BRIDGING THE AGRICULTURAL KNOWLEDGE AND INFORMATION DIVIDE: 
THE CASE OF SELECTED TELECENTERS AND RURAL RADIO IN TANZANIA

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ABSTRACT
Information and communication technologies (ICTs) are important resources for enabling poor farmers to make informed decision regarding their farming activities, especially in the rural areas of developing countries. Effective public access ICTs (telecenters and rural radio) based on farmers’ needs and with farmers’ rural and socio-economic constraints can bridge the knowledge and information divide and contribute to agricultural growth. This paper looks at the public access ICTs (telecenters and rural radio) in Tanzania, by assessing their knowledge and information services that focus on supporting farming activities of small-scale farmers, use of telecenters and barriers faced by telecenters in their knowledge and information services. A qualitative approach was deployed to interview eight telecenter operators, where two of them provided radio broadcasting services. The study found that there was low use of internet for knowledge acquisition, while cell phones were becoming popular for farmers to communicate with telecenter operators and rural radio in case of emergency or advice regarding farming activities. With consistent government funding and conducive regulatory environment, telecenters can develop demand led services and sustain their services by strengthening the following: regular information needs assessments; capacity building; knowledge culture; collaboration among farmers and other related organizations; and utilization of multiple sources of knowledge (such as, ICTs and indigenous communication approaches) in order to meet the disparate farmers’ needs.

Keywords: telecenter, community radio, information and communication technology, knowledge, information, agriculture, Tanzania

1. INTRODUCTION
Information and communication technologies (ICTs) are widely acknowledged as effective means of sharing knowledge and information and thus contributing to socio-economic growth, especially in rural areas of developing countries. Agriculture is the leading sector of the economy in most developing countries, and thus it is essential for socio-economic growth because most of the rural poor depend on agriculture for their livelihoods. In Tanzania, agriculture is the base for economic growth as it is a major source of the country’s food security, employs 70% of the work force, accounts for more than 25.7% of gross domestic product (GDP), and provides 30.9% of exports (United Republic of Tanzania, 2009). ICT interventions can increase quick access to relevant information and knowledge which may lead to agricultural growth in developing countries, especially in the rural areas. Quick access to relevant knowledge and information can enable smallholder farmers to make informed decisions regarding their agricultural production activities, marketing of their agricultural produce for better profits, and benefiting from health and disease prevention advice.

Developing countries, though, are constrained in their ability to access knowledge and information through ICTs for their agricultural growth and development agenda. Statistics show that the majority of the world’s population (71.3%) does not have access to the internet (Internet World Stats, 2010). Unequal access to and use of ICTs, generally known as the
digital divide, exists throughout the world, within regions, individual countries, and this disparity is even deeper within communities which has contributed to knowledge divide. Major factors that contribute to digital divide in developing countries especially rural areas are related to infrastructural, technical, regulatory, distributional, social, cultural, and economic issues (Zeleza, 2005:283).

A number of alternatives however, have emerged to bridge the knowledge and information divide between urban and rural areas. Shared access is the main mode of access to these technologies in most developing countries. The communities can either access these technologies at a distance (intermediation) or at close range (via telecenter, community radio) (James, 2010). Most of these possibilities focus on enhancing the communities to access and use knowledge and information through ICTs for sustainable agricultural development. However, there is an ongoing debate that telecenters may be expensive for rural communities to access and use knowledge and information for their agricultural development in developing countries (James, 2010). Further, there is an argument that research has not shown a clear link between access to information and knowledge through ICTs and socio-economic growth (Sey and Fellows, 2009). Another strand in the debate concerns the increasing use of mobile technologies which has over-shadowed some forms of public access to ICTs (such as telecenters) in developing countries. Research of 50 telecenters in Uganda and South Africa showed that ICT services, especially those related to computers, internet and information services, tend to be poorly utilized, whilst some others, including photocopying, and telephone have a moderate to high levels of demand (Parkinson, 2005). This debate indicates that public access ICT approach will soon come to an end, without any tangible impact to agricultural development.

Various scholars, on the other hand, have demonstrated that ICTs can provide quick access to relevant knowledge and information that may improve agricultural productivity, reduce poverty and ensure food security in developing countries, such as the use of rural radio in Ghana (Chapman, Slaymaker and Young, 2005), utilization of telecenters in India (Meera, Jhamtani and Rao, 2004:6), and ICT utilization in nine countries of Africa and Latin America (International Institute for Communication and Development, 2006). Despite the fact that studies have been conducted on the use of ICTs for agricultural development, these best practices are scattered in different countries, with various contexts and divides. In reality, not much has been done in the Tanzanian context. Most studies done thus far in the country have either analyzed the telecenter utilization (Nielinger, 2003; Mercer, 2005; Bjørn and Stein, 2007), or use of community television and radio by poor (Batchelor, Scott and Eastwick, 2005), or the socio-economic impact of ICTs (Chilimo, 2008; McNamara, 2008; Mwakaje, Mwakipesile and Nyakisinda, 2009), or socio-economic impacts of mobile communications (Myhr, 2006; Samuel, Shah and Hadingham, 2005; Souter et al., 2005), or social impact of mobile phones (Goodman, 2005). This study therefore fills the gap left by previous studies, by providing empirical evidence on the role of the telecenters and rural radio in providing access to knowledge and information for improved agricultural activities in Tanzania, with a specific focus on the knowledge providers (telecenters and community radio).

Further, there are more than nineteen telecentres that offer various ICT services, such as radio broadcasting, computer, internet, telephone and secretarial services to the rural poor (Tanzania Commission for Science and Technology, 2005). There is also a political will within the Tanzania government to facilitate the role of ICTs for agricultural development (United Republic of Tanzania, 2005a). The existence of these telecenters and political will also provides an opportunity to research community to study about the role of these telecenters in supporting agricultural activities of smallholder farmers in the rural areas of Tanzania. On the whole, the analysis of this study concentrated on the following: (i) the role of telecenters and rural radio in disseminating agricultural knowledge and information in the
rural areas; (ii) use of telecenters; and (iii) barriers regarding the dissemination of agricultural knowledge and information through telecenters and rural radio. This paper also provides a brief background of the need for ICT intervention for agricultural development in developing countries, diffusion of public access ICTs in Tanzania, and agricultural knowledge and information services through public access ICTs. The research findings, conclusions, and recommendations are also presented.

2. LITERATURE REVIEW
Under this subheading, the following concepts are discussed: need of public access ICTs intervention for agricultural growth, diffusion of public access ICTs in Tanzania, and access to agricultural information and knowledge through public access ICTs.

2.1 Need of Public Access ICTs Intervention for Agricultural Growth
Agricultural sector is significant for socio-economic growth because most of the rural poor in developing countries depend on agriculture. For instance, Tanzanian agriculture is dominated by smallholder farmers (approximately 85% of the arable land) who cultivate an average farm size of between 0.2 and 2.0 hectares and keep an average of 50 head of cattle (United Republic of Tanzania, 2001). Developing countries however, have been experiencing low agricultural productivity due to many factors, such as subsistence farming; unsustainable land management practices; land scarcity; increased population pressure; poor infrastructure; lack of markets and credits; inadequate policies; civil strife; adverse weather; the HIV/AIDS pandemic; lack of access to knowledge and information; and inadequate and inequality of labor supply where women do most of agricultural activities (World Bank, 2007:9). Given the fact that much of Africa's food is wasted due to lack of access to knowledge and information, one of the important resource could be the development and dissemination of relevant knowledge and information in the rural areas for sustainable agricultural growth.

However, small-scale farmers are deprived from accessing information on current and local market prices or timely need based information (advisory or time tested) which can enable them to decide in harvesting the crops (Rao and Sonar, 2010). The predominant approach of agricultural extension and outreach programs in developing countries, is based on the assumption that knowledge is created by scientists, to be packaged and spread by extension and to be adopted by farmers (Assefa et al., 2009), and thus it is not tailored to farmers’ needs. Hence, farmers experience low crop yields, increased wastage (unwanted and ill-advised inputs), slowed down market efficiency, and reduced income (Rao and Sonar, 2010). To bridge the knowledge divide between small scale farmers and productive and competitive markets, public access ICTs (telecenters and rural radio) interventions targeting rural poor can be effective in improving agricultural production and remunerative markets.

2.2 Diffusion of Public Access ICTs in Tanzania
There has been an increasing use of ICTs in developing countries mainly due to both demand-side factors, such as the increasing popularity of mobile phones and the Internet, and by supply-side factors, such as regulatory reforms, falling costs and prices, and technological innovation (Gray and Magpantay, 2005:9). In Tanzania, the formulation of policies and laws on the ICT sector have facilitated market entry, customer services, costs reduction and increased productivity of the telecommunication and other ICT services. These policies and laws include: Information and Communication Technology Policy (2003), Postal Policy (2003), National Information and Broadcasting Policy (2003), Tanzania Communications Regulatory Authority (TCRA) Act (2003), Converged Licensing Framework (CLF) (2005) and Telecommunications Policy (1997).
The formulation of these policies and laws made it possible that by 2010, there were 72 application services (internet and other data) in the country (Tanzania Communications Regulatory Authority, 2010). Access to internet and email services has been widened in urban areas through the establishment of internet cafes. In the rural areas, access to internet has been made possible due to the introduction of telecenters through the assistance of different international and local stakeholders such as the Commission for Science and Technology (COSTECH). Despite these achievements, the use of internet across the country is very low as compared to mobile phones. It is estimated that the total number of Internet users grew from 115,000 in 2000 to 676,000 (1.6%) in 2010 (Internet World Stats, 2010). On the other hand, the number of mobile subscribers and fixed telephones lines also increased from 126,646 and 173,591 in 2000 to 17.8 millions and 174,435 in March 2010 (Tanzania Communications Regulatory Authority, 2010). Many factors have contributed to the low use of internet, which include high cost of ICT services in rural locations compared to urban locations, low literacy rates, low incomes and limited number of service providers, inappropriate legal and regulatory framework for the expanding market, inadequate telecom infrastructure and ICT expertise (United Republic of Tanzania, 2005b).

Further, there are 47 radio stations in Tanzania (Tanzania Communications Regulatory Authority, 2010). However, the Tanzania Broadcasting Corporation (TBC), the national radio station is still the major source of developmental information to rural poor due to its wide coverage on the rural areas as compared to other radio stations in the country. Despite the fact that more than 85% of Tanzanians own a radio (Batchelor, Scott and Eastwick, 2005:14), there are only eleven community radio stations to cater for farmers needs (United Nations Educational, Scientific and Cultural Organization, 2009), due to the high costs of registration (between $500 and $2500) and the annual fee (between $1000), as well as the energy requirements to run a station are very high (Media Institute of Southern Africa, 2006). There are no special concessions for the establishment of community radio stations in the country (Media Institute of Southern Africa, 2006). Further, the information and broadcasting policy limits broadcasts to Swahili and English, in order to reduce tribalism and maintain unity in the country (United Republic of Tanzania, 2003). This language restriction inhibits the utilization of vernacular languages which would support better dissemination of agricultural knowledge in the local communities. These issues have negatively affected the establishment of community radio in the country. Until, these factors are addressed, small scale farmers will still be isolated from participating in the knowledge era to improve their agricultural activities.

2.3 Access to Agricultural Information and Knowledge through Public Access ICTs
Access to knowledge and information is an important resource for marginalized rural people, especially female farmers who have access to only 10% of agricultural extension programs (World Bank, 1998). There have been deliberate national efforts to enable the rural farmers to access knowledge and information through ICTs for effective agricultural production and linkages to markets in Tanzania. These initiatives include government projects, public-private partnerships and private initiatives. Currently, telecenters (both government projects and private initiatives) have been effective in disseminating agricultural information to rural poor, such as WIDA in southern zone, Sengerema, and Crop Marketing Bureau (CROMABU) telecentre in western Tanzania. The Tanzania Chamber of Commerce, Industry and Agriculture (TCCA) and Agricultural business information services (BIS) in Tanzania also disseminate information on crop prices to rural farmers via internet.

The community radio have also been effective in reaching resource poor farmers across distance in Tanzania, such as the Orkonerei Radio Station in northern Tanzania, Sengerema Community radio, and the Tanzanian’s Northern agricultural research institute.
Rural radios have increasingly been established in many developing countries, such as Burkina Faso, Bolivia, Ecuador, Jamaica, Ghana, Uganda, Zambia (International Institute for Communication and Development, 2006). In their review of the role of ICT for agricultural development in Tanzania, Lwoga and Ngulube (2008) found that farmers accessed agricultural knowledge and information through ICTs (such as, telecenters, cell phones and radio) which enabled them to improve their production, linkages to profitable markets, and reduce poverty.

These telecenters and rural radio, however face a number of problems in disseminating information and knowledge for sustainable agricultural practices in Tanzania. These problems are related to high cost of ICTs, illiteracy, distance to the telecentre, language barrier, lack of electricity, frequent power cuts, and sustainability issues (Chilimo, 2008). Further, most of the telecenter managers are not aware of the farmers’ information needs, which constrain from meeting disparate farmers needs. Inadequate road infrastructure also hinders farmer to transport their produce to markets outside the districts, even in cases where farmers are provided with information on the availability of those markets (Chilimo, 2008). Despite the various challenges faced by these ICT projects in Tanzania, the isolated ICT projects need to be studied and the experiences generated must be documented in order to draw lessons for the future strategies on agricultural development.

3. METHODOLOGY

A qualitative approach was deployed to interview eight telecenter operators, where two of them provided also radio broadcasting services. These rural telecenters were purposively selected from six districts in six out of seven agricultural research zones. These districts were selected due to their possession of telecentres. The southern zone was not included in the study because its telecentre was still at the planning stage and thus it was not yet operational. These districts and telecenters included the following: (i) Karagwe district (FADECO telecenter and community radio); (ii) Kasulu district (Kasulu Teachers College telecentre); (iii) Kilosa district (Kilosa Rural Services and Electronic Communication (KIRSEC), and Kilosa telecenter - Radio Jamii); (iv) Moshi rural district (Marangu Village Internet Services, and Guerba computer centre); (v) Mpwapwa district (Teachers College Multipurpose Telecentre); and (vi) Songea rural district (Wino Development Association). The study used the following criteria to select these telecentres: (i) operate in rural areas; (ii) offer a variety of services including internet and email services, printing and photocopying. Community radio and computer training will be an added advantage; and (iii) should have been in operation for more than 12 months. The same criteria for selecting telecentres were also used by Chilimo (2008) to select four telecentres in Tanzania to assess the impact of ICT for poverty reduction. NVIVO, a qualitative analysis software was used to identify the core themes from interview transcripts and analyze them.
## Table 1: Services Provided by the Telecenters

<table>
<thead>
<tr>
<th>Districts</th>
<th>Kilosa Rural Services and Electronic Communication</th>
<th>Kasulu</th>
<th>Karagwe</th>
<th>Songea Rural</th>
<th>Dodoma</th>
<th>Moshi Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilosa telecenter</td>
<td>Kilosa</td>
<td>Kasulu</td>
<td>FADECO</td>
<td>Wino Development Association</td>
<td>Mpwapwa</td>
<td>Guerba computer centre</td>
</tr>
<tr>
<td>Computers</td>
<td>10</td>
<td>3</td>
<td>41</td>
<td>4</td>
<td>5</td>
<td>72</td>
</tr>
<tr>
<td>Internet</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Email</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fax machine</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Photocopier</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Printer</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Radio</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Landline phones</td>
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<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ownership</td>
<td>Donor and Public support (COSTECH, UNICEF)</td>
<td>Private</td>
<td>Donor and Public support (USGCF, COSTEC, UNDP)</td>
<td>Private</td>
<td>Private</td>
<td>Public (Mpwapwa Teachers College)</td>
</tr>
<tr>
<td>Electricity supply service</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Solar power renting</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Internet Service Provider</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Computer Training</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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2. United States Global Catalyst Foundation (USGCF), Tanzania Commission for Science and Technology (COSTECH) and United Nations Development programme (UNDP)
4. **FINDINGS AND DISCUSSION**

This section discusses study findings in relation to the role of telecenters and rural radio in disseminating agricultural knowledge and information, use patterns of telecenters, and barriers regarding the dissemination of agricultural knowledge and information through telecenters and rural radio. The profile of telecenters and rural radio is also presented.

4.1 **Profile of Telecenters and Rural Radio**

All telecenters provided basic secretarial services, such as printing and photocopying. Almost all telecenter provided internet services with exception to Kilosa telecenter in Kilosa and WIDA telecenter in Songea (see Table 1). Kilosa telecenter provided radio broadcasting services and computer training, while WIDA telecenter provided email and other secretarial services. Only two telecenters also provided radio broadcasting services, which were FADECO and Kilosa telecenter, which was known as Radio Jamii. Most of the surveyed telecenters were private owned. Only one telecenter (WIDA) provided electricity services to rural communities, while KIRSEC rented solar power equipments to rural communities on a fee basis.

4.2 **The Role of Telecenters and Rural Radio in Disseminating Agricultural Knowledge and Information**

The study findings showed that agriculture was only a small component in the surveyed telecenters and rural radio in Tanzania. Few telecenters and community radio had specified services that focused on meeting farmers’ information and knowledge needs. Despite the fact that almost all telecenters provided internet services, few of them used internet to deliver agricultural knowledge and information to farmers. The study findings showed that out of eight surveyed telecenters, two telecentres used internet to deliver agricultural knowledge and information to farmers across the surveyed districts. These telecenters included FADECO telecenter and rural radio, Kilosa Rural Services and Electronic Communication (KIRSEC). These telecenters and rural radio used to download useful agricultural information from the internet, repackage and later disseminate to farmers.

For instance, the FADECO community radio in Karagwe, used to search the offline resources base (compendia, books, CD-ROM libraries), and internet and download useful web-based agricultural knowledge and broadcast to farmers in response to farmers’ queries and their needs. Farmers’ queries were delivered to the radio station either physically or through cell phone’s SMSs. FADECO radio also downloaded useful web-based knowledge and information based on farmer’s queries from the WORLDSPACE radio receiver, Open Knowledge Network, and BBC Swahili service website, and broadcasted the information to farmers. Typical response was that, “the radio broadcasts agricultural knowledge and information in response to farmers’ queries. It has been very useful to farmers because very few farmers can directly use internet to access agricultural knowledge and information”. The combined use of internet and radio has also been successfully implemented in various developing countries, such as the Kothmale community radio station in Sri Lanka (Girard 2003:13). FADECO radio also looked for marketing prices and daily exchange rates on the internet and broadcasted the information to farmers.

The KIRSEC (Kilosa Rural Services and Electronic Communication) telecentre in Kilosa also downloaded agricultural knowledge and information from the web, repackaged and disseminated the knowledge and information in print media to extension officers and farmers. KIRSEC linked farmer groups and extension officers to the online farmers’ discussion forum, which was called http://www.linkinglearners.net/. Through this online tool, farmers were able to share and access knowledge on natural resource management, market outlets and agricultural production. Four farmer groups were already registered to the linking...
learners’ website by May 2008, which were Usagara women group, Juhudi, Mshikamano and Jiendeleze. The telecentre charged farmers for translating their messages from Swahili to English, and sending and receiving messages from the linking learners’ forum, which was called e-runner service. KIRSEC assisted farmers to advertise their produce by placing their digital photographs on the link learners’ website. The telecentre also used the internet to assist farmer groups in securing soft loans from NGOs in UK.

There was low use of internet services to disseminate agricultural knowledge in other five telecentres, which were, Kasulu telecentre (Kasulu), Marangu Village Internet Service and Guerba computer centre (Moshi Rural), and Mpwapwa telecentre (Mpwapwa). The most popular services in these telecentres were access to examination results for secondary schools, distance learning, research, and tourism for telecentres in Moshi Rural. These telecenters did not have any specified services that focused on agriculture. In fact, most of these telecenters were working as internet cafés without any value added services to attract farmers to use their services. Thus, few farmers used to visit these telecenters to access agricultural knowledge and information due to financial and skill constraints. Consequently, the Wino Development Association (WIDA) telecenter in Songea Rural did not provide internet services to the communities. It only provided email services to the local farmers.

Cell phones were also important tools used by telecenters to disseminate agricultural knowledge and information to local farmers. Out of eight surveyed telecenters, three telecenters used cellphone to communicate with farmers in case of emergency or advice regarding farming activities. These telecenters included WIDA, KIRSEC, and FADECO radio and telecenter. The WIDA telecenter in Songea Rural used cell phones to contact individual farmers or farmer groups in case of a meeting or training on farming activities. The KIRSEC telecentre’s manager in Kilosa also trained individual farmers on how to use cell phones to access marketing information. The KIRSEC telecentre used cell phones to alert farmers and farmer groups in case of an urgent incoming email, if mobile access was available. In Karagwe, farmers sent SMS or made telephone calls to the FADECO radio station for advice on their farming problems. Typical response was that, “farmers can either send us SMS or call directly through live radio programs, and we respond to them via radio for wide impact”.

There was low use of email to disseminate agricultural knowledge and information to local farmers. Out of eight telecenters, only three telecenters used email to disseminate relevant agricultural knowledge and information to farmers, which included WIDA in Songea Rural, Radio FADECO (Karagwe) and KIRSEC telecentre (Kilosa). WIDA used email for e-business in the area, personal communication, and coffee marketing linkages to buyers abroad. WIDA telecenter, through its department, namely Wino Agricultural Marketing Cooperative Society (WAMCS) used email to search for best crop prices for its rural farmers, which included coffee, groundnuts, maize, beans, finger-millet, sunflower and timber. Thus, farmers were able to secure international buyers through a Fair Trade Coffee Register who paid better market prices when crop prices were low in Tanzania. WIDA also communicated with TACRI (Tanzania Coffee Research Institute at Moshi Rural) for technical support on coffee husbandry, and coffee disease diagnosis and treatment. Radio FADECO accessed market information from FOODNET in Uganda and KACE in Kenya via email and printed the information on the notice boards, and broadcasted the same information on radio. Through e-runner service, KIRSEC (Kilosa) assisted farmers to register their individual emails, and to send and receive their emails. The telecentre also helped farmers belonging to farmer groups to send and receive emails from link learners’ online forum.

Radio was also an important tool for providing access to agricultural knowledge and information in the rural communities. Two community radio stations (FADECO Radio in Karagwe, and Radio Jamii in Kilosa) broadcasted agricultural knowledge and information in
the local communities. For instance, 70% of the content of FADECO community radio was focused on agriculture, with topics ranging from production, marketing and value addition. FADECO radio also collaborated with various stakeholders to disseminate agricultural information and knowledge to the communities. These stakeholders included universities (Sokoine University of Agriculture), radio stations (such as TBC, deutschevelle, BBC), agricultural research institutes (Selian, Maruku, Ukiriguru), and the district extension and veterinary officers. Other collaborating international agencies were Arid Land Information Network East Africa (ALIN-EA), the International Network for the Availability of Scientific Publications (INASP), Technical Centre for Agricultural and Rural Cooperation (CTA), CAB International, Centre for Information on Low External Input and Sustainable Agriculture (ILEIA), and FOODNET. Through FADECO radio, farmers were able to ask questions through live radio programmes, report missing cattle, access knowledge and information on crop and animal production, and markets. For instance, the telecenter director reported that, “the market information radio program, now called Sokoni kunanini has opened farmers’ eyes about prices of crops and animals in other regions. Thus, farmers are no longer exploited, since their bargaining power has improved”.

On the other hand, radio Jamii in Kilosa disseminated information on environment and marketing such as crop prices, and business outlets. The radio station used to have an agricultural programme, which was known as, “kilimo chetu”. However the programme was last broadcasted in 2007 due to various reasons, which included inadequate support from public extension officers in content generation; inadequate facilities and staff; lack of incentives to pay government officials who would participate in the production of radio programmes; and lack of ward/village reporters. Most of the programmes at the Radio Jamii were entertainment, with few programmes on news, environment, health and marketing. Another study of four telecenters in north western Tanzania revealed that Sengerema Community radio had very few programmes that targeted farmers or livestock-keepers. Instead, the radio was dominated by entertainment, music and social programmes (Chilimo, 2008). There is thus a need to facilitate rural radio with adequate resources in terms of finances, facilities, and skills for effective dissemination of relevant agricultural information and knowledge in the local communities.

Other ICT services such as CDROM and video were used at a low rate to disseminate agricultural knowledge in the local communities. For instance, CDROM were used by three telecenters (FADECO NGO, KIRSEC telecentre and Mpwapwa telecentre) to disseminate agricultural information and knowledge to farmers and extension officers. WIDA NGO had a TV room with a satellite dish which was used to educate farmers on agricultural practices before they were taken to the demonstration plots.

On the whole, the study findings showed that few telecenters addressed farmers’ information and knowledge needs. The rural ICT investments should thus consider farmers’ needs in order to bridge the knowledge divide that exists between smallholder farmers and productive and competitive markets. Telecenters should also use multiple ICTs (such as cell phones, radio, and other ICTs) to increase access and use of knowledge and information for agricultural activities in the rural areas.

4.3 Patterns of Telecenters

The average use of telecenter facilities was predominantly low in the surveyed districts. The study found that telecenter in Mpwapwa and Kasulu had many users, followed by KIRSEC, and telecenters in Moshi (Guerba and Marangu telecenters) (See Table 2). These telecenters in Mpwapwa, Kasulu, and Kilosa were mostly used by school teachers, students from primary, secondary and open universities, workers from NGOs, public institutions, as well as researchers in some districts such as Kilosa, where the researchers from Ilonga research
institute were intensive users of this telecenter. Further, the telecenters in Moshi Rural (Guerba computer centre, and Marangu Village Internet Service) had large number of users (between 15 to 20) during high tourism season (August to January), while low number of users was observed in low tourism season (January to July) every year. Most users in these telecenters were students, potters, and volunteers (that is, volunteers who come to teach at the primary school and those ones who come to work at the church). There was low number of telecenter users at FADECO because the telecenter was shifting into radio broadcasting services. On the other hand, Kilosa telecenter was only providing computer training and radio broadcasting services, so the number of internet users could not be established. In addition, the number of users at WIDA telecenter could not be established because farmers used to send their email via the telecenter operator.

Table 2: Use Pattern of Telecenters

<table>
<thead>
<tr>
<th>Telecenter</th>
<th>Kilosa telecenter</th>
<th>Kilosa Rural Services and Electronic Communication (KIRSEC)</th>
<th>Kasulu</th>
<th>FADECO</th>
<th>Wino Development Association (WIDA)</th>
<th>Mpwapwa</th>
<th>Guerba computer centre</th>
<th>Marangu Village Internet Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of internet users per day</td>
<td>N.A.</td>
<td>20-25</td>
<td>30</td>
<td>10</td>
<td>N.A.</td>
<td>50</td>
<td>10-20</td>
<td>10-15</td>
</tr>
</tbody>
</table>

The study findings showed that few farmers had used the telecenters to access agricultural knowledge and information. All telecenter operators acknowledged that few farmers had visited their telecenters to look for agricultural knowledge and information. Even in those telecenters that had specific programs for farmers such as KIRSEC, FADECO and WIDA, the telecenter operators acknowledged that few farmers were accessing the services for agricultural purposes due to lack of awareness, skills, and funds. Further, lack of knowledge on the part of telecenter operators inhibited farmers to use telecenters for agricultural purposes. For instance, one respondent indicated that, “farmers would like to find loans for their agricultural activities in the internet but I can not assist them because I am not knowledgeable”. Similar observations were made in India, Mozambique and Tanzania that few farmers used internet and email services for knowledge acquisition (Souter et al., 2005). It is clear that there is a great need for extensive awareness creation and training programmes on the use of telecenters to enhance ICT utilization for agricultural development.

4.4 Barriers Regarding the Dissemination of Agricultural Knowledge and Information through Telecenters and Rural Radio

The study findings showed that lack of funds was the major barrier that inhibited telecenters from disseminating agricultural knowledge and information in the local communities. Lack of funds inhibited telecenters from acquiring appropriate ICT facilities, internet connectivity, paying staff remunerations and telecenters’ operational costs. Most of the telecenters could not sustain theirselves because the majorities were private owned, and they had low number of users. Other telecenters, such as WIDA was established with a financial support from the Embassy of Sweden. However, the support was provided for a limited time, and thus they were supposed to sustain their selves. For instance, one telecenter (WIDA) operator stated, “donors have pulled out, so the organization has to sustain itself, which is very difficult at times”. Further, financial constraints limited two telecenters which were involved with radio broadcasting to produce high quality radio programs. Lack of funds inhibited rural radio operators to involve agricultural experts in the production of agricultural programmes, to travel to the rural areas to interview farmers, and to purchase appropriate ICT tools, such as audio recorders, computers, and software due to high costs of ICTs. Typical response from
FADECO was that, “although we have already identified farmers’ needs, it is very expensive to pay researchers and extension officers to participate in the production of our agricultural programmes”.

Other major barriers included the following: inadequate ICT expertise, lack of awareness and skills on ICTs on the part of farmers, limited ICT facilities, lack of institutional ICT policy, inadequate efforts to generate local and relevant content, unreliable electricity, and low use of telecentres by farmers due to high costs. For instance, one respondent reported that internet users pay 32$ per an hour while the connectivity for the telecenter cost at 210$ per month which is very expensive. Other telecenters have even gone further by having two different levels of user charges. One telecenter operator (GUERBA) reported that, “the telecenter charges 5$ per 15 minutes for a person who does not need assistance, and 8$ for the same 15 minutes for a person who needs assistance on internet use”. These findings were consistent with the research findings of Akpabio, Okon and Inyang (2007) who reported that poor ICT infrastructure, high cost of broadcast equipment, high charges for radio/television presentations, high cost of access/interconnectivity and electricity power limited Nigeria’s extension officers to use ICTs.

Other barriers included: high user fees for internet services in the telecentres, lack of public and private partnership in the rural ICT investments, difficult to change farmers’ mindset, communities were located too far which inhibited the rural radio stations to involve farmers in the production of agricultural radio programmes, and difficulty in keeping pace with the technology advancements. Other barriers were difficult regulations by TCRA (Tanzania Communication Regulatory Authority) in establishing community radio; lack of research on the development of ICTs; lack of subsidy from the government on rural ICT investments; lack of trust between macro and micro companies involved in rural ICTs; poor recognition of agriculture as an income earning sector; the predominant small-scale agriculture had limited farmers to market their produce online; and telecentres may become unpopular due to the advancements of ICTs such as internet access through cell phones. Although most problems could be solved by the telecenters (such as institutional policies, ICT literacy, awareness, funding, and content), other challenges require efforts of both public and private sectors’ to be solved, which include trust between macro and micro companies, coordination among agricultural actors, capacity building, establishment of rural telecentres, content, and knowledge culture in the communities. Further, other problems would require government support to be solved, which include issues related to the regulations of community radio, rural electrification, subsidies for rural ICTs and improved infrastructure.

5. CONCLUSION AND RECOMMENDATIONS
The study found that the telecenters and rural radio can bridge knowledge gaps in the rural communities if they are facilitated with adequate resources, in terms of skills, facilities, finances, and policies. The study findings showed that there was low use of internet for knowledge acquisition, while cell phones were becoming popular for farmers to communicate with telecenter operators and rural radio in case of emergency or advice regarding farming activities. Few farmers used telecenter services, such as email and internet services due to lack of assistance, awareness, and skills, high costs, and language barriers. Telecenters also faced problems in the provision of their services, which were related to funds, policy and regulations, content, electricity, use of telecentres by farmers, research, trust between macro and micro ICT companies, and advancements of ICTs such as internet access through cell phones. If enhanced financially, with conducive regulatory environment and adequate value added services that target rural farmers, telecenters can be used as effective tools to disseminate agricultural knowledge and information in the local communities.
This study therefore recommends that the government should provide financial support, improve the supply of electricity in the rural areas, and create conducive regulatory environment for the rural ICT investments, such as by putting subsidies for the establishment of rural ICT services. This paper also recommends the following to the telecenters:

- Continuously improve and renew their services by conducting regular information needs in order to provide demand led services, satisfy disparate farmer’s needs and ensure their survival in the rural areas;
- Use multiple ICTs (such as mobile cinema, outdoor media, television, radio, cell phones) in combination with indigenous communication approaches such as storytelling, dance and drama specific to a local context to improve learning and sharing of knowledge in the communities;
- Build their capacity by seeking opportunities for further ICT training;
- Establish appropriate awareness creation and training programs to enable farmers to access and use ICTs to improve their agricultural activities; and
- Collaborate with other public and private officers, and village leaders to nurture knowledge culture to enhance learning and sharing of knowledge through ICTs in the communities; and
- Cooperate with farmers and other public and private organizations in the rural areas in content generation in order to bring the sense of ownership, and improve use of ICTs for agricultural development in the rural areas.

6. REFERENCES


