Rooted in grass: reorganization of an agricultural community

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May, 2000

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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*

Cycles of destruction and renewal in agricultural systems:

In a time of unprecedented economic growth and prosperity, United States farmers are fighting a losing battle to keep their livelihood. Between 1987 and 1998 the number of farms in the state of Minnesota fallen from 92,000 to 80,000, just over 1000 farms a year (MDA 1999). Federal programs have respond with subsidies, and yet the economic value of agricultural commodities has continued to decline (Cochrane 1999).

A farmer resides and works within a embedded hierarchy of social and ecological structures. The individual farmer makes management choices within the nested structure of local farmer networks, which are nested within larger social, political and economic systems. Likewise, the local farm is located within a watershed which is nested within a larger regional context. For example, a farmer in southeastern Minnesota communicates with a network of farmers who convene at extension meetings, trade shows, watershed meetings, and around the farm table. He or she is also influenced by state and federal

regulatory politics, subsidy programs, economic markets, and the ebb and flow of innovation technology emerging from land grant institutions.

Holling (1995) proposes that both ecosystems and social systems go through a natural pattern of change throughout time. Systems move from the "exploitation phase", in which many unconnected individuals struggle to get ahead through a variety of means, to the "conservation phase" in which a system has become both highly productive and interconnected. A "crisis" stage then occurs in which rapid change in a driving variable will cause the system to be radically changed. The system then goes through a process of renewal (Figure 2).

Agricultural systems throughout the United States have reached a state of crisis (Figure 2, box 3). In the past, farmers operated within a rural community. Ideas about farming spread across the landscape in a horizontal fashion: farmer to farmer. Without the help of genetically modified seeds or industrial machinery, farmers were forced to experiment with many different strategies for keeping their farms in business. By and large, farms were smaller, flexible, and more diverse than they are today, typifying what Holling describes as the "exploitation" phase (Figure 2, box 1). Paul Gruchow 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."

With the advent of agricultural technology there was a shift away from small, independent, diversified farms to large monocultures in which the farm was financially dependent on multiple forms of agribusiness (Figure 2, box 2). In the conservation phase

technologically complex information was transmitted vertically from the expert researcher to non-expert farmer. Agricultural research institutions grew, motivated by the goal of increasing production (capital). In order to achieve consistently high levels of production agricultural researchers sought to design products that could tightly control the ecological system by eliminating any impediment to production (Roling and Jiggins 1998). The average farm size increased considerably. Inputs of chemical herbicides and pesticides reduced the diversity of both crops and other vegetation on the landscape. High levels of fertilizers yielded excessively productive harvests. As one 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 the community of farmers were no longer independent or empowered to make their own decisions. Rolling and Jiggins (1998) describes a treadmill of innovation in which farmers who hoped to stay in the market had no choice but to keep up with the latest technology.

As predicted by the adaptive cycle, farming systems around the U.S. have entered a state of crisis (Figure 2, box 3). The long term effects of over-farming, due in part to the high yield potential, has lead to a reduction in top soil, and an increase in disease (Matson et al. 1997). For example farms in the Red River Valley, in NW Minnesota, have been devastated by a fungal disease *Fusarium graminearum* or "wheat scab" attributed in part to the decreased crop rotations (McMullen et al. 1997) associated with high input farming. Even farmers who would like to change their farming practices find it extremely difficult due to the lack of infrastructure for different crops and the perceived amount of difficulty associated with a more diverse cropping system (Corselius 2000).

Holling (1995) describes “reorganization” as the phase in which a small group of individuals can make the greatest structural change for the future (Figure 2, box 4). During this phase, the system is characteristically under-connected with weak organization and weak regulation, thus it contains the potential for innovation and novelty in ways not possible during other stages of the adaptive cycle. Farmers have responded to the agriculture crisis in a variety of ways. Many have simply stopped farming; others have dug in their heals and hope that with the help of additional federal aid programs they can wait out the storm. A third group are making an effort to reorganize, changing their strategies in novel ways.

In this chapter we will examine the reorganization phase following the agricultural crisis. We will explore the strategies of a small network of farmers who have not only used innovative ways to reinvent their own relationship with the land, but have sparked a social movement. This movement has grown to include individuals and institutions representing multiple layers of the embedded social structure (Figure 1). We will examine participant perceptions of how farmer and researcher knowledge differed, and how, within the context of a socially embedded movement, these knowledge systems are able to work together to achieve a common goal.

Methods:

Study Location:

The southeastern region of Minnesota is unique. Unlike most of the Midwest, much of this region was not glaciated during the Pleistocene age (Gebert and Krug 1996), thus it is characterized by steep bluffs that give way to fertile agricultural valleys.

Because of the steep topography and highly erodible soils this area was greatly affected by European settlement in this region during the mid 1800's. Over-grazing and associated erosion problems have been identified as critical resource issues in this region. Elimination of healthy vegetation followed by the subsequent soil erosion and flooding have resulted in whole towns being buried beneath sediment in the lower reaches of the Whitewater watershed (Waters 1977). Productive pastures have been replaced by dirt feedlots, affecting water quality as well as overall soil condition. Confinement of livestock has led to an increase in vet bills as well as a demand for row crop agriculture (Levins 1996).

The Biological Monitoring Team:

The Biological Monitoring Team was formed in 1992 when a group of six farmers began to collectively ask questions about the sustainability of livestock grazing. As a response to declining commodity prices, and the visible effects of overgrazing, each of the five farmers had chosen rotational grazing rather than conventional cropping systems as a means to feed their cattle. Rotational, or management intensive grazing is a process in which farmers carefully monitor the impact of their herd and move the cattle from paddock to paddock in order to preserve a healthy pasture ecosystem. Some had specifically been encouraged by a course on holistic resource management. Other farmers were simply returning to the farming system they had grown up with.

While the idea's made sense intellectually, some of the farmers wanted to get some help assessing the benefits of their new management plans. With the help of a local non-profit, the Land Stewardship Project, the idea of pulling together an interdisciplinary

research team was born. Initially, the goal of the team was to create a series of research projects that would help emphasize the whole farm response to alternative management decisions. The farmers hoped to create a team that would serve as a model for investigating whole system questions in a participatory manner.

In an attempt to develop a series of monitoring tools, 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 was collected from the perspective of the local farmer, and then followed up by a controlled research investigation conducted through the university. Organizers recognized the challenges inherent in bringing together a group of people representing fundamentally different research paradigms. Meetings were structured to leave time for personal interaction. Quarterly meetings were held to interpret and discuss research findings, and farmer field days were conducted to share and explore each local farmer's observations. Throughout the time in which the monitoring team was active, a total of 26 people were involved, several major research grants were secured, two master's theses were completed and team members presented results to professional and agricultural communities around the country.

Data collection:

Both authors of this chapter were participants in the biological monitoring team. Our experience as team members was supplemented with content analysis of team newsletters and a video produced by the Land Stewardship Project (LSP 1998), as well as

through interviews conducted with team members. Members were asked to reflect on the value of the team to them personally, and to greater society. They were also asked to consider 1) the barriers to communication and 2) the routes to clarity, between researchers and farmers.

Results:

Value of the team:

Team members agree that building trust was the primary value of the team experience. Forming this new community "*opened the door for many different conversations that would never have happened*." Eating together around a shared table, getting to know each other personally gave individuals an interest in understanding the "others" point of view. "*Being guests in their homes, eating farm raised meat, this was the glue. City folks were hungering for that."* As one 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*".

For the farmers, 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.*" Through the process of engaging university researchers to document the benefits of this type of farming, the farmers were able to get public attention, encouraging public policy makers and economists alike to

think about a new model for keeping the small farmer in business. *"To have people that I respect tell me that they're impressed with what I'm doing… I need that."*

Farmers also report 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 report having learned anything new about grazing, the team helped them focus on their goal of using a whole system approach.

Researchers report that the team helped to reshape their research agenda, giving them opportunity to get in touch with different perspectives on agricultural systems. They acknowledge that 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. One researcher reports that the most important part of the experience was that he felt so at ease with these people: "*This started the ball rolling for me, now I speak out all the time.*" Researchers reported that their respect for the farmer's knowledge grew immensely.

Bridges to communication:

Team members were also asked to comment on how successful communication came about. 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.

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 farm houses, some of the researchers thought that meetings in neutral, or public places, allowed for more exchange and discussion of research results. All members mentioned the critical role that field days played in trust building. 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 the farmer's 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.

Barriers to communication:

Team members were also encouraged to reflect on the barriers to authentic knowledge exchange 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 research constraints than the farmers. "*Scientists had*

their own agenda- they were using a different currency than the farmer." Farmers 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 90 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.*

While trust building was considered one of the most valuable products of the team process, most team members recognized that there were significant 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 an individual's underlying motivations for participation were often questioned. 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 8 research teams. "*In an effort to accommodate farmer's 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. Interestingly, farmers universally reported that they learned little from the researchers about how to manage their farms.

Value to greater society:

Almost all members of the team indicated that one of the most important outcomes of this project was the publicity it generated. 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 was talking 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.*" The monitoring team itself secured grants from several major foundations, as well as the Minnesota Legislative Commission on Natural

Resources. As a result of the team's leadership three large-scale legislative grants have been given to other integrated farmer driven research teams. Four hundred copies of the monitoring tool-box have been distributed, as well as videos on the objectives and outcomes of the team process. University classes have made trips to visit team member farms, farmers have been invited to key-note at regional conferences, present in university class rooms, grazing workshops and more. As one farmer put it:

> *Really what the team did for me was to give be 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 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.*

Many team members are hopeful that new farm legislation will recognize efforts such as this, and provide incentives for innovation through on farm experiments. While there is still a negative attitude about the impacts of grazing, people are starting to understand that carefully managed grazing can be done in a sustainable fashion.

Challenging patterns of knowledge exchange:

A knowledge system can be understood as different systematized and non-random structures, and stores of information that people use to understand and act in the world (Raedke and Rikoon 1997). These systems are embedded in knowledge communities in which a dynamic network of actors constructs knowledge through the processes of negotiation. (Richards 1993 in Raedke and Rikoon 1997). Knowledge and understanding

develops as these communities interact with the natural systems, and communicate with alternative knowledge communities. Often knowledge communities are associated distinct worldviews or paradigms through which individuals interpret the outside world with a common frame of reference (Beus and Dunlap 1990).

Traditional scientific knowledge is valuable to policy makers because it has the ability to close "political debates" by translating them into authoritative technical terms (Mukerji 1989 in Weeks 1995). Through appealing to logic and objectivity, policy makers have mobilized science as a force to legitimize policy (Weeks 1995). Thus certain forms of dominant "knowledge" about the effects of various land management practices on the greater ecosystem is translated into power in the hands of regulatory politics. Today the dominant social paradigm is associated with a belief in technological progress and relies on innovation diffusion to transfer information to the people.

Figure 3 illustrates a shift in the dominant form of knowledge exchange in the agricultural community. During the early 20th century (3a) farmers communicated with each other. The new research institutions helped to bolster their understanding by responding to their needs. With the advent of more sophisticated agricultural technology (3b), this flow of information shifted. The treadmill of innovation (Rolling and Jiggins 1998) eliminated the need for farmer to farmer exchange.

Watkins, an organic farmer, (1990:161) publicly expresses his frustration by his own lack of power to influence the research agenda of land grant institutions during this stage.

Prior to the formation of the monitoring team, each of the team farmers were involved in local knowledge exchange. As Hassanein and Kloppenberg (1995) have documented, a complex network of farmers had been gathering to exchange ideas about

grazing. Recognizing that the formal hierarchical structures of information distribution were not helpful to them, they rejected them and formed regional networks in which grazers spread knowledge: farmer to farmer (Figure 3c).

When asked how knowledge was built and shared during the team process all who were interviewed believed that the researchers had learned from the farmers. Researchers stated that they not only learned alternative viewpoints about farming, but that these experiences served to change their research agenda. In contrast, farmers did not claim to have learned from the researchers about how to manage their farms. Moving away from the technology transfer model of knowledge dissemination, this team appears to have flipped the system on it's head. Farmers more than researchers were sharing their knowledge (figure 4a), participating in a well orchestrated paradigm shift. As Hassanein and Kloppenberg (1995) observed in Wisconsin, alternative approaches to farming were emerging well before the monitoring team was formed.

The success of the monitoring team can be measured by the degree to which the dominant research paradigm was challenged within the group. Farmer knowledge has been legitimized, the worldview of researchers has expanded. Figure 4a illustrates that during the team process the majority of knowledge flowed from the farmers to the researchers. While this served to bolster the subordinate paradigm, such a switch in knowledge generation may not be realistic at a large scale. Many interviewed noted that a basic commitment to challenging the status quo was a prerequisite for involvement. Individuals were hand-picked to participate. This team did not attempt to engage narrowly conventional thinkers. Many times during the course of the team meetings

members lamented that the team was “preaching to the choir”. Knowledge was transferred to the easily converted.

In order to move forward into a successful new knowledge paradigm, society will have to proceed past this intermediate stage into an era in which farmers and researchers are able to work together to achieve sustainable relationships between human and ecological systems. While the dominant knowledge paradigm promises Cartesian objectivity and transcendence of subjectivity, the alternative paradigm has spurned this assumed transcendence, advocating instead that only experiential and local knowledge is legitimate. We can not return to pre-industrial times. Adoption of precision technologies, for example, might give us the information necessary to decrease pollution (Zilberman and Lipper 1998)As figure 4b. illustrates, true novelty will need to embrace the best of modern technological science as well as an integrated and local understanding of the landscape. Haraway (1991) espouses a “situated knowledge” in which humility is the first step towards truth. She advocates that both western science and proponents of experiential knowledge celebrate their limited vision, recognizing that it is within the partial perspective that the possibility of sustained rational objective enquiry rests.

Promoting Social Change:

One of the primary values of the monitoring team was to bring the values and the reality of this alternative agricultural movement to the attention of greater society. The monitoring team has influenced several distinct scales within the embedded social structure (Figure 1). Individuals on the team broadened their own individual

understanding of world, and in turn, the larger society has changed their outlook on sustainable agriculture. Social movement theory has attempted to define the relationship between individual agency and the greater societal structure in which that individual resides(Dalton 1994, Lofland 1996, Raedke and Rikoon 1997). As the team has illustrated, empowerment can be manifested at several different levels (individual, group and community level) and can lead to an increase in social action (Nelson 1994).

A social movement can be defined as a group of people who share interests that are incompatible with the existing social and political order (Foss and Larkin 1986 in Dalton 1994) Social action is not a rational practice. The ability to reorganize and reinvent farming systems is intricately tied to the actions and incentives provided by the larger society. In order for social movement to succeed in influencing the dominant paradigm, individual groups or social movement organizations (SMO) must secure social and material capital from both inside and outside the organization (Dalton 1994).

The founders of the monitoring team successfully garnered social and material resources, significantly enhancing the sustainable agriculture movement in the Midwest. Motivated by discussions of participatory research (Chambers, "farmer first and last" model), and of whole system farm management (Savory, "Holisitic Resource Management") these visionary leaders secured the financial and social resources needed to challenge the dominant research paradigm in a substantive way.

Conclusions:

The monitoring team represents one example of individuals coming together to reorganize their actions and ideology following a crisis. The farmers who conceived of

this organization have taken the first step towards restructuring a society that supports a reductionist approach to resource management. Rather than intensive farming, they have reverted to a grass based system, watching and responding to the land in a way that only a situated knowledge of the land can master.

Rather than keeping their alternative ideology to themselves, they have recognized the importance of long-term, large-scale change, and have effectively engaged individuals from multiple arenas. The formation of this team represents one step in many. With the support of societally sanctioned research institutions these farmers are moving their agenda forward. Returning, with the forgiveness of grass, to mend the violence to the land.

References

Beus, C. E. and Dunlap, R. E. 1990. Conventional versus alternative agriculture: paradigmatic roots of the debate. *Rural Sociology:* 55:590-616.

Cochrane, W. 1999. A Food and Agricultural Policy for the 21st Century. Institute for Agriculture and Trade Policy, web page (www.IATP.org).

Corselius, K. 2000. Farmer Decision Making in the Red River Valley. Department of Agronomy, University of Minnesota, M.S. Thesis.

Dalton, R. J. 1994. *The green rainbow : environmental groups in Western Europe*. 1994. New Haven: Yale University Press.

Gerber, W.A. and Krug, W.R.. 1996. Streamflow trends in wisconsin's driftless area. *Water Resources Bulletin* 32: 733-744.

Gruchow, P. 1995. *Grass Roots: the universe of home*. Minneapolis: Milkweed.

Haraway, D. J. 1991. *Simians, cyborgs and women: the reinvention of nature*. New York: Routledge.

Hassanein, N. and Kloppenburg, J. 1995. Where the grass grows again: knowledge exchange in the sustainable agricultural movement. *Rural Sociology:* 60:721-740.

Holling, C. S. 1995. What Barriers? What Bridges? In *Barriers and Bridges to the Renewal of Ecosystems and Institutions,* pp.3-34, ed. L. Gunderson, C.S. Holling and S. Light. New York: Columbia University Press.

Land Stewardship Project. 1998. *Close to the Ground,* video. Minneapolis MN: Blue Moon Productions.

Levins, R. 1996. Monitoring Sustainable Agriculture with Conventional Financial Data. White Bear Lake, MN: Land Stewardship Project Publication

Lofland, J. 1996. Social movement organizations: guide to research on insurgent realities. 1996. New York: Aldine de Gruyter.

Minnesota Department of Agriculture and the United States Department of Agriculture. 1999. MN Agricultural Statistics Report. National Agricultural. Statistics Service.

Matson, P. A., Parton, W. J., Power, A. G., and Swift, M. J. 1997. Agricultural Intensification and Ecosystem Properties. *Science:* 227:504-509.

McMullen, M. R., Jones, R., and Gallenburg, D.1997. Scab of Wheat and Barley: A Reemerging Disease of Devastating Impact. *Plant Disease:* 81:1340-1347.

Nelson, K. C. 1994. Participation, empowerment, and farmer evaluations: a comparative analysis of IPM technology generation in Nicaragua. *Agriculture and Human Values* 11:109-125.

Raedeke, A. H. and Rikoon, J. S.1997. Temporal and spatial dimensions of knowledge: implications for sustainable agriculture. *Agriculture and Human Values* 14:145-158.

Roling, N.G. and Jiggins, J. 1998. The ecological knowledge system. In *Facilitating Sustainable Agriculture*, pp283-311, ed. Roling, N.G. and Wagemakers, M.A.E.. New York: Cambridge University Press.

Waters, T.F. 1977. *The Streams and Rivers of Minnesota*. Minneapolis: University of Minnesota Press.

Watkins, G.1990. Participatory research: a farmer's perspective. *American Journal of Alternative Agriculture* 5:161-162.

Zilberman D. and Lipper L.. 1998. Sustainability and information. In *Sustainability in Agricultural and Rural Development*, pp. 193-216, ed. Scuza, G.E. and Gebremedhin T.G. Brookfield: Ashgate.

Figure 1: Social and ecological systems are structured in a nested hierarchy. Ecological knowledge resides in the link between each of the dynamic systems..

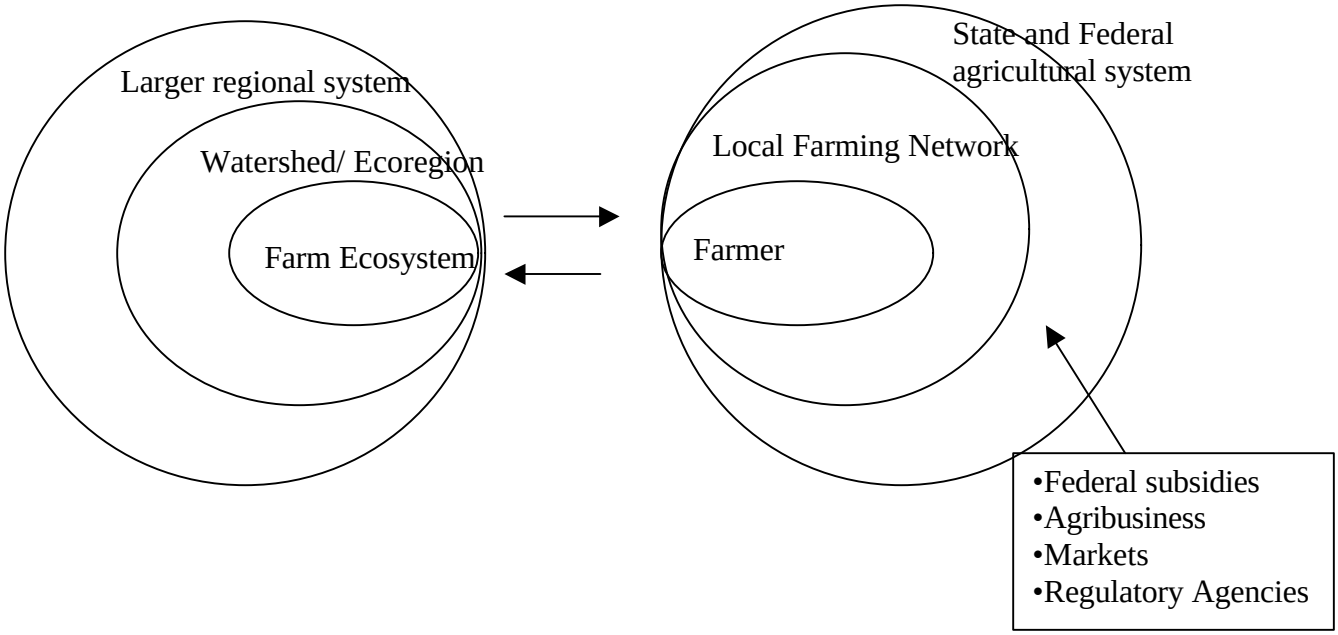


Figure 2: The agricultural cycle, adapted from Holling (1995).

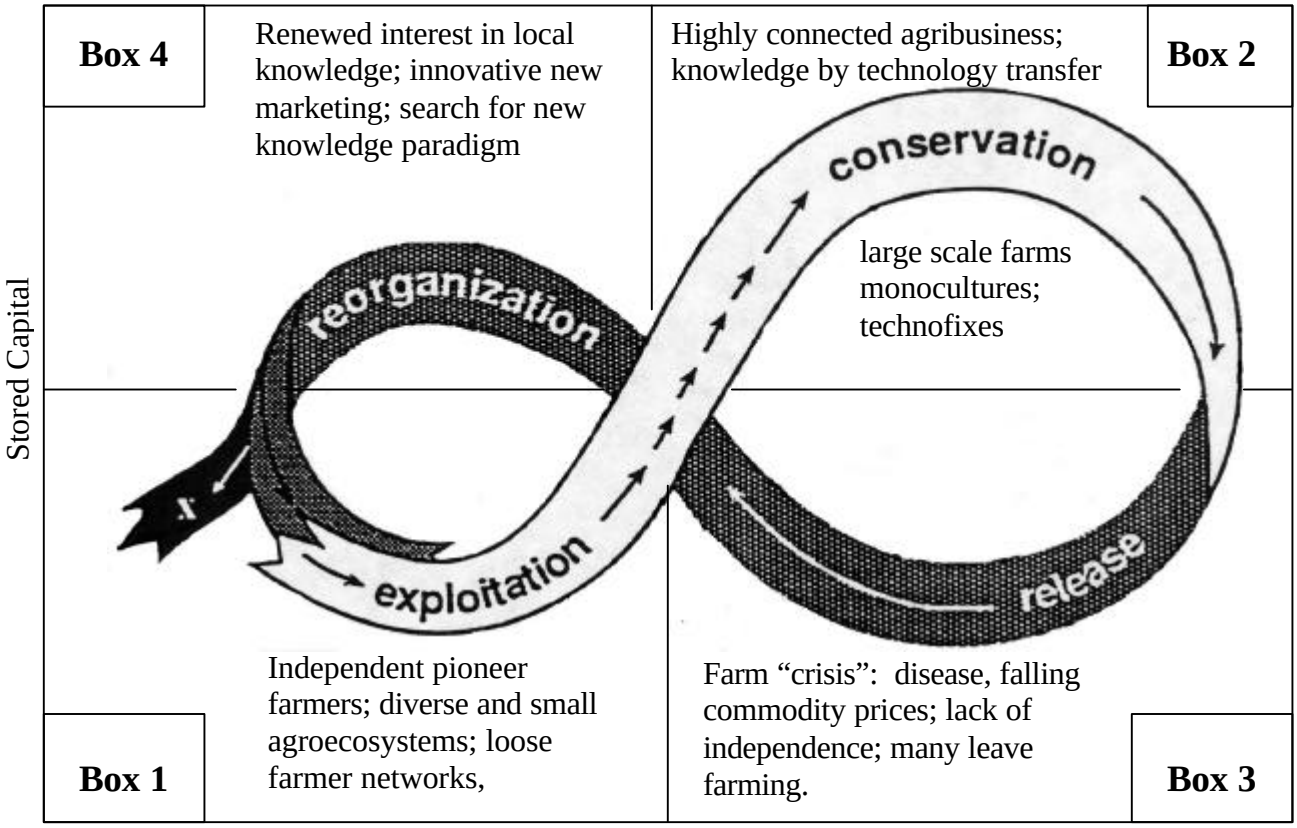
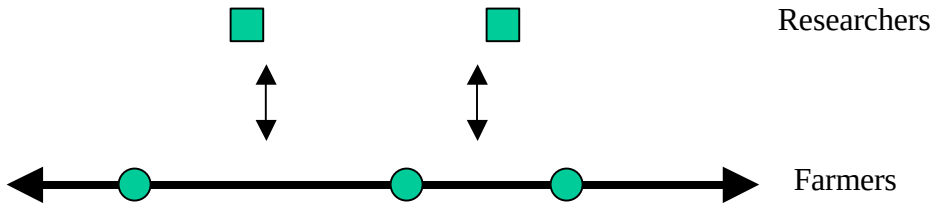
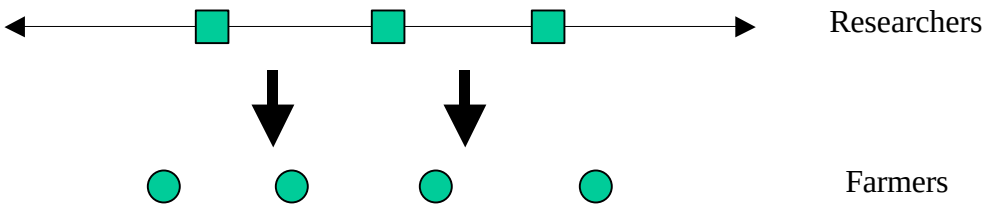


Figure 3: Agricultural knowledge exchange during exploitation, conservation, and early reorganization phases of the adaptive cycle. Boldness of line indicates strength of knowledge exchange. Farmers are represented with circles, researchers with squares.

3a. During the exploitation phase farmers communicated with each other. They also received some information from newly formed land grant institutions.



3b. During the conservation phase, exchange of information was from researchers to farmers according to the technology transfer model.



3c. During the early stages of reorganization some farmers returned to farmer networks. Lack of trust blocked flow of information from researchers to farmers.

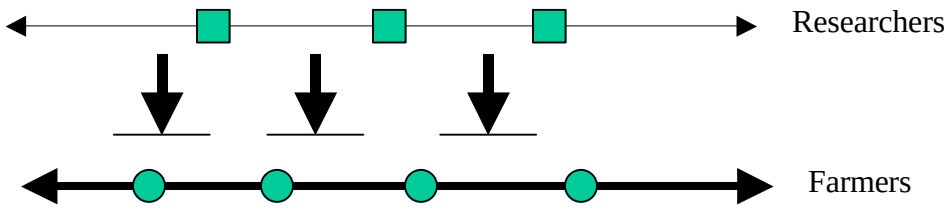
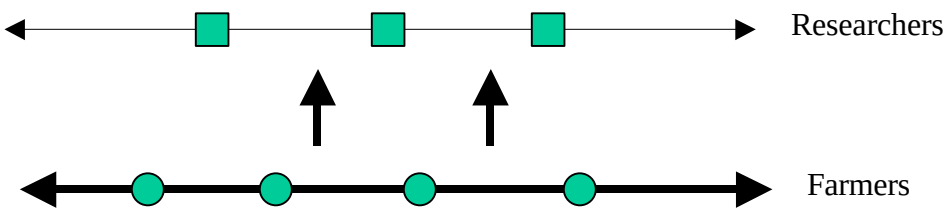


Figure 4: Reported and ideal knowledge exchange on the monitoring team.

4a. Participants reported the knowledge exchange on the monitoring team was from farmers to researchers.



4b. Ideally both researchers and farmers will be able to fully realize their potential and be equal partners in understanding human/ecosystem interactions.