marked for recapture purposed and released at the capture site.

Results

Trapping within the four study areas resulted in the capture of 159 small mammals. Eight species were represented in the survey: cotton rat, northern grasshopper mouse, western harvest mouse, house mouse, thirteen-lined ground squirrel, prairie vole, hispid pocket mouse, and deer mouse. The total number

of species per grid and percentage abundance (individuals/total mammals) was calculated (Table 1). The cotton rat was found in all four study areas, with the highest percentage abundance (96%) in restored prairie #2 and the lowest percentage abundance (63%) in restored prairie #1. The percentage abundance for the cotton rat for all areas was 80%. The western harvest mouse was the only other species found in all four study areas. However, its percentage abundance for the four areas was only 4 %. Although the grasshopper mouse had the second highest percentage abundance, 8%, it was found only in restored prairie #1. The remaining five species were found in only one or two of the study areas and made up 3% or less of all individuals trapped.

Within the polyculture enclosure 44 individuals were caught, but only eleven (25%) were trapped in polyculture plots while the remaining 75% were taken in the grassy borders between plots and along the southern edge. Of the eighteen polyculture plots in the enclosure, only eight plots accounted for the eleven captures. One of the eight plots was planted to wildrye while the other seven plots were planted with eastern gamagrass plus Illinois bundleflower and/or wildrye. Mammal species composition within the eight plots was nine cotton rats, one house mouse, and one harvest mouse.

A total of eight species was captured during the study but not all eight species were found in any one area. Of the eight species represented in the study, six were captured in restored prairie #1. In the polyculture enclosure five out of eight species were caught. No northern grasshopper mice, thirteen-lined ground squirrels, or prairie voles were captured in the polyculture enclosure, but the pair of sites accounted for 98 individuals or 61% of the total capture. In the second pair of sites, virgin prairie B and restored prairie #2, only three different species were caught in each, totaling 61 individuals or 39% of the captures (Table 1). Based on marked individuals, movement to different areas of the grid occurred on all study sites but no individuals moved from one site to another.

Discussion

No small mammal survey had been conducted at The Land Institute prior to this study. Our purpose this first year was to report on species composition in the polyculture plots, adjacent restored prairies #1 and 2, and virgin prairie B. There are several conclusions that can been drawn based on this year's data, but more in-depth analysis will be made in the next few years as more data are collected.

First, it is evident that the frequency of hispid cotton rats in each area was very high. This may be due to several factors. One factor may be favorable vegetation such as dense grass cover found in virgin prairie B and border areas of the polyculture enclosure. Another factor could be the disturbed nature of the restored prairies, especially #2 with its patchy vegetation and areas of bare soil. Cotton rats may prefer disturbed areas over undisturbed as well as burned over unburned (Kaufman et al. 1990, McMurry et al. 1994). All four study areas had been recently burned.

Second, we thought that the polyculture plots would attract a high number of different species. The perennials in each plot represent plants selected for stable high seed production, ease of harvest, and nutritious food for animals and humans (Piper 1993). Although 44 individuals within five species were captured within the polyculture enclosure, all but eleven individuals, representing three species (cotton rat, harvest mouse, and house mouse), were caught in the dense border grass. It will be interesting to see if this trend continues and if so, why.

Finally, there was movement of marked individuals within the grids but no movement to adjacent study areas by marked individuals. We anticipated some movement along borders of adjacent sites.

What effect the numerically high cotton rat population is having on the other species in this study is not known. There may be interspecific competition that is limiting the other species or perhaps the cotton rat is more aggressive in seeking out food in the traps. We hope that during the next several years population trends and patterns develop that will bring about a better understanding of the small mammal population dynamics in Land Institute research plots.

Acknowledgments

This project was supported by funds from the Biology Department, William Jewell College, Liberty, Missouri and through a faculty development grant from William Jewell College. We thank Jon Piper and The Land Institute and for logistical help and hospitality. We also wish to thank Judith Dilts and Paul Gabrielson for reviewing an earlier version of the manuscript.

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Table 1. Species composition of small mammals captured in study areas, showing total numbers and percentage abundance (individuals/total mammals). Eight species, totaling 159 specimens, were trapped from 14-18 August 1995.

Species	Polyculture Plots		Restored Prairie #1		Virgin Prairie B		Restored Prairie #2		Totals	
	No.	%	No.	%	No.	%	No.	%	No.	%
Hispid cotton rat	36	82	34	63	14	88	43	96	127	80
Northern grasshopper mouse	0	0	12	22	0	0	0	0	12	8
Western harvest mouse	2	5	3	5	1	6	1	2	7	4
House mouse	4	9	0	0	0	0	0	0	4	3
Thirteen-lined ground squirrel	0	0	3	6	0	0	0	0	3	2
Prairie Vole	0	0	1	2	1	6	0	0	2	1
Hispid cotton mouse	1	2	0	0	0	0	1	2	2	1
Deer mouse	1	2	1	2	0	0	0	0	2	1
Totals	**44**	**100**	**54**	**100**	**16**	**100**	**45**	**100**	**159**	**100**

Energetics for Broiler Production in a Portable Pen

Todd Wetzel

Abstract

This study presents a budget of the direct and indirect energy of the fuel, materials, and human labor in raising 73 broiler chickens in a portable pasture pen. Twelve percent of the caloric feed energy and 20 percent of the feed protein were recovered in the meat. Every BTU of meat required 8.5 BTU's of energy in fuel, supplies and amortized items. These values are similar to those for conventional broiler production. When an energy charge for the portion of American lifestyle energy to support human labor is included, the energy efficiency in broiler production is decreased by 40 percent. The energy budget revealed where we could save energy in our broiler production.

Introduction

The Sunshine Farm Project is a ten-year ecological case study of an energy-integrated organic farm. A major research objective of the Sunshine Farm is to do a detailed accounting of energy, materials and labor for all transactions on the farm. Energy budgets are being computed for the sustainable farming techniques, of which one is pasture-raised broiler chickens. Raising them in an open-bottom portable pen offers daily access to fresh vegetation, a feed supplement. This system eliminates the need for bedding and manure removal as wastes are distributed daily over the grazed area. The pen is a 10x12x3 foot cage, which is similar to one designed by Joel Salatin (1993).

In addition to the energy budgets, experiments are conducted on the farming practices. In 1994, the project studied the impact of broiler grazing on alfalfa. The grazing was found to be more detrimental to alfalfa regrowth than haying (see Land Report No. 53). In 1995, the broiler project compared the weight gain and feed consumption of 35 Cornish Rock chickens raised in the portable pasture pen on an old alfalfa stand and 35 broilers raised in a stationary indoor coop with no access to fresh vegetation.

The broiler energy budget and experiment results are presented for 1995. The energy budget data for the pastured and indoor flocks were combined because heavy rain and cool weather forced us to move the pasture broilers into the indoor pen for nine days. This means that the two groups were separated for only two weeks between the damp weather and slaughter.

Materials and Methods

To construct an energy budget for raising broiler chickens, a detailed energy accounting of labor, amortized and non-amortized supplies, and product output is done with FoxPro, a relational database software. The direct energy in fuels and electricity is computed, as well as the embodied or indirect energy in all equipment, supplies, and labor transactions.

Table 1. Raw materials for computing embodied energy of inputs.

Fuels:	acetylene	diesel	electric
	gasoline	kerosene	propane
	wood		
Metal, construction, synthetic, biological:			
adhesive	glass	plastic	
aluminum	inorganic chemicals	rubber	
asphalt	iron	sand & gravel	
brass	lead	steel	
brick	leather	galvanized steel	
caulk	lumber	stainless steel	
cement	medicine	sulfuric acid	
cloth	nickel	tin	
concrete	nylon	trace elements (salt)	
copper	paint	twine	
fiberglass	paper	zinc	
Imported feed:	corn	rolled milo	24% protein feed
Imported animals:	chicks		

For the embodied energy in farm inputs, the weight of every item, on the farm or imported, including machinery and facilities, is recorded. To compute the embodied energy of farm inputs, a list of literature values was entered into the computer database for the energy to mine, process and fabricate basic raw materials. Most literature values had been determined by process energy analysis, but a few, such as medicine, had been estimated from input-output energy analysis. Estimates of embodied energy for inputs such as animal feed or seed were based mainly on Pimentel (1980). For each item, the computer user selects from the list of literature values the one or two raw materials constituting or approximately representing that item (Table 1).

For each raw material that is recycled in society, the embodied energy was prorated for a mix of virgin and recycled materials according to: 1) the estimated recycled portion of that material in a solar future; 2) the reduced energy to reuse recycled materials; and 3) the increased energy to mine lower grades of metal ores or materials. There is much literature on the former two considerations, while the latter was based on Goeller and Weinberg (1976). What cannot be foreseen in the distant future is the substitution of materials.

The embodied energy for fuels is simply the enthalpic energy because this is what will be supplied by the renewable energy technologies on a net energy basis. Thus, the fossil energy consumed to make these fuels is not included because the net energy basis for the renewable fuels already takes into account the production of fuel.

In a sunshine future, we cannot expect new farms to bootstrap themselves in terms of energy and labor requirements for establishing a farm from scratch. Beginning farmers will have to

Table 2. Summary of energy charged to human labor.

	Energy (BTU/hour)[1]		
	Direct	Indirect	Total
Average U.S. farm labor[2]	28,400	42,700	71,100
Amish Labor	2,800[3]	20,900[4]	23,700

[1]Direct energy is that in fuel and electricity. Indirect energy is that embodied in goods and services (private, local, state, and federal).

[2]Fluck 1981.

[3]Direct energy to support Amish lifestyle is 10 percent of that for neighboring "English" lifestyle (Johnson et al. 1977).

[4]Based on our subjective assumptions of Amish consumption of goods and services, relative to the average U.S. farm worker. Computed by multiplying each lifestyle component given by Fluck (1981) by our corresponding estimated factor for that component of Amish lifestyle.

Table 3. Per capita feed consumption and carcass weight for the 1995 broiler experiment.

	Pasture raised (n=35)	Indoor coop (n=38)
Feed consumed (lbs)	15.6	14.3
Dressed carcass weight (lbs)	5.1	4.9
Feed conversion rate*	3.0 : 1	2.9 : 1

* Feed conversion ratio computed from dividing consumed feed by the dressed weight.

Table 4. Broiler output.

Output		Literature Values: Independent Animals		Population
Broilers slaughtered	73			
Dressed Carcass Weight (lbs.)	365			
Edible Meat (lbs.)	250			
Edible Protein (lbs.)	45.6			
Edible Energy (BTUS)	913,900			
Energy out/labor hour for broiler product (BTUs/hour)	13,100	374,000	(Leach, 1976)	—
Edible energy out/ feed energy in	0.120	0.12	(NAS, 1975)	0.13 (Holmes, 1971)
Protein out/in	0.198	0.15	(App, 1924)	0.18 (Pimentel et al., 1979)
		0.22	(Cooke, 1970)	0.20 (Lodge, 1973)
		0.31	(Cox & Atkins, 1979)	0.20 (Holmes, 1971)
				0.30 (Loomis, 1984)
Energy out/in	0.118	see Table 5		

Table 5. Human labor input.

Item	Quantity (hours)	Energy Charge (BTUs) Avg. U.S. farm labor	Amish labor
Animal Care	31.52	2,241,100	747,000
Transportation			
non-amortized	10.66	757,900	252,600
amortized	0.67	47,600	15,900
Construction			
non-amortized	0	0	0
amortized	1.40	99,500	33,200
Planning	1.00	71,100	23,700
Slaughter	25.25	1,795,300	598,400
Total Labor	69.67	5,012,600	1,670,900

borrow energy and labor from the local community and then return those inputs on an amortized schedule. So, FoxPro reports were written to amortize energy and labor inputs for construction projects over the lifetimes of items in each transaction. This will eliminate the cumbersome effort and potential mistakes that could be made in hand-calculating hundreds of amortized entries for each year of farming and carrying these amortized values over to the energy budgets of later years.

The energy budgets for enterprises on the Sunshine Farm also include energy costs for human labor. The energy costs for labor are calculated by multiplying the hours of human labor by energy factors. The energy factors are based not on the entire lifestyle of a farm worker, but on the portion required to support a farm worker's labor. Richard Fluck (University of Florida) did a detailed national study to estimate the portions of food, clothing, shelter, transportation and approximately 50 other goods and services required for a farm worker to earn a living. Since the lifestyle supporting farm labor is the biggest unknown in the energy budgets, the energy costs for labor are presented as a range across two extremes, the Amish at one end and the average lifestyle of U.S. farm households on the other. The U.S. factor was computed by Fluck, and the farm ecologist calculated the Amish factor by use of a study on the energetics of Amish households and by adjustment of Fluck's estimates for Amish lifestyle. The estimated energy cost for labor supported by Amish lifestyle is about one-third of that for the average U.S. farmworker (Table 2).

Results

In the 1995 broiler experiment, there was no difference between the dressed weights or feed consumption of the pasture-raised broilers and the stationary indoor broilers (Table 3). The damp, cool weather limited any differences since the two groups were separated for only two weeks.

The production of 73 broilers, or roughly 250 lbs. of edible meat (Table 4), required 70 hours of labor (Table 5), 7 million BTUs of direct and indirect energy in supplies (Table 6), and less than a million BTUs for amortized items in construction and machinery (Table 7). To produce each BTU of edible meat, 1/0.118 or 8.5 BTUs of energy in fuel, supplies and amortized items were needed (Table 8). Twelve percent of the caloric feed energy input and 19.8% of feed protein input were recovered in the broiler product (Table 4).

Of the 70 total hours of human labor, 45% was spent in animal care, 35% in slaughter and 16% in transportation (Table 5). For each hour of labor input, 13,100 BTUs of energy were produced (Table 4).

For the energy in farm inputs, 48% was imported chicken feed, 21% was electricity and 17% was gasoline (Table 6). For the amortized energy in construction projects, 57% was the sunshine farm truck and 25% was material items (Table 7).

The inclusion of an energy cost for human labor increased the total energy input by 65 percent for the average U.S. farm worker and 22 percent for Amish labor (Table 8). The same also applies to the ratios for energy input to meat and protein outputs. The energy charge for the average U.S. farm labor decreased the ratio of energy out/in for broiler production by 40 percent and for Amish labor, by 18 percent.

Table 6. Supply inputs.

Item	Quantity	Energy (BTUs)
Gasoline	9.54 gallons	1,183,000
Electricity	148.84 kwhrs.	1,488,400
Chicken Feed		
imported	1,090.00 lbs.	3,440,600
on-farm	0.00 lbs.	0
Chicks	75	311,300
Material Items	6.70 lbs.	132,400
Transport to dealer* (fuel, feed, materials, machinery)	1,154.89 lbs.	535,900
Total Supplies		7,091,600

* *Transport to dealer* accounts for energy consumed in transporting input items from their source of origin to the dealer where the Sunshine Farm transaction was made.

Table 7. Amortized item inputs.

Item	Quantity	Energy (BTUs)
Gasoline	0.31 gallons	38,400
Material Items	27.34 lbs.	156,400
Machinery		
Sunshine farm truck	16.78 lbs.	366,300
outside or rented	5.00 lbs.	54,000
Transport to dealer (fuel, feed, materials, machinery)	51.01 lbs.	23,700
Total Amortized Items		638,800

Discussion

Tables 4 and 8 include independent animal and population literature values which enable comparison between the Sunshine Farm and conventional broiler production. Population calculations include the energy consumed in raising the hens that produce the eggs that become broilers. The Sunshine Farm broiler production does not include population data. In energy input per pound of protein output (Table 8), the population literature values are much greater than independent animal values. In comparing population and independent animal values in other ratios of the broiler study, there is little difference. This indicates that there is generally too much variation in technique to detect a significant difference between population and independent animal calculations.

Using literature value comparisons is rough at best. In comparing our energy output per labor hour input (13,100 BTU/hr) to the literature value (374,000), we see that the effect of scale and farming technique on the energy budget is dramatic. The literature value was calculated with the labor input of one man raising 100,000 birds/yr. Other productivity results seem to be more scale-independent. Energy and protein efficiency, as well as energy input per meat output and protein output for our broiler production all compare reasonably with literature values (Tables 4 and 8).

With the inclusion of a human labor energy charge, the ratio of energy out/in is significantly less and the energy input per pound of meat and protein output is significantly greater than the literature values (Table 8). The efficiency differences are greater for the average U.S. farm worker than for the Amish labor. Conventional animal-raising techniques depend heavily on fossil fuel inputs to replace human labor. It is important to account for the energy costs in the human hands that may be necessary to replace fossil fuels in a post-fossil fuel era.

The energy budgets provide a unique perspective in which to study farming techniques. In Table 6 we see that more energy was consumed in electricity than gasoline, mostly in the heat lamp of the chick brooder, which was the result of raising chicks in an unheated, non-insulated barn in a cool, wet spring. The perspective of energetics therefore educates the farmer to consider an alternative brooder situation, such as tin brooders with small light bulbs.

The factors that effect efficiency values in raising broilers are numerous, including choice of breed, quality of nutrition, amount of time from birth to slaughter, and environmental circumstances such as the weather. Over the ten years of the Sunshine Farm Project, energetics values will fluctuate with these varying factors, especially as managers gain experience with the pasture pen system.

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Table 8. Effect of human labor on productivity.

	Energy Charge			Literature Values*			
	No labor charge	Avg US farm labor	Amish labor	Independent Animals		Population	
Total energy input (BTUs)	7,730,300	12,742,800	9,401,100	—		—	
Energy input/ meat output (BTU/lb)	30,700	50,600	374,000	26,100 17,200	(Leach, 1976) (Fluck & Baird, 1980)	—	
Energy input/ protein out (BTU/lb)	169,500	279,400	206,200	124,900 115,400 70,800	(Leach, 1976) (Holmes, 1975) (Pimentel, unpublished)	233,800 239,100	(Lodge, 1973) (Spedding et al., 1981)
Energy out/in	0.118	0.071	0.097	0.10 0.11 0.11 - 0.16	(Leach, 1976) (Holmes, 1975) (Poincelot, 1986)	0.10	(Holmes, 1971)

* Energy charge for farm labor was minimal or not charged.

Seed Yields Of Three Perennial Grains In Monocultures And Polycultures

Heather Brummer

Abstract

The year 1995 marked the fifth growing season for a perennial polyculture experiment at The Land Institute. Three perennials, grown in monocultures, bicultures, and tricultures, were monitored for seed yield and plant growth. In 1991, eastern gamagrass *(Tripsacum dactyloides),* a warm-season grass; mammoth wildrye *(Leymus racemosus),* a cool-season grass; and Illinois bundleflower *(Desmanthus illinoensis),* a legume, were planted in six cropping treatments in both a favorable (Site 1) and less favorable (Site 2) growing environment. By growing plants in mixture, we are attempting to bring about a higher yield in perennial grains. Eastern gamagrass generally yielded well at Site 1, most notably in biculture with wildrye and in polyculture; yields in these plots have risen steadily for five years. Gamagrass also grew well in tricultures at both sites. Mammoth wildrye grew better in monoculture and appears to be sensitive to both interspecific competition and soil quality. Bundleflower/gamagrass biculture yield at Site 2 has been steady for five years. Most plots overyielded. Five years of data suggest possibilities for future experiments that will enable more persistent polycultures.

Introduction

By using the wild prairie as a standard for sustainability, The Land Institute is attempting to construct a grain agriculture "in nature's image." Such an agriculture would protect and improve soil quality, feature biotic diversity, resist extreme weather events, manage pests and diseases, and require few or no synthetic chemical inputs.

We are growing perennial grains in simple mixtures in a first attempt to mimic natural grasslands. Advantages of intercropping include higher yield, protection against pests, reduced risk, and better use of resources (Gliessman 1986, Vandermeer 1990). For example, growing legumes with other crops can provide nitrogen for the companion plants.

Additionally, this research hopes to create a stable agricultural ecosystem, benefitting both the farmer and the landscape. The Conservation Reserve Program was established in 1985 to take highly erodible land out of row crop production and plant it to perennial plants, primarily grasses. Perennial grasses have extensive root systems that not only hold the soil against wind and water erosion, but can also improve soil quality (Burke et al. 1995).

There are four primary questions the Natural Systems Agriculture research is trying to answer. 1) Can perennials yield as much seed as annuals? 2) Can a polyculture of perennial plants overyield? 3) Can a perennial polyculture containing legumes provide its own nitrogen fertility? 4) Can a perennial polyculture manage insect pests, plant disease, and weeds? Here I focus on the first two questions.

This study began in 1991. In 1995, we continued monitoring seed yield and overyielding within plots containing three perennial grain candidates: eastern gamagrass, mammoth wildrye, and Illinois bundleflower.

Materials and Methods

The species used in this project represent three types of plants that predominate on the prairie. *Tripsacum dactyloides,* or eastern gamagrass, is a large, warm-season bunchgrass native to the Great Plains. It is found throughout the eastern part of the United States into the Great Plains, and has been found as far south as Bolivia and Paraguay (Great Plains Flora Association 1986). *Leymus racemosus,* or mammoth wildrye, is native to south- eastern Europe and in the northern desert and semi-arid areas of Russia, where it was used as a food crop when other crops fell to drought (Burritt 1986). It is a cool-season grass that grows and produces seed in early summer. *Desmanthus illinoensis,* or Illinois bundleflower, is a nitrogen-fixing legume that is also native to the Great Plains. It occurs from Florida to New Mexico and as far north as Minnesota (Great Plains Flora Association 1986).

Figure 1. Gamagrass

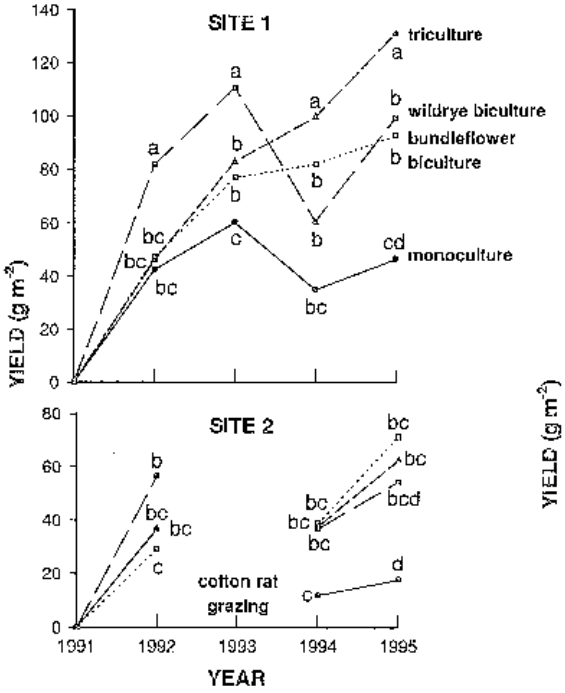

Figure 2. Wildrye

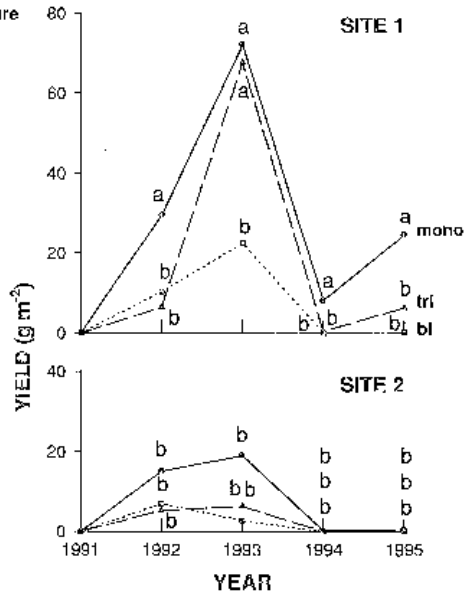

Figure 3. Bundleflower

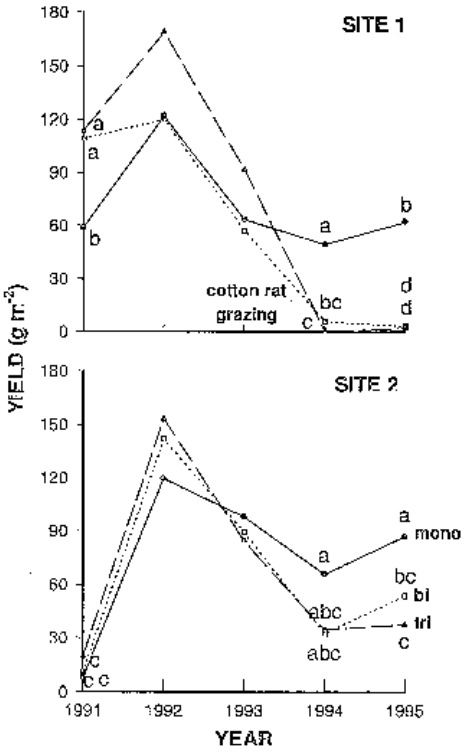

Table 1. Land Equivalent Ratios (LERs) for three perennial polyculture treatments. An LER>1 indicates overyielding.	Treatment	1992	1993	1994	1995
	Site 1				
	Gamagrass/wildrye biculture	1.06	1.10	0.87	1.07
	Gamagrass/bundleflower biculture	1.05	1.13	1.02	1.02
	Gamagrass/wildrye/bundleflower	0.78	1.26	1.09	0.99
	Site 2				
	Gamagrass/wildrye biculture	1.03	—	1.53	1.53
	Gamagrass/bundleflower biculture	1.01	—	1.90	2.01
	Gamagrass/wildrye/bundleflower	0.91	—	1.22	1.31

Plots were established in March 1991 at two different sites at The Land Institute. Site 1 is a level Cozad silt loam that was in continuous wheat until 1990, when it was planted to alfalfa. Site 2 is an eroded, south-facing Kipson-Clime complex soil. After being cropped for many decades, it was seeded to native grasses in 1982. At the start of the experiment, Site 1 had higher levels of soil organic matter and some nutrients (NO_3, total nitrogen, and potassium) than Site 2 (Piper et al. 1991).

Plots were planted in a substitutive design in which overall density was constant (1.46 plants/m^2). Eighteen plots were established at each site. Each plot was 7.32 x 9.75 m, with eight rows 0.91 m apart and plants 0.75 m apart within rows. To eliminate edge effects, no data were taken from the outer two rows.

Six cropping treatments were replicated three times at each site. Treatments consisted of monocultures of each species, alternate plant bicultures of Illinois bundleflower with eastern gamagrass and mammoth wildrye with gamagrass, and a 1:1:1 randomized mixture of all three species.

We evaluated overyielding for all mixtures by calculating Land Equivalent Ratios (LERs) using the formula

$$LER = A_p/A_m + B_p/B_m,$$

where A_p represents yield of species A in polyculture and A_m represents yield of A in monoculture. The LER represents the equivalent amount of land that must be planted to monocultures to match the yield found in a given mixture. First, the relative yield, the ratio of the monoculture plot yield to the mixture plot yield, is calculated for each species. The relative yields of each species in mixture are then summed to give the LER. Overyielding occurs if the LER>1.

Results

Seed yield

In 1995, eastern gamagrass continued to yield well in all plots. Most notably, yields in the triculture plots at Site 1 (yields>120 g/m^2) and the bundleflower bicultures at Site 2 (yields>60 g/m^2) (Figure 1). In 1993, eastern gamagrass and Illinois bundleflower plants at Site 2 experienced a cotton rat infestation that damaged many plants and limited bundleflower seed production in subsequent years.

Mammoth wildrye yields were high in monoculture this year at Site 1. Treatment effects were not significant at either site (Figure 2). It appears that the low soil quality at Site 2 was a factor in the poor growth of wildrye in latter years.

Overall, Illinois bundleflower yields are lower since 1992 (Figure 3). Yields ranged from approximately 60 g/m^2 at Site 1 to approximately 90 g/m^2 at Site 2. It appears bundleflower growth is independent of soil quality.

Overyielding

At Site 1, the gamagrass/wildrye bicultures and gamagrass/bundleflower bicultures overyielded in 1995 (Table 1). At Site 2, all treatments overyielded, most notably the gamagrass/bundleflower plots.

Discussion

Even in our relatively simple polyculture plot communities, it is possible to see the benefits of biodiversity to an agricultural ecosystem. Some perennial grains produce higher seed yields in mixtures, polyculture plots can overyield, and the system supplies some of its nitrogen needs.

Treatment effects were evident in seed yields. Eastern gamagrass grew well in triculture at Site 1 and in biculture with Illinois bundleflower at Site 2. The results suggest that gamagrass/bundleflower is a positive plant association in which bundleflower supplies soil nitrogen to the grass.

In the polyculture plots, mammoth wildrye declined steadily after 1993. The increase in wildrye yield at Site 1 in 1995 may have been due to a very wet, cool spring. The eventual disappearance of wildrye from Site 2 accords with what we have seen in native prairie: poorer soils tend to feature low representation by cool-season grasses (Piper 1995). Overall, Kansas may be a relatively unsuitable climate for this cool-season plant.

Year-to-year yield has not fluctuated greatly in Illinois bundleflower monoculture plots at either site, which suggests that an equilibrium has been reached. In the spring of 1995, we attempted to replace plants grazed by cotton rats during the winter of 1993-1994. This attempt was only partially successful as many of the seedlings transplanted did not grow. It appears to be difficult to place bundleflower seedlings into an established gamagrass stand.

Loss of many Illinois bundleflower plants to small mammal grazing at Site 1 had not occurred in previous experiments. Higher than normal rodent populations most likely resulted from the record high precipitation in 1993. This serves as a warning about unforeseen polyculture effects—namely that winter cover can provide habitat for destructive creatures.

The high LER for gamagrass/bundleflower at Site 2 was due to a high gamagrass relative yield. In all LERs, gamagrass accounted for most of the overyielding effect.

One of our greatest challenges has been to design perennial grain plots that are diverse, persistent, and productive over several years. Even a three-species mixture is vulnerable to the loss of one or two components. Other biodiversity research has shown that adding more types of plants to a system can contribute to its resilience. We could enhance our polycultures by adding more representatives from the warm-season grasses, cool-season grasses, legumes, and composites.

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Twenty Years of Friendship

Matthew Logan

Anniversaries provide us with opportunities to celebrate, reflect, and assess. But they are more than milestones marking the passage of time. Reflecting on the past can help give renewed purpose and meaning to our daily work. Anniversaries are reminders of dreams old and new.

The Land Institute began with an audacious dream twenty years ago. Who could have imagined a place in the middle of Kansas, far from the so-called centers of learning, where people could discuss, investigate, and work toward a way of life that places priority not on convenience and contrived abundance but long-term sustainability? Well, if you have read through this *Land Report* you know how the dream has been realized. This issue is a tribute to everyone who contributed to this place's success.

Scores of people have left their mark. We owe huge debts of gratitude to such people as E. F. Schumacher, Paul Sears, Wendell Berry, and Donald Worster whose thinking still provides a solid philosophical base for our explorations. The staff over the years has served the mission of The Land Institute remarkably well, even in times of difficulty. And, as this *Land Report* shows, Dana Jackson's presence is still deeply felt and appreciated.

The Land Institute would not be here today, however, without the committed support of our Friends of The Land. Fund raising letters have reduced it to a cliché, but I want you to know that "your support *does* make a difference." That difference here has been no less than the margin between failure and success. When a fire destroyed the original classroom building in 1976 after only a few weeks of use, Friends responded with gifts of building materials, books, tools, time, and money to restore the dream. In subsequent years, the generosity of our Friends enabled The Land Institute to build a greenhouse, acquire the Sunshine Farm, and remodel the old school in Matfield Green.

Today, the support of Friends is just as vital as ever. Your gift this year will allow us to add a new plant scientist to our staff. It will purchase seed for our experimental plots and defray the interns' living expenses in the form of stipends. Your support will guarantee that the Prairie Festival continues to attract first-rate speakers, artists, and activists. *The Land Report,* Visitors Day, and our newly developed summer workshops for rural educators would not be possible without your contribution.

Each fall you are no doubt inundated by appeals from worthy nonprofit organizations. As you read this *Land Report* and the next (it will contain highlights of the past year in an annual report), I hope you'll keep in mind that what we do is *grassroots* research. We do not enjoy fat government research contracts. Corporations rarely support our work. Because our approach to science—integrated, cooperative, non-reductionistic—is so uncommon, we must call upon our Friends across the globe to keep these ideas growing. Through the years you have responded collectively to our requests with extraordinary generosity.

The twentieth anniversary will soon pass, and with it our nostalgic musings about the "good ol' days." But the need to keep this work on course will not be diminished. I hope you will become a *perennial* Friend of The Land by making a gift and telling a friend or colleague about your support for our work. With your help, we look forward to another challenging but rewarding twenty years.

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