Access and use of agricultural information and knowledge in Tanzania

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Abstract
Purpose - The purpose of this study is to assess access to and use of agricultural knowledge and information in the rural areas of Tanzania.
Design/methodology/approach – Mixed quantitative, qualitative and participatory methods were deployed. Semi-structured interviews were used to collect qualitative and quantitative data from 181 farmers in six districts of Tanzania. Focus groups and participatory techniques (i.e. information mapping and linkage diagrams) were also used to collect qualitative data from 128 farmers in the same districts.
Findings – The results showed that deep, rich and complete data can be collected through the mixed quantitative, qualitative and participatory techniques. The findings demonstrated that the knowledge and information needs, and information seeking patterns of farmers were location specific. The major sources of information for farmers were predominantly local (neighbours, friends and family), followed by public extension services. Apart from radio and cell phones, advanced technologies (i.e. internet and email) and printed materials were used at a low rate despite their existence in the communities.
Research limitations/implications - The study necessitates a need to conduct regular studies on information needs, map communities' knowledge and information sources, create awareness of information sources, and knowledge culture, use participatory methods in design and development of technologies, and use multiple sources of knowledge and information (such as print and technologies) to deliver relevant information to farmers.
Originality/value – Provides a deep understanding of access to and use of agricultural knowledge and information in the rural areas, which necessitates a need for demand led and client based knowledge and information services in order to meet the disparate farmers' needs. These findings can serve as an example for the increasing use of mixed quantitative, qualitative and participatory methods in information behavior research.

Keywords: knowledge, information, agricultural knowledge and information, agricultural development, rural areas, Tanzania

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1. Introduction
An improved information and knowledge flow to, from, and within the agricultural sector are a key component in improving small-scale agricultural production and linking increased production to remunerative markets, thus leading to improved rural livelihoods, improving quality and yield, food security and national economies (Asaba *et al.,* 2006). 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 percent of gross domestic product

(GDP), provides 30.9 percent of exports, and employs 70 percent of the work force (United Republic of Tanzania, 2009). Various studies have revealed that there is a positive relationship between the increased flow of knowledge and information and agricultural development (Fawole, 2008).

However, most African countries have not devoted their efforts to the dissemination of knowledge and information, especially in rural areas, where 70 to 80 percent of the African population lives (Adomi *et al.*, 2003). Only a small amount of agricultural information is accessible to rural farmers, despite the large body of knowledge that exists in research institutions, universities, public offices and libraries. This situation is largely attributed to the weak linkages between research, extension, not for profit organizations, libraries and farmers and thus these technologies have neither reached nor been adopted by their intended beneficiaries to improve their farming activities in developing countries including Tanzania (Tire, 2006). Thus, it was imperative to assess the accessibility of the agricultural information and knowledge in the rural areas of Tanzanian.

The advancements in the information and communication technologies (ICTs) provide an opportunity for developing countries to harness and utilize information and knowledge to improve productivity in various sectors including agriculture (Lwoga, 2010). Unfortunately, resource poor farmers are mainly affected by the digital divide which is a gap between groups or individuals in their ability to use ICTs effectively due to differing literacy, technical skills, and useful digital content (Ghatak, 2007). Nevertheless, the emergence of low cost ICTs (such as radio, cell phones, and the media provided by the telecenters) may bridge the digital divide (Lwoga and Ngulube, 2008). Given the fact that there are disparities to the accessibility and utility of the ICTs especially in the developing countries, it is also important to investigate the application of these tools for the improved farming activities especially in the rural areas. Thus, the assessment of the information needs, the role of ICTs, and the access and use of knowledge and information in the rural areas were pertinent issues to this study. Thus, the objectives of the study included the following:

- To establish the agricultural information needs of farmers in the study area;
- To find out how farmers accessed the agricultural information and knowledge in the local communities;
- To assess how farmers used the agricultural information and knowledge in the local communities.

2. Methodology

This study used qualitative and quantitative methods. Six districts from six zones out of seven agricultural research zones were selected for the study. These districts were selected due to their high agriculture production and presence of ICTs such as telecenters, community radio, and cellular phone networks. These districts were Karagwe, Kasulu, Kilosa, Moshi Rural, Mpwapwa and Songea Rural. The qualitative data was collected through the semi-structured interview items, focus groups, and participatory rural appraisal (information mapping and linkage diagrams), while quantitative data was gathered through closed questions which were embedded in the same semi-structured interviews. Two villages were purposively selected from each of the six districts. A total of 181 smallholder farmers participated in the semi-structured interviews, and the respondents ranged between 27 and 37 farmers per region. A total of twelve focus group sessions were held in the surveyed villages, and one focus group session was held per village. One hundred and twenty eight respondents participated in the focus groups discussions, where the study participants ranged between six and twelve

respondents per session. The focus group discussion and interview data were studied and analyzed as they were collected, until it was clear that perspectives were being repeated and data saturation had been reached (Teddlie and Tashakkori, 2009). Both quantitative (descriptive and inferential numeric analysis) and qualitative approaches (description and thematic text and image analysis) of data analysis were used. Some of the qualitative themes were also transformed into counts in order to validate and compare quantitative and qualitative findings. SPSS and NVIVO software were used to analyze quantitative and qualitative data respectively.

3. Research findings and discussions

Profile of respondents

In the semi-structured interviews, 181 smallholder farmers (112 male, 69 female) participated. The mean age of the respondents was 48, where the majority of the respondents (74.6%; 135) were between 29 to 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 in extent. Most respondents (84%; 152) had some level of formal schooling and about (91.2%; 163) could read and understand simple instructions. Among those with formal schooling, male respondents dominated the higher education category as compared to female farmers. Male respondents accounted for 62.5% (75) 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)

For the focus groups, 128 smallholder farmers (65 men, 63 women) participated in the group discussions. Twelve focus groups were held in 12 villages. The mean age of the respondents was 45, where almost half of the respondents (48.4%; 62) were between 29 to 48 years. Most respondents (89.1%; 114) had some level of formal schooling and 190.7% (116) could read and understand simple instructions. Among those respondents (89.1%; 114) with formal schooling, 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.

Farmers information and knowledge needs

The study findings showed that there was a large information and knowledge gap in the surveyed communities. The major information and knowledge gaps identified in this study related to control of plant diseases and pests (66.3%; 120), marketing (59.1%; 107), credit and loan facilities (58.6%; 106), and control of animal diseases (54.7%; 99) (see Table 1). Further, the findings indicated that knowledge and information needs varied across the surveyed communities (see Table 1). For instance, control of plant diseases and pests was a major knowledge need for farmers in Kasulu (13.3%; 24), Karagwe (13.3%; 24), and Moshi Rural (12.2%; 22). Agricultural marketing was the main knowledge need for farmers in Kilosa (17.7%; 32), and Karagwe (14.9%; 27). Knowledge on credit facilities and control of animal diseases was a great concern for farmers in Kilosa (18.8%; 34). Soil classification (9.9%; 18) was a main knowledge need for Songea Rural's farmers. The knowledge and information needs were location specific due to slight variations in development, agricultural activities and agro-ecological conditions in the surveyed communities. These findings were similar to other studies on agricultural information needs in Kenya and South Africa (Wafula-Kwake and Ocholla, 2007), and Tanzania (Matovelo *et al.*, 2006).

Table 1: Farmers' information and knowledge needs (N=181)

Information and knowledge needs	Districts													
	Mpwapwa		Karagwe		Kasulu		Moshi Rural		Kilosa		Songea Rural		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Soil classification	8	4.4	6	3.3	9	5	11	6.1	20	11	18	9.9	72	39.8
Crop varieties	11	6.1	11	6.1	18	9.9	17	9.4	22	12.2	8	4.4	87	48.1
Crop husbandry	6	3.3	8	4.4	8	4.4	13	7.2	20	11	3	1.7	58	32
Irrigation	4	2.2	3	1.7	13	7.2	12	6.6	19	10.5	2	1.1	53	29.3
Agricultural tools	16	8.8	22	12.2	14	7.7	11	6.1	21	11.6	5	2.8	89	49.2
Animal feeding	2	1.1	8	4.4	8	4.4	19	10.5	31	17.1	2	1.1	70	38.7
Animal breeding	4	2.2	3	1.7	8	4.4	13	7.2	31	17.1	2	1.1	61	33.7
Credit facilities	10	5.5	17	9.4	16	8.8	15	8.3	34	18.8	14	7.7	106	58.6
Land preparation	6	3.3	3	1.7	11	6.1	13	7.2	20	11	1	0.6	54	29.8
Soil fertilization	7	3.9	14	7.7	20	11	12	6.6	21	11.6	13	7.2	87	48.1
Value added	10	5.5	4	2.2	10	5.5	12	6.6	22	12.2	7	3.9	65	35.9
Marketing	7	3.9	27	14.9	11	6.1	15	8.3	32	17.7	15	8.3	107	59.1
Animal housing	2	1.1	5	2.8	8	4.4	13	7.2	27	14.9	2	1.1	57	31.5
Animal diseases	11	6.1	16	8.8	19	10.5	16	8.8	34	18.8	3	1.7	99	54.7
Plant diseases and pests	21	11.6	24	13.3	24	13.3	22	12.2	17	9.4	12	6.6	120	66.3

(Multiple responses were allowed)

The study findings showed that there were slight variations in information needs according to gender. Males needed knowledge on agricultural marketing (62.5%; 70), and soil fertility (50.9%; 57), while women needed knowledge on value added techniques (42%; 29), crop planting (36.2%; 25), and irrigation (33.3%; 23) (see Figure 1). Although the study findings showed that there were slight variations in the information needs according to gender, other studies carried out in Nigeria (Adomi *et al.*, 2003) reported that there was a definite gender split in the information needs.

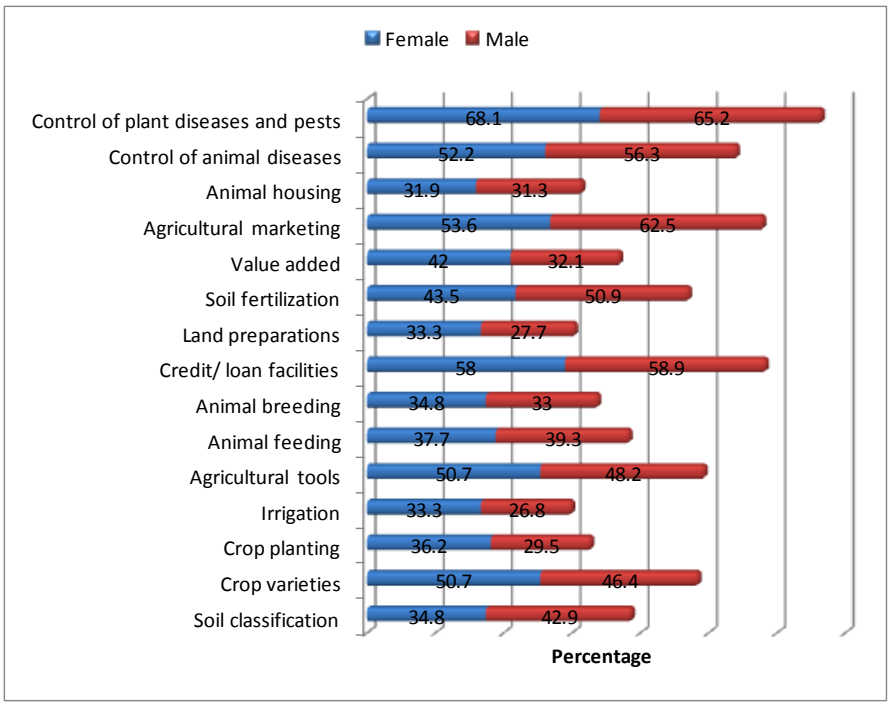

Figure 1: Farmers' information and knowledge needs by gender (N=181)

Access to agricultural information and knowledge through face to face communication and print materials in the surveyed communities

The study findings showed that neighbours/friends (72.9%; 132) were the main sources of agricultural information and knowledge in the local communities, followed by public extension officers (71.8%; 130) and parents/family (56.9%; 103) (see Table 2). Similar findings were observed in Nigeria (Adomi *et al.*, 2003), and Tanzania (Matovelo *et al.*, 2006).

In this study, the extension officers were important sources of information and knowledge, though farmers were dissatisfied with the frequency of their interactions, as it was also found in Nigeria (Adomi *et al.*, 2003), and Vietnam (Castella *et al.*, 2006). Agricultural input suppliers, village meetings, and farmer groups were important sources of agricultural information and knowledge in some regions. Print materials, with the exception of books, had low use due to their unavailability and the absence of the reading habit. This finding is consistent with the research findings observed in Nigeria (Adomi *et al.*, 2003) and South Africa (Mosia and Ngulube, 2005). Thus, there are still gaps in access to information and knowledge which need to be strengthened.

Table 2: Tacit and explicit sources of agricultural information and knowledge by districts (N=181)

Sources of information and knowledge	Districts													
	Mpwapwa		Karagwe		Kasulu		Moshi Rural		Kilosa		Songea Rural		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Parent/Children/family	14	7.7	27	14.9	8	4.4	16	8.8	24	13.3	14	7.7	103	56.9
Extension officers	27	14.9	12	6.6	17	9.4	26	14.4	20	11.0	28	15.5	130	71.8
Agricultural shows	7	3.9	3	1.7	2	1.1	7	3.9	5	2.8	4	2.2	28	15.5
Agricultural researchers	7	3.9	1	0.6	3	1.7	9	5.0	5	2.8	3	1.7	28	15.5
Cooperative unions	3	1.7	17	9.4	21	11.6	16	8.8	-	-	19	10.5	76	42.0
Individual traders	1	0.6	-	-	1	0.6	2	1.1	6	3.3	2	1.1	12	6.6
Religious leaders	4	2.2	4	2.2	1	0.6	16	8.8	3	1.7	-	-	28	15.5
Neighbours/ friends	12	6.6	27	14.9	23	12.7	28	15.5	25	13.8	17	9.4	132	72.9
Village meetings	13	7.2	7	3.9	2	1.1	15	8.3	11	6.1	15	8.3	63	34.8
Farmer groups	6	3.3	3	1.7	8	4.4	11	6.1	8	4.4	22	12.2	58	32.0
NGOs	3	1.7	6	3.3	7	3.9	9	5.0	6	3.3	17	9.4	48	26.5
Input suppliers	1	0.6	-	-	21	11.6	23	12.7	17	9.4	17	9.4	79	43.6
Schools	1	0.6	9	5.0	2	1.1	3	1.7	2	1.1	1	0.6	18	9.9
Observation					1	0.6	20	11	1	0.6	6	3.3	28	15.5
Village leaders	1	0.6	-	-	-	-	6	3.3	1	0.6	-	-	8	4.4
Social gatherings	1	0.6	-	-	-	-	14	7.7	-	-	3	1.7	18	9.9
Government agency	-	-	-	-	-	-	1	0.6	-	-	-	-	1	0.6
Seminars	3	1.7	5	2.8			2	1.1	-	-	8	4.4	18	9.9
Books	7	3.9	14	7.7	7	3.9	4	2.2	8	4.4	6	3.3	46	25.4
Posters	5	2.8	3	1.7	2	1.1	4	2.2	4	2.2	6	3.3	24	13.3
Training modules	1	0.6	1	0.6	-	-	-	-	-	-	1	0.6	3	1.7
Leaflets	7	3.9	3	1.7	1	0.6	4	2.2	7	3.9	3	1.7	25	13.8
Newspapers	8	4.4	9	5.0	2	1.1	2	1.1	3	1.7	3	1.7	27	14.9
Newsletters	5	2.8	6	3.3	2	1.1	11	6.1	-	-	2	1.1	26	14.4

(Multiple responses were possible)

Further, the tacit and explicit sources of knowledge varied across the districts (see Table 2). For instance, public extension officers were main sources of agricultural information and knowledge in Songea Rural (15.5%;28), Mpwapwa (14.9%;27) and Moshi Rural (14.4%; 26). Cooperative union were important sources of knowledge in Kasulu (11.6%; 21), Songea Rural (10.5%; 19) and Moshi Rural (8.8%; 16). Agricultural input suppliers were important sources of knowledge in Moshi Rural (12.7%;23) and Kasulu (11.6%; 21), while farmer groups and NGOs were significant in Songea Rural and Moshi Rural. This finding was found to be similar to cases in in another study in India (Conroy *et al.*, 2004). The findings suggest the need to have flexible rural information provision strategies which can take account of such variations.

It was clear from the information mapping and linkage diagrams that local and informal contacts of parent/family, personal experience and neighbours / friends were the dominant sources of knowledge in the local communities, followed by public extension officers (Figure 2). Village leaders, livestock headers, agricultural shops, NGOs, cooperative unions, farmer groups, religious bodies, and middle men were important sources of knowledge in some local communities. Explicit sources of knowledge were less considered as important sources of knowledge in the communities.

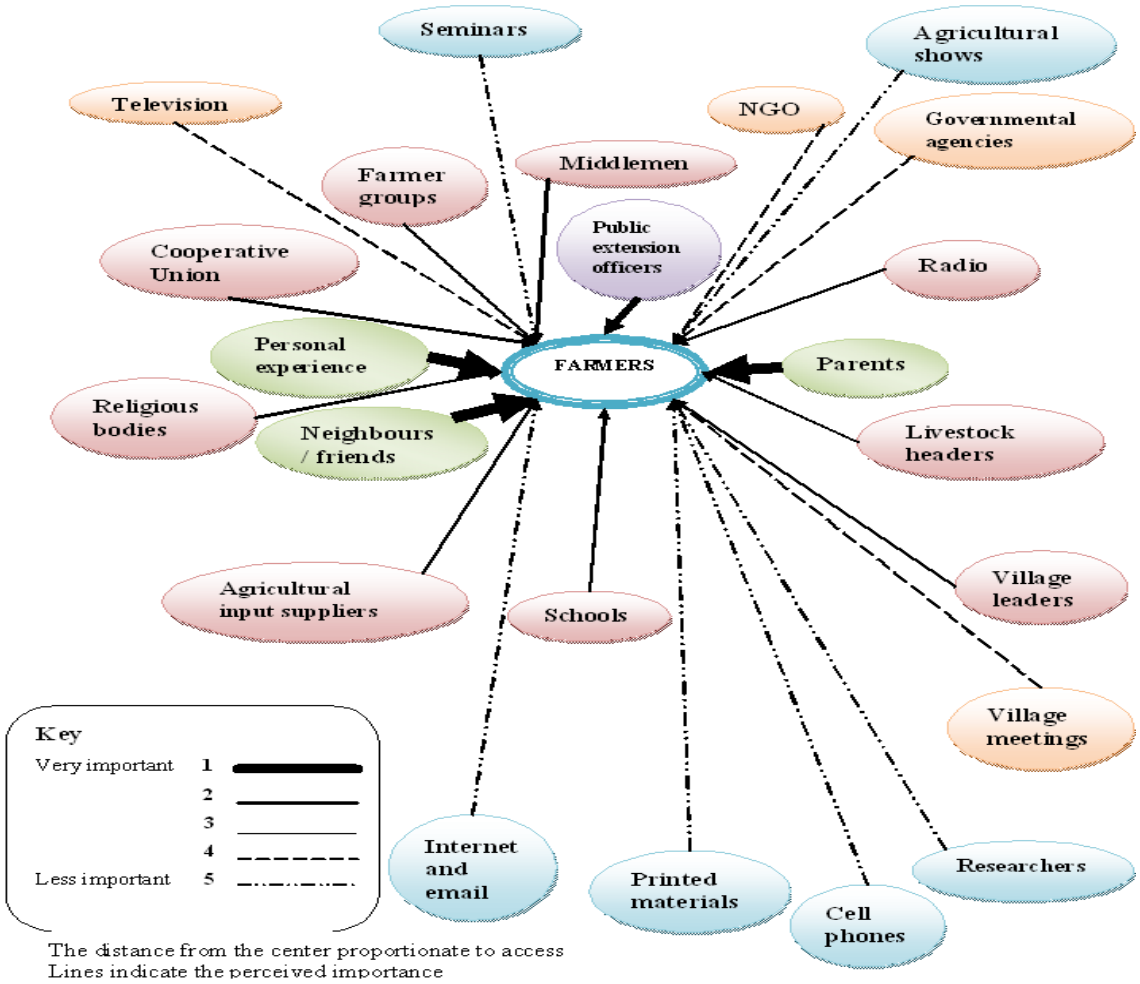

Figure 2: Consolidated information maps of the surveyed districts

Access to agricultural information and knowledge through ICTs

The majority of farmers (89%; 161) used ICTs to access information and knowledge. Most farmers (96.3%; 155) used radio to access information and knowledge on farming systems. Radio was an appropriate channel for accessing information and knowledge for large numbers of farmers in the rural areas probably due to its oral nature, low cost and its independence of electricity. Cell phones (44.1%; 71) were also becoming important ICTs for rural farmers to seek advice regarding their farming problems (such as animal and plant diseases, and technical details of farming) from extension officers, researchers, NGOs, farmer group members and village leaders. The study findings also indicated that television (39.8%; 64) was also an important ICT used by farmers to access agricultural information and knowledge in the surveyed villages. However, the impact of television on providing access to information and knowledge could be enhanced if access to power was improved in the rural areas as already highlighted in the other studies in Mozambique (Batchelor *et al.*, 2005).

Despite the introduction of community telecentres in the surveyed communities, this study revealed that few farmers used email 12 (7.5%), and internet 9 (5.6%) to access information and knowledge. Findings from Nigeria (Adomi *et al.*, 2003) and Tanzania (Chilimo, 2009) showed that few farmers had used internet and email services for knowledge acquisition. Other ICTs, such as film shows (5%; 8), and video cassettes (3.7%; 6) were also used at a

low rate. The study findings indicate that the mass media and interpersonal channels were the major sources of agricultural information and knowledge in the local communities.

The information mapping confirmed that radio was the principal ICT used by farmers to access knowledge as indicated in Figure 2. Television and cell phones were important tools used by farmers to access information and knowledge in some locations, while advanced ICTs such as Internet and email were less used to access agricultural information and knowledge in the surveyed communities.

Application of information and knowledge and technologies received through face to face communication and print materials

The study findings showed that most (77.9%; 114) respondents had applied agricultural conventional knowledge and techniques received through face to face communication and print materials. It was evident from the present findings that farmers mainly applied information and knowledge on crop husbandry (61.7%; 87), and new varieties and techniques (35.5%; 50) as shown Figure 3. The focus group discussions confirmed that knowledge on crop husbandry and new techniques and varieties were the most adopted information and technologies in the communities. Other techniques, arranged in descending order were: improvement of soil fertility, control of plant pests and diseases, environmental conservation, control of animal diseases, livestock husbandry, value added techniques, and agricultural tools.

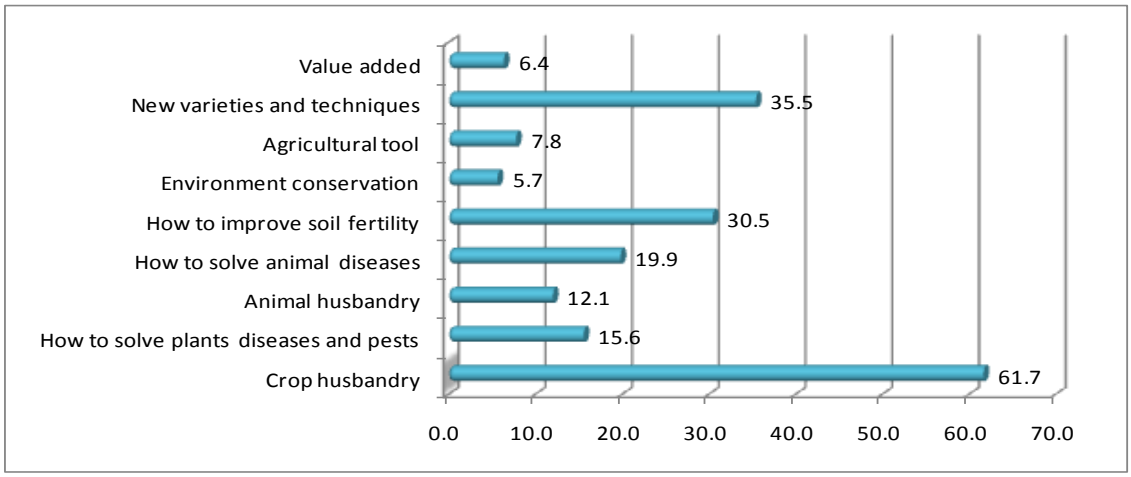

Figure 3: The application of information and knowledge and technologies in farming systems (N=141)

Improved agricultural production (94.3%; 133) was the major reason for applying information and technologies, especially on crop husbandry, control of plant and animal diseases, soil fertility, new varieties and techniques, agricultural tools, and value added techniques,. Other major reasons were effectiveness of conventional techniques (46.1%; 65), simplified field operations (8.5%; 12), source of income (7.8%; 11), to prevent soil erosion (3.5%; 5), to ensure food security (2.8%; 4), and no other alternative technology (1.4%; 2). The least cited reasons were to improve quality of crop produce, lack of access to local inputs, an instructions from village leaders (such as to plant trees), and to reduce crop loss, with a score of 0.7% (1) respondent each.

The focus group discussions confirmed that improved agricultural production was the major reason for applying information and technologies on crop husbandry, new varieties and techniques, and improvement of soil fertility. Another major reason was the effectiveness of information and technologies, such as crop husbandry practices, and control of animal and plant diseases. Other reasons, arranged in the descending order of importance were: boosted crop and animal growth; validated exotic techniques such as chemical pesticides; increased income; improved soil moisture and fertility; early maturity due to the use of improved crop varieties and seeds; simplified field operations; and assurance of food security due to the use of improved value added techniques such as pesticides. These findings show that the application of information and knowledge in the farming systems may also be linked to increased production and income, and lack of indigenous skills and resources.

Application of agricultural information and knowledge through ICTs

The study findings established that the majority of the respondents applied information and knowledge (77.9%; 141) received from tacit and explicit sources of knowledge in the farming systems, as compared to the information and knowledge received from ICTs (35.4%; 64). These findings show that oral communication channels are effective ways of delivering information and knowledge in the surveyed local communities to a greater extent than ICTs. Similary, Chapman *et al.,* (2003) found that the use of participatory communication techniques and indigenous communication channels (such as drama) through local languages and rural radio had some influence on the majority of the farmers regarding their decisions whether or not to cut down trees and to discontinue bush burning on their farms in future in Ghana. Indications are that the combination of participatory techniques, indigenous communication channels and ICTs can improve the sharing and adoption of agricultural technologies in the local communities.

The present study established that the majority of the respondents had mainly adopted the following information and techniques received from ICTs, which included crop husbandry techniques (48.4%; 31), followed by new techniques and varieties (32.8%; 21), improvement of soil fertlity 15 (23.4%; 15). Other adopted techniques through ICTs were control of plant diseases and pests (12.5%; 8), and control of animal diseases (10.9%; 7). Few farmers accessed knowledge on agricultural tools (7.8%; 5), livestock husbandry (10.9%; 1) and value added (1.6%; 1).

The major reasons for adopting these agricultural technologies and knowledge were improved crop and animal production (98.4%; 63). Other major reasons were to: control animal diseases (7.8%; 5), simplify field operations (6.3%; 4), and increase income (4.7%; 3). Similary, Jallov (2007) reported that community radio broadcasts on livestock husbandry and crop farming enabled farmers to improve their productivity and reduce poverty in East Africa. Indications are that ICTs can also play a key role in providing access to relevant and effective information and knowledge which can improve agricultural productivity and increase income in the local communities.

4. Conclusions and recommendations

It can be concluded that access to relevant information and knowledge is very important to improve the agricultural performances and livelihoods in the rural areas especially in African countries. The study findings showed that deep, rich and complete data can be collected through mixed quantitative, qualitative and participatory techniques. The objective truth existing in the world was measured and explained scientifically by using quantitative

approaches, and realism of the study findings was achieved through a qualitative method. Consequently, the study findings demonstrated that the knowledge and information needs, and information seeking patterns of farmers were location specific. The major sources of information for farmers were predominantly local (neighbours, friends and family), followed by public extension services. Agricultural input suppliers, village meetings, farmer groups, cooperative unions and NGOs were important sources of agricultural knowledge in some locations. Print materials with the exception of books had low use due to their unavailability and illiteracy. Apart from radio and cell phones, advanced technologies (i.e. internet and email) were also used at a low rate despite their existence in the communities. The findings suggest that farmers will continue to rely on face to face communication and probably radio and cell phones more than printed materials and advanced ICTs such as internet and email to access agricultural information and knowledge. Based on the findings, the following recommendations are made:

- Regular studies on information and knowledge needs: Researchers, educators, extension agents, agricultural support services should conduct regular studies on information and knowledge needs, in order to meet the disparate farmers' needs;
- Mapping and awareness of information and knowledge sources: Researchers, educators, extension agents, agricultural support services and village authorities should work together to identify knowledge and information sources in the communities, and create awareness of the available knowledge sources in the communities. This will enable farmers to locate what they need, as well as increasing their confidence in acquiring and adapting new knowledge to improve their farm outputs;
- Knowledge culture: Researchers, educators, extension agents, agricultural support services should nurture a knowledge culture to influence farmers' decisions to accept new knowledge, and in enabling agricultural experts to understand and determine farmers' needs and knowledge. Farmers are more likely to be motivated in adopting technologies from agricultural experts once they realise that their own inputs are incorporated in the design and development of such technologies;
- Participatory design and development of technologies: Researchers, educators, extension agents should involve farmers in the design and development of agricultural technologies to increase the adoption rate of agricultural information and technologies in the local communities; and
- Multiple sources of information: Researchers, educators, extension agents, agricultural support services should use multiple sources of information (such as, face to face, print and ICTs) to deliver relevant information to farmers. For instance, the public and private organizations should establish community radio that combines vernacular languages, and indigenous communication mechanisms (such as drama, storytelling) to disseminate relevant knowledge to farmers. Print formats (such as leaflets, newsletters, books) and ICTs such as internet, emails and cell phones can also be used to share and distribute knowledge among farming communities to supplement what was gained verbally.

For further studies, this paper recommends that mixed methods research be undertaken to establish the role of community radio, cell phones and television, in combination with the indigenous communication channels, in managing and communicating local and external knowledge for improved agricultural performances in the rural areas of developing countries.

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