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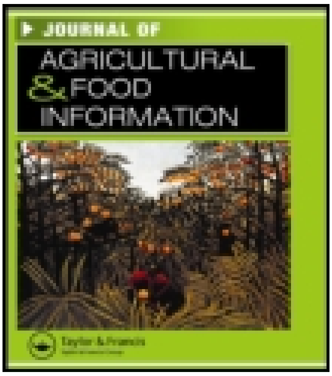

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Global Networks in Local Agriculture: A Framework for Negotiation

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Global Networks in Local Agriculture: A Framework for Negotiation

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Agricultural systems operate through the enrollment of local actors into social networks. These social networks share common idioms and expectations concerning appropriate knowledge and practices. Interaction and competition between social network segments creates the potential for technological change and sustainable production. In the past, global actors enrolled local actors into the networks of modern agriculture through the success of the technology transfer model. However, the innovation to resolve the current problems of local agroecologies requires a more reflexive approach. The adaptive management model facilitates the negotiation of boundaries between networks while addressing the most pressing issues of sustainable local agriculture.

KEY TERMS *adaptive management, globalization, innovation, knowledge networks, local agriculture, negotiation, social learn-*

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ing, social networks, sustainable agricultural systems, technological change, technology transfer

INTRODUCTION

This article is about social networks and their relationship to change in agricultural production systems in the context of globalization. Under what conditions and by what mechanisms is local agriculture promoted or constrained in its performance? Of course, technology availability is a limiting factor, but for a technology to be useful it must be perceived as such by the social actors involved. What appears to be an opportunity from one perspective may be a livelihood threat, or simply meaningless from another. “Social networks” and “technological idioms” are introduced here to better understand what filters and shapes these perceptions.[1]

People and technologies are interconnected in ways that reinforce and reproduce (institutionalize or codify) some types of knowledge and behavioral practices and not others.

In discussing networks, I will make three basic points. First, the shaping of desired outcomes operates through a set of relationships (a network) that share a common terminology (discourse, idiom) and expectations concerning appropriate practices. The Green Revolution modeled a particular network structure and idiom around the theme of scientific agriculture and technology transfer. Alternative agriculture (e.g., organic or conservation) models another network of agricultural transformations around the theme of sustainability. Similarly, local agricultural communities model locally meaningful agricultural network structures and idioms around their place-based production systems.

The second point is that networks shaping decision making are composed of network segments which may be either autonomous or dependent. Individuals, households, and groups organize themselves according to specific discourses that define roles and behaviors for those included in the network. There is competition between these structured network segments for control of what constitutes knowledge and appropriate practice. When various network segments vie for dominance, similar terms used to classify roles and behaviors may be interpreted differently from various perspectives or may disappear altogether. As relationships change, there are winners and losers; new discourses intermingle and may be translated across great distances.

[1] A number of social network methodologies and approaches are currently being promoted. They all have a considerable amount in common, but they all have their technical nuances as well. Here, we frame the discourse in terms more associated with Actor Network Theory, but, that too, has a certain degree of diversity within its ranks. See Lamb, Moore, and Christie (2010) for discussion.

My third point is that today, few—if any—forms of local agriculture exist apart from the influence of global networks. We cannot analyze local agriculture without considering commercial networks linking localities with the dynamic interrelationships and exchanges in the global economy. The involvement of these networks in the complex adaptive systems shaping our agroecologies provides no clean slate to establish pristine agricultural systems.

Röling and Jiggins (1998) set our point of departure over a decade ago.

> Transforming conventional agriculture is not just a question of training farmers, but of social learning in complex interwoven networks of interdependent actors. In most instances, we are not dealing with "virgin country" but with situations in which highly interwoven actor networks have already evolved around the needs of conventional farming. (p. 295)

I would add that "conventional agriculture" could just as easily be replaced here by any local agricultural system that has managed to survive many seasons.

What is it that we should be focusing on when we think about technological change in agriculture? How are actors enrolled in the complex adaptive systems that we call modern agriculture? What is the role of learning in the processes of innovation that change implies? Does learning new ideas/information result in the adoption of new practices? Or, is learning a product of on-going adaptation?

I've been thinking a lot about complex adaptive systems recently. There is a growing literature generated by basic (non-applied) sciences addressing questions of science, innovation, and adaptive management of our global ecosystem (Gallagher & Appenzeller, 1999; Weng, Bhalla, & Iyengar, 1999; Arthur, 1999; Kinzig et al., 2000; Walker, Holling, Carpenter, & Kinzig, 2004; Delmer, 2005; Liu et al., 2007). These insights suggest we have considerable work to do to develop our capacities for social learning for sustainability (Sayer & Campbell, 2004; Henry, 2009). Agricultural processes—and changes in them—routinely interact across the landscape, often in response to previous management decisions. Hence, complexity is caused by multiple actors adapting in response to each other—a type of organized chaos. These new ecosystem scientists are telling us to pay attention to a transdisciplinary set of features: scale, nonlinearity, thresholds, social construction, negotiation, and adaptive management.

This means we need to move beyond the framework of "scientific agriculture" with its linear idiom of technology transfer, because it limits our capacity to realize alternative possibilities for technological change in agricultural systems. My attempts to go beyond this socially constructed barrier have focused on integrating both the structure (social networks, see Wasserman & Faust, 1994) and the idiom/discourse (technological frames, see Bijker, 1995) which shapes agricultural practice and local identities.

The reality of social networks is that they exist in an overlapping web of network relations (Knoke & Yang, 2008). Within these networks certain clusters and individuals have more power than others. There is often domination by a particular paradigm or way of thinking associated with a particular network configuration. Indeed, some disciplines/subdisciplines can more easily invoke popular idioms than others. Actively competing network segments often propose apparently irreconcilable models of agricultural change.

NODES AND TIES

Let's take a look at the tools for analyzing networks. The structural components of the network analytic methodology involve nodes and ties. Nodes refer to individuals, organizations, other meaningful entities, and things. These are seen as actors, having independent agency. Ties are the relationships between nodes which are bound together in some meaningful fashion. These may be strong or weak.

The identity of a node is defined in two dimensions: structural and meaningful. Structurally, nodes can be identified by a relatively stable bundle of socially constructed positions. The structure is reinforced by actor enrollment and translation of meanings to reinforce certain sets of behavioral practices and network relations, but not others. Meaningfully, nodes are a function of stories, idiom, and discourse rationalizing certain behaviors and structures expected of a particular position. An example of a bundle of socially constructed positions would be father-son-brother, versus farmer-manager-laborer or merchant-stock boy-customer. Science is well developed for such rationalizations, but other meaning systems are equally strong in mobilizing behavior and practices, such as religions, local custom or practice, or commerce.

Can you find yourself in the network structure pictured in Figure 1? Find yourself within your network of friends or people with whom you work? Are you at the hub of the network or on the margins connecting that group with others? Who talks to whom in your group of friends? How do you and your network associates identify yourselves? What is the discourse and idiom that makes you part of the group?

Your responses to the above questions are the rationalizations: the stories that you have been thinking about to describe who you are, where you fit, and what your network is about. Are you subversive in one network or another (apparently representing one role, while acting as if another were the one that drives you)? It is said that everyone in the world is linked together by, at most, six degrees of separation, but for all meaningful purposes this connectedness depends on the idiom invoked which enrolls individuals in meaningful roles that indicate some felt/experienced degree of association.

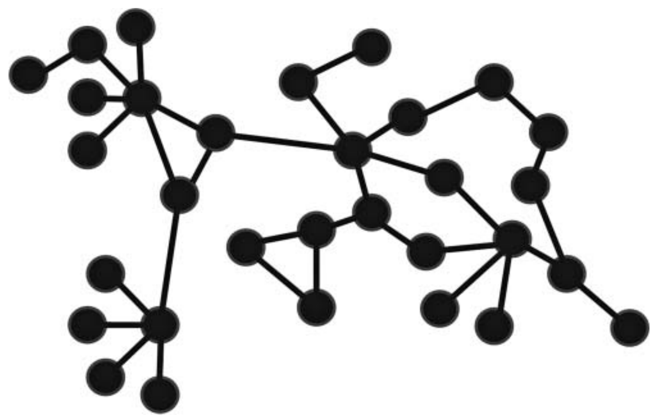

FIGURE 1 A network model for Heuristic purposes. (Figure available in color online.)

KNOWLEDGE NETWORKS

In order to better understand how the process of technological change occurs, I use the concept of knowledge networks. Knowledge networks are systems of rationalization—shared understandings (technological idioms or mindsets) among actors in a system (socioecological network). These shared understandings allow us to act and communicate effectively—a matter of "communicative competence." Knowing is not simply the accumulation of "objective" knowledge about a perceived external world. Knowing and acting are inseparable. Knowledge and behavioral practices are symbiotic and mutually constructed, assuring stability in relationships between people and technologies (Busch & Juska, 1997; Clark & Murdoch 1997; Latour, 1987; Röling & Jiggins, 1998).

Knowledge networks rationalize sociomaterial relationships in the agroecology. The factors shaping technological practices are not simply a matter of autonomous decision making, but are structured by other actors in the reference network extending beyond the farm gate and sharing a common terminology and perspective. Further, there is often competition between knowledge network segments. More than one knowledge network organizing and making sense of the same subject, object, or relational observation often exist. A single person—as an actor in networks—may at one moment see herself as a resource steward and, in the next moment, as a monocropping farmer. In each moment, she is applying different decision-making knowledge and supported in her understanding by a different configuration of network actors.

Knowledge Network Analysis (KNA) is introduced here to account for these two dimensions: structure and meaning. KNA combines Social Network Analysis (Knoke & Yang, 2008) and semiotic network approaches (Shrum,

2000) to understand network dynamics. Furthermore, it focuses our attention on both the internal design and functioning of network segments (including the technological frames which materially bind them together) and the external relations or boundary management governing colonization of or coexistence with other networks. Market networks and the “globalization” idiom with its commercializing logic of material relations offer simplifying universal solutions. Yet, local (indigenous or place-based) knowledge is built on personal interaction fostering networks of trust and understanding. Lacking personal connections to outsiders (scientists or market agents) often induces distrust, leading to relatively resistant and enduring local knowledge networks.

MOMENTS OF ENROLLMENT AND TRANSLATION

How are knowledge networks formed? What are change agents doing? To help us work through this, Michel Callon (1986) has proposed four moments of enrollment and translation in the constitution of subjects and objects as network actors (see Figure 2). The first moment is the invocation of actors around a certain definition of a problem, issue, constraint, or need. The second moment involves a knowledge-promoting actor attempting to impose identities and roles on other actors that support interest in the defined problem, issue, constraint, need, etc. The third moment is when a solution to the defined problem is demonstrated or a critical new piece of information establishes an empirical relationship between components of the network. If this rationalization is successful, in the fourth moment the knowledge network consolidates a consensus concerning the “facts,” and sociomaterial alliances are formed or reinforced across the network. Network knowledge reproduction is ensured through these mutually reinforcing alliances. This process may take some time to evolve—either in minutes, or months, or even years—and is reversible.

Callon’s Moments of Enrollment and Translation in the constitution of knowledge networks

1. Invocation of actors around a certain definition of a problem/issue
2. Imposition of identities and roles on actors relative to defined issue
3. Demonstration of a solution or critical information to the defined problem rationalizing empirical relationships between network components
4. Consolidation of sociomaterial alliances and consensus concerning the “facts”

Adapted from Callon, 1986

FIGURE 2 How networks form: Network enrollment and translation.

TECHNOLOGY TRANSFER KNOWLEDGE NETWORK

The Technology Transfer (TT) Model is a knowledge network based on the idiom of agricultural change that enrolls actors and translates their relationships in certain ways. The story goes like this: The traditional model of innovation begins with scientists determining a problem to research and developing a new technical invention to resolve it. This leads to an initial prototype developed to initiate the actual innovation phase. Early adopters (i.e., farmers who identify their interests with the proposed solution) pick up on the first commercialized version. Diffusion proceeds as the solution adapts local conditions and the technology is globalized. This conception of innovation sees the researcher at the origin of innovation establishing the validity of "scientific agriculture." Technology transfer is simply a linear extension of the process and provides the foundation for the adoption of innovations idiom.

Following in this tradition, farming systems research and extension was the first to recognize local systems (Collinson, 2000). It improved on the model by stressing on-farm field trials and evaluation—that is, applied research and adaptation. More importantly, however, this model assumes that the knowledge network that supports technological change in agriculture only involves researchers, extension agents, and farmers in its system of meanings.

This post-Green Revolution/Farming Systems Model of technological change resulted in our conventional agricultural production systems which are scientifically constructed to control variability and maximize targeted outputs. Those not conforming to this ideal are considered risk-averse (resistant) agricultural production systems, locally constructed to minimize risk and diversify livelihood options.

The TT Model operates well under conditions where technological change is a matter of component replacement, networks of shared knowledge extend from conception to execution, ecological and market conditions are stable and relatively homogeneous, and investments can be linked with outputs for quantitative priority setting. A common example of this model is the introduction of a new seed variety. Since seeds are easily interchangeable and a well-understood technology, production processes are not usually disrupted by the introduction of a new variety. Under stable ecological and market conditions (whether part of a technological package or not), the output levels of alternative seed choices can be accurately assessed by farmers within a few seasons. Consequently, the transfer of individually understood technologies combines successfully with commercial (globalized) knowledge networks. The TT Model began to decline when questions regarding sustainable resource use arose and production problems associated with crop pests and soil fertility shifted production concerns to the management of more complex ecological dynamics.

ADAPTIVE MANAGEMENT KNOWLEDGE NETWORK

The Adaptive Management (AM) knowledge network is based on the idiom of complex adaptive systems, nonlinearity, scale, etc. (Gunderson & Holling, 2002; Colfer, 2005; Moore, 2009). The set of articles in *Science* (American Association for the Advancement of Science, 1999), Kinzig et al. (2000), and Peat (2002) clearly demonstrate how principles of uncertainty have infiltrated the basic sciences over the course of the 20th century. Consequently, adaptive management and social learning arose in the late 20th century to restore the link between knowledge and action to confront these complex adaptive systems and their associated management problems.

The AM Model implies a different type of system of enrollment and translation (Salafsky, Margoluis, & Redford, 2001; Sayer & Campbell, 2004). It builds on the idiom of participation (Walker et al., 2002) with an open invitation for potentially interested actors. The first moment of enrollment begins with defining the common problem to be resolved. Innovation is a matter of bringing different stakeholder knowledge, skills, and perspectives to the table; deliberating over the various adaptations suggested by the interplay of the ensemble; and agreeing to test a course of action. Secondly, in the process of implementing the course of action, stakeholders come to learn the new roles they must play for success to be achieved. As progress is achieved, the (new) coalition of stakeholders finds a common idiom to translate their success and communicate it to others, enrolling them as partners.

Three trajectories are possible during the third moment of enrollment and translation. If the stakeholders find themselves adaptable to the course of action being tested and the action resolves the agreed upon problem without inducing unexpected problems, then a formal rationalization of the solution is promoted for generalization among other similar actor networks. If the stakeholders find themselves amenable to the search for a solution but don't achieve immediate success, they can repeat the process, building their knowledge about how to develop a viable response. If stakeholders find they cannot work together because the change exposes divisions based on interests or resources within their ranks, solutions and arbitration need to be sought at higher levels of governance.

This process of learning by doing involves a wide range of actors. Consequently, learning is reflexive and mutual—we all change. It is founded on an expectation of diversity, which is seen as a strength rather than something to be standardized according to some global universal. Social learning is about the conscious (i.e., negotiated) construction of knowledge networks.

Learning in adaptive management is an iterative process: actions are taken, monitored and evaluated, and reflected upon and revised as new information from preceding actions becomes available. Translations are tested—enrollment is more open-ended, taking alternative perceptions into account. Since innovation is a reflexive process in which subsequent adaptations are built on lessons learned from previous adaptations, no innovation is expected to be final (Berkes & Folke, 1998). Adaptive management tolerates, even nurtures, different ways of knowing and acting and promotes innovation in problem solving.

To facilitate this collective problem-solving approach, boundary management is required. Networks and platforms are developed on which local actors can negotiate with other network segments and confront challenging cross-scale (often global) issues in complex adaptive systems. Mechanisms for translating knowledge (and its manifestation in technology) across boundaries include farmer field schools, local management committees (CIALs), and advocacy coalitions to name a few (Ekboir, Dutrénit, Martínez, Vargas, & Vera-Cruz, 2009; Wright Morton & Brown, 2010; Pound, Snapp, McDougall, & Braun, 2003; Sabatier & Jenkins-Smith, 1993).

NEGOTIATING KNOWLEDGE NETWORKS

Among network segments, the key mechanism for this participatory learning process is negotiation. Negotiation assumes a diversity of interests and objectives that may or may not be mutually compatible. Consequently, negotiation needs to be built through mutual respect, establishing a foundation for trust.

Negotiation between differing versions of local reality and its potentials can provide a foundation for transformative technological change. Its converse, imposition of an external system, denies locally valued meanings often leading to resistance and subversion. For sustainable progress to occur, stakeholders need to be open to other perspectives and to negotiate the construction of new and improved knowledge networks.

Negotiation takes place at several levels: within and between the sciences; among local and extra-local stakeholders (like up-stream and down-stream in a watershed); between science, local, commercial, and government sources of knowledge; and between nested levels of the state (e.g., local, state, and national). Successful negotiation requires building trust across these boundaries. To influence stakeholders, information needs to be perceived as credible, salient, and legitimate (See Figure 3). Further, successful

To be influential, negotiator messages need to be:

- **Credible:** scientific adequacy for technical evidence & arguments
- **Salient:** relevant to decision-maker assessment of needs
- **Legitimate:** perception that information has been respectful of stakeholders' divergent values & beliefs

Adapted from Cash et al., 2003

FIGURE 3 Effective communication across networks.

negotiation requires the ability to translate from one's own idiom to another. This level of engagement involves modifying one's discourse and empowering the expression of alternative idioms.

Boundary Objects

Bridging between networks also requires that we identify structural artifacts through which translation can occur. Successful negotiation often relies on boundary objects to focus investigative dialog and boundary organizations to provide spaces for negotiation (Goldberger, 2008; Cash et al., 2003). For example, Andean farmers and climate scientists have very little in common between their respective knowledge networks. However, a project researching adaptations to climate change brought them together, facilitating their mutual enrollment around a boundary object—the problem of drought and shortened growing seasons (Valdivia et al., 2010). In the farmers' knowledge network, rainfall was measured with respect to the amount of water available for crop growth. The scientists' knowledge measured rainfall with rain gauges. Two distinct observations were made. The Andean farmers noted that there was less rain than in the past. The climate scientists noted that their rain gauges indicated no substantive change in rainfall levels. However, in trying to understand this discrepancy the scientists noted that there was also a trend of increasing temperatures. Engaging the farmers in the discussion of these findings led to a reformulation of the underlying observation in terms of increased rates of evapotranspiration. This allowed farmers to meaningfully translate their knowledge into scientific knowledge and vice-versa. Further, it suggested the types of adaptations most appropriate to capturing transient soil moisture that both farmers and scientists could support.

Boundary Organizations

Alternative agriculture non-governmental organizations (NGOs) can function as boundary organizations between global markets (applying universal knowledge) and local communities (applying their own knowledge networks). To the extent local NGOs/extension services offer negotiation space, adaptive management can be pursued (Goldberger, 2008; Shrum, 2000). However, it is all too easy to fall into the technology transfer mode.

Farmer Field Schools (FFS) are often promoted as boundary management organizations, facilitating the negotiation of meanings between scientists (including extension agents) and farmers. The FFS model was first introduced by the Food and Agriculture Organization (FAO) to construct new knowledge networks supporting integrated pest management (IPM) in Indonesia during the late 1980s into the 1990s (Kenmore, 1991; Röling & Jiggins, 2004). The approach is a form of adult education based on experiential learning through which new knowledge is negotiated in the field. Farmers observe and experiment with the modification of the ecology of their crops, learning about population dynamics, distinguishing pests and beneficial insects, and crop damage/yield relationships. Farmers also gain self-confidence and skills in cooperating with peers and communicating with specialists.

As an adaptive management knowledge network, FFS initially enrolls both farmers and extension agents as equal learners as they agree to work together growing a healthy crop. The second moment of translation is obtained through weekly meetings over the course of a production season. The FFS model achieves the third moment as farmers solve their own pest management problems and build on local knowledge, creating a new knowledge network. In the fourth moment, village associations are formed, solidifying the boundary organization allying scientists and farmers. The FFS is a practical model for farmer-change agent interaction that allows for interpretive flexibility and promotes a diversity of discourses/idioms.

The FFS approach to IPM recorded considerable success in reducing pesticide applications and increasing yields and farmer incomes (Röling & van de Fliert 1994; van den Berg, 2004). This was particularly so for rice farmers in Indonesia where the first programs were developed, tested, and generalized to tens of thousands of villagers across the country with the assistance of the FAO. However, follow-up studies have been more circumspect concerning their impacts (Feder, Murgai, & Quizon, 2004). While an initial and substantial decline in pesticide usage was noted, the volumes of pesticides applied began to increase over the next decade.

Renegotiating Knowledge Networks

Networks are created, evolve, and disappear in historical space and time. Various network segments respond differently to the idioms of existing knowledge networks. They cannot be planned once and for all according to a project's interests. The FFS-IPM experience leads us to question the traditional triumvirate of researchers, extension agents, and farmers as the essential repository of relevant production knowledge.

While FFS-IPM programs had been effective in the short-term in reducing pesticide applications and developing alternative knowledge and practices, in the medium-term (a decade), changes in the knowledge network occurred. Most significantly, the pest ecology adapted and diseases became more prevalent than insect pests. Farmers needed to save their crops and this required new learning and a renegotiated knowledge network to support them. Unfortunately, FFS had been disciplinarily based on insect pest management by entomologists, not disease management by plant pathologists. The entire knowledge network required new learning and new partners (van de Fliert & Winarto, 1993; Röling & van de Fliert, 1994; Moore, 2008). In the absence of this scientific network segment, the new learning required had a ready translator in the pesticide companies who were struggling to regain their lost markets. This network segment introduced a renewed idiom of enrollment and translation to address the disease problems of farmers with a reinforced narrative of pesticide use (including safety training). Enrollment was easily validated by the salient knowledge of pesticide use for the control of diseases. In this narrative, FFS had been retranslated as an expensive and incomplete Technology Transfer mechanism, since local learning had been insufficient to cope with the changing circumstances.

Scientific support for local agricultural production systems needs to be based on the recognition that knowledge networks sustaining agricultural production involve more than researchers, extension agents, and producers (Röling & Jiggins, 2004). There is a wider network of actors that contribute to and legitimatize the relevant knowledge necessary for system functioning. The commercial idiom of globalization is significant in this regard. While the schematic diagram of the rice producers' network in Figure 4 does not necessarily include all possible network members, it does indicate a couple of network segments that may function within a distinct knowledge network: (a) the commodity chain extending from producers to the consumers along which the product flows; and (b) the network of research, extension, and producer—the one we most often emphasize as the presumed agricultural knowledge network. In addition, the regulatory and/or trade regime networks could also be included. Each of these network segments has its own

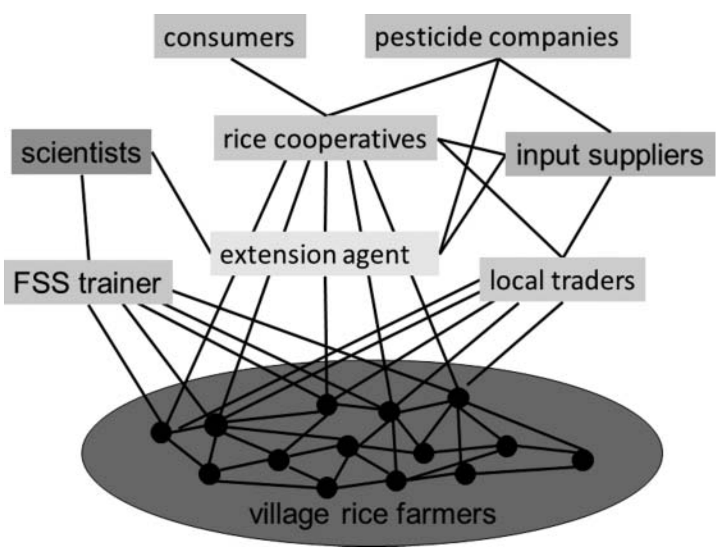

FIGURE 4 Schematic diagram of rice producers' knowledge networks. (Figure available in color online.)

priorities, which are not necessarily shared by other network segments. Nor do elements of any particular grouping need to have the identical interests to function symbiotically.

The enabling feature of FFS (the ability to locally generate new sources of appropriate knowledge) was not maintained because the metanarrative within which it operated (a global market economy) was not functionally enrolled. The discourse and idiom of FFS only accounted for researchers, extension agents, and farmers who see pest management problems as simply a technical matter. However, those involved in the exchanges linking local conditions with global markets rationalized the sphere of production in the wider context of the market chain. Consequently, FFS was retranslated as an advanced form of technology transfer, not a recurring management feature of the production system. The lesson to be learned by FFS promoters is that one cannot blindly assume that, because a message has been transmitted and received, it will be retained. Constant attention to the network sustaining the practice is necessary as the problems faced will evolve. There are competing technological idioms for pest management. IPM practices at the local level can be transformed by dominant network actors or network segments whether they are local or nonlocally based.

REBUILDING COMMUNICATIVE COMPETENCE FOR LOCAL AGRICULTURE

The U.S. Land Grant Universities (LGUs) were a model of institutional innovation in their time. Established in the 19th century, with an express mission of service, they were well-integrated with their local clientele. This made it relatively easy to build agricultural knowledge networks bringing science to the people based on local input and control. Research and education were responsive to local issues and problems. In the late 19th/early 20th centuries, the university populated the growing and technically more sophisticated agricultural production systems with the sons and daughters of each state's farming community. Local identities and local problems facilitated enrollment and translation, providing a common language and idiom among farmers and specialists to solve problems. In contrast, today's agricultural scientists are rarely raised in farming communities.

Historically, the rise of extension followed the establishment of the Land Grant system by nearly two generations. Coinciding with the rise of Taylorism in industry, extension followed the model of segmented industrial division of labor (Braverman, 1974). Philosophically rooted in Taylorism's separation of knowledge from action (conception from execution), the extension system functioned to disseminate the universalized knowledge of modern agriculture. This institutionalized the TT model and its supporting knowledge network we are now confronting as problematic. The problems generated by our increased capacity to disrupt the sustainability of the complex adaptive systems shaping our agricultural and natural resource landscapes require a renewal of locally adapted approaches.

Building the knowledge networks appropriate for local agriculture requires challenging the universalizing logic of globalization. While there is no blueprint, there are some underlying conditions that can enhance the potential for successful local innovations (Ekboir et al., 2009). The policies governing these reconstruction processes also need to ensure space for negotiation (Murdoch, 1998). Science, extension, and innovation policies need to be adaptable as new information evolves and opportunities for interactive learning are created. Innovation for complex adaptive systems requires the institutionalization of Adaptive Management. The AM model provides the flexibility and expects the surprises that allow for the reconstruction of networks and the idioms which render them meaningful.

In order to adapt to considerable local variability, effective search mechanisms should balance decentralized exploration with centralized documentation, comparison, and reflection. Solutions in one place do not necessarily apply in another, however apparently similar the landscapes may be. Research and extension institutions must recognize they are not the central actors, but play a critically important supporting role supplying new ideas and evidence concerning their applicability in other places. Perhaps most important, individual managers need to be carefully selected for their capability to manage boundary objects and boundary organizations.

U.S. LGUs were the ultimate boundary management organizations in the late 19th/early 20th centuries. Today, we need to be building networks and populating them with those possessing the skills to negotiate and mediate boundaries to create new knowledge networks for sustainable development.[2]

This implies restoring the dialog or enhancing negotiations between LGUs and local and/or alternative agriculture in the United States and linking training institutes, regional research centers, and community-based organizations (CBOs) in the African Sahel. Whatever the existing networks, institutional interactions and power relations must be accounted for; in addition, knowledge flows and bottlenecks between nodes need to be evaluated. New platforms and networks should avoid the reduction of extension to simply Technology Transfer and restore the communicative competence required for successful Adaptive Management. Knowledge networks that recognize

[2] With its new money and lack of institutional baggage, a question is currently posed concerning the Gates Foundation contribution to this learning pathway. Will it attempt to re-create the wheel of technology transfer (as it currently appears) or move on to support the building of local innovation networks?

the need for constant reevaluation and adaptation to new circumstances and partners must prevail.

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