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*“Harnessing the flow of geospatial information in addressing the challenges of sustainable development in Africa”*

## **Information and Communication Technology for Sustainable Forest Management in Tanzania: Challenges and Opportunities**

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### **Abstract**

Information and Communication Technology (ICT) is believed to accelerate Sustainable Forest Management (SFM), which advocates for the management of forests according to the principles of sustainable development. SFM is latest in a progression of forest management concepts preceded by sustainable forestry and sustainable yield forestry which uses very broad social, economic and environmental goals. While the role of ICT is widely recognized, the level of ICT utilization in Tanzania particularly in the forest sector is not well known. Based on this ground, this paper presents the status of ICT usage in Tanzania, depicting a case of Kitulangalo Forest Reserve in Morogoro Tanzania. The important issues explored include the level of ICT inclusion in the forest management plans, type of ICT being used and how ICT has facilitated the management and decision making. The findings revealed that there is very low penetration of ICT services and applications. The main challenges/constraints identified include; poor ICT infrastructure development, high cost of broadcast equipment, high cost of access/ interconnectivity and electricity power problems including inadequate experienced ICT personnel. Despite the challenges, there are opportunities for improvement that include the existence of forest policy that recognizes ICT as a means for sustainable forest management and prospects for investment in ICT. The paper concludes by suggesting continued propagation of the ICT to improve data management, information and knowledge sharing.

Keywords: Sustainable forest management, ICT, Kitulangalo Forest Reserve, Tanzania

### **1. Introduction**

#### **1.1 Sustainable forest management and ICT – an overview**

Sustainable Forest Management (SFM) means the conservation, development and utilization of forest resources; improve the general level of economic activity, and to enhance the environment and standard of living in designated forest areas (USDA, 2007). Conservation

means developing natural resources rationally and thus enabling maximum benefit to be obtained while production capacity is preserved indefinitely (Veloza, 1987), while development means enabling the populations of any rural community to live a “better life” in equilibrium with the environment and natural resources of the target area. The minimum level of a “better life” is at least to supply the basic needs of the population in terms of sufficient produce and/or income to provide adequate food, clothing, and shelter to maintain the health of the rural population and a general state of the well being” (Veloza, 1987). Therefore SFM advocates for the management of forests according to the principles of sustainable development. According to United Nations, the World Commission on Environment and Development (Brundtland Commission) (1987), Sustainable Development emphasizes on the concept that current generations should meet their needs without compromising the ability of future generations to meet theirs, and the debates of the Millennium Summit as presented by The United Nations Development Program (UNDP, 2001). Hughes and Johnston (2005) have recognized that sustainable development is now as much about social equity for current generations as about efficient resource-use and conservation of natural resources for future ones. Thus, sustained growth is the key to greater social equity. It is however important to note that achieving sustainable development, the use of Information and Communications Technologies (ICT) is imperative. Beneficial ICT activities in SFM, with clear framework for investments in capacity building and in promoting, multilayered cooperation and knowledge sharing locally as well as globally can enhance nationwide economic growth and social progress. This paper investigates the role of Information and Communications Technologies in sustainable forest management by looking at the challenges and opportunities for ICT usage in developing countries, taking a case from Tanzania.

Information and Communication Technologies (ICT) is the catch-all phrase used to describe a range of technologies for gathering, storing, retrieving, processing, analyzing and transmitting information (QSSS, 2007). ICT is not only about new technology; it is also about new ways of doing things. According to Hetemäki and Nilsson (2005), ICT can be seen as having three interlocking themes: i) new developments in the technologies themselves, ii) new innovations, developments within organizations, and developments in sectoral working/business practices, and iii) how quickly and how widely these developments are being taken up in society. The details of the technology are less important than the changes that ICT is bringing to the basic structures of society (Hetemäki and Nilsson, 2005). For example, ICT has important implications for the ways societies organize work and create economic wealth and for how

people spend their leisure time. It helps to interconnect people, economies, and societies in new ways.

There has been a lot of enthusiasm for the use of ICT to combat poverty and foster economic growth. In recent years, many global initiatives, such as the G8 Dot Force, UN ICT Task Force and World Summit on the Information Society (WSIS), have helped raising awareness of the benefits and opportunities offered by these technologies to the international communities, and more specifically, to the developing world (CIDA, 2008). Today, ICT is recognized as comprising important tools to access knowledge and information, and to create national, regional, and global networks that promote growth and democracy, and advocate change (CIDA, 2008). Furthermore, ICT tools are also recognized as crucial for enabling access to the global knowledge-based economy, thus empowering civil society actors and facilitating their participation in the sustainable development of their countries.

In recent years, the developed economics have made dramatic advances in the field of information technology, and the resulting upsurge has contributed significantly to economic growth. Information technology is used in fields ranging from government administration to social and economic activities (JICA, 2008). Examples include the computerization of central government functions (e-government), Internet-based education (e-learning), and electronic commerce (e-commerce). The use of IT in these areas brings improved economic and social efficiency and further stimulates economic growth (JICA, 2008).

Information and Communication Technology has the potential to realize better quality of life, including higher productivity and living standards, as well as improved community services (JICA, 2008). However, these benefits are not available to those who are unable to use or learn ICT, especially in developing countries. The “digital divide” between people and countries that are able to reap the benefits of ICT and those that cannot is also reflected in widening economic disparity (JICA, 2008).

## **1.2 ICT in Africa**

According to a Status Report on Information and Communication Technologies in Africa of 2002, the use of ICT has grown relatively rapidly in most urban areas. Five years prior to 2002, only a handful of countries had local Internet access, now it is available in every capital city (ICT-Status Report, 2002). There has been increased deployment of mobile cell phones

on the continent than the number of fixed lines laid in the last century. Hundreds of new local and community radio stations have been licensed, and satellite TV is now also widely available. However, the Digital Divide is still at its most extreme in Africa, where the use of ICT is still at a very early stage of development compared to other regions of the world (ICT-Status Report, 2002). According to ITU and UNESCO, of the approximately 816 million people in Africa in 2001, it was estimated that only: (a) 1 in 4 have a radio; (b) 1 in 13 have a TV; (c) 1 in 35 have a mobile phone; (d) 1 in 40 have a fixed line; (e) 1 in 130 have a PC; (f) 1 in 160 use the Internet; and 1 in 400 have pay-TV. However, presently these indicators are likely to have changed dramatically due to expansion and increased awareness on ICT.

While that has been revealed, the digital divide between the urban areas and the rural areas is greater. Most of the services and users are concentrated in the towns, while the majority of Africans are scattered in small communities spread-out across the vast rural areas. Very limited perfusion of the telecommunication networks into rural areas (often over 75% of the country's telephone lines are concentrated in the capital city) and irregular or non-existent electricity supplies are a common feature and a major barrier to use of ICTs, especially outside the major towns (ICT-Status Report, 2002). Although the relatively low level of ICT penetration amongst the public in Africa has so far limited the use of ICTs for governance purposes, many administrations are beginning to streamline their operations and improve internal efficiencies by adopting ICTs within the organization.

### **1.3 Policy context and ICT in Tanzania**

The Tanzania Development Vision 2025 (URT, 1995) envisages a nation imbued with five main attributes: high quality livelihood; piece, stability and unity; good governance; a well-educated and learning society; and a strong and competitive economy capable of producing sustainable growth and shared benefits. It recognizes ICT a major driving force for the realization of the Vision and have it that they should be harnessed persistently in all sectors of the economy and should be put to the benefit of all social groups with a view to enabling the meeting of basic needs of the people, increasing productivity and promoting competitiveness.

The National Forest Policy (1998) advocates strengthening forestry extension services to ensure increased awareness and skills amongst the people on sustainable management of forest resources. It emphasizes extension efforts towards private and Community Forestry as well as Joint Forest Management in the government forest reserves and that for efficient and

effective extension services, cross-sectoral coordination will be promoted. The policy recognizes ICT as very important in achieving the intended objectives.

The National ICT policy (URT, 2003) provides a platform for ICT in Tanzania. The Policy's Vision is:

*“Tanzania to become a hub of ICT infrastructure and ICT solutions that enhance sustainable socioeconomic development and accelerated poverty reduction both nationally and globally.”*

while the mission is:

*“To enhance nation-wide economic growth and social progress by encouraging beneficial ICT activities in all sectors through providing a conducive framework for investments in capacity building and in promoting multi-layered co-operation and knowledge sharing locally as well as globally.”*

#### **1.4 Status of ICT in Tanzania**

There is remarkable progress in ICT in Tanzania as explained by the key statistics indicators benchmarked at Tanzania's Independence, at the start of the major reform process, in 1993 and 2002 (Table 1).

Table 1: Key ICT statistical indicators

<b>Indicators</b>	<b>1961</b>	<b>1993</b>	<b>2002</b>
Population (in millions)	12.3	26.7	33.6
Fixed line exchange capacity	11,300	125,703	234,640
Mobile operators		1	4
Mobile subscribers		1,500	700,000
Teledensity (lines per 100 people)	0.10	0.32	1.22
Data communications operators			16
Internet service providers		1	23
Internet subscribers (Dialup accounts and Wireless)		10	14,000
Internet capacity (total bandwidth Kbits)		64	44,000
Television licences		1	24
Radio broadcast licences	1	2	18

Source: URT, 2003

The remarkable improvements in ICT as regard to the key statistical indicators partly result from significant government reforms, privatisation, telecommunication sector liberalisation, the emerging private sector and entrepreneurship, and official development assistance. The risk of being excluded from the knowledge economy and social development propelled the government to put in place a policy framework, through which coordinating mechanism and harmonized strategies might be nurtured. The policy framework makes it possible for enabling sectors (such as telecommunications, information, or broadcasting) to work together whereby enabled sectors (such as education, health, governance, forest and agriculture) can become further empowered through the appropriate development and application of ICT (URT, 2003).

Despite the rapid improvements, Tanzania's ICT environment is still somewhat challenged (URT, 2003). ICT is concentrated in large cities, especially Dar es Salaam, the commercial capital with little deployment or access in other urban centres or in rural Tanzania. Presently, very few educational institutions have computer laboratories and other multi-media facilities. Furthermore the lack of a programme for training teachers on computers and other multi-media utilization has been identified as a major reason for slow take up of computer studies in Primary and Secondary schools. In general, there is a shortage of well-qualified professionals of ICT in Tanzania. Access to online and distance learning for ICT is also still limited. Furthermore, opportunities for training are mostly limited to few urban centres (URT, 2003). While there are many Tanzanian websites, most are in English, and are not, therefore, a dominant medium for society to access information.

The current Tanzania ICT situation requires urgent steps to enable Tanzanians to participate meaningfully in the knowledge economy, recognizing that Tanzania has low levels of human capital development, local content creation, ICT infrastructure and access (URT, 2003).

## 2.0 Case study – Kitulangalo Forest Reserve

### 2.1 Location

Kitulangalo area is located about 50 km east of Morogoro Municipality towards Dar es Salaam on the sides of Zambia-Tanzania Highway (Figure 1). Morogoro Municipality is about 200 km west of Dar es Salaam.

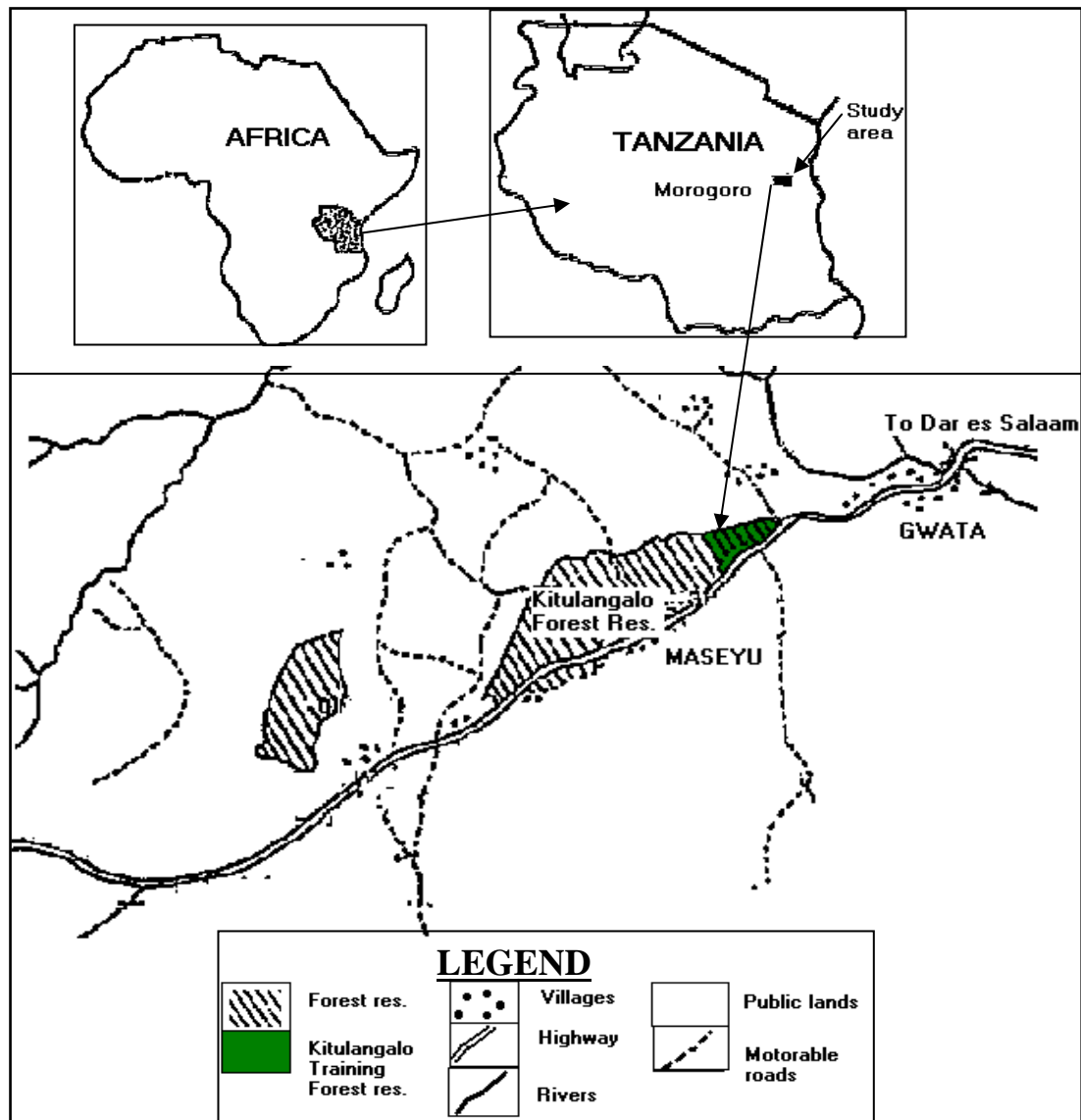


Figure 1: The location of the Kitulangalo area

The predominant feature in this area is the Kitulangalo Hill which is about 800 m above sea level situated at  $06^{\circ}41'S$  and  $37^{\circ}57'E$ . The major villages surrounding the forest are Maseyu, Gwata-Ujembe and Lubungo (Figure 1). Kitulangalo Territorial Forest Reserve with Map Job No. 244 was gazetted in 1955 by Government. Note No. 198/3/6/55 (Malimbwi and Mugasha,

2001). The total area of the forest was about 2,637.8 ha. The forest constitutes about 2100 ha after allocation of about 600 ha to the Faculty of Forestry, Sokoine University of Agriculture in 1995.

## **2.2 Management of the Forest**

According to Holmes (1995) cited in Malimbwi and Mugasha (2001), Kitulangalo was designated as a production forest reserve. However, its management was under the Regional Catchment Forest Officer Morogoro coordinated centrally by the office of the Director of Forestry and Beekeeping Division (FBD) in the Ministry of Natural Resources and Tourism. Traditionally, the major strategy adopted by third world countries to conserve natural forest resources has been to withdraw them from the public domain into the protective hands of the government (Malimbwi and Mugasha, 2001).

As population pressure, hunger for agricultural land and demand for wood and charcoal grew, the validity of the government strategy has been questioned. There have been conflicts between the government agents and the traditional users. Since the government's capacity to successfully guard these forests declined with the impact of Structural Adjustment Programs (SAP) which resulted in retrenchment of staff and limited financial support, undoubtedly a more practical strategy had to be put in place (Malimbwi and Mugasha, 2001).

Throughout the developing world new strategies, particularly those involving local forest users as guardians and managers are being tried and found successful. In Uganda, Tanzania, Ethiopia and Zimbabwe a growing number of initiatives towards involving local communities in forest management recorded progress (Iddi and Håkan, 1997). The government of Tanzania through the Forest and Beekeeping Division (FBD) took a leading role towards this strategy by revising its Forest Policy to address new challenges in Conservation and Management of the forest resources (URT, 1998). The new approach was to work in partnership with desired objective of sustainable forest management (Malimbwi and Mugasha, 2001). Community involvement in forest management is one of the key goals of the Tanzania National Forestry Program. A remarkable initiative by FBD was to train forest staff in skills to involve rural communities in the conservation and management of catchment and mangrove forests in 1998.



## 2.2 Study approaches

The main thrust of this study was to assess the impact of ICT on Sustainable Forest Management in Tanzania, using a case study of the Kitulangh'alo Forest Reserve in Morogoro. The key issues were to assess how forest managements have used ICT in managing forest resources, assess perception and understanding of ICT by adjacent communities and the level of ICT usage, identification of constraints facing application of ICT in SFM and propose future direction of ICT in SFM. In addressing these objectives, a combination of research approaches was used. The main methodology comprised interviews, questionnaire administration and discussion with various personnel at various offices and observations. Also a review of secondary information complemented the analysis.

## 2.3 Case study findings

### 2.3.1 Available ICT components

Table 2.1 presents the status of the available ICT components in the study area (Table 2.1). Results show that majority (40%) of respondents own either radio and phone, or radio only, followed by those who own phone only (5%) and those owning radio, phone and TV/video (5%), 10% of the communities don't have any ICT component. This implies that radios and phones are the most ICT components which are present in the communities, and used them in listening to various radio programs including news, music and sports, and for communication respectively.

**Table 2.1: Communication media used**

Communication media	No. of respondents	Percentage respondents (N=40)
Radio	16	40
Phones	2	5
Radio and Phones	16	40
Radio, phones and TV/Video	2	5
Total	36	90
None	4	10
<b>Total</b>	<b>40</b>	<b>100</b>

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The access to ICT was found correlated with the type and nature of the business one was doing. Those who were having greater access to ICT were found to be medium to high level business people. However, that did not imply their level of engagement in forest management.

The findings indicate that there was no use of advanced technologies like GIS in the management of the forest. The use of Participatory GIS can help to merge community knowledge and outside expert's, information in community based forest management. It is important to note that GIS is becoming recognized as a tool that can be applied to involve local people in the decision-making process, thus enhancing communication and understanding, and incorporating local people's perceptions regarding resources and their management.

### **2.3.2 Perceptions and ICT usage in sustainable forest management**

The findings indicated that over 70% of respondents understood the role of ICT in sustainable forest management but only 50% used ICT in communicating forest information. It was revealed that ICT facilitated the communication process in protection of forest reserve in the event of fire and that it enhanced the protection and patrol activities. Through use of ICT, it was easy for the villagers to respond timely in case of any event reported by the forest guards.

### **2.3.3 Constraints facing application of ICT in SFM**

There are many constraints in the management of Kitulangalo Forest Reserve. According to the respondents, the most pressing constraints include: a) limited connectivity to electricity and infrastructure, b) limited financial resources, c) low phones network coverage, and d) low knowledge on the application of ICT in SFM.

The above constraints are among the major problems experienced in most community based forest management. The issue of electricity is largely a rural problem and this is experienced in most parts of the world. For example, in order to develop a GIS database within the locality of the concerned community, there should be reliable electricity. This highlights on the need for improvement in rural electrification including infrastructural networks.

It is however very important to note that apart from the above constraints, there are many other challenges facing forest management in Tanzania. These include:

- Poor ICT infrastructure development,
- High cost of broadcast equipment,
- High cost of access/ interconnectivity
- Inadequate experienced ICT personnel
- Data availability and in required resolution

- Lack of centralized spatial database

### **2.3.4 The opportunities for ICT improvement in SFM**

There is a growing recognition of ICTs as potential tools for development at all levels. The National ICT policy (URT, 2003) exists that provides a framework on ICT in Tanzania. The Vision 2025 (URT, 1995) recognises ICT as very instrumental in achieving its objectives. In addition, the Forest Policy (URT, 1998) recognises ICT to be important tools for sustainable forest management. To ensure expansion of networks and connectivity, Tanzania has provided opportunity for investment in ICT. The existence of higher learning institutions providing ICT courses is an important opportunity for ICT improvement. Through these programmes more capacity (champions) is being generated.

### **3.0 Conclusions and recommendations**

The importance of ICT for sustainable forest management is widely recognised and continued propagation of the ICT technologies is required. Increased penetration of ICT in forest sector could make a greater impact and change the ways how things are being done. However, such a realization could only be possible by overcoming the existing impeding constraints while taking advantage of the available opportunities. Therefore, rural electrification and expansion of coverages are inevitable for the realization of ICT in rural areas. Furthermore, there is a need for increased capacity building and continued propagation of ICT to improve data management, information and knowledge sharing.

### **Cited references**

- Canadian International Development Agency (CIDA) (2008). ICTs for Development; Overview, [<http://www.aedi.cida.ge.ca>] site visited on 15<sup>th</sup> February, 2008.
- Hetemäki, L. and Nilsson, S. (eds) (2005). *Information Technology and the Forest Sector*. Report by the IUFRO Task Force on “Information Technology and the Forest Sector,” jointly organized by the International Union of Forest Research Organizations (IUFRO), the International Institute for Applied Systems Analysis (IIASA), and the Finnish Forest Research Institute (Metla). Vienna, IUFRO, IUFRO World Series Volume 18. 235p.
- Hughes, B. and Johnston, P., (2005). Sustainable futures: policies for global development, *Futures* (37) 8: pp 813-831.
- Iddi S. and Håkan, S. (1997). *Managing Natural Forests at the village level: Reacting ultimate Development goal*. A paper presented in 2<sup>nd</sup> Forestry Research Workshop, Sokoine University of Agriculture Olmotonyi Training Forest Arusha, Tanzania.

- Information and Communication Technologies (ICTs) in Africa-A status report (2002), [www.itu.int/osg] site visited on 22<sup>nd</sup> February, 2008.
- Japan International Cooperation Agency (JICA) (2008). ICT - Overview, [http://www.jica.go.jp/English] site visited on 20<sup>th</sup> February, 2008.
- Malimbwi, R.E. and Mugasha, A.G. (2001). Inventory Report of Kitulangalo Forest Reserve in Morogoro, Tanzania. Ministry of Natural Resources and Tourism, Forest and Beekeeping Division, Dar es Salaam. 57p.
- Queensland Smart State Strategy 2005-2015 (QSSS) Glossary [http://www.smartstate.gld.gov.au] site visited on 19<sup>th</sup> November, 2007.
- The United Republic of Tanzania (URT) (1995). The Tanzania Development Vision 2025. Planning Commission, Dar es Salaam. 42p.
- The United Republic of Tanzania (URT) (1998). National Forest Policy. Ministry of Natural Resources and Tourism, Dar es Salaam. 69p.
- The United Republic of Tanzania (URT) (2003). National Information and Communications Technologies Policy. Ministry of Communication and Transport, Dar es Salaam. 28p.
- UNDP (2007). ICT for development and the MDGs: document, [<http://ictd.undp.org>] site visited on 19<sup>th</sup> October, 2007.
- United Nations Development Programme (UNDP) (2001). Human development report, *Making New Technologies Work for Human Development*, Oxford University Press, New York.
- United Nations, The World Commission on Environment and Development (Brundtland Commission), (1987). *Our Common Future*, Oxford University Press, Oxford.
- United States Department of Agriculture (USDA), (2007). NRCS Conservation Programs, [http://www.nrcs.usda.gov/programs/rcd/] site visited on 30<sup>th</sup> October, 2007.
- Veloza, R. de, C. (1987). Incentives for community involvement in conservation programmes. FAO, Rome 159p.