Exploring Mechanisms in Tacit Knowledge Externalization: Preliminary Findings from Participatory Agricultural Innovation Practices in Ethiopia

Full papers

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Abstract

Tacit knowledge is embedded in people's experiences, expertise, know-how, skills, techniques, insights, judgments, actions or behaviors. This knowledge is a source of innovation that can provide dynamic responses to context specific problems. Effective exploitation and management of tacit knowledge is critical, but the subject of tacit knowledge in general and the process of its externalization and sharing in particular are still relatively unexplored and not fully understood. In addition, the agricultural sector has rarely been the topic of inquiry in research related to tacit knowledge elicitation and most previous studies focus on high tech industries and business organizations. This paper explored what mechanisms are being used to externalize tacit knowledge and what factors impact this process given the context of participatory agricultural research in Ethiopia. We applied a qualitative case study method using an in-depth semi-structured interviews, focus group discussions and document analysis as data collection tool.

Keywords

Tacit knowledge, tacit knowledge externalization, tacit knowledge externalization mechanisms, determinant factors, participatory agricultural research, Ethiopia.

Introduction

Knowledge is possessed in the mind of individuals which is related to facts, procedures, concepts, interpretations, ideas, observations, and judgments (Alavi and Leidner, 2001) which are either tacit knowledge or rooted in tacit knowledge (Alwis and Hartmann, 2008). Knowledge resource has been metaphorically expressed as an iceberg where explicit knowledge is considered as the visible top of the iceberg while tacit knowledge is the invisible and significant part of it which is found beneath the surface (Mahroeian and Forozia, 2012). It is therefore, claimed that the great majority of knowledge capital is tacit which is embedded in people's experiences, expertise, know-how, skills, techniques, insights, judgments, actions or behaviors (Nosek, 2004; Puusa and Eerikäinen, 2008; Alwis and Hartmann, 2008; Zhu, et al., 2007; McAdam, et al., 2007).

Tacit knowledge serves as a true source of innovation (Xu and Chen, 2010), provides dynamic responses to context specific problems (Vat, 2004), serves as a basis for developing, interpreting and applying explicit knowledge (Alavi and Leidner, 2001; Vat, 2004) and provides a mechanism for transferring best practices (Greenman, 2006). If an environment is more innovation oriented, tacit knowledge becomes increasingly important to the generation of new knowledge and to meet emerging environmental trends

and challenges (Bennet and Bennet, 2008; Wang, 2012). Therefore, effective exploitation and management of tacit knowledge has become critical (He and Li, 2010).

Despite the interest to manage tacit knowledge the field is still relatively unexplored and not fully understood compared to the work on explicit knowledge (Mahroeian and Forozia, 2012). Sigala and Chalkit (2007) claimed that "tacit knowledge has to be the focus of study in knowledge management field not only because of its greater strategic importance, but also because it runs a greater risk to become disregarded, as it is intangible and so, invisible". One area that needs further investigation and deeper understanding is the process of externalization of tacit knowledge and the potential factors influencing this process (Sigala and Chalkit, 2007; Mahroeian and Forozia, 2012).

In addition, rural regions have rarely been the topic of inquiry in research related to knowledge management and most studies focus on high tech industries and business organizations (Galindo, 2007). Currently, there is a growing trend of participatory agricultural research which mainly involves researchers, farmers and extension agents as key stakeholders. It is understood that the kind of knowledge exchanged in a collective environment is more of tacit and the more tacit forms of knowledge are said to have a crucial role in innovation processes (Hennala, et al., 2011). There is significant flow of tacit knowledge in the form of new ideas and insights, rich experiences, best practices, skills, attitudes and indigenous knowledge. These are embedded in the development and implementation of new agricultural technologies. Further studies are required to better understand how tacit knowledge is elicited and shared so that it is possible to develop appropriate tools and conducive environment that can facilitate the dynamic capabilities of converting tacit knowledge of stakeholders into appropriate processes, products, structures and systems successfully (Goffin and Koners, 2011; Gubbins, et al., 2012). Therefore, this paper explores the mechanisms and factors affecting the process of tacit knowledge externalization in the context of participatory agricultural research in Ethiopia.

The rest of this paper is structured in four sections. The first section reviews relevant literature for this study. The second section presents the methodology followed to conduct the study. The third section provides our preliminary results. The final section is comprised of some concluding remark and thoughts for future work.

Review of Related Literature

Tacit Knowledge

Tacit knowledge is unarticulated and tied to the senses, tactile experiences, movement skills, intuition, unarticulated mental models, or implicit rules of thumb (Nonaka and von Krogh, 2009). Know-how, procedural knowledge, practical or experiential knowledge are also used to describe tacit knowledge (Ambrosiny and Bowman, 2001). It is a high value knowledge which is embedded in actions, procedures, routines, ideas, values and emotions and it is dynamic as it is created within social interaction between individuals, groups and organizations (Nonaka and Takeuchi, 1995; Balestrin, et al., 2008). It is characterized as being personal, difficult to be fully articulated, experience based, contextual, both known and unknown to the holder, capable of becoming explicit knowledge, transferred through conversation, narrative, apprenticeship, training, watching and doing forms of learning (McAdam, et al., 2007).

Tacit knowledge is the most valuable resource in innovation and new product development (Jones and Leonard, 2009; McAdam, et al., 2007) and it plays a great role in achieving innovation success (Erden, von Krogh and Nonaka, 2008). Formulating scientific problems and developing strategies aimed at their solution depend on the ability of the individual to understand or interpret the coded knowledge based on his/her tacit knowledge which is acquired through practice and experience (Lawson and Lorenz, 1998). Tacit knowledge can contribute to innovation if it is converted into explicit knowledge in the form of a concept for a product or a service and justified by a social action (Korgh, 1998). Interest in tacit knowledge conversion has heavily increased, mainly because it is closely related to knowledge diffusion and utilization which in turn critically determines the process of innovation (Sigala and Chalkit, 2007).

Externalization of Tacit Knowledge

It is a process of conversion of tacit knowledge into explicit, codified and standardized knowledge (Yajun, et al., 2008) using language (Chen, 2008; Gubbins et al., 2012). Externalization holds the key to

knowledge creation, because it creates new, explicit concepts from tacit knowledge (Chatti, et al., 2007). In an ongoing dialogue for instance, people engage in collective reflection through which words develop into phrases and further to crystallized concept (Hussi, 2004). The engine of knowledge creation is "articulation"—a continuous process of making knowledge explicit and relevant to the task at hand (Tsoukas, 2009). In the context of participatory agricultural research, a brilliant agricultural researcher has an insight that leads to generation of new agricultural technology or an intelligent farmer may draw on years of experiences to come up with a process of innovation. In this process the tacit knowledge is transformed from the individual to group and from tacit to explicit (Nonaka et al., 2000). This mode of knowledge conversion is typically seen in the process of concept creation and is triggered by different mechanisms like dialogue, metaphor, collective reflection, etc. (Chen, 2008).

Mechanisms of Externalization

Although tacit knowledge is hard to formalize and communicate, it is possible to make parts of tacit knowledge conscious in the sense that some parts of tacit knowledge become "focal points" of (conscious) attention (Tuomi, 1999). This consciousness enables articulation and, thus, externalization of tacit knowledge. Tacit knowledge can be extracted and shared through highly interactive group deliberation or conversation, metaphor, analogy, narrative or storytelling, sharing experiences, demonstrations, coaching or mentoring, apprenticeship, asking question, cognitive mapping and collaborative critical thinking mediated by figurative/illustrative dialogue (Nonaka, 1994; Ambrosmi and Veronique, 2001; Sunassee and Sewrya, 2002; Balram et al., 2003; Vat, 2004; Taylor, 2007; McAdam, et al., 2007; Yajun et al., 2008; Chun, et al., 2010; Wu, et al., 2010; Martins and Martins, 2011; Zhang, 2012). As far as an individual is able to understand and explain the tacit knowledge, he/she makes use of his/her available expression media to reveal the tacit knowledge (Wu, et al., 2010). The description could be with any form of media (e.g. a word, a sentence, a gesture or a body language). Table 1 summarizes mechanisms of tacit knowledge externalization.

Mechanisms	Descriptions
Metaphor	It is figurative or imagery language that infers about least familiar concepts on the basis of other familiar concepts and makes tacit knowledge observable through symbolic comprehension and generating new meaning. It is used when no appropriate word or formal language is available for articulation. (Nonaka, 1994; Ambrosmi and Veronique, 2001; Hussi, 2004; Chennamaneni and Teng, 2011; Al-Qdah and Salim, 2013)
Analogy	It is a way of expression through compare and contrast and determining similarities and differences. It reduces ambiguity by highlighting the commonness of two different things and synthesizes diverse perception and images into a common expression. It also explores new concepts by referencing to things that are already understood (Nonaka, 1994; Korgh, 1998; Chennamaneni and Teng, 2011, Al-Qdah and Salim, 2013)
Storytelling/ Narrative	It is one of the forms of implicit communication used to uncover, capture, organize and convey tacit knowledge by allowing participants frame their experiences in stories and add meaning to the context. It could be oral, written, filmed, or illustrated with a very specific structure and chronology. (Ambrosmi and Veronique, 2001; Swap et al., 2001; Styhre, 2009; Venkitachalam and Busch, 2012; Al-Qdah and Salim, 2013).
Dialogue	It is a joint activity between at least two speech partners, in which a turn-taking sequence of verbal messages is exchanged between them, aiming to fulfill a collective goal. It involves reasoning and allows participants to further articulate their tacit knowledge (experiences, feelings), achieve a common understanding through collaborative meaning making and generate novel conceptual combinations. Tacit perspectives are converted into explicit concepts (Nonaka, 1994; Tsoukas, 2009).
Brainstorming	It is a process of generating creative ideas and solutions, through intensive group discussion (Al-Qdah and Salim, 2013).

Mechanisms	Descriptions
Apprenticeship or Mentoring	It is a process of learning a skill under the care and guidance of a master which facilitates the transfer of tacit knowledge through sharing experiences, observation, imitation and practice. (Hussi, 2004; Byosiere and Luethge, 2008;)
Observation	It is a means to build personal knowledge by observing the action of an expert and his/her explanation on how he/she performs a critical task. The internal behaviours are converted into external behaviours through observation (Chennamaneni and Teng, 2011)
Reflection on Action or Behaviour	Tacit knowledge emerges through open reflection on actions or behaviors since it can be explicitly shown as a skillful activity. (Nosek, 2004; Chennamaneni and Teng, 2011)
Lessons learned or Best Practice	Results gained are shared with other team members, so they can learn from others experiences. They are considered as guidelines, points, or checklists of what went right or wrong, in a special event. It involves identification, analysis and capturing of processes that fits well and the processes that needs improvement. Identification and sharing of best practices often result in generating innovative ideas (Chennamaneni and Teng, 2011a; Al-Qdah and Salim, 2013).
Learning by Doing	It refers to the capability to improve productivity, by regularly repeating the same type of action. The increased productivity is achieved through practice, self-perfection and minor innovations. Therefore, tacit knowledge is learnt by doing. (Al-Qdah and Salim, 2013)
Visual Representation	It is capable of communicating meaning symbolically and helps to articulate, exchange and understand tacit knowledge since it is claimed that picture is often worth 'a thousand words'. Tacit knowledge can also be transferred via rich media, such as simulation video, rich textual accounts (vignettes), etc. (Thomas, et al., 2001; Styhre, 2009)
Modeling Technique	Includes concept mapping, repertory grid etc that can elicit tacit skills by helping participants reflect on their behaviors and by representing their mental models in graphical format (Ambrosini et. al, 2001).
Asking Question	This applies to the extraction of tacit knowledge of experts. Expertise develops through repeated exposure to similar problems, given prior explicit training. Asking experts the right question is one way of transforming tacit knowledge into explicit (Ambrosmi and Veronique, 2001; Gourlay, 2006; Chennamaneni and Teng, 2011; Guddins, et al., 2012)
Exploration and Experimentation	Active exploration and experimentation are the critical mechanisms for externalizing tacit knowledge (Gourlay, 2006).

Table 1. Mechanisms of Tacit Knowledge Externalization

Factors Affecting Tacit Knowledge Externalization

Shared experience

Without some form of shared experience, it is extremely difficult for people to share each others' thinking processes (Nonaka, 1994). Shared experience enables individuals to directly understand others and facilitates the creation of "common perspectives" which can be shared by team members as part of their respective bodies of tacit knowledge.

Language

To externalize knowledge means to express experiences, shared practices, mental models and judgments through linguistic representation (Zappavigna and Patrick, 2010; Virtanen, 2011). The use of metaphors and analogies as externalization mechanisms means communication via language. One of the pre-requisites for making personal knowledge explicit through concept creation and its social justification is language that is known and acceptable to the team members (Korgh, 1998).

Cognitive Competence/Knowledge Capability

The efficiency of externalization and transfer of tacit knowledge depends on the knowledge capability among the members of the group, i.e., the ability of each member of the group to absorb the tacit knowledge (Xu and Chen, 2010). Despite the possible existence of discrepancy in knowledge capability among members of the group a group with tacit knowledge may still act as a "collective body and mind" by compensating the weaknesses via dynamic coordination and heedful interrelating (Erden, von Krogh and Nonaka, 2008). The competency of insightful individuals in the group enables them to build influencing skills (communication, assertiveness, dealing with conflict, persuading and developing others) as well as to cultivate sharing attitudes (Choudrie and Selamat, 2004). These influencing skills and sharing attitudes assist them to externalize and diffuse their tacit knowledge through the medium of ideas, actions, reactions and reflections.

Trust

The process of concept creation in a self-organizing team requires building of mutual trust among members through sharing one's original experience which is the fundamental source of tacit knowledge (Nonaka, 1994; Venkitachalam and Busch, 2012).

Other Factors

Creating an environment of respect, and commitment; letting people learn by doing and allowing time for reflection and interpersonal exchange are also major means to cultivate the sharing of tacit knowledge among people (Yi, 2006). Personal differences in skills, goals, prior knowledge and strategies also affect the externalization process. Some people rely more on images to learn while others learn better from verbal material and some are mixed processors who can learn from either format (Guddins, et al., 2012).

Methodology

Our target is identifying the dominant mechanisms of externalization of agricultural tacit knowledge and factors affecting the process. Due to the complexity of the concepts involved, we applied qualitative case study method that can generate rich and contextual data. Case study research is now accepted as a valid research strategy within the Information System research community (Lawrence, 2010). The research context is participatory agricultural research approach called Farmers Research Group (FRG) which was introduced since 2004 by the concerted efforts of Ethiopian Agriculture Research Institute (EARI), Oromia Agriculture Research Institute (OARI) and Japan International Cooperation Agency (JICA). This approach was introduced to improve the critical limitations of the traditional supply driven, highly centralized and top-down agricultural innovation and knowledge transfer system that had limited impact on agricultural sector of Ethiopia. FRG projects primarily involve researchers, farmers and extension agents working in a team/group at the functional level. This participatory research approaches enhanced functional and institutional linkages and strengthened technology development, verification, transfer and adoption. It also contributed to the integration of felt needs, innovative ideas, and indigenous knowledge of farmers. Farmers as technology developers in their own right are considered as key stakeholders being involved from the beginning to the last stages in the research process (Emana, 2009). The project has brought remarkable results in boosting agricultural production of major crops (Ibid.). We believed that selecting FRG as a case for this study can provide a rich environment for investigating tacit knowledge externalization and exchange. Farmers Research Group as an innovation platform is also contributing to the enhancement of innovation and productivity in agriculture which is a dominant sector in the

Ethiopian economy in terms of GDP, foreign exchange earning and creating employment opportunity for more than 80% of the population.

The study targeted FRG Projects led by different agricultural research institutes and universities and thus, a number of FRG projects run by these research institutes and universities have been considered as a case or as a subject of the study. According to Yin (2009) "The evidence from multiple cases is often considered more compelling and the overall study is therefore, regarded as being more robust than single case study". Snowballing technique was used to select relevant Agricultural Research Centers and Universities that implemented different FRG projects. We first contacted the Chief Advisor of FRG II/EIAR-JICA Cooperation Office and based on his recommendation we picked three Agricultural Research Centers and two Universities that have effectively implemented the projects and have rich experiences to share. From the selected research centers Melkasa Agricultural Research Center (MARC) and Adami Tulu Agricultural Research Center (ATARC) are the only two leading research centers in terms of implementing FRG projects between 2004 and 2009. The third one is Assosa Agricultural Research Center which was included in the study due to its exemplar best practices and experiences in FRG projects. The two Universities which were recommended as the best examples in FRG project implantation are Welayita Sodo University and Mekele University.

The case study protocol was adapted from past research which satisfied acceptable reliability and validity level. In-depth semi-structured interviews were conducted with 12 respondents picked from the selected Agricultural Research Centers and Universities. The profiles of respondents include 4 researchers with PhD, 6 researchers with Master of Science and 2 extension workers with diploma. Interviews were digitally recorded and transcribed verbatim for analysis. The data gathered through interview was supported by document review. Data analysis involved thematic analysis and thematic coding using NVivo qualitative data analysis software.

Preliminary Finding

Mechanisms of externalization

The participatory research approach enabled members to elicit and integrate the expertise of researchers with multidisciplinary background and indigenous and experiential knowledge of farmers. Members of the group used different mechanisms to externalize and share their tacit knowledge. The following part presents empirical evidences on each mechanism.

a) Metaphor

Both researchers and farmers use metaphorical expressions when they were unable to deliver their ideas using appropriate word or formal language. When a researcher responded to the question as to how he articulated and shared his idea he explained:

> In the discussion about the application of chemical fertilizer with farmers, I explained that UREA should be applied three times. They asked, at what time? I said, at planting, at tillering and at panicle initiation stage. Then, one farmer stood up and asked, why three times and why not one or two times? At this point I couldn't explain about the physiology of the plant to the farmers. I explained this using metaphor of the extent of food requirement at different stages of human physical development – childhood, youth and elderly. I also used metaphorical expression to explain about the term tillering. I said, it is just like many shootings growing from the base of a stem in a crop called 'Dagusa'. They were familiar with this crop and they understood the concept easily. In addition, there was a disease which is common to rice. The researcher wanted to explain this disease to farmers and applied metaphorical expression. He said, a rice plant which is attacked by this disease looks like a grass slightly burnt by fire (changed into yellowish color). Through such expression, farmers were able to visualize the symptoms of the disease.

> Other researcher also said:

> When a farmer expressed about the experimental plot with no fertilizer he said, this plot is like a child whose parents have died and starving or it is like a poor person.

b) Analogy

In order to facilitate communication and increase the understanding of farmers researchers used the existing practices of farmers or what they already know to compare it with the new ideas or technologies they proposed. One researcher said:

> To convince farmers about the need for 'Teff' seed spreader technology, I asked them how they can manage to cover big area using handful of 'Teff' seed. They said, it is difficult to spread such tiny seed to a wide area since it concentrates in a limited area as we broadcast it. Then, I told them how this problem can be solved by mixing the small amount of 'Teff' seed with sand or soil. This way of presentation increased their understanding.

c) Storytelling

Both researchers and farmers use narratives to frame their experiences and convey their tacit knowledge in the form of justifying or rejecting a particular idea or technology recommended by either party. They use stories to explain what that idea or technology mean to the specific context they are dealing with. In this regard one researcher stated:

> I told farmers a story about similar projects implemented by others within and outside the country and I related that story to the farmers' context. For instance, when I was introducing 'Teff' seed spreader technology, I told them how others achieved optimal seeding rate of carrot by mixing the seed with sand, manure and compost. Farmers also tell stories to justify their positions. In the evaluation of a technology when they reject it they explain what they tried before on similar solution in their own way and how that same solution couldn't work.

d) Dialogue

Multiple rounds of discussions and dialogues have been conducted among researchers, farmers and extension workers to achieve a common understanding on the issues raised and come up with best solutions to the agricultural problems in the area. One researcher responded:

> Researchers presented the idea of using a cart to transport goods from and to the farm field and they presented the kind of cart they developed to the farmers. But farmers rejected the cart and they presented their own reason. Farmers raised valid inputs on the drawbacks of a cart designed by the Research Center. They argued that the cart should be designed for cow rather than donkey. The dialogue continued until consensus was reached.

e) Observation and Judgment

Externalization of tacit knowledge was also facilitated through observation since it triggers judgment which represents expression of internal behaviours. In this regard, one researcher responded:

> Farmers make judgment about their performance of a particular variety by observing the phenotype of the plant. They observe the differences in performance. They say – this is not deep green, this is thin, this doesn't resist disease, this requires a lot of water, this has a problem of shattering, etc. Farmers externalize such kind of judgmental knowledge based on their daily observation of their own experimental farm plot.

f) Reflection on Action or Behaviour

As per the capacity of externalizing tacit knowledge through reflection on action, the researcher said:

> Based on their criteria, farmers do evaluation on the performance of each seed variety on the experimental plot. They use a matrix to collect data. Rows constitute different seed varieties and columns constitute the criteria, the weight and the actual point given to each criterion under each seed variety. They explain why they give higher point for one variety and lower point for the other. The big surprise to us was the kind of ideas they were raising during evaluation stage. For instance, we had tested that a rice variety called FKRS can be produced in both upland and lowland area and its performance was good. We took the variety to the farmers. They rejected this

variety based on their own experiment. They explained that the variety is not appropriate for their area because it requires a lot of water. Their judgment was correct. According to their experiment the FKRS variety took very long time to mature as compared to other varieties and based on this result farmers concluded that it requires a lot of water and they recommended a very swampy area for the variety to be productive.

g) Informal brainstorming

Informal meetings are common among farmers and it was stated that it is an important forum to share their tacit knowledge. One researcher responded:

> The 15 members of FRG were divided into 4 sub-groups and each of them had its own group leader. The members of the sub-groups share their ideas not only in a formal meeting but also in informal meetings like in a coffee ceremony or similar occasions. They exchange all the negative and positive aspects of the idea informally and then bring it to the formal meeting which is scheduled.

h) Demonstration

Farmers also formalize their tacit knowledge through demonstration. One researcher said:

> We (researchers' group) and the extension worker went to specific sub-group of FRG members to observe their activities. One farmer demonstrated how he is controlling weed using 'Shilshallo' method – Oxen driven inter-row plowing. Although this method is not recommended by science as it may damage the root of the plant, the way the farmer used this method to avoid weed without affecting the root was innovative. He was using the traditional method in a more effective and labor saving way. We also observed that this method has other advantages like facilitating water percolation and aeration.

i) Exploration and Experimentation

When a researcher explained how farmers articulate their internal tacit knowledge through experimentation he said:

> One farmer was conducting an experiment on his own seed variety called '*Kukit*' together with the seed variety we provided to him. At the time of evaluation he explained that '*Kukit*' is good in terms of production and seed color but during harvesting it shatters and causes product wastage. Based on his evaluation he recommended the need for improvement. We took his recommendation as an input for the research process.

> Other researcher also responded:

> Farmers do experiments by themselves. One farmer in Eastern Shewa Zone came up with his own high quality white "Teff" variety through making selection from what he has produced for subsequent years. After selecting the best qualities of seed from the harvested Teff for subsequent years, the farmer came up with such unique high quality seed and he is now multiplying and distributing that seed variety.

Factors influencing externalization of tacit knowledge

a) Use of local terminologies by farmers

Concerning the misunderstanding created due to the use of local terminology, one researcher responded:

> Farmers express their ideas based on their own understanding and using their own vocabulary. For instance, when we discuss about the problem of weeds, one farmer raised his hand and said, why don't we use '*Jimla Cherash*', which has the same English meaning of 'mass distracter'. We couldn't understand what the farmer was referring to but later the farmer clarified that he was referring to the chemical used to destroy weeds. Their terminology exactly represents the function of the chemical. It is applied before sowing and it destroys every plant type on the plot.

b) Use of Scientific terminologies/concepts/processes by Researchers

When researchers face difficulties in communicating scientific terms or concepts, they present the essence from its contribution perspective or using their local practice as a reference point.

> When the experiment deals with highly scientific and technical issue, e.g., testing the effect of the chemical content of fertilizer /UREA and DAP/ on productivity of a particular crop /wheat/, it is difficult to explain to farmers the level of Nitrogen or Phosphorus content and the effect of each. The same is true with compost (organic fertilizer). We just simply tell them about the benefits in terms of increasing the fertility of soil, providing the necessary food to the plant and its contribution to the growth of the plant. We tell them to use local measurement tools to determine the optimal combination of different fertilizer types.

> If it is difficult to use another alternative term in local language that can be easily understood by farmers we force them to use the scientific term as it is. For instance, NERICA is a scientific name for a rice seed variety. We forced farmers to use the term as it is.

c) Language Variation

Ethiopia is a multi-language country and language is cited by researchers as a major barrier for smooth transfer of tacit knowledge. Regarding this problem one respondent said:

> One major challenge is language. I know only Amharic and I don't speak the local language – 'Wolayitigna'. Farmers don't speak Amharic. It was difficult for me to directly communicate with them as much as I need. Farmers were also unable to fully express their feelings to me. If there is a third party involved as interpreter, the meaning of the idea/knowledge may be distorted. There might be lack of consistency in interpreting the ideas.

d) Cognitive Competence/Knowledge Capability

The group composition has an impact on the quality of communication among the FRG members and impact the success of elicitation and sharing of tacit knowledge. In this regard, one researcher responded:

> Farmers vary in terms of level of understanding and level of clarity in their expression. Some of them are fast to understand and efficient in clearly presenting their ideas while others are slow to understand and unable to express their ideas clearly. For instance, when some change is observed on the panicle of the plant, one farmer may say that it is being attacked by disease. But a conscious and active farmer may closely observe and say that it is rather a termite problem, not a disease. In this case the second farmer is able to observe and understand the phenotypic characteristics of the plant and expresses the exact problem of the plant. This shows the skill and high level of understanding of the farmer.

> When we select FRG members as much as possible we try to include model farmers or farmer innovators who can easily understand the knowledge and implement whatever technology we introduce. In addition, after the experiment we expect them to teach and convince other farmers based on their communication skills so that the results of the project would be widely diffused and have sustainable effect.

Conclusion and Future Work

Tacit knowledge provides dynamic responses to context specific problems like that of agriculture. Understanding of the mechanisms of externalization and factors impacting this process can contribute to the design and development of ICT tools and creation of conducive environment for the dynamic capabilities of converting the available tacit knowledge of stakeholders into appropriate processes, products, structures and systems successfully. The preliminary findings indicated that there is extensive practice of externalizing and sharing of tacit knowledge by farmers and researchers using different mechanisms. It is also found that there are different factors that influence the process. These findings have practical implications especially from the system development perspective. The identified mechanisms can inform the design and development of low-cost ICT based communication system, like

mobile based application, which is most appropriate to the rural domain. Such system enhances the process of elicitation, capturing and sharing of tacit knowledge of key stakeholders. Currently, this process is constrained by factors including lack of practice of encoding and sharing the externalized tacit knowledge, scattered nature of FRG projects, distance and time. Our future plan is to further extend the number of cases and samples to extract more rich data. Then, we will map the findings to the design of appropriate mobile based communication system applicable to the context of participatory agricultural innovation.

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