Understanding indigenous knowledge: Bridging the knowledge gap through a knowledge creation model for agricultural development

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ABSTRACT

This article addresses the management of agricultural indigenous knowledge (IK) in developing countries, with a specific focus on Tanzania. It provides background details on IK and its importance for agricultural development. It introduces various knowledge management (KM) concepts and discusses their application in managing IK in the developing world by placing Nonaka's knowledge creation theory (Nonaka 1991; Nonaka & Takeuchi 1995; Nonaka, Toyama & Konno 2000) in the context of the local communities. Data from focus groups were used to triangulate with data from interviews in order to validate, confirm and corroborate quantitative results with qualitative findings. The study findings showed that knowledge creation theory can be used to manage IK in the local communities, however, adequate and appropriate resources need to be allocated for capturing and preserving IK before it disappears altogether. For sustainable agricultural development, the communities have to be placed within a knowledge-creating setting that continuously creates, distributes and shares knowledge within and beyond the communities' boundaries and integrates it with new agricultural technologies, innovations and knowledge.

INTRODUCTION

The need to manage home-grown knowledge has demanded increasing attention; sustainable economic development depends on the indigenous knowledge (IK) of the local communities in developing countries, such as Tanzania, Uganda and Mali. IK is mainly used as the basis for local-level decision-making in agriculture, health care, education, natural-resource management, amongst others. The potential role of IK in improving agricultural performance is widely recognised in developing countries (Hart 2007). The agricultural sector is the backbone of many economies in Africa. In Tanzania, the economy depends heavily on agriculture, which accounts for more than 25.7% of the gross domestic product (GDP), provides 30.9% of exports and employs 70% of the work force (United Republic of Tanzania 2009a).

Despite the importance of the agricultural sector for economic development, low agricultural growth has been a major factor in Tanzania's slow progress towards the reduction of poverty and hunger. For instance, the agricultural sector in Tanzania grew by 4.8% in 2008 and 4.0% in 2007 regardless of the projected growth of 5% per annum and the actual growth rate of 5.1% in 2005 (United Republic of Tanzania 2009b). Effective management and use of knowledge as a competitive development resource can increase the annual rate of food production *per capita* to at least 4% and real economic growth rate to at least 7% without further damaging the environment (United Nations Development Programme 2003). Amongst other knowledge systems that exist in Africa, IK can be used as an important resource to ensure agricultural development across generations. As an example, the traditional sector accounts for more than 90% of the seeds planted in Tanzania (Mushi 2008).

However, IK is gradually disappearing in most African countries including Tanzania without any tangible efforts to recognise or manage it. Transfer of IK from generation to generation is mostly done through oral tradition or by demonstration. IK is not equally shared in the communities due to issues related to power relationships and cultural differences (Wall 2006). Knowledge management (KM) approaches can enhance the management of IK. However, KM approaches are mainly used to support business growth in the developed world (Ichijo & Nonaka 2007). Nevertheless, some scholars have argued that KM should not be restricted to supporting business systems in developed countries such as the United States of America, United Kingdom, Netherlands and Canada; rather, the developing world should adapt KM to their local practices for future developmental agendas (Mosia & Ngulube 2005). Hence the importance of assessing the applicability of these KM models in managing IK for improved agricultural practices in the local communities.

The objective of this research was to assess the application of KM models (with a specific focus on Nonaka's model) in managing IK for sustainable agricultural practice in the local communities. In developing our arguments, the article first draws on the following concepts: KM and its application in managing IK, approaches towards the application of KM in developing countries and the applicability of Nonaka's knowledge creation model.

Knowledge management and its application in managing agricultural indigenous knowledge

KM has been successfully adopted by many organisations in order to build their competitive strength and achieve a sustainable growth pattern (Ichijo & Nonaka 2007). KM practices in closed systems or formal organisations are likely to be more successful than those in informal systems or open systems

because they have formal structures and rules to which members of organisations adhere (Mosia & Ngulube, 2005). However, KM should also be applied in the rural communities of developing countries (i.e. Tanzania and Mali) for equitable and sustainable development because knowledge is an important resource for socio-economic growth. Rural communities have an extensive base of IK which is at risk of becoming extinct if appropriate measures are not taken to manage it. KM can be used to manage and share IK in communities that desire to achieve development agendas (Lwoga & Ngulube 2008).

However, much of IK is preserved in the memories of elders and thus this knowledge is gradually disappearing due to memory lapses and death. The oral tradition and empirical learning are the principal ways of transmitting knowledge. Nevertheless, access to IK is fragmented in the local communities due to various factors including social dimensions such as age, gender, status, wealth and political influence (Wall 2006) and attitudes, perceptions, norms, values and belief systems inherent to indigenous people (Meyer 2009). Other factors are related to the safety mechanisms used by the local people to protect their own intellectual property and to formal education which has also excluded IK. There is therefore a need for developing countries to recognise the importance of managing IK, as much of the knowledge required for agricultural development already exists with farmers and traditional practitioners.

KM balances out interest and power differences and encourages knowledge exchange and learning (Bode 2007). KM can enable the management of tacit and explicit knowledge. Tacit knowledge is defined as non-verbalised, intuitive and unarticulated (Polanyi 1962). Explicit knowledge is specified as being formal and expressed in systematic languages in the form of data, scientific formulae, specifications and manuals (Nonaka, Toyama & Konno 2000). The procedure in which explicit knowledge is presented has made its storage and sharing extremely easy and its popularisation overwhelming. A key challenge is therefore how to manage IK which is mainly tacit in nature or embedded in practices and experiences; it is highly personal and difficult to codify and diffuse.

According to Eftekharzadeh (2008), KM approaches can deal with tacit knowledge by either converting it to a more explicit form, or enhancing tacit knowledge flow by better human interaction (i.e. socialisation activities, motivation and suitable reward and recognition systems). However, tacit IK may change during the KM processes, such as documentation, due to strategies, goals and translation procedures of the practising communities. There is a need to strike a balance between the desire to preserve IKS in *ex situ* databases and the importance of facilitating the continued performance of IK in its original context (Ngulube 2003). This knowledge should thus not be separated from the individuals who hold it. Instead efforts should be made to enable the communities to innovate, create and manage their own knowledge and to adapt other knowledge systems for sustainable agricultural development in developing countries, such as Tanzania, Mali and Senegal. KM approaches provide many possibilities in this regard; it was therefore imperative to assess their application in managing IK for sustainable agricultural development.

Approaches towards the application of knowledge management in developing countries

Despite the fact that an overarching theory in the KM field has yet to emerge, the need to use KM for managing IK is well documented (Ha, Okigbo & Igboaka, 2008; Ngulube, 2003). This study is based on the most influential theory developed by Nonaka and colleagues (Nonaka, 1991; Nonaka & Takeuchi, 1995; Nonaka, Toyama & Konno, 2000) that considers KM as a knowledge creation process. The current paper introduces the model, discusses its potential weaknesses and presents the research findings from the selected districts of Tanzania in relation to the model.

The knowledge creation model

The knowledge creation model has three elements (i.e. SECI, or Socialisation, Externalisation, Combination and Internalisation), *ba* and knowledge assets) which interact with each other organically and dynamically to create knowledge. In this context, the knowledge assets of an organisation are mobilised and shared in *ba* whereas the tacit knowledge held by individuals is converted and amplified by the spiral of knowledge through the SECI steps (Nonaka & Toyama, 2003).

When Nonaka (1991) first introduced the SECI model at the epistemology level, he identified four distinctive interactions between tacit and explicit knowledge:

1. socialisation, where tacit knowledge is shared through shared experiences, for example face-to-face conversations
2. externalisation, where tacit knowledge is converted to explicit knowledge with the help of metaphors and analogies, for example, printed materials and rock paintings
3. combination, where explicit knowledge is systemised and refined, for example, by utilising information and communication technologies and existing databases
4. internalisation, where explicit knowledge is transferred to tacit knowledge, for example, learning by doing or translating theory into practice.

Ba is a concept that unifies physical spaces such as an office and virtual space (e.g. e-mail and mental space, including shared ideals, or good social relationships). Four different notions of *ba* are defined and correspond with the interaction in the SECI process (Nonaka, Toyama & Konno 2000):

- Originating *ba*: defined by individual and face-to-face interactions (individuals feelings, emotions, experiences and mental models are shared)
- Dialoguing *ba*: defined by collective and face-to-face interactions (individuals' mental models and skills are shared, converted into common terms and articulated as concepts)
- Systematising *ba*: defined by collective and virtual interactions (virtual space facilitates the recombination of existing explicit knowledge to form new explicit knowledge)
- Exercising *ba*: defined by individual and virtual interactions. It is a space where explicit knowledge is converted into tacit knowledge.

Knowledge assets are key elements that facilitate knowledge creation processes. Those assets include:

- experiential (i.e. skills and know-how)
- conceptual (i.e. concepts, designs and methods)
- systemic (i.e. technological platforms, manuals and patents and licences)
- routine (i.e. know-how in daily operations).

This article uses the knowledge creation model to discuss the management of IK in the local communities. The research findings are discussed according to the SECI steps (socialisation, externalisation, combination and internalisation) and *ba* aspects. The knowledge asset component was considered as being beyond the scope of this study.

A critique of Nonaka's theory

The authors of the present study are aware of the potential weaknesses of the SECI model as explained by Gourlay (2006), Kaplan (2008), Li & Gao (2003) and Snowden (2007):

- The model considers the knowledge creation process in the Japanese context and that it cannot be applied in a different setting (Li & Gao, 2003; Snowden 2007).
- Tacit and explicit knowledge are dimensions of knowledge that cannot be transformed from one form to the other (Snowden, 2000; 2007).
- The tacit dimension of knowledge, in the knowledge creation model, is different from that in Polanyi's original context. It actually includes considerable implicitness which

is idiosyncratic in Japanese context. The separation of implicitness from real tacitness indicates a need for careful consideration about the potential of tacit knowledge in different contexts (Li & Gao 2003).

- A further argument is that there is no evidence to prove that the knowledge creation process is not different from information creation and thus knowledge conversion has been conflated with knowledge transfer in the matrix. Further the Combination and Internalisation sub-processes from the SECI model are not described clearly (Gourlay 2006).
- The last argument is that there is a lack of 'knowledge content' development (Kaplan 2008).

However, despite these weaknesses, the theory claimed to be useful in understanding and testing the application of KM through knowledge creation processes in various non-Japanese organisations (Rice & Rice 2005; Kaplan 2008). Further, other schools of thought have argued that this theory can be adapted by the rural communities of developing countries, such as South Africa (Ngulube 2003) and can be applied to manage the IK of local communities in developing countries, such as Nigeria (Ha, Okigbo & Igboaka 2008).

METHODOLOGY

The present study used qualitative and quantitative methods to triangulate various data collection instruments with the intention that they will all converge to support the research objective of the study. The study used a qualitative approach because it tends to give more attention to the subjective aspects of human experience and behaviour (Powell & Connaway 2007). The quantitative approach allowed patterns of knowledge creation to be rigorously described. The study used a purposive sampling technique because it involves selection of individuals that yield the most information about the topic under investigation. Six districts from six out of seven agricultural research zones in Tanzania were selected for the study due to their high agricultural production and the presence of information and communication technologies (ICTs) in the form of telecentres, community radio and cellular phone networks. These districts included Karagwe, Kasulu, Kilosa, Moshi rural, Mpwapwa and Songea rural districts from Kagera, Kigoma, Morogoro, Kilimanjaro, Dodoma and Ruvuma regions respectively. Qualitative data was collected through the semi-structured interview items, focus groups and participant observation, whilst the quantitative data was gathered through closed questions which were embedded in the same semi-structured interviews.

In this study, two villages were selected purposively from each of the six districts to reflect the management of agricultural IK. A total of 181 smallholder farmers were selected purposively for semi-structured interviews, with the number of respondents ranging between 27 and 37 per region. A total of twelve focus group sessions were held in the surveyed villages, with one focus group session per village. One hundred and twenty eight respondents participated in the focus group discussions, with the number of study participants ranging between six and twelve respondents per session. The selection of respondent was based on age, gender, ethnicity and farming activity. These criteria were used because variations in knowledge can be observed by the diversity in agro-ecology, ethnicity, population characteristics and infrastructure (Röling 1989). Identification of these respondents was based upon discussions with community leaders and local extension officers in each village. The focus group discussion and interview data were studied and analysed as they were collected, until it was clear that perspectives were being repeated and data saturation had been reached (Teddlie & Tashakkori, 2009). The data analysis software packages (i.e. SPSS 15.0 and NUD.IST [NVIVO] 8.0) were used to analyse quantitative and qualitative data, respectively.

FINDINGS AND DISCUSSIONS

This section discusses study findings according to the knowledge creation model, where the results in relation to SECI processes and *ba* are presented and interpreted.

The profile of the respondents

In the semi-structured interviews, 181 smallholder farmers participated in the study, of which 112 were men and 69 were women. The mean age of the respondents for the interviews was 48. The study mainly involved smallholder farmers, where nearly two thirds of the crop farmers (61.9%; 104) had farm sizes below 19 829.60 square meters or 1.983 hectares. Most respondents 84% (152) had some level of formal schooling and about 91.2% (163) could read and understand simple instructions. Amongst those with formal schooling, male respondents dominated the higher education category, accounting for 62.5% (95) of those with primary school education, 9.2% (14) with secondary education and 3.4% (5) with higher education (i.e. four college diplomas and one university bachelor degree). On the other hand, 128 smallholder farmers participated in the focus group discussions, with almost equal proportions of men (50.8%; 65) and women (49.2%; 63). The mean age of the focus group participants was 45. Most focus group participants (89.1%; 114) had formal education and about 90.7% (116) could read and understand simple instructions. Amongst those with formal education (89.1%; 114), male respondents dominated the higher education category compared to female respondents. Male respondents accounted for 41.4% (48) of those with primary school education, 8.6% (10) with secondary education, 1.7% (2) with post-secondary education and 0.9% (1) with adult education.

The use of SECI model in the local communities

Under this subheading, we present findings according to the SECI processes as illustrated in the knowledge creation model, which include: socialisation, externalisation, combination and internalisation.

Socialisation

The socialisation process enables individuals to share tacit knowledge with each other (such as experiences and technical abilities). The study found that farmers created new knowledge through individual interactions, group meetings (such as social gatherings and farmer groups meetings) and observation. Agricultural IK was primarily acquired and shared within local and social networks, which involved parents or family (93.9%; 170), neighbours and friends (86.2%; 156), personal experience (85.1%; 154) and other local sources (see Table 1). Farmers made little use of print media and formal sources of knowledge, such as Non Governmental Organisations (NGO), extension officers, researchers and cooperative unions. Similar observations were made by another study carried out in Nigeria (Olatokun & Ayanbode, 2008). It is therefore indicated that IK is mainly created and shared within local and informal social networks with limited exposure to outside knowledge.

IK was also shared and created through cultural roles, such as apprenticeships[1], initiation rites during adolescence and age-set systems (although at a low rate). However, these cultural roles and traditions were location specific and were not used to share and create IK in all the surveyed communities. It is thus important to recognise and strengthen these cultural roles in their particular localities for improved knowledge creation activities in the rural areas. These cultural roles include the following:

Apprenticeships

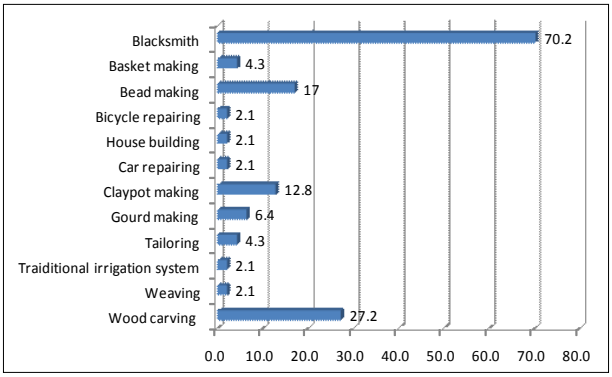
Interview findings showed that few farmers 26% (47 of 181 respondents) were practising apprenticeships in the surveyed

1. The training system by which a person learning a local practice such as craft or trade is instructed by a master for a set time under set conditions.

TABLE 1
Tacit and explicit sources of agricultural indigenous knowledge by district (N=181)

	Districts *N*						
Knowledge sources	**Mpwapwa**	**Karagwe**	**Kasulu**	**Moshi Rural**	**Kilosa**	**Songea Rural**	**Total**
Personal experience	22 (12%)	25 (14%)	17 (9.4%)	28 (15.5%)	33 (18.2%)	29 (16%)	154 (85%)
Parents/ guardian/family	28 (16%)	30 (17%)	23 (13%)	28 (15.5%)	36 (19.9%)	25 (14%)	170 (94%)
Neighbour/friends	24 (13%)	28 (16%)	25 (14%)	28 (15.5%)	28 (15.5%)	23 (13%)	156 (86%)
Women's meetings	-	1 (0.6%)	1 (0.6%)	3 (1.7%)	5 (2.8%)	2 (1.1%)	12 (6.6%)
Cattle herders	9 (5%)	-	3 (1.7%)	2 (1.1%)	8 (4.4%)	-	22 (12%)
Demonstration and observation	9 (5%)	1 (0.6%)	3 (1.7%)	21 (11.6%)	14 (7.7%)	9 (5%)	57 (32%)
Newsletters	-	1 (0.6%)	-	9 (5%)	1 (0.6%)	2 (1.1%)	13 (7.2%)
Posters	-	-	-	-	3 (1.7%)	2 (1.1%)	5 (2.8%)
Church/mosque	-	2 (1.1%)	1 (0.6%)	9 (5%)	5 (2.8%)	1 (0.6%)	18 (9.9%)
Social group gatherings	3 (1.7%)	1 (0.6%)	15 (8.3%)	24 (13.3%)	16 (8.8%)	7 (3.9%)	66 (37%)
Village leaders	1 (0.6%)	6 (3.3%)	2 (1.1%)	4 (2.2%)	9 (5%)	-	22 (12%)
Farmers' groups	-	2 (1.1%)	5 (2.8%)	12 (6.6%)	6 (3.3%)	19 (11%)	44 (24%)
Village meetings	-	3 (1.7%)	2 (1.1%)	5 (2.8%)	6 (3.3%)	-	16 (8.8%)
Newspapers	1 (0.6%)	3 (1.7%)	-	-	4 (2.2%)	2 (1.1%)	10 (5.5%)
Books	-	3 (1.7%)	-	3 (1.7%)	2 (1.1%)	5 (2.8%)	13 (7.2%)
Seminars	-	5 (2.8%)	-	2 (1.1%)	1 (0.6%)	4 (2.2%)	12 (6.6%)
Agricultural shows	1 (0.6%)	3 (1.7%)	3 (1.7%)	3 (1.7%)	2 (1.1%)	-	12 (6.6%)
NGOs	-	1 (0.6%)	1 (0.6%)	10 (5.5%)	-	-	12 (6.6%)
Researchers	-	-	-	4 (2.2%)	-	-	4 (2.2%)
Extension officers	-	-	-	3 (1.7%)	-	1 (0.6%)	4 (2.2%)
Cooperatives	-	-	-	1 (0.6%)	-	-	1 (0.6%)

Note: The percentages are based on the total number of respondents since multiple responses were possible.
N, total number of respondents in the surveyed communities.



N, total of respondents who practiced apprenticeships in the surveyed communities

FIGURE 1
Types of apprenticeships practiced in the surveyed communities (*N* = 47)

communities. Blacksmith work (70.2%; 33) was the predominant form of apprenticeship practiced in the communities, followed by wood carving (27.7%; 13) and bead making (17%; 8) (see Figure 1). These apprenticeships were location specific, for instance, blacksmith work was practiced in all regions, whilst bead and gourd making was practiced in Kilosa, basket and clay pot making in Mpwapwa, traditional irrigation systems in Moshi Rural, weaving in Mpwapwa and wood carving in Kilosa, Moshi rural, Mpwapwa and Songea Rural.

Initiation rites

The semi-structured interviews showed that 17.7% (32) respondents indicated that initiation rites were used to share agricultural IK, whilst 82.3% (149) did not. Initiation rites during adolescence were used to share agricultural IK at a low rate in four disticts (i.e. Kilosa, Mpwapwa, Karagwe and Kasulu) because their main aim was to prepare young women and men for adolescence and responsible sexual and reproductive behaviour.

Age-set system

Data from participant observation and focus group discussions showed that cultural, livestock management and ethno-veterinary knowledge was shared through a specified social system known as the 'age-set system' in the Maasai ethnic group in Kilosa (Twatwatwa Village). This structure allowed the transmission of knowledge from one age group to another. These age groups were spaced by 15 or 20 years. However, the age-set system was a gender based system in the Maasai community. Young boys and men were educated in livestock issues through the age-set system, whilst young girls and women learnt about livestock management and animal treatment from their mothers or other family members; wives learnt from their husbands on the use of local herbs to cure animals. Despite being location specific, the findings show that some IK may be accessed according to gender categories.

Further analysis of the individual interviews showed that the socialisation process enabled farmers to combine their knowledge with that of others to carry out their own experiments out of curiosity, to solve problems and as an adaptation of knowledge in their own environment. Firstly, farmers carried out local experiments in order to seek solutions to their problems, such as a shortage of land and difficulty in controlling animal diseases in Moshi Rural (Lyasongoro Village) and Kilosa (Twatwatwa Village). Secondly, new knowledge was generated through experiments driven by personal curiosity. Farmers in Kilosa (Kasiki Village) and Songea Rural (Lilondo Village) carried out experiments by means of trial and error and personal experience to select land for planting crops, control animal diseases and improve soil fertility; only after conducting some local experiments, were they successful. Thirdly, farmers carried out experiments by adapting and transferring new knowledge to new environments, which included new crop varieties and crop husbandry in Moshi Rural (Lyasongoro and Mshiri Villages) and Kasulu (Nyansha Village). One farmer in Moshi Rural (Lyasongoro Village) planted traditional pumpkins called *majani ya maboga (Cucurbita pepo L.)* to test whether it would work on her farm after she had heard about it from another village. The study results corroborate findings from a study of farmers in Andea (Rhoades & Bebbington 1995).

Externalisation

This externalisation process involves the articulation of farmers' hidden tacit knowledge into explicit knowledge. The study found that farmers externalised their tacit knowledge into explicit knowledge although it was practiced at a very low rate. The present findings showed that few (13.3%; 24) farmers converted their indigenous tacit knowledge into explicit forms which included written formats (87.5%; 21), carvings (16.7%; 4) and still pictures (7.4%; 2). Carvings included locally made traps for controlling plant pests, utensils, toys, ornaments and drawings on clay pots, hand mills and pestles. Poor recognition of IK and lack of a knowledge sharing culture may have limited farmers in externalising their tacit knowledge into explicit knowledge in the local communities.

Farmers also externalised their knowledge by interacting with others in formal and informal farmer groups, although at a low rate. The study findings showed that few farmers (40.9%; 74) were involved in the associations that existed in their communities, whilst 58% (107) were not. The findings showed that 85.1% (63) of the respondents were involved in an agriculturally related association, whilst 18.9% (14) were involved in non-agriculturally related groups. The majority of the agriculturally related associations were registered (77.8%; 49), whilst 27% (17) were not. The existence of informal and self-managed farmer groups in the local communities showed that communities of practice already existed in the local communities because they were voluntary and members shared a common interest and language. The findings suggest that there is a need to encourage farmers to join farmer groups in order to cultivate communities of practice which are effective mechanism for sharing knowledge.

Combination

Combination involves the creation of explicit knowledge by articulating explicit knowledge obtained from multiple sources. The findings showed that farmers captured and integrated new explicit knowledge by collecting externalised knowledge from other farmers (e.g. by borrowing books from other farmers and the library) as shown in Table 1. These printed materials included books (7.2%; 13), newsletters (7.2%; 13), newspapers (5.5%; 10) and posters (2.8%; 5). However, print media were used at a low rate in the local communities to create explicit knowledge, potentially ascribed to a lack of reading habit, knowledge culture and bookshops and rural libraries.

Farmers shared their explicit knowledge with others through village meetings, group interactions as well as print formats and ICTs, such as cell phones and e-mail. The study findings showed that few farmers used ICTs to combine and create new knowledge in the surveyed communities. The study found that almost half of the respondents (45.3%; 82) had used ICTs to acquire agricultural IK in the surveyed communities. Radio (89%; 73) was the predominant tool used by farmers to acquire IK in the surveyed communities, followed by cell phones (47.6%; 39) and television (36.6%; 30) (see Figure 2). Further, the study found that few farmers (18.8%; 34) had used ICTs to share IK in the local communities. Most respondents had used cell phones to share their IK (94.1%; 32), whilst 14.7% (5) had used e-mail and 5.9% (2) had used radio. It has been indicated that farmers mainly depend on oral media, such as radio and television, whilst advanced ICTs (such as e-mail and the Internet) were rarely used. Whilst developments in ICT have enabled access to

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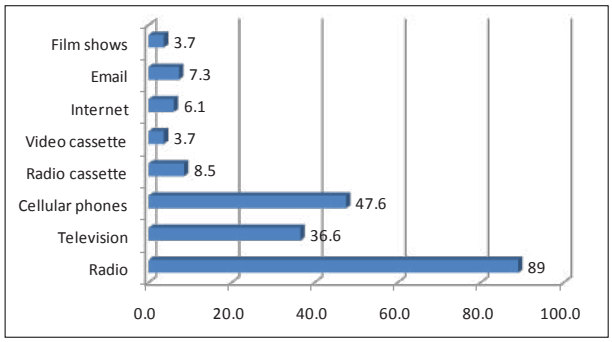


N, total number of respondents who had used ICTs to acquire agricultural IK in the surveyed communities.

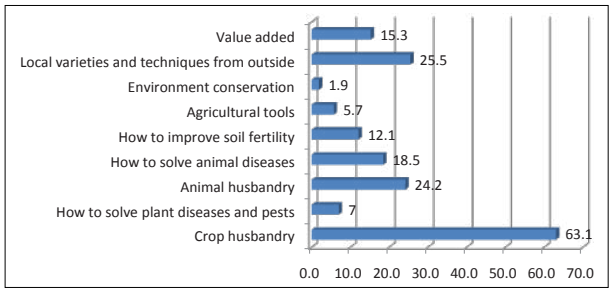
FIGURE 2
Use of Information and Communication Technologies to acquire agricultural indigenous knowledge, in the local communities (*N* = 82)

IK, the digital divide is still prevalent in the surveyed regions despite the fact that the study was carried out in those areas which had some form of ICT services.

Internalisation

This process enabled farmers to apply the gained explicit knowledge to the farming systems. The findings showed that most farmers applied IK (86.7%; 157) received from tacit and print sources of knowledge to the farming systems, as compared to the IK received from ICTs (9.9%; 18). Given the fact that most IK was shared through oral communication rather than through print media and ICTs, these findings show that farmers mainly applied IK received from tacit sources as compared to explicit sources of knowledge and therefore indicate that the internalisation process was partially fulfilled. The present study indicated that farmers applied indigenous techniques from tacit and print sources for crop husbandry (63.1%; 99), new techniques and varieties (25.5%; 40) and animal husbandry (24.2%; 38); see Figure 3.

Although the interviews showed that a knowledge of crop husbandry was the most adopted technique, the focus groups established that a knowledge of how to improve soil fertility was the most applied indigenous technology within communities, followed by value added technologies and control of plant pests and diseases and crop husbandry techniques. New varieties and techniques were the least adopted indigenous techniques in the communities. Despite these discrepancies, major patterns can be identified showing that farmers applied indigenous techniques to crop production rather than to animal husbandry. These techniques were related to crop husbandry, soil fertility, new varieties and techniques, value added technologies and control of plant pests and diseases. Farmers applied IK in the farming activities probably due to their effectiveness, affordability, safety, ease of use and lack of access to knowledge on alternative technologies such as conventional farming.



N, total number of respondents who had used indigenous techniques received from tacit and explicit sources of knowledge in the surveyed communities.

FIGURE 3
The use of indigenous techniques received from tacit and explicit sources of knowledge (*N* = 157)

The findings also showed that there was a low use of IK received from ICTs as compared to tacit and explicit sources of knowledge. The study found that few farmers (9.9%; 18) had applied IK received from ICTs into their farming systems. Most farmers had applied IK on animal disease control and animal husbandry, accounting for 10 (33.3%) respondents each, followed by new varieties and techniques 5 (16.7%) and soil fertility 5 (16.7%). The findings also suggest that face-to-face communication is very important for enabling the knowledge creation processes in the communities to develop as compared to other communication channels such as print formats and ICTs.

On the whole, all four types of Nonaka and Takeuchi's (1995) knowledge creation model (i.e. socialisation, combination, externalisation and internalisation) were practiced by the local communities to create new knowledge for farming purposes, but the externalisation, combination and internalisation processes were practiced at a low rate. These findings were almost similar to an earlier finding of Ha, Okigbo and Igboaka (2008) who found that Nonaka's (1994) model was partially fulfilled because farmers were able to create knowledge through socialisation and combination processes, whilst externalisation and internalisation processes were not quite as successful in Anambra State in Nigeria.

The adaptability of *ba* in the local communities

The study findings established that shared context or *ba* as proposed by Nonaka, Toyama and Konno's (2000) knowledge creation model was partially fulfilled in enabling farmers to create, share and apply knowledge for farming purposes in the surveyed communities. The majority of respondents shared their knowledge for farming purposes (56.4%; 102), followed by political (51.4%; 93), social (44.8%; 81) and agri-business purposes (32%; 58). According to Nonaka, Toyama and Konno (2000), *ba* is identified in four categories, which include:

- originating *ba*
- dialoguing *ba*
- systematising *ba*
- exercising *ba*.

The present findings illustrated that all four types of *ba* were practiced by the local communities to share knowledge for farming purposes, but the systematic and exercising *ba* were partially fulfilled. Farmers depended on physical space (where originating *ba* and dialoguing *ba* occurred) to share and create knowledge, whilst virtual space (systematising *ba* and exercising *ba*) was used at a minimal rate to share and create knowledge in the local communities.

Originating *ba* was commonly found in the local communities. Individual and face-to-face interactions amongst farmers and between farmers and knowledge intermediaries were common and occurred in a physical location. Farmers mainly met in their farm fields (44.1%; 45) to create, share and utilise knowledge. Other major places were homesteads (14.7%; 15) and village offices (13.7%; 14), open ground (7.8%; 8), NGO offices (7.8%; 8), grazing land (6.9%; 7), social clubs (2.9%; 3), visiting neighbours (2.9%; 3), under a big tree (2%; 2), the house of a *balozi wa nyumba kumi* or ten cell leader (2%; 2), ward office (2%; 2) and school (2%; 2). The least cited places where farmers met to share knowledge on farming activities were the church, on the road and the farmer groups leader's house, accounting for 1% (1) of the respondents each. Farmers also communicated individually for agri-business purposes at the village markets 63.8% (37 of 58 respondents), followed by the homestead (12.1%; 7), NGO offices (8.6%; 5), open ground (6.9%; 4) and the village offices (6.9%; 4). The least cited places were on the road (3.4%; 2), cooperative unions (3.4%; 2) and school (1.7%; 1).

In dialoguing *ba*, the findings showed that the dialoguing *ba* existed in the surveyed communities. Collective and face-to-

face interaction amongst farmers and knowledge intermediaries was common and occurred in a physical location. For formal farmer group meetings, evaluation and training, farmers mainly met at the farmer group offices (33%; 20), followed by village offices (15.3%; 9) and the church (13.6%; 8). Other places that formal farmer groups met to hold their meetings included: the group leader's house (11.9%; 7), farm fields (5.1%; 3), community telecentre (3.4%; 2), group member's house (3.4%; 2), hotel (3.4%; 2) and open space (3.4%; 2). The least cited places where formal farmer groups met to hold their meetings were the auction market, school, under a big tree and ward office, accounting for 1.7% (1) respondent each. Informal farmer groups mainly used group members' houses (8.5%; 5) and grazing fields (6.3%; 4) to hold their meetings. Other places where informal farmer groups met to hold their meetings included an open space (3.4%; 2) and a school (1.7%; 1). Formal farmer groups had more access to village facilities such as village and ward offices than to informal farmer groups. The findings also showed that farmers mainly met through formal farmer groups which indicates that there was little chance of sharing and creating IK as compared to external knowledge because IK was inadequately recognised in the formal farmer groups. Most interesting of all was that the telecentres (i.e. Family Alliance for Development and Cooperation (FADECO)) and Kilosa Rural Services and Electronic Communication (KIRSEC) were not just providing ICT support services, but they were also important places for local farmers to socialise and create knowledge. Similar observations were made in another study in Nigeria (Ha, Okigbo & Igboaka 2008). Farmers, through their farmer groups, were also found to be committed to the KILIMO KWANZA[2] (Agriculture First), a Tanzanian Green Revolution theme to transform agricultural practices into a modern and commercial sector.

Systematic *ba* was practiced at a low rate in the communities, although ICTs were already in existence in the surveyed villages. The study findings showed that almost half of the respondents (45.3%; 84) had used ICTs to acquire agricultural IK, whilst 18.8% (34) had used ICTs to share IK. Local farmers mainly shared their knowledge amongst each other or with the knowledge intermediaries through cell phones, whilst other ICTs (such as e-mail and electronic forums) and explicit sources of knowledge (such as books and newsletters) were used at a lower rate for farming purposes. Only a few farmers in Kilosa district used electronic forums to share their agricultural knowledge through Kilosa Rural Services and Electronic Communication (KIRSEC) telecentre.

Exercising *ba* occurred when local communities were able to apply IK from tacit and explicit sources of knowledge and ICTs (such as e-mail and the Internet) into their farming systems. However, the findings showed that farmers applied more knowledge received from tacit sources of knowledge (e.g. by consulting neighbours or families and farmer groups) as compared to knowledge received from ICTs. Indications are that the oral communication channels were the major sources of knowledge in the surveyed communities as compared to explicit sources of knowledge and ICTs.

CONCLUSION

The study findings showed that some of the KM practices are already practiced in the communities to enhance the management of IK. However, these existing KM practices need to be strengthened for IK to be useful for agricultural development. The utilisation of the SECI model (Nonaka & Takeuchi 1995) in the current study showed that farming knowledge is continuously created through the conversion of tacit knowledge into explicit knowledge (and vice versa) despite its weaknesses. The research findings revealed that the knowledge creation theory can partially be applied to manage the IK of the local communities. Apart from socialisation process, the findings showed that other sub-processes in Nonaka and Takeuchi's (1995) knowledge creation model were partially fulfilled in the current study, which included externalisation, combination and internalisation. The present study established that the shared context or *ba* as proposed by Nonaka, Toyama and Konno's (2000) knowledge creation model was also partially fulfilled in enabling farmers to create, share and apply knowledge for farming purposes in the surveyed communities. All four types of *ba* were practiced by the local communities to share knowledge for farming purposes, but systematic and exercising *ba* were partially fulfilled. The findings showed that IK is mainly tacit and oral in nature and thus physical communication is very important in enabling the creation and sharing of knowledge as compared to virtual communication; that is why externalisation, combination stages and systematic *ba* were partially fulfilled. Farmers mainly internalised knowledge gained from tacit sources of knowledge as compared to explicit formats (i.e. ICTs and print formats) and thus the internalisation stage and exercising *ba* were partially fulfilled. On the whole, with adequate and appropriate resources, the Nonaka's theory can be used to manage the knowledge of local communities. Thus, the communities have to be placed within a knowledge-creating setting, which is one that continuously creates knowledge, manages, distributes and shares within and outside its boundaries and integrates it with new agricultural technologies, innovations and knowledge.

RECOMMENDATIONS

The study findings showed that Nonaka's model can be effective in understanding knowledge creation processes in a non-Japanese context, despite the specified weaknesses. Farmers were able to transform their knowledge from tacit to explicit knowledge, thus creating new knowledge to improve their farming activities. However, for effective knowledge creation processes there is a need to strengthen the following: for effective knowledge creation activities in the communities, the study recommends that knowledge intermediaries (such as, extension services, research, education, cooperative unions, NGOs, telecentres, rural libraries) of a particular locality should create a conducive environment that enables farmers to create and justify their true beliefs in the following ways: encourage farmers to use indigenous communication channels and structures of a particular locality (such as apprenticeships, initiation rites, folklore, age-set system) to share and create IK; reward local farmers in terms of recognition when they innovate; promote a positive attitude and tolerance of mistakes made in attempts at innovation; and encourage farmers to participate in farmer groups, communities of practices and other informal social groups.

Further, knowledge intermediaries should consider the following: recognise and involve local innovators in knowledge production and dissemination; document IK so that it is available to the scientific and local communities for future agricultural development plans; train local farmers to document their local practices; combine ICTs (such as radio, cell phones and telecentres) with print media and indigenous communication channels when disseminating IK in the communities; and consider the gender and location differences in access to IK so that women and other vulnerable groups are not marginalised in knowledge creation activities.

Regarding intellectual property rights, the study recommends that the knowledge intermediaries and other government and private officers should have agreements with the local communities so that IK is not misappropriated and benefits return to the community from which they originated. The government should also review the existing IPR framework in order to protect farmers' knowledge. These laws should enable the registration of grassroots innovations and certification of their products for the authentication. Capacity building

2.A Tanzanian national programme for prioritizing agriculture by increasing investments in this sector in order to improve food security and enhance the overall socioeconomic transformation in the country.

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programs should be initiated to enable the communities to legally protect their knowledge and their genetic resources, as well as to negotiate benefit sharing agreements.

Knowledge intermediaries should also create linkages and collaborate in knowledge production and dissemination in the local communities, to enhance access, sharing and preservation of IK in the local communities. These intermediaries can explore the possibility of establishing linkages such as an association of rural agricultural actors in order to build their capacities and promote exchange of knowledge, experiences and sharing of resources where possible for effective KM practices in the rural areas.

The study also suggest that government should improve the supply of electricity in the rural areas, provide access to affordable power sources such as solar power and upgrade road and telecommunication infrastructure for effective knowledge creation activities in the local communities. The local communities and public and private sectors should also establish knowledge resource centres in their localities to enhance learning, sharing and preservation of agricultural knowledge.

REFERENCES

Bode, R., 2007, 'Knowledge management and communication in smallholder organisations: lessons learned', *GTZ Bulletin: Services for Rural Development* 16, 27–29, viewed 16 June 2009, from http://www.gtz.de/de/dokumente/en-bulletin16-2007.pdf

Eftekharzadeh, R., 2008, *Knowledge management implementation in developing countries: An experimental study*, viewed 24 March 2010, from http://www.entrepreneur.com/tradejournals/article/186785396_1.html

Gourlay, S., 2006, 'Conceptualising knowledge creation: A critique of Nonaka's theory', *Journal of Management Studies* 43(7), 1415–1436.

Ha, L., Okigbo, R.N. & Igboaka, P., 2008, 'Knowledge creation and dissemination in sub-Saharan Africa', *Management Decision* 46(3), 392–405.

Hart, T.G.B., 2007, 'Local knowledge and agricultural applications: Lessons from a Ugandan parish', *South African Journal of Agricultural Extension* 36, 229–248.

Ichijo, K. & Nonaka, I., 2007, 'Knowledge as competitive advantage in the age of increasing globalization', in K. Ichijo & I. Nonaka (eds.), *Knowledge creation and management: New challenges for* managers, pp. ix–xiv, Oxford University Press, Oxford.

Kaplan, L., 2008, 'Knowledge creation at the first tier level of the supply chain: An application of the SECI model' Master's thesis, Department of Information Science, Stellenbosch University, Stellenbosch.

Li, M. & Gao, F., 2003, 'Why Nonaka highlights tacit knowledge: A critical review', *Journal of Knowledge Management* 7(4), 6–14.

Lwoga, E.T. & Ngulube, P., 2008, 'Managing indigenous and exogenous knowledge through information and communication technologies for agricultural development and achievement of the UN Millennium Development Goals', in B. Njobvu & S. Koopman (eds.), *Libraries and information services towards the attainment of the UN Millennium Development Goals*, pp. 73–88, Walter de Gruyter, Berlin.

Meyer, H.W.J, 2009, 'The influence of information behaviour on information sharing across cultural boundaries in development contexts', *Information research* 14(1), viewed 20 August 2009, from http://informationr.net/ir/14-1/paper393.html

Mosia, L.N. & Ngulube, P., 2005, 'Managing the collective intelligence of local communities for the sustainable utilisation of estuaries in the Eastern Cape, South Africa', *South African Journal of Libraries and Information Science* 71(2), 175–186.

Mushi, D., 2008, 'Improved seeds help boost crop production', Daily News, viewed 29 June 2009, from http://dailynews.habarileo.co.tz/editorial/index.php?id=6711

Ngulube, P., 2003, 'Using the SECI knowledge management model and other tools to communicate and manage tacit indigenous knowledge', *Innovation* 27, 21–30.

Nonaka, I., 1991, 'The knowledge creating company', *Harvard Business Review* 69, 96–104.

Nonaka, I. & Takeuchi, H., 1995, *The knowledge creating company: How Japanese companies create the dynamics of innovation*, Oxford University Press, New York.

Nonaka, I. & Toyama, R., 2003, 'The knowledge-creating theory revisited: knowledge creation as a synthesizing process', *Knowledge Management Research and Practice* 1, 2–10, viewed 16 February 2007, from http://www.palgravejournals.com/kmrp/journal/v1/n1/pdf/8500001a.pdf

Nonaka, I., Toyama, R. & Konno, N., 2000, 'SECI, ba and leadership: a unified model of dynamic knowledge creation', *Long Range Planning* 33, 5–34.

Olatokun, W.M. & Ayanbode, O.F., 2008, 'Use of indigenous knowledge by rural women in the development of Ogun state', *INDILINGA: African Journal of Indigenous Knowledge Systems* 7 (1), 47–63.

Polanyi, M., 1962, *Personal knowledge: Towards a post-critical philosophy*, University of Chicago Press, Chicago.

Powell, R.R. & Connaway, L.S., 2007, *Basic research methods for librarians*, 4th edn., Libraries unlimited, Westport.

Rhoades, R. & Bebbington, A., 1995, 'Farmers who experiment: an untapped resource for agricultural research and development?', in M.D. Warren, L.J. Slikkerveer & D. Bonkesha (eds.), *The cultural dimension of development: Indigenous knowledge systems*, pp. 296–307, Intermediate Technology Publications, London.

Rice, J.L. & Rice, B.S., 2005, 'The applicability of the SECI model to multi-organisational endeavors: An integrative review', *International Journal of Organisational Behaviour* 9(8), 671–682, viewed 16 February 2007, from http://www.usq.edu.au/resources/vol9no8rice.pdf

Röling, N.G., 1989, *The research/extension interface a knowledge system perspective*, ISNAR Staff Notes, The International Service for National Agricultural Research (ISNAR), The Hague.

Snowden, D., 2000, 'Organic knowledge management, the ASHEN Model: An enabler of action', *Inside knowledge* 3(7).

Snowden, D., 2007, 'The big debate: Is KM finished?', in J. Ash & D. Snowden (eds.), Is KM finished? *Inside knowledge: incorporating enterprise information magazine* 10(7), 22–23.

Teddlie, C. & Tashakkori, A., 2009, *Foundation of mixed methods research: integrating quantitative and qualitative approaches in the social and behavioural sciences*, Sage, Thousand Oaks.

United Nations Development Programme (UNDP), 2003, *Human development report 2003: millennium development goals: A compact among nations to end human poverty*, viewed 05 February 2010, from http://hdr.undp.org/en/reports/global/hdr2003

United Republic of Tanzania, 1998, *Kilimanjaro region socio-economic profile*, Government Printer, Dar es Salaam.

United Republic of Tanzania, 2009a, *Budget Speech 2009/10 of the Ministry of Agriculture and Food Security*, viewed 06 August 2009, from www.parliament.go.tz

United Republic of Tanzania, 2009b, *The economic survey 2007*, viewed August 2009, from http://www.tanzania.go.tz/bspeechf.html

Wall, C.R.L., 2006, 'Knowledge management in rural Uzbekistan: Peasant, project and post-socialist perspectives in Khorezm' PhD thesis, Faculty of Philosophy, University of Bonn, viewed 26 November 2007, from http://hss.ulb.unibonn.de/diss_online