Knowledge management approaches in managing agricultural indigenous and exogenous knowledge in Tanzania

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Abstract

Purpose - The purpose of this study is to assess the application of knowledge management (KM) models in managing and integrating indigenous and exogenous knowledge for improved farming activities in Tanzania, by examining the management of indigenous knowledge (IK), access and use of exogenous knowledge, the relevancy of policies, legal framework, information and communication technologies (ICTs), and culture in KM practices in the communities.
Design/methodology/approach – Semi-structured interviews were used to collect qualitative and quantitative data from 181 farmers in six districts of Tanzania. Four IK policy makers were also interviewed.
Findings – The study demonstrated that western based KM models should be applied cautiously in a developing world context. Both indigenous and exogenous knowledge were acquired and shared in different contexts. IK was shared within a local, small and spontaneous network, while exogenous knowledge was shared in a wide context, where formal sources of knowledge focused on disseminating exogenous knowledge more than IK. Policies, legal framework, ICTs and culture determined access to knowledge in the communities. The study thus developed a KM model that would be applicable in the social context of developing countries.
Research limitations/implications – The study necessitates a need to test the developed model against existing KM models, in a specific context such as local communities of developing world, to determine if it better at explaining the link between KM principles and KM processes
Originality/value – The proposed KM model provides a deep understanding on the management and integration of agricultural indigenous and exogenous knowledge in the rural areas of developing countries. Previous KM models were developed in the context of organizational environment, and thus they failed to address the needs of rural communities. The proposed model thus advances theory on KM in developing countries, and provides linkages between KM processes and KM principles.

Keywords - knowledge management, indigenous knowledge, exogenous knowledge, agriculture, ICT, Tanzania
Paper type - Research paper

1. Introduction and background

Rural communities in the developing countries have an extensive base of widely available knowledge which is indigenous knowledge (IK). This knowledge is unique to a given culture, and it is predominantly tacit and embedded in practices and experiences of the local people (Sen

and Khashmelmous, 2006). IK is the basis for agriculture, health care, food preparation, education, natural resource management and other various activities. It plays a very vital role in sustainable agriculture in Sub-Saharan Africa because most farmers are smallholders, and thus they are familiar with indigenous practices. In Tanzania, about 93 percent of 11.9 million ha cultivated land is dominated by smallholder farmers who cultivate an average farm size of between 0.2 and 2.0 hectares (United Republic of Tanzania, 2006). More than 90 percent of seeds planted in Tanzania are obtained from the informal system (Mushi, 2008), where farmers themselves produce, disseminate and procure seed directly from their own harvest, through barter among each other, and through local grain markets or traders. Thus, farmers' knowledge has been responsible for improving agricultural productivity and ensuring food security for centuries in Tanzania.

The prevailing information management approach in Sub-Saharan Africa, like in many other parts of the world, is based on acquiring and documenting explicit knowledge, which is largely generated by researchers, laboratories and universities (Ngulube, 2002). Such approach leaves little room for IK of the local communities to be integrated into the exogenous knowledge system. Even if some of the IK is preserved in the global, regional and national repositories, local farmers can only access these databases through an intermediary (that is, researcher, extension officer, or any agricultural actor) who can afford to access and use these systems. Generally, IK is preserved in people's minds and local practices, which may be eroded by failing memories and death. IK is shared and communicated orally and through traditions and culture. However, its distribution is always fragmentary, due to gender dynamics, politics, power, culture, conflicts, resistance, religious beliefs and government policies (Mudege, 2005). Since IK is essential for agricultural development, it must be managed and preserved in the same systematic way as external knowledge. It is thus pertinent to determine a model for managing agricultural IK before much of it is completely lost.

In the absence of effective strategies to document IK, most of this knowledge has been exposed to the public domain and consequently available for all with the possibility of being misappropriated. Intellectual Property Right (IPR) is an important legal instrument by which IK can be protected from exploitation. However, the global IPRs inadequately protect IK because they are largely derived from European concepts of the individual which seldom articulate the communal rights within its design (Kabudi, 2004). That is why Ngulube (2002) contended that the main challenges to the management and preservation of IK are issues related to methodology, access, intellectual property rights and the media and formats in which to preserve it. It is thus imperative to investigate how IK can be managed and protected for sustainable agricultural practices in the local communities. The sharing and documentation of IK would enable the local communities to guard against its disappearance and misappropriation by checking to determine whether it is new or has always existed and, therefore, cannot be patented.

As much as local people need IK which exists in their communities, sustainable agricultural development may better be served by a system that incorporates both indigenous and exogenous knowledge systems. Exogenous knowledge is a broad base of non-traditional knowledge that local people draw from their interaction with non-local people and institutions, television and other media, formal education, and adoption of western scientific thinking, values, and philosophies (Karlsson, 1995:50). Research shows that the more the local people experiment

with exogenous elements, the more they strengthen their own knowledge and practices (Dove, 2000). Although the integration of indigenous and exogenous knowledge improves agricultural activities, research and extension have failed to understand and involve farmers in problem definition and solving in sub Saharan African. In Tanzania, public agricultural research and extension systems are still characterised by top-down approaches (Lema and Kapange, 2006), despite the introduction of participatory approaches which focus on the participation of local people, by working with and through groups, and building upon their IK. Most of the agricultural extension officers are deficient in participatory problem-solving skills in Tanzania (Lema and Kapange, 2006). The top-down information transfer approach is based on the assumption that technical knowledge is generated by research institutes, transferred by extension services and utilized by farmers, and hence little attention is given to local knowledge and value systems (Röth, 2001). This situation does not necessitate a need to determine a model to manage only IK, but also ways to strengthen the linkages between exogenous and indigenous knowledge for improved agricultural activities.

Knowledge management (KM), with its emphasis on capturing, creating, preserving, sharing, and utilizing knowledge has already begun to show its prominence in the management of indigenous and exogenous knowledge in developing countries (Ha *et al.,* 2008). However, the application of KM is still in its infancy in most developing countries. Hence, it is important to promote KM practices in rural communities by strengthening the interaction between local networks and organisational structures, even though communication and learning processes in rural communities take place in a less structured way through social networks and loose groups or between individuals (Bode, 2007). The explicit nature of exogenous knowledge has made its storage and sharing extremely easy, and its popularization overwhelming. However, IK is predominantly tacit and, therefore, highly personal and difficult to codify and diffuse. KM approaches can deal with tacit knowledge by converting it to a more explicit form, and by enhancing tacit knowledge flow through human interaction, so that it is not held in the heads of a few (Eftekharzadeh, 2008). Success in agricultural activities depends on the capability of farmers and agricultural information actors to leverage local knowledge and embody it with exogenous knowledge in order to produce value from these knowledge resources. It is thus imperative to assess the applicability of KM approaches for managing IK, and providing access to exogenous knowledge in the context of the local community.

ICTs are important tools in enabling the management and integration of indigenous and exogenous knowledge in developing countries (Lwoga and Ngulube 2008). However, the digital divide continues to grow so wide that many farmers do not have the opportunity to transform into knowledge driven communities in the Sub-Saharan African countries. The technological, economical and educational implications of disparities in the distribution of digital technology contribute to this situation (Malhan and Gulati, 2003). Further, documenting and disseminating IK through ICTs, contributes to the degradation of indigenous cultures and indigenous peoples' loss of intellectual property rights. It is thus important for African governments to improve ICT infrastructures, and formulate appropriate IPR and policies that will protect IK for its effective management through KM practices.

The purpose of this study was, therefore, to contribute to the conceptual development of KM studies on the management and integration of indigenous and exogenous knowledge for

improved farming activities in developing countries with a particular focus on Tanzania. It is with this background that the following objectives were posed:

1. To study the current status of acquiring, sharing, preserving and using agricultural indigenous knowledge in the local communities;
2. To assess how farmers obtain and use agricultural exogenous knowledge in the local communities;
3. To investigate the policies and legal frameworks that are relevant for protecting agricultural IK in Tanzania;
4. To determine the role of ICTs in managing agricultural indigenous knowledge, and providing access to exogenous knowledge in the local communities; and
5. To propose a KM model that could be used to manage and integrate agricultural indigenous and exogenous knowledge in the local communities.

2. Theoretical framework

Despite the fact that there is a large number of KM approaches for managing organisational knowledge, each approach has its characteristics and limitations. Selecting a suitable approach for KM practices requires an understanding of both the available KM approaches and the knowledge problem involved (Probst, et al., 2000). It is also argued that focusing on a single KM approach may limit organisations to a range of possible solutions for KM practices (Probst, *et al.,* 2000). Hence, this study used eight western based KM models which provided the theoretical framework (Boisot, 1987; Davenport, 1998; Kruger and Snyman, 2005; McAdam and McCreedy, 1999:2000; Nonaka and Takeuchi, 1995; Probst, *et al.,* 2000; Rowley, 2001; Small and Tattalias, 2000).

Nonaka and Takeuchi's (1995) model emphasized the creation of knowledge through the conversion of tacit and explicit knowledge and vice versa. In 2000, Nonaka, *et al.,* (2000) further developed the model of knowledge creation to consist of three elements which interact with each other to form a knowledge spiral that creates knowledge, and they include: (i) the SECI process assumes that knowledge is created by converting it between tacit and explicit knowledge through socialization, externalization, combination and internalization processes; (ii) *ba*, the shared context for knowledge creation; and (iii) knowledge assets - the inputs, outputs, and moderator of the knowledge-creating process. Boisot's (1987) knowledge category model supported Nonaka's model by classifying knowledge based on the ease of transmission and the readiness to share. Boisot (1987) regarded knowledge as either codified or uncodified, and as diffused or undiffused.

The KM models of McAdam and McCreedy (1999), and Rowley (2001) place major emphasis on KM processes, though they vary in the number and sequence of KM processes they identify. These KM processes include: knowledge identification, acquisition, development, sharing, preservation, use and re-use. While supporting the KM processes perspective, Probst, *et al.,* (2000:30) further identified two building blocks (knowledge goals and knowledge assessment) which influence KM processes in organizations, including knowledge identification, acquisition, development, sharing, utilization, and retention. Similarly to Probst, *et al.,* (2000), Small and Tattalias's (2000) KM model insisted that the second dimension elements (that is, strategy, measurement, policy, content, process, technology, culture) can enable or influence the knowledge creation activities in the first dimension perspective, which include knowledge

exchange, knowledge capture, knowledge reuse, and knowledge internalization. Davenport's (1998) ten principles supported the second dimension of Small and Tattalias (2000) and two building blocks (knowledge goals and assessment) of Probst, *et al.,* (2000). Davenport (1998) provided ten principles that can guide the KM processes in organisations. Kruger and Snyman (2005) also agreed with Davenport's (1998), Small and Tattalias's (2000) KM models. Kruger and Snyman (2005) proposed that not only should knowledge be governed by a strategy before detailed KM plans can be made, but more importantly that sound KM practice should be based on predetermined principles and strategies.

From the discussion of the nine KM models, it can be argued that all of these models focus on the business or organisational settings. However, this study sought to assess the application of KM models in managing IK in the local communities. The study therefore adapted ideas from all these eight models in order to provide theoretical guidance for the application of KM model in managing and integrating indigenous and exogenous knowledge in the local community setting. On one hand, the reviewed KM models also emphasized the identification of KM principles that could be used to guide or influence the implementation of KM processes in organizations (Davenport, 1998; Kruger and Snyman, 2005; Nonaka *et al.,* 2000; Probst *et al.,* 1999; Small and Tatalias, 2000) (See Table 1). These principles included the development of a policy, strategy, leadership, and legal frameworks (Davenport, 1998; Probst *et al.,* 1999; Small and Tatalias, 2000). Other principles include: measurement, content, culture, process and technology (Small and Tatalias, 2000). On the other hand, it is evident that these models emphasize the implementation of KM processes for the effective management of knowledge in organisations as shown in Table 1(Probst *et al.,* 1999: 33; McAdam and McCreedy, 1999; Small and Tatalias, 2000; Rowley, 2001). Similarly, Nonaka, *et al.,* (2000) also proposed that knowledge can be managed through the knowledge creation process. Boisot's (1987) knowledge category model is similar to Nonaka's model where the horizontal dimension of both models relates to the spread or diffusion of knowledge across the organization.

Table 1: A summary of KM principles and processes as deduced from the reviewed KM models

Models on KM principles	**Models on KM processes**
KM principles include: knowledge goals and knowledge assessment (Probst, *et al.,* 2000)	KM processes include: knowledge identification, acquisition, development, sharing, preservation, use and re-use (Probst, *et al.,* 2000)
KM principles include: strategy, measurement, policy, content, process, technology, culture (Small and Tattalias 2000)	KM processes include: knowledge exchange, knowledge capture, knowledge reuse, and knowledge internalization (Small and Tattalias, 2000)
Ten principles were proposed to guide the implementation of KM processes in organisations (Davenport, 1998)	KM processes include: knowledge acquisition, articulation and sharing, knowledge repositories' updating, knowledge diffusion, knowledge use, and knowledge revision (Rowley, 2001)
KM practice should be based on predetermined principles and strategies in organizations (Kruger and Snyman, 2005)	KM processes include: Knowledge construction, embodiment, and use (McAdam and McCreedy, 1999)
	Knowledge creation processes - socialization, externalization, combination and internalization

	(Nonaka and Takeuchi, 1995)
	Knowledge regarded as either codified or uncodified, and as diffused or undiffused (Boisot, 1987)

It is with this background that the study adopted the KM processes as deduced from the reviewed nine KM models to allow the local communities to manage their knowledge based on pre-determined principles. The focus of the study was particularly on the following KM processes: knowledge acquisition, sharing, preservation and application. The study also adopted KM principles which were used to guide or influence the implementation of KM processes in the local communities, which included the following: recognizing the importance of the policy, culture, a legal framework, and ICTs.

3. Methodology

Semi-structured interviews were conducted to gather quantitative and qualitative data from small scale farmers in Tanzania, where closed-ended and open-ended questions were posed. In-depth interviews were also used to collect qualitative data from IK policy makers. The study involved farmers in order to gain better understanding of the application of KM approaches in managing IK and introducing exogenous knowledge in the rural areas. IK policy makers were involved because they are concerned with the development of key policies that deal with the protection of IK. Since IK is site specific, the study used the purposive sampling technique because it involves selection of individuals that yield the most information about the topic under investigation (Cohen, *et al.,* 2007:115). The study selected six districts from six out of seven research zones due to their high agriculture production and presence of ICTs, such as telecenters, community radio, and cellular phone networks. Two villages were purposively selected from each of the six districts. The selected districts and their respective villages were: Mpwapwa district (Vinghawe and Mazae villages), Karagwe district (Katwe and Iteera villages), Moshi Rural district (Lyasongoro and Mshiri villages), Kilosa district (Kasiki and Twatwatwa villages), Songea Rural district (Matetereka and Lilondo villages), and Kasulu district (Nyansha and Kidyama villages). A total of 181 farmers were purposively selected to participate in the semi-structured interviews, where the respondents ranged between 27 and 37 per district. Four officers were purposively selected from the institutions that dealt with intellectual property and IK policy issues in Tanzania, where one officer was selected from each office. Interviews were terminated when it was considered that the saturation point was reached and no new information was forthcoming, thus determining the final sample size (Patton, 2002:246).

The semi-structured interview was structured as follows:

- Background information: age, gender, education, average farm size, and ICT ownership;

- The management of agricultural IK:
  - IK acquisition: sources of IK
  - Sharing and distribution of IK: folklore activities (types, and purpose of folklore activities), apprenticeships (types and aim of apprenticeships), initiation rites during adolescent age (aim of initiation rites), and farmer groups (types and aim of farmer groups)
  - Preservation of IK: types of non-ICT based tools used for IK preservation
  - Utilization of IK: adoption of different types of agricultural indigenous technologies received from tacit and explicit sources of knowledge
- The need to integrate agricultural exogenous and indigenous knowledge: sufficiency of IK to solve farming problems; and willingness of farmers to share their knowledge for further improvement
- Access to and use of exogenous knowledge: sources of exogenous knowledge; and use of exogenous knowledge and techniques received from tacit and explicit sources of knowledge in the farming systems

- Policies on IK: importance of establishing IK policy; and

- Role of ICT: use of ICT in IK acquisition, sharing, and preservation; and use of ICT in accessing exogenous knowledge.

The interview schedule for policy makers was structured as follows:

- Background information: age, gender, and education;
- Current policies on IK: awareness, aim and effectiveness of policies that address the utilisation of IK for development purposes; and future plans to establish IK policy;
- Current IPRs on IK: awareness, aim and effectiveness of IPRs that addresses the protection of genetic resources and expressions of traditional culture; and
- Examples of misappropriated IK under the auspices of IPRs in Tanzania.

In this study, the researcher ensured that relevant research permits were obtained before the commencement of data collection. The introduction letters obtained from the researcher's employer (Sokoine University of Agriculture (SUA) in Tanzania) were used to get permission to conduct research in the selected districts of Tanzania. An informed consent form was also used to facilitate voluntary participation in the study. Both qualitative and quantitative data were analyzed separately, and then quantitative data was merged to the qualitative data set in order to provide support to the results of qualitative data set. Further, most of the qualitative data was transformed into quantitative data in order to compare the datasets. SPSS 15.0 and NUD.IST (NVIVO) eight were used to analyse quantitative and qualitative data, respectively.

4. Results and discussion

4.1 Profile of respondents

A total of 181 smallholder farmers participated in the semi-structured interviews, of whom 112 were men and 69 were women. The gendered nature of the social, culture, economic and policy systems may have limited women farmers from participating in the study. The mean age of the respondents was 48, with the majority of respondents (74.6%; 135) between the ages of 29 and

68 years. The average farm size was 4.9 acres, where the majority of the crop farmers (61.9%; 104) had farms smaller than 4.9 acres. Most respondents (84%; 152) had some level of formal schooling and 91.2% (163) could read and understand simple written instructions. Among 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 (that is, 4 college diplomas and 1 university bachelor degree). Most farmers owned some form of ICTs (92.8%; 168). Radio was the predominant form of ICT owned by farmers, with a score of 18.5% (31) in Kilosa, 16.7% (28) in Moshi Rural, 16.7% (28) in Mpwapwa, 16.1% (27) in Songea Rural, 15.5% (26) in Karagwe, and 14.3% (24) in Kasulu (Table 2). The next most owned form of ICT was the cell phone, while television and video cassettes were the least owned ICTs. Farmers in Kasulu and Songea rural did not own television sets due to lack of electricity and high costs. All farmers did not own computer due to high costs, lack of ICT skills, lack of electricity, and poor telecommunication infrastructure.

Table 2: ICT ownership (N=168)

ICTs	Districts													
	Mpwapwa		Karagwe		Kasulu		Moshi Rural		Kilosa		Songea Rural		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Radio	28	16.7	26	15.5	24	14.3	28	16.7	31	18.5	27	16.1	164	97.6
Radio cassettes	5	3.0	5	3.0	-	-	4	2.4	3	1.8	8	4.8	25	14.9
Television	3	1.8	5	3.0	-	-	7	4.2	4	2.4	-	-	19	11.3
Video cassettes	2	1.2	3	1.8	-	-	1	0.6	1	0.6	-	-	7	4.2
Cell phones	13	7.7	7	4.2	5	3.0	18	10.7	19	11.3	14	8.3	76	45.2
Computers	-	-	-	-	-	-	-	-	-	-	-	-	-	-

4.2 Management of agricultural indigenous knowledge

In this section, the research findings are discussed according to the KM processes as identified in various KM models (Nonaka, *et al.,* 2000; McAdam and McCreedy, 1999; Probst, *et al.,* 2000; Rowley, 2001; Small and Tattalias, 2000), which include: knowledge acquisition, sharing, preservation and application.

4.2.1 Acquisition of agricultural indigenous knowledge

The study findings, in line with the KM process that deals with knowledge acquisition as indicated in KM model (Probst, *et al.,* 2000), showed that farmers acquired IK from within and outside their communities. However, the research findings showed that farmers mainly relied on the local sources of knowledge to acquire IK, as compared to external and formal sources of knowledge. IK was mainly acquired through local sources such as family or parents (93.9%; 170) and neighbours or friends (86.2%; 156) in the surveyed rural areas (see Table 3). Personal experience (85%; 154), social group gatherings (36.5%; 66), demonstration and observation (31.5%; 57), and farmer groups (24.3%; 44) were important sources of IK. Farmers made little use of formal sources of knowledge, such as Non Government Organisations (NGO), seminars, agricultural shows, public extension officers, agricultural researchers, and cooperative societies. Similarly, printed materials were less considered by farmers as important sources of agricultural IK. Consequently, Akullo *et al.,* (2007) also reported that local sources were the major sources of agricultural IK as compared to formal sources of knowledge in Uganda. Further, the study

findings were in line with the Boisot's (1987) KM model which references diffusion and codification of knowledge in terms of personal knowledge. The study findings indicated that most farmers depended on their personal knowledge to carry out their farming activities. According to Boisot's (1987) KM model, personal knowledge can neither be codified nor shared to the public in the organisation.

Table 3: Tacit and explicit sources of agricultural indigenous knowledge by district (N=181)

Knowledge sources	Districts													
	Mpwapwa		Karagwe		Kasulu		Moshi Rural		Kilosa		Songea Rural		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Personal experience	22	12.2	25	13.8	17	9.4	28	15.5	33	18.2	29	16.0	154	85.1
Parents/ guardian/family	28	15.5	30	16.6	23	12.7	28	15.5	36	19.9	25	13.8	170	93.9
Neighbour/Friends	24	13.3	28	15.5	25	13.8	28	15.5	28	15.5	23	12.7	156	86.2
Women meetings	-	-	1	0.6	1	0.6	3	1.7	5	2.8	2	1.1	12	6.6
Livestock headers	9	5.0	-	-	3	1.7	2	1.1	8	4.4	-	-	22	12.2
Demonstration and observation	9	5.0	1	0.6	3	1.7	21	11.6	14	7.7	9	5.0	57	31.5
Newsletters	-	-	1	0.6	-	-	9	5.0	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	5.0	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	36.5
Village leaders	1	0.6	6	3.3	2	1.1	4	2.2	9	5.0	-	-	22	12.2
Farmers' groups	-	-	2	1.1	5	2.8	12	6.6	6	3.3	19	10.5	44	24.3
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

(Multiple responses were allowed)

4.2.2 Sharing and distribution of agricultural indigenous knowledge in the local communities

The study findings, in line with the KM process that deals with knowledge sharing as indicated by KM models (Probst *et al.,* 2000; Rowley, 2001), showed that knowledge can be shared by either a centrally directed process of distributing knowledge among a particular group of farmers, or it can be transferred between individuals, or within a group of farmers. The study found that IK was shared in the local communities by using farmer groups and local traditions and cultures,

which were folklore practices, apprenticeships, and initiation rites during adolescent age. A study by Owuor (2007) in Kenya also found that IK was commonly shared and distributed in the communities through events such as folklore, initiation rites, apprenticeships and inheritance of specialized knowledge such as indigenous medicine.

Folklore activities

The findings indicated that folklore activities were important for sharing agricultural IK in the surveyed communities, although they were practiced at a low rate. Almost half of the respondents 43.6% (79 out of 181respondents) replied affirmatively that folklore activities were still practiced in their communities. The study established that songs (87.3%; 69) were the major form of folklore practiced across the districts, followed by dance (70.9%; 56), and storytelling (57%; 45). Other types of folklore activities were less practiced, which include drama (32.9%; 26), puppet shows (15.2%; 12), plays (11.4%; 9), debates (8.9%; 7), and poetry (5.1%; 4). However, there were variations of the folklore activities across the districts. Each of the 24 ethnic groups in the surveyed communities had a store of folklore activities that embodied their culture and tradition. Songs were the major folklore activities practiced in Mpwapwa (31.6%; 25), Moshi Rural (26.6%; 21) and Kilosa (21.5%; 17). Story telling was mainly practiced in Mpwapwa (20.3%; 16) and Kilosa (16.5%; 13). Traditional dances were mainly practiced in Mpwapwa (27.8%; 22), Kilosa (22.8%; 18) and Moshi Rural (13.9%; 11). Other folklore activities such as drama (21.5%; 17) and reciting proverbs (19%; 15) were mainly performed in Mpwapwa. In the present study, folklore activities were less practiced probably due to the ignorance of the present generation about such practices and the availability of information about other cultures through media which have replaced the traditional dances and storytelling.

The present findings showed that folklore activities were practiced for social purposes, which included songs, traditional dances, story telling, and proverbs. Other major purpose for performing various types of folklore were cultural, agricultural, political, and historical. Folklore were practiced at a low rate for tourism, religion, and health puposes. Despite the importance of folklore activities for cultural issues, they were significant for sharing agricultural knowledge in the surveyed communities. For example, a song from chagga ethnic group in Moshi Rural district shows how songs were used to encourage farming in the local communities. "…..Oyahe, wilewile wileleoya, mangi kaghambalewai oya, kaghamba lukape matuta oya, matuta mali gha serekalie oya, oyahe wilewile wilelee oya". Translation: "……Chief has said that lets design terraces for farming purposes. The design of these terraces is an instruction from the government". If strengthened and recognised, folklore could play a major role in managing and integrating IK with other knowledge systems.

Apprenticeships

The present findings showed that indigenous apprenticeships were less practiced in the surveyed communities, accounting for 26% (47 out of 181 respondents). Blacksmith work (70.2%; 33) was the predominant apprenticeship practiced in the communities, followed by wood carving (27.7%; 13), bead making (17%; 8), clay pot making (12.8%; 6), gourd making (6.4%; 3), basket making (4.3%; 2), and tailoring (4.3%; 2). These apprenticeships were location specific. For instance, blacksmith work was practiced in all districts, while beads and gourds making was practiced in Kilosa, basket and clay pot making in Mpwapwa, traditional irrigation system in Moshi Rural, weaving in Mpwapwa, and wood carving in Kilosa, Moshi rural, Mpwapwa and Songea Rural. Most of these apprenticeships focused on instilling agricultural indigenous

techniques and practices in the children and the community at large, such as the fabrication of agricultural tools, storage structures for crops and seeds varieties, traps for controlling pests, and traditional irrigation systems. These findings indicate that apprenticeships are mainly used to share agricultural IK, and thus there is a need to strengthen them for improved farming activities.

Initiation rites during adolescent age

Initiation rites during adolescence were used at a low rate to share agricultural IK, that is 17.7% (32 out of 181 respondents) in the surveyed communities, since their major aim was to prepare young women and men for adolescence and responsible sexual and reproductive behaviour. These initiation rites were mainly used to share IK on animal production (94%; 30), followed by crop production (63%; 20), and markerting of agricultural produce (53%; 17). Despite the fact that initition rites were practiced across all research sites, they were used to share agricultural knowledge only in four districts, namely Kilosa, Mpwapwa, Karagwe and Kasulu. It is obvious, therefore, that if these initiation rites are formally recognised and promoted, they could be a useful way of sharing agricultural knowledge in the communities.

Farmer groups

The present study showed that few farmers 40.9% (74 out of 181 respondents) were involved in the associations that existed in their communities. Most farmers (85.1%; 63) were involved in agriculturally related associations, while 18.9% (14) were involved in non-agriculturally related groups. The majority of the agriculturally related associations (77.8%; 49) were registered, while a minority (27% ; 17) were not. The existence of informal and self-managed farmer groups in the local communities showed that communities of practices already existed in the communities since the groups were voluntary, often nonroutine, and members shared a common interest and language. Communities of practices can also be used to bridge the knowledge divide between farmers and research, and thus, facilitate the fusion of indigenous and exogenous knowledge systems.

Of the 63 (85.1%) respondents who were involved in agriculturally related associations, 40 (63.5%) respondents were involved in agricultural production in the formal farmer groups, and 15 (23.8%) farmers were engaged in agricultural production in the informal groups. Of the 40 (63.5%) respondents who were involved in agricultural production in the formal farmer groups, the majority (65%; 26) were focused on the application of conventional technologies in the farming systems, while few respondents (22.2%; 9) were involved in organic farmer groups which promote the use of local inputs and technologies, and about 12.5% (5) respondents were involved in farmer field schools which focus on prioritizing farmers' needs and knowledge. On the other hand, farmers learnt about IK through informal groups engaged in agricultural production (23.8%; 15), environment (3.2%; 1) and fabrication of agricultural tools (1.6%; 1). IK was shared at a low rate in the farmer groups because most of the farmer groups received extension services from NGOs and extension officers whose aim was to promote conventional farming.

Cultural influence in IK sharing

The study findings, in line with the KM principle that deals with culture as illustrated in KM models (Noeth, 2006; Probst *et al.,* 2000; Rowley, 2001; Small and Tattalias, 2000), showed that cultural differences in various locations enabled or inhibited the sharing and distribution of knowledge in the communities. Further analysis of the study findings indicated that most of the

knowledge was made public (such as, folklore, farmer groups), while some of it was accessed through clan-based structures (such as blacksmithing). The study findings showed that most of the apprenticeships were inherited within families or clans in the surveyed communities, with the exception blacksmithery, which was restricted to certain families or clans in some of the surveyed communities. For example, the Makundi clan specialized in the making of iron tools in Moshi Rural, while the Olokononi in the Maasai community, Kilosa (Twatwatwa Village) was committed to the fabrication of knives and blades for security reasons in the community. A typical response from Twatwatwa Village (Kilosa) was that, "all children are supposed to learn all kinds of apprentices (beads making, gourds, cattle noise pins, sticks for grazing animal) with exception of the iron smith where few people from identified families are allowed to learn". The study also found that other knowledge was accessed through social structures, such as initiation rites during adolescence age. The research findings also showed that some knowledge can be codified and diffused (public knowledge), while other knowledge can be codified but cannot be diffused, namely proprietary knowledge as indicated in Boisot's (1987) KM model. The latter, proprietary knowledge, can be related to the discretionary and restricted knowledge categories as identified in the present study. Thus access to agricultural knowledge was influenced by cultural norms of a specific location in the surveyed communities.

The study found that the traditional culture such as folklore activities, apprenticeships, and initiations rites were not uniformly practiced to share IK in all the surveyed communities due to cultural differences in the surveyed communities. For instance, apprenticeships were practiced in five of the six surveyed districts, while initiations rites were used to share agricultural knowledge in four districts only. There were cultural differences in various locations probably due to the ethnic groups' differences, population pressure and cross-cultural interferences in the surveyed districts.

The present findings also showed that IK was transmitted according to gender due to cultural norms that existed in the surveyed communities. For instance, the study findings showed that apprenticeships were transmitted according to gender in the communities. Young women were allowed to learn about how to build houses, make baskets, clay pots, beads, and milk gourds, while young men of age were allowed to learn about blacksmith work, traditional irrigation systems, wood carving, and repairing cars and bicycles. Similar observations were made by Mudege (2005) who reported that some types of knowledge were gendered with women monopolising the fields of health, pottery and sewing. Consequently, traditional culture defined the extent to which women and men could access and share different forms of knowledge.

4.2.3 Preservation of agricultural indigenous knowledge

The findings demonstrated that IK was mainly preserved in human minds and thus it was vulnerable to gradual disappearance due to memory lapses and death. For instance, one farmer said that, "I memorize knowledge on farming activities, and I practice it everyday and that is why I can not forget it". Another farmer reported that, "knowledge and skills regarding farming activities is preserved in the memories of elders (such as, parents), whom we consult whenever we have a problem". Other respondents reported that IK is preserved in songs, and thus there was no need for them to document it. The study findings showed that few farmers 13.3% (24 out of 181 respondents) acknowledged preserving their agricultural IK. This knowledge was mainly preserved in written formats (87.5%; 21), followed by carvings (16.7%; 4), and still pictures

(7.4%; 2). Similarly, a study by Mearns and du Toit (2008) demonstrated that the extent of IK conservation at cultural villages was rated as fairly poor in South Africa. These findings from the present study and those from the literature call for a need to preserve knowledge by embodying it within people's understanding, practices and awareness, and through the creation of explicit knowledge repositories as highlighted by Rowley's (2001) KM model.

4.2.4 Utilization of indigenous knowledge and technologies in the farming systems

The research findings, in line with the KM process that deals with knowledge utilization as identified by KM models (McAdam and McCreedy, 1999; 2000; Probst *et al.,* 2000; Rowley, 2001; Small and Tattalias, 2000), showed that the present knowledge was applied productively for the benefit of their community. The study found that most farmers 157 (86.7%) applied IK, which was obtained from tacit and explicit sources of knowledge, in their farming systems. Further, the study indicated that farmers applied indigenous techniques for crop husbandry (63.1%; 99), farming techniques and crop/ animal varieties from outside their communities (25.5%; 40) and animal husbandry (24.2%; 38). Other indigenous techniques and practices that were adopted by farmers included: control of animal diseases 29 (18.5%), value added[1] techniques 24 (15.3%), and soil fertility 19 (12.1%), while indigenous techniques on control of plant diseases 11 (7%), agricultural tools 9 (5.7%), and environmental conservation 3 (1.9%) were less applied on farming activities in the surveyed communities. Farmers used traditional techniques probably because they were effective, affordable, available and easy to follow rather than conventional methods. On the whole, the findings showed that farmers relied on their IK to improve their agricultural practices in the surveyed rural societies. Despite the importance of IK for farming activities, it is also important to integrate the existing knowledge with conventional knowledge in the local communities. This fact necessitates a need to determine a KM model that will manage and integrate these knowledge systems for improved farming activities since the existing western based KM models focus only in the organizational environment as explained in section 2. Further, the existing KM models do not recognize that both indigenous and exogenous knowledge are created, shared, stored and utilized in different contexts.

4.3 The need to integrate agricultural exogenous and indigenous knowledge in the local community

Despite the fact that local people created and shared their knowledge to improve their farming activities, the study findings showed that most farmers (62.4%; 113) acknowledged that agricultural IK was not sufficient to solve some of their farming problems. A typical response was that, "IK is not sufficient to improve our animal productivity. For instance, I only get five litres of milk per day from ten cattle, which is very little to sustain my family". The present findings corroborate the results of Akullo *et al.,* (2007) who reported that farmers' knowledge may not be sufficient, and may not be effective in solving all farming problems in Uganda. However, these findings from the present study and the literature should not be interpreted as indicating that exogenous knowledge is better than local innovation, but that it needs to be put into the local context to increase understanding and strengthen IKS. Further, the study findings showed that most farmers 150 (82.9%) were willing to share their knowledge with the development agencies which shows that farmers are eager to strengthen their knowledge system by integrating it with exogenous knowledge to improve their farming activities. Thus, the need to determine a KM model that will manage and integrate indigenous and exogenous knowledge is

1 Information and knowledge on crop processing, storage and packaging

necessary for sustainable agricultural practices in the surveyed communities, and other rural areas with similar conditions.

4.4 Access and use of agricultural exogenous knowledge in the local communities

The study findings, in line with the KM process that deals with knowledge acquisition as indicated in KM models (Probst *et al.,* 2000; Rowley, 2001), showed that farmers acquired exogenous knowledge from within or outside their communities to improve their farming activities. The study findings indicated that farmers mainly relied on informal and face to face contacts with friends/neighbours (72.9%; 132) and parents/family (56.9%; 103) to access agricultural exogenous knowledge. Typical response was that, "I rely on my neighbors to access agricultural knowledge, as well as by observing and copying what others are doing in our village, because the public extension officers are always not available in our communities". Similarly, other studies in Kenya (Rees *et al.,* 2000), and Tanzania (Matovelo *et al.* 2006) showed that local sources of knowledge such as friends, neighbours, and family were also the primary sources of agricultural exogenous knowledge. In this study, the extension officers (71.8%; 130) were an important source of exogenous knowledge, though farmers were dissatisfied with the frequency of their interactions, as it was also found in Kenya (Rees *et al.,* 2000). Further, the study found that agricultural input suppliers (43.6%; 79), cooperative societies (42%; 76), village meetings (34.8%; 63), farmer groups (26.5%; 58), and NGOs (26.5%; 48) were important sources of exogenous knowledge. Apart from books (25.4%; 46), other printed materials were considered by farmers as being less important sources of knowledge, including newspapers (14.9%; 27), newsletters (14.4%; 26), leaflets (13.8%; 25), posters (13.3%; 24), and training modules (1.7%; 3). These findings show that the nature of knowledge required by rural communities is based on the oral tradition more than on the written word.

Concerning the use of exogenous knowledge, the study findings established that nearly two thirds of the respondents (77.9%; 141) used exogenous knowledge received from tacit and explicit sources of knowledge in the farming systems. It was evident from the present findings that farmers mainly applied exogenous knowledge on crop husbandry (61.7%; 87), and new crop/ animal varieties and farming techniques (35.5%; 50) as shown in Figure 1. Farmers applied exogenous knowledge probably due to improved production, effectiveness of the techniques, simplified field operations, and increased income. Apart from IK, the study findings showed that exogenous knowledge is also important in improving farming activities in the surveyed communities. Hence, it is important to determine a model that will enable the management and integration of indigenous and exogenous knowledge because the existing western based KM models target only the organizational environment as explained in section 2.

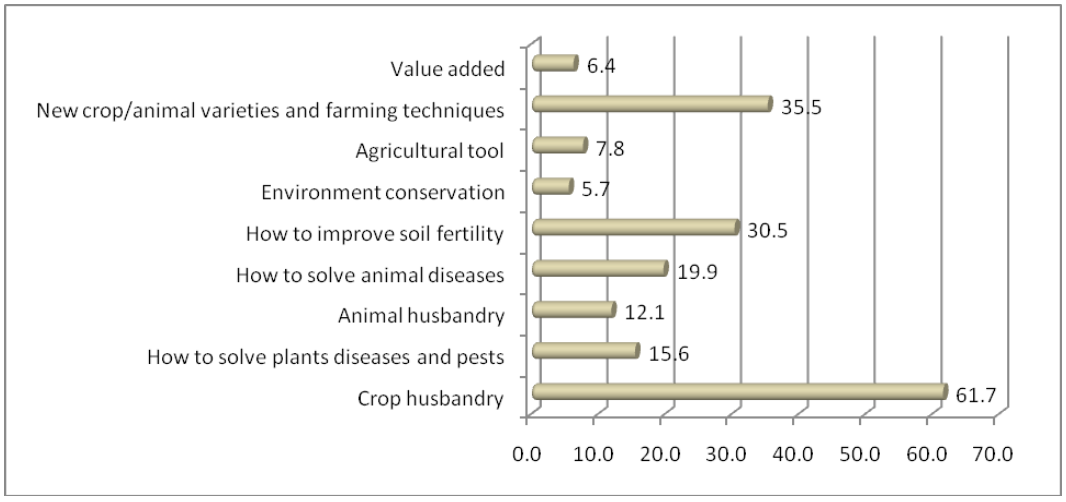

Figure 1: The application of exogenous knowledge and technologies in farming systems (N=141)

4.5 Relevance of policies and intellectual property rights in IK management

Various KM models have emphasized that effective KM activities need to embrace policies, culture, legal framework, and ICTs, to create a conducive environment for individuals to share and utilize their tacit knowledge and expertise to increase organisational performance (Davenport, 1998; Nonaka *et al,* 2000; Probst *et al,* 2000:33; Small and Tattalias, 2000). This section mainly focuses on policies and legal framework principles as they influence KM activities in the communities, while ICTs are discussed in section 5.6. Therefore, the findings in this section are discussed according to the need for establishing IK policy, and the current state of IK policy and IPR in protecting agricultural IK in the country.

With regard to IK policy, the present study findings support Kaiza-Boshe's (2003) observation that IK does not receive adequate treatment in the entire policy framework in Tanzania. The study found that all IK policy makers reported that IK was covered by various sectoral policies, though the said policies inadequately addressed IK issues. These sectoral policies included the National Strategy for Growth and Reduction Poverty (NSGRP), agriculture and livestock policy of 1997, forest policy of 1998, cultural policy of 1997, environmental policy of 1997, fisheries policy of 1997, ICT policy of 2003, and wildlife policy of 1998. Most of these sectoral policies were not well coordinated and they were not backed by implementation instruments, such as strategies and laws. Further, even when those laws were there, they inadequately protected access to IK and genetic resources in Tanzania. Typical response was that, "the environment law emphasizes the importance of Tanzanians to have land rights, and rights over their natural resources in order to conserve environment and heritage. However, it inadequately protects access and benefit sharing of genetic resources in the country". Thus, IK had not received adequate attention in the entire policy framework due to lack of coordination between policies and IPR in the country.

That is why most farmers agreed that it was important to establish a policy that would deal with IK issues within the country, with a score of 28.7% (52) and 24.9% (45) respondents in the very important and important categories. Other respondents indicated that it was probably important (21%; 38) to have IK policy, while 4.4% (8) respondents considered that it was less important to

have such a policy. It is thus significant to establish an IK policy, so that farmers' KM practices can be based on predetermined principles and strategies for effective KM activities in the country.

The study found that there were some initiatives on the ground to steer the establishment of an IK policy. The interview findings with IK policy makers showed that these initiatives included the newly established committee under the Ministry of Trade, Industries and Marketing, and the IK trust fund. However, these initiatives had not managed to come up with a significant IK policy document for institutionalization in the country due to lack of a political will, awareness, funds and poor coordination among the public and private actors that deal with IK issues. It is apparent that public and private partnership efforts are needed to foster the development of an IK policy in the country for the effective management and protection of IK.

In the present study, all IK policy makers acknowledged that IPRs were not effective to protect agricultural IK such as genetic resources and expressions of traditional culture. IPRs were weak in protecting IK due to many reasons, such as poor recognition of IK in the current IPR such as plant breeders' rights (PBR), and the patents act. In this study, the condition of novelty (must be new) required by the patents law was also difficult for farmers to meet, which contributed to the failure of IPRs to protect IK. That is why, one respondent suggested that, "farmers should raise their concerns and challenge the government, since the existing IPRs do not protect their knowledge and resources especially the plant variety act". IPRs were also weak in protecting IK due to the contradictions between IPR instruments. For instance, the patents act prohibited the registration of plant varieties under section seven, while the plant breeders' rights recognised the registration of plant varieties. Similar to Kabudi's (2004) observation, the study findings showed that the copyright and neighbouring act recognised only cultural expressions and folklore, instead of all IK issues. IPR were also weak in protecting IK due to the following: lack of funds; the registration and evaluation process of plant varieties was time demanding; international IPRs do not protect IK; no correspondence between the national and global IPR instruments; lack of a political will to formulate IK policy within the country; lack of awareness on IK and IPR issues; collective ownership of IK in the communities; and unwillingness of communities to share their knowledge due to secrecy and theft. One respondent reported that, "some local people such as traditional healers do not like to disclose their knowledge. They are scared of losing their market since other people would easily enter into their business". The findings suggest the need for the government to review the current IPR in order to protect IK, which will enhance KM practices and agricultural production in the rural societies.

In the absence of effective IPRs, the study findings from IK policy makers showed that other people (both local and international) had misappropriated IK under the auspices of intellectual property. These bio-prospectors had either commercialized or published some of the IK without any attribution, reciprocity, or benefit sharing with the local communities. For instance, one respondent reported that, "in 2007, the plant *usambara* was patented in UK as a garden plant due to the weak plant breeders' rights in Tanzania. *Usambara* is a well known plant in Tanzania which is used for healing purposes. However, nothing has been done by the government to claim the ownership of that particular plant". A traditional song owned by the Haya tribe in Karagwe, called *Indega inaondoka* (meaning, the aircraft is taking off) was also abused by the Inafrica Band in Tanzania. These findings were similar to a research on 762 randomly chosen patents

issued in the United States, where 49% of these were based on IK (United Nations University Institute of Advanced Studies, 2003). It is thus important to improve the existing IPRs in order to protect IK from being misappropriated. Further, the study findings showed that there were ongoing processes to review the industrial property rights which may incorporate IK issues, and to draft a bill for controlling the access to and benefit sharing of genetic resources in Tanzania. However, this bill will not directly protect IK, instead it will help to protect genetic resources.

4.6 Application of ICTs in managing agricultural indigenous knowledge, and providing access to exogenous knowledge in the local communities

In agreement with various KM models (Davenport, 1998; Kruger and Snyman, 2005; McAdam and McCreedy, 2000; Nonaka and Takeuchi, 1995; Probst et al., 2000; Rowley, 2001; Small and Tattalias, 2000), the study findings showed that ICTs are significant tools for KM since they allow the movement of knowledge at higher speeds and efficiencies, and thus facilitate the sharing as well as the accelerated growth of knowledge. In this section, the study findings are discussed in relation to the role of ICT in acquiring, sharing, and preserving agricultural IK, and the use of ICTs in providing access to exogenous knowledge in the local communities.

Farmers relied more on person-to-person communication than on ICTs for acquiring IK, although ICTs were already available in the surveyed villages. The study findings showed that almost half of the respondents (45.3%; 82) had used various forms of ICTs to acquire agricultural IK. This finding is probably due to poor ICT infrastructure, lack of electricity, language barrier, financial constraints limiting the purchase ICTs, and lack of awareness, culture and skills on how to use advanced ICTs such as the internet, and cell phones. The study found that farmers mainly used radio (89%; 73) to acquire IK in the surveyed communities. Other major ICTs were cell phones (47.6%; 39) and television (36.6%; 30). Audio cassettes (8.5%; 7), email (7.3%; 6), internet (6.1%; 5), video cassettes (3.7%; 3) and film shows (3.7%; 3) were less used to acquire IK in the communities. It is clear that radio and cell phones had a high use, while email and internet were used at a low rate to acquire agricultural IK, in spite of the availability of telecenters in the surveyed communities. Nevertheless, a study by Ha *et al.,* (2008) in Nigeria established that telecentres could help to make knowledge flow from the local communities outward (indigenous practices) and from the global community inward (exogenous practices). It is thus important to create relevant knowledge and information services at the telecentres, and to promote the use of telecentres, in order to improve the management of IK in the local communities.

ICTs were less used to share agricultural IK in the communities, in spite of their availability in the surveyed communities. The study findings showed that few farmers (18.8%; 34) had used ICTs to share IK. Most farmers (94.1%; 32) had used cell phones to share IK, while email (14.7%; 5) and radio (5.9%; 2) were less used to share IK. Further, there was little use of ICTs to preserve agricultural IK in the sample under investigation. Only 1.1% (2 of the 181 respondents) acknowledged using ICTs to preserve their IK. Local farmers had limited access to personal telephones, faxes, computers and other modern means of communication. However, Lwoga and Ngulube (2008) demonstrated that IK can be preserved and shared by farmers through telecentres and online databases in Tanzania. It is thus possible for farmers in the surveyed communities to document and share their knowledge if they are guided and empowered.

Regarding access to exogenous knowledge, the study findings showed that there was a higher use of ICTs to access agricultural exogenous knowledge (89%; 161) than IK (45.3%; 82) in the surveyed local communities. These findings indicate the predominance of the exogenous knowledge system over IK in the surveyed communities, as suggested in the literature (Ngulube 2002). In this study, most farmers (96.3%; 155) used radio to access exogenous knowledge on farming systems. Other major ICTs were cell phones (44.1%; 71) and television (39.8%; 64), while email (7.5%; 12) and internet (5.6%; 9) had low use. Another study by Ha *et al.,* (2008) in Nigeria reported similar findings that few farmers had used the internet and email services for knowledge acquisition. In this study, few farmers also used film shows (5%; 8), and video cassettes (3.7%; 6) to access exogenous knowledge in the surveyed communities. Thus, any initiative that seeks to invest in the rural KM should focus on the use of the radio and cell phones rather than the new ICTs (such as internet and email) to provide adequate access to knowledge in the local communities. It is thus important to determine a KM model that will enhance the use of appropriate ICTs for the management and integration of indigenous and exogenous knowledge for improved farming activities in developing countries.

5. Conclusion

The study findings showed that the western based KM models should be applied cautiously in a developing world context. These models were developed in the context of organizational environment, and thus they fail to address the needs of rural communities, where both indigenous and exogenous knowledge are acquired and shared in different manners. The study found that IK was acquired and shared within a local, small, weak and spontaneous network, and thus knowledge loss was prevalent. On the other hand, exogenous knowledge was shared in a wide context, where formal sources of knowledge (that is, Extension officers and other agricultural actors) focused on disseminating exogenous knowledge as compared to IK in the communities. Nevertheless, most farmers were willing to share their knowledge with the development experts in order to strengthen their knowledge system, since their knowledge was not sufficient to solve some of their farming problems. There is thus a need to determine a KM model that will manage and integrate indigenous and exogenous knowledge systems to improve farming activities in the local communities' context. In addition, various principles determined access to knowledge in the communities, including policies, legal framework, ICTs, and culture of a certain locality. The findings showed that the lack of an IK policy and the existence of IPRs that inadequately recognised and protected IK, limited acquisition, sharing, preservation and use of IK in the surveyed communities. With regard to ICTs, the study findings showed that farmers relied more on face to face communication mechanisms than on ICTs in the surveyed communities. Only radio and cell phones were used as important sources of knowledge in the surveyed communities, while internet and email had low use. Overall, the study findings showed that both indigenous and exogenous knowledge are important for sustainable agricultural development. It is the conclusion of this study that KM approaches that are developed in the context of developing world should be used to manage indigenous and exogenous knowledge for effective agricultural production. Based on the study findings and a review of western based KM models, the study developed a KM model that would be applicable in the local communities' context of developing countries.

6. A proposed KM model for rural communities in developing countries

Based on the findings, this study proposes a KM model for rural communities, which indicates that the potential of knowledge for agricultural development should be conceptualised within the framework of the targeted community (Figure 2). Since most of the farmer's knowledge is tacit, and it is embedded in oral culture, the focus should be on farmers (at the center of the model) rather than on ICTs. The study showed that farmers mainly acquired, shared and preserved indigenous and exogenous knowledge through face-to-face communication, both in individual and collective interactions in the local communities. On the other hand, knowledge intermediaries (at the center of the model) interact with farmers in an effort to understand and incorporate farmers' knowledge into the mainstream knowledge system, while farmers (at the center of the model) interact with knowledge intermediaries in an attempt to understand and learn new capabilities to improve their farming activities. Thus, knowledge integration becomes possible. The knowledge intermediaries (that is, public and private extension services, researchers, telecentres, input suppliers, librarians, and other agricultural actors) should therefore play a key role in facilitating knowledge creation activities in the local communities.

Based on the findings and a review of KM approaches, this model (at the bottom of the model) presents KM processes in a sequence of a cycle where each stage in the model can embrace either indigenous or exogenous knowledge which may result into a blend of indigenous and exogenous knowledge. Further, each stage of the cycle embraces both tacit and explicit knowledge. There is also a recognition that the KM processes move back and forth between different phases. These KM processes include: knowledge identification, knowledge acquisition, knowledge development, knowledge sharing and distribution, knowledge preservation, knowledge application, and knowledge validation. Further, the KM model for rural communities (Figure 2) emphasizes that the principles (at the top of the model) should first be determined in order to influence or enable KM and knowledge integration processes in the local communities. Figure 2 (at the top of the model) indicates that knowledge may be managed and integrated if there are policies that recognise IK and emphasize the management and integration of indigenous and exogenous knowledge, committed leadership for KM activities, knowledge culture, appropriate ICTs, IPR laws to protect the existing knowledge, favourable context and space, and mapping to locate knowledge bearers and knowledge resources. However, the absence of ICTs should not constitute a barrier for KM and knowledge integration processes, since the study findings showed that communities are more likely to understand, acquire and use knowledge that is shared through indigenous communication channels which are oral in nature than in other approaches such as ICTs.

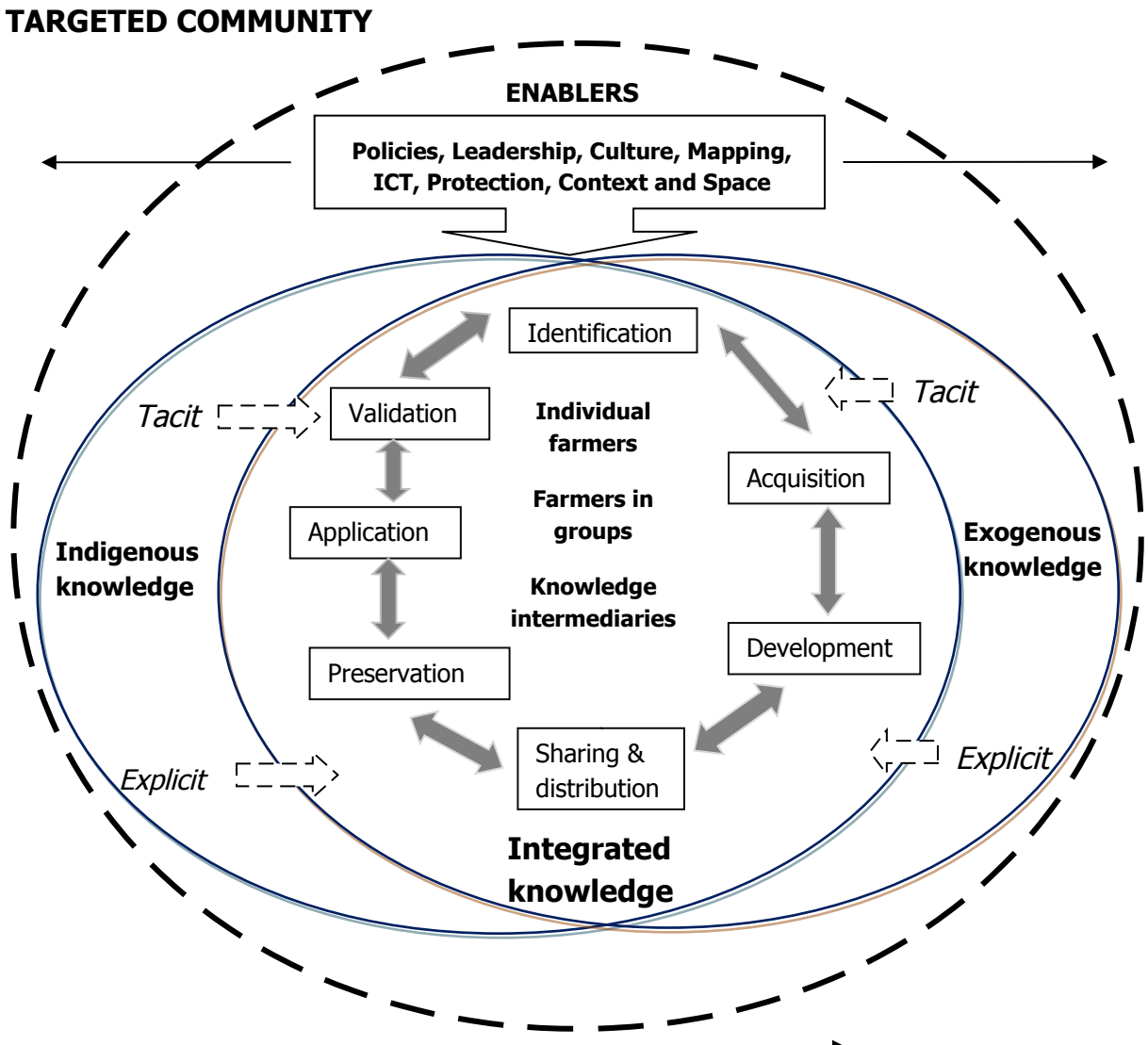

Figure 2: The knowledge management model for rural communities

This model expands on what Hess (2006) suggested that indigenous and exogenous knowledge may be integrated, if local farmers and knowledge intermediaries spend more time together, share knowledge in an open and respectful way and omit judging the others' knowledge as true or false. Thus, the absence of enablers may affect KM processes and the integration of indigenous and exogenous knowledge in the local communities. This means that the larger the intersection, the easier the communities are able to identify, acquire, develop, share, preserve, apply and validate new knowledge amongst themselves, and together with agricultural knowledge intermediaries. While, the smaller the intersection, the more difficult it is for the communities to identify, acquire, develop, share, preserve, apply and validate new knowledge amongst themselves and together with agricultural knowledge intermediaries. Overall, all these KM practices build a learning community which is skilled at identifying, acquiring, generating, preserving and sharing knowledge as well as adapting its actions to reflect new insight and innovation. This entails that KM practices may improve agricultural productivity since the existing knowledge would be managed and new skills and innovation would be created to

develop a learning community in the process. The communities would also be able to create their knowledge from within and outside their environment, and thus the integration of indigenous and exogenous knowledge systems would be possible.

7. Limitations of the research and suggestions for further research

The proposed KM model in this study is expected to provide a way of understanding the management and integration of indigenous and exogenous knowledge in the local communities of developing countries. However, the proposed model has not been empirically tested. A way forward would be to conduct a research study through qualitative or quantitative approaches. The proposed KM model should be tested against other existing KM models, in a specific context such as local communities of developing world, to determine if it better at explaining the link between KM principles and KM processes. Consequently, the linkages between KM processes (that is, identification, acquisition, development, sharing, preservation, application and validation), ICTs and other KM enablers such as culture, leadership, context and space, ownership, and policies need to be investigated to enhance the suggested model to be more robust than as the present case. Furthermore, the suggested model was only established to explain the management and integration of agricultural indigenous and exogenous knowledge in the rural communities. Building on this model, further research may be conducted to assess the application of this KM model in other sectors, especially the health sector since most of the developing world's population depends upon it. The model proposed in this study is expected to stimulate discussions and further theoretical and empirical studies, with the aim of constructing a comprehensive and universal model of KM for rural communities in developing countries.

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