decomposing the grid

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MIT MArch 2004
decomposing the grid
Ophelia Wilkins

ABSTRACT:
The American landscape chronicles the dreams of an agricultural nation through a series of regular lines en-
scribed on a flat plane.

Each 6 mile x 6 mile square frames a lose-lose situation in which government subsidies encourage intensive
monocultural production resulting in loss of topsoil, biodiversity and population while contaminating the ground
with chemicals and glutting global commodity markets.

Current “advances” in agricultural research demonstrate that age-old technologies – small scale rotational sys-
tems – properly managed, can multiply productivity while rehabilitating soils, retaining moisture and reducing
or eliminating chemical applications.

At a fragile moment in history when only 2% of the population produces the agriculture which supports the
other 98%, this thesis proposes an alternative to the current agro-political landscape in which rational lines no
longer suffice to measure a rotational landscape.

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PARABLE of the LAST FARMER

Before, it used to be, your neighbor a mile and a half down the road was dependent on you to help with the thrashing and silo filling and all that sort of thing. But now there's getting to be so few of us left. The way things are going now, I foresee the day when there's one farmer on the east side of the Mississippi and one on the west side. They'll be plowing and they'll meet at the river. There'll be a discussion, and shortly thereafter, there'll be one hell of a tiling project [to drain the river] and then there'll only be one farmer. And then he'll be the only one around, and he'll have trouble with his tractor on the way back, and he'll get stuck. He won't have anybody to fix it, and he'll be in worse shape than when he had a neighbor.

Virgil Thompson's story in Debt and Dispossession by Kathryn Marie Dudley
ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my family and my family of friends for their unconditional trust and patience over the last four years.

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Kate James for everything.
**LAND LOST**: The American West

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Image Credit:
movie still from “Northern Lights”
directed by Rob Nilsson
Landscape is not scenery, it is not a political unit, it is really no more than a collection, a system of man-made spaces on the surface of the earth... every landscape is the place where we establish our own human organization of space and time.

J.B. Jackson in Discovering the Vernacular Landscape
When we see how we have succeeded in imposing our own rhythm on nature in the agricultural landscape, how we have altered the life cycle of plants and animals and even transposed the seasons, we become aware of how dangerous a role we have assumed, and ... the salvation of Landscape 3 depends on our relinquishing this power to alter the flow of time and on our returning to a more natural order. But the new ordering of time should affect not only nature, [but] ourselves. It promises us a new kind of history, a new, more responsive social order, and ultimately a new landscape. J.B. Jackson, Discovering the Vernacular Landscape, p. 157.
INTRODUCTION

This thesis investigates the vast and vacant landscapes of the American West.

Once a land of promise for agricultural prosperity, the settlement of the frontier structured its own demise. As the transcontinental railroad increased connectivity between products and markets, boomtowns cropped up along the route. The introduction of mechanized farming caused these same towns to become obsolete as soon as they were built, with more land operated by fewer people.

Today the older generation is passing on, while children move to the cities, non-corporate farms cannot survive, and monocultural food production leaves the land to waste. Consequently, a new frontier of abandoned farm land has emerged.

From the earliest days of European settlement, land in the West has been formed by mechanisms linking it to technology and markets. This project proposes new strategies for settlement and agricultural production in these western wastelands, catalyzed by a reconfiguration of the Jeffersonian grid according to the technological demands of today.

Ironically, settlement and depopulation resulted from the same schizophrenic American mentality. A romantic desire to inhabit nature was made possible by exerting absolute control over nature through agriculture.
THE GRID

This vicious cycle was initiated in 1785 when Thomas Jefferson parcelized unsettled U.S. territory into a 6 mile by 6 mile township grid. Of the belief that "American success would stem from a strong and plentiful agriculture," his primary objective was to make land available efficiently and democratically to individuals for agricultural use.

The agricultural practices which take place within these perfect squares override the natural potential of the land with the latest technologies, in order to maximize crop yield for financial gain. These practices have caused irreparable environmental devastation in the form of widespread loss of biodiversity and depletion of soil nutrients, leaving the ground and water embedded with chemicals.

U.S. agricultural policy perpetuates this system by paying direct subsidies for specific crops – a minimum price for a crop regardless of global demand. A household income dependent on subsidies, however, falls short of minimum wage, such that farm consolidation has led to widespread loss of family farms.

Within this system, both financial and social "value" are measured by quantity of land owned, and purity of crop yield. The static land forms created by the grid make these values easy to quantify and evaluate by eye. Here, market forces influence interpersonal relationships, and the landscape is politicized and privatized as far as the eye can see.
Technology can save old small towns to be the technology of the past. Organic farming will play a role in re-opening hospitals and schools in smaller centers so there are more people travel. People will work in the fields, and live here, because of local food.

Can we build a computer that skins a deer?

Speaking as someone who went to Dako, sense that this fascination people have in beamining off the Prairie is wrong in so many ways. And usually science fiction fan when he has never actually lived in a rural area.

**1. Nearest Starbucks -- 50 miles.**

2. How will your salesforce feel about driving 50 miles on a national/international flight? Company near by has private airstrip, plane and pilot.

3. Last time I was in North Dakota, my town hospital was actually a nursing home.

4. Think you are getting the kids away from bad drinking and driving, we could touch bumpers at 50 miles an hour. That's a thing.

**Enjoy.**

**I work in the tech field in rural USA** by Eldorian1979 on Saturday January 21,

**we just did a little over 3 million dollars in sales this year.**

**Rural America outsourcing is a good idea.** We're not a bunch of
American Ideal[s] : Conflicting Ideologies of Space

Two conflicting ideologies typify American attitudes towards settlement: progressivism, characterized by an “uncritical commitment to technological progress,” and pastoralism which seeks “greater harmony between the man-made and the natural.”

In his “Notes on Virginia,” Thomas Jefferson describes his belief “that farmers represented the highest virtue and nobility among Americans.”

“In conceiving of the National Land Survey, Jefferson was most concerned with making land available, efficiently and equitably, for purchase and ownership by individuals.” However, without recognizing the variance inherent in each plot, he ultimately devised a progressivist implementation of his pastoral ideals, establishing an enduring framework of conflict and inequity.

Jefferson’s ideal subsequently became government policy. In the most literal sense, “agriculture was one of the first productive activities to acquire departmental status in the federal government in 1862.” Government actions such as the Homestead Act of 1862, which granted 160 acres of land to any head-of-household over the age of 21, perpetuated the “rationalization of agriculture.”

This irony poses a pervasive conflict in the American ideology of space: “on the one hand, [some] give the highest priority to economic growth, and to economic criteria, [while others are] committed to less tangible political, aesthetic, moral, environmental, or “quality of life” criteria in selecting social policies.”

...the nation’s overall direction in its treatment of space has been set by the dominant utilitarian ideology of progress, with such of its associated tenets as: the maximizing of economic growth; trust in the operation of the market; the commodification of land; the individualist ideal of "success" marked by upward social mobility and ownership of a detached single family home. As a nation, therefore, we have followed a zigzagging course in that progressive direction, with the partially opposed pastoral ideal causing many of the deflections from a straight course. But the fact is that the pastoral conception of American space has not issued in a genuine alternative to the dominant ideology, and probably never will, for it rests on too many of the same fundamental assumptions.

Leo Marx in The American Ideology of Space. p. 21.
It's a world of...
Agricultural Policy: Inefficient and Ineffectual

Three primary forces contribute to current agricultural politics: subsidies, global trade (i.e., exports, foreign aid and embargos), and the rise of trans-national corporations. All follow Jefferson’s lead of attributing “value” to quantity of acreage and total output, rather than quality or suitability of land.

The U.S. has historically adopted “deliberate policies [to protect] domestic producers.” Subsidies were introduced in order to guarantee farmers a minimum return on specific crops regardless of market rates. But the result is that U.S. growers eagerly adopt technological advances to maximize production and profit without considering long term implications for society, the environment and productivity, while “dumping heavily subsidized grain surpluses on world markets.”

The influence of trans-national corporations has made independent production virtually obsolete, subjugating producers to “a highly integrated system characterized by either contract or corporate production” in which the grower must, by contract, reach certain levels of production.

An ideological faith in efficient mass-production has led to worldwide surpluses of food, with 356 kg/person of grain being produced each year. Among grain producing countries, the U.S. produces the most grain per person at 1,156 kg.
Disenfranchisement: the Politics of Monotony  The pioneering spirit of individualism and self-sufficiency, which first attracted earlier generations to the lifestyle of family farming, initially allowed families to adopt, adapt to and resist change. But they ultimately encountered the "fundamental inability to resist – and tacit collusion with – the forces that threatened to destroy [them]." For example, in communities where each family represents a business enterprise, the success of one means the demise of one's neighbor, and "the loss of the farm ... is a loss of one's place in the world." 

While neighbors compete with neighbors, the U.S. exerts its power over the rest of the world, by imposing embargos which cut food supplies to protest human rights violations, causing a human rights crisis at home. Isolation is constantly reinforced by the frailty of social bonds in a market economy and the physicality of the country. The harsh climate and vast distances necessitate the insularity of the automobile, and passive, one-way communication becomes the only connection to urban centers and global markets which exert powerful control over the rural condition.

Although family farms as previously structured will be lost forever, life in the rural west is far from obsolete. Among other "new pioneers," remnants of former communities are preserving their lasting ties to their hometowns, and company towns are forming where corporations choose to relocate workers in order to lower operating costs.
THE GRID: REVISED

Jefferson’s grid was a pure idea imposed absolutely on the land. It left no gaps, and today remains inevitable and inescapable. It manifests itself as roads, fences and property lines - as barely-visible boundaries which prevent humans from actually setting foot on the land which surrounds them. The economic and political systems which exploited it will undoubtedly persist until no one is left to perpetuate them.

Nevertheless, those who have left the Great Plains often describe a magnetic force - an emotional, psychological and physical attraction - which pulls them inevitably back to the land. If the force of the land far exceeds that of the human will, then it must also harbor the potential to override the system it has submitted to.

This thesis asserts a series of proposals and a collection of devices which identify and exploit loopholes in the grid in order to decompose it from the inside out, and establish a sustainable relationship between the land and its inhabitants.
THESIS QUESTION

Leo Marx asks “Can there be any doubt that the prevailing American ideology of space has done more to shape the national terrain than the ideas and practices of our most gifted architects, landscape architects, and planners?” But Jefferson himself was an architect.

In what way, then, can a contemporary architect engage in the problem of the grid?

The greatest obstacle to understanding this question is that architectural practice is typically structured around an Urban paradigm of an economy of land in service of a density of people, rather than a Rural paradigm of an economy of social capital in charge of vast tracts of land. It is focussed so intently on designing boutique machines for living that it has forgotten about the machines in which we live – the rural mechanisms which construct our societies. I would also argue that these rural mechanisms are as embedded in urban centers as urban structures are in rural societies.

One model of architectural thought that has reconceived architecture as a participant in a ubiquitous environment is the sustainable design discourse of William McDonough outlined in his book Cradle to Cradle. He conceives of architecture as a catalytic mechanism embedded in a given environment which can give back as much as it takes. It is, essentially, a living organism within an ecosystem, differentiated only by being one of human design. Whether it behaves parasitically (as most buildings do) or symbiotically within this environment depends on the designer’s ability to understand and therefore control this mechanism. “Just about every process has its side effects. But they can be deliberate and sustaining instead of unintended and pernicious. ...What is the entire system - cultural, commercial, ecological - of which this made thing, and way of making things, will be a part?”

The difference between this model and the question of the grid is of applying this idea not to a singular entity but to a continuous system in an environment. The central investigation of this thesis is whether this attitude can transfer to the scale of the territory. A number of current attitudes within landscape architecture redefine landscape itself as a collection or system of interconnected mechanisms on the surface of the earth. For example, Alex Wall conceptualizes the urban settlement as one continuous surface populated with dynamic networks of activity, “the extensive and inclusive groundplane” which is not unlike a dynamic agricultural field.
Indeed, architecture does not offer the tools necessary to solve the problems created by the grid. It is capable, however, of understanding this artifact as a catalytic mechanism with tangible impacts on society and the environment.

Jefferson’s primary shortcoming is that he only understood his system in the abstract, and the west as an entirely blank slate. He did not treat the territory as a differentiated topography and geology inhabited by a diversity of established societies. As such, he neither foresaw the economic forces which would enter the scene along with the settlers and exploit his system for their own gain, nor did he project how his “pure” system must transform to the specific conditions of the land in order to achieve its desired effects.

Those economic forces essentially hijacked the system and became the rules, measures and operations according to which the system behaved. We can start to imagine instead an alternative system which is intentionally rather than accidentally structured around the requirements of a given technology.

In the *Cradle to Cradle* hypothesis, ecology is the operative mechanism, and one in which site conditions are embedded in the rules. This thesis tests whether sustainable forms of agriculture can provide a model of a technology in which humans’ settlement participates productively and symbiotically in an ecosystem.
PLANTING a NEW GRID

Even if we can’t solve the host of problems initiated by the Jeffersonian grid in 1785, what type of seed could we plant now that will proliferate in another two hundred years into a self-sufficient confluence of land and society?

The following pages document my research into a range of agricultural solutions for the Northern Plains region. While detrimental systems impose absolute control over natural systems, sustainable systems work with natural growth cycles in order to augment their productive potential.

In decomposing the Jeffersonian grid, sustainable forms of agriculture become the model for a new system of inhabitation of the gridded landscape which enables the symbiotic coexistence of ostensibly irreconcilable “organisms,” or programmatic uses of the land.

Ultimately I will propose a new settlement strategy for the “New Frontier” of the Northern Plains which learns from alternative methods of agricultural production which diversify soil, land use and society through the act of rotation.
9. ibid, p. 34.
13. ibid, p. 34.
14. ibid, p. 16.
15. ibid, p. 34.
16. ibid, p. 16.
17. ibid, p. 34.
We found the American West a curious place, alien and bare to our ears. Because of this, we failed to allow it to tell us its story, to give us its name.
from Richard Manning’s Grassland, quoted in The Horizontal World
Nowhere in the U.S. is the disappearance of farming as a viable lifestyle and economic activity more evident than in the Northern Plains where over 90% of land is dedicated to agriculture, but population is markedly on the decline.

North Dakota has become the first of the Northern Plains states to fall into advanced decline. As its children flee in droves from a life of isolation in a brutal landscape, the state has no choice but to change its ways, taking advantage of new market opportunities, if it wants to retain both population and agriculture.

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<th>ND</th>
<th>SD</th>
<th>IA</th>
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<tr>
<td>Population : % change 2000-2005</td>
<td>3.7%</td>
<td>-9%</td>
<td>2.8%</td>
<td>1.4%</td>
<td>5.3%</td>
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<tr>
<td>Persons &gt; 65 : %, 2004</td>
<td>13.7%</td>
<td>14.7%</td>
<td>14.2%</td>
<td>14.7%</td>
<td>12.4%</td>
</tr>
<tr>
<td>American Indian Persons : %, 2004</td>
<td>6.4%</td>
<td>5.2%</td>
<td>8.6%</td>
<td>3%</td>
<td>1%</td>
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<tr>
<td>Land Area : sq. miles, 2000</td>
<td>145,552</td>
<td>68,976</td>
<td>75,885</td>
<td>55,869</td>
<td>3,537,428</td>
</tr>
<tr>
<td>Persons per Square Mile : 2000</td>
<td>6.2</td>
<td>9.3</td>
<td>9.9</td>
<td>52.4</td>
<td>79.6</td>
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<tr>
<td>Average farm size : acres, 2000</td>
<td>2,146</td>
<td>1,300</td>
<td>1,386</td>
<td>353</td>
<td>—</td>
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Note: all subsequent diagrams based on maps and data from McIntosh County.
The land in McIntosh County, like most of North Dakota, was once the sea bed of a prehistoric ocean. The massive movement of glaciers 65 million years ago formed much of the landscape we see today, leaving behind rich soil called "glacial till." The two primary geological structures in the state are Badlands west of the Missouri and Glaciated soil to the east.¹

McIntosh County lies along the Coteau Range of "pohole" hills - a continuous chain of mounds and valleys. Along this range, rocks perpetually rise to the surface and must be cleared by farmers yearly. When water tables rose in the 1990s, a network of underground aquifers made themselves known as they too rose to the surface, flooding the pothole valleys. This event is just one moment in a roughly 50 year drought and flood cycle.²
Climatic conditions are extreme. Located roughly five miles from the 100th meridian, referred to as the "inflexible line of aridity," the county experiences extreme droughts, with occasional floods. Summers are extremely hot, and winters extremely cold with strong winds unhindered by obstacles in the landscape.

This dust-filled place... the dry place of kicking rocks down gravel roads would be hard to reconcile against this new image of a burgeoning green land teeming with underground rivers. Hadn’t I always sensed some untamed thing rumbling beneath our feet?

All data and indicated maps on pp. 26-27 from:
http://quickfacts.census.gov/qfd/states/46000.html

1. All of the data regarding North Dakota geology stated here is common knowledge in the area, repeated to me by multiple sources.

2. Information about climatic conditions in McIntosh County comes either from interviews with Bill Klein, the extension agent in Ashley, ND or the book The Horizontal World based in neighboring Logan County.

Irony is about contradictions that do not resolve into larger wholes, even dialectically, about the tension of holding incompatible things together because both or all are necessary and true.

Donna Haraway in *The Cyborg Manifesto*
**taxonomy of ideals**

IDEAL 0
Primary Condition
return to wilderness

IDEAL 1
Pastoral Ideal
the "middle landscape"

IDEAL 2
Progressivist Ideal
commitment to technology
SEARCHING for an AGRICULTURAL IDEAL

Agriculture and settlement are the primary ways in which humans exert control over the environment in order to survive. For every opinion that exists about how to re-settle the New Frontier, there exists a unique approach towards agriculture. These opinions align with the American ideology of space previously outlined: or the constant tug-of-war between progressivist and pastoral ideals.

While some believe that the Great Plains was never suitable for agriculture and should be returned to its “natural” state where buffalo can once again roam free, others at the opposite extreme attempt to override all topographic and climatic obstacles to productivity through the genetic manipulation of organisms.

In reality, all variations of these ideals are inevitable and currently exist. Each is actively being played out in the landscape, tensely co-existing with the others as counter-productive neighbors.

At left is a taxonomy of the range of agricultural options vying for dominance in the Northern Plains region. The continuum measures the degree of control humans exert over natural cycles in each system, while indicating that sustainable agricultural systems exist in which the health of the soil - based on criteria which I will detail in this section - arguably exceeds that of the primary equilibrium condition.
AGRICULTURAL DESTRUCTION

The adverse effects of the dominant system of agricultural production are substantial. Three pervasive problems repeatedly cited as being the greatest impacts of intensive monocropping are soil erosion, loss of biodiversity, and of course the loss of family farms. 90% of U.S. cropland is losing soil at rates 17 times faster than rates of formation, while the U.S. has lost 75% of its agricultural biodiversity in the last 100 years.\(^1\)

An extreme increase in crop yield between roughly 1920 and 1980 correlated to a net decrease in rural population, with no substantial growth of cultivated acreage after WWII. Between 1920 to 1945, rural population declined from 31.4 million to 2.3 million, whereas the average farm size increased from 143 to 191 acres. Soon after WWII, in 1956, the U.S. produced 84 million tons of corn whereas in 1980 it produced 224 million tons of corn due to an increase in productivity given that there was no net increase in cultivated land during the same period.\(^2\)

In other words, the efficiencies introduced by automation initiated the consolidation of land into larger and larger farms operated by fewer and fewer people. The loss of family farms began almost as soon as they were established.

These three problems are, however, entirely interdependent, and simultaneously avoidable without loss of productivity.

u.s. ag : dominant system

The fertile prairie sod was rich in Nitrogen accumulated over 10,000 years with topsoil up to six feet deep when settlers arrived, but plowing immediately released 1/3 of this stored Nitrogen to the air, followed by continual decline thereafter.

paraphrased from Geoff Cunfer, On the Great Plains, p. 204.
AGRICULTURAL POTENTIAL

As one source explains, the primary task of crop farming is soil management: "At the heart of farming is a complex quandary: you must cut into the earth to increase its productivity but at the same time, prevent the cut soil from washing or blowing away."³

A number of tried-and-true solutions to this problem have been developed over the last 10,000 years – techniques such as farming where nature routinely deposits fresh nutrients (i.e. near river beds), slash-and-burn, crop rotation, and fertilizing.⁴ In order to maximize immediate crop yields, however, intensive agriculture excludes basic soil erosion prevention strategies such as crop rotation and crop diversity in order to perpetuate constant productivity.⁵

Furthermore, small farms arguably "produce more agricultural output per unit area than large farms." Below 27 acres, small farms can be up to ten times more productive than large farms, while farms less than four acres can be up to 100 times more productive.⁶ Currently, sustainable growing methods are indeed more common amongst small to medium sized farms, and very rare amongst larger enterprises since outputs are often mixed yields which are harder to quantify, catalog and market.

The following pages detail the full range of growing methods employed in the Northern Great Plains, and attempt to generalize the most sustainable mechanisms into a system of land use and inhabitation.
FUNDAMENTAL MECHANISMS for SOIL HEALTH

[nutrient] cycling

“Plants are conduits pulling nutrients out of the air and directing them into living pathways and into the soil. Alternatively, they pull nutrients from the soil and direct them toward life processes and then out into the atmosphere.” Chemical fertilizer should only be necessary when attempting to artificially increase crop yield, and negatively impacts soil by interrupting the natural cycling of nutrients and organisms.

crop rotation

A 10,000 year old technology of growing different crops on different fields each season in order to promote biodiversity and fertility while discouraging pests and mitigating erosion. Rotation as a standard practice was replaced by chemical inputs after WWII in conventional agricultural operations. As detailed in the following pages, rotation is the fundamental model behind all alternative approaches to agricultural production, but also presents the greatest psychological barrier to entry for the conventional farmer.

ag basics: soil health

The primary motivation behind all major approaches to agriculture in the U.S. is profit. Profit margins are so slim regardless of the specific market that farmers have no choice but to optimize their operations to the best of their ability. What derives different approaches towards agriculture, then, is differing definitions of “optimize.”

The two primary attitudes are to focus on increasing yield, or increasing soil performance. These two methods can be distinguished by short term versus long term benefits. In the former, soil structure and nutrients decline over time, but yearly crop yield is very high. In the latter, soil structure and nutrient content are maintained or improved, but management is complicated and costs are high.
**Primary Variables**

The basic factors every farmer has to control are fertility and pest management. Chemical inputs must be added to crops to encourage growth, but these inputs can be either "external" or "internal." External inputs are toxic, petroleum-based synthetic chemical agents. Internal inputs are naturally occurring chemical agents such as pollen from adjacent crops or manure.

**Field Buffers:**

Because of these conflicting approaches towards agriculture, field buffers - a physical space between one field and one’s neighbor - becomes necessary to prevent the spread of contaminants from one field into another field. This is done by collecting or absorbing run-off from groundwater contaminants, or placing a windbreak to filter airborne contaminants.
NATIVE PRAIRIE

Once the predominant land type of the Great Plains, native prairie is a model of the ideal, productive equilibrium ecosystem, suited to the extreme climatic conditions of the region.

Occasional prairie fires would prevent trees from taking root, while returning nutrients to the rich soils and allowing a diversity of grasses to thrive.

TWICE-OVER RANGELAND

Based on the biological requirements of native prairie grasses, twice-over range is a sustainable grazing system, optimizing cattle production while cultivating native prairie.

Grazing is timed to "prune" the grasses once so that they reproduce a second time in the same growth cycle. Because grasses multiply with each re-growth, this system actually builds prairie, making it stronger and more resistant to invasive species.

Grazing can occur either in open land, or on cropland in the winter, potentially serving as an interface between the two land uses.

NO-TILL AGRICULTURE

No-till refers to a method of growing crops which does not turn the soil and therefore must rotate crops in order to prevent the spread of disease.

This method was also developed to emulate the native prairie ecosystem, based on the premise that native prairie soils are among the healthiest in the country, but the act of tilling interrupts this natural productivity and regenerative capacity.

Despite the major drawback of chemical use (hypothetically less than conventional ag), no-till builds soil health over time, with yields nearly twice that of conventional growing methods. For this reason, I would describe no-till as "sustainable," and believe that it should be marketed as a "natural" production method in order to receive a higher market value. Such a market incentive is not yet in place.

IDEAL 0: wilderness

IDEAL 1: pastoralism

seasons
field rotations
geologic forces

crop rotations
ORGANIC AGRICULTURE
A method of growing crops which does not apply external chemical inputs such as synthetic pesticides and fertilizers. Crops must be rotated in order to prevent the spread of disease.

The major advantage of organic agriculture is its avoidance of all external chemical inputs. Chemical abstinence allows organics to earn a reliably high market value, making them far more profitable than conventional crops. It is, however, a fundamentally unsustainable system for many of the same reasons as conventional growing methods, such as soil depletion and decreased productivity over time, with highly unpredictable yields.

MONOCULTURAL AGRICULTURE
Conventional growing methods typically grows individual crops over large tracts of land without rotating fields, and depend exclusively on synthetic chemical inputs for disease and fertility management.

Intensive tilling and ever-increasing quantities of external inputs are necessary to maintain productivity. Over time, soil structure and organic nutrients become completely exhausted and can never be regained.

This current agricultural norm was established soon after WWII when wartime resources and research were funneled into domestic productivity such as agriculture and manufacturing. Synthetic pesticides and fertilizers were first developed at this time.

GMOs
The current progressivist panacea is the technology of genetically modified organisms, or GMOs. GM seeds are granted certain traits in the laboratory such as genetic immunity to drought, pests or weeds.

While the benefits are not guaranteed, the potential threat is both unknown in its magnitude, and unpredictable. Cross-pollination with any other plant could spread the modified gene infinitely, contaminating crops and destroying ecosystems. Containment is virtually impossible.

20% of farmers in McIntosh County grow Round-up Ready GMO soybeans altered to grow in a colder climate than soybeans are typically able to and to combat a specific local weed which may one day develop a resistance to Round-up.
THE ROTATING LANDSCAPE

PHASE 2
EXHAUSTED

Coteau Hills
"prairie potholes"

ND

McIntosh County

PHASE 1

PHASE 0
RENEWED

The white, or "regenerated," area on the map directly correlates to an unarable zone of extreme topographic conditions: "potholes" (permanent and temporary lakes), and rocky soil. These obstructions make themselves evident despite the grid.
The map at left suggests that the landscape as we see it is merely an isolated moment in the constant shift of time and relationships. The phases represented in the map are based on only one of the many time-cycles which rotate through the land.

The taxonomy above describes a range of temporal cycles operative in the Northern Plains and attempts to find correlations to physical scales of land, levels of human control in each cycle, and possible programmatic functions which could take place at each scale.
Seed Onseti Firita ng O'sk Wheel Opena Fls ANNUAL vs. PERENNIAL ROOTS
6ft... ... ...
0ft
-6ft

NO TILL

TILL

EROSION

stabilized by roots
The image of a rotating landscape leads us to the conclusion that depopulation is inevitable, but repopulation is equally inevitable. Once the territory empties out, New Pioneers will be attracted to the idea of independence and self-sufficiency in a vacant land - a blank slate of opportunity - and will discover this lost region once again.

The model of sustainable agriculture which acknowledges and augments cycles of growth rather than overriding them suggests that settlement should not be a stubbornly stationary construct, but one which acknowledges and plans for its own inevitable obsolescence.

Image: A scale study which compares the elevations, depths and health of forces and entities in the landscape.

The roots of a perennial plant (prairie grass) below ground equal the height of the human above. The 1.5 inch incision of the No-Till drill yields an infinite depth of water in the soil, whereas the constant churn of the till eventually drains the soil of all moisture.
[preventing] resilience
STRUCTURING ROTATION through RESILIENCE

The agricultural strategy of rotation capitalizes on the resilience of soil to absorb trauma and still return to its optimal function as a living organism. However, its ability to revive depends on leaving a certain degree of life intact, and not exceeding a certain threshold of impact. Field rotation is a craft which constantly seeks the optimal number of crops, adjacency of fields, size of field buffers, and timing of rotation.

The absolute structure of the Jeffersonian grid leaves no margin. Fragmented plots of soil created by infinitely thin boundaries do not permit any perimeter buffer. No policies regulate the degree of life remaining in each fragment.

Furthermore, although the current landscape demonstrates rotation at one scale, the presence of the grid prevents it from occurring at other scales or across scales. As previously mentioned, another consequence of the infinitely thin boundary lines is a complete lack of human-scale access to the land prevented by roads, fences and property lines.

The following proposal considers how rotation and a capacity for resilience can be structured into the grid. Within this structure, naturally unarable regions are capitalized upon such that re-population of the territory always leaves a certain margin of life. During periods of de-population, this margin reconstitutes back into a complete living organism, absorbing and erasing traces of human life.
GRID 0
Jeffersonian Ideal of private ownership

GRID 1
Natural features obstruct agriculture, become public. Current condition of fragmented public space.

GRID 2
The maps above trace the evolution of McIntosh County as it introduces the structure of an ecological buffer.

This buffer generates a continuous network of marginal land that is able to maintain a self-sustaining ecosystem. While providing uninhibited access for humans and wildlife throughout the county, it can also absorb runoff from adjacent programs without compromising its long term stability. As the county depopulates, this buffer will grow to rehabilitate the abandoned land, and retract once again to absorb the inevitability of re-settlement.
human error:
cludes natural ecosystems to absorb
silence. A physical space which en-
A continuous habitable zone of re-
BUFFER

DEPOPULATION

REPOPULATION

PROPOSAL 2: IDEAL GRID
INVERTING FIELD and FRAGMENT

Natural ecosystems permit a certain margin of error to the follies of humans on earth.

In the majority of American settlements, structured by the Jeffersonian grid, "ecosystems" per se have ceased to exist. Naturally self-sustaining systems have broken into discontinuous fragments within a field of human inhabitation. We have eradicated even the slimmest margins and sealed over every inch of ground.

In Proposals 1 and 2, wilderness - or the "primary" condition of an equilibrium ecosystem - becomes the field condition occupied by fragments of human activity. This spatial relationship ultimately ensures the subservience of humans to their environment.

This new structure introduces necessary adjacencies which only occurred previously in isolation. In the vocabulary of the taxonomy at the beginning of this chapter, "Ideal 0" is now the field condition within which its opposite - "Ideal 2" - must reside.

The program I have chosen to play out in this landscape - an institute for biogenetic research - investigates how a Progressivist attitude towards settlement might behave within the constraints of this new grid which finds stability in a state of natural equilibrium.


6. ibid, p. 56-7.


9. The psychological barriers to adopting rotation systems were reiterated by a number of primary sources.


Image Credit:
http://www.monsanto.com
It should be the aim of every young farmer to do not only as well as his father, but to do his best; "to make two blades of grass grow where but one grew before."

GENETIC ENGINEERING

The genetic modification of organisms epitomizes Progressive ideals by demonstrating a devout faith in the power of human intervention to overcome the obstacles presented by naturally occurring phenomena. Genetic engineering is able to control specific characteristics such as immunity to drought, pests or weeds.

The primary threat posed by GMOs is the mystery of their impact, specifically the uncertainty of genetic drift and the impossibility of containment.

Genetic drift refers to the possibility of genes transferring from one plant to any other plant species through cross-fertilization. This can happen, for example, through seeds or pollen travelling in the wind. “Contamination” of one crop with modified genetic material destroys the entire yield. Most threatening of all is the possibility of gene transfer into the wild where it can spread without notice, and destroy entire ecosystems.

Gene transfer only happens above ground - not through soil or water - and, while health effects of GM food products on humans are up for debate, gene transfer to humans is not a threat since transfer cannot occur between dissimilar organisms.

Despite its detractors, GM crops are already here, and here to stay. Roughly 20% of farmers in McIntosh County depend on GMO Soybeans in order to survive.

**genetic drift**
CONTAINMENT

Use of GMOs introduces the problem of containment. In short, genetic drift is a problem of risk assessment. Containment only lessens but never eliminates this risk. The full extent of possible drift is also unknown due to insufficient research. While transfer is most likely to occur within 150 feet, it has been known to occur over a distance of miles.

One quintessentially progressivist solution to containment that is being researched is 'biocontainment' - genetic inhibitors that function at the molecular level. But the most reliable form of containment known is simply physical distance between fields. Given our current lack of knowledge about the potential risks of GMOs, the greatest risk is negligence, while the best defense is vigilance.

Assessing Risk:
- 20' maximum risk of cross-pollination
- 33'-59' zero outcrossing likely
- 50' current typical natural boundary
- 60'-90' research recommended isolation
- 90' zero outcrossing highly probable
- 150' maximum distance viable pollen can travel
DRIFT proposes to locate a new research facility in McIntosh County, ND. The company plans to develop crops which are resistant to drought and extreme cold, but their primary mission is to research genetic drift and its potential impacts on agriculture.

The research mission requires the release of potentially harmful materials into the open such that the facility must be located in a highly remote location with a large buffer of vacant land between itself and the nearest neighbors. McIntosh County is the ideal location for this facility. Land is cheap and plentiful, and climatic conditions are extreme. The area is sparsely populated posing little threat of resistance to the institute's activities.

The facility’s remote location is positioned within a cluster of lakes in the Coteau Hills which provide habitat for wildlife, and recreational sites for residents.

DRIFT has an incentive to appeal to local farmers in order to promote their product and deter resistance. As they have done successfully at previous research and manufacturing facilities, they commit to converting their property to wilderness for public recreational uses such as hunting and fishing or snowmobiling.
1. Personal conversation with Katie Theoharides: PhD candidate in Ecology, University of Massachusetts, Boston, MA.

2. Personal interview with Robert McDonald: Lecturer in Landscape Architecture, Harvard Graduate School of Design.

3. Personal interview with Bill Klein: Ashley Extension Agent, Ashley, ND.


2. Personal interview with Robert McDonald: Lecturer in Landscape Architecture, Harvard Graduate School of Design.
When we see how we have succeeded in imposing our own rhythm on nature in the agricultural landscape, how we have altered the life cycle of plants and animals and even transposed the seasons, we become aware of how dangerous a role we have assumed... the salvation of Landscape 3 depends on our relinquishing this power to alter the flow of time.

J.B. Jackson in Discovering the Vernacular Landscape
**known potential field drift**

**FIELD SCALE**
Experiments have demonstrated that genetic material such as wheat pollen can travel up to 150 feet before it is no longer viable.

The diagram above shows the potential drift zone of one field. The distances have been adjusted to account for prevailing wind patterns.

---

**experimental field drift**

**FARM SCALE**
Genetic drift and contamination has been known to occur up to a 2 mile radius, although risk assessments based on experimental data suggest this phenomenon is impossible.

The research strategy shown above plants fields within the potential plume of a primary field in order to test agricultural impacts of drift. These fields in turn generate new plumes.
REGION SCALE
Plumes continue to propagate over an ever-increasing distance as research continues.

RESEARCH
DRIFT's mission is to research how genes might travel at a territorial scale. Their basic strategy is to plant fields within the theoretical "plume" of prior fields. These recipient fields in turn propagate new plumes.

This recursive research strategy propagates plumes through the region over time. The time-based strategy diagram above shows how, as one trajectory of research is underway, new trajectories are initiated simultaneously. With each new line of research, strategies are adjusted according to the lessons learned in the experiments already underway.
siting drift

- **arable land**
- **unarable land**: privately owned
- **unarable land**: public access (wilderness recreation area)
GROWING WILDERNESS

For its own benefit of secrecy, DRIFT chooses to locate its operations in the most remote location in McIntosh County neighboring a network of wilderness protection zones which also places it in a position of greatest potential threat to the region. But the greatest risk of genetic drift is negligence, while the best defence is vigilance, and the company’s incentive to remain vigilant is its desire to prevent resistance to its activities.

DRIFT appeals to the community by converting each site it uses into a new wilderness recreation area, slowly growing the network of open space in the county.

At each site where the company establishes its research operations, one field is planted which propagates a plume over an assumed distance. For experimental purposes, this plume is continuously sampled by researchers.

Over a roughly 10 year period, the majority of the site remains unused except for the tracks of the researchers, and occassional mobile field stations. The site is essentially being conserved, allowing ecosystems to regenerate and wildlife to return. The constant surveillance of the land provides the best assurance possible that any potential contamination will be promptly detected.
While one line of research initiated by the primary site is underway, a secondary site is activated. As new lines of research are initiated on neighboring sections of land within the region, scientists modify their tactics to incorporate lessons-learned from prior experiments. At any one time, up to three threads of research can be underway simultaneously.
Although complete control over the drift of genes is never possible, various physical controls are placed on site in order to increase the probability of release or containment.

**RELEASE and CONTAINMENT**

**introduction:** The land, as-found, begins in a middle state of post-agriculture rehabilitation.

**release & propagation:** A concentrated collection of fields is planted and allowed to release contaminants into the territory. Sub-fields are then planted in their plume. The surrounding area is continuously monitored.

**erasure:** Abandoned fields begin rehabilitation, while monitored lands fully regenerate into a self-sustaining prairie ecosystem. Introducing range animals can assist rehabilitation of contaminated fields as well as encourage the prairie ecosystem if it fails to thrive on its own. About 50% of agricultural activity in McIntosh County is ranching.
OVERVIEW
The maps at right document the arrival of the DRIFT Institute at a remote site in McIntosh County, its modification of the land and eventual departure and erasure. The following pages detail the phasing of the site and the landscape devices which both activate and abandon the site.

The three phases of occupation are Introduction, Propagation and Erasure. Despite short-term risks to the surrounding areas, this process allows the renewal of ecosystem function and the decommissioning of roads - the most basic physical manifestation of the pre-existing grid.

Even an entity which believes it can extert absolute control over its environment can strike a symbiotic equilibrium with the system it occupies.

SITE PLANS and PHASING

phase 1: introduction and release
existing conditions, research established
phase 2: capture and propagation
site intervention aids propagation

phase 3: erasing and prospecting
initial site abandoned, new site identified

A. Elliptical Research Sampling
Elliptical sampling is based on risk assessments of drift according to wind and weather patterns.

B. Gridded Legal Sampling
Gridded sampling is based on normative survey techniques, used in measuring for liability.
<table>
<thead>
<tr>
<th>stone mounds</th>
<th>cuts</th>
<th>permeable walls [movable]</th>
<th>obstructing walls [semi-permanent]</th>
<th>buildings relative to land</th>
<th>burying as control</th>
</tr>
</thead>
<tbody>
<tr>
<td>indicate property lines</td>
<td>suggest passage</td>
<td>prevent access</td>
<td>prevent access</td>
<td>exemplify varying levels of</td>
<td>an example of greatest</td>
</tr>
<tr>
<td></td>
<td>create drainage</td>
<td>permit wind and drift</td>
<td>built from rocks excavated from</td>
<td>interior and exterior control</td>
<td>control.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>soil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**existing lakes**

large lakes used for recreation [i.e. boating, fishing]
lake edges with tall grasses provide wetland habitat for ducks

**berms [topographic scale]**

create wind breaks to provide protection over long distances
bermed plateaus collect wind on top where fields can be located in order to encourage spread of plant material.

**constructed lakes**

divides two areas of the site: restricts access
receives field runoff where chemicals can break down after the site is abandoned, increases total wetland habitat for ducks.

**berms + wind break [landscape scale]**

small berms must be planted in order to protect seedlings.
mature wind break trees provide both a wind barrier and filter, protecting habitat at water’s edge, and water surface for recreational use.

---

**landscape devices**

The landscape devices above are a toolkit that assist the research institute with its activities. Each manipulation of the site does not disrupt its function as a closed-loop ecosystem and therefore permits the site's eventual rehabilitation to an equilibrium state. The three primary factors being controlled are:

*Propagation* of organisms, both experimental and naturally occurring.

*Containment* of organisms, both to control spread and protect specific site conditions or property lines.

*Access*, to allow continuous passage of public and wildlife through the site, despite being privately owned. Manipulations are never a guarantee of any of these conditions but an increase in probability that a desired outcome will occur.
PHASE 1
The research institute arrives on the site, establishing a primary cluster of fields and arraying an optimal network of sampling points. The map at left shows the existing site conditions with an overlay of the sampling grid.

Site Selection: The institute tries to select sites which are located within a cluster of state or federally owned recreation zones (i.e. North Dakota or U.S. Fish and Wildlife departments) such that the majority of the plume lands on their own property or government land.

While the conversion of the site to wilderness is perceived as beneficial to the public, the institute is at liberty to sample freely according to their own methods on public properties. If a neighboring section of land is privately owned, both suspicion and liability are raised.

Sampling: Along with liability comes specific demands to implement a "gridded" sampling strategy which complies with normative surveying methods. Gridded sampling, however, is both less efficient and ultimately less effective since efforts are equally distributed rather than focussed where probabilities are highest.
Above: Bermed field with constructed drainage and temporary fences.

Below: Entry into site along a cut through the berm. View of wind break (right).

Wind break for protection of recreation and habitat.
PHASE 2

The strategy for occupation established in Phase 1 must deform to the specific conditions of the site.

The primary field is bermed into a plateau in order to increase the probability of spread. A second site within its plume to the SE is acquired, and a “recipient” field is also bermed. An unobstructed corridor of land which passes between the two lakes at center and connects sites 1 and 2 is maintained.

Obstructions are placed to protect the large lake at center, the property lines to the east and west, and restrict public access to the field sites.

While obstructing the spread of genes into these bodies of water is not of great concern, protecting the wetland habitat around the perimeter is critical. The lake is also used recreationally as well as for a research field station. A wind break of tree rows effectively protects all uses, including an access point for boats which can patrol the banks.

The east and west property lines are marked by pre-existing roads which sufficiently inhibit access, but sampling must continue on the adjacent property to ensure that contamination has not occurred. In this way, the optimal sampling grid deforms to the site conditions.

At the main entry to the site - the northernmost road - the road cuts into the field plateau. The main research facility is half buried into this cut so that it prevents public access to the fields, while maintaining access to both zones for its own use. Permeable barriers are placed around the unobstructed edges of the fields.
Above: Wind break protects new settlement at intersection of new roads.

Below: Identifying a new primary site.
In the third phase, the primary fields are abandoned. The bermed field, constructed lake and research facility - which remains active - are left behind, but all temporary permeable barriers are removed.

A new "primary" site for a parallel research operation is identified to the Northeast, and new field sites within the plumes generated in Phase 2 are also located.

The soil within the abandoned field is extremely depleted of nutrients. But the continuous and increasingly healthy soil surrounding it, with the help of an increase in grazers and forragers on the site after removing the temporary barriers, will quickly re-integrate this footprint.

As these sections of land slowly evolve into a self-sustaining ecosystem and wildlife habitat with a minimum of human presence, roads that once gridded the site are slowly decommissioned. Pre-existing roads trace virtually every section-line of the Jeffersonian Grid, but the majority of them are only dirt which, when unused, grow over with grasses and slowly disintegrate.
site sections

longitudinal section [scale: 1" ~ 1500']

0
cross sections [below]
close-up sections
[scale: 1" ~ 32']

[scale: 1" ~ 128']
Above: View from research facility laboratories. Bermed or buried portions of the building allow continuous access for the public and range animals.
CONCLUSION

This project directly confronts a cultural-commercial-ecological system and proposes a deliberate series of relationships to the components of this system. Essentially, I have proposed a means of occupying space by designing strategic behavior.

Evaluating the “success” of this intervention from an architectural point of view is virtually impossible because architecture does not possess the vocabulary to describe it. It is a little bit too big and a little bit too intangible and invisible to really be called “architecture.” As such, it brings to the table a dilemma within architecture today.

The scope of architecture seems to be continually expanding beyond the limits of the individual building, as evidenced by a growing trend towards landscape and urbanism (the motivation behind the “Landscapism” issue of Praxis, for example). Perhaps this tendency is occurring in order to integrate built form into its immediate and extensive environment, or in the ceaseless quest for new form, or perhaps in order to find greater relevance in the world beyond aesthetic satisfaction. Regardless, architects are speaking about landscape, and about territory, but at what extent do we ultimately exceed the limits of the discipline altogether?

In the context of this project, the lingering architectural question is whether the visibility or invisibility of the intervention matters. Referring to Landscapism, I would answer that no, it does not. In the introduction to Praxis 4, the editors describe that the projects “provide provisional solutions to the question of how to accommodate change over time in a flexible framework. (...) Economic, social, and political factors, technologies, and ecological considerations are all employed as active agents in the design process,” and are related through the diagram which “does not describe the project, [but] embodies the project.” The diagram serves as “a kind of guide, a configuration of relations between material conditions that could yield numerous possible futures (...) implicitly recognizing the impossibility of projecting a final condition.”

While architects have been designated as being responsible for making space aesthetic I would argue that architecture is fundamentally about the relationships it constructs: between individuals, identity groups, market interests, or in this case between humans and the land they occupy, and the forces which act upon the land. What became the focus of this intervention was in fact to eradicate the obstructions to the building of relationship between humans and the land, and in so doing, to clean the slate for a new beginning.
**native prairie**

The original grassland ecosystem of the Great Plains. One third of the Nitrogen stored in these rich soils was released immediately upon plowing by homesteaders.

Native prairie can be called a rotation system because it is the direct result of the seasonal and climatic conditions of the region. Severe droughts would trigger occasional wildfires, preventing trees from maturing and contributing to soil fertility.

Native prairie is the natural ecosystem after which No-Till agriculture is modelled. Undisturbed prairie soils are alive with organisms which facilitate nutrient cycling and aerate the soil, giving it a healthy structure while allowing it to absorb scarce supplies of water and preventing erosion.

Nutrient cycling occurs naturally through periodic fires, lightning strikes, cross-pollination of a diversity of plant species, and roaming range animals subsisting off of prairie grasses and redistributing the nutrients with their manure.

Virgin native prairie self-managed against invaders through its own fertile proliferation. Drought and burn cycles were the basis for determining which species could survive.

Erosion is a non-issue in healthy native prairie ecosystems.

Native Prairie uses only solar energy for photosynthesis.

Productivity is difficult to assess for a system which does not have a measured or marketed "yield." However, prairie can be described as being "productive" due to the continuous proliferation of a specific collection of species.

Native Prairie provides a natural example of a healthy, self-sustaining ecosystem.

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**twice-over range**

A method of grazing in which livestock cycle twice during the spring, summer and fall through the same series of fields. By eating the tips of budding prairie grasses during the spring and early summer, these grasses multiply five-fold, enough to provide livestock with a second grazing later in the season, while pushing out invasive species and restoring a healthy prairie.

Rotation occurs through the timed cycling of livestock twice through a series of fields, according to the seasons. Winter grazing on harvested fields can also be done in order to distribute manure and fertilize fields for the spring.

Tilling is not involved in range management. However, the system of multiplying grass productivity in order to push out weeds performs the same function that tilling would provide.

When livestock bite off the tips of grasses, these grasses are able to absorb more nitrogen from the air and pull it into the soil. Evenly distributed manure returns most nutrients to the soil, and winter grazing on fallow fields can fertilize soil for the spring.

The rapid multiplication of native grasses pushes out weeds and invasive species.

While erosion can be a major problem in traditional range management systems, Twice-Over Range Management prevents erosion through grassland regeneration.

Range land usually requires water to be pumped from a central source out to the fields, which can be done sufficiently with solar power.

Twice-over rangeland has a higher carrying capacity for grazing animals than traditional rangeland, with no known impacts to that land - only benefits. Limiting factors are acreage of grasses and the availability of water.

Properly managed rangeland demonstrates how natural and managed systems can sustainably and productively co-exist.
conventional & GMO

Conventional growing methods typically grow one or two subsidy crops on an entire farm, and depend exclusively on synthetic chemical inputs for disease and fertility management. GMO crops have no special requirements, although growers are reputed to rely more heavily on chemical inputs attributed to an ideological faith in agricultural technologies.

Monocultural agriculture does not rotate crops. Occasionally, a field will be left fallow, but fallow fields are susceptible to erosion.

Organic agriculture typically employs a minimum of 3-4 crop rotations, including soil building crops such as legumes. Organic crop production depends on tilling soil to eradicate weeds without use of external chemical agents. In this way, it can be considered most similar to conventional approaches to agriculture, and least similar to the native ecosystem.

Conventional agriculture relies heavily on tilling. After growing the same crop on one field over many years, the soil requires every possible defense against pests and disease.

Fertility is managed through planning rotations with legumes, including fallow fields in rotations, and encouraging cross-polination through field adjacencies.

Carefully planned rotations and tilling are the primary defenses that organics have against pests and diseases. If a crop becomes infected by a pest or disease during the growing season, most often, the entire crop will be lost.

Both tilling soil and leaving fields fallow make soil highly susceptible to erosion, loss of nutrients, and degraded structure. Organic growing systems struggle to maintain a precarious balance between soil degradation and rejuvenation.

Tilling uses highly energy intensive heavy machinery, and requires multiple passes over the same field. Arguably, the total energy used in organic crop production is greater than that used in no-till systems (including chemical agents).

Carefully planned rotations and tilling are the primary defenses that organics have against pests and diseases. If a crop becomes infected by a pest or disease during the growing season, most often, the entire crop will be lost.

Erosion is the end-state of monocultural agriculture. The more soil is tilled, and the more natural nutrient cycles are displaced by synthetic nutrients, the more the soil structure breaks down and becomes susceptible to erosion.

Conventional agriculture uses by far the most energy of any of these systems primarily in the form of petroleum-based synthetic inputs. Tilling also requires intensive mechanical labor.

Organic agriculture is hardly the sustainable system it is publicized to be, but rather a continual struggle to maintain fertility despite soil degradation over time. The future of organics can only be found in developing a no-till strategy which is mutually exclusive with current methods.

Conventional agriculture undoubtedly produces high yields from year to year. However, high yields of a single subsidy crop is not necessarily the most efficient route to profit. Subsidies, although consistent, can be barely enough to live off of. The cost of external inputs - although subsidized as well - can greatly compromise overall profit.

Conventional agriculture - characterized by a continual depletion of soil quality and overall yield - can not be considered sustainable.
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**Markets**


**Mechanisms**: Seeds / Fertilizers / Farm Credit / Farm Management / Subsidies / Energy Co-ops


also see *Personal Interviews*

**History & Cultural Framework**


Personal Interviews

Frank Kutka: Assistant Director, Sustainable Ag Specialist, Dickinson Research Extension Center, Dickinson, ND
hybridizing, viability of sustainable alternative agriculture systems

Llewellyn Manske, PhD: Range Scientist, Dickinson, ND.
twice-over range management, the prairie ecosystem, soil structure / composition

Pat Carr, PhD: Associate Agronomist, Dickinson, ND.
viability of organics, barriers to change

Roger Ashley: Extension Agronomist, Dickinson, ND.
no-till agriculture

Bill Klein: Ashley Extension Agent, Ashley, ND.
Julie Hetteger: Adams Extension Agent, Lehr, ND.
Duane and Chantra Boehm: organic producers in Richardton, ND
Marlow and Sandy Werth and Henry: certified seed producers in Lehr, ND

Robert McDonald: Lecturer in Landscape Architecture, Harvard Graduate School of Design.
GMOs and intensive agriculture: contamination and containment.

Katie Theoharides: PhD candidate in Ecology, University of Massachusetts, Boston, MA.
Plant invasion in grasslands. Nutrient cycling and ecosystem functionality.