

The Role of Tacit Knowledge in Developing Networks for Sustainable Agriculture

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Abstract

Whilst objectivist epistemologies have been dominant in productivist agriculture, the local, cultural and environmental contexts of sustainable agriculture are more fully informed by constructivist epistemologies. Within constructivism, tacit knowledge – an intuitive knowledge that cannot be formalised – is explored empirically. Six types of tacit knowledge were identified as a result of working closely with a sustainable food network: the Brighton and Hove Food Partnership. Customs cohere around integrating food with other sustainable activity; developing a complex unregulated organisation requires *savoir-faire*. The unique character of Brighton has developed an operational folklore, and network identity is important, particularly in relation to conventional agriculture and to the city as a whole. A confidence in people's roles has helped define network development and using different discourses, communicating the network in diverse contexts, is important for understanding the network. All these tacit knowledge elements have a strong influence over the network but have to be assimilated knowledge rather than learned.

Introduction

Much has been written from a social-scientific perspective about the content of the knowledge required for the development of sustainable agriculture (Hendrix *et al.* 1992; Lichtfouse *et al.* 2009; Hanayani and Prawito 2011) and about the appropriate systems of learning required for knowledge transfer in such development (Pretty 1994, Röling and Wagemakers, 1998). Rather less attention has been paid to the different forms of knowledge that have significance for the development of sustainable agriculture. Morgan and Murdoch (2000) note that the dominance of objectivist knowledge in 'conventional' agriculture tends to replace 'local' knowledge with 'expert' knowledge and underplays social, economic and cultural values. It is argued in this article that approaching sustainable agriculture through a constructivist knowledge lens allows a range of these values within 'sustainable' agriculture to be more clearly identified thus improving an understanding

of the distinctive nature of sustainable agriculture. Within this constructivist knowledge domain, the article examines the nature of tacit knowledge because it is claimed to offer the potential to embrace both values (Merton 1973) and belief systems (Polanyi 1946) explicitly, and is considered to provide a component of 'local' knowledge (Morgan and Murdoch 2000). Certainly these claims for tacit knowledge merit its examination to see if it can help make sense of some of the claimed precepts of sustainable agriculture. This examination is developed empirically through an English case-study.

In doing this, the article is structured in the following way. Firstly, a characterisation of sustainable agriculture is offered as a context for forms of knowledge likely to be important in its development. Some salient strands of objectivist and constructivist epistemologies are then reviewed. Here, it is argued that the precepts of the objectivist epistemology have been dominant in productivist agriculture, as 'science' has sought to increase food outputs for a hungry world. But for sustainable agriculture, constructivist epistemologies, particularly in relation to local, social, cultural and environmental contexts, have an important role.

One manifestation of constructivist epistemology is argued to be tacit knowledge, and this is developed for empirical study. Using the notions of tacit knowledge asserted particularly by Polanyi (1966) and developed by Gerholm (1990), six forms are postulated: customs; *savoir-faire*, folklore, identity, roles and discourse. These are evaluated in the context of negotiating sustainable agriculture values in the development of a sustainable food strategy. Conclusions are then drawn about the relative importance of different forms of knowledge in the development of sustainable agriculture in practice, identified in the research.

The case-study used is from a European Framework VII programme, designed to identify barriers and catalysts to the development of learning and innovation networks for sustainable agriculture.¹ 17 case-studies of sustainable agriculture networks were chosen across eight European countries. They were chosen because they operated largely outside mainstream knowledge provision in agriculture and had identifiable 'grassroots' origins. They were termed Learning and Innovation Networks for Sustainable Agriculture (LINSAs). The case-study reported here is that of the development of the Brighton and Hove Food Strategy (Brighton and Hove Food Partnership (BHFP), 2012) which involved the identification and interplay of a large number of stakeholders in various networks concerned with all elements of sustainable food production and consumption in the city.

A participatory methodology has been deployed, which advocates the involvement of research stakeholders in the majority, if not the entirety, of the research process (Allen-Collinson *et al.* 2005). Thus, specific research methods for collecting data were co-designed by the research team and the BHFP in partnership and were played out over a period of two years. Commonly termed research 'co-production', such an approach provides experiential expertise that outside 'experts' on their own might not perceive (Collins and Evans 2002). As an 'interpretivist' approach (Evans *et al.* 2000) it commits the researchers to understanding the social world from the perspective of those social actors who inhabit it. It also allows participant-stakeholders' preferences and needs to inform the research process, leading to what Ostrom (1996) considers are potentially better and more achievable outcomes.

Within this frame, research methods embraced interactive learning (a two-way discursive flow of information) which included world cafés, workshops, focus groups and knowledge exchange forums, all of which took place in Brighton and Hove. Three members of the research team took an active part in these activities and cumulatively they involved over 100 people involved with BHFP activities. All of these forms were active, participatory and involved mutual learning: flows of information and ideas passed from the LINSAs to the research team and vice versa, with the intention of benefiting both. In addition, as preparation for this interactive mutual learning approach, the research team undertook a series of 15 face to face and 12 telephone interviews and a desk study to become informed about the nature and content of the strategy development. All of these methods collectively provided the information reported in this article. Following our data-driven, inductive approach, thematic analysis was carried out on the data in order to explore the nature and relevance of tacit knowledge as portrayed by our participants.

The purpose of the methodological approach is to encourage participant-stakeholders to engage fully in the research. It allows differing positions of participants to be explored: insider versus outsider relations (Garfinkel 2002); degrees of 'insider-ness' (Allen-Collinson 2011); differences in cultural values (Fetterman 1989) and the ethics surrounding this kind of involvement (Sieber 1992). But as Wadsworth (1998) suggests, using participatory methods can be seen as an expression of 'new paradigm science' that differs significantly from old paradigm or positivist science.

This 'new paradigm' approach is a particularly useful way of examining constructivist knowledge, which is considered fully below. The approach potentially empowers the participant-stakeholders and can provide a voice for 'ordinary' people (Freire 1972). Data are collected entirely within their context and observations about this context are part of the data (Allen-Collinson *et al.* 2005). Participatory methodology then can lead to action for change within a local context (Minkler and Wallerstein 2003).

Within this study, however, some limitations to this approach were experienced. Some participant-stakeholders were reluctant to become involved because the researchers were 'outsiders'; and the workings of the Food Partnership were not really to do with these outsiders. Some felt that the 'monitoring' culture was not really part of the ethos of the movement and measures such as 'efficiency' (as a common characteristic of monitoring exercises) were not within the Partnership lexicon. Certainly, not all participant-stakeholders were equally committed to a participatory method and therefore some voices were 'louder' than others in the progress of the research. But as Kavannagh *et al.* (2002) note, it is an inherently 'messy' research approach (and even one that is unattractive to academic journals because of this) that nevertheless is an important one because of the distinctive results it can provide.

In the literature used in the development of the argument of this article, the term knowledge is used both differently and imprecisely. Lejeune's (2011) constructions are used here as a benchmark for the meaning of knowledge, although it is recognised that other writers may well be using it (legitimately) in different ways and yet others use it in ways which are sometimes difficult to deduce with certainty. Lejeune (2011) draws a distinction between data (observations or measurements which he claims at least consciously, are devoid of intention – and therefore considered objective), information (the organisation of data to provide meaning) and knowledge: information

that has been assimilated and interpreted on different occasions by a person or people. Information has to be understood and interpreted to become knowledge (Lee and Yang 2000). Whilst open to debate, using this convention allows objectivist and constructivist knowledges (as opposed to data and information) to be distinguished.

The knowledge context for sustainable agriculture

Sustainable agriculture cannot be defined (Pretty 1994). This is because, Pretty claims, it is not an objectivist construct subject to independent verification by immutable laws. Despite this, writers and policymakers have attempted to identify some of its parameters. There is some consensus that it embraces non-market, social, cultural and environmental goals, as well as market ones. Thus, it should indefinitely meet food needs within acceptable social, economic and environmental costs (Crosson, 1992) and be resilient to environmental and economic change (Conway and Barbier 1990). The UK Biotechnology and Biological Sciences Research Council (2002) considers that it should be socially acceptable whilst minimising environmental and financial risks and the English Department of the Environment, Food and Rural Affairs (Environmental Challenges in Farm Management 2012) further add food security, the protection of landscape, wildlife, cultural and archaeological values, and animal welfare, into the mix.

This combination of values and principles makes learning systems for sustainable agriculture complex. They are required to embrace the multiple perspectives of a variety of stakeholders and they must continually adjust over time to changing conditions and insights. Pretty (1994) asserts that such systems of learning need to be participatory to be effective because they must embrace the values of all. To the extent that knowledge of, and for, these values goes beyond objective knowledge, such values are commonly developed through trust as much as through verification (Palmer *et al.* 2009). In essence, sustainable agriculture is driven as much by values as by the 'scientific' knowledge of food production, an issue explored by Ingram (2008) in the context of soil management.

The established Agricultural Knowledge and Information System (AKIS) in England, as in most other 'western' nations, is not particularly well suited to these kinds of knowledge requirement. From the late 1980s, it shifted from a state-based system to a market-based one where commercial research into 'scientific' knowledge displaced trust-based processes, and learning networks between farmers and state advisers were lost (Hall and Pretty 2008). Just as the non-market knowledge needs for a 'values-based' sustainable agriculture were becoming more evident, the market-based AKIS was becoming less well suited to providing them. Whilst advice about the non-market components of agriculture has had a role in the sector, this non-market advice has developed largely in the context of securing grant aid and for regulatory compliance (Garforth *et al.* 2003; House of Commons Environment, Food and Rural Affairs Committee, 2011), both of which are commercial considerations. Because of this, knowledge about the values of sustainable agriculture are commonly offered outside of the conventional AKIS altogether (McNie 2007). Knowledge and information systems for sustainable agriculture that embrace beliefs and actions beyond conventional agriculture are not only different in the content of knowledge (see

below), but in the means of knowledge transfer. This more commonly takes place through co-learning, networks, mutual support and more informal mechanisms than through 'expert' advice (Curry *et al.* 2012). They have been termed Learning and Innovation Networks for Sustainable Agriculture (LINSAs) of which the case-study in this article is an example.

Forms of agricultural knowledge

The limitations of conventional AKISs to provide an adequate knowledge base for sustainable agriculture are connected with the relationship between market and non-market knowledge, but also with the form of knowledge that is most appropriate. It is argued in this section that the form of agricultural knowledge offered by the AKIS is largely objectivist but the forms of knowledge deployed for sustainable agriculture are largely constructivist, the domain into which tacit knowledge falls. Salient differences between these two forms are developed in this section through a review of the constructivist critique of objectivist knowledge.

Objectivism

Objectivist (sometimes termed 'positivist' in the literature) knowledge approaches in agriculture aspire to eliminate all social influences over knowledge creation and in so doing determine the 'true' nature of the world outside of the individual mind (Louth 1990; Wilson 1998). Cleveland (2001) notes that plant breeding has exemplified the development of this objectivist 'scientific knowledge' in agriculture, firmly grounded in Darwinian constructs of species selectivity. It has been remarkably successful in increasing technical productivity and food production (Evans 1998). Cleveland (2001) considers most plant breeders undertake their work consistent with this approach, as 'applied evolutionists' (p. 253) although their development of science is largely empirical rather than theoretical. Here, social context is used as a justification for science (in order to feed a growing population²) rather than an influence over it (Wallace and Yan 1998). Objectivist knowledge is argued to be socially neutral and responds to market signals such as profitability or gross margins (Cleveland 2001), avoiding any consideration of values outside of the market.

Empiricism is seen by many as the entry point of objectivist knowledge (Baird and Kaufmann 2008). It is founded on evidence and experimentation: hypotheses and theories are tested against observation rather than reasoning, tradition or beliefs. Observations, according to Spedding (2009) then accumulate over time sufficient for the hypothesis to be generally accepted as a 'theory'. Theories are then seen as 'best explanations' and hold until better explanations come along, creating new theories. This is 'science' pushing back the boundaries of knowledge. Objectivist knowledge, then, has at least the goal of eliminating errors or biases due to perspective, history or culture and establishing 'facts' independent of the observer. This requires accurate scientific measurement that can be reproduced, and the avoidance of personal bias (Daston and Galison 2007).

Such an epistemology has done much to achieve productive objectives and increase farm incomes. It has led to more uniform (or universal) plant and animal

varieties adapted to geographically wide, relatively optimal growing environments with high yield and yield stability (Fischer, 1996; Cleveland 2001). But whilst such 'scientific' achievements were significant in their time, the changing imperatives of sustainable agriculture suggest a need to maintain valuable agricultural outputs but with both fewer inputs and on more marginal areas of land (Mann 1999).

Constructivist critiques of objectivism

These objectivist approaches have been criticised through constructivist epistemologies, which claim that scientific knowledge is, in fact, dominated by social forces, power relationships and cultural contexts (Foucault 1994; Bourdieu 2000). At an interpersonal level, far from being value neutral, objectivist knowledge is simply validated as being true by mutual endorsement rather than any objective truth (Polanyi 1951). 'Scientific' knowledge therefore grows largely from co-operation and is beyond the gift of any one person to develop as it requires consensus. Because of this, empirical method, Polanyi (1958) suggests, is not able to provide the 'truth' in any mechanical way. For all of us, scientists included, our beliefs go beyond what we can prove.

In this societal and personal context, the objectivist epistemology is dominated by the social control of technology and information, for example, through industrial modernisation and agricultural intensification. Objective knowledge becomes 'expert' knowledge that the expert 'scientist' deems too difficult for the 'lay' public to use meaningfully (Rosenbaum 1978; Bok 2001).

Constructivists claim that objectivists ignore the social and cultural context of putative 'objective' knowledge (for example, of plant breeding) at their peril: a universal 'objective' science ignores local contexts, conditions and cultures, that local farmers are much better placed to understand (Scott 1998). Whilst developing hybrid plants that yield increased outputs per acre is considered good objectivist science, it may well be more to do with the culture of capitalism seeking to maximise profit (Kloppenburger 1988).

Whilst constructivists emphasise this social and cultural context in the production of knowledge, there are similar contexts in its consumption. 'Scientific' knowledge needs to be believed and trusted before it becomes adopted. This has a number of components. The knowledge needs to be believed but also those who produce it need to hold the confidence of the user. Palmer *et al.* (2009) for example, report people's lack of trust in scientific institutions having a strong influence on the uptake of strategies for the control of animal disease. Maye *et al.*'s (2012) analysis of grower decision-making strategies for plant diseases also notes the influence of trust. In this case a good deal of trust is placed with professional advisors and agronomists but scientific risk assessments are often modified by local conditions.

Such objectivist knowledge also needs to have an acceptable political context. Grant (2009) reports contentions between scientists and government in relation to the reduction in the incidence of bovine TB. And of course, decisions are constantly being made in social contexts as to whether the outcomes of objective knowledge are desirable outcomes for the individual decision-maker anyway.

A further criticism of objectivism is that it oversimplifies the real world to create rules and operational techniques. It tends to isolate knowledge into 'silos' in order to

examine it. As Spedding (2009, p. 2) has suggested 'it is always best if only one independent variable can be changed at a time'. This approach has been termed by Simon (1991) 'bounded rationality' which, through simplification, can lead to imperfect knowledge, uncertainty and an increased risk of making wrong decisions.

Dryzek (1987) suggests reasons for this reductionism. Firstly, objectivist knowledge tends to break down complex problems into a set of more simple ones so that they can be examined more closely. But if the complexity is maintained and the social context of the problem is embraced, it becomes possible to examine the linkages between the disaggregated problems as well as the problems themselves. Constructivist knowledge is better at addressing the linkages. Haas (2004) emphasises this in the context of sustainable development generally because, he claims, it takes place through interacting elements and intersections of complex problems. Scientific knowledge is not well suited to informing these intersections because they require:

'a simultaneous assault on pollution, economic development, the unequal distribution of economic resources, and poverty reduction'. (p. 570)

Secondly, objectivist knowledge tends to be reduced in order to allow a single value system to be applied to the issue. Constructivist epistemologies can accommodate more than one value system at a time. Similarly, constructivist epistemologies can accommodate different viewpoints and can even be used in situations where there are no articulated viewpoints (Ostrom 1990). This kind of negotiated knowledge also has advantages where the nature of the 'problem' is unclear (Fischer 1993). In these contexts, to reduce what Polanyi (1958) terms 'higher level realities' to lower level 'truths' is what he terms 'moral inversion'.

Kuhn (1962) also claims that there can be no objective scientific truth at any one point in time. Scientific 'beliefs' rely upon a consensus of the scientific community. Spedding (2009) suggests that with new discovery there is a period when research findings that do not support existing theory are seen as being the fault of the researcher. Only after there is sufficient evidence that does not support the theory, will the original theory be abandoned in favour of another one. This new consensus, Kuhn (1962) states, then changes the nature of 'objective' science sometimes fundamentally, through paradigm shifts, which often provide competing accounts of scientific knowledge.

This can leave objectivist knowledge indeterminate. Spedding (2009) exemplifies this with climate change knowledge. Climate change is such a complex 'problem' that it cannot be simplified: there are a number of competing simultaneous paradigms that derive from 'objective' evidence. As a result it is not sound, for example, to claim that global warming arises as a result of burning fossil fuels, or indeed that it does not (Boykoff and Boykoff 2004). These are not 'observations' but hypotheses, unprovable because there are too many variables at work. In any event, as Polyanin (2002) notes, boundary conditions mean that one set of evidence can 'objectively' lead to a number of different solutions: there is no necessary unique interpretation of one set of 'facts'.

Objectivist epistemologies thus may well tend to oversimplify the real world, be conservative because of the reputational risk of being wrong (Polanyi 1958) and have a propensity to be indeterminate. Haas (2004) also suggests that they have a limited

influence over policy because they may be neither wisdom nor true, they may have significant and negative equity consequences and:

'politicians don't want science, they want justification for political intentions'. (p. 572)

In this context, Haas (2004) defines useable knowledge as accurate information that is also useable for policymakers and politicians: it should be at the same time, credible, legitimate and timely.

Objectivism and constructivism in knowledge for sustainable agriculture

Morgan and Murdoch (2000) set these differing epistemologies into an agricultural context, arguing that conventional agriculture (in Europe at least) has been driven by objectivist approaches, using codified knowledge that is standardised, explicit and easily transferable. It builds upon previous science and is therefore both cumulative and path dependent. They assert that it has been actively introduced into conventional agriculture by upstream input industrialists (fertiliser manufacturers for example) and downstream food retailers as a means of wresting power over the whole food chain.

This increase in 'codified' knowledge has redistributed knowledge away from the farm, but it also represents a shift away from more constructivist approaches that pertained in agriculture historically. The dominance of 'local' farming knowledge gave way in a post war Europe to a 'scientific' knowledge to arrest food shortages and make agriculture more 'efficient'. State support ensured effective knowledge transfer, but in this, farmer knowledge was replaced by external 'specialist adviser' knowledge. Morgan and Murdoch (2000) suggest that with farmer knowledge of local farm fertilities, for example, being displaced by the ubiquity of standard and universal pesticides and fertilisers, whilst the ownership of the farm did not change, the ownership of the production of food, did.

In the context of sustainable agriculture, there are arguments that favour a reassertion of more constructivist forms of knowledge (Adler 2002). Cleveland (2001) acknowledges the importance of the social and economic context of knowledge specifically for sustainable agriculture:

'Our ability to develop more sustainable agriculture will depend to an important degree on a clearer understanding of the joint contribution of biophysical and social reality to scientific knowledge, and of the epistemological processes of its production.' Cleveland (2001, p. 263)

An understanding of the joint contribution of objectivist and constructivist approaches is intuitively attractive here, as it combines the evidence, for example, on plant development, gene function and the like, built on years of observation and experimentation, with the influence of social context and both market and non-market values (Bager and Proost 1997). Cleveland (2001) characterises this as a third epistemology: holism. This more pluralistic view is supported by Tsouvalis *et al.* (2000) who explore 'knowledge cultures' that embrace the fluidity of diverse forms of knowledge and information, personally, socially and scientifically constructed. In empirical research of precision farming in England, they are able to observe a

'mingling' of objectivist and constructivist information in farmer decision-making. This is consistent with Ingram's (2008) findings in relation to soil management in England, where farmers were found to use a combination of both 'scientific' and 'tacit' knowledge. Van Gorp and van der Goot (2012) add to this 'mingling' characterisation, by asserting that constructivist notions mooted in a sustainable agriculture context can be as mythical as objectivist notions and are limited: not all that comes from nature is axiomatically good.

But Sparkes and Smith (2009) argue that this 'mingling' position is untenable. Either there is an objective scientific reality that exists outside of ourselves, or there is not. The world is either absolute, or it is relative (Smith and Hodgkinson 2005).

Cleveland (2001) concludes that the usefulness of objectivist knowledge in its consumption also will be critical in the development of the objectives of sustainable agriculture: the 'science' of increasing food outputs per hectare is of limited value if the agricultural system in question is not seeking to achieve this in the first place.

As well as social and economic context, Morgan and Murdoch (2000) emphasise the importance of relearning local knowledge for sustainable agriculture. Such agriculture requires a departure from path dependent knowledge – a stepping aside from the codified knowledge of intensive agriculture. A reassertion of local knowledge, they claim, will help to secure co-existence of food production with natural systems, minimising pollution and environmental damage as well as reducing the use of non-renewable resources. The building of natural soil fertility and the ethical treatment of animals also are likely to ensue with a reassertion of local or 'indigenous' understandings. In contrast to objectivist constructions in research, which focus on the discovery of new knowledge, a localist element to constructivist knowledge might suggest research on rediscovering 'old' knowledge: the way that things were done before they were forgotten.

Thus, in the sense of Foucault (1978) sense, local knowledge leads to a reassertion of control locally, enabling individuals' more effective self-governance. But at the same time, it can lead to a scepticism and mistrust on the part of outside 'professionals' (Zanetti 1998; Yang 2006).

Morgan and Murdoch (2000) conflate this local knowledge with tacit knowledge, suggesting that knowledge that is conveyed through personal interaction in a context of shared experiences is:

'local, context-specific, tacit knowledge' (p. 161)

A departure from this position is argued here, drawing a distinction between local knowledge which is context dependent but known and articulated, and tacit knowledge, which essentially remains unstated. This distinction is critical in being able to differentiate tacit knowledge in the way set out below.

Tacit knowledge

Polanyi (1946) claims that objectivist knowledge has an 'explicit' part (the findings) but also a 'non-explicit' part which is our underlying belief systems. Often we are not consciously aware of this non-explicit part of objectivist knowledge. Polanyi (1958)

termed this 'tacit' knowledge and one of the characteristics of tacit knowledge, he asserts, is that it prevents knowledge from being reduced to a set of rules.

In a related vein, Merton (1973) suggests that scientific knowledge comprises three components: the methods that verify facts, the facts themselves and then a set of complex values and norms that are held to be binding (reinforceable by sanction) in the science in question. Again, Merton terms these values and norms, 'tacit' knowledge.

As with sustainable agriculture, there is no agreed definition of tacit knowledge. Lejeune (2011) asserts that we must guard against its use in a superficial or 'catchall' sense simply to mean informal or unstated knowledge. In particular, he suggests, this fails to distinguish between that knowledge which has yet to be formalised (which is not tacit knowledge) and that which cannot be formalised (which is).

Thus, in placing a finer grain on the interpretation of tacit knowledge, Polanyi (1966) posits that tacit knowing is the process by which people integrate subsidiary awareness into what he terms 'focal awareness'. He feels that it has four elements: phenomenological, (as knowledge appears to us from our experiences), instrumental (the extent to which the knowledge is useful to us or serves a purpose), semantic (what linguistic meaning we accord knowledge) and ontological (how knowledge fits in with our own existence or reality). Tacit knowledge, Polanyi feels, is that which derives from experience and intuition and through shared experiences (Allen-Collinson 2004). As such, it is often difficult to translate into rational language because it derives from a context, or a set of cultural rules, often implicit (Ingram 2008), within which knowledge assimilation takes place. This makes it, asserts Lejeune (2011), intuitive.

These cultural rules are rarely laid down or taught, but are rather assimilated through interaction. They are nevertheless essential to 'know' to be able to function properly in a particular context. They are not susceptible to codification or representation through conventional means such as 'rational' language (Allen-Collinson 2003). Instead, they are understood through observation, intimation, socialisation and mechanisms such as mentoring (von Krogh *et al.* 2000).

Gerholm (1990) provides a useful framework for adapting Polanyi's (1966) four elements of tacit knowledge into an empirically testable frame. He discusses the nature of tacit knowledge from his perspective as an academic anthropologist. His discussion has been adapted here in an attempt to identify the different kinds of tacit knowledge that can be explored within a LINSAs. This is done as a heuristic device in order to allow empirical testing of tacit knowledge (Garfinkel 1967).

At least six discrete (but overlapping) types can be distinguished. The first will be called customs. It will be important to be aware of the customs and routines that operate within a LINSAs and to understand the way it operates and what is expected of people working within it. Bourdieu (2000) has suggested that this kind of tacit knowledge is often understood differently in different contexts, citing the norm of co-operation and teamwork in scientific discovery but also providing examples of how this can be broken to good effect through the stimulus of competition (not co-operating), a 'counter-norm'. Reix (1995) terms this form of tacit knowledge, implicit knowledge.

The second, to use Gerholm's (1990) term, is *savoir-faire*. Being aware of customs is not the same as knowing how to handle them (and therefore replicate them), particularly when they appear to be in conflict. *Savoir-faire* is the ability to work

effectively within the LINSAs. It is similar to that form of tacit knowledge that Albino *et al.* (2001) term 'the knack', Giunipero *et al.* (1999) 'intuition' and Bourdieu (2000), 'a feel for the game'. The third kind of tacit knowledge is folklore. This is what gives the LINSAs its mentality. It would include knowing who is whom, what their position is in the organisation (prime mover, pessimist) and where the LINSAs are actually going, almost despite any stated objectives. It embraces the LINSAs' underlying values. This has parallels with what Valente and Luzi (2000) term 'context' and what Howells (2002) observes as varying by geographical location.

A fourth kind of tacit knowledge is termed identity. This is the essence of the LINSAs themselves: how it sees itself and how it perceives its position, almost as a feeling, in wider society. How does the LINSAs relate to the values of conventional agriculture, for example? How self-conscious is it in a context where people are not committed to sustainable principles? This kind of tacit knowledge, is influenced by how well developed the LINSAs are. A fifth tacit knowledge is termed roles. It is concerned with knowing how individual people, actions and policies fit in with each other and the ultimate 'direction of travel' of the LINSAs. This knowledge requires continual adjustment as the roles of other aspects of the LINSAs continually change.

Finally, there is discourse. This relates to the kind of tacit knowledge associated with the understanding of different scientific discourses, which have many different genres and styles. Does the LINSAs present itself differently at official conferences relative to internal discussion groups, for example? Is the LINSAs represented differently 'over coffee' (Goffman's (1959) back stage) than it is at the Annual General Meeting (the front stage), even though the same people might be present at each? Here, situations have to be read correctly and discourses adjusted as a result.

Exploring the nature of tacit knowledge empirically

This taxonomy was explored within the BHFP through the mix of methods reported in the first section. Customs were explored through understandings of the LINSAs operating within its wider spatial, organisational and 'values' context. Dominant here is a sense that 'new' customs and distinct routines had been created that broke the mould of earlier thinking about food in the city of Brighton and Hove. Food production and consumption were only one aspect of a wider push for the adoption of sustainable principles in the city. It was widely understood that there was an expectation of food being subservient to a larger sustainability project. A member of the BHFP board noted:

'Our system is looking at the whole system, so ... our role concerns a more holistic approach to sustainable living: community development, healthy lifestyles, mental health – it is about all of these things. It's about jobs, it's about livelihoods, it's about the economy, it's about delivering the 360 degree sustainability picture. Whilst the strategy is a food strategy, the benefits that we wanted to communicate in the strategy are about what overall difference it is going to make. Agriculture and food production are part of this but we are not taking this as a starting point'.

Other participant-stakeholders appeared accordant with this expectation. Whilst not all were able to embrace every aspect of what they perceived to be sustainable

principles, all aspired to the pursuit of multiple objectives. A member of a social enterprise offered the following:

'The importance of food for us is to offer a better mental health stability, like controlling sugar levels. This has led to honey production up at the farm and people buy this in the truckloads in the café. Getting people up early to knead bread for the bakery is good therapy. At the farm, the expectation is to grow more food, but the purpose is therapeutic stuff, there is a sensory garden, but some see that as a space for growing more food ... What we do here (in the café) is to teach people how to cook food, how to prepare food and how to manage waste. We work with black and ethnic minority people and help them look at, sort of, look at, you know, British cuisine and how the transition of ingredients they are used to using can come into it'.

And those with a particular interest in environmental issues still saw the value of using food production to achieve a number of purposes simultaneously:

'With our particular (environmental) background we are looking at more perennial soft fruits and, you know, perennial vegetables and things like that, integrated into ornamental plantings. There is obviously a certain amount of resistance to putting raised vegetable beds throughout the (municipal) parks and public spaces, but if the city is going to plant a tree for amenity reasons, why not make it a fruit tree? Why not make flowers flowering vegetables?'

Without any prompting or orchestration, there was a pervasive and common understanding of the custom of seeing food in its wider context.

In the research, various aspects of *savoir-faire* also were considered. From a range of different contacts with participant-stakeholders, it was clear that the 'feel for the game' was variable. Some acknowledged that they had a partial perspective on the LINSAs as they had a particular interest in only certain aspects of its work. Here, though, there was felt to be a 'comfortable intuitive territory' in areas of specialism.

Others felt that they had a good grasp of what was going on generally, but were not sure about how much they did not know. This grasp was felt by yet others to be impossible to achieve in any comprehensive way as the LINSAs were constantly changing (in a good way) to accommodate new views and values. One participant-stakeholder who worked for a state body suggested that the values and assumptions embedded within the LINSAs were sufficiently important as to require an intuitive response:

'as we develop our thinking (as a state body) and given that we have signed up to the precepts of the Food Strategy, we have to develop a feel for how our plans will be consistent with theirs. This requires new layers of our thinking that can fit into the Partnership'.

A state elected member also suggested that, given the holistic context of the LINSAs and its relationship with the city, the movement was simply too large to be driven by anything other than a feel for what is going on:

'This intuitive grasp is strong and critical. There are so many things going on in developing a sustainable Brighton and Hove that there has to be an intuition that sits underneath it. A purely "rational" basis for development would make the whole process just too big for progress to be made. There has to be a degree of "gut instinct" in developments to keep the momentum up. There is probably not enough expertise available in any one person to do anything other than work intuitively a lot of the time. Intuition has to be underpinned with a clear idea of one's belief systems, though'.

An intuitive understanding also was seen as important in the operation of a network that does not have a regulatory frame. Because the 'rules of the game' often are not written down, they have to be assimilated in different ways. In this context *savoir-faire* plays out through trust relations rather than rules. Whilst trust relations were felt to be the norm in voluntary networks, one of the major successes of this LINSAs was felt to be the way in which state bodies (local municipalities, national parks and health authorities) had embraced a trust-based *modus operandi*.

Amongst the majority of participant-stakeholders, there was a folklore surrounding the unique nature of place: a sense that the LINSAs happened in the way that it has, only because of the context of Brighton itself. A social enterprise manager expressed it as follows:

'Brighton was historically quite a transient town where people came to visit and actually ... a lot of people just didn't go, they just stayed. And as such they've grown up with kids and suddenly they've got this responsibility to make the city suitable for what their needs are. And I think what has arisen out of that is an incredible amount of partnership working, openness, people throwing ideas into the pot and everyone else going ... "yeah, let's have a look at that, let's have a look at this". We've been to conferences in Leeds and Manchester and places where they are just really struggling to get people to help with ideas. Brighton is a really nice place to do that, um, and I think that's where the Food Partnership fits in very nicely ... There is a certain "hippyishness" of the, sort of, the people who've settled here, that have kind of formed this together, but actually now they're now looking at it very cleverly, very responsibly ... It's the nature of Brighton is why it's worked'.

With the only national Green MP in England and a Green City administration, sustainable issues are uniquely high on the agenda. As an employee of the local state put it:

'You will find things in Brighton like a massage therapist working out of a wholefood restaurant, that you won't find in other places'.

In terms of folklore, too, there appeared a strong understanding of who people were amongst those who considered themselves members of the BHFP, despite no formal organisational structure to the BHFP outside of its Board. At group meetings, for example the launch of the second BHFP Food Strategy, *Digging Deeper*, there was a clear rapport and common sense of purpose amongst those present. There were no boundaries defining who may and may not be present at this launch but upwards of 70 people from local state bodies, voluntary organisations and commercial concerns were present. Most seemed to know each other well, many were on first name terms.

There was an acknowledgement that different groups could sign up to the Partnership even though their overall values might differ from those of the Food Strategy: in this sense there was enough in common for a working relationship to succeed.

In terms of the tacit nature of the identity of the LINSAs, two elements constantly surfaced: how the LINSAs was perceived in relation to the city, and how it saw itself in relation to conventional agriculture. Participant-stakeholders felt that there was unusually high buy-in from the local population. There is very high interest in growing local food, foraging is systematic and despite the increasing provision of allotments, waiting lists are growing. For many people, this reinforces identity with their locality.

Participant-stakeholders did note, however, that the sustainable food message did not necessarily touch everyone in the city. Here the importance of viewing the LINSAs as a social movement rather than a food movement was considered important. This has led to the development of training and learning and some targeting of the less well off, at least by housing type. As a state employee noted:

‘part of the value (of BHFP) as a community movement is er, is that it can have a social impact ... it can encourage specific social groups to become involved in local food production and consumption. There are specific projects in Brighton’s most deprived wards, you know, that encourage food production, and projects for the unemployed, young people, ethnic minorities and people like that. The outdoors and being close to nature can be important to these groups in particular’.

Because the LINSAs are concerned with food consumption and its role in health as much as production, the link with agriculture can be seen as tenuous. The disparity in the amount of public funds to conventional agriculture (through the CAP) compared with community agriculture was another stark distinction made by more than one participant-stakeholder. Making connections with mainstream agriculture is a priority in the Food Strategy, but not that straightforward. The city, for example, owns farms but can do little to transform the way they operate. A member of a voluntary body noted:

‘Yes, there’s little connection with commercial agriculture, yes, ... there is more crossover with small scale organic agriculture but even then ... it remains to be seen. Most of the farmland around the city is owned by the City Council but most of it is tied up under longer, longer term tenure – three generations. Nothing innovative has happened there. It is not too late for it to happen but the Council’s priorities for that land (in sustainability terms) are nature conservation and recreation and food production is pretty low’.

Some strengthening connections with local agriculture were noted, however, particularly in respect of short food chains (farmers’ markets, farm shops, local shop supply and so on).

In terms of the tacit understanding of the roles of people involved in the Partnership, participant-stakeholders who were employed by the local state had a confidence in knowing what their own roles were even though these roles were seen as partial and had never actually been articulated by anyone. This confidence came as a result of some perceived commonality of purpose between the local state and the LINSAs, and in the case of the City Council, the Food Strategy had been adopted as policy: purposes became synonymous. The importance of adopting the Strategy and reinforcing the mutuality of roles in this area was noted by a City Council member participant-stakeholder:

‘It is important from our perspective that it (the Food Strategy) succeeds because there are increasing numbers of people suffering from food poverty and we need to make food a higher priority. We are beginning to tackle obesity – it is very prevalent and there is much to do there’.

Aside from state stakeholders, a social entrepreneur noted the inevitable tensions for most members of the partnership in having roles that were both inside the Partnership’s objectives but also outside of it. These roles could be sympathetic, antithetic

or irrelevant to the Food Strategy. A voluntary sector participant was clear and enthusiastic about his role, however, because he had been given a choice about what it could be. Recognising the broad holistic precepts of the role of the Partnership, he was pleased to be able to concentrate on that small part of it that he felt he could do best.

There was less clarity over the roles of others within the LINSAs. One participant-stakeholder claimed that she was not really concerned about the roles of others and another that her knowledge was partial: the roles of state bodies were clear, others less so. A Board member suggested that it was not to be expected that everyone would know everyone's roles. The partnership was informal and roles were changing constantly over time. Most member organisations had different roles inside and outside the partnership and these are not always easy to differentiate, with members moving both within and outside the Strategy Framework. This was good, the Board member felt, lest the Partnership became too formal or 'closed':

'there are over 100 initiatives going on in Brighton and Hove around food in one way or another. Now, the Partnership can act as a hub for all of those and facilitate communication between all of those but, you know, they're autonomous projects at the same time. The Partnership does not tell them what to do but they are part of the larger movement and they can help share knowledge'.

Whatever any one person understood of the roles of 'others' in the Partnership, they did seem to know what they were doing and how they fitted in with each other. The success of the first Strategy in achieving 90 per cent of its targets in the first five years is testimony, the state elected member felt, to that. The Food Partnership has been a success as a partnership in bringing lots of small groups together but the key players have been vital in achieving things because of their persistence and enthusiasm.

In terms of discourses, both Food Strategies had been deliberately written in an accessible language and were concerned with objectives, principles and values as well as action. In contrast, regular newsletters supporting the strategy were more practical and anecdotal in respect of action on the ground: each type of document covered different characteristics of the strategy. This extended to verbal discourse. A voluntary sector member sought to explain the strategy differently, to different people:

'That's my tendency, to work in that way anyway, but erm ... yeah, a lot of people are turned off by policy and it only becomes real in terms of what it enables to be achieved on the ground. Um, and that is definitely a way of communicating to say a box scheme operator or someone like that'.

In this context, a Board Member suggested that it was not so much the language that had to change according to whom one was speaking, but the subject of the conversation:

'If you wanted to talk to a local interest group, be that local farmers, you'd want, it wouldn't be the language so much but it would be the focus of the conversation, you know, what is it, where are the synergies between what you're doing and what we're doing ... your focus would be very much on understanding their needs and their challenges and how the Food Partnership could assist in that. So it's not so much the language, I suppose, but it's about understanding what their priorities are'.

Whilst two employees of the local state who were involved with the Partnership felt that the language of the Strategy was so universal that it did not need to be explained in different ways to different people, a state elected member felt that it provided an excellent platform for debate. In this context, the discourse was steered by the citizenry as much as the originators of the Strategy:

'I mean, you communicate with different people in different ways. Er ... no one's going to say no to having healthier food or more local food, having food as a much more interesting aspect of your life. And you can have so many good conversations with people around that, at all different levels. People in the city are very up for this'.

Conclusion: how important is tacit knowledge for sustainable agriculture?

Researching tacit knowledge can be difficult because of its implicit and unstated nature. Nevertheless, the adaptation of Gerholm's (1990) taxonomy does allow an exploration of some of its different facets. As a subset located within constructivist epistemologies, tacit knowledge described in this way can be observed to be a significant presence in the development of the LINSAs in this case-study. Indeed, in the context of the participatory methods used in this research, the enthusiasms and commitments observed and evidenced within the LINSAs appeared not so much based in the 'science' of food production but in the 'community' of food production. If sustainable agriculture is to embrace the social, cultural and environmental fully, tacit knowledge is likely to have a clear role to play in shaping courses of action.

In this context, tacit knowledge invariably is acquired indirectly or incidentally. It can be assimilated where lessons are learnt about one thing whilst seeking knowledge about another. Where people assimilate knowledge through mutual learning, it is possible that explicit and tacit knowledge can be closely aligned. Such mutual learning is often a fertile context in which new customs, cultures and value systems grow and can provide the opportunity to see 'scientific' knowledge in context, rather than externally imposed. But it is not always the case that users of such knowledge interpret these distinctions between objectivist and constructivist knowledges consistently. Kings and Ilbery (2010), for example, found that there is no necessary relationship between those who believe that they are farming in sustainable ways and their adherence to constructivist knowledge. In their case-studies, both 'organic' and 'conventional' farmers used a mix of both objectivist and constructivist knowledges but there was no tendency for either type of farmer to use one type of knowledge over another.

Certainly, tacit knowledge cannot be overtly learned. It has to be experienced and assimilated rather than simply passed on. It invariably involves 'beliefs' as well as 'facts', which can marginalise it within the objectivist epistemology. Exchanging specific tacit knowledge is thus a limited activity because there are small numbers of people to whom it can meaningfully be passed on and the means of exchanging it is experiential rather than word-based and requires a mutuality of values between giver and receiver. Such exchange is also something that the conventional (codified) AKIS is not geared up to do.

Morgan and Murdoch (2000) suggest that knowledge is one of the key elements that binds partnerships such as LINSAs together. In this role it can be prescriptive or

negotiative. Prescriptive knowledge here tends to be of the objectivist type – as codified knowledge it brings rules and norms that lead to conformity. Negotiative knowledge tends to be more about local autonomy. This notion of negotiative knowledge can be extended beyond local knowledge to the notion of tacit knowledge used in this article. This extension beyond local knowledge stresses the important distinction between local and tacit knowledge that has been emphasised here, as a departure from the original Morgan and Murdoch (2000) construction. Different types of knowledge are likely to be distributed and redistributed in various different ways. Murdoch (1998) suggests that the prescriptive knowledge has a ‘coercive’ element to it and negotiative, a ‘co-operative’ (or even consensual) element and therefore different types of knowledge describe different kinds of power relations within partnerships. Within this mix, the operation of tacit knowledge requires more trust than objectivist or codified knowledge but is pervasive and often remains under-considered because of its implicit nature.

For the development of sustainable agriculture in general, then, it is likely that constructivist forms of knowledge will become embraced more fully into AKSs, and objectivist knowledge adapted to more holistic farming systems. The ‘complex’ set of objectives, values and styles of implementation in sustainable agriculture do not lend themselves well to reductionist or universalist knowledge. It will need to be acknowledged that the application of knowledge for sustainable agriculture will be context dependent and that context will be scientifically, culturally, purposefully – and tacitly – different in each locality.

Notes

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¹ The project, entitled Support for Learning and Innovation Networks in Sustainable Agriculture (SOLINSA) was funded by the Seventh Framework Programme of the European Commission and ran between February 2011 and January 2014.

² This social context, however, assumes the ‘problem’ is absolute food shortage rather than the unequal distribution of food.

References

- Adler, E. (2002) Constructivism and international relations. Pp. 95–118 in W. Karlsnaes, T. Risse and B.A. Simmons eds, *Handbook of international relations* (London: Sage)
- Albino, V., A.C. Garavelli and G. Schiuma (2001) A metric for measuring knowledge codification in organisation learning. *Technovation* 21 (7) pp. 413–422
- Allen-Collinson, J. (2003) Working at a marginal ‘career’: the case of UK social science contract researchers. *The Sociological Review* 51 (3) pp. 405–422
- Allen-Collinson, J. (2004) Occupational identity on the edge: social science contract researchers in higher education. *Sociology* 38 (2) pp. 313–329
- Allen-Collinson, J. (2011) Intention and epoché in tension: autophenomenography, bracketing and a novel approach to researching sporting embodiment. *Qualitative Research in Sport, Exercise & Health* 3 (1) pp. 48–62
- Allen-Collinson, J., S. Fleming, J. Hockey *et al.* (2005) Evaluating sports-based inclusion projects: methodological imperatives to empower marginalised young people. Pp. 45–59

- in K. Hylton, J. Long and A. Flintoff eds, *Evaluating sport and active leisure for young people* (Eastbourne: LSA)
- Bager, T. and J. Proost (1997) Voluntary regulation and farmers' environmental behaviour in Denmark and The Netherlands. *Sociologia Ruralis* 37 (1) pp. 79–98
- Baird, F.E. and W. Kaufmann (2008) *From Plato to Derrida* (Upper Saddle River, NJ: Pearson Prentice Hall)
- Biotechnology and Biological Sciences Research Council (2002) Review of BBSRC-funded research relevant to sustainable agriculture. A report for BBSRC Council, October, Swindon
- Bok, D. (2001) *The trouble with government* (Cambridge, Massachusetts: Harvard University Press)
- Bourdieu, P. (2000) *Pascalian meditations* (Cambridge: Polity Press) (First published as *Méditations pascaliennes*, Éditions de Seuil, 1997)
- Boykoff, M.T. and J.M. Boykoff (2004) Balance as bias: global warming and the US prestige press. *Global Environmental Change* 14 pp. 125–136
- Brighton and Hove Food Partnership (2012) *Spade to Spoon: digging deeper: a food strategy for Brighton and Hove 2012–2017*. Available online at <http://www.bhfood.org.uk/food-strategy>
- Cleveland, D.A. (2001) Is plant breeding science objective truth or social construction? The case of yield stability. *Agriculture and Human Values* 18 pp. 251–270
- Collins, H.M. and R.J. Evans (2002) The third wave of science studies: studies of expertise and experience? *Social Studies of Science* 32 (2) pp. 235–296
- Conway, G.R. and E.B. Barbier (1990) *After the Green Revolution: sustainable agriculture for development* (London: Earthscan)
- Crosson, P.R. (1992) Sustainable agriculture. *Quarterly Newsletter, Resources Future* 106 pp. 14–17
- Curry, N.R., J. Ingram, J. Kirwan *et al.* (2012) Knowledge networks for sustainable agriculture in England. *Outlook on Agriculture* 41 (4) pp. 243–258
- Daston, L. and P. Galison (2007) *Objectivity* (New York: Zone Books)
- Dryzek, J. (1987) Complexity and rationality in public life. *Political Studies* 35 (3) pp. 424–442
- Environmental Challenges in Farm Management (2012) Sustainable agriculture, University of Reading, Available online at http://www.ecifm.rdg.ac.uk/sustainable_agriculture.htm, accessed February 20 2012
- Evans, L., L. Hardy and S. Fleming (2000) Intervention strategies with injured athletes: an action research study. *The Sport Psychologist* 14 (2) pp. 188–206
- Evans, L.T. (1998) *Feeding the ten billion: plants and population growth* (Cambridge: Cambridge University Press)
- Fetterman, D. (1989) *Ethnography step by step* (London: Sage)
- Fischer, F. (1993) Citizen participation and the democratisation of policy expertise. *Policy Sciences* 26 (3) pp. 165–188
- Fischer, K.S. (1996) Research approaches for variable rainfed systems – thinking globally, acting locally. Pp. 25–35 in M. Cooper and G.L. Hammer eds, *Plant adaptation and crop improvement* (Wallingford, Oxford: CAB International in association with IRRI and ICRISAT)
- Foucault, M. (1978) *Governmentality* (lecture at the Collège de France, 1 February). Pp. 87–104 in G. Burchell, C. Gordon and P. Miller eds, *The foucault effect: studies in governmentality* 1991 (Hemel Hempstead: Harvester Wheatsheaf)
- Foucault, M. (1994) *The order of things* Reprint of 1971 English edition (New York: Vintage Books) (Originally published in French in 1966 as *Les Mots et les choses*)
- Freire, P. (1972) *Pedagogy of the oppressed* (Harmondsworth: Penguin)
- Garfinkel, H. (1967) *Studies in ethnomethodology* (Englewood Cliffs: Prentice Hall)
- Garfinkel, H. (2002) A. Warfield Rawls) *Ethnomethodology's program: working out Durkheim's aphorism* (New York: Rowman & Littlefield)

- Garforth, C., B. Angell and J. Archer (2003) Fragmentation or creative diversity? Options in the provision of land management advisory services. *Land Use Policy* 20 (4) pp. 323–333
- Gerholm, T. (1990) On tacit knowledge in academia. *European Journal of Education* 25 pp. 263–271
- Giunipero, L., D. Dawley and W.P. Anthony (1999) The impact of tacit knowledge on purchasing decisions. *Journal of Supply Chain Management* 35 (1) pp. 42–49
- Goffman, E. (1959) *The presentation of self in everyday life* (Garden City, New York: Anchor Books)
- Grant, W. (2009) Intractable policy failure: the care of bovine TB and badgers. *The British Journal of Politics and International Relations* 1 pp. 557–573
- Haas, P. (2004) When does power listen to truth? A constructivist approach to the policy process. *Journal of European Public Policy* 11 (4) pp. 569–592
- Hall, J. and J. Pretty (2008) Then and now: Norfolk farmers' changing relationships and linkages with government agencies during transformations in land management. *Journal of Farm Management* 13 (6) pp. 393–418
- Hanayani, I.O. and P. Prawito (2011) Indigenous soil knowledge for sustainable agriculture. Pp. 303–317 Chapter 11 in E. Lichtfouse ed., *Organic farming, climate change and soil science Sustainable Agriculture Reviews 3* (New York: Springer Science and Business Media)
- Hendrix, P.F., D.C. Coleman and J.D.A. Crossley (1992) Using knowledge of soil nutrient cycling processes to design sustainable agriculture. *Journal of Sustainable Agriculture* 2 (3) pp. 63–82
- House of Commons Environment, Food and Rural Affairs Committee (2011) *The outcome of the independent Farming Regulation Task Force. Tenth report of session 2010–12, volume 1: report HC 1266*, 23 September House of Commons (London: The Stationery Office Limited)
- Howells, J.R.L. (2002) Tacit knowledge, innovation and economic geography. *Urban Studies* 39 (5–6) pp. 871–884
- Ingram, J. (2008) Are farmers in England equipped to meet the knowledge challenge of sustainable soil management? An analysis of farmer and advisor views. *Journal of Environmental Management* 86 (2) pp. 214–228
- Kavannagh, A., J. Daly and D. Jolley (2002) Research methods, evidence and public health. *Australian and New Zealand Journal of Public Health* 342 pp. 26337–26342
- Kings, D. and B. Ilbery (2010) The environmental belief systems of organic and conventional farmers: evidence from central-southern England. *Journal of Rural Studies* 26 pp. 437–448
- Kloppenborg, J. (1988) *First the seed: the political economy of plant biotechnology, 1492–2000* (Cambridge: Cambridge University Press)
- von Krogh, G., K. Ichijo and I. Nonaka (2000) *Enabling knowledge creation: how to unlock the mystery of tacit knowledge and release the power of innovation* (New York, NY: Oxford University Press)
- Kuhn, T.S. (1962) *The structure of scientific revolutions* (Chicago: University of Chicago Press)
- Lee, C.C. and J. Yang (2000) Knowledge value chain. *Journal of Management Development* 19 (9) pp. 783–794
- Lejeune, M. (2011) Tacit knowledge: revisiting the epistemology of knowledge. *McGill Journal of Education / Revue des Sciences de L'éducation de McGill* 46 (1) pp. 91–105
- Lichtfouse, E., M. Navarrete, P. Debaeke et al. (2009) Agronomy for sustainable agriculture, a review. *Agronomy for Sustainable Development* 29 (1) pp. 1–6
- Louth, A. (1990) *Discerning the mystery: an essay on the nature of theology* (Oxford: Clarendon Paperbacks)
- McNie, E.C. (2007) Reconciling the supply of scientific information with use demands: an analysis of the problem and review of the literature. *Environmental Science & Policy* 10 pp. 17–38
- Mann, C. (1999) Crop scientists seek a new revolution. *Science* 283 pp. 310–314

- Maye, D., B. Ilbery and R. Little (2012) Rationalising risk: grower strategies to manage plant disease in the UK wheat and potato sectors. *The Geographical Journal* 178 (4) pp. 338–347
- Merton, R. (1973) *The sociology of science* (Chicago: Chicago University Press)
- Minkler, M. and N. Wallerstein eds (2003) *Community-based participatory research for health* (San Francisco: Jossey-Bass)
- Morgan, K. and J. Murdoch (2000) Organic vs. conventional agriculture: knowledge, power and innovation in the food chain. *Geoforum* 31 pp. 159–173
- Murdoch, J. (1998) The spaces of actor-network theory. *Geoforum* 29 (4) pp. 357–374
- Ostrom, E. (1990) *Governing the commons: the evolution of institutions for collective action* (Cambridge: Cambridge University Press)
- Ostrom, E. (1996) Crossing the great divide: co-production, synergy and development? *World Development* 24 (6) pp. 1073–1088
- Palmer, S., F. Fozdar and M. Sully (2009) The effect of trust on West Australian farmers' responses to infectious livestock diseases. *Sociologia Ruralis* 49 (4) pp. 360–374
- Polanyi, M. (1946) *Science, faith, and society* (Oxford: Oxford University Press)
- Polanyi, M. (1951) *The logic of liberty* (Chicago: University of Chicago Press)
- Polanyi, M. (1958) *Personal knowledge: towards a post-critical philosophy* (Chicago: University of Chicago Press)
- Polanyi, M. (1966) *The tacit dimension* (London: Routledge)
- Polyanin, A.D. (2002) *Handbook of linear partial differential equations for engineers and scientists* (London: Chapman & Hall)
- Pretty, J. (1994) Alternative systems of inquiry for a sustainable agriculture. *IDS Bulletin* 25 (2) pp. 37–49
- Reix, R. (1995) Savoir tacite et savoir formalisé dans l'entreprise. *Revue Française de Gestion* 105 pp. 17–28
- Röling, N.G. and M.A.E. Wagemakers (1998) *Facilitating sustainable agriculture: participatory learning and adaptive management in times of uncertainty* (Cambridge: Cambridge University Press)
- Rosenbaum, W.A. (1978) Public involvement as reform and ritual. Pp. 81–96 In S. Langton ed., *Citizen participation in America* (Lexington, Massachusetts: Lexington Books)
- Scott, J.C. (1998) *Seeing like a state: how certain schemes to improve the human condition have failed* (New Haven: Yale University Press)
- Siebert, J.E. (1992) *Planning ethically responsible research* (London: Sage)
- Simon, H.A. (1991) Bounded rationality and organisational learning. *Organization Science*, special issue: organizational Learning: papers in honor of (and by) James G. March. 2(1) 125–13. *Theoretical and Applied Genetics* 82 pp. 363–367
- Smith, J. and P. Hodkinson (2005) Relativism, criteria and politics. Pp. 915–932 In (Eds.) in N. Denzin and Y. Lincoln eds, *Handbook of qualitative research* 3rd edn (London: Sage Books)
- Sparkes, A. and B. Smith (2009) Judging the quality of qualitative inquiry: criteriology and relativism in action. *Psychology of Sport and Exercise* 10 pp. 491–497
- Spedding, A. (2009) *Science, belief and rational debate*, RuSouce, the rural infomration network, Briefing 839, 15th June
- Tsouvalis, J., S. Seymour and C. Watkins (2000) Exploring knowledge cultures: precision farming, yield mapping and the expert–farmer interface. *Environment and Planning A* 32 pp. 908–992
- Valente, A. and D. Luzi (2000) Different contexts in electronic communication: some remarks on the communicability of scientific knowledge. *Journal of Documentation* 56 (3) ISSN 0022-0418 Available online at <http://editlib.org/p/91930/> Accessed 15 April 2014
- Van Gorp, B. and M.J. van der Goot (2012) Sustainable food and agriculture: stakeholders' frames. *Communication, Culture and Critique* 5 pp. 127–148
- Wadsworth, Y. (1998) What is participatory action research? *Action Research International Paper* 2: doi: <http://www.scu.edu/schools/gem/ar/ari/p-ywadsworth98.html>

- Wallace, D.H. and W. Yan (1998) *Plant breeding and whole-system crop physiology: improving crop maturity, adaptation and yield* (Wallingford, Oxford: CAB International)
- Wilson, E.O. (1998) *Consilience: the unity of knowledge* (New York: Knopf)
- Yang, K. (2006) Trust and citizen involvement: decisions trust in citizens, trust in institutions, and propensity to trust. *Administration & Society* 38 pp. 573–595
- Zanetti, L.A. (1998) At the nexus of state and civil society. Pp. 102–121 In (Eds.)in C.S. King and C. Stivers eds, *Government is us* (Thousand Oaks, CA: Sage)

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