An assessment of SARE-funded farmer research on sustainable agriculture in the north central U.S.

Margaret M. Kroma and Cornelia Butler Flora

Abstract. *Emergent research shows how some farmer groups in the United States are gaining visibility as a critical knowledge community, making important contributions to the ecological health and overall sustainability of the natural resource base. This study focuses on funded farmer research projects in the north central region, to analyze the process and outcome of local inquiry embodied in the discursive contents of reports to a funding agency, the U.S. Department of Agriculture's Sustainable Agriculture Research and Education program. The analyses suggest that farmers' locality-.specific agricultural practices may constitute a reflective and learning community, generating local knowledge keenly attuned to an underlying value system that supports actions towards sustainability.*

Keywords: alternative agriculture, learning communities, local knowledge, on-farm research, social networks

Introduction

Sustainability of agricultural systems depends on careful balance of ecological, financial, and social capitals (Flora and Kroma, 1998). Agricultural researchers and practitioners in developing countries increasingly recognize that the strategic manipulation of these sustainability capitals is in part undergirded by local ecological knowledge grounded in farmer experience and practice (Colin, 1994; McCorkle, 1994; Warren, 1994). That knowledge, experience, and practice emerges in the context of communities of interest. Communities are interactions of individuals and groups for mutual support and are not limited by geography.

M.M. Kroma is Assistant Professor, Department of Education, Cornell University, Ithaca, NY 14850, C.B. Flora is Professor of Sociology and Director, North Central Regional Center for Rural Development, Iowa State University, Ames, IA 50011. Corresponding author is M.M. Kroma (mntk26@cornell.edu).

What farmers in developing regions do, and why they do it, is seen as constitutive of a complex but systematic knowledge and learning system based on principles of experience, practice, and native intellect. The knowledge that system creates and the learning that occurs in the process are keenly attuned to the ecological specificity of place and the realities of local culture and economy (Feldman and Welsh, 1995; Kloppenburg, 1991).

In contrast, agriculture in the United States is dominated by a capital-intensive, high-input management system historically supported by scientific agricultural knowledge and technology. Scientific agricultural knowledge developed in controlled environments (laboratories) and experimental settings (agricultural experiment stations) is often assumed to be superior to knowledge developed in farmers' fields (Molnar et al., 1992). Because that knowledge is defined as independent of context, and therefore, putatively objective, it is assumed to be generalizable across different spatial and temporal locations. By eschewing context and specificity, however, scientific agricultural knowledge obscures the existence of local agricultural knowledge emerging from farmer experience, while sustaining a view of farmers as recipients and consumers of knowledge. As a consequence, the cognitive dimensions of local knowledge have not been subject to systematic study. More importantly, the potentials to enhance the sustainability of agricultural systems, which are embedded in such knowledge, have not been fully realized.

In this article we assess the process by which farmers in the north central U.S. creatively produce agricultural knowledge through on-farm research. Through an interpretive exploration of the discursive contents of their reports to a funding agency, we highlight indicators that suggest that their locality-specific agricultural practices may constitute a reflective and learning community, generating local knowledge keenly attuned to an underlying philosophical value system that supports actions towards sustainability.

Exploring critical linkages between local knowledge and patterns of decision-making, and highlighting indicators reflected in farmers' discourse increase confidence in the value of locally generated knowledge for achieving a more sustainable agriculture. These exploratory insights lay the foundation for systematically and empirically accessing the ways that local agricultural knowledge is created, socialized, and exchanged.

The Research Context

Through the Food Security Act of 1985 (P.L. No. 99-198, sections 1461-1471), the U.S. Congress authorized the Sustainable Agriculture Research and Education (SARE) program in response to a movement for greater institutional support of sustainable agriculture research. The Food, Agriculture, Conservation, and Trade Act of 1990 changed the program's name from Low Input Sustainable Agriculture (LISA) to Sustainable Agriculture Research and Education (US GAO, 1992). While initially dominated by university and private nonprofit sector agricultural scientists, the program was expanded in 1992 to directly include farmers. Financial support is offered to farmers interested in local inquiry on agricultural problems with direct relevance to real-world farming conditions and sustainability issues. Because of the specificity of agricultural research, administration of the program was established on a regional, rather than national, basis.

The North Central Region Sustainable Agriculture Research and Education (NCR SARE) program became the first regional program within SARE to support the direct participation of farmers in sustainable agriculture research and experimentation when it initiated, in 1992, its small grants program for farmers and ranchers. Because SARE's North Central Region has the longest history of farmer research, we chose to examine projects from the 12 states in this region (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin). We presumed that farmers involved in local-level research initiatives have accumulated a store of experiential knowledge, the cognitive dimensions of which contribute to expanding the grassroots knowledge base for sustainable agriculture.

In the S ARE Producer Grant Program's annual "call for proposals" to farmers and farmer groups, prospective participants are invited to undertake research that tests, evaluates, and adapts sustainable agriculture practices relevant to their operations. Providing evidence of activities that reflect collaborative learning events, such as learning circles, field days, or on-farm farmer demonstrations as means of disseminating novel agricultural information to other interested farmers, is part of the grant requirements. While participants may collaborate with university researchers, it is not an explicit condition for award of a grant.

A regional body, the NCR SARE Administrative Council, consisting of farmers, researchers, and extension agents, assesses funding proposals and approves grant awards based on specific criteria. From 1992 to 1995, the North Central SARE Producer Grants Program, on the recommendation of the NCR SARE Administrative Council, awarded a total of 158 grants to farmer-researchers to support their on-farm inquiry on alternative production systems and technology (NCR SARE, 1997). An important condition that attends the award of a grant is that the farmer-researcher prepares an annual and final report documenting activities, experiences, and progress towards the achievement of research goals. The final reports for the 68 projects that were completed in 1997 provide the data for this analysis.

The Hermeneutic-Interpretive Method

We draw on established methodologies of analyzing qualitative data (Denzin, 1989; Miles and Huberman, 1994) to explore the discursive contents of farmers' annual reports to a funding agency. Our objective is to understand the process by which farmers took action on their farms to create new knowledge, giving meaning to their practical experiences that, in turn, has shaped their actions towards nature and community. This interpretive approach attempts to understand the world of lived experience and how such meanings shape perception and self-action (Denzin, 1989; Miles and Huberman, 1994). Accordingly, we uncover the voices and actions of the farmers through reflecting on and interpreting the experiences documented in their reports. All communication involves expected responses by the presumed audience. The authors of the reports, representing the farm households or groups in which the research was done, were writing for the SARE program, for which sustainability of agriculture is a key expected outcome. Thus we would expect that the discourse of the reports would touch upon sustainability in ways that reflect the authors' understanding of that concept. Our non-intrusive method of analysis examines natural outcroppings of data that arise as part of the granting process.

Wainwright (1994) has drawn attention to the production of practical, experience-based knowledge as a social process distributed, valued, and appropriated in ways that can be transformable. While not specifically emphasizing personal practical knowledge, Eyerman and Jamison (1991) similarly point to the importance of grassroots actors' cognitive activities in transforming knowledge and shaping action.

Eyerman and Jamison (1991) identify three dimensions of transforming knowledge and shaping action, which they describe as cognitive praxis:

1. underlying world views and values,
2. the type of knowledge created, and
3. the social organizational form characterizing the sharing and exchange of knowledge created.

By linking values and contextually situated experiences to the creation of different types of knowledge, these perspectives present a useful crucible for exploring how a knowledge process, relevant to a particular cultural environment, can shape actions toward sustainable agriculture.

Adapting Eyerman and Jamison's conceptual dimensions, we interpretively identify and trace thematic patterns and regularities across the reports. We identified passages in the reports that reflect or symbolically infer

1. why farmer-researchers do what they do,
2. the kinds of knowledge/practice emerging from the context, and
3. the participatory process mediating the creation and dissemination of emergent local knowledge/practice to the broader community of farmers interested in alternative agriculture.

We employ "thick description" in reading and interpreting symbolic meanings embodied in the texts of their final reports.

Each SARE farmer-researcher report is interpretively "read" to identify underlying values, social meanings, and type of knowledge directly conveyed or inferred linguistically and/or symbolically by the text. We interpret the relationships between those values and the documented

agricultural activities. We then discuss elements of critical technical knowledge reflected in their discourse and the social organizational framework within which a process of knowledge creation, exchange, and learning are intertwined and mediated as "praxis."

Because the data are natural outcroppings of information originally gathered for another purpose, the analyses constitute an interpretation of ideas and themes constructed in the texts, and are not observations of actual processes as they occurred in the contexts of farmer practices. It is conceivable that the perceived demands and worldviews of the funding entity may have an influence on how discourses are constructed. But as Rochon (1998) argues, the link between values and public discourse often leaves an imprint in the form of new ideas and new philosophical positions that one can observe by examining the texts in which they are embodied. In the context of this study, such insights can become the critical foundation for in-depth participant observation of the cognitive process as it unfolds in local arenas.

Analysis and Discussion

Why SARE farmer-researchers do what they do: Values that drive inquiry

The driving forces behind SARE farmer-researchers' actions and choice of farming practices fall into three distinct but overlapping categories or value sets: environmental sustainability, economic sustainability, and social sustainability. Environmental sustainability broadly refers to an ethic of farming that values the natural resource base in itself (land, water, air), while recognizing that the resource base is to be protected and conserved, even as it is manipulated for human survival. Economic sustainability, as reflected in SARE farmer-researchers' reports, relates to the ability to manage a farming operation whose net returns exceed its net expenditures consistently through time. Social sustainability broadly encompasses the value of relationships, quality of life, and social justice.

Regular recurrence of each category or value set indicates the importance of that underlying value, which, in turn, shapes the actions and decisions of farmers in relation to their production practices. Of the 68 farmer-researcher reports, 76% acknowledge the importance of ecological/environmental values. Sixty-four percent reflect an emphasis on economic sustainability as impetus for participation, while 20% mention social sustainability values.

Table 1. Categories of sustainability identified by SARE-funded farmer researchers[1] as important in the selection and application of farm management practices in the north central U.S.

Social sustainability	Economic sustainability	Environmental sustainability		Total
		Yes	No	
Yes	Yes	3	1	4
Yes	No	8	2	10
No	Yes	31	11	42
No	No	12	—	12
(Total)		54	14	68

[1] Numerical values were derived from reports of farmer-researchers (total 68) and indicate their views on the relative importance of the three categories of sustainability comprising the SARE program. For example, 31 farmer-researchers considered both economic and environmental sustainability as principal motivating factors, but social sustainability less important. Moreover, 11 farmer-researchers considered economic sustainability as most important, with social and environmental sustainability less so.

The values identified are not mutually exclusive. While some farmer-researchers ascribe direct importance to only one category, others identify more than one category as important in shaping their choices of agricultural practices. This reflects some differences among farmers notwithstanding their common interest in alternative agricultural knowledge and practice. Table 1 shows the overlaps among the reasons farmer-researchers give for participating in the SARE program.

As shown in the table, only 3 of the 68 farmers identify all three sustainability categories as reasons for their participation. Thirty-one farmers (46%) identify both economic and environmental sustainability concerns as motivating factors for their participation. This distribution suggests that farmers involved in local processes of inquiry do not necessarily constitute a homogenous pool, or ideologically subscribe to a unitary value as a basis for participation. Illuminating differences in motivation can be critical in revealing barriers that mitigate shifts to alternative systems of management. For ease of conceptual clarity, the motivating factors are discussed separately.

Environmental sustainability

The values of environmental sustainability, though intertwined with other underlying values, are evident as motivating factors in sustaining SARE farmer-researchers' interests in participating in on-farm research. As stated by one farmer-researcher,

> [O]ur objective, increased diversity, was achieved through more accurately mimicking the key pressures that shaped the diverse prairie. Our grazing system can be viewed as a miniature prairie: solar energy is the primary input. Plant, animal, and soil health are interdependent. The massive migrating herds, we believe, were chiefly responsible for maintaining, if not also creating, the vast diversity of the prairie. By more closely approximating the density (caused by predators) and migration of these herds, diversity is increasing [Report no. 44: rotational grazier, Missouri].

Many farmer-researchers recognize diversity as important and associate it directly with reduced chemical inputs. Their adoption of ecological practices that nurture diversity is contrasted with conventional systems that favor homogeneity as opposed to "mimicking" nature. According to one farmer-researcher,

> [I] have been farming with reduced or no chemical inputs for the last 20 years ... The absence of sprays contributes to the diversity in the pasture because of the clovers and other broad leaves that are otherwise destroyed ... [Report no. 3: diversified producer, Nebraska].

These excerpts illustrate the recogni-

tion of values that celebrate working in harmony with nature, as opposed to controlling it, and a personal satisfaction in the feeling that one's production practices are adding value to nature, as opposed to accelerating its deterioration. That cognition is translated into an affirmative moment that becomes the motivator for sustaining action and further retooling towards sustainable agriculture.

Economic sustainability

For some farmer-researchers, the choice of sustainable agricultural practices is directly linked to their searches for alternative management systems that can secure financial viability, as their conventional systems become more vulnerable to market forces and politically driven economic changes. As stated by one farmer-researcher,

> In a recent University of Wisconsin Extension Report dealing with the Dairy 2020 initiative, it was noted that farm commodity prices would not be on an upward trend in the years to come. In order to survive into the 21st century, dairy farmers must quickly become low-cost, market-oriented, and profit-driven producers. There are many ways to achieve the above advice, including the adoption of rotational grazing practices and allowing young stock specialists to raise the dairy owners' animals. Why did the grant recipient consider and ultimately develop a heifer harvesting, grass-legume based feeding system for half the year? The economic efficiencies of forage production provide the answers [Report no. 24: rotational grazier, Wisconsin].

While a farmer may be aware of the potential economic benefits of alternative practices and have a desire to shift to more sustainable practices, a perceived economic barrier can prevent a farmer from attempting alternatives. That perception of financial risk can be a critical element mediating a shift towards sustainable agriculture. According to one farmer-researcher,

> Implementing a project like this requires innovation and the willingness to put some of your land "at risk" for experimentation. A person never knows what can ultimately happen, even though everything is well planned. The advantage is that a new practice can be developed with SARE helping, thereby reducing the risk for the farmer [Report no. 34: certified organic farmer, Minnesota].

Social sustainability

For others, participation is less a matter of some financial or environmental consideration than of quality of life. For example, the following excerpt from a farmer in Michigan shows that farm families with older operators can be forced to shift practices as conditions favoring large-scale operations become unfavorable.

> Since our children are grown and gone, my wife and I needed to assess and change our workload. We became interested in management-intensive grazing. We hadn't done much grazing prior to this, as our operation was conventional, using stored feed fed in confinement, with small exercise paddocks [Report no. 32: rotational grazier, Michigan].

Farmer-researchers achieve social sustainability in terms of quality of life and personal empowerment or autonomy in decision-making; social sustainability is a value that emerges as a central tenet underlying their motivation for participation in the SARE program. Quality of life in this context is different from objective measures of material well-being, such as educational and literacy levels, personal income, and personal net worth. It emerges in farmer-researcher reports as subjective rather than objective and relates to personal, family, and life goals, such as time and labor flexibility.

Some farmers link quality of life directly to their ability to satisfactorily "carve out" individual and family leisure time from the necessary demands of production. Others attribute lack of quality time to being locked in a conventional system that they find increasingly unprofitable. For example, one farmer-researcher stated that,

> Our goal was to diversify our current farm operation by establishing a farrow-to-finish swine facility with attached pasture. We felt that diversifying our farm was the first step in creating a sustainable and self-sufficient operation; however, there were other family- and community-oriented goals we considered. We wanted a livestock enterprise that would allow us to work together as a family unit. This would increase our "family time" and give us the opportunity to teach our children responsibility. We also wanted a community [Report no. 43: diversified livestock farmer, Minnesota].

The value of "family time" is reiterated in many farmer reports. Spending time with their children stands out as an especially valued goal that appears to influence farmers' participation in a process that sustains an alternative approach to agricultural practice. Indeed, for some, enhanced quality of life became an unanticipated bonus realized as they continued innovating along the continuum of sustainable practices. As this farmer-researcher articulates,

> [O]ne of the most important benefits for our family is the reduction of labor and time. With rotational grazing, one person can feed, move animals and watering systems, and put up paddock fences, with the added benefit of getting in daily walks and social time with our two young children [Report no. 31: rotational grazier, Wisconsin].

Research focused on quality of life at the household level (Meares, 1997; Striegel, 1996) shows that the dimensions of love/respect, empowerment, and family recreation time are the most important, although gender can lend nuance to perceptions of quality-of-life dimensions as well. Relational dimensions, such as respect, reciprocity, and cooperative relationships with other farmers, constitute additional dimensions of quality of life that some farmer-researchers acknowledge.

Farmer-researcher inquiry and local knowledge: An emergent cognitive process

SARE farmer-researchers have diversified farm enterprises, integrating crop and livestock operations or dissimilar crop types and legumes in rotations. Their reports manifest a preference for crop and livestock diversity, substituting low-impact, stabilizing ecological processes through crop rotations and innovative, diversified production enterprises. The inclusion of a more diverse set of alternative crop species reflects, in effect, a dynamic learning process as farmers observe the outcomes of new crop-microenvironment interactions within specific and localized agroecologies.

Farmer participation in alternative practices can be symbolically understood as reflecting a conscious search for an alternative approach to agricultural production that expresses farmers' broader defi-nition of themselves in relation to

agricultural practice and its potential environmental and social impacts. As one farmer-researcher reflects,

> With the help of this grant we were exposed to many different ideas and thoughts on IRG (intensive rotational grazing) and how they may be applied in our own operation. We have reached the conclusion that it is not an exact science with absolutes, but a varied system that you learn to manage by on-going observation. The effect this has on our operation will be an on-going observation of our financial results, as well as our environmental management and our lifestyle [Report no. 32: rotational grazier, Michigan].

Pasture-based livestock management or management-intensive rotational grazing has not been a priority research agenda in the last several decades, as is reflected in the dearth of scientific knowledge on its general principles and practices (Liebhardt, 1993). Scant knowledge on this management system has also meant that farmers who have adopted this alternative have, by necessity, needed to engage their mental and creative potentials through experimentation with different techniques and practices of management-intensive rotational grazing. The locale-specific learning experiences and technical knowledge that had grown out of farmer practice consistently run through their reports. The reports suggest creativity in the way farmer-researchers are implementing pasture management. The dairy and beef cattle research reports reflect keen attention to subtle changes and sensitivity to complex interactions in the grazing environment. Through their practices, farmers have come to appreciate the complexity of the process and gain a self-consciousness of the skills, ingenuity, and creativity they contribute to the knowledge base of that management system. As one farmer-researcher puts it,

> An individual who is seriously considering the start-up of a custom heifer grazing business must deal with more than economics. Management-intensive grazing demands plenty of "brain-power" and open-mindedness. One ultimately must develop entrepreneurial, as well as observation and interpretation skills, to be successful [Report no. 25: rotational grazier, Wisconsin].

Farmer-researchers' reports suggest that where a crop-based enterprise is the choice, the management strategy often includes complex crop rotations rather than simple rotations. A carefully planned and executed crop rotation includes a sequential combination of nitrogen-fixing legumes (grown not for harvest, but to serve the purpose of a green manure) with conventional cash grains, oilseeds, and vegetable crops, to increase temporal and spatial diversity of crops. Those interests and values are usually reflected in the very detailed descriptions of farmer-researchers' farm and production enterprises. This farmer-researcher's description of his operation presents an illustration:

> The "S" family farm has been practicing low-input biological/organic farming for the past 20 years, utilizing crop rotations, manures (green and livestock), and natural soil amendments (lime, soft rock phosphate, gypsum, etc.). When row crops were grown, cultivation was used to control weeds [Report no. 56: organic farmer, Michigan].

Satisfactorily balancing complex crop rotations (i.e., using the most appropriate alternative species), while adjusting a range of other related practices (such as estimating correct seed application rates, or the correct height of pasture grasses for grazing), demands finely honed powers of observation, intuition, and ingenuity on the part of the farmer. Developing these abilities can transform and extensively sharpen a farmer's "performance skills" as that experiential process unfolds through time. Farmers not only come to recognize that their activities constitute a process, but to consciously understand that such actions can lead to important new ways of thinking and accumulating knowledge that is qualitatively different from conventional knowledge.

To complement their crop rotation practices, SARE farmer-researchers also experiment with other alternative cultural and pest control strategies, including biological controls. For example, a diversified farmer in Illinois set out to find the soil-enriching and nitrogen-fixing benefits of hairy vetch, a leguminous crop. He documents his experiences this way:

> No one had experience with no-tilling hairy vetch into a heavy stand of fescue. I could only make an educated guess that it would work. And virtually no one incorporated hairy vetch or followed it with milo. The closely mowed fescue had more vetch growth early because there was less shading, but by May there was no apparent difference. The vetch was not killed, since the field is still in the CRP [Conservation Reserve Program] .... The fescue was completely killed by the vetch. The vetch could be pulled back and only a few yellow blades of fescue could be found ... [I]n 1993, there was no difference in the hairy vetch growth where the fescue was mowed extremely low or 8 to 10 inches high. Logic would say that mowing height could affect growth some years [Report no. 8: diversified crop farmer, Illinois].

Although conventional research shows that certain chemicals released or derived from some crops can sometimes substitute for purchased herbicides, those crops, which are generally referred to as allelopathic crops, have not been a priority in U.S. breeding programs (Liebman and Janke, 1990). As farmers shift towards more sustainable agriculture, their experimentation with alternative weed management strategies places them strategically at a point where they are generating their own personal insights on allelopathic crops and how such crops work within their specific contexts. Although the farmer's immediate interest is usually couched in terms of "What works on my land?," over the course of the research, that personal knowledge is often translated into a set of general principles. The process of experimentation uncovers consistent patterns and systemic interactions within the crop-weed and soil microbial environment.

Farmer-researchers' crop and livestock choices and the local inquiry they pursue in support of their management strategies reflect their roles as innovators of technologies and creators of new knowledge in agriculture. In particular, they illustrate how philosophical shifts in the "ought" questions of agricultural practice (i.e., values, beliefs, and ethics) can motivate technological innovation that, in turn, can shape the level and depth of farmers' knowledge of what works for them in their particular localities.

The learning forum: Mediating knowledge exchange and action

Social networks. Grassroots networks constitute an important dimension of sustainable/alternative agriculture (Hassan-

ein, 1999). About one-third (23) of farmer-researchers' reports reflect a linkage with a sustainable agriculture network or organization. Although that link is not an indicator of formal membership, we argue that their participation reflects an orientation to, or affinity with, the broader philosophical principles defining sustainable agriculture, to which those groups subscribe. That self-expressed affinity constitutes a socio-psychological foundation of a group identity that can be gradually amplified and transformed with sustained interpersonal interaction in farmer networks.

Farmer-researchers' reports infer a wide array of types of relationships. Membership in established grassroots networks is explicitly documented in some reports, as noted by the following passage:

> ... as part of our involvement with the Chequamegon Organic Growers (COG), our local producers network, we were able to ... [Report no. 33: organic fruit grower, Missouri].

Overall, 23 SARE farmer-researchers' reports documented membership in sustainable agriculture groups or related organizations. Some grassroots networks were also directly involved in "group" research activities with the aid of SARE grants. An example is excerpted as follows,

> Our research area includes the farms of roughly 100 members of the Southeast Minnesota grazing clubs. Currently there are a total of five neighborhood grazing clubs which meet at our neighbors' farms throughout the year to examine members' pastures and farming operations, discuss management methods and techniques, and network [Report no. 5: rotational graziers' network, Minnesota].

More commonly, networking activities are expressed in terms of field days held and participation in similar events on other farms. As stated by one farmer-researcher,

> Our field day was held on October 17 to explain and demonstrate our projects. Over 60 people attended from 3 states. We are on the agenda to give a slide presentation about our project at the 1994 Upper Midwest Organic Conference [Report no. 6: certified organic farmer, Wisconsin].

Farmer-researchers ascribe great importance to their grassroots networks as arenas for the cognitive valuation of their local knowledge and techniques. They perceive their social networks as important arenas for sharing and exchanging that knowledge. Indeed, this is thematically reflected in all but 2 of the 68 reports ana-lyzed. According to one farmer-researcher,

> On-farm research and experimentation, however loose and uncontrolled, is the best form of research to impact us farmers. We find that farmers trust other farmers much more than they trust university researchers. There is a feeling that the universities are not living in the "real world." Whereas if a farmer can make it work, then it is worth looking into ... However, it certainly helps to have university folks [available] during our presentations, because some of the issues can be supported by university research and/or some technical questions can be answered by them as well ... [Report no. 39: diversified livestock farmer, Missouri].

That farmers who have shifted from conventional agriculture to alternative agriculture find the institutionalized agricultural knowledge and extension system less useful is increasingly acknowledged in the discourse on alternative knowledge (Gerber, 1992; Hassanein and Kloppenburg, 1995). Paralleling that is the recognition that the knowledge requirements for alternative agriculture are different from the knowledge and information needs of the conventional, high-input system of agriculture (Altieri, 1993; Dlott et al., 1994; Francis et al., 1990; Rosmann, 1994). Consequently, as the farmers' reports suggest, alternative agriculturists value locality-specific and holistic knowledge, while tacitly acknowledging the need for knowledge boundaries that remain permeable to other potential sources of knowledge.

That alternative agriculture is now more favorably viewed among some mainstream science experts is tribute to how successfully its adherents have created a web of networks through which their cognitive processes and collective identity are constantly negotiated, affirmed, and legitimized. Field days, pasture walks, grazing club meetings, and informal workshops are integral components of the network activities of SARE farmer-researchers. Those activities attract other farmers, as well as institutional experts both within and outside the land-grant university complex. Among these communities of interest, cognitive exchanges are horizontally rather than vertically organized; one-on-one exchange is the norm rather than the exception.

Some SARE farmer-researchers view being part of an alternative knowledge network as more than an opportunity to cross-check technological innovations or establish the validity of a particular agronomic practice. They perceive social networks as spaces for fostering solidarity, building affective ties, and developing social capital. Thus, they express the reasons for their participation in terms of the opportunities that are created to meet with other farmers and build a personal community of interest. According to one farmer-researcher,

> Our interest in sustainable farming has involved us with a (hopefully) growing community of people who share our views about the importance of all of those factors to the future of agriculture ... [Report no. 25: rotational grazier, Wisconsin].

Knowledge flows for sustainable agriculture in the north central region

SARE farmer-researchers' reports show that cognitive practices are social. The flow of knowledge from its local contexts of creation also involves important processes of social interaction, negotiation, and mediation. The knowledge flow processes that farmers describe seem to mirror a continuity of cooperative activities characterized by mutual learning primarily among farmers, while extending the boundaries of flow to embrace the wider community of interests in sustainable agriculture.

Much of the knowledge created through farmer-led processes of inquiry flow through direct informal exchanges that occur during field days, pasture walks, and farmer workshops, or through newsletters and published monographs of sustainable agriculture organizations. Table 2 lists various modes and methods of sharing and exchanging knowledge as identified in SARE farmer-researchers' reports.

Field days are the most common, with 25 out of 56 farmer-researchers indicating they hold one or more field days during the tenure of their respective grant programs. Twelve reports did not indicate whether the farmer researchers participated in any knowledge exchange activity. An instruc-

Table 2. Modes and methods of sharing and exchanging knowledge as identified in SARE farmer-researchers' reports.

Modes and methods of communication	No. of farmer-researchers (n=56)
Field days/pasture walks	25
Newsletters	18
Workshops	11
Community newspapers	9
Published monographs	6
Professional journals	1

tive insight farmers infer in their reports is that the processes of knowledge flows, like the inquiry process itself, can be participatory. Farmers describe researchers and extension personnel as pivotal to the success of farmers' field-based social and communicative events. As partners, university researchers are also described as centrally involved in the dialogue on emergent insights from the inquiry, answering questions and complementing farmer responses to questions from participants. For example,

> We held one field day and one pasture walk. Over one hundred people, three implement dealers, and resource people attended the field day from MSU [Michigan State University]. Fifteen people attended the pasture walk with [Dr. M.] from MSU sharing his expertise as they walked the paddocks at both farms. Both these events were featured in our local newspapers [Report no. 29: rotational grazier, Michigan].

Because all participants are involved in interpreting and sharing research findings, this process can be viewed as democratic. Participants not only enjoy the autonomy of "seeing" through the lenses of their own personal experiences, but they are also empowered by the recognition that they can be teachers as well as learners.

Conclusions

This assessment of SARE-funded farmer researchers' reports strongly suggests an approach to knowledge creation and sharing within an agricultural landscape that is rapidly changing in both economic and social complexity. Production and distribution of undifferentiated agricultural commodities has become more globalized and centralized, while growing consumer demand for specialty products grown under environmentally safe conditions is creating greater diversity in production enterprises located in strategic niches.

The values encapsulated in local-level farmer activities suggest an emergent community of producers driven less by the imperative to maximize a single goal than by the desire to optimize multiple goals. The related multiple goals of sustainable agriculture enfold a search for knowledge and ideas that enhance financial sustainability, while sustaining the quality of our environmental capitals (water quality, soil quality, and ecological diversity) and quality of life.

Public support of this process, as reflected in the award of USDA producer grants, constitutes a critical challenge for public sector research and extension. Research and extension needs to take the initiative for empirically verifying the cognitive value of local agricultural knowledge, and concretely establishing the relationship between this knowledge base and the adoption of management strategies that foster sustainability. Institutionalizing sustainable agriculture requires integrating local agricultural knowledge into the broader knowledge base for productive activities.

This assessment of SARE-funded farmer research highlights critical indicators of local knowledge and underscores the need to move beyond reasoned speculation to systematic verification. The former abounds in current studies on farmer knowledge in the U.S. There is some ur-gency for the latter if public sector research and extension are to sustain their historic public mission of serving all ag-ricultural constituents irrespective of social location, while responding to the demands of a sustainable agriculture.

References

1. Altieri, M.A. 1993. Crop Protection Strategies for Subsistence Farmers. Westview Press, Boulder, CO; IT Publications, London.
2. Colin, J. 1994. Systems of production and production of knowledge. Farming Systems Research-Extension 4:31-46.
3. Denzin, N.K. 1989. Interpretive Interactionism. Applied Social Research Methods Vol. 16. Sage Publications, London.
4. Dlott, J.W., M.A. Altieri, and M. Masumoto. 1994. Exploring the theory and practice of participatory research in U.S. sustainable agriculture: A case of insect pest management. Agric. Human Values 2:126-139.
5. Eyerman, R., and A. Jamison (ed.). 1991. Social Movements: A Cognitive Approach. Polity Press, Cambridge, U.K.
6. Feldman, S., and R. Welsh. 1995. Feminist knowledge claims, local knowledge, and gender divisions of agricultural labor: Constructing a successor science. Rural Sociol. 60:23-43.
7. Flora, C.B., and M. Kroma. 1998. Gender and sustainability in agriculture and rural development. In G.E. D'Souza and T.G. Gebremedhin (eds.). Sustainability in Agricultural and Rural Development. Ashgate, Brookfield, VT. p. 105-118.
8. Francis, C., J. King, J. DeWitt, J. Bushnell, and L. Lucas. 1990. Participatory strategies for information exchange. Amer. J. Alternative Agric. 5:153-160.
9. Gerber, J.M. 1992. Farmer participation in research: A model for adaptive research and education. Amer. J. Alternative Agric. 7:118-121.
10. Hassanein, N. 1999. Changing the Way America Farms: Knowledge and Community in the Sustainable Agriculture Movement. Our Sustainable Future Vol. 12. University of Nebraska Press, Lincoln.
11. Hassanein, N., and J.R. Kloppenburg, Jr. 1995. Where the grass grows again: Knowledge exchange in the sustainable agriculture movement. Rural Sociol. 60:721-740.
12. Kloppenburg, J.R., Jr. 1991. Social theory and the de/reconstruction of agricultural science: Local knowledge for an alternative agriculture. Rural Sociol. 56:519-548.
13. Liebhardt, W.C. 1993. Farmer experience with rotational grazing: A case study approach. In W.C. Liebhardt (ed.). The Dairy Debate: Consequences of Bovine Growth Hormone and Rotational Grazing Technologies. University of California, Sustainable Agriculture Research and Education Program, Davis. p. 131-188.
14. Liebman, M., and R. Janke. 1990. Sustainable weed management practices. In C.A. Francis, C.B. Flora, and L.D. King (eds.). Sustainable Agriculture in Temperate Zones. Wiley and Sons, New York. p. 111-143.
15. McCorkle, C.M. 1994. Farmer Innovation in Niger. Studies in Technology and Social Change No. 21. Iowa State University, Technology and Social Change Program, Ames.

16. Meares, A.C. 1997. Making the transition from conventional to sustainable agriculture: Gender, social movement participation, and quality of life on the family farm. Rural Sociol. 62:21-27.
17. Miles, M.B., and A.M. Huberman. 1994. Qualitative Data Analysis: An Expanded Sourcebook. 2nd ed. Sage Publications, London.
18. Molnar, J.J., P.A. Duffy, K.A. Cummins, and E. Van Santen. 1992. Agricultural science and agricultural counterculture paradigms in search of a future. Rural Sociol. 57:83-107.
19. NCR SARE. 1997. Operations Committee Report and Update for Fiscal Year 1996, North Central Region SARE. University of Nebraska, Lincoln.
20. Rochon, T. 1998. Culture Moves: Ideas, Activism and Changing Values. Princeton University Press, Princeton, NJ.
21. Rosmann, R.L. 1994. Farmer-initiated on-farm research. Amer. J. Alternative Agric. 9:34-37.
22. Striegel, R.M. 1996. Development and Initial Validation of the Sustainable Quality of Life Questionnaire. Ph.D. diss. University of Iowa, Iowa City.
23. US GAO. 1992. Sustainable Agriculture: Program Management, Accomplishments, and Opportunities. GAO/RCED-92-233. U.S. Gen. Acctg. Ofc., Washington DC.
24. Wainwright, H. 1994. Arguments for the New Left: Answering the Free Market Right.Blackwell, Oxford, U.K. p. xii.
25. Warren, D.M. 1994. Indigenous agricultural knowledge, technology and social change. In G. McIsaac and W.R. Edwards (eds.). Sustainable Agriculture in the American Midwest: Lessons from the Past, Prospects for the Future. University of Illinois Press, Urbana. p. 35-53.