

LAND REPORT

THE LAND INSTITUTE · SPRING 2010



THE LAND INSTITUTE

MISSION STATEMENT

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

OUR WORK

Thousands of new perennial grain plants live year-round at The Land Institute, prototypes we developed in pursuit of a new agriculture that mimics natural ecosystems. Grown in polycultures, perennial crops require less fertilizer, herbicide and pesticide. Their root systems are massive. They manage water better, exchange nutrients more efficiently and hold soil against the erosion of water and wind. This strengthens the plants' resilience to weather extremes, and restores the soil's capacity to hold carbon. Our aim is to make conservation a consequence, not a casualty, of agricultural production.

LAND REPORT

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ELECTRONIC MEDIA

To receive Scoop, e-mail news about The Land Institute, write to Joan Jackson at olsen@landinstitute.org, or call. Our Web site is landinstitute.org.

SUPPORT

To help The Land Institute, see the contribution form on the back cover, or contribute online at landinstitute.org. Funders receive the Land Report.

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Cover: John Steuart Curry, "Our Good Earth," 1942, lithograph, 10 by 13 inches, courtesy of Bone Creek Museum of Agrarian Art, 2007.8.
Contents photo: Land Institute perennial wheat.

Need for perennial crops is gaining attention beyond The Land Institute. The US Agriculture Department noted it in the budget request to the president for fiscal year 2011. And the February 12 issue of the prestigious magazine *Science* three times, including in the editorial, describes perennial grains as part of how to make food production more secure.

The winter 2010 edition of *Issues in Science and Technology* details how perennial grains can help both assure food for a growing human population and reduce farming's damage to soil, water and other species. The writers are Jerry Glover of The Land Institute and John Reganold of Washington State University. They call for public investment to speed a years-long job of breeding the needed plants and devising how to farm them. For more on this policy idea, see page 8.

Agriculture, Ecosystems and Environment published online, with print forthcoming, studies showing that even when cut to make hay each year for decades, perennial grasslands beat adjacent annual wheat fields for soil fertility, soil structure and beneficial, complex soil biology. The scientists included Land Institute research graduate fellows Steve Culman of Cornell University and Tianna DuPont of the University of California at Davis, and institute scientists Glover and Lee DeHaan.

The same journal also published a study that found maximum biomass production among varying numbers of grassland species depended largely on the presence of one nitrogen-fixing legume. Upping diversity beyond the legume and one warm-season grass wasn't necessary to achieve maximum yield. The lead author was DeHaan.

The previous three studies are on our Web site, landinstitute.org, under Publications, Science.

Worldwatch Report 179 includes farming with perennials as one of five major strategies for mitigating climate change through food and land use. Sara J. Scherr and Sajal Sthapit, authors of the 50-page paperback from Worldwatch Institute, propose also restoring degraded range and wetlands, protecting natural habitat, livestocking improvements, and careful farming to enrich soil with carbon.

The popular online reference Wikipedia now has thorough entries for perennial rice and domestication of the perennial intermediate wheatgrass.

BREEDING NOTES

From among about 1,700 Maximilian sunflower plants in breeding plots, technician Sheila Cox found three seed heads with greatly reduced shattering, which is one key to making a crop plant. Wild plants disperse seed at provocation as light as wind. Crop plants must hold on until harvest. The genetics and mechanics of shattering in wild



sunflowers like the perennial Maximilian is a major obstacle to domestication. Cox and scientist David Van Tassel cut a head from each plant in breeding plots before birds got to feeding. Cox examined the heads after they dried. Gentle shaking caused most heads to dump their seeds. Van Tassel looks forward to seeing what comes this year from crossing the exceptional plants with each other and with those having big seed heads.

Land Institute scientist Cindy Cox, who spends much time looking through microscopes to study the genomics of plants from our breeders, recently found wheat hybrids that for the first time appeared to have most of the chromosomes from both annual crop wheat and perennial wheatgrass. A perennial wheat able to survive stressful environments probably will require at least half of the chromosomes from wheatgrass because perenniality is determined by a complex gene array. And crop traits already established in wheat's genome, such as short stature and threshing ease, are also important. Plant breeder Lee DeHaan obtained these new plants through several generations of crossing to the perennial parent.

CONSTRUCTION PROGRESS

Our new research center's roof and exterior walls are on. Interior work can proceed through spring rains. Winter weather →

NOT STUCK ON SMALL: At far left is a typical wild intermediate wheatgrass head. Next is the result of generations of selection for large seed and seed head. Critics say that overwintering perennials can't afford to invest in seed like annual grain crops. When treated like crop plants, they can. For more questions and answers about developing perennial grains, see page 13. The image is 90 percent life size.

slowed construction, but Land Institute scientists still hope to move in by late spring or early summer. In early March, the Perennials on the Horizon Capital Campaign had raised \$2.4 million of its \$3 million goal – the \$2 million research center is covered. The balance will improve our greenhouse, house-turned-office and other buildings.

NEW BOARD MEMBER

Patrick McLarney was a managing partner of Shook, Hardy & Bacon, a law firm in Kansas City, Missouri, that grew to more than 500 attorneys in his time. He is chairman of the University of Missouri, Kansas City, Board of Trustees, and serves in many other civic and nonprofit capacities.

PRAIRIE FESTIVAL

Writers Wendell Berry and Scott Russell Sanders, and biologist Sandra Steingraber are to speak at The Land Institute's Prairie Festival September 24-26. Also scheduled to talk are ecological economist Joshua Farley, Kent Whealy, co-founder of Seed Savers Exchange, artist Matilda Essig and Land Institute scientists, including Wes Jackson.

Steingraber won recognition for "Living Downstream: An Ecologist Looks at Cancer and the Environment." The book connected industrial poisons with cancer, and presented the disease in terms of human rights. She continued with exploration of how poisons affect development of fetuses, in "Having Faith: An Ecologist's Journey to Motherhood." Steingraber is a scholar in residence at Ithaca College, New York.

Berry is a prolific champion of agrarianism and rural community, a leading critic of the effects of industrialism and its economics. "The Unsettling of America" addressed this, as do his numerous essay collections. He also writes novels and poetry. Berry lives in Port Royal, Kentucky.

Sanders' more than 20 books are novels, story collections and personal nonfiction. "A Private History of Awe" was nominated for the Pulitzer Prize. "A Conservationist Manifesto" is his vision of a shift from a culture of consumption to a culture of caretaking. Sanders taught at the University of Indiana and lives in Bloomington.

Bloomington's Krista Detor, Dave Weber, Tim Grimm and Malcolm Daghiesh will perform music that incorporates words of Sanders, Berry and Darwin.

Farley pushes for economics to recognize ecology – real-world connections and limits. "In ecology, if your theory is not supported by real life, you change your theory," he told interviewer Lissa Harris. "In economics, if your theory is not supported by real life, you try to come up with policy measures that change real life to make it a closer fit to your theory." Farley wrote, with Herman E. Daly, "Ecological Economics." He works at the University of Vermont.

Kent Whealy's Seed Savers Exchange preserves and shares heirloom plants, and is credited with valuable conservation of the genetic diversity of vegetable crops.

Matilda Essig is a painter recently devoted to making detailed photographic scans of native grasses near her home in Arizona.

PRESENTATIONS

Land Institute staff members spoke at conferences and colleges in Quebec, Vermont, Missouri, California, New York, Illinois and Nebraska.

Upcoming: April 8, Traverse City, Michigan. April 11-12, Xavier University, Cincinnati. April 15, Oklahoma State University, Stillwater. April 29, Manhattan, Kansas. May 18, Salina: David Orr, author of "Down to the Wire: Confronting Climate Collapse."

For more, call us or see Calendar at landinstitute.org.

PRAIRIE FESTIVAL RECORDINGS

September 25-27, 2009, The Land Institute

QUANTITY	TITLE	SPEAKER
_____	Report from The Land Institute	Land Institute staff
_____	When environment boils the political pot and ecology wins in the clash of world views	George M. Woodwell
_____	Social and biological complexity	Verlyn Klinkenborg
_____	Global warming: are we doomed?	Richard Harris
_____	Endangered species, climate change and legislators: Odd but certain bedfellows	Mike Phillips
_____	Economics and ecology: A new synthesis	John Todd
_____	Resilience: A positive substitute for growth	Wes Jackson

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One man cannot put himself in the place of science. – Nikolai Vavilov



YEAS FAR BILL

Seeds of perennial crops years in the making spell out needed change in farm policy to preserve land and feed humanity. Shown life-size.



R
M

Our soil and water need perennials, which need help from Washington

Anyone familiar with The Land Institute's work over the last three decades knows we've emphasized that grains grown in a context more like natural prairie, featuring perennial mixtures, would check farming's continuing degradation of the land and water. In fact, we have relentlessly stated that this perennialization of the landscape is the most cost-effective way for us to stop the damage and stay fed. But to develop a full array of these perennials to replace their annual analog will take more decades. And there is the rub. Profit-paying industry won't invest for returns so long coming, even if they are more long-lived.

There are a few people breeding prototypes for perennial grains now: Land Institute scientists, researchers at a few land grant schools, and scientists in China, Australia and Canada. But these efforts are few, small and isolated. To significantly cut our ecological losses calls for a broad and committed social contract beyond the current social contracts for agriculture: the US farm bills. These are five-year deals, shortsighted for what's needed, and allotting only a thin slice for conservation.

What's needed is to think like a 50-year farm bill, just as Aldo Leopold urged us to think like a mountain. Think of federal policy aiming for an agriculture that is as nature-tough as we can make it. Develop perennial grains that make farming resilient and sustainable in a way impossible for today's agriculture, where govern-

in photo by Scott Bontz.

POSSIBLE FARM BILL MILESTONES

2010	2015	2020	2030
Hay and grazing operations continue as they exist. Preparations for subsidy changes begin.	Subsidies encourage more perennial grass growth for production of meat, eggs and milk.	The first perennial grain, Kernza, becomes available to a small number of commercial farms while seed supplies build.	Farmers and consumers learn about the new perennial grain crops.

ment and fossil fuel subsidies obscure but do not staunch the hemorrhaging. Use the five-year bills as mileposts and adjustment points for scientists breeding those perennial grains, and to meanwhile encourage other perennial cover, like pasture for grazing, or perennials in rotations, instead of subsidizing annual grains to supply feedlots. In 50 years we could see the farm landscape go from 80 percent annuals, dead half of the year or more, to 80 percent perennials. For the first time we could see grain agriculture capable of conservation that restores natural fertility to fields and keeps them productive for millennia.

Based on Agriculture Department figures for current research funding, 120 scientists and their staff could do the work with \$50 million a year. This is 8 percent of what the public and private sectors together spent on plant breeding in the late 1990s. The breeders could tackle six to eight major crops, at locations across the country to as-

sure the plants are diverse and, so, the food system more dependable.

The Land Institute doesn't seek this funding for itself or any other organizations in particular. It offers to the endeavor free seed from its decade of progress with hybrid prototypes of perennial wheat, sorghum, sunflower and other crops. See sidebar on page 16.

Our advance has come from five scientists and a handful of technicians and summer field hands. But because the change needed is systemic, the Agriculture Department should take the lead.

Land Institute President Wes Jackson last year met top USDA officials to promote a 50-year plan. The Land Institute also sponsored 10 meetings across the country with farmers, ranchers and representatives of organizations for sustainable agriculture. The coalition can help build a broader constituency for long-range federal policy that includes returning grain lands to perennial

2040

Three decades after 40 percent of US waters were deemed unfit, it again is safe to swim in every stream.

2045

A variety of perennial grain crops are available across the country, with growth methods that include grazing and haying.

2050

Former dead zones at river mouths are again thriving sea fisheries.

2055

Perennials cover 80 percent of farm acreage, a reversal of five decades earlier. Valuable annual crops grow only on the least erodible fields.

plants, even if only in crop rotations. This kind of policy shift depends not only on endorsement by the secretary of Agriculture, but the president, Congress, nonprofit organizations, corporations and citizens.

Jackson went to Washington with Fred Kirschenmann, of the Leopold Center for Sustainable Agriculture, and writer Wendell Berry. They say a 50-year bill's goal is necessary and its enactment possible. Even if a bill doesn't pass, it will increase imagination for dealing with problems bound to become more daunting. Berry said, "If it fails politically, that doesn't invalidate it."

Essentially all of nature's ecosystems feature perennial plants growing in species mixtures, and they build soil. Agriculture turned this complex, productive and long-lived system on its head, by substituting annual monocultures. Annual tillage loses soil nutrients, soil structure beneficial to plant growth, and soil itself. Modern "no-till" farming cuts erosion

with herbicides that pollute water – and it still loses soil. Adding to the water pollution is fertilizer that compensates for how annual cropping has gutted soil fertility. Agriculture is blamed for 70 percent of US water contamination. The fertilizer comes from unsustainable mining – of fossil fuel to synthesize nitrogen, and more directly, phosphorus, among other minerals. Most land available for new production is of marginal quality that declines quickly under cultivation. But these lands will be pursued as human population and its appetite grow. So along with greater rate of erosion comes greater application of fertilizer and pesticides, while they last. The United Nations' Millennium Ecosystem Assessment said agriculture is the largest threat to biodiversity and ecosystem function of anything humans do.

Perennial grains can help by mimicking the wild perennials that dominate nature. Perennials' massed roots and underground

stems remain alive year-round. They guard soil against erosion by wind and water. Their roots, and the arthropods, fungi and bacteria that live among them, make the soil more porous, friable and alive. This soil soaks up water rather than shed it. And because the perennials' roots are more massive, reach deeper, live longer and build a soil web, they make more productive use of the water, along with nutrients. The continuous underground infrastructure also gives green growth and photosynthesis a head-start of weeks over annuals struggling from seed.

Grain agriculture began with annuals probably because they were in some ways more convenient to Paleolithic farmers. But with our knowledge of biology today, there is no reason that perennial grains cannot feed us well. See sidebar on the next page.

We are not arguing to stop anything all at once. The 50-year farm bill proposes gradual systemic change in agriculture. In the short run, we can achieve gains through policy that encourages farmers to increase the use of perennial grasses and legumes in crop rotations. The big gain will come when perennial grains become available over the coming decades. By capturing more solar energy, improving soil and water quality, and taking less fuel and equipment time to work them, perennials will present a compelling alternative to annual grains.

To help win support for development of perennial grain agriculture, The Land Institute has given people small samples of flour from a perennial wheat relative, intermediate wheatgrass. It has an excellent nutritional profile. And folks like it. We secured a trademarked name, Kernza. Researcher Lee DeHaan estimates that with funding expanded to support two full-time scientists and support staff, a product could be ready for farmers in another decade. The

FILLING THE BILL

Five-year farm bills have been for

- Exports.
- Commodities.
- Subsidies.
- Some soil conservation.
- Food programs.

The 50-year bill would add these larger goals for sustainability:

- Protect soil from erosion.
- Cut fossil fuel dependence.
- Sequester carbon.
- Reduce poisons in soil, water.
- Manage nitrogen carefully.
- Reduce coastal dead zones.
- Cut wasteful water use.
- Foster farm communities.

other crops aren't yet as close, but they are progressing.

Perennialization of the 70 percent of US cropland now in grains could extend the productive life of our soils from the current tens or hundreds of years to thousands or tens of thousands. New perennial crops, like their wild relatives, seem certain to better handle climate change. Without a doubt, they will increase sequestration of carbon. They will reduce the polluted runoff that drives life from ocean fisheries, as well as improve the quality of scarce surface and groundwater. They will improve food security, and this will bolster social stability and ecological sustainability. The three go together.

PERENNIAL CHALLENGES AND ANSWERS

Over the past three decades, interested people have posed good questions about The Land Institute's work to develop perennial grain crops. Here are some of those most frequently asked, and our best answers.

You expect to take at least 25 years to achieve more than two or three profitable, productive perennial grain crops. Isn't that too late to address the problems facing the world today?

We hope not, but we do need to move as fast as possible. The sooner that these crops are available, the more land we can save from degradation. Global agricultural acreage likely will expand over the next two to three decades as human population grows toward the forecast of 9 billion. Recent projections are for agricultural land to expand 18 percent by 2020. The best soils are already farmed. Much of the expansion will be onto marginal lands, where risk of irreversible degradation under annual grain production is high. As these areas degrade, chemical, energy and equipment inputs will become less effective and less affordable. Thirty-eight percent of global agricultural lands already are ranked as degraded, and the area grows. To reduce encroachment onto unfarmed lands, already degraded lands will need to be kept in production *and* made more productive. Where costly fertilizers, chemicals and fuels are not an option, farming that is highly efficient and conservative of natural resources is needed – and will be needed even more 25 years from now.

Can perennial grains be as productive as annual grains and, if not, won't they worsen environmental problems by taking more land for farming?

Both wild annuals and perennials have much lower yields than grain crops. But perennials can use much more of the water and nutrients moving through soil, and can photosynthesize longer. The amount that they grow above ground each year regularly trumps that of comparable annuals. The job of perennial plant breeders is to channel more of that growth away from leaves, stems, crowns and roots, and toward seed production, just as the breeders of annuals have done.

Won't the seed yields of perennials always be limited by the need to save energy for overwintering?

Annuals and perennials both must spend energy to survive winter – one as seed. It isn't clear that overwintering as seed takes less energy than overwintering as a perennial. Even if it does, many perennials have more energy available each year because their



Summer worker Ann Huston, from Austin College, plucks anthers from Silphium. Their pollen will be used to fertilize another plant in breeding for a perennial grain crop. Silphium is in the sunflower family. Scott Bontz photo.

growing season is longer and they don't need to establish as a seedling each spring. Perennials can even grow during dry spells when annuals are limited by roots too short to reach moisture. Rapid spring growth, combined with season-long access to water deep in the soil, means that perennials such as alfalfa are overall more productive than related annuals like soybeans. Again: much work by breeders of perennial plants is to shift the allocation of resources. But the resources are there.

*Can no-till farming match
perennials at protecting
farmland and water?*

No. Although no-till technology has reduced erosion, problems remain with the biological limits of annual plants. They are absent or too small for much of the year, and relatively inefficient at capturing water and nutrients. What they let slip by can exceed that of perennials by 500 percent. This wasted water carries soil nutrients, fertilizer and pesticides that pollute rivers, lakes and coasts. Annual crops will always have this limitation.

*Several attempts have been
made in the past to perenniate
grain crops and we
have none to date. What
has changed that offers
promise of success now?*

History need not discourage us. The most ambitious past researchers were Soviet wheat breeders who saw their funding cut in the middle of the 20th century. Since then have come great advances in plant breeding techniques, knowledge of genomics and evolution, and computational power. With institutional devotion to the job, breeding of perennial grain crops can now succeed.

*Since mechanical tillage
and annual rotations are
largely eliminated in perenniate
systems, don't the
perennial plants become
sitting ducks for pests and
disease?*

Perennials dominate most native landscapes, constitute roughly 80 percent of North America's native flora, and have thrived throughout evolutionary history despite the pressures of pests and disease. In some fields or some regions, some perennial crops will prove to be more problematic than others, and breeding for complexly determined traits like yield and perenniality can unintentionally purge genes for resistance. But these problems also afflict our most productive annual crops. And there are many examples of herbaceous perennial plants – alfalfa, switchgrass, brome – that remain highly productive for many years despite exposure to pests or disease. Plant diversity, whether at the field or landscape scale, or over time, are potentially powerful tools for managing pests of perennial crops. So are field burning and breeders selecting for resistance.

*How do alternative
methods such as
permaculture, biointensive
or organic fit in with
perennial grain crops?
What about vegetables
and fruits? Community-
supported farms?*

We focus on grains, which occupy 68 percent of global cropland and provide about the same percentage of food calories. Any number of approaches, alternative or conventional, could be used in managing perennial crops and distributing the harvest. This is not to say that efforts aimed at reducing the scale of industrial agriculture and increasing local food security are misguided. They are necessary to transform our food system over the long term. But while promoting local, small-scale, organic agriculture, we must also assess how and where the bulk of our calories can best be produced. If all or even a large portion of the calories consumed by New Yorkers came from New York state, there would be few trees left and the state's thin, poor soils would be quickly degraded. The bulk of the calories consumed by New Yorkers must come directly or indirectly from grain crops that grow well in the Midwest and Great Plains states.

PERENNIAL GRAINS IN THE MIX



WHEAT has been hybridized with several different perennial species to produce viable, fertile offspring. The Land Institute has produced thousands of such plants. Many rounds of crossing, testing and selection will be necessary before perennial wheat varieties are available for use on the farm.



KERNZA is The Land Institute's trademark name for intermediate wheatgrass, a perennial related to wheat. Using parental strains from the USDA and other sources, we have established genetically diverse populations. We harvested 30 acres in 2009 and planted 100 acres more for this year. Kernza lacks wheat's gluten quality, but the overall nutritional quality is comparable to annual wheat.



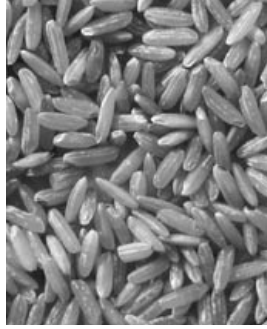
GRAIN SORGHUM is a drought-hardy feed grain in North America and a staple human food in Asia and Africa. It is reliable in places where hunger always threatens. Sorghum can be bred with a perennial relative, and The Land Institute has produced large populations from hundreds of such hybrids. We have selected perennial strains with seed size and grain yields up to 50 percent those of annual grain sorghum.



ILLINOIS BUNDLEFLOWER is a native prairie legume that fixes atmospheric nitrogen and produces abundant, protein-rich seed. It is one of our strongest candidates for domestication as a crop. We have assembled a large collection of seed from a wide geographical area and have a breeding program. We see it as a partial substitute for soybean.



SUNFLOWER is another annual crop that The Land Institute has hybridized with perennial species in its genus, including *Helianthus maximiliani*, *H. rigidus* and *H. tuberosus*, which is commonly known as Jerusalem artichoke. Breeding has turned out strongly perennial plants. At first the hybrids made scant seed, but recently some are highly fertile.



UPLAND RICE feeds millions in Asia, but this annual's fields are highly vulnerable to erosion. In the 1990s, the International Rice Research Institute made significant progress toward breeding a perennial upland rice using crosses with wild perennial species. After funding fell in 2001, the work transferred to the Yunnan Academy of Agricultural Sciences in China, with help from The Land Institute. In recent breakthroughs, a small number of perennial plants with good seed production have been produced.



CORN AND SOYBEANS are two crops that perhaps more than any other need to be made perennials. Corn occupies more than 80 million acres in the United States. Until soybean acres increased, corn caused the greatest amount of soil erosion. One route to perennial corn is by obtaining genes from distant perennial relatives, in the genus *Tripsicum*, which are winter-hardy. Another is by crossing with two perennial relatives of corn's direct wild ancestor. Unfortunately, both are tropical and can't survive freezes. Seth Murray at Texas



A&M favors using them rather than *Tripsicum* in crosses and then selecting for winter survival. Jim Holland, a USDA corn geneticist at North Carolina State University, says that perennial corn development, at least for tropical regions, comes down to a few technical issues. Several Australian species of the soybean genus *Glycine* are perennial. They are difficult to breed with it, but might be domesticated directly. The Land Institute has not explored perennial soybean. We work instead to substitute Illinois bundleflower.



In 1987, farmers of the High Plains boiled at Easterners Deborah and Frank Popper, who suggested that it made sense for the region to become a “buffalo commons” of perennial grassland more like before settlement. But people continue to leave the Plains, and the Poppers’ idea grows hair and gains purchase. Scott Bontz photo.

HOPE IS A THING WITH ROOTS

JAKE VAIL

A wild ripple spread out over the sea of grass recently, when the Kansas City Star ran an editorial proposing a million-acre Buffalo Commons National Park on the High Plains of western Kansas. According to Frank Popper, co-author of the original buffalo commons paper, it was the first newspaper endorsement of the idea. The editorial certainly caught me by surprise, for I had just driven a long loop across the Plains with that very notion in mind.

I returned home to find not only the Star's hopeful editorial, but the tragic news that nearly three and a half million acres had been taken out of the US Agriculture Department's Conservation Reserve Program the previous month - a grass-covered area of highly erodible land the size of Connecticut, uprooted and exposed for want of public support. At the same time, the US Fish and Wildlife Service was proposing a million-acre conservation area in the Flint Hills of eastern Kansas, and bison were (re)introduced at the Tallgrass Prairie National Preserve. At its annual Prairie Festival, The Land Institute offered a breathtaking display of perennial grass roots, the past and future power of the Great Plains, even as farmers rearranged the topography with mountains of corn and soybeans for a biofuel-besotted nation. The

pendulum of history still swings between nature and economy above the country's midsection.

I hadn't expected to see signs of the buffalo commons so early on my trip out of eastern Kansas to the higher and drier Plains, but there they were, grazing right next to the turnpike. Pronghorns. Two hundred and four years ago, explorer Zebulon Pike reported "buffalo, elk, deer, cabrie and panthers" on the prairies of the "very ruff flint hills" just a few miles from where I drove, but the sight of "cabrie" here and now nearly sent me into the ditch.

Pronghorns graze in the Flint Hills today because of decades of collaboration between ranchers and scientists, but also because they can. Remnants of the grasslands they evolved with still exist, despite vast changes in the land since Francisco Vasquez de Coronado's 1541 *entrada* at the other end of the state. My twenty-first century vision of the fastest herbivores on the planet chewing their cud as the traffic sped past was the result of how we've managed - how we've made space into place and land into landscape, as writer William L. Fox likes to say. Prodded by the pronghorn, for the next 2,500 miles of my High Plains expedition I felt for the shifting layers of natural and cultural history, and pondered how we'll manage in the future.

Beside Pike and Fox, my traveling companions-in-print included Frank and Deborah Popper, the progenitors of the buffalo commons. In 1987 they proposed the establishment of a commons on the immense dry prairie that stretches from Texas to Canada. They saw large-scale emigration from what historian Walter Prescott Webb called “the least-known, most fateful part of the United States,” a direct result of what they termed “the largest, longest-running agricultural and environmental miscalculation in American history.” They suggested the government “take the newly emptied Plains and tear down the fences, replant the shortgrass and restock the animals, including the buffalo.”

Farmers, ranchers and Chambers of Commerce from Montana to the Rio Grande were incensed, and for the next several years the Poppers toured the Great Plains to explain their proposal. Some talks had to be canceled because of death threats, but fairly quickly the tenor of the meetings changed. In the years since, many of the social and environmental trends that the Poppers brought to attention have continued, compounded by some unexpected changes – not the least of which being accelerating climate change and economic recession.

A couple years ago, before “sequestration” and “recession” were much heard on the High Plains, I interviewed the Poppers via e-mail. Frank got right to the point: “Nature and economy always rebel,” he said. Their thoughts came to mind as I drove through tornado-torn Greensburg, Kansas, and headed for the epicenter of our most obvious nature-economy rebellion, the Dust Bowl of the 1930’s. Timothy Egan’s “The Worst Hard Time” and Dan Flores’ “Horizontal Yellow” had convinced me that I needed to see this overworked land, and on south to the *Llano Estacado* of Texas.

I camped near Santa Fe Trail wagon ruts in the Oklahoma panhandle, and as coyotes yipped I thought back on the landscape I had just crossed. Nearly eighty years after the Dust Bowl it appeared heavily managed yet remarkably jumbled, handsome stands of replanted native grass growing next to fallow wheat fields, while right across the road center-pivot irrigated sorghum stood bright green beside scrappy overgrazed sandsage prairie. The land was punctuated by oil jacks, some motionless, some solar-powered. As nearly everywhere, plastic fluttered on barbed wire fences and roads were under repair. The Dust Bowl winds blew hard and long here, and it looked to me like the locals were still trying to figure it all out – though I didn’t see too many locals.

“The buffalo commons idea wasn’t numbers driven,” Deborah Popper had said, which surprised me. “You didn’t need the numbers [of regional population decline] to see the pressures – we were influenced by reading the history. The numbers came as a response to the uproar – the letters about whether the fence was going to enclose the whole of the ten states of the Great Plains. I spent a lot of time at the computer downloading census data as a way of providing a sense of scale for the buffalo commons.”

Frank explained that he has long been interested in the frontier. “When I got to Rutgers in 1983, I felt a lot of tenure-related pressure to publish a lot quickly, so I reduced the idea of the frontier to the Great Plains, just to simplify my task. In summer 1985 Deborah and I took a car trip with our kids to the Plains, decided to write about the region, and finally began publishing about it in late 1987. The 1987 Planning [magazine] piece, “The Great Plains: From Dust to Dust,” was a major hit, the most controversial article Planning had ever published at that time.”

Perched upon an ebbing aquifer, I was surrounded by top-down responses to the dust: Cimarron, Rita Blanca and Comanche National Grasslands, created to save soil. The economic winds of the 1980s farm crisis blew in the Conservation Reserve Program, created to save farmers. By establishing perennial grasslands, both programs also happen to save carbon. The Star editorial makes it clear: "The prairie is the greatest long-term carbon sequestration landscape available." To cope with the latest winds of change, those of climate disruption, we would do well to establish more deep-rooted and resilient landscapes, from national parks and conservation areas to prairie-mimicking agro-ecosystems.

Deborah had some tough questions for Plains residents: "I think the energy questions and global warming scenarios are critical, particularly for their unintended consequences. How much will we decentralize energy? Will adaptations to climate change occur more at the local scale or at some larger one? Will we change our perceptions of inland areas as sea levels rise? What is the rate of change? We can anticipate short-term competition for corn, for example, but I can't tell how the adjustments will play out. But they will affect the Plains."

"None of this stuff dims the prospects for the buffalo commons, and some of it enhances them," pointed out Frank. "Water is clearly an issue - the large-scale depletion of the Ogallala or other water sources tends to move in a buffalo commons direction."

Hoping to dig deeper into the landscape around me, I made for the red rock strata of Palo Duro Canyon, recalling historian Dan Flores' unearthing of Georgia O'Keeffe's artistic roots there and Terry Tempest Williams' O'Keeffe story, "In Cahoots with Coyote." As I approached the north end of the Llano Estacado, where the

FREEDOM OF SPEECH IN LIBERAL, KANSAS

KIM STAFFORD

This is the place where travelers
could count on water a neighbor gave -
liberal wells, a bucket's bounty.

Before first light, out along the breaks
above the Cimarron, one big star
burns east, and low along the river

mist softens the dark. Down there,
blackbirds by the thousands cling
to reeds. Owls call. Coyote.

In the dark, the silence, the cold
would you be first to speak
when a secret rides in your throat?

All those blackbirds - low, hidden, alive
gather by the call of one to swarm
with a whump and whirl to swirl

and ribbon away toward dawn.
Your voice waits, water in the ground.

great tableland falls dramatically into the Canadian River Valley, I passed a sprawling dairy, seeming very much out of place, and a massive wind ranch. Apparently Texas doesn't grow wind *farms*. Cows and towers outnumbered people, and I remained virtually alone in the Lone Star State until Amarillo, "an urban island in a shortgrass sea," as the Poppers would say.

Some of the layers I found at Palo Duro: blistering heat and flash floods, a sign informing me that famed cowboy Charles Goodnight slept here, and, most metaphorically, notice of an oil well that hit an air pocket and blew with a bang heard nine miles away. The well was abandoned. A family with his-and-hers SUVs set up camp nearby, and I heard Dad explain to his daughters, "Number one rule: Have fun. Number two: Be safe."

Following rule number one, part of my plan was to follow Georgia O'Keeffe's radiant light across the lands from Palo Duro west to the painted hills of Abiquiu, and what better way than to take part in a Land/Art symposium in New Mexico. William L. Fox was to discuss "The Art of the Anthropocene" in Santa Fe, exploring how we are reacting to the new era that we've created. Director of the Center for Art + Environment at the Nevada Museum of Art, Fox writes on how we perceive place, blending land and literature with art and our haptic sense – how we feel, bodily, in a given landscape. His description of recent changes in relationships among art, science and exploration reminded me of when the Poppers spoke at Kansas State University five years ago. Kansas Secretary of Wildlife and Parks and former Governor Mike Hayden shocked everyone there by embracing the buffalo commons, and led Deborah to suggest that our inner geographies were changing. I asked her to elaborate.

"I expect I referred to our way of experiencing place – our expectations, what we notice, what we see as significant, necessary, important," she explained. "These are largely unarticulated values, derived from past experience, that in turn affect ongoing experience. We have nostalgic landscapes in our heads, literary and film ones, and the ones we daily experience. They bump against each other. At its most obvious, this affects whether the Great Plains seems right with wheat, with buffalo; whether towns are supposed to have Main Streets or strip malls on the highway. This also includes who looks right – as though they belong – and certainly the Hispanic and Native American numbers are growing. They belong."

The Plains continues to experience population loss in most counties, but one area that has grown is southwest Kansas and the Oklahoma-Texas panhandles, due to a continuing influx of Hispanic workers.

"The growth in numbers makes these groups more important to the economy, and their own entrepreneurial efforts are important," Deborah said. "This applies especially to Hispanic populations. Native Americans have largely appreciated the buffalo commons, at the same time realizing it's more their concept than ours."

Frank expanded on this: "It is clear that Americans now think Indians and buffalo are a lot cooler – and less dangerous – than they were, say, 150 years ago. Now that the Plains Indians and their prime food source, the buffalo, no longer present the – even bogus – national security threat that they did at the time of Little Bighorn or the Pine Ridge Massacre, the nation can afford to indulge them. The nation can concern itself with Plains environmentalism, aesthetics, land preservation, and species protection. The populations of both Indians and buffalo are rising fast in the Plains, as

the white population is aging and falling.

“Latinos have always been prevalent on the southern Plains and are now becoming more prevalent in the northern Plains. Their relative youth and high birth rates, just as with the Indians, mean that across the Plains they are sooner or later likely to challenge the long-time white dominance. The Latinos are still going through the usual exhausting (national) immigrant and (local) newcomer rites of passage, for instance as slaughterhouse workers in southwest Kansas, or in numerous national and local political-cultural struggles with whites. But they’re beginning to establish themselves in a lot of places in the Plains where they had not previously been.

“I’d guess in the end that the immigrants and newcomers will prove themselves brilliant new additions to American society. It’s startling how many small towns on the Plains – and the Mississippi Delta and the Corn Belt – already have a good, relatively cheap new gathering place elbowing its way into long-established local social and eating habits – a Mexican restaurant.”

From New Mexico’s intense Native American and Hispanic flavors and Georgia O’Keeffe’s beloved hills I made my way back across the grasslands of eastern Colorado and western Kansas to El Cuartelejo, a seventeenth century pueblo outlier – from Ghost Ranch to ghost towns, and not just the pueblo. The density of “For Sale” signs I saw in upscale Santa Fe was a surprise, and well into Kansas I passed abandoned feedlots, quiet towns, farms for sale, rusting well heads, and acre upon acre of very weedy fields.

I saw no buffalo on the buffalo commons. I did see wild turkeys and harriers. Lark buntings, nighthawks and Swainson’s hawks made their way south over prairie dog towns and pronghorns. Also on the

LUCKY 4 A.M.

KIM STAFFORD

Little bird who wakes me in the dark
be molecule in the bonded chain of good.

Sip of water who refreshes
be rain pilgrim winking through centuries.

Glimpse of gold sun out the office window
who catches breath, be one click

in the clock of beauty, benefactor of dimes
in a world of paltry millions that take us

far from what we love.

First published in Orion magazine.

move were endless pickup trucks, as well as several flatbed tractor trailers hauling wind turbine blades. “High Speed Internet and Hot Waffles” announced a sign in one town; in another a billboard announced an ethanol plant opening soon. Despite summer rains, both the Arkansas and the Smoky Hill Rivers were dry.

“The pressures on the Plains and their people remain more or less what they were twenty years ago,” Frank said. “We’d still stand by most of the points in the Planning piece. But the one thing we got wrong is that we expected that somewhere off in

the distant future the federal government would take more 1930's-style action to help the Plains. It hasn't – or at least hasn't yet. Instead the action has come mainly – and relatively quickly – from Indian tribes, state governments, NGOs, big ranchers like Ted Turner, smaller farmers and ranchers, etc.”

“It's a region with lots of overt limits looming – water, most significantly,” said Deborah. “We tend to be caught between optimism and pessimism, seeing the need for change, but hoping to get by – in Plains terms, this has often meant no major change in agriculture – and at the same time seeing change and embracing it, and not worrying about the unintended consequences. Here we might wonder what ethanol might do to the region. What we know is the pressures haven't gone away, and the solutions seem elusive.”

The road forward was indeed elusive, as a weird, thick, fog socked in the western half of Kansas. Eventually it lifted, and I found myself following the towers of another wind farm east, toward a Salina coffee shop – where I could clear some fog of my own. There I bumped into the authors of a *Scientific American* article on the sort of major change in agriculture that Deborah Popper lamented: perennial crops. Soil scientists Jerry Glover of The Land Institute and John Reganold of Washington State got me thinking about roots, and sustenance, and about Georgia O'Keeffe again. She loved it at Ghost Ranch because she couldn't garden there, which gave her more time to paint.

But after a few years she felt compelled to move to where she could grow fresh food.

Wide open though it is, we seem to have a hard time reading the buffalo commons – translating the land into landscape. Buffalo in sight daily, Francisco Vazquez de Coronado, “Misfortune's Explorer,” got lost

on the Llano Estacado for weeks, marched hundreds of miles across the High Plains in search of gold, then turned around and went home. The Taos Apaches and Picuris who moved to the Plains to escape Spanish rule instead found themselves in a whirlwind of conflicts at El Cuartelejo, and after a few decades abandoned the pueblo. The subtle landscape of the prairie constantly disoriented Zebulon Pike, “the Lost Pathfinder,” who was charged to map it. Two generations later, huge numbers of farmers and ranchers swept onto the Great Plains with their own mental maps and disoriented the landscape, until the Dust Bowl blew many of them away again. The countryside has been emptying ever since.

Perhaps our confusion comes out of the place itself, which embodies – and thrives upon – the contradiction and challenge of overlapping patterns of movement and deep rootedness.

The Poppers concluded “The Great Plains: From Dust to Dust” by suggesting that the government “turn the social costs of space ... to more social benefit than the unsuccessfully privatized Plains have ever offered.” But turning space into place on the prairie has always come from both the top down and the bottom up, from the migratory and the rooted. To find real sustenance where the buffalo roam, we explorers, natives, farmers, politicians, scientists, newcomers and artists must allow the Plains' confounding outer geographies to better inform our inner geographies.

Nature and economy always rebel, says Frank Popper, yet on the most fateful part of the United States the nature of the economy increasingly is pointing us straight toward the economy of nature.

Expanded from an interview previously printed in The Lawrencian.

FIELD NOTES

Growing high quality food on grade 1 agricultural land, and then burning it in order to power cars which travel in opposite directions to each other every morning and then back where they came from in the evening, must be one of the most fatuous uses of land that any society has ever dreamed up. – Simon Fairlie in *The Land*, not to be confused with the Land Report

THE RULE IS SIMPLE: The more machinery man gets, the more machined he is. When the traveler got off a horse and into a machine, the tempo of his mind as well as his locomotion changed. – J. Frank Dobie, “The Mustangs”

ONE DOES NOT act rightly toward one’s fellows if one does not know how to act rightly toward the earth. – Liberty Hyde Bailey, “The Holy Earth”

ALL OF LIFE OR LIVING in the country does not necessarily consist of farming, but farming as such, which has been practiced or undertaken, wherein the sole object has been the accumulation of a fortune, has inevitably resulted in either impoverishment of the land or the failure of the undertaking. In fact it generally results in both. – Samuel Ogden, “This Country Life”

THOUGH BY ANY REASONABLE definition Iowa is a rural state, it is more thoroughly developed than many cities: A mere 2 per-

cent of the state’s land remains what it used to be (tallgrass prairie), every square foot of the rest having been completely remade by man. – Michael Pollan, “The Omnivore’s Dilemma”

THERE WILL COME A DAY when there won’t be any economists. They’re the ones who believe in perpetual motion machines. – Wes Jackson, at a Land Institute staff meeting

FAR FROM BEING a child of nature, the West was actually given birth by modern technology and bears all the scars of that fierce gestation, like a baby born of an addict. – Donald Worster, “Under Western Skies”

EROSION is one of those things that nickels and dimes you to death. – David Pimentel, *Science* magazine

BUT IN ALL OF THESE PLACES that couldn’t be more deprived by worldly standards I also find an expansiveness, a giddy openness that has allowed me to discover gifts in myself and others that most likely would have remained hidden in more busy, sophisticated, or luxuriant surroundings. – Kathleen Norris, “Dakota”

HE WAS ABSOLUTELY a man of the 20th century. His last coherent words, in the delirium of illness, were “Don’t worry, I’ll bring the car around ...” – James Howard Kunstler, “World Made by Hand”

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