Farmer-scientist knowledge exchange

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Julie Ingram
Countryside and Community Research Institute,
Gloucester, Gloucestershire, UK
jingram@glos.ac.uk

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Introduction

The last 25 years has seen a paradigm shift in the understanding of the nature of knowledge and how it is exchanged in the agricultural context. A changing backdrop, with the move towards multi-functional land management, persistent environmental problems and the search for sustainable agricultural approaches, has brought new challenges. At the same time the research agenda on knowledge has changed as an era of positivism, during which science and scientific experts were given unrivalled authority, was challenged by social studies of science that began to question the superiority of scientific knowledge, and value alternative forms of knowledge such as those held by farmers. Theory and practice of knowledge exchange in agriculture has evolved in line with this, shifting from a linear model of knowledge transfer to a perspective that integrates knowledge from multiple actors through facilitation and participation and emphasises learning in a social context. The attention paid to knowledge within agricultural research is part of a wider consideration of contested knowledges and expert-lay divides, and the democratization of expertise in science and environmental studies. These developments are indicative of wider changes in the rural development, natural resource management and science in society perspectives and of changes that have taken place in intellectual debates, where postmodern concerns for pluralism have enabled marginalized groups to become stakeholders.

In the agricultural setting the tensions at the interface between farmers and scientists have been the focus of much scholastic work, with attention given to how the two groups construct issues relating to agriculture (new technologies and sustainable agriculture), conservation and environmental management, and to how they communicate with each other. Farmer - science relations, specifically the *nature* of the knowledge they hold and the *processes* involved in the *exchange of this knowledge*, have provided a useful context for situating these discussions.

Nature of Knowledge

Scientific and local knowledge

A range of analysts have explored distinctive ways of knowing the world through elaboration of paired concepts such as codified/tacit knowledge; scientific/local; scientific/indigenous knowledge; expert/lay and explicit/tacit. Terms such as local or indigenous knowledge have different connotations; however, they all indicate types of knowledge that culminate through the experience of social groups embedded in specific localities and cultural contexts. Scholars have typically juxtaposed such constructs against Western, scientific, instrumentally rational knowledge (Richards, 1985) and extensively debated the epistemological distinctions between them.

Those critiquing scientific knowledge have emphasised its universal, objective and decontextualised character. It is referred to as codified, expert, formal, standardized, institutionally legitimate and explicit in that is can be systematized, written, stored and transferred (Norgaard 1984). Understandings of scientific knowledge have been embedded in a realist-positivist perspective which regards scientific knowledge as produced through a process of reductionism, derived from data verified by independent observers under controlled conditions. According to this perspective science is viewed as open, systematic and analytical, advancing by building rigorously on prior achievements. The relationship with participants is regarded as detached, the methods as value-neutral, cases are treated as representative rather than having intrinsic value, the approach is deductive and the aim is to develop predictive criteria that provide a basis for universal and context-free generalization. With respect to knowledge exchange, as discussed below, scientific knowledge is regarded as discrete, tangible and transferable.

The term 'local knowledge' came from the international development and anthropology literatures. Such knowledge has been described as fundamentally linked to direct experience and the practical, sensuous and personal skill that develops with attention to a specific place. Scholars have emphasised the attributes of local knowledge that distinguish it from scientific knowledge, describing it as closed, non-systematic and holistic rather than analytical, and without an overall conceptual framework, advancing on the basis of new experiences, not on the basis of a deductive logic. Where science is regarded as universal, local knowledge is strongly rooted in place, anchored to a particular social group in a particular setting at a particular time. Due to its tacit nature, local knowledge is seen to rely on social processes for knowledge exchange.

Criticism of scientific agriculture

Over the last 25 years criticism of scientific agriculture, in particular focusing on the authority given to scientific knowledge and the neglect of local forms of knowledge, has emerged as a strong force within both developing and developed countries. Scholars point to science's privileged role in the development of agriculture and agricultural policy in Western countries, particularly in the post-war period, as scientists were charged with `modernising' agriculture and increasing food production. Critics have argued that there was an assumption of superiority of scientific knowledge developed in controlled research settings over knowledge developed through practice in less controlled settings as on farms. They consider that the status accorded to scientific knowledge, by virtue of its 'rigour', 'systemic' approach and 'rationality' effectively allowed science to stand apart from other knowledge systems and enabled science to be the standard paradigm against which all other forms of knowledge were to be assessed. Philosophical perspectives on science and its dominance come from scholars who argue that science constitutes institutionalized power because scientists impose a system of ordered procedures for the production, regulation, circulation, and operation of statements.

Consequently, scholars argued, 'non-institutional' forms of knowledge, perceived as lacking the rigour, rationality and logic of science, and categorized as 'backward', 'primitive', 'irrational', or 'parochial', have been

ignored, marginalized or underrepresented in society as a whole and specifically in agriculture. As such **l**ocal farmer knowledge in both developing and developed countries was seen as being denied legitimacy**.** This criticism is aligned to debates about expert and lay knowledge where the 'deficit model' of scientific understanding deems non-scientists ignorant when it comes to scientific and technical matters and where lay knowledge is assessed and judged from the scientific point view. In the environment management context similarly policy makers are described as using the discourses of certainty and technical expertise to maintain their privileged status as legitimate arbiters of environmental standards (Whatmore 2009).

As part of the criticism of agricultural science it was argued that, as scientific knowledge and practice was applied in new situations, the complexity which has coevolved in many areas over long time periods between local agricultural practices and local natural environments was often destroyed (Kloppenburg 1991). Scholars, particularly those from the Wageningen school have documented this displacement of local knowledge and cultural practices by 'alien' scientific techniques (Long and Long1992). With this displacement science was seen as a new form of 'colonialism' and for some commentators this imposition of western scientific knowledge explained why development had become unsustainable. Debate about the disregard for local knowledge was not restricted to developing countries. A seminal study by Wynne (1996) in England documented how, in the aftermath of the Chernobyl nuclear disaster in 1986, scientists ignored local farmers' knowledge in their research in the Cumbrian hills to find out how to protect sheep from radioactive contamination.

The rise of local, knowledge

These criticisms and debates heralded a shift in thinking about traditional knowledge. Whereas previously many theorists regarded it as an obstacle to development, today indigenous knowledge is seen as pivotal in sustainable resource use and development predominantly in less industrialized countries. In works such as Richards' *Indigenous Agricultural Revolution* (1985), researchers have attempted to validate the existence and utility of indigenous knowledge systems. The Farmer First movement launched in 1987, which questioned the scientific 'way of knowing' as an appropriate model for future sustainable development and for the extension of democratic principles, was a landmark in this shift towards valuing farmers' knowledge (Chambers et al. 1989) and heralded two decades or more of farmer-centred research and development in international development. Central to this 'rediscovery' of the concept of local knowledge was the continued critical examination of the impacts of orthodox science. The body of work grew documenting farmers' local knowledge of soils, pests, varieties etc. This work claimed that farmers have an intimate and intuitive knowledge of their farms and a refined understanding of local spatial and temporal processes, gained through years of walking and cultivating the land. This work has also shown that local knowledge is, characteristically, related to 'use' rather than the standardized categorization criteria derived from science.

In the Western world, local knowledges have long been denied a legitimate status. Since the 1990s however there has been growing interest in farmer knowledge in developed countries fuelled by debates about the epistemological distinction between local and scientific knowledge systems; the changing role of farmers and scientists in research and extension; and the need for environmental and social change. In the context of economic crises in agriculture, environmental pollution, agribusiness domination and concerns about food quality, it was considered that new insights and perspectives which valued alternative knowledge forms were needed. Exponents of this view also agreed that local knowledge, being more ecosystem-sensitive and context–dependent, was more relevant to sustainable practices than 'decontextualised' scientific knowledge. As such the term 'local knowledge' entered the sustainability discourse in developing countries. A number of

studies have demonstrated how ‘sustainable’ knowledge and practice have developed outside of conventional knowledge systems, for example, Kloppenburg’s (1991) analysis of rotational grazing in Wisconsin, USA..

The changing attitudes towards, and relevance of, local knowledge is apparent in the increasing number of research, development and management models that include farmers as active participants and knowledgeable stakeholders. However, as interest has turned to farmers’ knowledge as part of resource management and environmental disputes, this has highlighted the contentious nature of the relationship between local and scientific knowledge (Whatmore 2009). Authors have described the way in which farmers draw on context-specific experiential understandings in completing their practices, and how these understandings can conflict with, and are negotiated alongside, those understandings embedded within science, technologies and with conservation practices (Eshuis and Stuiver 2005).

Advocates of farmers’ knowledge, however, have been criticised as naïve and guilty of distorting and exaggerating its value while neglecting its limitations. Critics warned against mythologising local knowledge suggesting that it can often be nothing more than a set of improvisational capacities summoned by needs (Molnar et al. 1992). With respect to the argument that local knowledge is sustainable knowledge, critics point to the fact that some indigenous people in fact degrade their own land. Scholars argued that scientific agriculture may be just as capable as local knowledge of finding sustainable solutions. Indigenous knowledge, although still of great value in developing countries, is thought to has no relevance to modern westernised agriculture where farmers have come to rely heavily on scientific applications in agriculture.

These debates have culminated in an acceptance that it is unhelpful to reduce the discussion to one that distinguishes scientific or local knowledge as the ‘right’ or ‘wrong’ sorts of knowledge and that instead there is a need to understand the processes that bring about integration of different knowledges.

Knowledge processes

Over recent years the concept of `knowledge' in the singular has been increasingly challenged by ideas of differentiated, contextualized `knowledges'. Debates about the dichotomy between local or scientific knowledge and their respective value have lead many researchers to criticize this categorization and argue that conventional distinctions between the two no longer hold. It has been argued that these knowledge forms are fundamentally complementary , that knowledge is comprised of blends of all knowledge forms and that it is heterogeneously constituted (Long and Long 1992). Equally others have suggested caution should be exercised in the use of prefixes such as `expert' and `lay' when talking about knowledges as this strengthens the processes keeping them apart.

The distinctiveness of different forms of knowledge has also been challenged within the social sciences where there has been a growing conviction that knowledge is the outcome of social processes. Sociological interpretations of science challenged ideas about the distinctiveness of scientific knowledge and ideas by Knorr-Cetina (1981) were developed in a number of empirical studies that followed. These have shown that science is socially constructed in a specific location and as such is ‘achieved’ in much the same way as other kind of knowledge. As a consequences social scientists have argued that the distinction between universal knowledge and local knowledge is weakened. There have also been support for theoretical criticisms of what has been called the ‘rise of indigenous knowledge' which argues that the classification into indigenous and

Western knowledge fails not only because there are similarities across these categories but differences within them. This science philosophical approach is called social-constructivism and has become a main paradigm from which many social scientists analyse the role of knowledge. However, as with distinguishing forms of knowledge, others academics have argued that it better to integrate this social-constructivist view with the positivist approach of knowledge development which aims at finding measurable parts of reality to validate knowledge claims.

Given these theoretical and philosophical arguments many scholars have concluded that it makes much more sense to describe knowledge, not as a fixed thing, but as fluid and changing, the outcome of a set of processes where social processes are central (Murdoch Clark 1994; Scoones and Thompson 1994).

Knowledge exchange

There has been increasing emphasis on the need to find effective ways of exchanging knowledge between farmers/land managers and the many actors they interact with to enhance sustainable agriculture and environmental management. Many different terms are used to describe knowledge exchange processes, these include knowledge sharing, generation, co-production, co-management; transfer, brokerage, storage, exchange, transformation, mobilization, and translation but knowledge exchange can be simply understood as constituting the processes that generate, share and/or use knowledge through various methods appropriate to the context, purpose, and participants involved. Whilst early models of knowledge exchange focused on linear processes of knowledge production and consumption, a shift toward more systemic approaches provided frameworks for understanding knowledge exchange as multiple processes operating between multiple actors (Roling 1992).

As with the nature of knowledge, the last 25 years have seen major debate and changes in thinking about the knowledge exchange processes in the agricultural context. This is the main part has been undertaken within the discipline of agricultural extension, both scholastically and in practice, although contributions have come from a number of other disciplines including environmental management, rural sociology, development studies, communication science. These have all tended to highlight issues such as legitimacy of different knowledge forms, inequality and power dynamics, including the effect of relative position or status of those generating and using knowledge.

Knowledge transfer models

In the agricultural extension literature it is possible to document an evolution in theory and practice from persuasive 'knowledge transfer' approaches to more facilitative 'human development' perspectives (Roling 1992). Theory and methodology has traditionally been predicated on the promotion of technological innovations with a reliance on the top-down, uni-linear model of transfer from science to practice (the knowledge transfer model). This notion of a 'one-way' path was developed and adapted by a number of authors, the most pervasive being Roger's (1995) diffusion of innovation theory and the technology transfer (TOT) model which has underpinned the activities of many extension services and development activities. The large literature on adoption of innovations has been reviewed in general (Rogers 2003) and for extension (Black 2000). This knowledge transfer approach is analogous to the 'technical-rational' model of policy development. The knowledge transfer paradigm as the dominant model of knowledge production in conventional agriculture captured the concerns of the so-called 'productivist' era of the 1970s and 1980s in industrialised countries when the focus was on food production (Buttel 2001). However, it has since been found limiting.

Academics from rural sociology within the USA and European schools of international development argued that, because the model was embedded within realist-positivist theoretical view of scientific knowledge (seen as a discrete, tangible entity which can be transferred between actors), it did not accord with new interpretative views of knowledge, as discussed above. They also argued that the uni-linear approach failed to represent the many different sources from which knowledge is generated and that it was irrelevant to modern agriculture, which has multiple goals, and demands more stakeholder negotiation and agreement. Concerns were raised about equality specifically with reference to the adoption/diffusion model which ignored many of the important social issues such as the unequal distribution of impacts and benefits of the technology , as the service provided by the extension agencies reached, differentially, the better educated and more economically powerful farmers. Those adopting were seen as 'innovators' and held in high regard, while those not adopting (and/or rejecting) new technologies were labeled as 'laggards' and viewed disparagingly. This dominating 'techno-strategic discourse' according to critics such as Kloppenburg (1991) assumed that farmers had nothing to contribute; their knowledge and skills were marginalised and discredited. Agricultural extension was seen in these terms as espousing, uncritically, pro-corporate ideology and was criticised as being the 'handmaiden' of the scientific-industrial agribusiness complex in that it accepted that all farming problems could be overcome by the continued application of conventional science. Furthermore research institutions were also criticised as developing technologies that were not value neutral and often resulted in creating greater social and economic inequalities. Thus the knowledge transfer approach to science as the domain of knowledge élites was seen as problematic for the inclusionary ethos of the human development paradigm.

Human Development approaches

These criticisms have led to the waning of this 'dominant paradigm' in research and theory, and to the formulation of 'human development' approaches based on the principles of participation, empowerment and ownership of the problem. Increasing interest in multi-functional land management; a general challenge to technocracy and scientific superiority, persistent environmental problems and the need to develop more sustainable agriculture provided the backdrop for this paradigm shift. With human development approaches the implication was that, given the right conditions, information, mutual interaction and opportunity, land managers will use their own knowledge and develop their own appropriate solutions to their problems. These approaches view the extension process as facilitation of social learning, a philosophy focusing on participatory processes of social change. They give validity to expert and non-expert forms of knowledge and are thought more likely to lead to adaptive forms of environmental management and longer lasting or more effective outcomes. Scholars also argue that such approaches are particularly suited to understanding the transformation towards more sustainable agriculture a process that it thought to require mutual interaction between actors. The Wageningen School (Roling 1992; Roling and Wagemaker 2000) were central in providing theoretical conceptualizations to underpin these developments and in using systemic approaches (Agricultural Knowledge Systems) as frameworks for understanding the multiple actors and processes of knowledge exchange they were involved in. The human development approach is analogous with theories of 'negotiated knowledge' in the broader field of deliberative governance, whereby inter-subjective judgement is regarded as essential to effective decision-making. This paradigm shift reflects wider changes in the disciplines of rural and development sociology and rural geography during the 1980s and 1990s where culturalist or subjectivist views emerged in a post-Marxist era to counter the perceived determinism of political economy.

Agricultural research and extension organisations have, to a varying degree, become involved in various human development approaches. Research and development in developing countries embraced participatory methodologies such as the Farming Systems Approach (FSA), Participatory Rural Appraisal (PRAs) and Participatory Technology Development (PTD). Chambers et al. (1989) were the early exponents of these participatory approaches. These approaches have been reviewed extensively (see Garforth and Usher 1997; Black 2000). In extension, Farmer Field Schools, where participatory training and hands-on experimentation are a key principle, gained prominence in many developing countries. Scholars and policy makers have also documented a number of cases which exemplify effective facilitation of farmer learning, such as the Australian Landcare initiative and farmer learning groups in the Netherlands.

Although seen as an improvement on the failings of the knowledge transfer model, scholars have voiced a number of criticisms of human development models and methodologies. These have been divided under five main themes (Black 2000). Firstly, the lack of a coherent theoretical foundation; secondly, the lack of attention to issues of legitimacy, accountability and representation; thirdly, the problems associated with poor participation practices; fourthly, the difficulties and dangers in working with multiple forms of knowledge and finally, the political dangers inherent in shifting responsibilities from the state to civic society. Issues such as the professional identity of scientists, the skills base and available human resources, and perceptions concerning the validity of research methods, have arisen in practice. Most researchers argue that participation involves ensuring the knowledge and views of people are more equitably incorporated in decisions, and consider that this requires managing and reforming the power-relationships.

Conclusion

Today there is recognition that sustainable agriculture, which encompasses balancing agricultural production with elements such as ecosystem protection, the continuing supply of natural resources, and the well-being of rural communities, needs to be supported by diverse knowledge systems which draw on both local and scientific knowledge. In policy circles in industrialised countries the language and discourse is changing from one of knowledge transfer to one of knowledge exchange which is seen as a key device for achieving change in the agricultural context, particularly where voluntary participation for environmental protection is encouraged. However, issues still remain in effectively implementing knowledge exchange such as how to evaluate the outcome of knowledge exchange activities, how to accommodate different cultures, how to deal with power relationships, and how to develop effective techniques and tools (Fazey et al., 2012).

In agricultural development arenas the social and political dimensions of knowledge generation and exchange remain the focus of interest but with a move towards improving understanding of knowledge entrepreneurship and marketing, knowledge brokerage, governance and of networks and alliances which can reconcile the needs of scientists and of local needs through new forms of equitable collaboration which go beyond what some observe to be the somewhat 'tired discourse of participation' (Scoones and Thompson, 2009). The debate has moved on from a concentration on the interaction between farmers and technologies/science to incorporate wider perspectives of institutional change. The concept of the Agricultural Innovation System is becoming a popular as a way of framing the processes

of networking and interactive learning among a heterogeneous set of actors, which go beyond knowledge producers and consumers.

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