
Minding the Gaps: Information and Communication Technologies (ICTs) and Sustainable Agriculture Development in Rural Areas of Tanzania

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ABSTRACT

This paper reviews the state of information and communication technologies (ICTs) in connection to agricultural development in rural areas of Tanzania. Over the last two decades, Tanzania has emerged as the most preferred destination for outsourcing of ICTs services, while rural development forms an important government agenda. However, agricultural sector of the economy is lagging behind in utilizing ICTs services. The main reasons for this are poor ICTs infrastructure in rural areas, and poor ICTs awareness among agency officials working in rural areas. Hence, the paper explores the lessons learned from applying an “institutional lens” to the ICTs deployment to address agricultural challenges in Tanzanian rural settings. The paper examines the thinking about the ICTs tools initiatives that addresses the institutional challenges facing Tanzanian agriculture. Using literature review, this paper examines and discusses the rapid strides, which the country has registered in the ICTs field. These strides remain incomplete unless ICTs is fully utilized for efficient and productive agriculture. Likewise, the adoption of ICTs services in agriculture depends on the main functionaries involved in Tanzanian agriculture. The following functionaries are considered; farmers, industries providing inputs to agriculture, industries dealing with agricultural output, government, NGOs, and telecentres working for the benefit of farmers and agricultural research points. Therefore, this calls for “institutional efforts” to provide ICTs-based services for sustainable agricultural development. This is because at theoretical level, New Institutional Economics (NIE) postulates that information is asymmetrically distributed and market transactions for gathering information come at a cost. Consequently, institutions have to be formed to reduce costs. The paper attempts to understand critically how ICTs help to overcome the structural, social, economic, and cultural barrier, in delivering agricultural information and knowledge to farmers in rural areas.

Keywords: *information and communication technologies (ICTs), agriculture development, agricultural-based ICTs services, new institutional economics (NIE)*

I. INTRODUCTION

Tanzania's main economic pillar is embedded in the agricultural sector, which supports over 33 million people and contributes 60 percent of the country's GDP, 61 percent of the export earnings, and provides 84 percent of rural employment (Chongela, 2015; World Bank, 2019). The Tanzania Development Vision has set a target of achieving a level of general standards of living typical of medium-income countries by the year 2025. For the agricultural sector to contribute fully towards sustainable development target, it should grow annually by 7 percent, implying more than doubling the current annual growth rate of 3.3 percent. Agricultural research has a major role to play in increasing productivity and profitability of the sector through development of scientific knowledge to generate improved technologies for the production systems. Agricultural extension in Tanzania complements this effort by transferring technologies developed by the National Agricultural Research Systems (NARS) to the end-users.

Farmers in Tanzania operate in widely distributed rural locations, which deprive them of the benefits of timely and useful information from research centres and services organizations. This is because of the inadequate dissemination and adoption of agricultural technology. Hence, information technology has a definite role to play in making the Tanzanian farmer more prosperous. This is because information technologies play a significant role in enhancing rural development in developing countries. Rural development forms an important agenda of the government of Tanzania. However, the application of Information Communication Technologies (ICTs) in the rural development sector, specifically in agricultural development, has been relatively slow. The main reasons for this include poor ICTs infrastructure in rural areas, poor ICTs awareness among agency officials working in rural areas and local language issues. Therefore, the paper explores the lessons learned from applying an "institutional lens" to the ICTs deployment to address agricultural challenges in rural settings of Tanzania. Furthermore, the paper examines the thinking about the ICTs tools initiatives that addresses the institutional challenges facing Tanzanian agriculture for agricultural development.

It is well documented that ICTs are crucial in facilitating communication and access to information for agricultural and rural development (Ngowi and Mwakalobo, 2017). Since agriculture is the national priority sector, it is one of the potentially beneficial areas for the application of ICTs for economic transformation. According to Ngowi *et al.*, (2015), development of networks and the use of low-cost ICTs

enhance timely access to accurate and reliable information. Therefore, there is a call for investment of part of the country's limited resources for ICT development.

According to Lwoga (2010), there is no single area in agriculture where ICTs has no role to play. In the light of globalization and the impact of World Trade Organization (WTO) on agriculture and agro-based industries, the use of information technologies based services in this field has become imperative (Mojisola and Mbibi, 2007). The immense scale and diversity of Tanzanian agriculture provides the ultimate challenge to the potential of information technology. The rapid strides, which the country has registered in the information technology field remains incomplete unless it is utilized to ensure more efficient and productive Tanzanian agriculture.

Since ICTs has revolutionized the world and has formed an integral part of all sectors, e-commerce has a tremendous potential in agribusiness. Information of the required quality has the potential of improving efficiency in agriculture. The current and future challenges faced in providing ICT-based learning desperately call for the reengineering of education, to move out of the formal structure of teaching and learning towards building a more practical and realistic approach for agricultural development.

Using literature review, this paper examines and discusses why it is important to examine the latest developments in information technologies that facilitate its effective penetration into rural areas and the types of systems required in this post-WTO environment. This is because the state of rural people, specifically in Tanzania, is characterized by their cultural, social, and economic diversity. They consist of sparse human populations whose key occupations are farming, pastoralism, and fishing. Conversely, a rural non-farm economy exists and alternates with the agricultural season, and includes various activities such as trading, manufacturing, and agro-processing. , considering the limited opportunities women have due to gender bias in the formal employment sector and other cultural barriers to property ownership, the farm economy is a crucial source of employment for rural women in Tanzania (International Fund for Agricultural Development, 2010). This is supported by the New Institutional Economics (NIE), which postulates that information is asymmetrically distributed and market transactions for gathering information come at a cost. Consequently, institutions have to be formed to reduce costs and improve productivity. This is because the field of economics has been paying increasing attention to institutional issues. As a result, it has developed

strong concepts and analytical tools that are particularly relevant to the problems of agricultural change in Tanzania.

This paper therefore, presents the efforts of consolidating lessons learned from applying an “institutional lens” to ICTs deployment to address agricultural challenges in the rural settings of Tanzania. It presents thinking about the institutional challenges facing Tanzanian agriculture and identifies the ICTs tools of agricultural development analysis that can be used to address them. The combination of theoretical aspects on core themes, supported by literature reviews from a wide range of literatures, makes an important contribution to the existing literature. Through an accessible synthesis of new institutional economics theory and literature, the paper develops a better understanding of Tanzanian agriculture and of how to improve agriculture through utilization of ICTs tools. Therefore, this paper recognizes the importance of ICTs as tools of socio-economic development (Lwoga, 2010, World Bank, 2019). However, the role of ICTs in fostering sustainable agricultural development and addressing the needs of the people in rural areas of developing countries have become the subject of a heated debate. This could be due to study differences, flaws, or sampling variations. As such, this paper employed “systematic review approach” on the relationship between ICTs and sustainable agricultural development in rural areas of Tanzania applying an “institutional lens.” This meant a theorization of how far and for what purposes ICTs have been used in various aspects of agricultural development in the rural settings. The New Institutional Economics (NIE) formed the theoretical background of the paper.

2. METHODOLOGY

Many publications are produced each year, often with conflicting findings possibly resulting from study differences, flaws, or chance, (sampling variation). These trends create uncertainty on what the overall picture is, or which results are the most reliable and should be used as the basis for practice and policy decisions. This analysis employed a “systematic review approach.” This approach aimed at addressing these problems by identifying, critically evaluating and integrating the findings of all relevant, high-quality individual studies in addressing one fundamental research objective. In its endeavour to understand the subject matter, the analysis established the extent to which the existing research has progressed towards clarifying the problem, identifying relations, contradictions, gaps, and inconsistencies in the literature. In addition, the analysis formulated a general overarching conceptualization that guided, commented on, and evaluated the analysis. Moreover, the analysis developed

a general conceptual analytical framework upon which the understanding of the role of ICTs in agricultural development, and its apposite solution and implications for practice and policy proposed in this paper were anchored. This was followed by a thorough clarification of whether and the extent to which the planned systematic review had already been done. Since the analysis aimed at conducting a search that was exhaustive and therefore representative of all studies on the subject under study the search terms were identified and carefully broken down from the main research question to help find as many potentially relevant articles as possible for inclusion.

3. FINDINGS AND DISCUSSION

Theoretical Perspective: “New Institutional Economics and ICTs for Agricultural Development”

It is useful to begin by presenting the conceptualization and consideration of ICTs in this paper. The main selection criteria were, on one hand, the prospects of using these technologies in the agricultural sector and, on the other hand, the potential for generating greater value and making the activity more sustainable. ICTs include a variety of electronic components ranging from computers, telecommunications equipment, multimedia equipment, measurement instruments, and electronic consumer goods (television sets and radios). They also include services (telecommunications, computing, software, maintenance, data processing and storage, webpage design, remote sensing among many others) that develop generic or specific applications for different economic sectors.

In the case of agriculture, the most widely used ICTs are those that allow basic communication: radio, television and, now, cell phones (whose use has exploded in recent years). However, there are also important areas of ICTs application in production and marketing: this is particularly the case for technologies associated with precision agriculture, information, and traceability systems. Given the importance of these technologies and their recent applications in agriculture, for example, in early warning systems, remote diagnosis of pests and diseases, application of an “institutional lens” becomes a paramount theoretical perspective. As such, new institutional economics (NIE) has been opted for, because they strongly influence current development theory and policy. It is an expansion of a neoclassical economic theory and its merits stems from the fact that it has identified efficient institutions to be the prerequisite for development. Therefore, NIE attempts to

incorporate a theory of institutions into economics. It is a deliberate attempt of making neoclassical economic theory more realistic (see for example, Hazell, 2005).

Neoclassical economic theory assumes that information flows freely between actors in competitive markets = as a result, institutions do not matter. In contrast, NIE postulate that information is distributed asymmetrically (asymmetrical information) and that market transactions come at a cost (i.e. the cost of gathering information, or transaction costs). Consequently, institutions have to be formed to reduce these costs. NIE retains the neoclassical assumptions that individuals seek to maximize their utility from scarce resources subject to budget constraints and that collective outcomes rest on the choice made by rational individuals (i.e. methodological individualism). However, it discards the concept of instrumental rationality, which implies that the choices made by each individual are foreseeable. With all information readily available to everyone (perfect information), uncertainty should not be expected in human actions. Institutions become unnecessary and efficient markets characterize economics.

The necessity for a modification of neoclassical theory arose from the fact that the so-called social dilemmas could not be explained by it. Social dilemmas are situations in which the choices made by rational individuals yield outcomes that are socially irrational. This is obvious in the case of public goods such as rural telecentres that are open to all, free of charge and thus not usually supplied by the market, but also applies to the case of asymmetrical or imperfect information (i.e. information to farmers is not fully available to everyone. Imperfect information might cause moral hazards in other words, the danger that one of two parties (rural ICTs service provider and farmer) in a contract knowingly alters their behaviour in order to maximize utility at the expense of the other party. Another aspect is adverse selection (e.g. imperfect information supplied to farmers), and/or principal-agent dilemmas (i.e. the problem of how “principal” (ICTs service provider) can motivate an “agent” (farmers) to act for the benefit of increasing productivity. In this context therefore, a widely accepted objective for agricultural development in Tanzania is the achievement of sustainable intensification (Reardon, 1998) through the adoption of new technologies.

The final prominent case where NIE is used is in the analysis of financial services for the ICTs adoption among poor farmers for agricultural development. The banking sector usually does not offer financial services to the informal sector because information is asymmetrically distributed between the potential borrower

and the lender. The lender does not have sufficient information on the borrower, whom he does not know personally, and who does not usually keep ICTs based written accounts or business plans and who cannot offer physical collateral. Thus, the lender cannot calculate the risk of default. As a result, credit to the informal sector is rationed since lenders are reluctant to give out credit. In this respect, the “agricultural skeptic” view holds that, there is overdependence on rain-fed agriculture with minimal application of ICTs, which, because of its inherent limited productive potential, is unable to support an increasing rural population. Thus, diversification out of agriculture is needed, as are investments to create non-agricultural employment and income opportunities (see, for example, Ashley and Maxwell, 2001; Ellis, 2005).

ICTs and the Agricultural Development

The theoretical and methodological approach adopted in this paper (which are mutually complementary) analyse technological development focusing on the agricultural development. According to this approach, which is useful in various lines of the new institutional economics (NIE), knowledge and innovation are generated through collaborative interactions among farmers, technology, and institutions. Such interactions can therefore speed the development of agricultural systems. Given their crosscutting nature and their impact on communications and data management, ICTs have a direct effect not only on interactions between farmers and their environment, but also on the forms of production and learning within the production chains. These technologies, then, have the capacity of transforming directly the manner in which agricultural systems evolve.

With this theoretical framework, the paper seeks to analyze some of the questions that arise concerning multiple dimensions of agricultural development that are affected by the new ICTs paradigm. As the World Bank (2019) argues, the development of ICTs-based technologies in agriculture is a result of a simultaneous evolution of multiple technological systems exchanging information and knowledge within a common institutional and regulatory framework. Lwoga (2010) analyze recent trends in ICTs access and use in rural areas of Tanzania in the light of the spatial transformations that have also been promoted by the digital revolution. Chapman *et al.* (2005) provide a detailed description of ICTs applications in agriculture, based on progress on the supply side, that is, in the development of generic ICTs and their adaptation to agricultural tasks. Therefore, at the global level, there is a plethora of ICTs applications to agriculture, and other platforms and communities of practice

facilitate the exchange of information and experiences amongst farmers, policy makers, agricultural and development experts, and international organizations (Chapman et al., 2005; Lwoga, 2010, World Bank, 2019). They raise awareness on how ICTs can contribute to many aspects of agricultural development.

With modern ICTs, extension services provide tailor-made advice for each farmer to help them select the most profitable route of creating optimal conditions for plant growth. This is because due to population growth and the shrinking of natural resources, the increase in food productivity has been through higher and more efficient use of inputs, such as quality seeds, fertilizers, and water. The availability of timely and adequate information on these critical inputs is essential for sustainable high productivity and food security. This depends on the judicious use of natural resources, such as soil, water, livestock, plant genetics, forestry, climate, rainfall, and topography. Development in the enabling technologies such as ICTs, geographical information system technology (GIS), and global positioning system technology (GPS) facilitate informatics led agricultural development, which is a step towards enhancing the quality of life of the farming community.

Agriculture has undergone many changes in the 20th century, including introduction of new farming machinery, intensive fertilizers and agro-chemical management, plant breeding, high-yielding varieties of seeds, and genetics manipulations. The growing demand for food grains, vegetables, fruits, milk, poultry and newer challenges to agriculture, ICT, bio-technology and environment technology are viewed as the drivers of globalization in the scenario of liberalization, privatization, and a tighter Intellectual Property Rights regime (Chauhan and Kar, 2019). Moreover, the global environment arising out of WTO poses challenges requiring Tanzanian agriculture to be competitive, sustainable, viable, and equitable. In addition, until harvest, agriculture is a state subject, while it becomes a commodity of global trade afterwards. Hence, it is important that, agriculture be given its due recognition.

Tanzania is vast and has a variety of landforms, climate, geology, physiography, and vegetation. It has great regional diversity, which accounts for its uneven economic and agricultural development. Tanzania is becoming an information society with emphasis on information technology. The fusion of various technologies aided by information technology ushers in the desired inputs for sustainable agricultural and rural development. Hence, these technologies have many potential applications spanning the use of agriculture in all occupations from the farmer to the cooperative and professional bodies, from farm machinery vendors, fertilizer and chemical

companies, insurance, and commodities to agronomists, consultants, and farm advisors.

Since farming is also a business, the farmer takes several decisions to maximize returns through meeting information and commercial needs. Technology dissemination is crucial for getting across the benefits of any technology to farmers. This is because traditional methods are not cost effective. Therefore, a central repository for storing information in local languages is required.

ICTs and the Farmers

The basic information generated by various agencies must be analysed and presented to the farmer with respect to location of specific crops, forecasts of pests, diseases, and impacts of weather on crops, to name a few. The analysis of market-related information, namely the impact of cropping patterns and the effects of exports/imports on prices must also be done.

The differences between farming practices in developed and developing countries are reflected in the developed and underdeveloped areas within the same country. In addition, the ground realities often do not reflect the results of research, due to the awareness gap, which can be filled by technological revolution of information in stimulating agricultural development. This can provide smallholder farmers with the flexibility they need to change crop choices, develop products for small markets, and market directly to distantly located consumers. Organizations of small producers can strategically plan for low-cost inputs, better storage facilities, improved transportation links, and collective negotiations with buyers for better remuneration in order to benefit the farmers directly.

In the context of agriculture, the potential of information technology can be assessed under two heads:

- ⇒ As a direct tool for contribution to agricultural productivity;
- ⇒ As an indirect tool for empowering farmers to take decisions that have a positive impact on agriculture, known as agricultural extension services.

The precision farming extensively uses information technology to make a direct contribution to agricultural productivity. The technique of remote sensing using satellite technologies, geographical information systems, and agronomy and soil sciences, are used to increase agricultural output, which are more suitable for

corporate farming. However, the indirect benefits of information technology in empowering Tanzanian farmers require timely and reliable sources of information inputs for taking decisions. The changing environment faced by Tanzanian farmers makes information not merely useful, but necessary so that they can remain competitive.

The emerging scenario of a deregulated agricultural system has made the deployment of information technology necessary as a strategic tool for the benefit of rural Tanzania. These facilitate a proper understanding of the implications of the WTO on Tanzanian agriculture, without any ambiguity. The mandatory changes in government policies on tariffs, imports, annual phasing of the same and the impact on various subsidy schemes, would be of great concern to people. Since the removal of restrictions on Tanzanian agricultural markets, the macroeconomic situation related to foreign exchange, and inflation to name a few, has a significant impact on Tanzanian agriculture.

Decision Support Systems for the Farmers

The Tanzanian farmers are cautious and usually tend to avoid taking risks. The provisions of WTO stipulating reductions in exports subsidies on farm products will make Tanzanian exports more competitive. The data on the cost of cultivation, efficient agricultural practices, and availability of inputs will help to assess the strengths of indigenous products vis-à-vis imports. Availability of information of the adverse effects of WTO regulations on any specific agricultural product will help farmers take corrective measures. In the emerging scenario, competitive advantage should be fully exploited to improve export potential. Opportunities for specialization may lead to better export potential. Similarly, forecasts on threats in terms of information related to cheaper imports and the macroeconomic conditions of other countries are required.

It is possible to lift geographical barriers by helping farmers come together online and facilitating the disposal of their produce at attractive prices. Online bidding can be introduced for various agricultural commodities. However, this will require complicated information technology systems, which should be supported by proper infrastructure and post-harvest technologies, and storage to name a few. Therefore, it is necessary to bring Tanzanian farmers together for value additions to their agricultural output and to get them better returns from their produce. The opportunities for setting up such units, procedures related to exports, the quality

norms to be adopted, packaging, and the like must also be made available. As such, it is necessary to promote monitoring cells in all major institutions related to agriculture and allied activities to maintain data, provide periodic analytical reports, and raise advance alerts.

Remote Sensing in Agriculture

The basic principle involved in remote sensing is that different objects reflect different amounts of energy in different wavelength ranges, based on different properties. A sensor is used to record such reflected energies from the surface of different objects. This recorded energy is then transmitted to the users, processed to form an image, and then analysed to gather information about the target. In the context of frequent droughts and given the fact that weather forecasts are often wide off the mark, the use of remote sensing becomes imperative. The success of farm operations, from sowing to harvesting, depends upon correct forecasts. Moreover, it is also helpful in gathering vital information on pests, water, and other natural resources depletion to name a few, which can help planners and researchers effectively and strategically counter these effects. In addition, it is possible to study continuously all kinds of renewable and non-renewable resources such as water resources, forest cover, land use/land cover patterns, coastal resources, geology, and geomorphology to name a few. Satellite remote sensing has great potential and is an efficient technology for the inventory and monitoring of natural resources. However, remote sensing is not without constraints, some of which include

- ⇒ Non-availability of uniform spectral data,
- ⇒ Data gaps due to clouds cover,
- ⇒ High cost and time consuming, and
- ⇒ Low correlation yield for certain crops, such as groundnuts.

Expert Systems in Agriculture

Expert systems are currently considered the most commercially successful product of artificial intelligence research. The problems confronting farmers are complex; these include yield losses, soil erosion, diminishing market prices because of international competition, increasing chemical pesticide costs and pest resistance, and economic barriers hindering the adoption of farming strategies. Hence, farmers

need to become expert managers of all aspects of their farming operations. Expert systems are used to aid the following,

- ⇒ Single-point decisions, such as the design of an irrigation system, the selection of the most suitable crop variety;
- ⇒ Sequence of tactical decisions throughout the production cycle, plant protection and nutritional decisions;
- ⇒ As a stand-alone advisory system for a specific case; and
- ⇒ As a delivery system for extension information.

Some of the agricultural expert systems in Tanzania and abroad include

- ⇒ Farm advisory systems to support agri-business management;
- ⇒ Rice-crop doctors to diagnose pests and diseases for the rice crop and suggest preventive measures;
- ⇒ Computer assisted agriculture, a system developed for farmers, agricultural officers and researchers with the facility of interacting in the local language;
- ⇒ Expert systems for cotton, coffee and maize crop management for cotton, coffee, and maize growers; and
- ⇒ A variety of systems for forecasting the needs of farming, cost-benefit analysis, water quality monitoring and crop rotation planning systems.

Constraints and Remedies for Effective Dissemination of ICTs-Information in Agriculture

Some major constraints, which are delaying the spread of the e-revolution in agriculture in rural Tanzania, include the following.

- ⇒ Haphazard development, namely the duplication of efforts due to limited subjects: this can be overcome through a coordinating agency with advisory powers such as user interface, standards for setting up telecentres alongside community radios in rural areas.
- ⇒ Non-availability of user-friendly technologies: this can be overcome by providing touch screen monitors and intuitive graphics-based presentations.
- ⇒ Difficulty in providing advice in local languages through computers;

- ⇒ The government's map restriction policies, which hinder optimal utilization of data generated through remote sensing;
- ⇒ Uncertain and poor quality power supply in rural Tanzania, which can be overcome by providing solar power packs for uninterrupted power supply (UPS) in telecentres and community radio. Despite the many facilities available, connectivity in rural areas requires improvement.

The face of Tanzanian agriculture can be transformed by a well conceived deployment of information technologies. The key players involved in this process including industries, the government, educational institutions, and research centres are required to develop immediately the necessary information technologies based on agricultural services.

In the light of globalization, it is necessary for the industry related to agriculture to review their current infrastructure on information technologies with respect to marketing function and undertake measures to strengthen the same. No single institution or organization can succeed in e-powering farmers in rural Tanzania. At the same time, scattered and half-hearted attempts cannot be successful in meeting the objective. Industries with major stakes in the villages should come together to provide the initial impetus.

The success of any information technologies based service to rural Tanzania hinges on evolving a proper revenue model for the dissemination points. The telecentres alongside community radios can draw revenue from the industry by providing and disseminating the required services. Once these dissemination points prove to be economically viable, the revolution of information technologies in rural Tanzania will not require crusaders. However, it must be kept in mind that the challenges and rewards in the field are reciprocal and the greatest challenge is to keep pace with the ever changing and evolving technologies.

Future of Extensions in Agriculture

In view of the emerging competition in the fertilizer industry resulting from an increase in fertilizer consumption and crop productivity, the thrust areas of fertilizer promotion must be properly defined and tackled in order to get the desired results and improve the socio-economic conditions of farmers. Information is an important resource in agriculture. Farmers need information to improve their farming and extensions to provide them relevant and timely information. The main function of

the extension is the transfer of information. These services can overcome obstacles in technology transfer and pave the way for agricultural development. Applications of communication technology in the transfer of agricultural information have two implications:

- ⇒ The results provide the basis for adjusting strategies.
- ⇒ Successful cases can become a model for replication.

Fertilizer marketing without promotion and extension is merely a selling activity. In a competitive market, service to the consumer/customer is most important. Availability of fertilizers has improved; and farmers today have the option of selecting from various brands available in the market. Hence, extension education has become a dynamic concept in the fertilizer industry. Therefore, the current strategy of extension education is to keep farmers not only within the fold of balanced fertilizer use, but also to care for the maintenance of soil productivity. Extension services can guide farmers to have a proper mix of traditional and innovative farming practices.

Structural and functional changes in agricultural extension are important in meeting the needs and challenges of the new millennium. Globalization and liberalization era has made people re-think of the role of public extension in developing countries. Extension workers/farmers can acquire knowledge as and when they have time and want to do so. For instance, a farmer may visit an extension officer for pest control. He/she can identify the type of insect by consulting a database through photographs, consult the local entomologist, and select suitable pesticides as a measure of pest control. The quality of extension material and process can be supplemented from time to time by multimedia, computer simulation, and the like. Moreover, these extension systems can also make earnest efforts of organizing farmers' groups and motivating and directing them so that they can demand appropriate and better extension services on a cost-sharing basis. The empowerment of small and marginal farmers through the cost effective intensive use of electronic communication technologies is one of the most important possibilities.

4. CONCLUSION AND RECOMMENDATIONS

The paper concludes that there are numerous, well established barriers against improving information exchange. Knowledge capture, high cost of information access, and infrastructure constraints affect the equitable distribution of information

in rural areas. However, technological advances in ICTs have reduced the cost and increased the quantity and speed of information transfer dramatically. That is to say, technologically, it is possible to develop suitable systems to cater for information needs of the Tanzanian rural farmers. User-friendly systems, particularly in local language, can generate interest in farmers. It is possible to create dedicated networks or harness the power of the internet to make these services available to farmers in all parts of the country. However, the task of creating application packages and databases to cater for the entire spectrum of Tanzanian agriculture is a giant task.

Specialized Tanzanian institutions cater for various aspects of agriculture and can play a crucial role in designing the necessary applications, databases, and services. Efforts should be made to promote a coordinating agency, which would have an advisory role and evolve a standard interface for users. This will call for urgent measures of introducing state-of-the-art technologies, such as remote sensing, geographical information systems, bioengineering, satellite technology, and the like, to monitor effectively agricultural performance. This will not only help in planning, advising and monitoring the status of the crops, but also in responding quickly to crop stress conditions and natural calamities. However, while developing these systems it must be borne in mind that the population, which is targeted, is not comfortable with the use of computers, and a major challenge is the dissemination of information to the rural farmers. The need for a concerted effort of building knowledge partnerships and of engaging the private sector and technology drivers in the pursuit of rural development goals is paramount if ICTs are to have a role in future strategies.

Finally, this paper presents the efforts of consolidating lessons learned from applying an “institutional lens” to ICTs deployment in addressing agricultural challenges in rural settings of Tanzania. It presents thinking about the ICTs tools, initiatives of addressing institutional challenges facing Tanzanian agriculture for agricultural development. The combination of theoretical aspects on core themes, supported by literature reviews from a wide range of literatures, makes an important contribution to the existing literature. Through accessible synthesis of new institutional economics theory and literature, the paper develops a better understanding of Tanzanian agriculture and of how to improve it through utilizing ICTs tools. Thus, the focus of this paper is on the potential for more strategic application of ICTs in addressing the challenges facing agricultural development in rural areas. In particular, the paper looks at how far ICTs offer solutions to long-standing agricultural development problems and whether they can make a

significant contribution to enhancing the existing and the ongoing initiatives. This is because the agricultural sector faces major challenges in enhancing production in a situation of dwindling natural resources, which are necessary for production. The growing demand for agricultural products, however, offers opportunities for producers to sustain and improve their livelihoods. ICTs play an important role in addressing these challenges and uplifting the livelihoods of the rural poor. ICTs offer an opportunity of introducing new activities, new services, and applications to rural areas and or to enhancing the existing agricultural services. ICTs play a significant role in combating rural poverty and fostering sustainable rural development through creating information rich societies and supporting livelihoods. If ICTs are appropriately deployed and streamlined to realize the differential needs of urban and rural people, they can become a powerful tool of economic, social, and political empowerment.

There is a substantial body of literature on the potential role of ICTs in agricultural development and the fundamentals of these debates are well rehearsed. Current debates on the potential role of ICTs tend to be constrained by an inherent mutual lack of understanding between the technology drivers and development agencies that find it difficult to establish a common ground, especially when the technology and its implications for society are changing so rapidly. This apparent impasse raises some particular problems for development research. ICTs applications in rural Tanzania remain largely uninformed by recent developments in the literature, and conversely many development agencies have failed to effectively mainstream strategies to harness the potential of ICTs.

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