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IN THE FIELD

Rooted in grass: Challenging patterns of knowledge exchange as a means of fostering social change in a southeast Minnesota farm community

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Abstract. By convening a multidisciplinary team (the Monitoring Team) that included farmers, university and agency researchers, and non-profit staff; a small group of farmers in southeast Minnesota, U.S.A., bolstered the legitimacy of the sustainable agriculture movement. Through the experience of forming a team and working with individuals who operated within the mainstream knowledge paradigm, farmers gained validation of their knowledge about farming, while researchers came to value alternative knowledge systems. In the context of a socially embedded movement, farmers were empowered by sharing their knowledge with researchers, and ultimately contributed to the sustainable agriculture movement by challenging traditional patterns of knowledge exchange.

Key words: Embedded hierarchy, Knowledge community, Participatory research, Social learning, Social movement, Sustainable agriculture

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> *Grass is the forgiveness of nature – her constant benediction. Fields trampled with battle, saturated with blood, torn with the ruts of cannons, grow green again with grass, and carnage is forgotten. Streets abandoned by traffic become grass grown, like rural lands, and are obliterated. Forests decay, harvests perish, flowers vanish, but grass is immortal.*
>
> – Senator John J. Ingalls, 1872

Introduction

In this paper, we study the efforts of a small group of farmers to reclaim an independent and innovative approach to farming in the 1990s. First, we examine the rise of the sustainable agriculture movement in the United States. We then turn to knowledge creation and validation at the group and societal level and consider how alternative knowledge emerges. Lastly, we explore a case in which the creation of a participatory research group, the Monitoring Team (MT), gave farmers in southeast Minnesota the opportunity to share their knowledge with broader society, and to garner the resources and legitimacy necessary to forward the agenda of the sustainable agriculture movement.

Rise of the sustainable agriculture movement

Throughout much of American history, farmers were viewed as knowledgeable individuals and admired for being self sufficient, innovative, productive, and hard-

working (Danbom, 1986). As Thomas Jefferson once said, "those who labor the earth are the chosen people of God, ... [and are endowed with] substantial and genuine virtue" (Danbom, 1986). Today, small farmers in the United States are fighting a losing battle to keep their livelihood (Cochrane, 1999). Between 1987 and 1998, the number of farms in the state of Minnesota fell from 92,000 to 80,000. Just over 1,000 farms a year have been lost (MDA, 1999). Since World War II, there has been a general trend towards larger production units, corporate land ownership, mass migrations to urban areas, and the decay of rural towns (Dahlberg, 1986). While a wealth of new technological information has been generated about how to improve farming systems, agriculture continues to contribute the single largest source of pollution to surface water, depletes critical sources of groundwater, and erodes away soil through cultivation of marginal land (NRC, 1989; Pimentel and Pimentel, 1986).

The sustainable agriculture movement arose to redress the environmental and social impacts of large-scale agriculture. As with other social movements, it grew because a diverse group of people shared interests that were incompatible with the existing social and political order (Foss and Larkin, 1986, in Dalton, 1994). Social movements are most often the result of both institutional and extra-institutional action (McAdam and Snow, 1997) aimed at challenging an accepted societal norm. For a social movement to succeed in changing mainstream society, individual groups or social movement organizations, must secure social and material capital from both inside and outside their organizations (Dalton, 1994). Through changing the way people think, what they know, how they act, and how they use their resources, individuals and institutions contribute to the slow process of challenging the status quo.

Patricia Allen, in 1991, defined the sustainable agriculture movement as "one that equitably balances concerns of environmental soundness, economic viability, and social justice among all sectors of society" (Hassanein, 1999). In general, people who identify with this movement are opposed to the industrialization of agriculture, support family owned farms over corporate farms, and are concerned with the long-term ecological health of the land (LSP/SFA, 1998; Hassanein, 1999; Duram and Larson, 2001). Correspondingly, advocates of sustainable agriculture, ranging from farmers to urban activists, often stress personal stewardship and the deep connection of a farmer to ecological processes. Institutions supporting this movement range from holistic learning centers, to farmer organizations, to university sponsored sustainable agriculture institutes.

The sustainable agriculture movement in the United States and Europe is related to a worldwide movement that strives to make agricultural research more effective through recognizing the value of local knowledge and participation in agricultural research (Okali et al., 1994). Robert Chambers et al. (1989) characterizes this "farmer participatory research" movement by describing a "farmer first" paradigm in which he encourages agricultural researchers and nonprofit representatives to view themselves as catalysts or consultants, aiding the farmers to adaptively generate their own information. Through building the capacity of community based research, this approach will ultimately lead to a richer and yet more localized understanding of the agro-ecosystem (Farrington and Martin, 1988). Despite a large body of literature that has characterized the nature and content of participatory relationships throughout the developing world, its use in community development projects in the United States is a relatively new phenomenon (Rutherford, 2000).

Background

The agro-ecosystem as an embedded hierarchy

A farmer resides and works within an embedded hierarchy of social and ecological structures (Berkes and Folke, 1998; Flora, 2001). Both ecological and social processes define the agro-ecosystem. The single farm is located within a watershed, which is nested within a larger network of different watersheds and ecoregions. Likewise, the individual farmer makes management choices while influenced by local farmer networks, which in turn are affected by the larger social, political, and economic system (Figure 1).

On the most basic level, human individuals respond to changes in the ecosystem, just as the ecosystem responds to human action (Figure 1). Thus, each layer in the ecological hierarchy is impacted by the social hierarchy and vice versa. This feedback loop has informed farmers for millennia. For example, a farmer makes a decision to heavily graze one pasture. This results in soil erosion, an ecological response. The farmer takes note of the ecological response and changes strategies. S/he will now move the cows from one pasture to another on a weekly basis. Farmer acts; ecosystem responds; farmer changes strategies.

Observing and taking note of changes in the landscape is the first step in knowledge construction, the process through which humans define and make sense of what they experience. The understanding of a single farmer comprises a "knowledge system," or stores of information an individual uses to understand and act in the world (Raedke and Rikoon, 1997). These systems

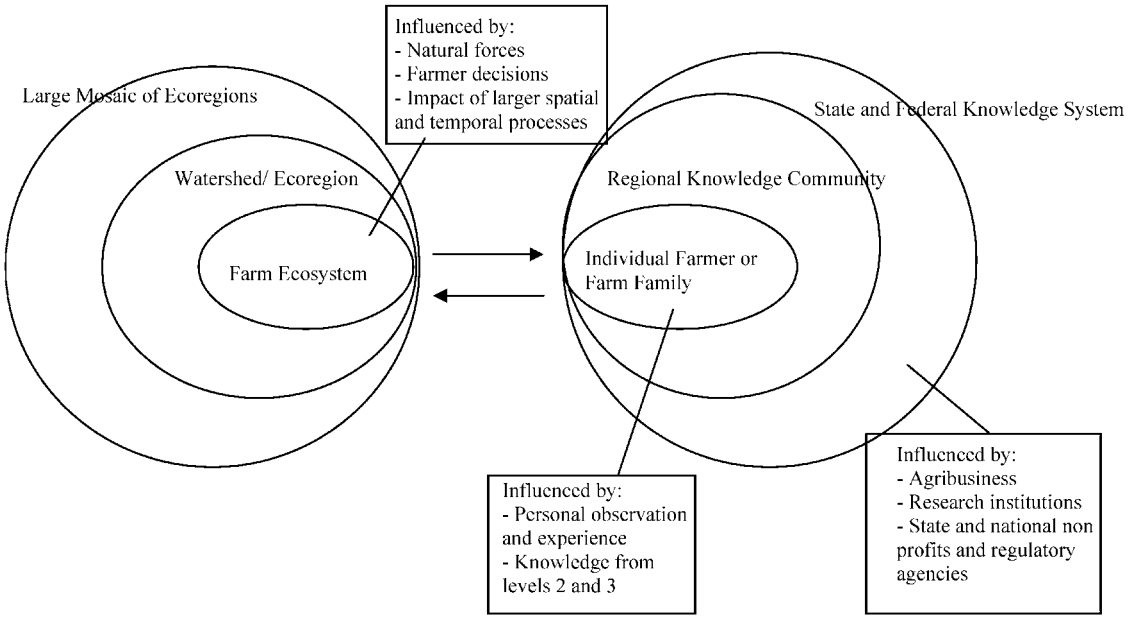


Figure 1. Social and ecological systems are structured in a nested hierarchy. Ecological knowledge resides in the link between each of the dynamic systems (Folkes and Berkes, 1998).

are embedded in knowledge communities, in which a dynamic network of actors constructs knowledge through the processes of exchanging ideas (Richards, 1993 in Raedke and Rikoon, 1997). These knowledge communities provide a forum a collective experience called social learning. Through relationships with others, understanding is integrated over space and time. Knowledge develops as these communities interact with the real world and communicate with other knowledge communities. For example, a farmer gains ideas by attending extension meetings, trade shows, watershed meetings, or just learning about the neighbor's strategies around the dinner table. He or she is also influenced by information coming from university research stations by state and federal regulatory politics, subsidy programs, economic markets, and the ebb and flow of new technology (Flora, 1998).

In the western world today, the dominant knowledge paradigm is associated with a reductionist approach to inquiry in which problems are reduced to the sum of their parts before an effort is made to predict a logical solution (Hassanein, 1999). This view of knowledge provides the foundation for the scientific inquiry that is both taught in secondary schools and conducted in formal settings such as research institutions. The general public in the United States supports this reductionist approach to knowledge generation and it has come to rely on scientific experimentation to create a "fix" for agricultural problems.

Knowledge generation does not happen in a vacuum, but is a social process. The way a society generates knowledge is closely linked to the way action unfolds at each level of the nested social hierarchy (Figure 1). For example, if the dominant worldview favors reductionist thinking, the majority of farmers who lose their wheat crop to wheat scab believe that scientific experimentation will be able to generate a "fix" for the problem. Instead of taking action themselves by observing and testing new approaches, they wait for a solution to come from a higher level in the embedded hierarchy (Figure 1), thus creating a demand for agricultural research. The university system learns about the widespread problem and subsequently receives federal funds to develop a "fix." Farmers adopt the new technology and produce wheat again, until the next problem arises.

Alternate knowledge paradigms emerge when the dominant paradigm fails to help a knowledge community act in the world. If, in the above scenario, some of the farmers realize that the cycle of relying on outside assistance is causing many to go out of business, they may begin to reevaluate their approach to knowledge generation. New knowledge communities begin to form, and new ways of thinking about farming are generated.

While knowledge is often a key to empowerment of an individual or knowledge community (Nelson, 1994), it does not always translate into action. The ability to act, and thus to experience and learn from the outcome of that action, is limited by both material reality defined by the resources available on landscape, and social reality defined by the communities in which we reside. Action is also restricted by the power dynamics that emerge within a society

(Giddens, 1986). For example, while individual farmers and farmer networks might understand that technological fixes to their wheat scab problem will provide only temporary relief, they are forced to keep planting wheat if they want to receive federal subsidies. Decisions made at a higher level in the embedded hierarchy control their actions. To gain control over their own decision-making, they must challenge the existing power dynamics and focus on creating a system that rewards small, independent, and self-sustaining farms.

Through the rest of this paper, we explore the efforts of one farming community in Minnesota who sought to gain legitimacy for farmer generated knowledge. We examine how these farmers reinvented their own relationship with the land, and how they subsequently shared their knowledge with a broader community as a means to alter power dynamics within the embedded hierarchy.

Farming in southeastern Minnesota

The southeast region of Minnesota was settled by pioneer farmers during the mid 1800s. Unlike most of southern Minnesota, the region is characterized by a diverse landscape comprised of flat agricultural uplands; steep, highly erodible bluffs; and narrow agricultural valleys. Farmers were attracted to this "blufflands" region by the rich uplands as well as the proximity to the Mississippi River. Unfortunately, the highly erodible limestone bluffs were not able to withstand the impacts of intensive wheat production and overgrazing during the early 1900s, and they experienced severe soil loss during this period. Depletion of healthy vegetation through overgrazing, followed by the subsequent soil erosion and flooding have resulted in whole towns being buried beneath sediment, such as in the lower reaches of the Whitewater watershed (Waters, 1977). Soil conservation legislation enacted during the 1930s has allowed much of the steep erodible land to be taken out of production. Erosion continues to be a problem, as more and more acres are devoted to corn and soybean production. Between 1974 and 1999 the percentage of tillable acres in soybeans climbed from 64% to 80% (Randall, 2001). While soil conservation incentives continue to protect the steepest part of the bluffs, the condition of soil and water in the area remains significantly impacted (Randall, 2001).

In Minnesota between 1987 and 1992, the estimated market value of farm machinery increased by 25%, from an average of $55,741 per farm in 1987 to an average of $69,859 in 1992 (USDA, 1992). In southeast Minnesota, as in regions across the midwest, the cost of agricultural technologies and chemical inputs, coupled with a tight market for agricultural goods, led many small farmers to leave the business (Cochrane, 1999; Berry, 1977).

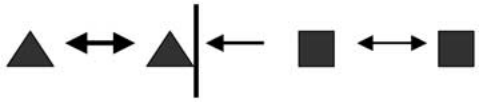
Knowledge exchange

During the early 1900s, farmers in southeast Minnesota were part of a rich information exchange network. Farmers operated within a rural community spreading ideas about farming across the landscape in a horizontal fashion: farmer to farmer. Without the help of genetically modified seeds or industrial machinery, farmers were forced to observe the local landscape and experiment with different strategies for keeping their farms in business. By and large, farms were smaller, more flexible, and more diverse than they are today. Paul Gruchow (1995) describes a traditional farm: "To each day and to each season, was dedicated a suitable labor, but no labor was ever exactly repeated. No year was ever the same as another, and each field had its own character. Farming the land was always new work, not repetitious but experimental, always unfolding, destined to never be completed." Knowledge was generated through observing the local landscape and adaptively changing strategies to respond to current needs.

Local township meetings, organized through the Farmer Institute of Minnesota, flourished throughout the region. In 1908, for example, 800 were in attendance in the town of Goodhue and 500 were in attendance in Dodge. At these events farmers relayed their experiences on the land. Topics such as how one farmer learned to control quack grass through planting millet (Smith, 1908) or how farmers developed a cooperative club for the purpose of providing a space where "farmers can come together ... regularly to discuss various questions" (Johnson, 1908) are recorded in a series of volumes titled: Minnesota Farmers' Institutes Annuals. "By their works ye shall know them," the 1908 edition boasts (Wilson, 1908). Indeed, in 1908 the knowledge of the farmer was critical to the development of farming innovation across the landscape (see Table 1 (A)).

Despite the establishment of agricultural research institutions during the nineteenth century, farmer-to-farmer knowledge exchange continued to thrive until the period of high production agriculture of the 1950s (Danbom, 1986; Hassanein, 1999). During the post World War II period, pesticides and fertilizers became readily available, bringing production levels to a new height. Transfer of technology, developed through the universities, began to surpass farmer-to-farmer knowledge exchange as a means of enhancing agricultural production (Danbom, 1986; Hassanin, 1999). Land Grant institutions, initially charged with aiding the

Table 1. Agricultural knowledge exchange within the embedded hierarchy. Arrows indicate the direction of information or knowledge flow. Farmers are represented with triangles, researchers with squares.

(A) 1900	Farmers produce and share knowledge within the farming community. Agricultural research is just beginning.	
(B) 1960	Researchers produce and transfer knowledge to farmers. The need for farmer to farmer knowledge exchange is eliminated.	
(C) 1990	Knowledge is produced and shared among sustainable farmers; knowledge from research community is intentionally blocked.	
(D) 1995	Monitoring Team farmers produce and share knowledge with other farmers and also with researchers. Researchers share less of their knowledge.	

farmer, began to focus on increasing production levels rather than guarding the well being of the whole farm.

With the advent of agricultural technology there was a shift away from small and independent farms, to large monocultures, in which the farm was dependent on agricultural technology (Danbom, 1986). Technologically complex information, generated through controlled experiments, was transferred vertically from agricultural researcher to farmer (Chambers, 1994; Scoones and Thompson, 1994). The average farm size increased considerably. New technology created emerging markets for products such as herbiscides and pesticides, which reduced the diversity of both crops and other flora and fauna on the landscape. High levels of fertilizers, created and sold by agribusiness, yielded extremely productive harvests for low levels of effort. As one Minnesota farmer reflected, single crop farming is easy to do, "You put it in the ground, you spray the weeds, and then you watch it grow for the rest of the year until harvest" (Corselius, 2000). Easier, maybe, but due to reliance on outside assistance, the community of farmers was no longer able to make the independent decisions that traditional farmers made (Berry, 1977; Roling and Jiggens, 1998). Roling and Jiggins (1998) describe a treadmill of innovation in which farmers who hoped to stay in the mainstream market had no choice but to keep up with the latest technology (see Table 1 (B)). While many farmers continue to rely on agricultural researchers, their lack of independence causes them to distrust those who control their success.

The Land Stewardship Project and the Sustainable Farming Association

In southeast Minnesota, as elsewhere in the United States, alternative approaches to farming began to emerge during the late 1970s and early 1980s. The Land Stewardship Project (LSP) was formed in 1982 to "foster an ethic of stewardship for farmland, to promote sustainable agriculture, and to develop sustainable communities" (LSP/SFA, 1998). Since the late 1980s, LSP has been working to promote an ethic towards farming that integrates the social, ecological, and financial well-being of Minnesota farms. They are committed to facilitating communication between farmers and non-farmer specialists by bringing together the knowledge and skills of many different types of individuals (LSP, 2001). Influenced by advocates of farmer knowledge worldwide (e.g., Savory, 1988; Berry, 1977; Chambers et al., 1989), LSP promotes a participatory approach to agricultural research.

During the late 1980s, LSP was instrumental in sponsoring a series of workshops in which Allan Savory worked with farmers and activists to promote ecologically sustainable farms. At these workshops, he shared the vision explored in his 1988 book, *Holistic Resource Management*. His method includes a three-tiered approach to holistic farm management: quality of life, economic health or production potential, and ecosystem health (Savory, 1988). He also stressed the importance of monitoring as a means to understand the relationship between the three goals stated above. Through these workshops, farmers gained prac-

tical ideas about achieving balance on their farms and an appreciation for more sustainable production. In particular they were encouraged by Savory to explore the idea of rotational, or management intensive grazing (Savory, 1988).

The Sustainable Farming Association (SFA) of Minnesota began in southeast Minnesota in 1988 in order to provide a forum for farmer-to-farmer information exchange. Originally this group was convened by LSP, but quickly began to take on an organizational life of its own. Farmers interested in information exchange were asked to become dues paying members. This resulted in an active network of individuals who published regional newsletters, sponsored summer farm tours, held annual workshops, and organized equipment exchanges. They also planned to initiate discussions about sustainable agriculture with the University of Minnesota. Over 100 people attended the first state wide annual meeting in March of 1992, where board members from seven existing or potential chapters were elected to serve. By March 1995, 12 active chapters had formed (LSP/SFA, 1998). SFA continues to support farmer-to-farmer information exchange around Minnesota today.

The Monitoring Team

The Monitoring Team (MT) was officially formed in 1992 when a group of SFA farmers joined with LSP to start investigating the sustainability of grazing in a more formal way. As a response to falling commodity prices, and the visible effects of overgrazing, each of the six SFA farmers had chosen rotational grazing rather than conventional cropping systems as a means to feed their cattle. Each of the farms, located in southeastern Minnesota (see Figure 2), grazed between 40 and 200 cows on farms that ranged from 160 to 477 acres. Four of six farm families received 100% of their family income from the farm, 1 received 40% and another between 50 and 100%. All started rotational grazing during the 1980s (see Table 2).

Rotational, or management intensive, grazing is a process in which farmers carefully monitor the impact of their herd on the pasture. With the help of electric fences they are able to selectively graze paddocks in order to preserve a healthy pasture ecosystem (Savory, 1988; Andersen, 2000). Knowing exactly when and where to move the cattle is not done with a predetermined formula. "It is somewhere between an art and a science," one MT farmer commented, and depends on having knowledge of multiple factors such as weather, forage condition and diversity, soil history, and cattle need. As one Wisconsin grazer describes, "You have to look ahead and determine when to graze, and that requires experience and observation. There aren't any rules. . . . You've got to look at the whole picture" (Hassanein, 1999).

While the benefits of rotational grazing made sense to the Minnesota farmers, they recognized they were doing something potentially risky. Not only were their practices not sanctioned by conventional agricultural research, but they were not supported by federal agricultural policy and incentives. As one farmer put it: "I literally bet the farm [by switching to rotational grazing]," and thus sought confirmation that the strategy was a good one. While some of the farmers wanted to assess the benefits of their new management plans, others openly admitted that they were simply interested in sharing their ideas with others. With the help of LSP, the idea of inviting researchers in, and pulling together an interdisciplinary research team was born.

Initially, the stated goal of the team was to create a series of research projects that would investigate the whole-farm response to rotational grazing. Their stated goal was to create a team that would research grazing using a process that:

1. was farmer driven.
2. was participatory and team based.
3. used a whole systems approach.

The founders of the MT hoped to create a team that would help them document the impact of their new grazing practices on the landscape and would serve as a model for investigating whole-system questions in a participatory manner. In addition, LSP wanted to document how informal monitoring could lead to the development of alternative approaches to conventional agriculture (LSP, 2001).

Once the initial goals were articulated, LSP took the lead and secured funding through several private foundations and the state-supported Minnesota Institute for Sustainable Agriculture (MISA). As funds became available, researchers from the University of Minnesota, and Iowa State University as well as representatives of agencies such as Minnesota Department of Natural Resources, Minnesota Department of Agriculture, and U.S. Fish and Wildlife Service were chosen to join the effort. There was no formal invitation process, rather individuals were contacted who had prior contact with LSP or SFA efforts. Those who expressed an interest in being involved with a participatory research team were asked to join.

The team chose to investigate many different facets of the social-ecological system, including soil quality, pasture vegetation, terrestrial fauna, stream quality and fauna, hydrology, farm family quality of life, and economics. Information about each facet, such as how the fast grass recovered, or how many hours cattle spend in or near the stream was recounted

Table 2. Demographic information on Monitoring Team farms.

Farm	Start year for rotational grazing	Percentage of income from farming	Farm size (acres)	% of tillable land used for grazing	Number of cattle grazed
1	1989	100	300	70	140
2	1984	100	477	95	99
3	1988	100	240	90	150
4	1987	100	250	50	200
5	1980	40	160	90	40
6	1988	75	300	75	100

Figure 2. Location of Monitoring Team farms in southeastern Minnesota.

from the perspective of the local farmer, and then followed up by a controlled research investigation conducted by one or more researchers. For example, several farmers were particularly interested in understanding the impact of cattle on streams. To address their interest, three researchers were brought on to work on the issue. Following initial meetings, in which the farmers shared their questions and observations, the researchers designed controlled experiments to compare the impact of rotational to conventional grazing systems on stream ecosystems.[1] Indicators of stream health, acceptable in the stream ecology and management literature, were chosen by researchers. After the initial design sessions, in which farmers were full participants, the research was conducted by university scientists. Over the course of three summers, data were collected on and around four monitoring team farms. Results of the research were shared with the team at meetings and field days, and farmers provided feed back on the findings by comparing the results to what they had observed over the years.

After the research was completed in each of the above disciplines, a publication called the "Monitoring Tool Box" was compiled so that the MT could share ideas about monitoring with a broader audience. While the goal was to share successful farm monitoring techniques with other farmers, the document was primarily written by researchers and reviewed by farmers. The Monitoring Toolbox was accompanied by a video, *Close to the Ground*, that described the process of putting together a participatory research team.

LSP organizers recognized the challenges inherent in bringing together people with fundamentally different knowledge paradigms. Because team members were coming from such fundamentally different places, meetings were structured to leave time for personal interaction. Quarterly meetings were held to interpret and discuss research findings, and on-farm field days were conducted to share and explore each local farmer's observations. Throughout the time in which the MT was active, a total of 26 people were integrally involved, nine research grants were secured, two master's theses were completed, and team members (farmers, non-profit representatives, and researchers) gave 55 presentations to professional and agricultural communities around the country. The MT also held over 12 field days, reaching over 560 people, in which farmers shared their knowledge (LSP, 2001).

Data collection

Both authors of this paper were participants in the biological monitoring team, one as a researcher, who participated during the last year of team activity, and the other as one of the six farmers who participated throughout. Our personal experience and informal field notes were supplemented with content analysis of team newsletters and a video produced by the LSP (LSP, 1998). We also conducted interviews with

team members. We attempted to contact 100% of the farmers and 50% of the researchers and non-profit staff.

Seven out of sixteen researchers and agency people, two of four non-profit representatives, and six of six farmers were interviewed on the telephone using a semi-structured approach. Each of the above were asked to reflect on 1) the value of the MT to them personally, 2) the routes to clarity (or bridges) between researchers and farmers, 3) the barriers to communication between researchers and farmers, and 4) the value of the MT to greater society. Because of their informal nature, interviews were not taped. Instead, notes were taken during the interviews, and statements were reviewed with interviewees to confirm the accuracy of interviewer notes. Notes were then typed and qualitative analysis was used to code for emerging themes. Coding was done by hand for each question. A basic start list of codes was used to identify content that referred to the central themes of "benefits," "knowledge exchange," "new understanding," "team process," and "empowerment." After reading all the responses several times, sub-themes emerged and were coded accordingly (Rubin and Rubin, 1995; Miles and Huberman, 1994).

Results

Participants entered the MT believing in the efficacy of whole farm management and participatory research. From the beginning the team was designed under the direction of LSP with the belief that conducting on-farm research in a participatory manner would lead to new knowledge about rotational grazing and new relationships between researchers and farmers. While farmers were directly involved with establishing the research questions, by and large researchers were on their own when it came to conducting the projects. Despite opportunity for exchange of research results among research areas (streams, pastures, soils, etc.) and between researchers and farmers, long lags between data collection and final synthesis impeded the process of knowledge exchange about the investigations.

Most of the research teams eventually produced results that were marketable to the academic and policy worlds. For example, two peer-reviewed journal articles (Sovell and Vondracek, 1999; Sovell et al., 2000), and numerous professional presentations emerged from the stream research. The results, which were summed up by one of the researchers as, "yes indeed [rotational grazing] is making a difference," have been shared informally throughout the sustainable agriculture community.

While the results of the research efforts have no doubt given credence to earlier beliefs about rotational grazing, farmers admit that the benefit of this new knowledge was that it proved, with science, what they already knew about their farms. Consequently, very few of the farmers admit to making any land management changes as a result of being on the MT.

Value of the Monitoring Team

> Really what the team did for me was to give me the confidence to believe in what I was doing. Being part of this broadened my perspective on whole systems and reinforced my beliefs about what I observed. I was trained [as a university student] to believe that streams and cattle were incompatible, but this project absolutely gave me the confidence that what I was doing might have some truth in it.

As the above farmer has illustrated, each of the farmers indicated that one of the primary values of the MT was to help them build their confidence about what they were doing: "To have people that I respect tell me that they're impressed with what I'm doing . . . I need that." Membership on the team gave them a sense of hope. "I literally bet my livelihood [on switching to rotational grazing]," said one farmer. "Forming this team gave me the confidence to go forward." Having researchers listen to them, and agree, was much different than getting support from other farmers.

Farmers also reported a renewed interest in observing the changes taking place on their farms: "I used to always take my four wheeler out to shut the gate, now I walk out because there's so many things I'm afraid I'll miss . . . The other day I saw a scarlet tanager, it just made my whole day." While few farmers reported having learned anything new about grazing, the team helped them focus on their goal of using a whole system approach by affirming the importance of the link between farming and quality of life. It also caused them to take the time, as one farmer noted, "to question why they do what they do."

Farmers and researchers agreed that building trust was a key part of the experience. As one researcher reflected: forming this new community "opened the door for many different conversations that would never have happened." Eating together around a shared table, and getting to know each other personally gave individuals an interest in understanding the point of view of others. As another researcher commented: "Being guests in their homes, eating farm-raised meat, this was the glue. City folks were hungering for that." Likewise a farmer commented: "Walking the land together we got to know each other as humans with the same basic values." Because meetings were organized to be

a mixture of play and work, people looked forward to these days. One researcher commented that no matter how frustrated she was with her work, team meetings always sent her home "completely recharged."

Researchers reported that the team helped to reshape their research agenda, giving them the opportunity to get in touch with different perspectives on agricultural systems. One researcher reflected that he "came into [the team] thinking that he would help farmers see what was out there by building baseline information." What he learned from the farmers was that "the whole was more than its parts, and that we must build on the strong instincts for the land." Many acknowledged this was one of the most positive experiences in their career because it gave them the opportunity to get out of the "traditional box," and experience something different: "The team really changed the direction of research that I do. I used to study fish, now I have an ecosystem restoration focus." One researcher chose to reduce her appointment at the university in order to focus more on family. "In the spirit of the project I did a lot of quality of life reflection myself, this was a big part of what impelled me to reevaluate my work life." Researchers also reported that their respect for the farmers' knowledge grew immensely.

Bridges to communication

Team members were also asked to comment on the structure and success of communication efforts. Four participants independently noted that the team had been hand picked to include like-minded thinkers. While this was a great advantage for the team, it has led people to wonder how well the team-approach might work with a more conventional group of farmers or researchers.

> We communicated well because we were kindred spirits involved in an unconventional group. We were all out of the box. This led people to feel more comfortable, like there was something subtle beneath the surface. I would say that at the beginning there was a tacit acceptance that there was a common vision – during the project this built and gathered momentum, snowballing to create understanding and trust. (Researcher)

Farmers and researchers alike reiterated the important role of trust building in making the team function. Interestingly, while farmers reported having the most productive meetings at their farmhouses, some of the researchers thought meetings in neutral, or public places, allowed for more exchange and discussion of research results. All members mentioned the critical role field days played in building trust. Farmers expressed satisfaction at having the focus of the discussion turn to on-farm observation, while researchers expressed an appreciation for what they learned, not only about the farm system as a whole, but about farmers' methods of understanding. Overall, these field days helped to reinforce the team's underlying commitment to the farmer-to-farmer network that had given birth to the team, and brought life to the idea of information sharing between researchers and farmers.

Barriers to communication

Interviewers also encouraged team members to reflect on the barriers to authentic communication between researchers and farmers. Researchers, in particular, recognized that in order to publish their work in peer-reviewed journals they were held to a fundamentally different set of constraints than the farmers. "They didn't understand how we did things," one researcher noted, and as one farmer observed, "scientists had their own agenda, they were using a different currency than the farmer." Two farmers also noted with frustration that researchers sometimes made decisions about sampling locations without paying adequate attention to the history and biological complexity of their farms:

> Early in the project I was extremely annoyed [at the researchers] for putting the plots where they wanted, and not doing comparison plots on this farm. For example, no ninety year old plots were sampled on this farm. I also have some virgin soil, likely never tilled. These areas weren't sampled either. There was definitely a trace of the "dumb farmer" syndrome.

Another was sympathetic with the researcher limitations but was skeptical about their ability to adequately describe what was going on. "Each farm is independent. One can't paint it with broad strokes. We were afraid of trying to provide a recipe for success in grazing."

While building trust was considered one of the most valuable products of the team process, most team members recognized there were barriers to be overcome. "They thought they knew more about our farms than we did, and they had their own agenda," one farmer reflected. Farmers were also frustrated because they had already recognized a shift away from the single focus of the land grant institutions, to a whole farm approach. "Some people thought this was something the team had invented," one farmer lamented. "Some of us had been doing [alternative grazing] for years. They didn't invent these sustainable practices; we did." While it was relatively easy to build trust on a personal level, when disagreements emerged, team

members tended to question the underlying motivations for participation. One farmer admitted that, "We had a stereotype view of academia. Since I no longer was farming in the way they had taught me, I was definitely not entirely trusting." One of the non-profit representatives reflected that more attention to providing effective liaisons between these two groups might have helped alleviate tension.

Many team members also mentioned that while the whole farm approach was critical, the large number of different research efforts made it impossible for each of the six farm families to engage with each of the eight research teams. As one non profit representative reflected:

> In an effort to accommodate farmers' busy schedules researchers would visit the farms, check in with the farmers, and then go about their business collecting data. At the end of the day the farmer is left wondering – what was that all about? This might have been avoided if we hadn't grown the team so fast.

Farmers and researchers both expressed frustration at the lack of overall synthesis. While eight different research teams were invited to investigate aspects of these farm systems, adequate time and attention was never devoted for researchers to coordinate with each other in order to produce a truly integrated product. Several researchers called attention to a lack of closure: "What haunts me is the lack of synthesis, of pulling everything together. The scientific work was never fully integrated and so much was left unclosed." Interestingly, farmers universally reported that they learned little from the researchers about how to manage their farms.

Value to greater society

> I have concerns about policy and regulations, and some people on the team were involved with that. Things are being imposed on agriculture that may not be the best for agriculture. . . . The team gave us an opportunity to educate folks at the "U" and in state agencies to see an alternative.

As the above quotation illustrates, most farmers believed that the team provided the opportunity to spread the word about sustainable agriculture. For the farmers, sharing their ideas with other team members was a first step towards reaching a broader audience. Through the process of engaging university researchers to document the impact of sustainable agricultural practices, farmers attracted public attention and encouraged public policy makers and economists alike to think about a new model for keeping the small farmer in business. Being on the team gave farmers the hard data needed to present information about their alternative farming practices to a broad audience. Researchers and farmers, often together, presented material related to the team at professional meetings and farmer gatherings around the country. One team member recalls, "I talked to somebody out east, and they started telling me about how progressive things were in Minnesota. They had heard of a [research] group in which the farmers were equal members . . . I couldn't believe it, they were talking about us."

Farmers also perceived that by generating publicity about alternative farming the team helped create economic opportunities for small farmers. As one farmer articulated: "It opened up networks, and person to person contact makes marketing possible." Today two of the team farmers have successfully started direct market operations that serve both the urban and rural communities in Minnesota.

The team also served to generate resources for other individual or group initiatives to grow. As a result of the team's leadership three large-scale legislative grants have been given to integrated farmer-driven research teams. Four hundred copies of the monitoring toolbox have been distributed, as well as videos on the team process. University classes have made trips to visit MT farms, and farmers have been invited to present at everything from national conferences to local grazing workshops. Many team members believe that because of their efforts to spread the word about the MT, society will begin to pay attention to the knowledge of sustainable farmers. Ultimately, they hope to influence future farm legislation to provide incentives for sustainable farming initiatives.

Discussion

Forming the MT constituted a deliberate act on the part of farmers and LSP to further the economic and social well being of sustainable farmers in Minnesota. By bringing researchers and farmers together in a forum that was deliberately created to promote equality between farmers and researchers, the MT successfully challenged the dominant model that researchers are the creators and farmers the users of knowledge.

The MT brought multiple benefits for all involved. Being part of a formal team provided the incentive for farmers and researchers to meet together on a regular basis. This new contact succeeded in breaking down barriers to communication and fostering a sense of trust among individuals who operated in different worlds. While researchers felt that the experience helped to broaden their worldview and change their research agenda, farmers indicated that the MT exper-

ience served to renew their interest in alternative agriculture and helped to build their confidence about rotational grazing. Farmers and researchers alike found that the focus on holism and quality of life helped them to focus on bigger goals than just profits or publications.

Through careful planning and design, LSP effectively created a social learning arena that facilitated communication among researchers and farmers. This was no accident. Selection of like-minded individuals served to build a team that started with many of the same core values. Holding meetings at an array of venues, and hosting public events such as on-farm field days were central to creating relationships that placed farmers and researchers on equal ground. By creating an agenda that placed the farmers' questions and knowledge at the forefront, and through funding an effort that led researchers to create knowledge that was acceptable within the policy arena, the MT furthered the sustainable agriculture movement.

Despite the many positive outcomes, the MT had its share of struggles. Farmers and researchers had different motivations. In a decade when farms were being lost at the rate of 1000 farms per year in Minnesota (MDA, 1999), MT farmers were primarily interested in promoting a new approach to agriculture that would help them and their families stay on the land. Researchers, on the other hand, were looking for a new kinds of experiences that would further their professional careers. Despite a genuine respect for the farmer's non-quantitative knowledge, they were nevertheless driven to produce quantitative data that could be shared in academically sanctioned publications.

Challenging patterns of knowledge exchange

The MT brought a new dimension to knowledge exchange in Minnesota. In the interviews, when asked how knowledge was built and shared during the team process, both researchers and farmers stated that the researchers had expanded their worldview as a result of interaction with farmers. Researchers reported they not only learned alternative viewpoints about farming, but that these experiences served to change their research questions and agenda. In contrast, farmers did not report having learned from the researchers about how to manage their farms.

Prior to the formation of the monitoring team, each of the participating team farmers was involved in local knowledge exchange. As Hassanein and Kloppenberg (1995) have documented in Wisconsin, in the late 1980s and early 1990s SFA in Minnesota had been gathering to exchange ideas about farming. Recognizing that the hierarchical structures of information distribution were not always helpful to them, farmers were eager to form regional networks in which graziers shared their knowledge farmer to farmer (see Table 1 (C)).

Moving away from previous models of knowledge dissemination, this team appears to have flipped the system on its head. Farmers, even more than researchers, were sharing their knowledge (see Table 1 (D)), and thus in a deliberate fashion challenging the status quo. This shift in knowledge exchange was critical because it gave farmers more power to influence decision-makers operating at higher levels in the embedded hierarchy. "Objective knowledge," such as data collected by agricultural researchers, is valuable to policy makers because it is seen as accepted by mainstream society. By citing the results of scientific studies, researchers are able to legitimize or challenge current policy (Weeks, 1995). In this way, "knowledge" about the effects of various land management practices on the greater ecosystem is translated into action through the mechanism of regulatory politics. MT farmers achieved this goal through their connections with formal researchers by sharing their ideas with audiences that were formerly inaccessible to them.

Motivated by discussions of participatory research (Chambers et al., 1989) and whole system farm management (Savory, 1988), the founders of the MT set out to challenge the reductionist and production-oriented approach to conventional agricultural. By creating a social movement organization and naming it the Monitoring Team, these visionary leaders successfully garnered the social and material resources necessary to bring the values and knowledge of the sustainable agriculture movement to the attention of greater society. By selling their ideas to granting agencies, they received significant funding for advancing their ideas, successfully gathering the financial resources necessary to move their agenda forward. Because team members were explicitly chosen to be open minded, the team was able to successfully model a knowledge community in which farmer knowledge was legitimized, not only in its own circles, but in professional meetings and policy discussions throughout the country.

Unlike strictly farmer-to-farmer networks, the MT brought individuals with fundamentally different approaches together. Being on the land, looking at the same physical reality gave these individuals from diverse backgrounds the opportunity to come into a social learning community. Building trust made it possible for farmers and researchers alike to feel at home with the idea of stretching their imaginations. It also helped to break down the stereotypes that emerge when encountering a group only as "the other." As one farmer put it, "I was willing to cooperate with the

researchers because I liked them." Almost everyone interviewed expressed excitement about the prospect of broadening their worldview and doing something different. While there were challenges in integrating the different approaches, both groups recognized they were part of something bigger than just learning about rotational grazing. While they did not succeed in totally understanding one another, the process of working together provided the model necessary for LSP to begin advocating farmer-researcher cooperation throughout greater Minnesota.

Entering into a process of social learning was not always easy. Several of the farmers interviewed expressed frustration with regard to ownership of ideas, complaining that the team should not be claiming credit for their choice to pursue rotational grazing. Researchers also experienced the cost of expanding their knowledge community by realizing their worldview was previously incomplete. Researchers returned to their institutions feeling increasingly frustrated with the realization that to publish they would have to attempt to universalize their experience. Through participation with the team they were reminded that their research findings expressed only a part of the complex whole.

While the MT expanded people's vision, it is only a first step in truly integrating the different approaches to knowledge generation. Future research will need to be done to document the conditions of social learning that leads to substantive communication about ideas. As we move forward with a new knowledge paradigm, society will have to proceed past this intermediate stage into an era in which farmers and researchers are able to truly build new knowledge together, finding new solutions to creating sustainable relationships between human and ecological systems. True innovation will need to embrace the best of modern technological science as well as an integrated and local understanding of the landscape that empowers local observers to adaptively respond to changes on the land. The MT was an important first step to developing what Haraway (1991) espouses as, a "situated knowledge" in which proponents of western science and experiential knowledge are able to celebrate their limited vision, recognizing it is within the partial perspective that the possibility of sustained rational objective enquiry rests. It is our hope that future collaborative teams can build on this experience by moving past the era in which both farmers and researchers need to prove their legitimacy, into a space where both partial perspectives can be integrated into a more complete whole.

Conclusions

As articulated by the original founders of the sustainable agriculture movement, true sustainability should balance environmental soundness, economic viability, and social justice. The Monitoring Team created a social movement organization that was able to challenge the status quo in each of these arenas. Recognizing the environmental and economic limitations of conventional agriculture, these well-connected farmers reverted to a grass-based system. As generations of farmers around the world have done, they monitored and responded to the needs of the land. However, they did not stop by simply changing their land management or profit incentives. With the support of a local non-profit, they recognized that their ability to create change was limited by power dynamics within the embedded hierarchy. To reclaim their own power, and create a more socially equitable system of knowledge exchange, they engaged individuals and resources from multiple arenas to illustrate how an alternative ideology might function. The formation of this team represents one step in a long process. With the support of socially sanctioned research institutions, these farmers are reclaiming the legitimacy of their own power and knowledge. In a new way they return, with the forgiveness of grass, to mend the previous violence done to the land.

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Note

1. Note that the goal of the university research team was to create universally applicable knowledge about the impacts of cattle on streams.

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