

Interfacing ICT and Indigenous Knowledge Systems for Sustainable Environmental Management in South Africa

Joyce Myeza and Hassan O. Kaya

*University of KwaZulu-Natal, South Africa
E-mail: kaya@ukzn.ac.za*

KEYWORDS Sustainable Development. Geographical Information Systems. Environmental Information. Public Libraries. Gender

ABSTRACT The paper uses a survey of cases from South Africa to interrogate the prospects and challenges of using Information and Communication Technologies (ICT) in Indigenous Knowledge Systems (IKS) for sustainable environmental management. The examples demonstrate the practical application of ICTs in collecting, storing and disseminating indigenous knowledge for culturally specific environmental issues. The paper advances the view that community-based ICT centres could be useful tools for facilitating the transmission of culturally specific environmental information and the promotion of interface between indigenous and other knowledge systems for community-based environmental management. This implies that ICT services should be designed to enhance these processes and community needs. This will make ICT more relevant, cost effective hence locally manageable and sustainable. Moreover, since most of the IKS in local communities are orally transmitted, the focus should be made on technologies that promote oral interaction such as audio-visual technologies and text to speech.

INTRODUCTION

In the context of this paper Information and Communication Technology (ICT) comprises any communication tool or use of tools such as radio, television, cellular phones, computer and network hardware and software, and satellite systems. This includes the various services and applications associated with them, such as videoconferencing and distance learning (Hakansson 2006). The paper advances the view that ICT facilitates knowledge retention because of the role they play in collecting and retaining vital tacit and explicit knowledge which tends to be at a risk of loss. Yet local communities which depend on Indigenous Knowledge Systems (IKS) for livelihood including environmental management have no access to ICTs to meet the challenges of 21st Century and globalization (Dan 2008; Levy 2011). In this discussion IKS to bodies of knowledge, know-how, practices, and beliefs which people in specific cultural communities develop over time in the process of interacting with their natural environment for livelihood (Nyasani 2005).

Nakashima (2004) and Tusubira (2009) elaborate that both the corporate and government decision makers in Africa tend to overlook this aspect partly due to lack of knowledge and awareness on the importance of IKS in environmental management, lack of a formal methodology to collect, assess, and use IKS. In this

discussion environmental management refers to a determined activity which aims at conserving and improving the status of an environmental resource affected by human activities (Turban et al. 2004). It is on the basis of these limitations that the paper has the view that IKS-based knowledge and awareness training programmes should be organised to empower both the private and public sector, especially the youth on the role of ICT and IKS in sustainable environmental management.

Lwoga and Ngulube (2008) reiterate that ICTs have an important role to play in the retention of community-based knowledge on environmental management because they can facilitate the transfer, sharing, capturing and storage of this knowledge. Their infrastructure and the information systems enable knowledge networking among individuals or teams connected together to an ICT network. This helps to create community-based new and faster ways of delivering, transferring and retrieving information and knowledge for improving productivity and meeting the challenges of the 21st century. Technologies such as email, mailing lists, newsgroups, discussion forums, and knowledge web logs could be used to this effect (Mutula and Mooko 2008).

METHODOLOGY

The study used an examination of secondary sources and cases from different provinces

in South Africa including KwaZulu-Natal province to interrogate some of the prospects and challenges of interfacing ICTs and IKS for sustainable environmental management. The secondary sources used in this study included journals, magazine articles, news reports, encyclopedias, books and past research reports. Unlike primary sources, which provide first-hand accounts, these secondary sources were available and offered different perspectives, analysis, and conclusions of the relevant accounts of the research problem. Emphasis was on sources which cover the period after the democratic election in South Africa (Berg 2004).

RESULTS AND DISCUSSION

Indigenous Knowledge in Sustainable Developmental Context: Prospects and Challenges

United Nations Educational Scientific and Cultural Organization (UNESCO) (2011) shows that knowledge and awareness on the role of IK in sustainable development is increasing. In recent years there has been growing flow of information from developing countries including South Africa on the role that indigenous knowledge plays in diverse sectors. These include agriculture (intercropping techniques, animal production, pest control, crop diversity, animal healthcare, seed varieties), biology (botany, fish breeding techniques), human healthcare (through traditional medicine), the use and management of natural resources (soil conservation, irrigation and other forms of water management), education (oral traditions, local languages), and poverty eradication at large (Awori and Odhiambo 2003; Pappas 2008).

Andersen (2009) observed that scientists and development agencies in South Africa and other developing countries are using indigenous knowledge in various development projects and other contemporary contexts. Universities in South Africa such as the North-West University, University of KwaZulu-Natal, Universities of Limpopo and Venda are all developing innovative new teaching curricula at different tertiary levels and new approaches to the transfer of knowledge that take local knowledge systems into account. These growing research and socio-economic developmental interests in indigenous knowledge are reflected in

policy statements made by governments and non-governmental organisations in many countries.

South Africa has since 2004 adopted a National IKS Policy to protect and promote the use of IKS in sustainable development. The University of KwaZulu-Natal in South Africa has since 2013 adopted an institutional IKS policy to guide the integration of African Indigenous Knowledge Systems (AIKS) into its core business of research, teaching, learning and community engagement. AIKS is one of its tools of implementing the institutional vision and mission of being a premier university of African scholarship and contribute to Africa-led globalisation (University of KwaZulu-Natal Strategic Plan 2007-2016). International organizations such as the World Bank, International Labour Office, United Nations Education, Science and Culture Organization (UNESCO) and the Food and Agriculture Organization (FAO) are explicitly acknowledging the contribution that indigenous knowledge can make to sustainable economic and ICT development (UNESCO 2011).

However, African Economic Outlook (2009) indicates that although indigenous knowledge-based solutions to developmental challenges have proven their value in various cases in countries such as Ghana, China, India and Thailand like any knowledge system (IK), it is culturally and situation specific. This implies that it has also to be critically assessed before application. This is based on the observation that not all indigenous knowledge provides sustainable solutions to contemporary developmental challenges including sustainable environmental management.

However, the paper acknowledges that African indigenous knowledge systems are in danger of disappearing not only under influence of global processes of rapid change, but also because the capacity and facilities needed to document, evaluate, validate, protect and disseminate such knowledge are lacking in most African countries. The necessity for change requires capacity in terms of facilities, research, and financial resources. It also needs moral support, as local knowledge is usually given a lower status in both development and scientific circles than Western-based knowledge and technology systems. Further research has to be done on its various fields, and methods need to be developed for dealing with it. Such research must

of course be done together with the knowledge holders and practitioners in the specific local communities (UNESCO 2011).

ICT and Environmental Management: Implication for African Indigenous Knowledge Systems

Studies argue that in spite of the problems posed by technology on the environment, it is also one of the most useful tools available to the human race to help mitigate against developmental challenges including those associated with environment (Tusubira 2009). Example is given of technological advances in agriculture, industry, and transportation which have greatly improved human life in these activities; they are also sources of pollution on land, atmosphere, vegetation and rivers. Research in various parts of South Africa show increasing environmental problems such as desertification, urbanisation, deforestation, overpopulation and pollution (Awori and Odhiambo 2003).

At the same time Nakata et al. (2005) indicates that computers and other information systems are available to assist local knowledge systems in the prediction of natural and technological events that affect the environment. Wood (2006) emphasizes the need to protect the physical environment in South Africa. Despite the remarkable progress made in providing environmental information, there are still substantial constraints to the effective management and development of the environment. The challenges of increasing urbanisation, deforestation, desertification and pollution are now more remarkable than ever before in the country. The problems of uncoordinated policies and legal instruments, weak data base, inadequate enforcement, institutional conflicts, inadequate and untimely funding, and lack of public awareness are evident in the environmental management process in the country. ICT provides potential opportunities to solve diverse environmental challenges by providing a means of generating information, regular monitoring and analysis to predict and visualise future scenarios. Currently, it is used to define the association between variables on the earth surface and helps environmental managers in taking informed decisions. Modelling is assisting in analysing trends, identifying problems, revealing alternative paths to solving given problems, and indicating the

implications or consequences of decisions. Geographical Information Systems (GIS) is used to integrate data enabling professionals in various disciplines to analyse and visualize spatial relationships. Tambala (2004) adds that ICT is used in the country to evaluate changes in the physical environment and for trend analysis in spatial features throughout time.

Furthermore, the use of the internet can help identify users of recyclable materials and provide information about solar energy, low cost pumps and building materials. Users of computers can watch presentations on deforestation, pollution, loss of wildlife and habitat and then learn about ways to care for the environment. ICT has a significant role in providing the public access to timely, accurate and understandable environmental information which has been a major issue with environmental monitoring. Access to the data collected by Environmental monitoring (EM) systems is crucial to support public participation within any environmental decision making process. However, the paper argues that although ICT is used in various aspects of mitigating environmental management challenges in South Africa as indicated above, currently the interaction between ICT and Indigenous Knowledge Systems in this area in South Africa and Africa at large is still very limited.

African Economic Outlook (2009) reveals that in the predominantly rural provinces in South Africa such as KwaZulu-Natal, agriculture is the most vital sector for ICT intervention in environmental management using indigenous knowledge systems. A large proportion of the people in these areas depend on the natural environmental and the local knowledge systems for livelihood.

Nakashima (2004) states that rural people's community knowledge of their environmental flora and fauna can contribute to the improvement of their lives in terms of food security, natural resource management and healthcare. Access to ICT like telephone and internet is required to make it easy for them to share and make accessible their knowledge and skills available to the rest of the medical, food security and environmental management world through video, CD and Internet access. Therefore, the awareness and application of the value of indigenous knowledge (IK) will be a potential contribution to ICT and sustainable environmental manage-

ment for poverty eradication and Africa's contribution to the global pool of knowledge. This potential could spawn youth empowerment and community development growth in South Africa and the continent at a time when such knowledge is being neglected in policy, programme and project issues relative to sustainable environmental management.

Hooker (2011) shows that with agriculture, people learned and acquired knowledge through sharing information with each other. However, farmers in these rural areas are now faced with modern developmental challenges which necessitate the ability to take hold of updated information like prices, production techniques, services, storage, processing, etc. This brings the importance of capacity building in the use of ICT with regard to the Internet, mobile phone, and other digital technologies.

Poor families in the rural areas have limited or no access at all to ICTs. However, they also need access to ICT since this technology can help lessen their expenses on resources like time, labour, energy, and physical resources. This will have a greater positive impact on their livelihoods and incomes. Tusubira (2009) states that the lives of the rural poor in provinces such as KwaZulu-Natal could be alleviated through the application of information and communication technology through: supplying information on policies, institutions, and processes that affect their livelihood options; providing access to information needed in order to pursue their livelihood strategies, including financial capital. For instance, online and mobile banking will allow them to have greater access to: banking facilities and provide a secure place for cash deposits and remittances; human capital as using ICT will allow intermediaries or knowledge providers to impart updated knowledge, techniques and new developments in technology to the locals; physical capital, that is, service providers will be able to monitor access to local services; natural capital, that is, access to information about availability and management of natural resources will be enhanced. Also, market access for agricultural products will be enforced. ICT could provide: early warning systems to reduce the hazards of natural disasters and food shortages; social capital through connectivity, social networking and contact for geographically disparate households will be reinforced (Nakashima 2004).

Public Libraries in KwaZulu-Natal Preserve IKS for Sustainable Livelihood Using ICTs: Prospects and Challenges

There is a growing realization among public libraries in South Africa on the importance of IKS in sustainable development and community livelihood. As a result of this various public libraries have started to work with local communities to preserve IKS. This involves teaching them to use ICT tools to avoid the loss and distortion of this knowledge. Most of this knowledge is not documented and is traditionally transmitted orally.

For example, the consortium of eThekweni Municipal Libraries, which serves 89 local public libraries in the Durban area, started a crowdsourcing experiment to collect local indigenous knowledge systems. The Ulwazi Township based programme mainly records various Zulu cultural livelihoods, but it has the broader aim of capturing the mix and interaction of different cultures in the eThekweni Municipality. Besides documenting various aspects of Zulu traditional medicine, foods, biodiversity, indigenous agricultural methods, other aspects of IKS documented through the programme include traditional celebrations, traditional clothing, Zulu proverbs, and traditional folk tales. The Ulwazi programme has a collaborative online community memory database of local indigenous knowledge systems. It relies on the community to deliver content and post it on the web. The community assumes ownership of the database, while the library focuses on custodianship of the information resource. Community participation ensures that local knowledge is collected, recorded and preserved, and in the process it therefore shares knowledge, develops people's skills, creates job opportunities and empowers local communities.

McNulty (2015) indicates that The Ulwazi Community Memory website has been developed in the form of a wiki, an open-source webpage designed to enable contributions and modifications from multiple users. It also runs a blog and other social software applications, such as Facebook and Twitter. Since the development of the mobile interface in 2010, which can be used on the simplest of internet-enabled mobile devices, access via mobile devices has increased dramatically, now accounting for 20 percent of all visitors. At the moment Ulwazi does not have

a process for collecting indigenous knowledge systems via mobile phones, but this has been under discussion and should be rolled out in the next year or so. Indigenous knowledge is collected from local communities through community journalists, members of the public who can register an account and submit a story on a more ad-hoc basis, and through direct engagement with local residents often through community groups. Community journalists are actively recruited. They are generally younger people from the communities with some ICT skills, an interest in heritage and culture, and a desire to acquire new skills and gain work experience. The community journalists collect stories through personal interviews, in the form of audio recordings and video interviews. As such, this ground-level approach generates a much richer quality of content than external researchers could collect as they already have a relationship of trust with members of the community.

Community journalists are trained in oral history research and protocols, digital media production and internet literacy skills. Their submissions consist of short journalistic reports, but can be supplemented with oral histories and stories recorded as audio or video files. Community journalists are required to submit at least three stories a month and attend the monthly feedback meetings, where they discuss new entries. The real checks and balances are made by the community, whose knowledge it is. The Ulwazi Programme keeps the costs to a minimum through the use of open-source software, existing government infrastructure and volunteers. However, some limitations to the model have been discovered. These include a high turnover of community journalists, who, due to being sourced from an unemployed sector of the community, leave the programme once employment opportunities arise. This places additional stress on the recruitment and training aspects of the programme. Another challenge noted is that while the decision to embrace a multilingual approach towards content has been successful, this has also created the need for selective translations. Content management takes time and requires a certain set of skills and relevant experience. Training and development of volunteers and community journalists has proven to be time-consuming, as the development of ICT skills is generally slow among rural communities in the municipality. The training of small groups and

one-on-one support, while effective, is labour intensive. But in the end, the sharing of this local knowledge strengthens social coherence within communities and enhances tolerance between cultures.

Gender, ICT and Indigenous Knowledge Systems: Theoretical and Empirical Contestations

Grjestani (2000) indicates that there is a comprehensive body of literature focusing on ICTs in the context of various development discourses including gender and environmental management. Within the context of modernisation discourses, the focus on women emerged in what is currently known as the women in development (WID) discourse followed by the women and development discourses (WAD) which challenged the notion of women as automatic beneficiaries of economic development as assumed in WID discourse. The debate was followed by gender and development (GAD) which acknowledged the common suffering of poor men and of other marginalised people, not just of women. In terms of its proposed strategies for change, the latter argues for widespread social and economic transformation that will result in equitable and sustainable development (Webb 2009). However, none of these discourses and developmental strategies looks at the issue of gender, ICT and environmental management within the context of IKS (Etta 2005; Jain 2006). This is elaborated by Marcelle (2002) and Adera (2004) who argue that women are the main subsistence producers and environmental managers in African societies. Most of them have limited access to modern knowledge and technology systems depend on IKS for livelihood. Yet the introduction of modern technologies such as ICTs in the rural and marginalized communities where they live, is conceptualized by policy makers and development agencies as gender neutral (Bunwaree 2005; Huyer 2006). Grjestani (2000) states that there is ample evidence of a digital divide in African countries, especially among marginalised women in rural and poor communities who live on their community-based knowledge systems. There is an overall disparity between male and female access, which necessitates the need for policy intervention for mitigation.

Muturi (2006) further reveals that men and women differ in their usage of ICTs, especially

since the model used to analyse the relationship between gender and e-skills controlled for other relevant factors such as level of education and income. Unwin (2009) found that men and women adopt and use technology including ICT differently, as men's decisions to use technology are more strongly influenced by their perception of usefulness, while women's decisions are based more on perceptions of the technology's ease of use. Further, men and women may view the same mode of communication differently. For instance, women are said to use cell phones mainly for social reasons like maintaining relationships while men use them for maintaining employment contacts, professional and other work related issues (United Nations 2005).

CONCLUSION

The paper interrogated the prospects of interfacing ICTs and Indigenous Knowledge Systems for sustainable environmental management in Africa, drawing examples from South Africa. The study showed that knowledge and awareness on the importance of IKS in sustainable development is increasing worldwide. However, due to the cultural specific of IKS its application in different situations need to be critically examined. This is based on the observation that not all indigenous knowledge provides sustainable solutions to contemporary developmental challenges including sustainable environmental management. However, African indigenous knowledge systems are in danger of disappearing not only under influence of global processes of rapid change, but also because the capacity and facilities needed to document, evaluate, validate, protect and disseminate such knowledge are lacking in most African countries. Most of the IK in rural communities and marginalized communities is not documented and is traditionally communicated orally. ICT is important in this case because it facilitates knowledge retention through collection, transfer, sharing and storage. The ICT infrastructure and the information systems enable knowledge networking among individuals or teams connected together. This helps to create community-based new and faster ways of delivering, transferring and retrieving information and knowledge for improving productivity and meeting the challenges of the 21st century.

The paper laments that both the corporate and government decision makers in Africa tend to overlook this aspect partly due to lack of knowledge and awareness on the importance of IKS in environmental management, including lack of a formal methodology to collect, assess, and use IKS. Poor households, especially women, in the rural areas have limited or no access to ICTs. They need access to these technologies to lessen their expenses on livelihood resources and improve their environmental management capacities. It will also provide them access to policies, institutions, and processes that affect their livelihood options.

There is a growing realization among public libraries in South Africa on the importance of IKS in sustainable development and community livelihood. Some have already started to work with local communities to preserve IKS. This involves teaching them to use ICT tools to avoid the loss and distortion of this knowledge. The paper also noted that the discourse on digital divide in Africa tends to marginalize gender issues related to IKS and environmental management. This is in spite of the fact that women are the main subsistence producers in rural areas and marginalized communities using IKS.

RECOMMENDATIONS

It is on the basis of the concluding remarks that the paper recommends the following: (i) building capacity in terms of ICT facilities, research, and financial resources in local communities; (ii) need for moral support and political commitment in the integration of ICTs into IKS, as local knowledge systems tend to given a lower status in both policy development and scientific circles; (iii) research has to be done on various IKS fields in relation to the use of ICT and specific methods need to be developed for this interface of IKS and ICTs. This research must be done together with the knowledge holders and practitioners in the specific local communities where the ICTs will be used; (iv) in order for environmental management programmes in Africa and South Africa in particular to be truly effective, local communities, especially marginalised women as custodians of IKS, must take ownership of the processes involved in the interface between ICT and IKS to address environmental management; (v) policy makers and development agencies should establish moni-

toring systems using ICT and community-based knowledge systems to forecast and monitor the impact of natural and human-made disasters. This should also involve women as custodians of indigenous knowledge systems associated with environmental management; (vi) IKS-based ICT knowledge and awareness training programmes should be organised to empower both the private and public sector, including the youth on the role of ICT and IKS in sustainable environmental management.

REFERENCES

- Adera E 2004. *Gender and the Information Revolution in Africa*. Ottawa: International Development Research Centre (IDRC).
- Andersen D (Ed.) 2009. *Conservation in Africa: People, Policies and Practices*. Cambridge, England: University of Cambridge Press.
- Awori A, Odhiambo O 2003. Resource journal for sustainable development in Africa. *A Journal for Sustainable Development in Africa*, 4(2): 32-45.
- Berg L 2004. *Qualitative Research Methods for the Social Sciences*. 2nd Edition. Boston: Allyn and Bacon.
- Bunwaree S 2005. *Gender, Education and Development: Beyond Access to Empowerment*. London: Zed Books.
- Dan K 2008. Knowledge Retention. From <http://it.toolbox.com/wiki/index.php/Knowledge_Retention> (Retrieved on 28 February 2011).
- Etta F 2005. *Engendering ICT Policies in Africa: WSIS Gender Caucus Efforts*. WSIS. Washington: The World Bank.
- Hakansson A, Deer K 2006. Indigenous Peoples and ICTs: Millennium Development Goal 8 and the Information Society. *Paper presented to the 1st session of the Global Alliance for ICT and Development*, Moscow, June 2006.
- Hooker M 2011. *African Leadership in ICT and Knowledge Societies: Issues, Tensions, and Opportunities for Learning*. Nairobi: GESCI.
- Huyer S 2006. *Cinderella or Cyberella? Empowering Women in the Knowledge Society*. USA: Kumarian Press, Inc.
- Jain P 2006. Empowering Africa's development using ICT in a knowledge management approach. *The Electronic Library*, 24(1): 51-67.
- Levy M 2011. Knowledge retention: Minimizing organizational business loss. *Journal of Knowledge Management*, 15(4): 582-600.
- Lwoga ET, Ngulube P 2008. Managing indigenous and exogenous knowledge through information and communication technologies for agricultural development and achievement of the UN Millenium Development Goals. In: B Njobvu, S Koopman (Eds.): *Libraries and Information Services Towards the Attainment of the UN Millennium Development Goals*. Berlin: Walter de Gruyter, pp. 73-88.
- Marcelle G 2002. *Information and Communication Technologies (ICT) and Their Impact on and Use as an Instrument for the Advancement and Empowerment of Women*. New York: United Nations.
- Mutula SM, Mooko NP 2008. Knowledge management. In: LO Aina, SM Mutula, MA Tihamiyu (Eds.): *Information and Knowledge Management in the Digital Age: Concepts, Technologies and African Perspectives*. Ibadan: Third World Information Services Limited, P. 457.
- Muturi N 2006. Gender empowerment through ICTs: Potential and challenges for women in the Caribbean. In: FS Caballero (Ed.): *Redes.com: Revista de Estudios para el Desarrollo Social de la Comunicacion*, pp.138-144.
- Nakashima D 2004. *The Local and Indigenous Knowledge Systems Programme of UNESCO*. Paris: UNESCO.
- Nakata M, Langton M 2005. *Australian Indigenous Knowledge and Libraries*. Sydney: UTSe Press.
- Nyasani JM (Ed.) 2005. *Philosophical Focus on Culture and Traditional Thought Systems in Development*. Nairobi: Konrad Adenauer Foundation.
- Pappas S (Ed.) 2008. *Essays on Knowledge and Justification*. Ithaca: Cornell University Press.
- Tambala S 2004. *ICT for Environmental Monitoring Information Networks*. New Delhi: Ashoka Publishers.
- Turban E, McLean E, Wetherbe J 2004. *Information Technology for Management: Transforming Organizations in the Digital Economy*. 6th Edition. New York: John Wiley & Sons.
- Tusubira FF 2009. *Challenges to Development and Indigenous Knowledge Management in Africa*. Kampala: Phantom Solutions
- UNESCO 2011. *ICTs and Indigenous People: Policy Brief*. Paris: UNESCO.
- Unwin T 2009. *ICT4D: Information and Communication Technology for Development*. London, UK: Cambridge University Press.
- Webb A 2009. *African Women and ICTs Investigating Technology, Gender and Empowerment*. London: Zed Books.
- Wood S 2006. *ICT for Accelerating Development in Rural Africa*. London: Phantom Solutions.