

2009

Landscape, Community, Countryside: Linking Biophysical and Social Scales in US Corn Belt Agricultural Landscapes

Ryan Atwell
Iowa State University

Lisa A. Schulte
Iowa State University, lschulte@iastate.edu

Lynne M. Westphal
United States Forest Service

Follow this and additional works at: http://lib.dr.iastate.edu/nrem_pubs

 Part of the [Agricultural Science Commons](#), [Biodiversity Commons](#), [Environmental Monitoring Commons](#), [Natural Resources and Conservation Commons](#), and the [Natural Resources Management and Policy Commons](#)

The complete bibliographic information for this item can be found at http://lib.dr.iastate.edu/nrem_pubs/147. For information on how to cite this item, please visit <http://lib.dr.iastate.edu/howtocite.html>.

This Article is brought to you for free and open access by the Natural Resource Ecology and Management at Iowa State University Digital Repository. It has been accepted for inclusion in Natural Resource Ecology and Management Publications by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.

Landscape, Community, Countryside: Linking Biophysical and Social Scales in US Corn Belt Agricultural Landscapes

Abstract

Understanding the interplay between ecological and social factors across multiple scales is integral to landscape change initiatives in productive agricultural regions such as the rural US Corn Belt. We investigated the cultural context surrounding the use of perennial cover types—such as stream buffers, wetlands, cellulosic bioenergy stocks, and diverse cropping rotations—to restore water quality, biodiversity, and ecosystem function within a Corn Belt agricultural mosaic in Iowa, USA. Through ethnographic techniques and 33 in-depth interviews, we examined what was most important to rural stakeholders about their countryside. We then used photo elicitation to probe how interviewees' assessments of farm practices involving perennial cover types were related to their sense of place. Our interviewees perceived their rural “countryside” as a linked social and biophysical entity, identifying strongly with the farming lifestyle and with networks of people across

the landscape. While most interviewees approved of perennial farm practices on marginal agricultural land, implementation of these practices was neither a priority nor strongly assimilated into rural experience and ethics. We identified three scale boundaries in our interviewees' perception of place which present key challenges and opportunities for landscape change: landscape-community, individualcommunity, and community-institution. In all cases, community social norms and networks—exhibited at landscape spatial scales—may be instrumental in bridging these boundaries and enabling networks of perennial cover types that span privately owned and operated farms.

Keywords

complexity, Iowa, non-point source pollution, perennial vegetation, restoration, social-ecological systems, water quality

Disciplines

Agricultural Science | Biodiversity | Environmental Monitoring | Natural Resources and Conservation | Natural Resources Management and Policy

Comments

This article is from *Landscape Ecology* 24 (2009): 791, doi:[10.1007/s10980-009-9358-4](https://doi.org/10.1007/s10980-009-9358-4).

Rights

Works produced by employees of the U.S. Government as part of their official duties are not copyrighted within the U.S. The content of this document is not copyrighted.

Landscape, community, countryside: linking biophysical and social scales in US Corn Belt agricultural landscapes

Ryan C. Atwell · Lisa A. Schulte ·
Lynne M. Westphal

Received: 19 February 2008 / Accepted: 18 April 2009 / Published online: 17 May 2009
© Springer Science+Business Media B.V. 2009

Abstract Understanding the interplay between ecological and social factors across multiple scales is integral to landscape change initiatives in productive agricultural regions such as the rural US Corn Belt. We investigated the cultural context surrounding the use of perennial cover types—such as stream buffers, wetlands, cellulosic bioenergy stocks, and diverse cropping rotations—to restore water quality, biodiversity, and ecosystem function within a Corn Belt agricultural mosaic in Iowa, USA. Through ethnographic techniques and 33 in-depth interviews, we examined what was most important to rural stakeholders about their countryside. We then used photo elicitation to probe how interviewees' assessments of farm practices involving perennial cover types were related to their sense of place. Our interviewees perceived their rural "countryside" as a linked social and biophysical entity, identifying strongly with the farming lifestyle and with networks of people across

the landscape. While most interviewees approved of perennial farm practices on marginal agricultural land, implementation of these practices was neither a priority nor strongly assimilated into rural experience and ethics. We identified three scale boundaries in our interviewees' perception of place which present key challenges and opportunities for landscape change: landscape-community, individual-community, and community-institution. In all cases, community social norms and networks—exhibited at landscape spatial scales—may be instrumental in bridging these boundaries and enabling networks of perennial cover types that span privately owned and operated farms.

Keywords Complexity · Iowa · Non-point source pollution · Perennial vegetation · Restoration · Social-ecological systems · Water quality

Electronic supplementary material The online version of this article (doi:[10.1007/s10980-009-9358-4](https://doi.org/10.1007/s10980-009-9358-4)) contains supplementary material, which is available to authorized users.

R. C. Atwell (✉) · L. A. Schulte
Natural Resource Ecology and Management, Iowa State University, 339 Science II, Ames, IA 50011, USA
e-mail: ryancardiffatwell@gmail.com

L. M. Westphal
Northern Research Station, 1033 University Place,
Suite 360, Evanston, IL 60201-3172, USA

Introduction

Emerging demand, associated with the global rise of biofuels, presents linked ecological, economic, and social challenges and opportunities for regions of intensive agriculture such as the US Corn Belt (Hinkamp et al. 2007; FAO 2008; Field et al. 2008). In the short term, production of corn-based ethanol is exacerbating social and environmental deficits in the Corn Belt associated with intensive row

crop agriculture; yet, in the future, cellulosic feedstocks of perennial vegetation may be used to produce biofuel in ways that are both economically viable and environmentally sustainable (Tilman et al. 2006; Jordan et al. 2007; Robertson et al. 2008). Such cropping systems have the potential to bolster biodiversity, carbon sequestration, flood control, soil retention, and surface water quality (Jordan et al. 2007). But to fulfill this potential, these cropping systems must be implemented at key landscape positions along with other forms of perennial vegetation such as crop rotations and pastures, riparian buffers, wetlands, and patches of remnant and restored forest and prairie (hereafter collectively referred to as “perennial farm practices”) (Boody et al. 2005; Schulte et al. 2006; Nassauer et al. 2007).

To improve understanding of how social, economic, and ecological drivers and outcomes of perennial farm practices may be linked, Jordan et al. (2007) have proposed that broad-scale experiments are needed that change land cover in medium-sized watersheds ($\sim 5,000 \text{ km}^2$) and monitor the outcomes. However, because more than 95% of the land in the Corn Belt is privately owned (USDA NASS 2002), such landscape change entails participatory approaches that involve rural stakeholders in scientific and decision-making processes (Schulte et al. 2006). In order to lay groundwork for future implementation of perennial farm practices at broad scales, we conducted a social landscape analysis using ethnographic techniques and in-depth interviews in a small Corn Belt watershed community ($\sim 500 \text{ km}^2$) to address the following study questions: (1) What is most important to rural stakeholders about the places in which they live? (2) What are rural stakeholders’ attitudes towards perennial farm practices? (3) What key scale mismatches or synergies explain how rural stakeholders’ perceptions of perennial farm practices are linked to their sense of place?

Gauging the potential for perennials

It is not currently clear how perennial farm practices are perceived by rural people. Research and theory in the environmental social sciences show that conservation behavior is not based solely on rational or economic decision making, but rather on a complex interaction of values, attitudes, and norms that are in turn shaped by an individual’s biophysical, social,

and cultural context (Cheng et al. 2003; Ajzen 2005; Clayton and Brook 2005). This generalization is born out by substantial research on attitudes and decision making surrounding agriculture and conservation in the Corn Belt (e.g., Napier et al. 2000; Fliegel and Korsching 2001; Morton and Padgitt 2005; Urban 2005). Rural attitudes toward farm stewardship, neatness, scenic beauty, and progressiveness have all been shown to play an important influence on farmers’ land use decisions (Nassauer 1989; Ryan et al. 2003; Urban 2005). However, this research also shows that the practices motivated by these cultural norms may or may not coincide with particular conservation outcomes.

Perennial farm practices present a markedly different agricultural strategy than that practiced in the Corn Belt for the last several decades (Schulte et al. 2006; Nassauer et al. 2007; Atwell et al. 2009). Driven by emerging demands for biofuels, current trends in land use are towards increased corn monoculture and decreased participation in federal conservation programs, such as the conservation reserve program (CRP), that remove sensitive land from row crop production and plant it in perennial cover types (Secchi et al. 2008). Government subsidies and research conducted at regional land grant universities are focused on bolstering production of a few commodity crops such as corn and soybeans (Boody et al. 2005). Proponents of the dominant trend towards intensification of row crop agriculture have pointed to current set-aside programs, improvements in soil stewardship, and field-based management innovations (e.g., minimum-till, no-till, and precision application of nutrients) as evidence that major alterations in the landscape are unnecessary to balance agricultural production with environmental goals (Peters et al. 1999). Policy makers and farmers are often resistant to increases in farm diversification or landscape heterogeneity, seeing such changes as expensive and counter-productive throwbacks to the past (Peters et al. 1999; Urban 2005). In addition, farm diversification and landscape heterogeneity may conflict with the cultural norms of what a successful, well-operated farm looks like (Nassauer 1989; Napier et al. 2000; Urban 2005).

Two recent studies in the Corn Belt included stakeholder perspectives in the formation of future landscape scenarios, some of which highlighted perennial farm practices. Nassauer et al. (2007)

showed photos of current and future landscapes developed by an interdisciplinary team of scientists to 32 farmers in a central Iowa county adjacent to our own study site. They found that stewardship was the concept that most consistently characterized farmers' responses to these photos, and good stewardship and poor soil quality were the characteristics of landscapes that farmers found either most advantageous or disadvantageous, respectively. When farmers were asked to rank photographs according to which landscapes would be best for the people of Iowa in 25 years, they consistently chose landscapes depicting the use of perennial farm practices to maximize water quality and biodiversity over those representing current landscapes or those designed to maximize corn and soybean production. Boody et al. (2005) incorporated the perspectives of 40 rural Minnesotans into the design of landscape scenarios and found that more diversified agricultural systems had the potential to bolster future social and economic sustainability. Both of these studies tested spatially explicit models and concluded that landscapes designed to achieve water quality and biodiversity benefits—largely through the use of carefully targeted perennial farm practices—have the potential to achieve ecological, economic, and social objectives simultaneously.

Social landscape analysis

Emerging approaches to understanding complexity and change in linked social–ecological systems emphasize the importance of analyses that cross scales and perspectives (Gunderson and Holling 2002; Walker et al. 2002; Liu et al. 2007). Hierarchy theory in ecology posits that function and process at any one spatial or temporal scale of a system must be understood in relation to function and process at broader and finer scales (Allen and Starr 1982). In addition to space and time, the social dimension is increasingly recognized to play a critical role in the dynamics of linked social–ecological systems (Westley et al. 2002; Bürgi et al. 2004; Cumming et al. 2006). This social dimension suggests that actors at different levels of organization, power, and culture may perceive the interworking of a system in different ways. All of these perspectives may be valuable in understanding and effectively managing system dynamics.

One key to understanding the potential for change in complex systems may be found by looking closely at synergies or mismatches among system components existing at different spatial, temporal, and social scales (Gunderson and Holling 2002; Walker et al. 2002; Cumming et al. 2006). Our research pinpointed and analyzed key scale mismatches and synergies to determine how stakeholders' understanding of place is related to their attitudes regarding perennial farm practices. In later stages of our research (Atwell 2008), we also integrated the results from this community-level study with the perspectives of actors at different scales of the system, including scientists and regional decision makers.

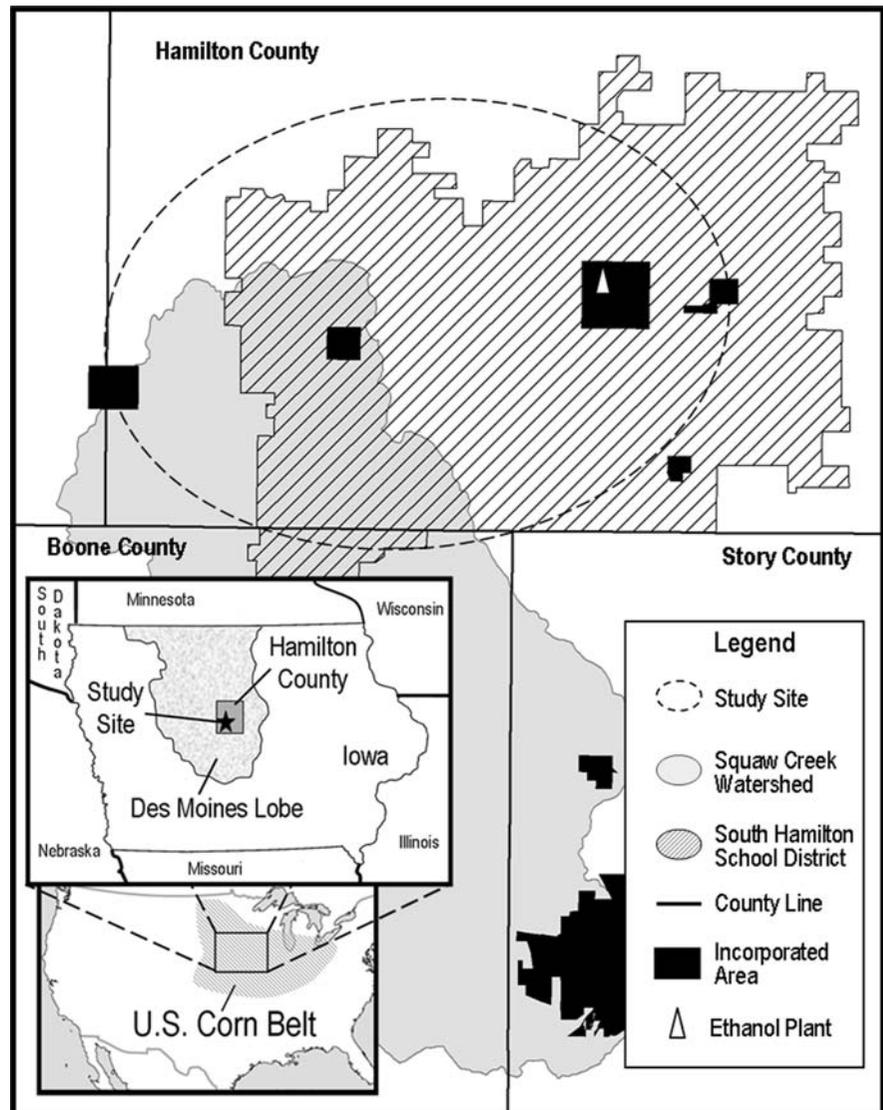
Several models from the environmental social sciences show that synergies or mismatches across scale help to explain why rural stakeholders do or do not embrace seemingly beneficial conservation practices (Norton and Hannon 1997; Westley et al. 2002; Morton and Padgett 2005; Morton 2008). These models all suggest that community-level social norms and networks may play a key role in mediating macro-scale influences on decision making—such as economic markets and government regulations/incentives—and the micro-scale values and beliefs of individuals and households. Because of the recognized importance of community and culture in determining environmental outcomes, here we discuss a social landscape analysis (Field et al. 2003) in one rural Corn Belt watershed community.

Methods

Study area

Hamilton County, Iowa lies on the Des Moines Lobe (Omernik et al. 1993; Fig. 1), an ecoregion possessing several characteristics that make it an exemplary location for investigating issues that are relevant to the larger US Corn Belt. Due to its flat macro-scale topography and extensive subsurface drainage, the Des Moines Lobe sees relatively low levels of surface erosion. Hence, less land in the region is removed from agricultural production and planted in perennial vegetation as part of government set-aside programs such as the CRP. However, at a microscale, this region's Clarion-Nicollet-Webster soils have poor natural drainage and it contains copious prairie

Fig. 1 Our study site is a network of farms and communities in Hamilton County, Iowa that overlaps with both the headwaters of the Squaw Creek Watershed and the rural South Hamilton School District



pothole wetlands, more than 90% of which have been artificially drained to boost agricultural production (Wangpakapattanawong 1996).

As a result of these drainage networks, the Des Moines Lobe now has more tillable hectares and more subsurface leaching of nitrate into regional waterways when compared with other geologic formations in the Corn Belt (Anderson 2001). Nitrate export from the region's river systems have been identified as contributing disproportionately to downstream Gulf of Mexico hypoxia (Rabalais et al. 2002). Hamilton County has 109,298 hectares of drainage networks that plumb 73% of its land area, the greatest

proportion of any county in the Corn Belt (Hamilton County Auditor's Office, personal communication). Hamilton County in particular, and the Des Moines Lobe in general, also exemplify the Corn Belt in high preponderance of row crop agriculture, high levels of concentrated animal production, consolidation of agriculture into large farms, and decline in rural population (Table 1).

We initially bounded our study site to the 393 km² headwaters of the Squaw Creek watershed that lie in Hamilton County (Fig. 1). Previous research throughout this entire watershed by Wagner and Gobster (2007) documented the uncertainty in residents' understanding

Table 1 Characteristics of Hamilton County as compared to the average of all fifteen Iowa counties located entirely or nearly entirely within the Des Moines Lobe geologic formation (USDA NASS 2002; EWG 2006)

Characteristic (values for 2002 unless noted)	Hamilton county	Average of Des Moines Lobe counties
Hectares (ha)	149,365	145,949
Percent of total land in farms (%)	94	95
Percent cropland (%)	89	88
Percent land in harvested corn and soybeans (%)	84	82
Percent land in perennial cover types (%)	9	9
Percent land in govt. conservation programs (%)	2	2
Cattle and calves sold (number)	5,701	16,564
Hogs and pigs sold (number)	1,270,158	556,630
Average size of farm (ha)	177	175
Median size of farm (ha)	96	107
Farms (number)	797	790
Corn and soybean subsidies 2005 (US \$)	26,582,426	24,581,155
Conservation subsidies 2005 (US \$)	1,913,244	1,619,051

of the definitions, causes, consequences, and current state of local water and stream quality. As we began to work in the upper portion of the Squaw Creek watershed, it quickly became apparent that the municipal and ecological boundaries that defined our study site did not mesh with the ways in which our subjects experienced their landscape. Many watershed residents farmed and had close family and community ties across an expanse of countryside that also encompassed the headwaters of two other small watersheds, the Boone and the South Skunk, and four small towns. To remain consistent with our research objectives, we expanded our study area to include this “peopleshed,” an area which roughly coincides with the western two-thirds of the rural 526 km² South Hamilton School District (Fig. 1). All three of the watersheds in our study area are within 25 km of an ethanol plant that began production in 2006. They are also being targeted by ongoing research and management initiatives to better understand and influence the interplay between agricultural intensification and ecosystem function.

Data collection

Our data were derived from in-depth interviews with rural stakeholders who were chosen using a multi-stage, nonprobability sampling design (Handwerker 2005). First, we used an ethnographic approach to gain entrance into our study site. This included initiating informal conversations with local residents about our research through visits to local coffee spots,

churches, and other gathering places. Based on insight gained from these discussions, we used purposive sampling to seek out participants for in-depth interviews who represented a diversity of local perspectives within the following overlapping groups that were particularly relevant to our study questions: farm operators, farm owners, non-farm rural residents, rural opinion leaders, and local conservation personnel.

Among these groups, we prioritized interviewing civically active farmers whose behavior, decisions, and influence were recognized by other community members as impacting sizable portions of the landscape (>200 ha). Snowball sampling techniques, in which ongoing interviews and continued ethnographic work generated more interview contacts, were also used to identify subjects. Only three of the people we asked to participate in interviews refused. We continued to initiate interviews until we reached “saturation” in relationship to major study questions—the point at which we begin to be able to predict subject responses based on previous interviews and analyses (Neuman 2003).

Interviews followed an open-ended guide (Appendix A—see Electronic supplementary material)—while similar questions were asked and similar topics were covered in each interview, the exact wording and flow of questions varied among interviews. Interviews included three sections. The first section began with the broad question, “What is most important to you about the rural countryside?” We probed how interviewees perceived

the natural landscape, how they viewed their neighbors and community, what challenges they saw facing their rural area, and what local assets and amenities they most valued. In the second section, we asked interviewees to sort and discuss 14 photographs (Appendix B—see Electronic supplementary material) of Corn Belt agricultural landscapes in order to probe what was noticed, liked, and disliked about each photograph. Photos were selected to represent a suite of potential landscape scenarios that varied from maximization of row crop production on one end of the spectrum to high concentration of perennial farm practices on the other. Each interview closed by reviewing our conversation and by asking each interviewer what they desire in the future countryside and how desired futures might become a reality. Results from this final interview section were used to develop future scenarios in later phases of our research (Atwell 2008) and are addressed in this paper only so far as they relate to the research questions outlined in the introduction.

Qualitative data analysis

All interviews were recorded and transcribed. Text transcriptions were imported into the NVivo7 data management and analysis software package (QSR 2006). Interview data were coded in NVivo7 into descriptive and topical categories by the lead author. These codes were used to analyze which themes in the data were strong or weak, how themes were related to one another and to study questions, and how the data reinforced themes and with what caveats (Miles and Huberman 1994; Ryan and Bernard 2003). When evaluating the strength, or emphasis, of different themes, we counted how often a theme was revisited within and among interviews, but we also looked closely at when, how, and why the theme was voiced (Ryan and Bernard 2003). This included paying attention to strong language and emotion, key transitions, metaphors, and stories. We also considered the spatial and social scales at which interviewees spoke about each theme and whether each theme was more closely linked to biophysical characteristics of the land itself or aspects of human social organization (Fig. 2). To ensure that analysis was consistent, valid, and confirmable, the second and third authors each read a non-overlapping and randomly assigned one-third of all interviews. Together, all authors compared coding choices and

worked to develop consensus on the meaning and identifying features of themes in the text. After consensus was reached, transcripts were re-read and re-coded to more closely analyze the agreed upon themes.

Results

Interviewee characteristics

We conducted 33 in-depth interviews with 42 participants; several interviews were conducted with pairs, usually husband–wife couples. Although these pairs often agreed with one another, our analyses documented several differences between their perspectives. Interviews generally took place in participants' homes and lasted an average of 74 min. Of the 42 people we interviewed, 11 were women and 31 were men; 14 were non-farm rural residents and 28 were farm operators. Five of these farmers had retired. Twenty-six of our interviewees owned farmland. Most of the non-farm rural residents we interviewed worked within our study area; four commuted between 20 km and 120 km one way to their places of employment. Thirty-seven of the people we interviewed were raised in rural areas, and 31 grew up within 20 km of our study site. Five interviewees were currently or formerly employed in conservation-related fields; four of these conservation agents lived in our study area, and three were also farmers. Our interviewees participated in formal and informal civic organizations such as coffee groups, churches, farm and service organizations, fraternal societies, and municipal boards.

The 23 active farmers we interviewed ranged in age from 23 to 64 years old, and averaged 51 years old. Nineteen of these farmers received 50% or more of their household income from farming. Farm operations ranged in size from 13 to 1,505 ha, with an average size of 495 ha. The average holding size among landowners was 157 ha. In total, our interviewees owned or operated 9,834 ha of farmland, most of which was planted in corn and soybeans, with the exception of 432 ha (4%) which was planted in perennial vegetation as part of US Department of Agriculture (USDA) farm conservation programs. In 2005, our farmer interviewees received an average of \$57,015 in USDA commodity support subsidies

(based on land area of corn and soybeans planted) and an average of \$5,348 in USDA conservation support payments (EWG 2006). Twelve of our interviewees owned livestock, eight of these in concentrated animal feeding operations (CAFOs). These CAFOs housed hogs ($n = 6$) or turkeys ($n = 2$) and ranged in size from 6,000 to 47,000 head of animals sold per year.

Emergent themes

Seventeen themes of varying strength emerged through analysis of the interview data (Table 2). These themes encapsulated what was most important to our interviewees about their rural places. Consideration of how these themes related to one another in light of our major study questions led us to understand them in terms of four overlapping groups described below—countryside, stewardship, independence, and conservation. These groups were linked and differentiated in interviewees' experience across overlapping biophysical and social scales (Fig. 2). Some themes are contained in more than one group.

Countryside

This group is comprised of the following themes: farming lifestyle, people on the land, family, rural aesthetics, farming becoming big business, and the economic realities of farming (Table 2; Fig. 2b). Both farm operators and non-farm rural residents most consistently and strongly spoke of their connection to rural areas in terms of networks of farms and people. "Countryside" emerged through the interview process as the term best able to capture, in the vernacular of our interviewees, this collage of farms, families, and communities interconnected across the landscape. The themes that comprise this set illustrate that our interviewees perceived their countryside as an integrated social and biophysical entity.

Out of all interview themes, farmers and non-farm rural residents most consistently and emphatically identified with the "farming lifestyle" (Table 2). Interviewees were eager to talk about the rhythms, challenges, and edifying character of farm work and often did so at length. Childhood experiences and the work ethic instilled through farm life were important to many interviewees. As one non-farm rural resident

put it, "Our son needs to be raised in an environment where he is somehow connected to the farming community, learning how to work with his hands next to his intellectual education." Interviewees relished participation in food production, plant and animal growth, and the cycles of the seasons. One farmer who ran a large corn, soybean, and hog operation said:

In farming you're a part of the creation of life. If you don't start out farming having that in you, by the time you're done farming you feel that a little bit. You're doing something; that is, you're seeing life evolve in front of you.

Two of the other most repeated and most strongly-voiced themes among interviewees were highly social in nature: "people on the land" and "family" (Table 2). Interviewees valued connections and supportive relationships with neighbors and community members, including church and coffee groups, sharing meals and celebrations, and the ways in which people helped each other out in times of crisis. Many interviewees—and almost all females with whom we spoke—told stories that tied their experiences of rural place to family members. The strongest and most consistently voiced theme relating to primarily biophysical aspects of the countryside was rural aesthetics. Both farmers and non-farm rural residents related to the beauty of the crop rows, the mosaic shades of green across the landscape, and the sights, smells, and sounds of farming.

Interviewees not only appreciated the linked social and biophysical aspects of living in the countryside, but also lamented the ways in which the threads of this once tightly interwoven way of life were unraveling. Farmers especially talked about the way that farming is becoming more corporate and intensive in character. Input costs, land prices, and the "cash rent" that operators must pay farm owners to work the land are all increasing. In turn, profit margins are narrowing, which leads to fewer farmers farming more ground to make a living. This makes it difficult for young operators to get started—a trend mentioned as particularly disturbing to nearly half the farmers we interviewed. Interviewees were eager to discuss how the decrease in farmers, farm families, and return of agricultural revenues to rural communities has led to loss of commerce, amenities, and schools in their towns. The sense of loneliness and

Table 2 The major themes that arose from qualitative analysis of our interview data are listed in order of importance

Theme	Description	Quote	Interviewees expressing
1. Farming lifestyle	Work, rhythms, relationships, ethics, and activities of farms are valued. Both farmers and non-farm residents consider maintenance of farms, farmers, and an agrarian culture a rural priority.	"I like working with livestock. My kids were all in 4-H and showed cattle at the county fair, and I enjoyed working with that, and it was kind of a bonding time for them and me, working together. And I like the harvest. I like to watch the crop come in."	83% emphasized 14% important
2. People on the land	Interviewees value social networks among neighbors and community members. Loss of people from the land and decline in schools and commerce is mourned.	"Oh, in an ideal world, we'd go back 50 years. I'd go back to when there was people in the country. Look at these little towns that are drying up. There's just nothing left. Schools have a big problem."	71% emphasized 17% important 2% secondary
3. Family	Farms and rural areas are seen as a good place to raise children. Relationships with and stories about past and present family members are often emphasized.	"This was my grandparents' farm... It's the same dirt, it's the same [gets teary-eyed; laughs]... It's a partnership, it's a family business, it's traditions that you carry on, and you can do things that your grandparents did."	60% emphasized (91%♀; 48%♂) 33% important
4. Rural aesthetics	The beauty of crops and animals, well kept farmsteads, the many shades of green, open spaces, fresh air, and peace and quiet are all valued aspects of country living.	"The corn stands tall... you could come up with a thousand different shades of green... There's comfort for me in hearing tractors and combines moving through the driveways... I love the beautiful, old farmhouses. I wish we had more of them left."	48% emphasized 31% important
5. Farming becoming big business	Agricultural intensification and consolidation, increasing land prices, loss of local ownership and revenue, and competition for land is changing rural life.	"I'm afraid that conglomerates are going to step in and take over and, the little farmer, he ain't gonna have a word to say... You're going to be a hired man again is what it boils down to me in my mind."	33% emphasized (46%fm; 7%nf) 55% important
6. Land/farming ethics	There are better and worse ways to farm. The ways that people care for their land and their families and relate to neighbors and the community matter.	"They didn't touch those corn stalks last fall. Everybody else I know, they're doing fall plowing and you got black soil all the way around.... Whoever is farming this... they are really doing a responsible job... I'm just real happy with the way they farmed."	29% emphasized 52% important 10% secondary
7. Economic realities of farming	It is getting harder and harder to raise a family on a farm income. Production costs are high and even large farm operators often make only a small return per unit land.	"Most [farmers] have a job in town or they are custom feeding for somebody. You know, they aren't really doing it the way that it has always been done in the past. Everybody does what they have to—to earn a living."	29% emphasized (0%♀; 39%♂) 52% important
8. Suspicion of government & regulation	Government is an untrustworthy outsider. Government farm programs are associated with bureaucracy, red tape, hassles, poor implementation, and are seen as ephemeral.	"...but it does complicate farming, 'cause you got, you got to follow the rules, and sign contracts and, you know? That's the only thing I'm uneasy about is... you sign... a piece of your independence away."	24% emphasized (0%♀; 32%♂) 31% important 5% secondary

Table 2 continued

Theme	Description	Quote	Interviewees expressing
9. Distance from people & suspicion of outsiders	Being removed from the hustle and bustle of town and the watchful eyes of neighbors is valued. People who are not active in the local community are viewed with distrust.	“[I like] being away from everybody... Just being away. You don't walk out, and there's neighbors watching what you're doing... Nobody bothers you...I don't wanna live in town. I'd hate it.”	14% emphasized 45% important
10. Own boss & private property	The ability to be your own boss is voiced as a reason for both farming and living in the country. Private property is valued as a great good.	“When I got started, I was my own boss. I made a boo-boo, it was my fault. Things went well, we profited from it.” “Just very few restrictions on what a person can do out in the country.”	21% emphasized (0%♀; 7%nf) 19% important (0%♀; 7%nf) 26% emphasized (9%♀; 32%♂) 10% important 24% secondary
11. Tillage & soil erosion	Soil erosion is a concern and minimum tillage practices were one mark of a careful farmer. Interviewees picked these practices out of photos and talked about how they till.	“It impressed me that he was so conservation minded. There isn't too many people that are drilling beans in a corn stubble like that... This guy did nothing. He drilled it [the seed] right in those stalks.”	12% emphasized 38% important
12. Regional rivers, lakes, & scenic areas	Regional water bodies and scenic byways, parks, and preserves—areas outside of, but connected to the agricultural mosaic—are valued as places for recreation and retreat.	“I like some of the natural resources we have, and from this house I can't see them, but there's some lakes around, and I like to go fishing sometimes. And there's the Boone River; we like to canoe down that.”	14% emphasized 26% important 24% secondary
13. Wildlife	Wildlife and habitat are valued for hunting, observation, or for their own intrinsic value—either within the agricultural mosaic or at regional marshes, lakes, and rivers.	“They're [deer, when not on roads] kinda cute to watch. Since the wetlands program, there's so many more species of birds and wildlife that has come back to our area.”	10% emphasized 26% important 29% secondary
14. Water quality	Animal manure and agricultural fertilizers, herbicides, and pesticides are recognized as a threat, or a perceived threat, to local and downstream water sources.	“I think it's important to, well, do whatever we can to keep our water clean, especially if, I think the situation down the Gulf of Mexico is gonna end up making us use less fertilizer.”	10% emphasized (0%fm; 29%nf) 19% important (14%fm; 29%nf) 17% secondary
15. Natural areas for recreation within farm land	Some interviewees, primarily non-farm rural residents, valued interconnected natural areas such as wetlands and stream buffers for walking, biking, hunting, or wildlife viewing.	“Just to, uh, hear all that stuff, all the birds, different birds. Oh, our kids love taking the grandkids out through that, and letting them see that, and riding their bikes, and little things. It's one of the, I guess, perks of living here.”	5% emphasized (0%fm; 14%nf) 24% important 55% secondary
16. Perennial cover on marginal farm land	Although rarely a priority, many interviewees responded positively to pictures of perennial cover types (buffers, wetlands) on marginal agricultural land to help water and wildlife.	“There's no need to pull tile [underground soil drainage system] out of good productive farmland... But if it's ground that you're having trouble keeping dry, yeah, that might pay to make it into wetland. Help water quality...for us and for the fish.”	

♀ Female interviewees, ♂ male interviewees, *fm* farm operator interviewees, *nf* non-farm rural residents

powerlessness surrounding these changes was expressed consistently throughout interviews. One farmer in his mid-50s put it this way:

The farms are getting bigger now. The people are leaving... When I was [young], my folks, they had some relation around and they always used to do things. They just aren't around anymore... I've got no family around... There are only half the people in the class now as there was when I graduated [from high school]. So they've gone somewhere.

Independence

In seeming contrast to the desire for connectedness with farms and people, many interviewees also expressed ideas associated with independence including: distance from people, suspicion of outsiders, being one's own boss, private property, rural aesthetics, and suspicion of government and regulation (Table 2; Fig. 2c). Many respondents lived in rural areas because they value the freedom to be their own boss and to do what they want to on their own private property. Some interviewees also enjoyed solitude, fresh air, open spaces, sunrises and sunsets, the peace and quiet of country living, and being outside. One non-farm rural resident illustrates the desire voiced by many for distance from town and neighbors:

It's just so much nicer being out in the country away from people... Friends [are] around if you want to go see them, but they aren't right next door to you... Just very few restrictions on what a person can do out in the country, whereas in town you got to consider the neighbor.

In interviews, misgivings were regularly shared about outsiders, such as new residents and commuters, who were not known or involved in the local community. About half of our interviewees, most of them male, voiced a suspicion of the government and frustration with government farm programs, especially conservation programs, which were seen as ephemeral and lacking common sense.

Stewardship

Themes in this set included: land/farming ethics, soil stewardship, farming lifestyle, people on the land,

family, rural aesthetics, the economic realities of farming, and farming becoming big business (Table 2, Fig. 2d). Thirty-eight of the 42 people with whom we spoke volunteered a strong ethic related to taking care of one's land, farm, family, and/or community. While there was much variation in the ethics expressed among different interviewees, the people with whom we spoke generally held that there are better and worse ways to farm. Many of these farm ethics related to caring for the land at infield, on-farm scales. These included practices such as building soil, preventing erosion, keeping tillage to a minimum, and leaving your farm better for future generations. Twelve farmers and three non-farm rural residents, all but one of them male, placed particular importance on using reduced tillage practices to take care of the soil. For example, upon being shown two pictures that we had chosen to depict agricultural landscapes dominated by monoculture corn or soybean agriculture, several of these farmers' first comment had to do with the lack of last year's crop residue between rows which indicated a lack of conservation tillage practices.

As is illustrated by the overlap of the stewardship set and the countryside set (Fig. 2b, d), ethics expressed by interviewees not only related to the land, but were equally strongly tied to preservation of farms, families, and the rural way of life. Farmers often explained how careful management and marketing choices allowed their operations to remain profitable despite difficult economic realities. Several farmers and non-farm rural residents expressed dissatisfaction with large farm operators in the area who were hungry for land, who were not highly involved in the community, and whose tillage and manure application practices were sub-optimal. Interviewees also commented on the upkeep and cleanliness of their neighbors' farmsteads and fields. Farmers and rural residents who were concerned about air and water pollution from herbicides, pesticides, and CAFOs, often emphasized that they were not criticizing farmers in general, but rather certain practices evidenced by only a few of the worst offenders. Interviewees' approval or disapproval of certain groups of outsiders—such as commuter residents, scientists and academics, city people, and environmentalists—hinged on whether these groups were seen, or not seen, as being supportive of rural farmers and communities. As a

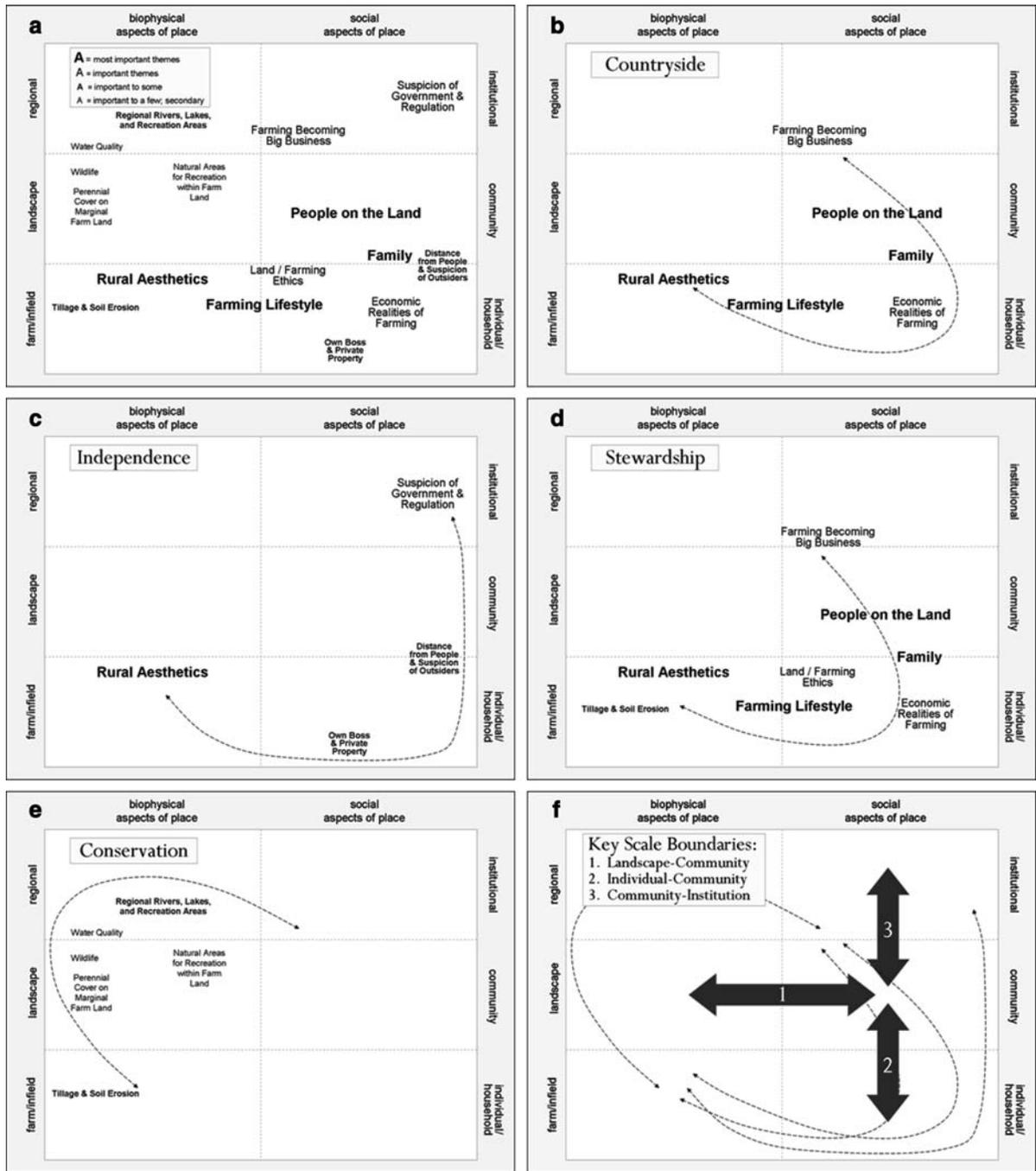


Fig. 2 Major themes emerging from qualitative analysis of interview data are oriented according to overlapping biophysical and social spatial scales (a). Themes in larger and *bolder font* were voiced more strongly and consistently across interviewees. Placement of themes is an approximation of the majority sentiment; some themes were discussed at different scales by different individuals. The themes most important to our interviewees tended to cluster at more local and more

social scales and demonstrate that the rural people with whom we spoke view their surroundings as a linked social–ecological system. Arcs denote groups of themes that were found to be closely related to one another: **b** countryside, **c** stewardship **d**, independence, and **e** conservation. Note that some themes are exhibited in multiple groups. Interview data revealed three key boundaries between biophysical and social scales (**f**) that pose challenges and opportunities for landscape change

farmer who worked with a local watershed initiative stated:

I went to their latest Midwestern conference out at Nebraska City. And as a farmer, you know The Nature Conservancy, so is that just another ecological group that is down on farmers? No! They want to work with us... on a working landscape.

Conservation

Themes directly related to perennial farm practices—including tillage and soil erosion, regional rivers, lakes and scenic areas, wildlife, water quality, natural areas for recreation within farm land, and perennial cover on marginal farm ground—were generally of secondary importance to our interviewees (Table 2; Fig. 2e). Several respondents brought up infield soil stewardship or enjoyment of regional rivers, lakes, and scenic areas in response to early questions about the countryside in the first part of the interviews. However, themes related to conservation at broad landscape and regional scales—such as wildlife, water quality, local natural areas for recreation, and perennial cover on marginal agricultural land—would seldom have been brought up in interviews if perennial farm practices had not been introduced into interviews through photo elicitation.

Once shown photographs, 36 of the 42 people we interviewed voiced general approval of perennial farm practices on *marginal* agricultural land—such as wetlands and riparian buffer strips—and of “green” government programs and incentives to support these practices. Such practices were, however, rarely considered a priority for farmers. Twenty-four out of 28 farmers and 12 out of 14 non-farm residents we interviewed clearly indicated that perennial farm practices were of secondary importance when compared with more pressing farm and community concerns. Implementation of perennial vegetation on *productive* farm ground, through strip intercropping or restored prairie, received more mixed responses. While some interviewees approved of these practices, most suggested that they are impractical, time intensive, and better suited to more rolling terrain than that found in the Des Moines Lobe.

Reasons for approval of perennial farm practices varied. Nine rural residents, but only two farmers,

mentioned the beauty of perennial farm practices; seven additional farmers talked about the beauty of trees associated with farmsteads or their benefits in wind protection. Farmers tended to view perennial farm practices in terms of their benefits for regional and downstream water quality and voiced a desire to be seen as good stewards by the public. One farmer’s comment captures the tone of many, “[sigh] yeah, we ought to be doing more of that.” Only three respondents expressed concern with the quality of their own drinking water. Most non-farm residents saw perennial farm practices as providing local places for recreation (Table 2) including walking, riding horses, wildlife viewing, or hunting. Many farmers and non-farm rural residents approved of the positive impact that perennial farm practices had on wildlife populations, especially game bird species such as ducks, geese, and ring-necked pheasant (*Phasianus colchicus*). White-tailed deer (*Odocoileus virginianus*) were consistently viewed as an overpopulated nuisance.

Discussion

As with other research on rural perceptions of, and attitudes towards, conservation and landscape change in the Corn Belt (Nassauer 1989; Ryan et al. 2003; Urban 2005; Nassauer et al. 2007), our interview data shows that stewardship, including caring for the land, is a normative dimension of rural culture. Our study builds on this body of research, by exploring how landscape change is related to other rural priorities through social landscape analysis. Ethnographic components of our sampling strategy allowed us to interview a culturally representative cross-section of our study community, including rural opinion leaders and large farm operators who influence sizeable chunks of the landscape.

Analysis of interview data revealed that three scale boundaries play a key role in understanding how interviewees’ perceptions of perennial farm practices interface with their broader sense of place: (a) the landscape/community interface, (b) the individual/community interface, and (c) the community/institution interface (Fig. 2f). Mismatches in rural perception at each of these boundaries have the potential to cripple landscape change initiatives; however, each of these boundaries also identifies a leverage point (Meadows 1999) that has the potential to catalyze landscape change.

Landscape-community interface

As in previous research conducted near our study site (Wagner and Gobster 2007), we found that rural residents did not readily conceive of their surroundings in terms of a watershed or readily display acute knowledge of the way that biophysical landscape change impacts ecosystem function. While our interviewees generally knew which watershed they lived in and understood that conservation practices such as riparian buffers and restored wetlands were associated with benefits for water quality and wildlife, these issues did not emerge as rural priorities in the first section of interviews. Rather, their sense of stewardship was tied more strongly to maintenance of threatened rural livelihoods and infield soil stewardship, both issues that have been recognized as rural priorities (Ryan et al. 2003; Boody et al. 2005). Linking landscape networks of perennial farm practices to achieve broad-scale societal goals was a concept with which our interviewees expressed much less familiarity. Our results suggest that such an approach represents a new paradigm in rural culture and is, as of yet, not integrally linked with rural stewardship ethics.

However, residents displayed a strong conception of their surrounding countryside as a network of people and farms exhibited at the community social scale (Fig. 2b). Through the process of initiating interviews in our study site, we found that these networks, although overlapping, were nonetheless identifiable. The resulting “peopleshed” existed at a similar spatial scale to that often described by a biophysical “landscape” (Fig. 1). Countryside social networks have the potential to build understanding of, and support for, establishment of perennial farm practices in locales where landscape-scale conservation is not currently a priority. Our results suggest that initiatives in the Corn Belt that use the concept of countryside to link landscape-scale conservation and stewardship (Fig. 2f) are more likely to be assimilated into the social and cultural norms of rural people.

Individual-community interface

The autonomy of rural people presents a formidable challenge to implementation of landscape-scale conservation practices that span private property

boundaries. Congruent with other research in the Corn Belt, we found that rural people have strong ethics that motivate the way that they farm, but that these ethics vary a great deal between respondents (Napier et al. 2000; Ryan and Bernard 2003; Urban 2005). This variety of subjectively held motivations is reflected in the inconsistent participation in incentivized farm conservation programs currently observed in the Corn Belt. In addition, although a favorable disposition towards farm policy that rewards farmers for implementing conservation practices was voiced by 32 interviewees, including 22 of the 23 active farmers with whom we spoke, 15 of these same farmers simultaneously voiced a hesitancy to actually participate in these types of programs. As one farmer put it, “There is nothing wrong with the program, I think the program is excellent... I just didn’t want to deal with the government.”

However, while the rural people we interviewed prized their independence, they voiced a much stronger desire for social connectedness (Fig. 2; Table 2). Two of the themes associated with countryside, “people on the land” and “family farm,” indicated a strong desire among our interviewees for close knit community. In addition, the stewardship ethics voiced by our interviewees were just as strongly tied to caring for your family and local community as they were to caring for the land. Desire for connectedness and ethics of care are two community-level values that have the potential to bring independent rural people together to achieve common goals, including landscape change. Later stages of our research highlight the importance of linking economic incentives for conservation with both community development and local-level conservation support networks and personnel in achieving landscape-scale goals (Atwell et al. 2009).

Community-institution interface

The farmer quoted above who did not want to “deal with the government” also voiced, not more than 5 min later in the same interview, regret that consolidation of agriculture, schools, and commerce is having a profoundly negative impact on small communities. When asked what could be done to counter this trend, he quickly answered, “the government, that’s all I can think about.” In like manner, other interviewees who lamented the decline of rural

communities recognized that drastic institutional changes, including government regulations and aid, were needed to reverse this trend. This illustrates another important pattern in our data. The most strongly and positively voiced themes cluster around the interface between the community and individual/household social scales (Fig. 2). While state and federal institutions were recognized as having a profound impact on rural ways of life, interviewees viewed these macro-level forces with distance and suspicion, and voiced a sense of powerlessness to affect institutional change.

This mismatch between desire for strong communities and the distrust of institutions reveals a striking challenge for rural areas and for conservation initiatives in these areas. Bellah et al. (1991) define institutions not only as organizational entities, but as “normative patterns embedded in, and enforced by, laws and mores [informal customs and practices].” In interviews with people from all walks of life, they found that Americans mourn the decline of societal benefits arising from strong institutions, but simultaneously view institutions as something external to themselves over which they have little control. Based on our interview data, we argue with Bellah et al. (1991) that to affect lasting change in landscapes and communities ways must be found to bridge the gap between autonomous individuals, households, and communities and the ethical and political dialogue that undergirds strong institutions.

Through her work with Iowa farmers, Morton (2008) has developed a model to show how community-level civic engagement in watershed management initiatives may help bridge this divide, while simultaneously building social resources and improving water quality. The importance of farm and community networks exhibited by our interview data corroborates Morton’s model. As discussed above, our results suggest that landscape-scale conservation initiatives are likely to be more successful if connected with countryside concerns.

Conclusions

In linking our interviewees’ perception of perennial farm practices to these important scalar considerations in their sense of place, our research adds a caveat to the findings of Nassauer et al. (2007) that

rural stakeholders are highly attuned to stewardship concerns and respond positively to photographs depicting landscape scale networks of perennial farm practices that bolster biodiversity and water quality. In our interview data, rural peoples’ sense of stewardship was related primarily to on-farm and community concerns, and only secondarily to landscape-scale networks of perennial farm practices. In addition, our interviewees approved of perennial farm practices on *marginal* agricultural land, but the implementation of such practices within crop rotations or on *productive* farmland was, almost always, seen as impractical and unnecessary, especially on the relatively flat landscapes of the Des Moines Lobe.

Our research also builds on the finding of Boody et al. (2005) that government incentives to promote adoption of perennial farm practices will not be successful unless coupled with development of social and human capital in rural communities. We initiated interviews to learn how private property boundaries, social norms, and perceptions of place impacted the potential of perennial farm practices to bolster regional social and ecological resilience. At the spatial scale where we saw landscapes and watersheds, the rural people we interviewed were eager to talk about farms and communities. Our interviewees were acutely affected by declines in rural social and economic vitality, and expressed strong ethics of stewardship related to the preservation of the farming lifestyle of rural communities.

To be successful, initiatives that focus on bolstering ecosystem function through networks of perennial farm practices, must also focus on development of rural social and human capital at spatially similar community scales. Future landscape change initiatives should consider coupling biophysical analyses with social landscape analyses to identify and bridge boundaries among individual values, community norms and networks, societal goods, ecosystem capacity, and collective institutions.

Acknowledgments We thank our interviewees for their honesty and insight. We also thank Terry Besser, Tricia Knoot, Kris Atwell, and three anonymous reviewers for comments improving earlier drafts of this manuscript, and Megan Boyd, Carrie Eberle, Luke Gran, Bonnie Jan, Anna MacDonald and Krystina Smith for assistance with interview transcription and analysis. This research is funded by the Leopold Center for Sustainable Agriculture, USDA Sustainable Agriculture Research and Education (SARE), the US Forest Service Northern Research Station, Iowa State University

(ISU) Department of Natural Resource Ecology and Management, and the ISU Graduate Program in Sustainable Agriculture.

References

- Ajzen I (2005) Attitudes, personality and behavior. Open University Press, New York
- Allen TFH, Starr TB (1982) Hierarchy: perspectives for ecological complexity. University of Chicago Press, Chicago
- Anderson KL (2001) Historic alteration of surface hydrology on the Des Moines Lobe. Water Fact Sheet 2001-15. Iowa's water ambient monitoring program, Iowa Geological Survey. Iowa Department of Natural Resources, Iowa City, Iowa. Available from <http://www.Igsb.Uiowa.Edu/gsbpubs/pdf/wfs-2001-15.Pdf> (accessed 2/02/09)
- Atwell RC (2008) Perennial vegetation, human adaptation, and resilience in the US Corn Belt social-ecological system. Dissertation. Iowa State University, Ames, Iowa, USA
- Atwell RC, Schulte LA, Westphal LM (2009) Linking resilience theory and diffusion of innovations theory to understand the potential for perennials in the US Corn Belt. *Ecol Soc* 14:30. [online] URL: <http://www.ecologyandsociety.org/vol14/iss1/art30/>
- Bellah RN, Madsen R, Sullivan WM, Swidler A, Tipton SM (1991) The good society. Vintage, New York
- Boody G, Vondracek B, Andow DA, Krinke M, Westra J, Zimmerman J, Welle P (2005) Multifunctional agriculture in the United States. *Bioscience* 55:27–38. doi:10.1641/0006-3568(2005)055[0027:MAITUS]2.0.CO;2
- Bürgi M, Hersperger AM, Schneeberger N (2004) Driving forces of landscape change: current and new directions. *Landscape Ecol* 19:857–868. doi:10.1007/s10980-004-0245-8
- Cheng AT, Kruger LE, Daniels SE (2003) “Place” as an integrating concept in natural resource politics: propositions for a social science research agenda. *Soc Nat Resour* 16:87–104. doi:10.1080/08941920309199
- Clayton S, Brook A (2005) Can psychology help save the world? A model for conservation psychology. *Anal Soc Issues Public Policy* 5:87–102. doi:10.1111/j.1530-2415.2005.00057.x
- Cumming GS, Cumming DHM, Redman CL (2006) Scale mismatches in social-ecological systems: causes, consequences, and solutions. *Ecol Soc* 11:14. [online] URL: <http://www.ecologyandsociety.org/vol11/iss1/art14/>
- EWG (2006) Farm subsidy database. Environmental Working Group, Washington, D.C. [online] URL: <http://www.ewg.org/farm/>
- FAO (2008) The state of food and agriculture. Food and Agriculture Organization of the United Nations, Rome. Available from <http://www.fao.org/catalog/inter-e.htm> (accessed 1/15/09)
- Field DR, Voss PR, Kuczynski TK, Hammer RB, Radeloff VC (2003) Reaffirming social landscape analysis in landscape ecology: a conceptual framework. *Soc Nat Resour* 16:349–361. doi:10.1080/08941920390178900
- Field CB, Campbell JE, Lobell DB (2008) Biomass energy: the scale of the potential resource. *Trends Ecol Evol* 23:65–72. doi:10.1016/j.tree.2007.12.001
- Fliegel FC, Korsching PF (2001) Diffusion research in rural sociology: the record and prospects for the future. Social Ecology Press, Middleton, Wisconsin
- Gunderson LH, Holling CS (eds) (2002) Panarchy: understanding transformations in human and natural systems. Island Press, Washington, DC
- Handwerker WP (2005) Sample design. In: Kempf-Leonard K (ed) Encyclopedia of social measurement. Academic Press, Burlington, MA
- Hinkamp D, Borich T, Euken J, Devlin S (2007) County bio-economy discussion results. Iowa State University Extension, Ames, Iowa
- Jordan N, Boody G, Broussard W, Glover JD, Keeney D, McCown BH, McIsaac G, Muller M, Murray H, Neal J, Pansing C, Turner RE, Warner K, Wyse D (2007) Sustainable development of the bioeconomy. *Science* 316:1570–1571. doi:10.1126/science.1141700
- Liu J, Dietz T, Carpenter SR, Alberti M, Folke C, Moran E, Pell AN, Deadman P, Kratz T, Lubchenco J, Ostrom E, Ouyang Z, Provencher W, Redman CL, Schneider SH, Taylor WW (2007) Complexity of coupled human and natural systems. *Science* 317:1513–1516. doi:10.1126/science.1144004
- Meadows DH (1999) Leverage points: places to intervene in a system. The Sustainability Institute, Hartland, VT
- Miles MB, Huberman AM (1994) Qualitative data analysis: an expanded sourcebook. Sage Publications, Thousand Oaks, CA
- Morton LW (2008) The role of civic structure in achieving performance based watershed management. *Soc Nat Resour* 21:751–766. doi:10.1080/08941920701648846
- Morton LW, Padgett S (2005) Selecting socio-economic metrics for watershed management. *Environ Monit Assess* 103:83–98. doi:10.1007/s10661-005-6855-z
- Napier TL, Tucker M, McCarter S (2000) Adoption of conservation production systems in three midwest watersheds. *J Soil Water Conserv* 55:123–134
- Nassauer JI (1989) Agricultural policy and aesthetic objectives. *J Soil Water Conserv* 44:384–387
- Nassauer JI, Santelmann MV, Scavia D (eds) (2007) From the Corn Belt to the gulf: societal and environmental implications of alternative agriculture futures. Resources for the Future Press, Washington, DC
- Neuman WL (2003) Social research methods: qualitative and quantitative approaches. Allyn and Bacon, Boston
- Norton BG, Hannon B (1997) Environmental values: a place-based theory. *Environ Ethics* 19:227–245
- Omernik JM, Griffith GE, Pierson SM (1993) Ecoregions and Western Corn Belt plains subregions of Iowa. US Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR, USA
- Peters M, Ribaldo M, Claassen R, Heimlich R (1999) Reducing nitrogen flow to the gulf of Mexico: strategies for agriculture. USDA ERS. *Agric Outlook* 788:20–24
- QSR (2006) Nvivo7 (qualitative data management and analysis software). QSR International, Doncaster, Australia
- Rabalais NN, Turner RE, Scavia D (2002) Beyond science into policy: gulf of Mexico hypoxia and the Mississippi River.

- Bioscience 52:129–142. doi:[10.1641/0006-3568\(2002\)052\[0129:BSIPGO\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2002)052[0129:BSIPGO]2.0.CO;2)
- Robertson GP, Dale VH, Doering OC, Hamburg SP, Melillo JM, Wander MM, Parton WJ, Adler PR, Barney JN, Cruse RM, Duke CS, Fearnside PM, Follett RF, Gibbs HK, Goldemberg J, Mladenoff DJ, Ojima D, Palmer MW, Sharpley A, Wallace L, Weathers KC, Wiens JA, Wilhelm WW (2008) Sustainable biofuels redux. *Science* 322:49–50. doi:[10.1126/science.1161525](https://doi.org/10.1126/science.1161525)
- Ryan GW, Bernard HR (2003) Techniques to identify themes. *Field Methods* 15:85–109. doi:[10.1177/1525822X02239569](https://doi.org/10.1177/1525822X02239569)
- Ryan RL, Erickson DL, DeYoung R (2003) Farmer's motivations for adopting conservation practices along riparian zones in a mid-western agricultural watershed. *J Environ Plann Manage* 46:19–37. doi:[10.1080/713676702](https://doi.org/10.1080/713676702)
- Schulte LA, Liebman M, Asbjornsen H, Crow TR (2006) Agroecosystem restoration through strategic integration of perennials. *J Soil Water Conserv* 61:164A–169A
- Secchi S, Tyndall J, Schulte LA, Asbjornsen H (2008) Raising the stakes: high crop prices and conservation. *J Soil Water Conserv* 63:68A–73A. doi:[10.2489/jswc.63.3.68A](https://doi.org/10.2489/jswc.63.3.68A)
- Tilman D, Hill J, Lehman C (2006) Carbon-negative biofuels from low-input high-diversity grassland biomass. *Science* 314:1598–1600. doi:[10.1126/science.1133306](https://doi.org/10.1126/science.1133306)
- Urban MA (2005) Values and ethical beliefs regarding agricultural drainage in central Illinois, USA. *Soc Nat Resour* 18:173–189. doi:[10.1080/08941929590894570](https://doi.org/10.1080/08941929590894570)
- USDA NASS (2002) 2002 Census of agriculture. National Agricultural Statistics Service, US Department of Agriculture, Washington DC. Available from [http://www.nass.usda.gov/Census of Agriculture/index.asp](http://www.nass.usda.gov/Census%20of%20Agriculture/index.asp) (accessed 1/05/08)
- Wagner MM, Gobster PH (2007) Interpreting landscape change: measured biophysical change and surrounding social context. *Landsc Urban Plan* 81:67–80. doi:[10.1016/j.landurbplan.2006.10.019](https://doi.org/10.1016/j.landurbplan.2006.10.019)
- Walker B, Carpenter S, Anderies J, Abel N, Cumming G, Janssen M, Lebel L, Norberg J, Peterson GD, Pritchard R (2002) Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology* 6: 14 [online] URL: <http://www.ecologyandsociety.org/vol6/iss1/art14/print.pdf>
- Wangpakattanawong P (1996) Extent of historical wetlands of the prairie pothole region, North Central Iowa. MS Thesis. Iowa State University, Ames
- Westley F, Carpenter SR, Brock WA, Holling CS, Gunderson LH (2002) Why systems of people and nature are not just social and ecological systems. In: Holling CS, Gunderson LH (eds) *Panarchy: understanding transformation in human and natural systems*. Island Press, Washington, DC, pp 103–120