



Farmer to farmer (F2F) knowledge networks

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Abstract

The aim of this research is to develop a learning framework that underpins the development and implementation of a Farmer-to-Farmer (F2F) knowledge exchange network. Farmers themselves have a pivotal role in identifying the cognitive distance (CD) between what they know and “what they need to know” in order to drive personal development and the ability to adopt new ideas, new technology and innovative practice. The development of a community of practice means that the learning process is facilitated by and not isolated from the culture, norms and beliefs of the social group. Facilitation of such knowledge exchange networks requires the effective scaffolding of learning and the creation of opportunities for both collective and individual critical reflection. This approach will build on existing indigenous knowledge, and promote innovation and change through the adoption of new practices and technologies. In each learning situation, the distance of travel between where an individual, or the whole group, rest and the learning goals that have been set will influence the interaction within the F2F knowledge network and the timescale for delivery.

Key words: farmer, knowledge, exchange, transfer, network, F2F,

Introduction

Knowledge networks enable the generation of agricultural knowledge and local solutions within a supportive social environment (Ingram, 2010). These knowledge networks can be vertical in nature such as the knowledge transfer (KT) extension model i.e. the uni-directional flow of information from knowledge provider to knowledge seeker e.g. extension officer to farmer. Alternatively, they can be horizontal peer networks such as farmer-to-farmer (F2F) enabled learning whereby farmers disseminate and build collective knowledge with others. The aim of the research was to review existing literature on KT and the development of F2F knowledge networks and then propose a conceptual learning framework for F2F interactions.

Traditional agricultural extension approaches assumed that knowledge originated in science and academia and was then transferred uni-directionally to farmers who adopted the new technology or ideas (Black, 2000). However, this approach has been criticised as being inappropriate, as it does not reflect how farmers use the information and does not take into account the influence of environmental, social, and economical factors that provide context for the application of knowledge. KT also fails to represent the many different sources from which knowledge is generated, particularly that produced by farmers themselves (Chambers et al. 1989). The degree of learner engagement, in this case farmers' engagement, is influenced by whether the general body of knowledge (GK) involved can be translated into local or indigenous knowledge (IK), or can be combined with existing local knowledge to form enhanced IK that drives improvements in the individual farming businesses and ultimately the farming sector as a whole.

IK can be described as the knowledge that is unique, and thus valuable, to a given culture or society (Warren, 1991). The United Nations Environmental Programme (UNEP, 2011) defined IK as the knowledge that a community accumulates over generations of living in a particular environment i.e. the information, skills and practices engendered by that environment. Grenier (1998) state that IK systems are dynamic with new knowledge being continuously added or existing knowledge being adapted to suit local environments. These environments can constraint knowledge update as a result of physical features such as local micro-climate, soil structure, water quality, or livestock breed. Further cultural or social structures and interactions can constrain KT in individual businesses or across communities. Farmers have an intimate knowledge of their local environment, conditions, problems, priorities and actively engage in experimentation as part of their farming routine

(Sumberg et al. 2003). In other words, farmers and land managers are custodians of salient local language (Oliver et al. 2012).

IK provided by farmers to other farmers is believed to be more context-dependent, relevant and ecosystem-sensitive (Röling and Wagemaker, 2000). It is therefore important for this knowledge to be captured, communicated and reused within and beyond the farmers' immediate social group. Millar and Curtis (1997) suggest that farmer knowledge remains dormant in groups unless social interaction allows it to emerge alongside associated scientific knowledge and then farmer knowledge can assert itself in the building of common understandings amongst the social group. Millar and Curtis argue that farmers may well undervalue their IK and yet it is this knowledge that will enable research to be applied effectively in practice. Therefore group interaction and the building of sustainable relationships as well as the enabling of group learning is important for the successful translation of research into effectively applied farming practice. Group learning in this context is facilitated through access to appropriate information, active learning opportunities and effective management of the learning process. The effective management of the learning process can be through the development of knowledge networks.

Knowledge withholding is a further barrier and is defined as the likelihood that an individual will give less than full effort to contributing knowledge (Lin and Huang, 2010). The biggest challenge in fostering a F2F knowledge network is the contribution and supply of knowledge by individual farmers (Chiu et al. 2006). Knowledge withholding can be as a result of individual and organisational barriers as well as group pressures. Individual barriers include the knowledge gap (Bureš, 2003), internal resistance and trust (Barson et al. 2000), loss of power and uncertainty (Disterer, 2001) and distance (Nonaka, 1991). Loss of power is also bound into loss of exclusivity i.e. a reduction in ability to favourably compete if innovations are shared or a reduction in influence if personal dominance is reduced. Organisational barriers in established F2F knowledge networks can include language, conflict avoidance and enforced bureaucracy or hierarchy (Disterer, 2001). Sherwood and Covin (2008) cited by Kelly et al. (2008) conclude that by minimising perceptions of cultural barriers between the parties involved the possibility of building trusting partnerships that ensure legitimate and continued knowledge access is made easier.

Farmer Learning Networks

Agricultural extension systems have been defined as the function of providing need and demand based knowledge, skills and technologies to farmers with the objective of improving their production and livelihoods (Foresight, 2011). Factors such as lack of institutional support, the space available for experimentation, a lack of infrastructure and/or technical support will hinder the development and maintenance of such knowledge network (Oerlemans and Assouline, 2004). Farmers may not participate in learning opportunities due to lack of interest or time. This may in turn lead to fragmented rural social networks generally and decreased social bonding and those least networked are then increasingly more likely to lack the information they require to develop their businesses (Blackstock, 2007). This least networked social group will then by its nature fall further behind other farmers who are engaged in knowledge exchanging activities and connected with opportunities for business development and innovation. Differences in personal and business priorities may also hinder knowledge sharing between farmers as some may tend to lay back and wait for suggestions and options from the more experienced and more confident rather than become vulnerable themselves by expressing their lack of knowledge and their need for support. Levin and Cross (2004) propose that the knowledge seekers can feel vulnerable in the KE relationship as it requires them to identify and communicate current and historic shortcomings in order to obtain the relevant information and skills they seek. These can be weaknesses can be in organisational structure, products or processes, and/or a lack of human capital. There may also be personal differences between the farmers who initially initiated participation in knowledge networks and the ones who join in later. This cultural diversity will impact on the value that individuals will derive from being part of a knowledge network. The structure of a F2F knowledge network will be influence by these factors as outlined as well the lack of coherence among individual farmers in terms of expectations, commitments, goals and expected benefits (Oerlemans and Assouline, 2004).

One of the main aims of vertical agricultural extension networks is to effect behavioural change in the target audience (Conte et al. 2010). The research by Conte et al. identified several factors that influenced adoption of behavioural change namely:

- the level of education, training and industry experience;
- farm structure and financial as well as farm family characteristics;
- attitudes and perceptions towards and expectations of change;

- the social and institutional contact as a source of change; and
- whether participation is compulsory or voluntary as the factors that influence adoption.

Social bonding and norms form boundaries to this interaction encapsulated in the individuals and group contextualising what they see as “trust”. Trust as a social process drives reciprocity i.e. sharing knowledge mutually; the development of common rules, norms and sanctions and connectedness; the bonding within and beyond the group, and ultimately determines the inherent value for the knowledge being shared (Millar and Curtis 1997; Pretty 2003; Skopic et al. 2010). Marshall (2004) concluded in his research that the farmers' preparedness to cooperate in knowledge networks was more sensitive to socially oriented factors like perceptions of community benefits, and trust that others will also cooperate in the process, than it was to private materialistic considerations such as fairness and business security. However, it is the latter that is often focused upon by governments in attempting to motivate farmer interaction and cooperation and adoption of innovation and best practice.

When it comes to farming, the best agricultural education is obtained through hands-on work and learning by doing (Trauger et al. 2008). The benefits of F2F exchange have been identified by Scarborough et al. (1997) as employing the use of appropriate language, relevance, ease of availability, level of accountability; as well as the provision of credibility within a sustainable structure. Furthermore, the F2F knowledge network should welcome members who are new and inexperienced and still, within the social norms and boundaries of the knowledge network created, not penalise those who initially are not able to contribute as much as others. Further the F2F knowledge network should strive for a culture of accepting mistakes and errors as part of the overall learning process. F2F knowledge networks exist within a wider social network and in order for knowledge networks to succeed they must be embedded within a framework of mutual support and working relationships between all stakeholders. Shoup Olsen et al. (2009) determine that there is a complicated web of relationships such as employees, financial advisors, suppliers, markets that surround and influence farming businesses. Knowledge exchange (KE), as opposed to KT, can be seen as being the multidirectional exchange of ideas, information and expertise between a range of stakeholders. Effective KE is based on the premise that no individual is the holder of all knowledge assets. KE is therefore enabled through an inter-personal framework and strong inter-organisational ties to drive common goals and mutual ways of thinking and communication.

Bennett (1975) developed a tool to evaluate the effectiveness of an agricultural extension programme and its impact. Morford et al. (2006) argue that at the first level of the extension hierarchy success is usually measured in terms of money spent on the programme rather than the outcomes in terms of farmer development and adoption of practice and innovation. It is only at higher levels of the extension hierarchy that the success of the programme is measured in terms of farmer knowledge, attitude, skills and aspiration (KASA) and also actual behaviour change. Riddell (2001) identify three specific knowledge networks which had been developed in New Zealand namely monitor farms, farmer discussion groups and farm monitoring groups; all being examples of F2F knowledge networks. In the United Kingdom (UK), F2F knowledge networks such as the Linking Environment and Farming (LEAF) Demonstration Farm Network (LEAF, 2012), and Smart Farms (Agrii, 2012) are well established too. Owen (2003) determines that F2F discussion groups specifically provided a supportive and non-competitive environment that enhanced farmer learning through problem sharing and solving and encouraged members to reflect on new and existing practices. This process of personal and shared reflection is a pivotal learning element of F2F networks. Tinsley and Lebak (2009) argue that it was through collaborative reflection that all members of a peer group focused on communally agreed upon goals, which led to cognitive development across the group. A major driver in this was the development of not only personal knowledge, but also collective knowledge as well. Owen (2003) suggests that F2F discussion groups also promoted access to specialists, professionals and consultants, group progression and personal and business development.

Zhuge (2002) states that KE between peers is much more effective than between non peers because:

- Peers tend to work on the same types of tasks so their mutual experiences are of greater value to each other and they can assist to resolve mutual problems;
- Peers have similar knowledge structures so they can understand each other especially with regard to cultures and behaviour much more when sharing knowledge than non-peers; and
- Common interests exist between peers and this will aid knowledge sharing.

It could also be argued that peer to peer (P2P) learning provides a naturally evolving framing context for learning. This social construct will be specific in form to the peer group who is developing it and will evolve as the group evolves. Wenger (2000) proposes that

community boundaries needed to be clearly defined both in terms of internal and external boundaries. Boundaries in this context are fluid and focus internally on how individuals engage and the development of a structure that as shared practice develops it creates its own confines. The interaction needs to address both common ground and differences and mechanisms for translating experiences and levels of competence so that individuals can interact and gain mutual benefit. This element of coherence and shared goals is critical to its success. Furthermore, it is important that boundaries do not create knowledge withholding, internal divisions and disconnection. Wenger (2000) asserts that it is often on these boundaries that new insights are discovered and new possibilities arise. Damon and Phelps (1989) identify three approaches for P2P learning namely peer tutoring, cooperative learning and peer collaboration. They suggest that each approach differed in the depth of peer engagement, composition of learning groups and curriculum material (Table 1).

Table 1: Approaches to peer learning (Adapted from Damon and Phelps, 1989)

Category	Interaction	KT or KE	Status
Peer tutoring	Linear - involves a knowledge provider and a knowledge seeker where one is seen as providing the skills and knowledge.	KT	Unequal limited mutuality
Cooperative learning	Team based learning through working on individual components of a project or task	KE	Greater equality and builds mutuality
Peer collaboration	Team based learning working jointly on the same problem. Can break down if competitiveness develops between peers or trust is lost.	KE	High equality and high mutuality if personal barriers controlled

The three approaches reflect elements of both KT and KE and in all instances there are barriers both personal, group, institutional and organisational that will impact on their potential for success. The degree of mutuality will vary across the three peer learning approaches. Mutuality can be defined in terms of the degree of sharing of the learning process itself as well as the context of learning in terms of degree of trust, interdependence, respect and reciprocity of shared experience and shared values. In cooperative learning and peer collaboration the development of an appropriate community of practice is key. Within a community of practice it is through the mutual development of agreed goals for learning as well as the process of sharing information, knowledge and

experience that the group then learns from each other. This process requires both personal and group reflection that aids personal development for members of the group. Wenger (2000) establishes the elements of a community of practice as the establishment of community norms and mutuality, trust of partners and a shared repertoire of communal resources. These cultural resources include language, routines, tools and stories. The real strength of communities of practice is when there is a suitable framework to ensure the resources are used effectively for mutual benefit. The dynamic of leadership is crucial. Wenger (2000) argues that poor leadership prevents a community of practice from developing. Therefore leadership of F2F networks needs to be in multiple forms through the facilitation, mediation, and then the ongoing sustaining of the networks.

Promoting knowledge sharing

Kuo and Young (2008) evaluated the Theory of Planned Behaviour (TPB) to determine if such models can adequately predict knowledge sharing behaviours through identifying the influences that predict and change behaviours. Behavioural intention is the most immediate determinant of behaviour (Fishbein and Ajzen, 1975) and is influenced by a person's attitudes; subjective norms and perceived behavioural control. Attitude is affected by both personal and group dynamics. A positive attitude is a critical factor in promoting knowledge sharing practices. Farmers may consider sharing their knowledge within the F2F network if they believe this is personally important and valuable to them whilst a negative attitude will arise if farmers are seen to withhold their all or elements of their knowledge to prevent competition. Within a F2F knowledge network subjective norms will affect behaviour in terms of whether the knowledge, or the process of sharing that knowledge, is acceptable to the group or persons of influence. Therefore, effective knowledge sharing needs to be facilitated by determining the group or persons of influence and ensure their full integration into the process.

Subjective norms are also important predictors of knowledge sharing intention. These subjective norms can influence farmers in a number of ways as farmers may be under the social pressure to share or not to share knowledge. An individual farmer's social standing in the group may be affected by the knowledge they have shared. Farmers may be concerned that other farmers within the network will approve or disapprove of them disclosing knowledge or of the way they have disclosed knowledge. These subjective norms form a powerful influence on the success of F2F knowledge networks. Perceived behavioural control influences how individuals perceive the degree of difficulty in adopting

new or modified skills or accepting knowledge (Ajzen, 1991) i.e. the distance between where they are now and where they perceive they need to be. Thus distance can be influenced not only by the distance of travel for their learning but also the distance of travel required to change the construct of their business e.g. financial constraints, physical constraints such as current breed of livestock, production system to alternative enterprises on their farm or to collaborate with others to reduce costs etc. The determination of such “degrees of distance” for themselves and their own goals and also relative to other farmers will influence initial participation in a F2F knowledge network. The degrees of distance will also affect the ongoing perception of value to both individuals and the group as a whole from participation in a F2F knowledge network where some may see the “distance of travel”, otherwise known in the context of learning as cognitive distance, for them as insurmountable.

Knowledge sharing will be more greatly facilitated in a situation where engaging in the process of receiving knowledge will enable the farmer to actively change behaviour and prevent financial or material loss. Individual farmer attitudes to the knowledge provider/knowledge seeker interaction, especially where the knowledge provider can also be the regulator, or has financial power in the supply chain as well as the perceptions of others in their immediate and wider social group will influence their behaviour and the degree of knowledge sharing. This will include concerns over the potential stigma of admitting fault or disadvantage and the perceived or actual social pressure for individuals sharing or withholding information that is of value to the entire peer group. Concerns over peer group reaction, the degree of social support and the fear of social isolation will all have an influence on the intention to share knowledge and ultimately actual farmer behaviour. Understanding the interplay of the factors that influence knowledge sharing practices can assist in targeting specific components of the TPB for further development of F2F knowledge networks to minimise barriers to knowledge sharing and behavioural change.

The impact of cognitive distance on knowledge flow

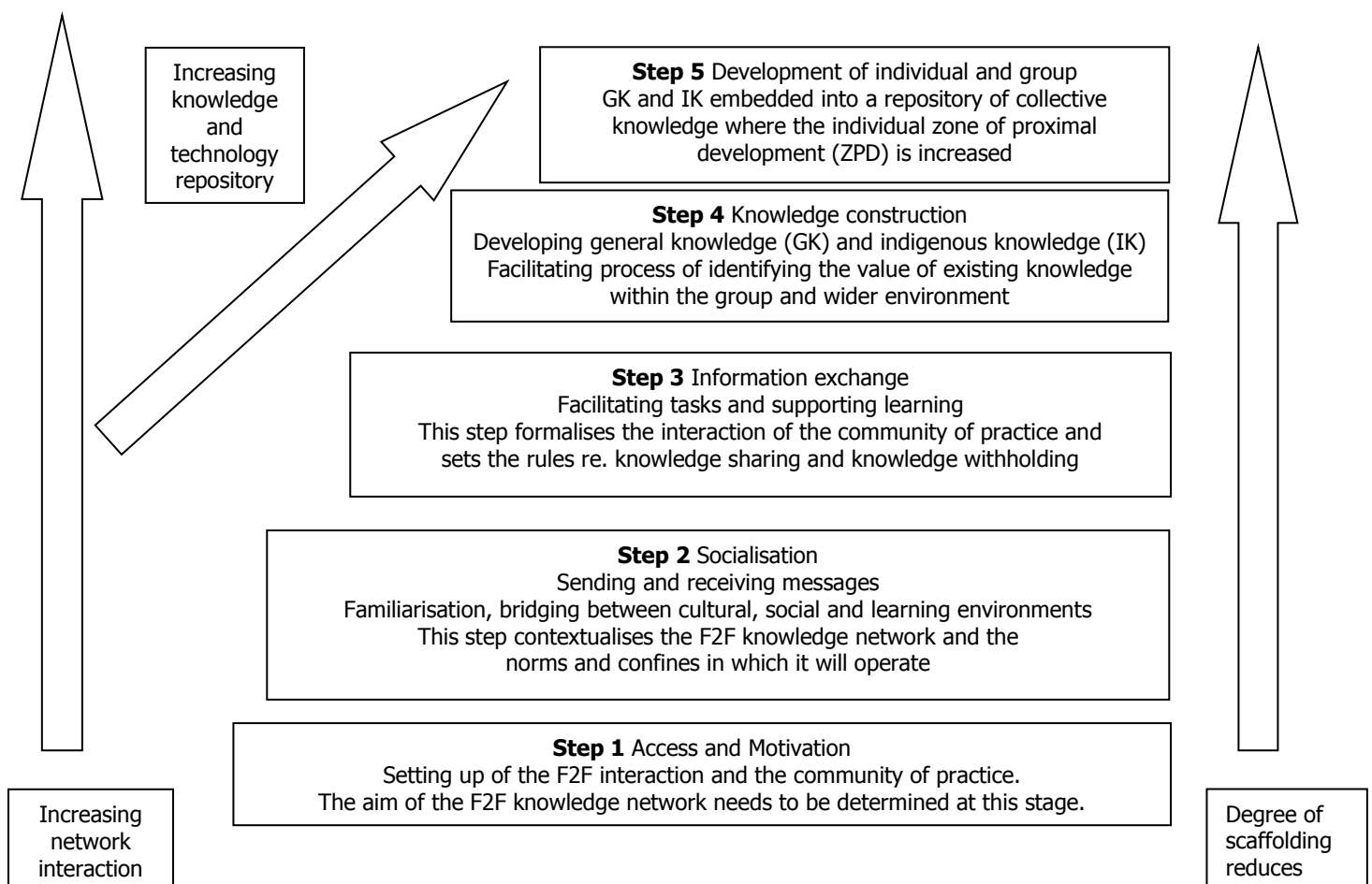
Knowledge flow (KF) is the process of knowledge passing between individuals or groups or the development of knowledge processing mechanisms. Indeed effective KF requires the consideration of three factors namely direction, content and carrier (Zhuge, 2002). Direction addresses the interaction between those providing and those seeking knowledge. In the context of F2F knowledge networks individuals may be both seeking

and providing elements of knowledge simultaneously. The knowledge content affects the flow as does the media through which it passes. F2F knowledge networks may interact in terms of face to face e.g. discussion groups; through text, or increasingly through the use of social media that includes Twitter, podcasts, telephone applications and videos. Furthermore, such networks can extend an individual's zone of proximal development (ZPD) in terms of the distance between their actual level of development, skills and knowledge, and problem solving abilities and the level they could exhibit under the guidance of another person or through collaboration with capable peers (Vygotsky, 1978). This suggests that an able facilitator, who may or may not be a peer, would be able to guide, support and plan the content and context and then enhance the overall learning experience.

Educational literature introduced the term "scaffolding" which described the support given by facilitators to guide an individual or group through the ZPD and enable them to gain knowledge or develop a skill. In the context of F2F knowledge networks the facilitator could be a stakeholder, advisors and/or a suitable peer. Within the learning and critical reflection process scaffolding is transient i.e. it is a series of temporary structures designed to set up, facilitate and assist learning which can be taken down as the learner develops (Bruner, 1983). The degree of scaffolding will vary according to the character of the F2F network, the degree of peer to peer learning and the social interaction of the group. According to Black (2000), there are four major strategies or models in agricultural extension: a linear top-down transfer of information, a participatory bottom-up approach, one-to-one advice and finally formal or structured education and training. The scaffolding of F2F knowledge networks encompasses all these structures. For example, the linear top-down approach occurs when experienced farms or land managers provide information or guidance to novice farmers and new agricultural graduates who benefit from the participatory approach. Meanwhile, one-to-one advice can be utilised within the F2F knowledge network, particularly for novice farmers. Farmers also have the possibility to gain access to information, advice and resources more effectively by using the F2F knowledge network. The facilitator can be an active participant in the learning experience i.e. the learning experience is multi-directional and the farmer facilitator develops their learning too as a result of the overall social interaction. This will lead to the "fixing" of knowledge through the facilitator promoting the evaluation of the learning experience of self and others.

Through critical reflection the group can adapt the learning experience in real time (adapted from Faulkner et al. 1998). This approach drives an active rather than passive learning experience through providing genuine situations of experience; relevant problems to solve, information and observations within that context and the determining of appropriate solutions provided by the learner(s); with opportunity to test ideas by application to make the meaning clear and discover their validity (Dewey 1916; Brockbank and McGill, 2007). These elements are embedded within the critical factors for farmer knowledge in the group learning model developed by Millar and Curtis (1997). The model identified the importance of integrating information, effective facilitation and developing both group autonomy and inter-personal relationships and trust. This underlines the interplay of social constructivism namely that the context, structures and the conditions in which the two-way learning takes place are crucial (Brockbank and Gill, 2007; Wenger, 2000). Salmon (2000) developed a scaffolding model for the virtual learning environment and this has been adapted within the context of F2F knowledge networks (Figure 1).

Figure 1: Scaffolding of F2F Knowledge Networks (Adapted from Salmon, 2004)



The scaffolding model has five steps which begin with the setting up of the F2F interaction and a mutually supportive community of practice. As the interaction develops through socialisation it is important to consider the barriers to knowledge sharing and ensure they are adequately addressed as this will then facilitate the effective information exchange necessary to drive meaningful learning. The mutual sharing of knowledge will build on existing GK and IK to create a repository of collective knowledge where the individual's ZPD is increased. The growing dynamic of network interaction as each stage progresses will mean that the facilitator will need to play less of a role and indeed if they are a peer within the learning group their own learning process then will itself develop.

Nooteboom (1992, 1999 as cited in Nooteboom et al. 2007) considered the relationship between cognitive distance and innovation performance. In this context, cognitive distance between people reflects the impact of their life experience and how that influences their individual perceptions and values. Cognitive distance between farmers could result from their individual experiences and the business environments they have been exposed to. Within the F2F knowledge network for some farmers this cognitive distance may be small, for others it will in itself form a barrier to interaction with others, the enabling of behavioural change and the adoption of innovative practice and new technology. Indeed, Nooteboom (1992, 1999 as cited in Nooteboom et al. 2007) proposed that there is an inverted-U shaped relationship between cognitive distance and innovation performance. Initially as cognitive distance increases between farmers, it has a positive effect on mutual learning by increased interaction as opposing views will stimulate conversation and stretch knowledge i.e. impact on each individual's ZPD. However depending on the diversity of the group at a certain point the cognitive distance of a specific group can become so large that the feeling of mutuality and therefore trust is lost. There is, therefore, a balance therefore between developing groups where there is appropriate cognitive distance to stimulate discussion and provide value for the individual in their contribution to group learning and then creating groups where the degree of cognitive distance impacts on learning and drives some to disassociate from the process. Nooteboom et al. 2007 determined that in order to drive collaboration and innovation the process should identify individuals (or organisations) at sufficient cognitive distance to share something new, but not so distant as to preclude mutual understanding. Having considered these factors a framework for an effective F2F knowledge network has been proposed in this research.

F2F knowledge network – a framework

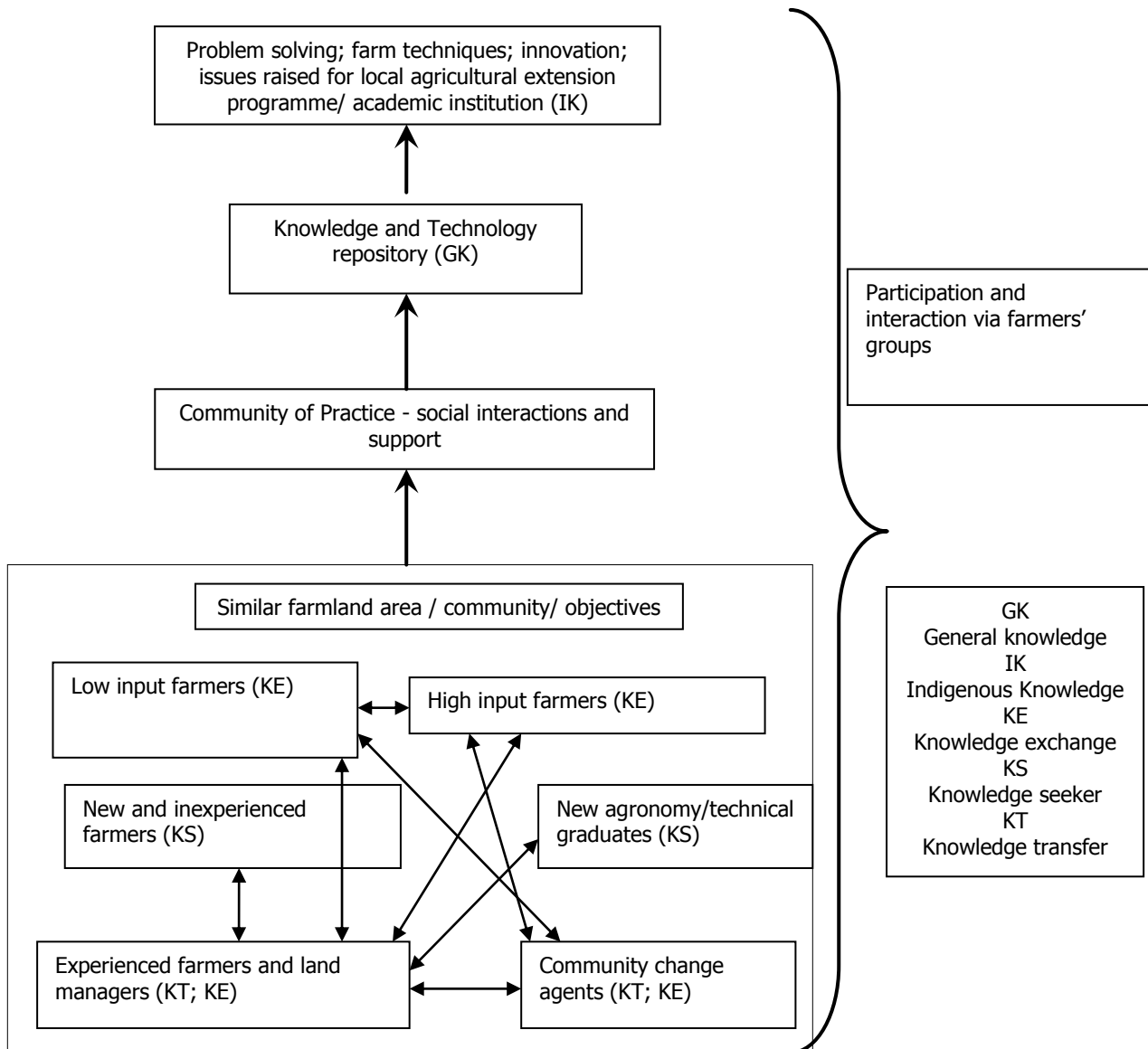
F2F knowledge networks may progress along general themes or be specialised in terms of the specific aims and goals that have been developed. The social groups that form communities of practice can encompass low input and/or high input farms, new and/or experienced farmers and land managers, and new agronomy and technical graduates. These individuals can take on the role as multiple agents of change within the community of practice. The involvement of community, as opposed to external, change agents differs in F2F knowledge networks from the traditional KT approach in that the individuals concerned are considered to be embedded within the self-same community of practice. They could be veterinarians, advisors on nutrients, crop protection products, machinery or technology, food safety specialists and so forth, but essentially they act with the social norms, conventions and mechanisms of interaction of the learning community.

Community change agents may facilitate KE, but the process is two way with feedback mechanisms to enhance their own understanding and knowledge of the practical implementation of their general knowledge in specific indigenous practice environments. Jones (2006) distinguished between change agents and champions whereby champions are embedded within the social system or organisation in which they seek to effect change and change agents are deemed outside the community. This framework sees community change agents as a form of champion and playing a different role to that of external change agents that are recognised socially as being outside the community of practice. Farmer champions themselves form a fundamental element of F2F knowledge networks, but we suggest that community change agents that have bridging capital between one community and another play a crucial role in the described community of practice. The community change agent is trusted and accepted by that community and within the social construct there is mutuality within the interaction with no individual being seen as the sole provider of knowledge and none seen as being socially vulnerable in that knowledge is being bestowed upon them as a passive activity.

The primary seekers of knowledge have also been identified in the framework but this does not preclude other stakeholders from also having this objective. The community of practice will develop their own knowledge and technology repository of GK which is then framed by the collective subjective norms in order to create the learning environment. The community of practice will then determine the elements of GK that will support their existing IK and the GK that is of relevance in terms of enhancing their individual or group ZPD. Therefore the community of practice will determine collective learning objectives and

then within this context individuals will create their own knowledge seeking process. It is important that as the community of practice develops there is appropriate “scaffolding” of the learning process. The learning objectives will drive the F2F knowledge network in terms of the need for problem solving, improving farm techniques and the adoption of innovation and technologies. Opportunities for individual and group critical reflection within this process are vital to its success.

Figure 2: Framework for a F2F knowledge network



Further inputs into the F2F knowledge network can be by regulators or academic institutions as a result of new research or changes to policy or the inputs can arise from issues raised by community change agents such as veterinarians, agronomists on better practice in the field. The outputs from the process are the strength of the community of practice itself, the depth of the knowledge and technology repository that is creates and

the development of enhanced IK which can drive business performance and the implementation of innovative and best practice. Furthermore the framework provides a feedback mechanism into the development of new knowledge in that the F2F knowledge network can ultimately drives the research questions for the academic institute itself. The framework for the F2F knowledge network (Figure 2) demonstrates how all these factors interact and the flow of knowledge.

Conclusion

Knowledge sharing as has been discussed in this paper will benefit all members of a F2F community of practice through shared experiences, learning from mistakes and errors on other farms, developing plausible solutions and innovations in farming practices, drive efficiency and better return on assets employed and raise potential queries to local agricultural extension programmes, policy makers or academia. Benefits aside, F2F knowledge networks may face barriers that could hinder the development and maintenance of the network. Identifying beliefs or factors that influence farmers' knowledge sharing behaviour is beneficial in enabling success and in forming the scaffolding process needs to be allied with the knowledge sharing activity. For the framework to be effective, the depth of scaffolding in terms of the support provided, however transient, is crucial in order to guide individuals and the group as a whole through the process. This is especially so with the elements of critical reflection and the associated adoption of behavioural, business and structural change that may be required so that the aims and objectives of the F2F knowledge network are achieved.

The framework developed identifies community change agents as those who are embedded within the community of practice rather than being isolated in terms of culture, norms and beliefs. Community change agents and farmers alike need to engage in mutual knowledge sharing in order to develop a strong community of practice. Facilitators within such communities need to understand the requirements for scaffolding of learning and creating opportunities for both group and individual critical reflection in order to promote the development of IK and the adoption of new practices and behavioural change. The influence of cognitive distance also needs to be recognised and how this can be both a barrier and an enabler of success for farmers as individuals and the communities of practice as a whole. The UK Foresight Report (2011) determined that such frameworks underpin the progress required in the skills and knowledge base of food producers in both

low income and high-income countries. This progression is vital to achieving the sustainable productivity improvements in the food supply chain that are so urgently required. This framework therefore has direct application in the development of such activities. Further research is planned to address the use of the proposed framework in practice and the practitioner methodology that is required in order for it to prove effective scaffolding techniques. The interplay of cognitive distance within F2F communities of practice is also worthy of further research.

References:

Agrii (2012), Available at <http://www.agrii.co.uk/smart-farms/what-are-smart-farms/> [Accessed on 31/05/12]

Ajzen, I. (1991) The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.

Barson, R.J., Foster, G., Struck, T., Ratchev, S. and Pawar, K. (2000) Inter- and intra-organisational barriers to sharing knowledge in the extended supply-chain. *Proceedings of the eBusiness and eWork (e2000)*, Madrid, Spain, Oct 18-20.

Bennett, C.F. (1975), Up the hierarchy. *Journal of Extension*, 13, 7-12.

Black, A.W. (2000) Extension theory and practice: a review. *Australian Journal of Experimental Agriculture*, 40(4), 493-502.

Blackstock, K.L. (2007) *Negotiating change: the importance of knowledge networks in mitigating diffuse pollution*. CAIWA Conference on Integrated and Adaptive Water Resource Management, Basel, 12 – 15 November 2007. Available at: <http://www.newater.uni-osnabrueck.de/caiwa/data/papers%20session/J1/CAIWA%20KLB%20Sept%202007%20final.pdf> [accessed 1 March 2012].

Brockbank A., and McGill I. (2007) *Facilitating Reflective Learning in Higher Education*, 2nd Edition. Open University Press McGraw-Hill Education

Bruner, J.S. (1983) *Child's Talk: Learning to use Language Oxford*, Oxford University Press.

Bureš, V. (2003) Cultural barriers in knowledge sharing: E+M economics and management. *Liberec*, 6, 57-62.

Chambers, R., Pacey, A., and Thrupp, L.A. (1989), *Farmer First – Farmer Innovation and Agricultural Research*. Intermediate Technology Publications .

Chiu, C.M., Hsu, M.H., and Wang, E.T.G., (2006) Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories. *Decision Support Systems*, 42(3), 1872-1888.

Conte, J., Baudains, C. and Lyons, T., (2010) Connecting the dots: what can we learn from other disciplines about behaviour change [online]. *Extension Farming Systems Journal*, 6(1), 106-110.

Damon, W. and Phelps, E., (1989) Critical distinctions among three approaches to peer education. *International Journal of Educational Research*, 13, 9-19.

Dewey J. (1916) *Democracy and Education*. London: Macmillan

Disterer, G. (2001) Individual and social barriers to knowledge transfer. *Proceedings of the 34th Hawaii International Conference on System Sciences*, Hawaii, USA, January 3-6.

- Faulkner, D., Littlejohn, K., and Woodhead, M. (1998) *JSTOR: Learning Relationships in the Classroom*, Routledge, UK.
- Fishbein, M. and Ajzen, I. (1975) *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading: Addison-Wesley.
- Foresight (2011) *The Future of Food and Farming (2011) Executive Summary*. The Government Office for Science, London.
- Grenier, L. (1998) *Working with Indigenous Knowledge: A guide for Researchers*. International Development Research Centre.
- Ingram, J. (2010) Technical and Social Dimensions of Farmer Learning: An Analysis of the Emergence of Reduced Tillage Systems in England. *Journal of Sustainable Agriculture*, 34,183–201.
- Jones, B.B (2006) *The NTL handbook of organization development and change: principles, practices, and perspectives*. NTL Institute for Applied Behavioural Science. John Wiley and Sons.
- Kelly, D., Henchion, M., and O'Reilly, P. (2008) *Knowledge transfer in the Irish food innovation system: industry and researcher perspectives*. 12th EAAE Congress 'People, Food and Environments: Global Trends and European Strategies', Gent (Belgium), 26-29 August 2008.
- Kuo, F.Y. and Young, M.L. (2008) Predicting knowledge sharing practices through intention: A test of competing models. *Computers in Human Behavior*, 24(6), 2697-2722.
- Leaf (2012), Available at <http://www.leafuk.org/leaf/home.eb>; [Accessed on 31.05.2012]
- Levin, D.Z., and Cross, R. (2004) The strength of weak ties you can trust; the mediating role of trust in effective knowledge transfer. *Management Science*, 50(11), 1477-1490.
- Lin, T.-C. and Huang, C.C. (2010) Withholding effort in knowledge contribution: The role of social exchange and social cognitive on project terms. *Information & Management*, 47(3), 188-196.
- Marshall, G.R. (2004) Farmers cooperating in the commons? A study of collective action in salinity management. *Ecological Economics*, 51(3-4), 271-286.
- Millar, J. and Curtis, A. (1997) Moving farmer knowledge beyond the farm gate: An Australian study of farmer knowledge in group learning. *European Journal of Agricultural Extension*, 4(2), 133-142.
- Morford, S., Kozak, R., Suvedi, M., and Innes, J. (2006) Factors Affecting Program Evaluation Behaviours of Natural Resource Extension Practitioners--Motivation and Capacity Building. *Journal of Extension*, 44(3), Article Number 3FEA7.
- Nonaka, I. (1991) The knowledge-creating company. *Harvard Business Review*, November-December, pp. 162-171.

- Nooteboom, B. (1992). Towards a dynamic theory of transactions. *Journal of Evolutionary Economics*, 2, 281–299.
- Nooteboom, B. (1999) *Inter-Firm Alliances: Analysis and Design*. Routledge, London.
- Nooteboom, B., Haverbeke, W.V., Duysters, G., Gilsing, V., and van den Oord, A., (2007) Optimal cognitive distance and absorptive capacity, *Research Policy*, 36, 1016–1034
- Oerlemans, N. and Assouline, G. (2004) Enhancing farmers' networking strategies for sustainable development. *Journal of Cleaner Production*, 12(5), 469-478.
- Oliver, D.M., Fish, R.D., Winter, M., Hodgson, C.J., Heathwaite, A.L. and Chadwick, D.R. (In Press) Valuing local knowledge as a source of expert data: Farmer engagement and the design of decision support systems. *Environmental Modelling & Software*. 36, 76-85
- Owen, A. (2003) *The Role of Discussion Groups: Their assistance in the development of successful agriculture with particular reference to the dairy industry*. Nuffield Farming Scholarship Trust. UK
- Pretty, J. (2003) Social capital and the collective management of resources. *Science*, 302, 1912-1914.
- Riddell, I. (2001) *A Farmers Club Charitable Trust Scholarship Monitor farms and farmer discussion groups in New Zealand . (Summary) Their role in improving physical and financial performance through collective learning*. Accessible at: <http://www.sac.ac.uk/mainrep/pdfs/monitorfarmnz.pdf> [accessed 1 March 2012]
- Röling, N. G. and Wagemakers, M. A. E. (1998). *Facilitating sustainable agriculture: Participatory learning and adaptive management in times of environmental uncertainty*. Cambridge University Press. 1-307.
- Salmon, G. (2000) *E-moderating: The Key to Teaching and Learning Online*. London: Kogan-Page.
- Scarborough, V., Killough, S., Johnson, D.A. and Farrington, A. (1997) *Farmer-led extension. Concepts and practices*. Intermediate Technology Publications, Overseas Development Institute.
- Sherwood, A.L and J.G. Covin. (2008) Knowledge acquisition in University-Industry alliances: An empirical investigation from a learning theory perspective. *The Journal of Product Innovation Management*, 25, 162-179.
- Shoup Olsen, C., Jones, R., Jost, J. and Griffin, C.L. (2009) Integrating Economics, Management, and Human Relationship Issues into Training for Successful Farm Family Businesses. *Journal of Extension*, 47(5), Article Number 5IAW6.
- Skopic, F., Schall, D. and Dustdar, S. (2010) *Trustworthy interaction balancing in mixed service-oriented systems*. Accessible at http://www.infosys.tuwien.ac.at/staff/skopik/2010_trustbalance_ssd.pdf [accessed 16 March 2012].

Sumberg, J., Okali, C. and Reece, D. (2003) Agricultural research in the face of diversity, local knowledge and the participation imperative: theoretical considerations. *Agricultural Systems*, 76(2), 739-753.

Tinsley, R. and Lebak, R. (2009) Expanding the zone of reflective capacity: Taking separate journeys together, *Networks*, 11(2), 1 – 11.

Trauger, A., Sachs, C., Barbercheck, M., Kiernan, N. E., Brasier, K. and Findeis, J. (2008) Agricultural education: Gender identity and knowledge exchange. *Journal of Rural Studies*, 24(4), 432-439.

UNEP (2011), *United Nations Environmental Programme: Indigenous Knowledge in Africa*. Accessible at: <http://www.unep.org/ik/> [accessed 16 February 2012].

Vygotsky, L.S. (1978) *Mind in Society: Development of Higher Psychological Processes*. Cambridge, Mass., Harvard University Press

Warren, D. M. (1991). Using Indigenous Knowledge in Agricultural Development. World Bank Discussion Paper No.127. Washington, D.C.: The World Bank.

Wenger, E. (2000) Communities of Practice and Social learning Systems. *Organisation*, 7(2), 226-246.

Zhuge, H. (2002) A knowledge flow model for peer-to-peer team knowledge sharing and management. *Expert Systems with Applications*, 23(1), 23-30.