For the Public Good: Weaving a Multifunctional Landscape in the Corn Belt

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Noelle M. Harden, Agroecology Program, University of Wisconsin-Madison

30553 Co Hwy 35

Underwood, MN 56585

*Loka L. Ashwood, Dept of Community and Environmental Sociology, University of Wisconsin-Madison

350 Agricultural Hall

1450 Linden Dr.

Madison, WI 53706

William L. Bland, Dept of Soil Science, University of Wisconsin-Madison

263A Soils Building

1525 Observatory Dr.

Madison, WI 53706

Michael M. Bell, Dept of Community and Environmental Sociology, University of Wisconsin-Madison

340C Agricultural Hall

1450 Linden Dr.

Madison, WI 53706

*Contact for corresponding author:

Email: ashwood@wisc.edu

Phone: 608-262-1510

Fax: 608-262-6022

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Abstract

Critics of modern agriculture decry the dominance of monocultural landscapes and look to multifunctionality as a desirable alternative that facilitates the production of public goods. In this study, we explored opportunities for multifunctional Midwestern agriculture through participatory research led by farmers, landowners, and other local actors. We suggest that agriculture typically fosters some degree of multifunctionality that arises from the divergent intentions of actors. The result is a scattered arrangement of what we term *patchwork multifunctionality*, a ubiquitous status quo in which individuals provide public goods without coordination. In contrast, *interwoven multifunctionality* describes deliberate collaboration to provide public goods, especially those cases where landowners work across fence lines to weave a synergistic landscape. Using examples from two case studies, we demonstrate the spectrum of patchwork and interwoven multifunctionality that currently exists in the Corn Belt, and present underutilized opportunities for public good creation.

Keywords: Multifunctionality, agriculture, phosphorus pollution, participatory research, landscape

1. Introduction

Contemporary modes of agricultural production in the Corn Belt of the United States are decried by critics for producing row crop wastelands and "ecological sacrifice zones" (Jackson and Jackson 2002). Activists and scholars also point to the discursive monoculture of modern industrialized agriculture, signified by the dominance of productivist institutions and agribusiness. However, even the most fertile Midwestern grain farms can, and frequently do, provide public goods beyond the production of agroindustrial commodities (Boody et al. 2005; Evans et al. 2002). The strategic placement of grass on a grain farm, for example, can provide ecological benefits like habitat for grassland birds and the filtration of agricultural runoff (Jackson 2002; Schulte et al. 2006; Glover et al. 2007), and also could foster "bioeconomies" in rural communities based on local energy production (Jordan et al. 2007). This is the concept of agricultural multifunctionality, which in its simplest form is about farms providing public goods in addition to food, fiber, fuel, and feed (OECD 2001). Agricultural multifunctionality is sometimes regarded as an antithesis to the corn and soybean farms that thrive in the American Midwest. This paper is an attempt to challenge this polarized understanding of multifunctionality by recognizing underutilized opportunities for public goods to be created and sustained across the landscapes of the Corn Belt.

We propose that agricultural landscapes are always multifunctional, in some sense, because they are cultivated by a variety of actors with diverse intentions – farmers growing corn with the help of government representatives, landowners seeking to preserve game habitat, locals fortifying connections to each other through common traditions, and much more. Multifunctionality often provides multiple benefits for the

farmers and landowners in addition to the public. For example, farmers throughout the world have derived individual benefits from agroecological changes, such as food security, financial stability, input efficiency, and quality of life attributes (Amekawa et al. 2010, Lovell et al. 2010).

On practically any farm we could point to public goods that are produced simply through the manifestation of individual intentions as farms respond to internal and external contexts (Bland and Bell 2007). This sort of *patchwork multifunctionality* occurs without coordination, and often inadvertently. Through a holistic process enacted in two case studies, we sought to instead promote *interwoven multifunctionality,* which we define as the achievement of public goods through the weaving of human intentions with biophysical contexts across farms and landscapes. Interwoven multifunctionality requires farmers to act deliberately and collectively to "compose" farm arrangements through careful attention to social and ecological contexts, ultimately producing "an integrated whole that is stronger and more resilient than the sum of its parts" (Janke 2002, p. 210). Farms are most effectively interwoven into the landscape when they produce public goods across fence lines, through the cooperative action of multiple actors with diverse intentions. We used a combination of focus groups and interviews in two case study watersheds to ascertain Corn Belt farmers' capacity to work across property boundaries to design and achieve multifunctional solutions for nonpoint water pollution. The results of this study detail a series of contextual factors that favor multifunctionality in the Corn Belt. We suggest that utilizing multifunctionality in places often stigmatized as monocultures can promote public goods and address problems associated with industrialized agriculture, such as water pollution.

2. Multifunctional Agriculture in the Corn Belt

The formal incarnation of multifunctionality arose as a European Union (EU) policy initiative intended to diversify farm subsidies by promoting social and ecological benefits of agriculture (OECD 2007). The concept has been broadened to encompass any creation of public goods on land used primarily for agricultural production (Boody et al. 2005; Wilson 2007). In one vision, multifunctional agriculture includes: "...the desire to reassert localism, to embrace endogenous skills and knowledge, to establish or assert new norms of production and consumption practices, and to value diversity in both the scale and practice of farming" (Marsden 2003, p. 229). In this sense, multifunctionality presents an opportunity for individual farmers and landowners to engage local community and landscape contexts as they make land management decisions. In contrast to views of multifunctionality as exclusive to heterogeneous cultural landscapes (e.g. Mander et al. 2007), or as an alternative to the agroindustrial modes of production employed by the "conventional farmer" (e.g. Marsden 2003; Marsden and Sonnino 2008), we believe that multifunctionality is common to most, if not all, agricultural landscapes.

In practice, multifunctionality is often reduced to a fragmented approach that focuses on individual farms. Policies such as the single farm payment scheme in the EU (IATP 2007) and the Conservation Reserve Program (CRP) in the United States (NRCS 2011) evaluate farms as discrete, contained entities, without consideration of surrounding biophysical landscapes and community capacities (Guzmán and Alonso 2010; Claasen et al. 2007; Morgan et al. 2010). These fragmented policies encourage farmers to look

internally to solutions, rather than engaging the other actors on a shared landscape (Batie 2009). As a result, opportunities for farmer collaboration and creativity are often overlooked, as are context-specific solutions. Guzman and Alonso (2010) describe the challenge this paradigm poses for farmers transitioning toward "ecological agriculture" in the EU: "The farmer faces the period of transition in isolation, without neighboring farmers with whom to share the process" (p. 244). While the individualized, internalized status quo does produce some public goods, it does not encourage farmers to weave their intentions with the multifunctional objectives of community members and other farmers.

In contrast, we employ Wilson's (2007) notion of the "multifunctionality spectrum…[that] enables the conceptualizations of multiple pathways that bring agriculture 'back in' as a significant shaper of the countryside and rural areas, both for productivist and non-productivist purposes" (p. 220). Even on the corn and soybean landscapes of the Midwest, multifunctionality can be expanded through landscape changes, such as strategic perennialization on and across individual farms. But multifunctionality does not just exist in these landscapes as a result of intentional design as some would suggest (Lovell and Johnston 2009, Jackson 2008), but also emerges spontaneously. We contend that multifunctionality can exist in a greater diversity of spaces by recognizing a wide spectrum of patchwork and interwoven multifunctionality. We avoid discourses that narrow multifunctionality to "defend spaces for postproductivism" through a dualistic framing of different types of farmers, (Potter and Tilzey 2005, p. 596) sizes of farms (Amekawa 2011) or by referring to the "conversion" between binary modes of production (Porter et al. 2009).

In this paper, we suggest that the landscapes of the agricultural Midwest currently enable multifunctionality to emerge largely in a patchwork configuration across the landscape reflecting limited, narrow objectives and bounded property lines that result in high degrees of contrast (Figure 1). This default situation can and does create some public goods as positive externalities and unaccounted value, rather than only the unaccounted costs associated with negative externalities (OECD 2007). Yet a patchwork of adjacent but incompatible land uses (e.g. housing developments and large animal feeding operations), can lead to intense community conflict and other negative externalities that diminish the overall public good, as we discovered in our research. Similar research in the Netherlands shows potential for landscape change through locally organized, cooperative efforts between farmers and other actors (Franks and McGloin 2007). We too report some success with our participatory action process on the much different landscapes of the Corn Belt. Like other studies (Bouma et al. 2008), we found trust and cooperation at the community scale promotes individual adoption of soil and water conservation practices. We submit that low trust can act to sharpen contrasts on landscapes of patchwork multifunctionality.

From our research we learned that many problems associated with modern industrialized agriculture can be attributed to the patchwork nature common to multifunctionality, and can be remedied through concerted efforts at an integrated approach. However, we also learned that patchwork boundaries are sometimes so brightly defined that there are great impediments to an interweaving of the landscape. Land use policies, such as municipal zoning rules, regrettably in some circumstances can strengthen the barriers and further hinder multifunctionality. We propose that some farms

can move toward interwoven multifunctionality by addressing collaborative intentions on an individual scale. However, in order to truly become interwoven (represented by the far right of the spectrum in Figure 1), farmers must broaden the set of intentionalities guiding the deliberate creation of public goods by working with other actors, especially adjacent property managers. We suggest policy changes that can better facilitate interwoven multifunctionality through collaborative, action-oriented processes.

[Figure 1 about here.]

3. Case Study Methodology

To implement our action-oriented process, we selected two case study watersheds with landscapes reflecting the centralization and homogenization of Corn Belt agriculture (Friedmann 1982; 1990). Both watersheds contained water bodies officially designated as impaired from phosphorus runoff (EPA 2011). We worked primarily with family farmers, defined as farmers who work on their own farms or rented land, and do not hire wage labor. In a few instances, farmers did employ wage labor, but continued to work alongside their employees. To protect the identities of our participants, we use two fictional names representing Midwestern states to describe the locations of our watersheds: Ruritania and Agraria. We also use pseudonyms to refer to specific participants.

At the time of our study, corn and soybeans comprised approximately 90 percent of the land use in the Agraria watershed, and about 60 percent in the Ruritania watershed (FSA 2010). An additional 15 percent of the Ruritania watershed was used for other

agricultural purposes including pasture, vegetable production, and forestry (FSA 2010). Land competition was high in both areas. Cash rental rates averaged nearly $200 per acre in the Agraria watershed, 90 percent higher than the national average in 2010, compared to $130 per acre in Ruritania (NASS 2010). In Ruritania, livestock operations comprised nearly 55 percent of the agricultural market compared to 10 percent in Agraria (USDA 2007). Ruritania hosted a diverse mix of rural residential land, farmland, nature reserves and other scenic and social amenities that attracted exurban development from major metropolitan areas. Tensions flared at the exurban-rural interface, and local zoning hearings are front lines of conflict between local residents. Since Agraria lies in the heart of the fertile Corn Belt and a long distance from any large city, agricultural use of the land was seldom contested in this way.

Our experimental process entailed a series of four meetings with what we term "action cluster" groups that represented general categories of intentions on the landscape. The action cluster methodology is based on participatory action research, a social research paradigm that aims to promote collaboration between researchers and participants to produce outcomes that are more just and useful for the participants (Greenwood and Levin 1998). Participatory action research is closely tied to the holistic methodology of agroecology, oriented around local problem solving processes among farmers and other alternatives to top-down institutional approaches often employed for land use change in agriculture (Cuellar-Padilla and Calle-Callado 2011). In this study, we acted as facilitators through interactive action research on phosphorus pollution, guided by participant-driven solutions based on multifunctionality.

We facilitated a process involving the four clusters—farmers and landowners, community members, government representatives, and academics—using a case study methodology intended to explore opportunities for individual and collaborative public good enhancement (Poteete et al. 2010). For a more detailed description of the action cluster methodology see Ashwood et al. (2011). We focus our discussion in this paper on the results of our first action cluster meeting with farmers and landowners in both watersheds, and our subsequent interviews with some of these participants. The two-hour meetings were akin to focus groups in that they were oriented around small and large group discussions (Patton 2002). Participants worked in groups of four to six to identify strategies to address the phosphorus pollution to improve surface water quality and promote multiple benefits. Then, the large group reformed and consolidated repeated strategies that were subsequently voted on. The top vote recipients became the representative strategies of the Agraria and Ruritania farmer and landowner action clusters. Participants also completed anonymous evaluations at the end of the meeting. In Agraria, 45 individuals attended the meeting. In Ruritania, 35 individuals attended.

After the meetings, we interviewed participants individually. We selected interviewees initially by asking farmers and landowners at the end of the action cluster meeting. After these first interviews, we then employed snowball sampling to select farmers and landowners who were invited to, but did not attend, the meeting based on three criteria: farmers renting land from landowners who were interviewed; neighbors of interviewed farmers with cross-boundary opportunities or disputes; and farmers that other participants had identified as disproportionate polluters in the watershed. We completed 45 interviews in Agraria and Ruritania using a semi-structured interview form. We

analyzed interviews and action cluster focus groups through transcription, coding, and network mapping (Emerson et al. 1995).

Our action cluster process revealed participants' abilities to design and implement multifunctional land use changes to reduce water pollution and produce other benefits. We traced through this process land use changes implemented by participants that crossed property boundaries and the utilization of other collaborative, interwoven solutions. During the focus group meetings, we asked participants to answer one question: How can we reduce the phosphorus in [water body] with multiple benefits? Participants then designed, in their own language, solutions to non-point water pollution. During individual interviews, researchers worked with participants to find specific ways of implementing those solutions on their farms. This two-step process provided a test trial for multifunctionality as a participatory action research tool that can be employed to address specific public good dilemmas, such as water quality. Unlike existing approaches in conservation and agricultural policy that focus singularly on problems, we used multifunctionality as an alternative paradigm by asking participants to think holistically about multiple benefits throughout the group meetings and interviews.

4. Results

Critics seldom conceive of corn and soybean agriculture as compatible with multifunctionality, and often approach 'conventional' farming as its adversary. As one government official commented in our research, these landscapes represent, "you know, the corn-soybean desert." During our case study meetings and interviews, we learned otherwise. In both Ruritania and Agraria, several farmers were working toward versions of multifunctionality far more nuanced than these monological conceptions of the Corn

Belt. Many of the farmers we encountered during our research demonstrated a capacity for interwoven multifunctionality. Other farmers paid less attention to external contexts of land and community in shaping their farm management practices, but nonetheless often created public goods through patchwork multifunctionality, such as small woodlots that provide wildlife habitat.

Our results were even more surprising when we examined the differences between the two watersheds. In the more diverse Ruritania watershed, literature would suggest multifunctionality ought to thrive (e.g. Wilson 2007). However, we found that farmers and landowners in our Ruritania case study found it very difficult to work together collectively to develop interwoven solutions across fence lines, reflecting the polarizing influences of social heterogeneity and the institutional entrenchment of boundaries. Contrary to our expectations, the less diverse Agraria landscape better facilitated interwoven multifunctionality through collaboration between neighbors. The bounding together of Agraria grain farmers and landowners by their shared interests enabled their collective capacity to creatively develop pathways to interwoven multifunctionality. These different results lend support to prior studies that have shown socioeconomic heterogeneity can reduce trust and cooperation, limiting potential for collective action in resource management (Ostrom 2005, Bouma et al. 2008). Our research also shows the polarizing impact of landscape heterogeneity (of both social and biophysical characteristics), and how it can thwart opportunities for interwoven multifunctionality.

4.1. Stitching the Patchwork

Threads that bind and tie people together weave in and out to form the complexity of the landscape. When threads are broken and conflicts flare, interwoven multifunctionality cannot be cultivated across a landscape, and instead develops within individual farms bounded by private property lines. Before farmers and landowners ever gathered in the same room for our action cluster meetings, we learned that these threads of common intentions must be intact for multifunctionality to weave across a landscape. Farmers and landowners in the more diverse Ruritania watershed began to call Harden and Ashwood as soon as they received their letters of invitation. Landowner Charlie was in a fit of rage about a manure lagoon in the watershed, which he referred to as a "shit pond…right by the creek!" Charlie's angry phone call was only the beginning.

After a brief hello, grain farmer Tim launched into a long tirade of grievances against a nearby farm: "I've been waiting for this moment for years!" He cursed the hog farmers who farmed next to him, saying "the little shits" applied tons of manure on limited acreage directly next to the polluted water body. When he approached the confinement operators to tell them to stop polluting the creek and killing his corn with the 'hot' manure, "They told me to stick it where the sun don't shine," he said. Despite his unsuppressed anger over the phone, Tim explained he would not be so forthcoming at the meeting with other farmers and landowners: "I mean I can come if you want me to, but I don't really want to stand in front of a bunch of people and say that." After a different individual told us that a restraining order had been filed against him for punching a dairy farmer, our anxiety intensified. We wondered if fights would erupt when forty of these people were sandwiched into one room. Standing in stark contrast, our invitations in Agraria were greeted with polite phone calls of acceptance or decline.

After our meetings in Ruritania, the angry phone calls about farmers with large animal feeding operations continued. Charlie reported one day that a neighboring farmer, and his "poopy trucks," were spreading liquid manure right next to the polluted water body, and "not even plowing it under." These complaints highlight the obtrusive nature of some animal feedlots, which often feature the highly visible and pungent storage of a large amount of manure, and at times the application of that manure in environmentally sensitive areas. The controversy over these operations in Ruritania was amplified by the landscape of stark social contrasts, in which large dairy and grain farms, small organic farms, and rural and exurban retirees exist side-by-side. These contrasts produce a patchwork of multifunctionality – landscape variety, agritourism, hiking, fishing, and agricultural production – in which individual differentiation prevails, and common threads between neighbors are often broken.

Patchwork multifunctionality often arises when farmers focus on prevalent threads of a social and ecological landscape quilt, and do not take up opportunities to interweave practices within the farm and across property boundaries. Livestock farmer Gus spoke of the profit thread frequently during the interview, but struggled to interweave it with other practices on his farm: "A farmer will grow anything if he can make a profit on it. Corn seems to be the best bet, so that's what you grow." Throughout our interactions with Gus, he maintained two threads: producing to make money, and rigid government programs. For example, he described a field that needed a filter strip, but said he could not afford it, in part because it fell outside the financial support of a US Department of Agriculture program: "This [field] didn't qualify for that filter strip [program] because it's in hay too much of the time. So when you want to put it into corn,

you farm right up to the drainage ditch, because you can't put a filter strip in." In this case, Gus's reliance on an inflexible program that focuses on farm-by-farm initiatives, as well as specific interpretations of profitability and success, prevented him from weaving more perennials into his farm system.

Gus was not blind to the frayed threads of the patchwork that he helped comprise, but he felt near the physical and emotional limit of what he could do about them. Gus described not being able to take a vacation, and working long hours, every single day of the year. Gus also spoke of the personal freedom of farming, but could not avoid the unpleasantries of a dairy farm, like the dead calf we stepped around during our walk through the barn, or a gruesome accident in the machine shed. Perhaps this lifetime of experiences caused Gus to expect tolerance from his neighbors about the stench of his manure lagoon, saying, "What the heck am I going to do about a smell? Some people are just stupid." His dismissal of other community members' complaints about the manure lagoon exemplifies his tendency to focus internally and to ignore the extension of landscape threads beyond the boundaries of his own farm.

At the end of his interview, however, Gus softened his attitude toward community members: "I suppose that community relations is probably a good thing. I'm probably not very good at it because I don't really care what some people say. A lot of people don't have too much common sense, you know. But no, I imagine that if … you keep your place looking nice, and you keep the road scraped off, I know all of that stuff is a good thing, and being proactive would make people think you are doing a better job. That makes sense." Gus ultimately acknowledged his embeddedness in the community, as well as the problems that it sometimes caused. However, Gus enacted practices and

relationships that further entrenched the division between himself and his neighbors, placing the multifunctionality in which he participated far at the patchwork end of the spectrum. Patchwork multifunctionality is rife with internal and external tensions, and farmers like Gus are in a constant struggle to tend to the most frayed threads at any given moment, producing temporary or problematic solutions – patches – that can create more problems than they solve.

While Gus focused on barriers presented by state and national governmental institutions, his neighbors and many other Ruritania residents pointed to local zoning politics as the primary obstacle to interwoven multifunctionality. Land use zoning policies are intended to promote a coordinated landscape and prevent incompatible land uses from occurring adjacent to one another. However, the micropolitics of zoning sometimes produce an unfortunate side-affect when they constrain the evolution of attractive interwoven models of multifunctional land use. Jeff, the owner of agricultural land and a local restaurant in Ruritania, discussed his rejected proposal for an agritourism milk processing facility: "It was supposed to be a destination point…. [with] a restaurant, a little museum, a cheese factory for people to witness cheese being made." The facility could have been a collaborative project far on the interwoven side of the multifunctionality spectrum in Figure 1, but, as Jeff explained, "The community wasn't ready for it…. The modern techniques are not in the codebook yet, and to get those approved by the village board is horrendously expensive." The project's possibilities for interwoven multifunctionality – simultaneously promoting the rural economy and local culture, and educating the public about renewable energy including wind, solar, and

geothermal – were rejected by the zoning board. The rigidity of existing administrative codes made this potential example of interwoven multifunctionality prohibitively costly.

Because they are often implemented in a top-down way – rife with conflict between local networks of actors, and missing a serious effort to engage local knowledge through a more participatory process – zoning and other attempts to "design" rural landscapes often fail to prevent incompatible land uses from occupying adjacent spaces on the landscape. Contention over zoning at times prevented Ruritania landowners from exercising shared multifunctional intentions or working to reduce their own contribution to the phosphorus pollution. Landowner Steve spoke of his frustrating efforts to prevent Francisco from building a new confinement building near the creek through fruitless testimony at the local zoning hearing. At one point during our interview, Steve even professed, "I'm not positive, but I think there are payouts under the table," in reference to the county zoning committee. This concern also came up at Steve's table at the action cluster meeting. Ruritania landowner Diane complained of the futility of efforts to change the practices of local dairy farmers, describing it as an "old boys' network." This divisiveness and perceived corruption does not encourage the very coordination and interweaving of a landscape that zoning is often hoped to provide. In such circumstances, formal rules and procedures are susceptible to micropolitics and become tools for participants to defend their competing spaces, rather than weave threads of synergy. Zoning policies entrenched division in our Ruritania watershed, thus constricted multifunctionality to patchwork forms.

We were surprised, however, to encounter more opportunity for collaboratively interwoven multifunctionality in the Agraria landscape of corn and soybeans. The action

cluster meetings provided an opportunity to evaluate the potential for farmers and landowners to reach consensus on causes and solutions to the water pollution. It was the first step in our search for interwoven multifunctionality across property boundaries. The strategies selected by participants at the end of the action cluster meetings are indicative of the contrasting patchwork and interwoven forms of multifunctionality that we encountered in our two cases (Table 1). In Agraria, farmers and landowners took ownership over soil erosion as the main contributor to the pollution, and selected strategies that pertained to farm practices and would create multiple benefits (Table 1). A number of farmers in Agraria spoke of the multiple benefits of cleaning up the impacted water resource in a response to an evaluation question after the meeting. One farmer or landowner wrote: "Yes, I can benefit. Everybody can benefit. Clean water is getting harder and harder to come across, so it is very important to keep the water we have CLEAN" (original emphasis). The top strategy in Agraria of "soil erosion control" demonstrates the collective sense of responsibility expressed in the action cluster meeting. By designating this as a top strategy for pollution by a wide margin, farmers stood in agreement that soil from their fields was a major contributor to the phosphorus overload.

[Table 1 about here.]

In Ruritania, the farmers and landowners' comparably lukewarm sense of responsibility was evident in the top strategy of "more monitoring" (Table 1). One farmer expressed this lack of commitment in an evaluation response: "I do not think it is possible to 'clean' up the [water resource] completely." Farmers generally struggled to demonstrate a sense of personal investment in cleaning up the water, and used the "more

monitoring" strategy as a way to focus the blame for the pollution on a neighboring rival, large livestock feeding operations, or industrial sources in the watershed. Ruritania farmers and landowners also stressed the importance of getting more information about urban and residential phosphorus sources, and raised the prospect of restricting residential phosphorus — all forms of deflecting responsibility.

4.2. Crossing the Fence Line toward Interwoven Multifunctionality

Nothing exemplifies the separation of ownership, control and division as powerfully as fence lines, but Agraria farmers were able to work across them. Farmers in the Ruritania watershed were hindered by the division between neighbors and categories of farmers, and therefore unable to work together, or even collectively agree on the source of the problem. Large livestock operations in particular were a major source of contention that entrenched divisions between neighbors. Agraria did not host any large animal feeding operations. With few exceptions, livestock farmers in the watershed owned very small herds. The Agraria grain farmers, unlike those in Ruritania, had no concentrated source of phosphorus next door that made their own contribution to runoff appear relatively minor, and thus lessen their sense of responsibility for the problem.

Agraria farmers set to work to address the pollution through thoughtful discussion, as reflected in the strategies voted in as the top ways to reduce phosphorus pollution in the watershed. Working together was inherent in their identification of solutions and their current farming methods, as Andy, a young farmer in Agraria stated later in an interview: "You could have your farm totally pattern tiled and great drainage, but if your farm is lower than the other neighboring farms and they don't want to do anything, then all that water is just coming down on you. So everybody kind of needs to

get on the band wagon if they really see problems with runoff, and all work together." Andy's understanding of connections and openness to collaborative possibilities between farms recurred throughout our experience with Agraria grain farmers.

Discussions about soil testing in the action cluster meetings exemplified the constraints to collaboration in Ruritania versus the opportunities through shared intentions in Agraria. In Ruritania, Phil, a large dairy farmer, responded to government funding of soil testing: "Sure, somebody else can pay for it so we won't have to, right?" Gary, a cattle farmer, echoed, "That'd be great." Dave, also a dairy farmer, joked, "Charge it to Obama." The room erupted in laughter. Landowner Henry chipped in, "Just print more money!" While the participants may have agreed that soil testing should be done to promote the public good, they were disengaged and made a joke of the funding discussion. As with the individual interviews, these farmers and landowners did not interweave their own intentions with those of their neighbors, and their responses remained loose threads.

In Agraria, as the consolidation of a soil testing strategy with the option of state funding was debated, the farmers and landowners collectively wove an understanding of soil testing into a plan for action. Shawn, a grain and beef cattle farmer, disagreed with state funding of soil testing, responding that, "It's what, three to five dollars per acre. I don't think it's that big of a deal to pay for it yourself." Jim, a grain farmer, said, "You're talking about our basic business." The group moved quickly to implementation, discussing the need to have a single laboratory do all of the testing. The room exploded in conversation, everyone talking about the possibility of different labs doing incorrect tests. Ashwood finally called the debate to a halt, asking for a show of hands to see the final

vote on whether or not the soil tests strategy should include funding from the state. Not a hand rose in favor. The farmers and landowners had interwoven their knowledge to collectively refuse state funding because they identified it as their own stewardship responsibility, and instead focused their conversation on which labs they should use. The differences in the soil testing consensus process are emblematic of the possibilities of collaboratively interwoven multifunctionality in the Agraria case study, and the limitations in the Ruritania case.

After the meeting and in subsequent individual interviews, many Agraria farmers expressed an openness to collaboration, including Larry: "I think a lot of people who were at the meeting last night would be willing to work together." Many of these conversations were hypothetical, but one collaborative grassed waterway project emerged from the action cluster process and subsequent conversations between Joe and Mike. Joe discussed the potential solution to the "trouble spot" on his farm: "Ideally, the grassed waterway needs to go clear to here," gesturing on the map at his neighbor's field. When asked what he thought of working with the neighbor, he responded, "…if Mike decides to do a waterway, I would do my part and finish it….it'd be good for both of us." Harden asked Mike a few days later about the project. He responded without hesitation: "If [Joe] wanted to work on it now, I wouldn't even be opposed to …destroying some beans in that area." When asked if he would be able to use the grass, Mike thought for a moment, and then said, "I don't think that would be a problem, Joe's son-in-law has cattle." The two farmers took ownership over their contribution to the problem without contestation,, both reconceptualizing the boundaries of their farms. The two farmers exemplify collaboratively interwoven multifunctionality through their integration of a grassed

waterway, crossing the normally rigid fence line of private property and each trusting that the other farmer would maintain his end of the waterway.

In contrast, Ruritania farmers maintained conceptual fence lines when collaborative solutions were presented to them. Trying to probe possibilities for collaboration, Harden asked Tim, a Ruritania grain farmer, if animal waste from nearby operations could be linked to grain crops as an alternative fertilizer to reduce manure runoff. Tim had just described the "hot spots" in the watersheds, where he thought manure from a nearby livestock operation was polluting the creek. He said, "two little guys…their whole goddamn lot basically cleans itself, and where does it go? Right in the crick!" When Harden asked Tim is he would ever use the neighbor's manure on his own farm, Tim explained that although most of the livestock farmers "are good boys," he would not use his neighbors' manure on any of his own fields, because the farmers were "too arrogant to work with." Significantly, he added, "Why would I pay for their manure? It's *their problem*" (emphasis added).

Tim was difficultly positioned. He could take the manure from the local polluters and try to help clean up a problem they initiated, or he could continue to purchase fertilizer mined from a great distance. The hog operation outraged Tim because he perceived it as personally injuring him, and polluting the swimming and fishing resources of the community. The injustice of the polluting operation hung heavily for Tim, and it solidified a barrier between himself and the other farmer, stagnating the potential for resolution. This context of polarization left his farm fragmented from others, unable to sustain interwoven multifunctionality. In contrast to the example with Joe and Mike, Ruritania farmers like Tim chose to pursue solutions that entrenched, rather than crossed,

fence lines. This example demonstrates how general landscape heterogeneity, without specific attention to the types of farms and uses of the landscape, does not necessarily deliver multifunctionality. As our research shows, large animal feeding operations can reduce cooperation and trust even between neighbors with similar socioeconomic traits.

In contrast, farmers in Agraria showed a sense of co-ownership of the public good from our very first meeting. The immediate success of our research process in Agraria was first expressed by farmers after the meeting. As Derek, a landowner and fertilizer dealer said, "The meeting was excellent....The best thing you did at the meeting was the group of people that you got to help with this. Because you were lucky enough to get a top notch group." Grain farmer Danny echoed this sentiment directly after the meeting, pulling one of us aside and saying, "This is the best meeting I've ever been to." Another Agraria farmer or landowner (we couldn't be sure which), in response to an evaluation question about whether there would be additional benefits to cleaning up the polluted waterbody, wrote: "Yes. Seen as connecting with community leaders and people, particularly if farmers are proactive in attaining results." In Agraria, many farmers conveyed this self-awareness of the implications of public good provision, including the community perception of their actions. This sense of ownership of the public good exhibited by private landowners and farmers in unexpected places is an essential tool for interwoven multifunctionality, in theory and in practice.

After the meeting in Ruritania, no one told us that it was the best meeting they'd ever attended. In fact, the sentiment was the opposite. One landowner even apologized on the phone the following day, saying "I felt bad about you getting attacked last night," referring to the anger and contestation at the meeting that had been occasionally directed

at Harden and Ashwood. The pursuit of more monitoring continues in Ruritania, but government representatives and academics are the proactive clusters cleaning up the creek, while farmers and landowners have faded from the process. While some Ruritania farmers were able to rearrange their farms to accommodate the intentions of others on the landscape, they did not cross any fence lines toward collaboratively interwoven multifunctionality as the Agraria farmers did.

Trust and homogeneity helped Agraria farmers and landowners take collective ownership of the public good (see Table 2). Previous instances of cooperation in Ruritania sometimes led farmers to work together more, but also produced negative outcomes. Overall, farmers in both watersheds remain strongly independent. Competition reduced trust between farmers, but also prompted farmers to try to outdo one another through their conservation efforts. In Ruritania, trust between neighbors was low to nonexistent; neighbors testified against one another at zoning meetings, spoke of one another in strings of profanities, and in some cases carried with them past histories of interpersonal violence. Competition existed between developers, rural residents, and farmers, rather than primarily between farmers as in Agraria. In Ruritania, previous instances of cooperation occurred during hay cutting, for example, but did not always produce opportunities for collaboratively interwoven multifunctionality.

[Table 2 about here.]

Interwoven multifunctionality continues in the Agraria watershed through collaboration amongst the leading farmers in the process. The Agraria farmers remain actively involved as of August 2012. They are currently working on planting a small

perennial bionenergy crop in a strategically identified area to produce local energy and reduce soil runoff on land adjacent to the water body. The new relationships created by such an arrangement, as well as the other rearrangements on farm landscapes described here, indicate the emergence of new social configurations and a conceptual deconstruction and reconfiguration of the boundaries between farms.

In both watersheds, we found examples of individually interwoven multifunctionality. The diverse Ruritania case study illustrated why multifunctionality can be limited to patchwork variations on landscapes of high contrast. However, some individual Ruritania farmers exemplified the application of interwoven multifunctionality on an individual farm. Farmers diverged from the land use choice made by neighbors for a number of reasons. Jake is a Ruritania livestock farmer who practices rotational grazing of cows, goats, and chickens on 200 acres of pasture, a practice which provides many public goods, as many advocates contend – including Jake. His primary reason for this decision is the healthy subsistence of the family, since they provide "70 to 80 percent" of the family's food on the farm. Jake described how his practices reduced runoff and erosion as additional benefits, noting that the neighbor's ground "is so highly eroded…after it rained there were big gullies…. And I don't see that [on my farm]." Throughout the interview, Jake extolled several threads related to environment, health, and community that influenced his interwoven approach to farming.

Dave sat with Jake at the Ruritania action cluster meeting, but farms in a much different way. Dave grows corn and alfalfa for approximately 200 cows and farms more than 3,000 acres using modern equipment and chemicals, a style of farming not often associated with public good creation. During his interview, Dave described 35 acres of

land he set aside for a dog park: “This was our way of giving back a little bit too… to Mother Earth.” Dave also described another piece of set-aside land: “This farm over here, we took some of that and re-established wetlands, and built some natural ponds. And it’s a duck heaven now.” Dave explained that letting his friends hunt on the ground “goes a long way in the relationship with the people we work with.” These examples illustrate the opportunities presented for individuals to move toward the interwoven end of the multifunctionality spectrum through deliberate efforts to create public goods. Yet very few of the farmers in Ruritania, even the individuals like Dave and Jake, spoke of the possibilities of interwoven multifunctionality across a property boundary.

Matt and Brandon are two brothers in Agraria who farm about 1,000 acres and raise about 250 steers. Two weeks after our action cluster meeting where farmers discussed the phosphorus impairment, Matt and Brandon were still thinking about what they could do on their own farm to address the issue. Matt explained, “This is what concerns us: we have a feedlot, and a lot of the area right there is probably high in phosphorus. We try to do a better job of evenly spreading that.” Matt summarized a discussion that they had had after the meeting: “Brandon and I were talking about what we could do to possibly cut down a little on any possibility of soil erosion and any possibility of nutrients coming out of the feedlot.” Consideration evolved into action when the two farmers installed a stream buffer on their own, without the government programs that Gus had been reliant upon.

Actors like Dave, Jake, Matt, and Brandon take ownership of the public good, a key step on the path toward interwoven multifunctionality. In a property-bound world, the notion of ownership is often antithetical to the efforts to preserve the public good. The

property boundaries on a landscape create an infamous airplane-view image of a patchwork quilt that also represents a diverse matrix of uses, human intentions, and ecological contexts. Private property lines form a patchwork of multifunctionality, sometimes resulting in conflict. But multifunctionality is fundamentally a recognition of agriculture as a public good (Boody 2002). We encountered a strong sense of ownership over the public good throughout our process – not only private land ownership, but also a sense of ownership for the environmental or social consequences of individual land use decisions. This ownership is reflected in one grain farmer's self-identification as "a steward of the land that God has given us here. You can't let gullies wash away your farm." These examples of personal stewardship and responsibility remind us of notions of the "land ethic" and the "farmer as conservationist" that Aldo Leopold wrote about so famously (Leopold 1949; Leopold 1991), and remain essential elements of an interwoven approach to land conservation, even in the Corn Belt.

Discussion

Our application of multifunctionality recognizes that farms are comprised of a multitude of intentions that drive farmers' decisions, and that Midwestern 'monoculture' might be a rather narrow conceptualization. This multitude of intentions often includes a sense of ownership over the public good that is sometimes ignored in the context of farming as strictly business. Profits and yields are not the only motivations for farming; previous work has shown that other powerful intentionalities include commitments to the family, land, and community (Bell et al. 2004). Every farm is situated in an ecology of contexts (Bland and Bell 2007), including political, social, and environmental threads that construct the quilted socioecological landscape of the Midwest. All farms produce

agricultural goods, and they inevitably produce other consequences that reverberate along the threads of the social and ecological landscapes of the Corn Belt. A farmer cannot hold onto all of these threads at once on her own, so she focuses on a few, maybe family, for example, or yield, identity, stewardship, and so on. But our research clearly demonstrated that the notion that Corn Belt farmers are solely driven by economics and a productivist monoculture is an oversimplification.

Multifunctionality provides a pathway for solving environmental problems by weaving together the multiple intentions of actors in local contexts, more richly exploiting social and biophysical synergies. The sustenance of our action cluster process in both watersheds is encouraging. Different action cluster groups led the process forward, and like the farmers and landowners in Agraria, did so in surprising ways that confound popular farmer stereotypes. We too had our assumptions as we began this project: that our corn and soybean landscapes would only support patchwork variations of multifunctionality, while interwoven multifunctionality would be more likely to thrive in a diverse landscape. The result in our two case studies turned out to be the reverse. These findings extend some of the research of economists and game theorists on the polarizing effect of socioeconomic heterogeneity (e.g. Ostrom 2005, Bouma et al 2008) by demonstrating that landscape heterogeneity, both social and biophysical, can act as an impediment to interwoven multifunctionality despite its assumed suitability for such diverse landscapes. Importantly, we found that differences in biophysical context and resulting differences in farming can override socio-economic homogeneity and impede the potential for collaboration.

Just as we have had to rethink our own assumptions about the limited potential of Midwestern 'monoculture,' we propose that government agencies, university researchers, and environmental advocates could become more effective agents of change in these landscapes through the same reflexive recognition of the nuance of these distinct ecologies of contexts and intentions. Agricultural scholars have frequently deplored the problems created by the decoupling of animal and grain production (Hudson 1994). Wendell Berry (1977) on the subject once chided, "The genius of American farm experts is very well demonstrated here: they can take a solution and divide it neatly into two problems" (p. 62). Proponents of multifunctional landscapes often presume, as we did, that diversification across an agricultural landscape will inevitably result in the logical recoupling of these systems, and the transformation of a waste product to a substitute for fossil fuel based fertilizers. But our work shows that a heterogeneous farming environment can create polarized social interactions, leaving individual actors unwilling to work with others. Conservation professionals should recognize the potential for landscape diversity to create conflicts that prevent implementation of Berry's elegant solution, rather than lead to it.

Our research revealed other lessons for professionals in conservation and agricultural policy. Conservation measures may be more effective if they consider that multifunctionality should also benefit the farmer, and that private farms and public goods are not mutually exclusive patterns on the landscape. The Conservation Reserve Program (CRP) is an example of a policy that would benefit from this advice. Although this program was the second most popular strategy selected by farmers and landowners in Agraria, no farmers in the room that night, or during interviews, professed to use the

program. Farmers cited difficulty signing up for the program due to strict qualifications and restrictions on use of the land. Programs like the CRP should allow for local flexibility and recognize that farmers are more likely to take action within a framework of multiple benefits and collective action. Our study indicates that community and educational tools that promote collaboration amongst farmers, like the Dutch environmental cooperatives, could yield positive results on the Corn Belt (Franks and McGloin 2007).

The lessons to be learned are not all easy ones. The conflict across the landscape in Ruritania created tension during our process, although it did not derail our work completely. The group meeting participants veered from the task of multifunctionality, while interviews revealed potential for individually interwoven multifunctionality in an array of creative forms. In a context of conflict like the Ruritania example, working towards multifunctionality on a farm-by-farm, patch-by-patch basis may be the most practical way forward for actors promoting conservation and other public goods. Perhaps with time, these efforts these could even achieve a degree of interweaving through careful encouragement and support by agencies, researchers, and advocates. The Ruritania farmers and landowners demonstrated that multifunctionality in its current conception as a patchwork configuration across the landscape is reinforced by institutional barriers and high contrasts that create land use conflicts. These challenges often prevent collaboratively interwoven multifunctionality from ever reaching the ground.

The bigger surprise from our research may be the potential for landscapes of corn and soybeans to support interwoven multifunctionality. The grain farmers and landowners in our study have taught us that multifunctionality exists throughout the Corn

Belt. The farmers who were able to move toward interwoven multifunctionality exhibited a degree of shared ownership over the public good that motivated their efforts to weave public good creation into the landscape of the farm, rearranging its composition to produce benefits for the community and environment. The farmers in Agraria were able to move collectively toward a vision of interwoven multifunctionality at the landscape scale, working collaboratively to plant perennial bioenergy to provide local energy, habitat, and water filtration.

Conclusion

Our study provides two important lessons about multifunctionality in the Corn Belt. First, multifunctionality already exists in many forms on the Corn Belt landscape, but in a patchwork formation. Conflict and heterogeneity entrench this patchwork, as the Ruritania case demonstrates. Heterogeneity provides rich opportunities for individual farms to exploit niches for multifunctionality, such as small-scale organic products sold through a local co-op. Yet this individual farm heterogeneity remains confined to individual property lines, serving as a barrier to collective action and interwoven multifunctionality. The objective for conservation and other professionals should not be to reduce heterogeneity, but rather to work within these individual action spaces that are more conducive for multifunctionality.

Second, our study demonstrates how less heterogeneous, but still highly competitive, farm landscapes can provide rich opportunities for collectively interwoven multifunctionality. The relatively homogeneous landscapes of Agraria do not denote monofunctionality, nor is the Corn Belt simply a monoculture. Homogeneity enabled the expansion of the action space to include neighbors and other farmers in the watershed.

Conservation professionals should recognize the opportunities presented in our Agraria case, in which farmers worked together to achieve multifunctionality across and on their farms, and demonstrated capacity for collective action.

As we conceive of possibilities for multifunctionality in the future, drawing on the shared contexts and intentions of corn and soybean farmers as a collective offers opportunities to bring objectives back into the countryside that researchers actively seek: local knowledge, maintaining natural process, and improving human welfare. By understanding from the start that multifunctionality can appear in places stigmatized as monoculture, can be a difficult challenge in more diverse landscapes, and can be valuable in both patchwork and interwoven forms, the rich opportunities presented by the notion of agriculture as a public good can be more surely achieved.

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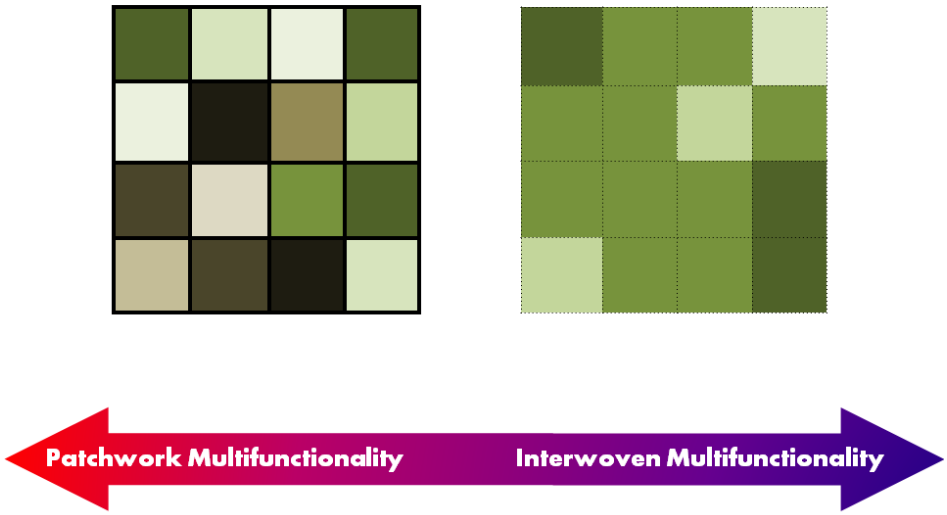

Figure 1: Multifunctionality exists along a spectrum. Patchwork multifunctionality is characterized by private landowners making individual decisions within their own property boundaries, which produce public goods primarily as positive externalities (represented by distinct shades and thick borders between cells). Interwoven multifunctionality is characterized by collaboration between property owners with deliberate efforts to produce public goods (represented by more similar shades and more porous, or dashed, borders). Individuals can move along the spectrum toward interwoven multifunctionality when they deliberately produce greater public goods within a farm through thoughtful integration. However, farms can only become truly interwoven, or reach the far of the multifunctionality spectrum, when they work across property boundaries with other farmers and landowners to produce public goods at the landscape scale.

Table 1: Top strategies selected by farmers and landowners at the action cluster meetings in Agraria and Ruritania. Strategies have been rank ordered based on vote totals.

Top Farmer and Landowner Strategies		
	Agraria	**Ruritania**
1	Erosion Control	More Monitoring
2	Conservation Reserve Program	Erosion Control
3	Conservation Tillage	Fertilizer Application Methods
4	Bioenergy Production	More Information
5	More Information	Restrict Residential Use of Phosphorus

Table 2: General levels of trust, cooperation, competition, and heterogeneity exhibited by farmers and landowners in Ruritania and Agraria.

Characteristics Impacting the Multifunctionality Spectrum		
	Agraria Farmers & Landowners	**Ruritania Farmers & Landowners**
Trust	Moderate	Low
Cooperation	High	Low
Competition	High	High
Heterogeneity	Low	High

Author Biographical Sketches

Noelle Harden is currently teaching an online class and finishing a Sustainable Food Production diploma program at Minnesota State Community and Technical College in Fergus Falls, MN. She graduated with an M.S. in Agroecology in the summer of 2011 from the University of Wisconsin-Madison. Since that time, she has also been involved in community organization and outreach with the White Earth Land Recovery Project and Probstfield Historic Farm in west central Minnesota.

Loka Ashwood is currently a dissertator in the Community and Environmental Sociology Department at the University of Wisconsin-Madison. Her research interests include agro-food systems, participatory action research, rural social movements, and environmental justice.

Michael M. Bell is a Professor in the Department of Community and Environmental Studies and the Gaylord Nelson Institute for Environmental Studies. He serves as Director of the Center for Integrated Agricultural Systems.

William Bland is a Professor of Soil Science and of Environmental Studies, and a member of the Agroecology Program faculty, at the University of Wisconsin-Madison.