Networks from an Interdisciplinary 'Social Science' Perspective: A Preliminary Review

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I. Introduction

The following is a review of recent literature on social networks as studied in the social sciences, particularly sociology[1]. The purpose of this review is to establish foundations for a conceptual framework for empirical research, which is both valid from a social science perspective and meets with the needs of the CAVES (Complexity: Agents, Volatility, Evidence and Scale) project. CAVES is explicitly oriented towards evaluating land users' social networks, but this has been developed primarily from a computer modelling perspective. In order to publish findings from the CAVES research in social science journals, and indeed to be true to the spirit of 'interdisciplinarity' inherent in the CAVES project, it is important that project research also reflect social science perspectives.

In this paper, I first review the critical assumptions about social networks stated in the CAVES research documentation. I then review the development of social network studies in the social sciences in general, before focusing on current thinking, represented in distinct approaches: social network analysis, social capital, and actor-network theory. I also include a section reviewing how social networks are described in the rural studies literature. Although this is not a distinct approach specifically addressing networks, this is the literature in which CAVES results will be published, and it is therefore useful to discuss how social networks have been researched in this area to date. I conclude the paper with a summary of the relative utility of the different approaches, and questions surrounding the conceptualisation of networks in the research plan, which arise from the literature review.

II. Social Networks in the CAVES Project

In the study of social networks, there are many conceptual positions from which to choose. It therefore makes sense to identify at the outset the critical assumptions of the CAVES research, and utilise these as a means of evaluating possible social science approaches. The basic hypothesis implied in the CAVES literature is that multiple, long-established social and informational networks increase the resilience of a land use system in response to technological and demographic change, and particularly to external shocks. Any research undertaken would thus have to conceive of land use as being part of a 'system': use of this term implies boundaries, and an identifiable structure. This system must include social and informational networks, as well as land, technology, and actors. Other statements in the project summary indicate that these networks are assumed to consist of 'networks of networks', implying differing types of network, and levels of hierarchy within the system. The adopted approach must also address the notion of shocks – significant, unexpected events within the system, which may or may not result in 'volatile episodes' of internal system response.

[1] There are numerous approaches to the study of networks in the social sciences. I have chosen to focus on interdisciplinary, largely sociological perspectives because this is my academic background. There are also established approaches in political studies, economics, development psychology and education, to name a few.

The CAVES project is by definition lodged in complexity science. Basic assumptions of complexity theory, stated in the project summary, include 'metastability' - the idea that change, although ongoing, tends to occur through periods of slow and fast transition. A system may appear fairly stable for a period of time, but a small change will 'push it over the edge' and result in rapid transition to another fairly stable state, which is not linearly predictable from the slow change processes evident in the pre-transition state. This has specific implications for data analysis, ruling out the use of linear projections. In addition, individuals in the system are assumed to have agency – the power to make voluntary decisions – but these decisions are not based solely on economic reasoning. While economics are important, individuals also consider personal goals, and respond to social norms. The inclusion of these concerns in the decision-making processes rules out the use of traditional economic approaches, opening up the range of possible individual, and thus system responses. However, the inclusion of diverse personal and cultural issues in the decision-making process does not make for chaotic action. Networks are conceived of as representing patterns of action, producing consistent 'statistical signatures'. Data drawn from empirical study should therefore result in evidence of patterned behaviour.

The CAVES project also involves more practical, logistical issues such as research timeframes, staffing and general research budget. These will be further considered in the formal research plan. However, it is clear that there are limits to the amount of data of different kinds that can be collected during the study period. There are also limits within the computer modelling approaches, which require further discussion. The purpose of this paper is to outline the major research options and issues from a social science perspective, in order to facilitate discussion among team members about the theoretical and logistical issues in implementing the CAVES project.

III. Development of Social Network Approaches

The importance of human relationships to economic development has been recognised for centuries, if not millenia – Freeman (2005) considered the importance placed on genealogies in the bible to be evidence of this, whereas other authors cite Greek philosophy (Scott, 1996). Most proponents recognise the origins of modern studies to be the Jacob Moreno's sociometry studies of the 1930s. Moreno was the inventor of the 'sociogram' – a diagram of connections between individuals. Prior to that point, thinking about networks had not had visual representation (Scott, 1996). Moreno's work was based on the analysis of friendships, identifying social leaders and isolated individuals, as well as asymmetry in friend relationships and small group dynamics (Berry et al, 2004). More in depth exploration of the roots of network analysis also finds origins in developmental psychology and education, which explored children's networks in the 1920s and 1930s, through observation of their voluntary social interactions, and choice of friends (Freeman, 1996). Study of social relationships is also central to social anthropology. A milestone study in the 1920s by Warner, Mayo, Roethlisberger and Dickson (in Scott, 1996) uncovered the informal social networks underlying employment relations – and productivity – in a Chicago factory.

In the 1950s, what later became known as the 'Manchester School', at Manchester University in the UK, began investigating how social relationships affected society as

a whole. Based on this work, a group at Harvard in the 1960s and 70s began translating concepts into mathematical terms, a transition aided by the widespread use of computers in the 1970s. Out of this school came the work of Mark Granovetter about strong versus weak ties, which is one of the most frequently referenced works in the study of networks throughout the social sciences. Granovetter (1973) found evidence that it is weak ties – distant connections – that are most useful in finding employment, refuting previous assumptions that strong ties are the primary source of resource access. The 1960s and 1970s also saw the advent of the 'diffusion of innovations literature', which identified and investigated the primarily social means by which technological innovations came to be adopted in by an industry over time. Researcher like Rogers (1962) found that 'early adopters' rely on different social connections than 'late adopters'.

The study of social networks continued throughout the 1980s, including well-known works such as Bourdieu (1983) and Coleman (1988)'s (separate) explorations of the economic significance of 'social capital'. However, it was in the early 1990s that the study of social networks took off (Wasserman et al., 2005). This coincided with similar interest in the physical sciences, resulting in hundreds of papers from disciplines as diverse as physics, computer science, biology, economics and sociology (Watts, 2004). The rapid expansion of research on social networks in the social sciences in the 1990s was in part a natural progression of existing interest, but more a reflection of shifting trends throughout the social sciences. Growing literature around the subject of late modernity (Giddens, 1990), second modernity (Beck, 2000) and postmodernity in general, brought with it recognition the diversity of social relationships inherent in Western societies. Individuals were recognised to maintain relationships across traditional boundaries of class, space and time. The utility of these relations was based on trust, raising academic interest in its formation. No longer was trust placed solely in interpersonal relations, but also in individuals who may never meet (Giddens, 1990). The formation, institutionalisation and propagation of these relationships - on which society was increasingly built - became of primary interest in the social sciences. Academic attention was also shifting from social structure and organisations to the actions of individuals, giving rise to the 'structure-agency' debate in sociology: the extent to which individuals have voluntary choice, rather than acting as socially controlled robots within social structures. Looking at the role of individuals also raised the issue of linking macro and micro level analyses – larger debates on social change with evidence from the field of specific social interactions. Network theory was a means of bridging these gaps, and grew rapidly as a result.

IV. Social Network Analysis

Social network analysis (SNA) is an approach to studying social networks that combines empirical sociological research with highly developed mathematical analysis. Social networks are visually represented as nodes and ties, which are used in the analysis of social structure. The approach is sufficiently developed to be considered a 'paradigm', with a corresponding professional society (the International Network for Social Network Analysis – INSNA), web-site (www.insna.org) and three academic journals (Connections; Social Networks; Revista REDES). The annual 'International Sunbelt Social Network Conference' started in 1997 and, owing to its Canadian founders, is traditionally held in a warm location. There are also an extensive range of textbooks, educational seminars and computer programs designed

specifically for the study of social networks (as conceptualised in this field). The SNA paradigm traces its roots to the sociometry studies of the 1930s, with advances through the Group Networks Laboratory at MIT in the 1940s and the 'Harvard Structuralists', who developed block modelling[2] in the 1960s (Berry et al., 2004). It was in the 1970s that the field took off, however, due to developments in mathematics – specifically modern discrete combinatorics (particularly graph theory) – and computer technology, which allowed more complex mathematical analysis of data (Freeman, 2005). More recent work has found applications in organisational behaviour, inter-organisational relations, the spread of contagious diseases, mental health, social support, the diffusion of innovations and animal social organisation.

The SNA approach is by definition committed to both systematic analysis of empirical work and to formal theory expressed in mathematical terms (Freeman, 2005). Tindall and Wellman (2001) defined social network analysis as:

> the study of social structure and its effects... network analysts investigate patterns of relationships that connect members of social systems, and how these patterns channel resources to specific locations in social structures.
>
> Tindall and Wellman, 2001, p. 266

SNA is thus a means of studying social structure – proponents of this approach believe that position in networks largely determines an individual's actions. Many believe that the success of organisations and indeed, societies, is a reflection of the patterning of their internal network structure (Freeman, 2005). Tindall and Wellman (2001) go on to identify five primary principles of SNA:

1) Structured social relationships are a more powerful source of sociological explanation than the personal attributes of system members

2) Values, attitudes and norms emerge from location in structural systems of social relationships

3) Social structures determine the operation of dyadic relationships

4) Social systems are networks of networks

5) General principles – objectivism, generalisability, and structure

Adapted from Tindall and Wellman, 2001, p. 270-271

The first principle states the primary distinction between SNA and other social science approaches: the emphasis on structure, as opposed to individual characteristics. In SNA, although individual characteristics are considered to be important, the location of the individual within specific networks (at the centre, periphery etc), and the structure of the networks themselves, are considered to be more important. As a result, studies of networks using SNA investigate how dense,

[2] A block model is a hypothesis about relationships in a network, characterised by identifying subsets of actors, and identifying the presence of absence of a time within or between each pair of actors (Wasserman and Faust, 1994)

clustered or bounded a network is, its size and composition, how specialised the identified relationships are, and how indirect connections operate (Tindall and Wellman, 2001). Related to this, Wellman (1988) argued that it is important not to start with the assumption that norms and values guide behaviour, and instead look at the types of structures in which individuals are embedded. His belief is that these structures give rise to norms and values, and are therefore the focus of research. The third principle is a reproach to studies that focus on dyadic relationships, to the exclusion of other relationships. Given the importance of the networks, a relationship between two individuals is necessarily impacted on by other relationships of those individuals. This also impacts on the types of support or resources that can be gathered and transferred by these individuals. Similarly, the fourth principle is that social systems are networks of networks – people with membership in more than one organisation are considered to be more integrated, and to serve as bridges for other individuals. Organisations or networks which are more structurally central will have more influence than those on the periphery. The fifth principle is more general, stating proponent belief in the objective existence of networks – as opposed to post-modern beliefs in relativity.

SNA emphasises the study of entire networks. These exist in two kinds: whole networks which represent the entire set of social connections of a population, limited by geographic or interest area; and ego-centred networks – the entire set of relations of a given individual. A whole network is achieved by compiling an ego-centred network for every individual within it (Marsden, 2005). Due to the extensive data gathering requirements of studying whole networks, ego-centred network studies are most common. However, studies of informal structures within limited bodies, such as organisations or businesses, can employ whole network methods. The logistical necessity of utilising an ego-centred network in most cases can result in difficulty accurately identifying an individual's centrality: the researcher has already made this distinction by choosing the ego individual's network to study. An individual's network is generally considered to consist of at least 140 active ties, which would include family, friends, neighbours and work colleagues, but up to 1500 more distant relationships (see Wellman and Wortley, 1990). Identification of these obviously a time consuming process, and it is therefore more common to focus on the strongest three to six, or those utilised for specific purposes, such as finding work or borrowing money, or to reanalyse existing data (Wellman and Workley, 1990). Studies also limit the number of types of relationships which are investigated – for example friends or co-workers, or the purpose of the relationships, such as business or leisure (Marsden, 2005).

Research techniques in SNA typically rely on interviews and questionnaires, although Tindall and Wellman (2001) comment that ethnographic work can also be utilised. Data is drawn from respondent reports - usually about their own relationships, but sometimes also for those in their networks – but due to the emphasis on quantification of responses, the qualitative nature of these relationships is rarely examined. Instead, relationships are analysed for characteristics such as strength (frequency and importance), ease of access (geographic proximity), structural position within the network, kinship, characteristics of network members (demographics and personal resource levels) and similarities of network members (this example taken from Wellman and Wortley, 1990). The magnitude of this field of study has resulted in the development of numerous, often standardised, questionnaires that can be

utilised to elicit this type of information. Marsden (2005) identifies standardised tools for generating names of network members and evaluating comprehensiveness, evaluating network size, position in networks and resources available through networks. In addition to these are the computer programs and analytical techniques for developing this information into mathematical equations.

Evaluation

Research findings based on SNA provide useful insights into a number of areas of interest to CAVES. Studies of network structure indicate that individuals with broader ties – those beyond the local area – typically have greater access to information[3] (Granovetter, 1973). Similarly, those individuals located near 'structural holes' – areas of limited interaction within or between networks[4] – have broader connections, and therefore access to more information than other network members (Burt, 1992). Specific types of ties are also known for providing access to specific resources. Wellman and Wortley's (1990) study of support provided through networks in East York, Ontario, analysed the networks of households in East York, Ontario. They found that neighbors are more likely to provide large and small services, but are less likely to provide companionship or loan money. Parent-child relationships provide the most support – including services, emotional aid and financial loans; parents are by far the most likely of all network members to provide loans. Sibling relationships are similar to friends in providing small services and emotional support, but more likely to provide large services and less likely to provide companionship. Extended family ties are the least likely of all network members to provide any kind of support. Given the high level of resources necessary for maintaining a viable farming operation, the influence of networks on resource access and transfer will be of primary importance to the CAVES research.

SNA is clearly an established field, offering a well-developed, sociologically valid means of investigating social networks. It fits conceptually with CAVES notions of systems and multiple networks in hierarchy. It also offers well developed tools for network measurement and analysis, and is well accepted within the field of sociology in general. In a review of the most recent INSNA conference program, I found an abstract for a paper on agent-based modelling. This suggests that some research is being done in this area, but it is difficult to say how much.

There are some difficulties with utilising SNA in the CAVES project, however. There does not appear to be literature addressing change processes – networks simply appear to evolve – nor network response to external shocks. SNA has historically been criticised for being stronger on methods than theory, although proponents argue that this is no longer the case. There does appear to be conflict between the largely structural assumptions of SNA and the agent based perspective of CAVES. In CAVES, actors are perceived as making choices based on personal and economic rationales, not simply responding to their structural position. CAVES also

[3] Granovetter's study was based around individuals seeking employment. He found that individuals typically had direct, although weak, ties to their new employers. The significance is not the number of weak ties – by definition everyone can be expected to have many of these – but the positions (power) of individuals to which they were directly connected.

[4] Burt identified structural holes through a whole network analysis of a corporation's staff. By identifying all the linkages between all of the staff members, he was able to identify areas of low connectivity, or 'structural holes'.

emphasises the importance of qualitative research, rather than the quantitative required by SNA, to elicit the reason individuals give for their actions, rather than deriving these from network positions. There may also be issues surrounding the inclusion of ecological data – land uses, climate change, and crop yields – in a study which utilises SNA. The extensive data collection required by SNA in order to justify generalisation to larger populations may also be prohibitive.

V. Social Capital

Social capital is a relatively new idea in the social sciences. Origins are credited to Jane Jacobs in 1961 and Glen Loury in 1977 (Wall, Ferrazzi and Schryer, 1998), but the concept did not become mainstream until the 1990s. Foundational authors also include Bourdieu (1986), Coleman (1988) Putnam (1993), Burt (who I have already mentioned in conjunction with Social Network Analysis), Fukuyama (2000) and Lin (2001). Social capital represents an interdisciplinary body of literature at the other end of the spectrum from Social Network Analysis: whereas SNA proponents revel in mathematical analysis, studies of social capital are frequently qualitative, focused on descriptions of the significance of social interactions to economic activities. Studies of social capital do not necessarily look at networks – while typically recognising that social capital is held by groups or within the context of relationships, rather than by individuals, studies of social capital tend not to address specific types network structure. Instead, research addresses specific issues such as trust, sources of information and the role of social capital in facilitating economic activity. Social capital theorists remain interested in social structure, however, but analyse it in a more general way.

Although social capital has an extensive body of literature, its authors are inconsistent as to the precise definition. Use of the term 'capital' links the concept directly to economic theory, but this is developed more explicitly by some authors than others. Pierre Bourdieu developed a conceptualisation of social capital alongside cultural and economic capital. He argued that it is impossible to account for the structure and functioning of the social world without considering capital in all its forms, not merely economic (Bourdieu, 1983). Bourdieu's interest was in how social (and cultural) capital is transformed into economic capital, which he conceived to be the root of other capital types. For Bourdieu, the essence of social capital is group membership – the resources, or resource credits to which one has access as a result of belonging to a group. The amount of social capital an individual possesses is thus a reflection both of network size, and the amount of resources held by other network members. Social norms, or ingrained dispositions to act, as well as educational levels, were considered to be part of 'cultural capital'. Bourdieu viewed all forms of capital – social, cultural and economic – as representing forms of accumulated labour, which can be transformed back into labour under the correct circumstances. The purposes of capital development and use, then, are to secure profits, which could be symbolic or economic. Individuals are born into groups, and have access to social capital as a result, but build these connections over time, making it possible to secure positions of greater wealth – economic, cultural and social – by means of the connections which they reinforce. Social capital is held by the group, which reinforces it constantly by exchanges, again either symbolic or economic. Through these exchanges, the boundaries of the group are maintained.

James Coleman, another founding father of the social capital concept, had a very different conceptualisation of social capital. He defined social capital by what it achieved. For Coleman, social capital is a part of social structure which acts to facilitate the actions of actors, which could be individuals, groups or organisations. He is unusual among social capital thinkers for including relationships within the immediate family or household as part of social capital transfer. His examples of social capital included obligations, expectations and trustworthiness; information channels; and norms and effective sanctions (Coleman, 1988). Coleman saw the concept of social capital was a means of introducing social structure to the rational action paradigm. Rational action, based on rational choice theory, is the notion that actors are active in their decision-making, rather than simply responsive to structural change. By including social capital, Coleman could include social structural constraints such as access to information and social norms, into the rational action paradigm. Coleman's work was largely based on field research into educational achievement, pointing to evidence of household based social capital's influence on academic achievement. This is in contrast to Bourieu, whose work was primarily theoretical.

Robert Putnam is the third of the three 'big names' in social capital, after Coleman and Bourdieu. He defined social capital as: "the features of social organization … that can improve the efficiency of society by facilitating coordinated actions." (1993, p. 167). His 1993 book Making Democracy Work: Civic Traditions in Modern Italy Putnam used his research on regional economic performance in Italy to generate hypotheses about the importance of history, wealth and social ties in achieving effective governance. He argued that horizontal (as opposed to vertical, authoritarian) networks of reciprocity are fundamental to civil society, as made evident through participation in voluntary organisations, as well as trust, and norms of reciprocity. Putnam argued that organizations are important because they reinforce habits of cooperation, solidarity and public spiritedness, building skills in those areas. Putnam also emphasized the importance of history in determining patterns of social capital, and identified roots for current issues in his study of Italy stretching back to the thirteenth century. Putnam's work has had a variety of reviews and criticism. One of these is empiricism – Putnam's hypotheses are based on but not directly attributable to numeric indicators. Putnam's early work also held an apparent idealism – no where in his 1993 book does he suggest that strong horizontal linkages can in fact impede economic development, through such phenomena as rent seeking, although this has been demonstrated in other studies (Knack and Keefer, 1997). This omission was corrected in his 2000 book, Bowling Alone: The Collapse and Revival of American Community.

Francis Fukuyama (2000) is distinctive for his emphasis on social norms, defining social capital as: an instantiated informal norm that promotes cooperation between two or more individuals. Fukuyama is clear that although trust, networks and civil society are evidence of social capital, they are not social capital in and of themselves. Neither are any instantiated informal norms social capital – only those that lead to cooperation in groups. However, like Putnam, he sees group membership as a viable measure of social capital, in addition to survey data on levels of trust and civic engagement. The actual measurements he proposes, however seem suspect, as they are not backed up by empirical data. Similar to other theorists, he sees the function of social capital as having economic value, specifying that it reduces the transaction

costs associated with bureaucracy. Fukuyama also has more of a political agenda than most authors, giving recommendations for state facilitation of social capital, particularly through educational policies and providing public goods.

Lin is a more recent entrant to the literature on social capital, but his (2001) book, outlining his conceptualisation of the concept, has become well known. He defines social capital as: "resources embedded in a social structure that are accessed and/or mobilized in purposive actions" (Lin, 2001, p. 29). He goes on to identify four ways in which these resources enhance the outcome of actions: information exchange; influence (on decision-making through personal weight, authority); social credentials (existence of specific social ties with resultant implications) and reinforcement (worth of individual and group membership). Oddly, however, he neglects to include the access to resources in his list. Similar to other social capital theorists, his interest is in how social capital is captured in investments. He differentiates his work from that of Bourdieu, Coleman and Putnam by arguing the value of weak ties, a position already taken by Granovetter. According to Lin, the three primary social capital theorists focus on social capital in groups, which implies dense or strong, immediate ties.

Evaluation

The concept of social capital is an interdisciplinary concept widely accepted in the social sciences. It is weakened, however, by the wide variety of conceptualisations, many of which are not well developed. This facilitates the very weak use of the term in many empirical studies. According to the various authors, social capital may include trust, social norms, social credentials, information channels, family relationships, voluntarism, group membership and community engagement. Theorists decide on the 'types' of social capital on the basis of differing theoretical arguments – for Putnam, it was the force of history, Coleman was interested in adding a structural component to rational action theory, whereas Bourdieu was looking at labour and class-based analyses. There is also no established methodology for utilizing social capital in research: studies range from quantitative analysis of standardized survey data (see for example http://www.statistics.gov.uk/about_ns/social_capital), to qualitative description of social norms.

For the purposes of the CAVES project, the flexibility in definition and use of the social capital concept may actually be beneficial, allowing the integration of the diverse ideas embedded in the project documentation. The concept fits well with the proposed qualitative field research, and theoretical linkages to economic decision-making. Use of the social capital concept, rather than a SNA perspective, allows the focus of field research to remain on land use change processes, and the role of social relationships within these, rather than a primary focus on network identification and analysis. In addition, the study of social capital does not require the identification of whole or ego-centred networks, and so is much more feasible for achieving successful field research (under the conditions of the CAVES project) than Social Network Analysis. The literature on social capital is sufficiently wide ranging as to include all of the issues identified in the CAVES project documentation, but care will have to be taken to ensure theoretical consistency when bringing these ideas together to define social capital in the project. Some work will also need to be done in order to integrate social capital with complexity theory.

VI. Actor Network Theory

Actor network theory (ANT), although the most clearly sociological of the approaches described in this paper, is actually outside of mainstream sociological thought. Initiated in the work of Bruno Latour, and formed into a more consistent theory by John Law and Michel Callon, actor-network theory has become infamous in the study of social networks for including inanimate objects as 'actants' in the identified networks. Latour (2005) openly challenges what he considers to be the basic premises of sociological thought, returning to a debate between father of sociology Emile Durkheim and his contemporary Gabriel Tarde about the fundamental focus of sociology. The result is what Latour terms 'critical sociology' or 'sociology of associations', which he constructed in opposition to mainstream sociology, or the 'sociology of the social'. His primary argument is that sociological thought is circular – that by identifying 'social forces', 'social movements' or 'social structure' as if they exist in a separate reality from the 'natural' world, sociologists first artificially create their subject matter, and then study their creation.

As could perhaps be expected of a critique of sociology, the basic principles of ANT are specific about what is not, than what 'is'. Latour (2005) emphasises social interaction, rather than social forces. In doing so, he not only argues that social structure and social forces do not exist, and that the distinction between society and nature is artificial, but that there is no useful distinction between local and global. 'Macro' level forces are located in specific activities and places, be they board rooms, stockmarket floors or houses of parliament, and only require observation to be revealed as such. In line with this, there are no 'givens' in the research process – not the state, not markets, not environmental conditions. Instead, the researcher follows interactions, considering every mediator (object or individual who 'translates' – changes by interaction – resources or meaning). Research methods are therefore qualitative, almost ethnographic in nature. The criteria for good research are highly subjective – Latour identified rich description, with many mediators and few intermediaries (actants who do not influence resources or meaning). It is not the job of the researcher to interpret findings – Latour argues that the actants are best able to identify meaning themselves – but to report them sufficiently that a cohesive picture emerges. In doing this, ANT claims to be both realist and objectivist – founded in empirical work, and revealing real processes.

Interestingly, ANT is not specifically designed for the study of networks. Instead, the term network refers to the outcome of the analysis, which is typically presented in network form. By nature of the actor-network methodology – following actant to actant to understand a specific process – results are most easily portrayed as a network. Latour (2005) identified four primary data sources: texts, such as organisational charts, which are indicative of network structure; technical artefacts, or the objects ranging from computer technology to climatic conditions, necessary for an action to occur; money transfer, because this is easily translated into actions; and human beings, with their various relationships.

Evaluation

ANT is useful for identifying the most important issues surrounding a change process, be they lodged in human relationships or not. This direct connection between what is often construed as social and natural is useful for the CAVES project, where environmental issues are included with social networks in the computer models of land-use change. ANT also recognises complexity, although perhaps more in-line

with ‘complicated’ than attachment to complexity theory. ANT deals with complexity by naming and exploring it, rather than reducing it to pre-identified areas of interest. More problematic are the statements in the CAVES research proposal regarding ‘networks of networks’ – implying human membership only - and hierarchies within complex systems. ANT is explicit in denying the existence of hierarchies, and of multiple networks. Instead, in ANT, everything is woven together into a whole, which can be analysed in network form. In addition, although ANT is an established theoretical approach, it has been heavily criticised within academic circles, and may in fact be on its ‘way out’ of sociological practice. This is perhaps due to the time investment necessary to digest it ANT theory, resulting in rejection on the basis of its most distinctive characteristic: the inclusion of inanimate actants. Interestingly, although social capital is occasionally mentioned in conjunction with social network analysis, my reading did not reveal any references to ANT in the SNA literature.

VII. Networks in Rural Sociology

The purpose of reviewing the study of social networks in the rural sociology literature is to frame the body of literature in which CAVES findings are likely to be published. Unlike the three approaches or conceptualisations of social network studies previously presented, there is no recognised body of literature within rural studies for the study of social networks. Studies of social capital are fairly frequent, and there is the occasional use of actor-network theory. Social network analysis is notably missing from this literature, however, perhaps due to the ‘cultural turn’ in rural studies during the 1990s (see Cloke, 1997), which has emphasised qualitative research. Although networks per se are not a major focus of this literature, there is considerable literature on aspects of networks, such as social norms and resource transfer, as they relate to agriculture and rural development.

Perhaps the best known research on networks in rural studies is found in the adoption and diffusion of agricultural innovations. The research originated in the 1960s, in line with other studies of technological diffusion. The diffusion of innovations literature is founded on the premise that new ideas and practices spread through interpersonal networks (Valente, 2005). Rogers (1962) developed a specific interest in the diffusion of agricultural innovations, and looked at both the decision-making process, and influences on it. He argued that early adopters – those who adopt new technology sooner than others – are influenced differently by social considerations than those who wait to adopt innovations. ‘Early adopters’ typically have many contacts with extension agents and people outside of their social group, and participate actively in many organisations. In contrast, ‘late adopters’ tend to get their information through interpersonal contacts who have already been successful in adopting the innovation.

The diffusion of innovations literature also gave rise to the identification of personal characteristics which co-relate to adoption of agricultural innovation. Van den Baan and Hawkins (1996) identified the following:

- high level of education
- high level of literacy
- high level of social status
- commercial economic orientation

- favourable attitude to credit
- favourable attitude to change
- favourable attitude to education
- intelligence
- social participation in organisations
- urban contacts
- mass media exposure
- exposure to interpersonal channels
- active information seeking
- opinion leadership (someone who passes on information readily)
- high positive general attitude toward change
- high aspirations for themselves and their children

Other studies include age of farmer, life stage of farmer, as well as structural issues, such as the availability of other employment opportunities, and policy change. However, the adoption and diffusion of innovations literature has widely been rejected in contemporary agricultural extension practice (Buttel et al., 2000) and has not been replaced (Vanclay and Lawrence, 1994). The criticisms of the adoption and diffusion of innovation approach include the assumptions that all innovations are beneficial to all farming operations, and that farmers follow a rationale process of awareness, information, evaluation, and trial, before adopting the innovation throughout the farm enterprise.

The factors identified in the adoption and diffusion of innovations literature are also identified in the significant body of research on the determinants of diversification (non-traditional farm enterprises) and pluriactivity (off farm employment) in farm households. In general, this literature analyses the patterns and range of resources necessary for farmer engagement in non-farm activities. Although the engagement of farm household members in pluriactive and diversification strategies has long been recognised, Ellis (2000) points out that this feature of agricultural production systems has not had a strong place in theories of agrarian change, which tend to focus on agriculture alone. Early failure to include non-agricultural household activities and income in debates about agrarian transition was largely the product of assumptions that pluriactive strategies were a means of disengaging from primary agricultural production, and thus consistent with both Marxist differentiation and neoclassical economic perspectives. The notion that off farm employment was undertaken primarily in an effort to 'save' the family farm also assumed the temporary nature of this activity. Work by Bryden and Fuller (1982) demonstrated that pluriactivity, rather than being transitional or temporary, was a long-term phenomenon, characterising well over half of the farm households in Europe. A study by Quin and Mitchell (2000) found that approximately 60% of Scottish farm households are pluriactive.

Murdoch's (2000) review of networks in rural studies emphasised the development of commodity chain analysis – analysis of the vertical linkages between farmers, processors and markets. This approach is largely structuralist, lodged in Marxist political economy, attributing changes in agricultural production to the penetration of capitalism into the agro-food sector. The reference to 'commodity' reflects the viewpoint in the studies that different types of commodities are organised

differently, with some more easily dominated by large-scale industrial actors than others. Although social, technical, economic and natural components of food chains are included in the analysis, the emphasis is on power relationships, with credit (or blame) for change typically given to multinationals and other 'macro' actors (Murdoch, 2000). Although this would appear to contrast markedly with agency-oriented approaches such as actor-network theory, some work has been done to combine the two. However, Lockie and Kitto (in Murdoch, 2000) point out that this combination has limited added value: resultant analyses tend to identify the same agencies already identified through commodity chain analysis.

Literature on the significance of social norms also features in recent rural studies literature. Burton (2004) demonstrated that farmers in his Scottish study site have clearly developed norms surrounding the characteristics of being a 'good farmer', which impact on their decisions regarding up-take of agri-environmental schemes. Villa's (1999) work in Norway identifies the historic role of farm work experience in shaping expectations, now being challenged by a larger cultural shift toward individualisation and choice. Shucksmith and Hermann (2002), following Shucksmith (1993) utilise Bourdieu's concept of habitus (derived from cultural capital), a socially embedded disposition reflecting the dominant cultural mode of thought and personal experience, which guides and constrains an individual's freedom to act. These approaches have in common the role of historical experiences and social norms for influencing personal and business decisions of agricultural producers, identifying the juxtaposition of traditional cultural expectations with 'modern' emphasis on individualism. Although these studies do not address networks per se, these norms and values identified can be expected to be reinforced and shaped by the personal relationships between these individuals.

There is also a also growing body of research on issues of intergenerational resource transfer, or family farm succession, in light of the ageing of farm operators, and the increasing scale of production (and thus investment) on Western farms. Symes (1990) in his discussion of British farming, reveals that family succession is becoming more, rather than less important over time. He argues that farming is becoming a 'closed' occupation: only those able to access sufficient resources (land, labour and capital, most easily through inheritance or intergenerational transfer), are able to establish or maintain a viable farming operation. Even so, it is not always possible to transfer the farm, nor is there necessarily a willing successor. This has implications for the viability and market orientation of the farm both short and long term. Studies on farming succession have found that farm operators who are without successors, or without formal succession plans, are less likely to invest in the development of their operations (Bryden et al., 1993).

Evaluation

Rural sociology developed separately from mainstream sociology, due to its foundations in agriculture and the study of farming. Indeed, most rural sociologists in the UK are geographers by training. The result is a field that differs significantly from mainstream sociology (Burton, 2004b), to the extent that highly empirical approaches such as social network analysis would sit poorly with many European academics, who tend to focus on qualitative approaches. The notion of social capital is well accepted within this literature, and actor-network theory fits to a degree. The positive side of the current state of rural sociology is that there are considerable gaps

in the literature, which research from the CAVES project can begin to address. These include: extended kinship ties, labour sharing, group membership (formal and informal), and networks in general.

VIII. Discussion

It is clear from the review of literature thus far that there is no single 'perfect fit' for grounding the CAVES project in the sociological study of social networks. The closest fit appears to be social capital, largely due to the flexible definition of its primary concepts. Social Network Analysis is well developed, and offers useful tools for the study of networks as a whole, and resource flows within networks. However, the scale of study required to meet the mathematical requirements of SNA is problematic, as is the highly structural focus: qualitative research appears to have little place. In addition, a formal SNA study is unlikely to be accepted in the rural studies literature, because it is too far off mainstream approaches. Actor-network theory, in contrast, might be accepted in the rural studies literature, but appears too actor-oriented for the CAVES project. CAVES explicitly includes ideas surrounding hierarchy, to which ANT is opposed. The notion of including inanimate objects as actants may useful for giving equal weigh to geographic considerations of the computer model, as well as flexibility in investigating land use change processes

In order to proceed with developing a conceptual framework for the CAVES – Grampian project, there are several key questions which need to be addressed. These primarily have to do with clarifying the requirements of the CAVES project, and the opportunities and limitations of the FEARLUS model.

1) Types of networks we can model:
    - informational, resource sharing, social norms, group memberships of different kinds
    - forms these networks take – not just neighbours, but relatives, group members, farming types (commodity, business orientation, labour investment)
    - How many different types of relationships can be modelled?
    - How many different relationships can be modelled? (number of connections between actors)

2) Do we want to look at whole networks or just types of relationships?
    - note that whole networks (or even ego-centred networks) would take us beyond a localised geographic region
    - What network relationships are we interested in – interactions directly related to land use, or all network connections?

3) What levels do we work at?
    - horizontal networks - networks between land users
    - vertical networks - everyone in the production chain
    - Are household members part of the node, or are they also part of the network? How is this defined?

4) How detailed versus extensive do we want the field research to be?
    - issues of representativeness, generalisability, and accuracy

- What types of data do we want to result from field research – type and frequency of connection vs qualitative descriptions of specific interactions
- Are we looking at the land-use decision-making process?

5) How many of these questions do we want to leave until preliminary field research demonstrates the most likely findings, and viable means of data collection?

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