Managing indigenous knowledge systems in Botswana using information and communication technologies

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Abstract:
Indigenous Knowledge (IK) and Indigenous Knowledge Systems (IKSs) have long been undermined especially in Africa. Due to its intrinsic values and the advancement of Information and Communication Technologies (ICTs), only recently IK has begun to gain attention. However, it is often misinterpreted and misunderstood, while it should be recognised like any other knowledge system in order to make the most of this precious knowledge. In the above context, this paper focuses on the role of ICTs in capturing, storing and disseminating indigenous knowledge for socio-economic development in Africa in general and Botswana in particular. The paper introduces the concept of IK and IKSs. Thereafter, the paper deliberates on the benefits of IK and the relationship between ICTs and IK, followed by the current trends in ICT use in Indigenous Knowledge Management (IKM), IK Systems in Africa, and linkage between ICT, IKS & poverty alleviation. The paper discusses IKS & ICT policy initiatives and implementation in Botswana, and the major challenges. Finally, this paper concludes with the recommendations on strong partnership between Government of Botswana and other stakeholders, integration of appropriate ICTs into IKSs, legal and regulatory framework, empowerment of local people, establishment of National IKS Knowledge Systems database and recognise the need of active involvement of informational professionals. This paper was based on desk-top research/review of relevant literature and the authors' observations and points of view.

Key words: Indigenous knowledge, Indigenous knowledge systems, Botswana, ICTs.

Introduction

In the current knowledge-based economy, knowledge is considered the most vital resource in each spheres of human being; hence increasingly, there is emphasis on a knowledge-driven economy and need of knowledge management. Knowledge management can benefit

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everyone from a local newspaper retailer to a multi-dimensional company. Knowledge is a tool to gain and sustains a competitive edge over the competitor, key to innovation and creation, which is linked to development and productivity.

Knowledge has two major dimensions, explicit and tacit knowledge. Explicit knowledge is documented and articulated into a formal language; it is rule-based, stored in certain media, easily communicable and shared and it is codified knowledge. Tacit knowledge is, "a form of knowledge that is highly personal and context specific and deeply rooted in individual experiences, ideas, values and emotions" (Gourlay, 2002). Being personal in nature; it is hard to put into words and difficult to transfer but expressed through action. Tacit knowledge are; know-how, skills, or expertise. Knowledge is defined as 'the state or fact of knowing something with familiarity, awareness, or understanding gained through experience or association' (Merriam-Webster 2006: online). The above definition well-fits in the context of indigenous knowledge, which is based on local peoples' age-long experiences and understanding as means of their living and survival.

This paper focuses on indigenous knowledge. The sources of indigenous knowledge systems are indigenous people, indigenous knowledge, technology, community environment, community gate-keepers, databases, websites, and people who manage and codify IK.

Today science and society has begun to reconnect IKs through information and communication technologies (ICTs). ICTs play major roles in preserving, availability and spread IK. So IKs are blending with the modern scientific and technical knowledge. There are conferences, journals, blogs and e-Bario Knowledge Fairs especially focusing on ICTs for rural development and the third Knowledge Fair will adopt a theme of Indigenous Technological Innovation for Malaysia's Indigenous Peoples (Riggs, 2011). The World Health Organisation [WHO] declared 2001 to 2011 the decade of traditional medicines. This paper is motivated in the above background of growing importance of indigenous knowledge and indigenous knowledge systems. The focus of the paper is on the role of ICTs in capturing, storing and disseminating indigenous knowledge for socio-economic development in Africa in general and Botswana in particular.

Definitions
IK has been defined in various ways: cultural knowledge, environmental knowledge, community knowledge, local knowledge, traditional knowledge, farmer's or pastoralist's knowledge, folk knowledge, traditional wisdom, traditional science, people's knowledge, indigenous traditional knowledge, indigenous technical knowledge, traditional environmental knowledge, rural knowledge, traditional ecological knowledge and also as a sub-set of traditional knowledge (Jain, 2008, UNEP, 2008). According to Grenier (1998: online), IK is "the unique, traditional, local knowledge existing within and developed around specific conditions of women and men indigenous to a particular geographic area". UNESCO, MOST and - Nuffic -CIRAN (2001-2002: Online) define IK as "the local knowledge that is unique to a given culture or society. It is the basis for local level decision-making in agriculture, health care, food preparation, education, natural resource management, and a host of other activities in rural communities". Averweg & Greyling (2010: Online) defined IK as the "knowledge that an indigenous (local) community accumulates over time. This

description of IK encompasses all forms of local knowledge acquired experientially – arts, languages, understanding, practices, technologies and beliefs –that enables a community to achieve stable livelihoods in its geographical residence". There is no single definition of indigenous knowledge concept. It is culture-specific, dynamic, constantly evolving and instigating from age-old beliefs, traditions, experiences and observations, indigenous to a specific area, non-formal, orally transmitted and usually not documented, adaptive, and it is still basis of survival in decision-making for many people. To sum up, IK is local knowledge to solve local problems in local language and using local approach with local understanding.

Knowledge systems are systems through which people make sense of and attach meaning to the world in which they live. These views and perceptions originate within a specific community or culture and are handed down from generation to generation (Kok 2005). Indigenous knowledge systems (IKSs) are "the complex set of knowledge and technologies existing and developed around specific conditions of populations and communities indigenous to a particular geographic area – and their interfaces with others (NRF, 2006: Online). IKSs are also defined as "specific systems of knowledge and practice, developed and accumulated over generations within a particular cultural group and region, and as such are unique to that group and region" (USNC/UHPS, 2001: Online). According to Bray & Els (2007), indigenous knowledge systems refer to the complex set of knowledge and technologies existing and developed around specific conditions of populations and communities indigenous to a particular area. These indigenous knowledge systems provide 'an everyday realisation that rewards individuals who live in a given locality' (Bray & Els, 2007). More recently, Kaya (2010: Online) defines IKS as, "a distinctive body of knowledge and skills, including practices and technologies, that have been developed over generations outside the formal educational system, and that enable local communities in their specific natural and cultural environments to survive sustainably". In the context of this paper:

> "Indigenous or local knowledge refers to the complete bodies of knowledge, know-how, practices and representations that have been maintained and developed by generations of Batswana in their interaction with the environment. These IKS represent understandings, interpretations as well as meanings and have been part of a cultural complexity that encompasses amongst others, language, naming and classification systems, ways of using resources, rituals as well as spirituality (GEF Small Grants Programme 2008: Online).

Based on the above definitions, the main attributes of IKSs are: (i) indigenous knowledge, (ii) technology, (iii) a particular cultural and community specific, and (iv) generations long experience. In the simplest form, IKSs can be defined as knowledge systems, that are composition of informal knowledge and technologies, which are practiced, accumulated and evolved over generations within a specific region to epitomize the locality with that specific knowledge. IKSs are the representation of the relations between indigenous people and their surroundings (Jain, 2008). The sources of indigenous knowledge systems are: indigenous people, indigenous knowledge, technology, community environment, community gate-keepers, databases, websites, and people who manage and codify IK. IKS are the maps of how indigenous people manipulate the indigenous knowledge which have

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built up, grown, experienced and practiced for generations. IKSs are especially important to the poor, as they are dependent on them for their day-to-day needs, in terms of food security, health, education, and natural resource management. Some of the examples of IKSs are: traditional indigenous knowledge systems for environmental management; *Kgotla*, health systems; and ecological systems (Jain, 2008).

It is to be noted that KSs may be similar, but IK is community and environment specific. For example, IK among the Luo of western Kenya who live by the shores of Lake Victoria is different than the Swazi people living in the mountainous western side of the southern Africa kingdom which is characterized by steep slopes, incidence of frost, sour grasses, poor soils and poor grazing. IKSs can differ even within a country, for instance, IK of the Maasai who are pastoralists in the rangeland areas of the Rift Valley in Kenya is different from that of the people of Lamu Island on the Indian Ocean whose livelihood is based largely on fishing. Due to diversities in environment in different countries, IKSs in Africa cannot be generalised (UNEP, 2008).

Thus, IK refers to the content part of indigenous knowledge and IKSs mean the whole infrastructure required to collect, generate, archive, maintain and disseminate indigenous knowledge including human, technology, information, financial and physical resources.

Benefits of IK
Indigenous knowledge is part and parcel of the culture and history of any local community. Development agencies "need to learn from local communities to enrich the development process" (World Bank, 1998: Online). The world's 80% population depends on indigenous knowledge for medicinal purpose and at least 50% rely on it for food. Several authorities have put the major IK benefits as below:

IK contributes to economic development; this is evidenced by the explosion of herbal products onto the global market. The herbal products market, based on IK, is expected to reach US $ 5 trillion by 2020;

Using IK in research gives such research legitimacy and credibility from researchers, and builds local capacity and empowerment;

In the endeavour to manage IK some of the lost African traditions and information will be traced;

Indigenous people can provide valuable input in the local environment for the efficient use and management of local resources;

IK is readily available at little or no cost;

IK is vital for ecologically sensitive socio-economic activities;

IK can contribute to sustainable local and national development.

Through IK, African cultures are getting known better to the global society;

In the endeavour to manage IK, some of the lost African traditions and information are being discovered;

It supports the wellbeing of the majority of people in developing countries;

It builds identity around the world;

IK is a problem solving mechanism for indigenous people;

It is a tool to poverty eradication; and,

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It will facilitate sustainable development (Ngulube, 2002; Nyumba, 2006; Masuya, 2006; Greyling, 2008; Jain, 2008).

ICT & IK
ICTs can provide the following benefits to preserve protect and disseminate IK:
   ICT is means to spread IK;
   ICT can be used to capture, store and disseminate IK in various forms for future generations.
   ICTs integrates IK into both formal and informal education systems and disseminate local cultures to students and provide schools the possibility to teach some curriculum in a local language
   ICT applications can store such local content on Internet web pages;
   by putting IK on web sites, it can be used for business purposes;
   sometimes African information is hijacked; by making it available on the web
   With a copyright, it will not be taken over; and,
   In Agricultural Knowledge and Information Systems (AKIS), ICTs improves linkages between research and extension systems (Jain, 2006, Global Voices, 2009; Averweg, 2010).

However, the potential of ICTs depends on how they are used and not merely in their presence – this remains a challenge for IK preservation (Averweg, 2010). Hence, it is important to exploit and explore ICT to maximise its benefits.

Current trends in ICT use in indigenous knowledge management
Due to the advancements of ICTs, today knowledge and technical know-how travel around the world at the speed of the light. Jain (2006) has seen ICT as a tool that empowers local people to manage indigenous knowledge for Africa's development. It is essential to empower those local people who are the creators of IK and use it to make their living before IK vanishes.

Ranganathan (2004: Online) has mentioned about "building knowledge bottom-up approach" by placing the IKSs at the heart of the process of education for sustainable development facilitated by the ICTs. This approach may be more realistic opportunity to capture the ideals of people-centred, need-based sustainable development opposite to the usual top-down approach. Ranganathan (2005) further advocates for virtual communities reasoning it is rare to come upon a "new" problem that no one has encountered before. Mailing lists, e-groups and discussion forums are logical groupings of common interest and discuss the problem. One can pop a question and wait for the world to answer. When people share their own experiences, it is easier to evaluate empirically what works, what does not work and why. This way multiple views are gathered in one place, which helps to go beyond experts.

Greyling & Zulu (2010) cite a good example of online preservation of indigenous knowledge resources, where community participates in the project using the latest ICTs to create a collaborative local indigenous knowledge database. This programme is coordinated by the local public library, where community people are actively involved in the development of

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content encouraged take ownership by sharing their knowledge. There three components; social software technology, the public library, and the community. It is presently running as a pilot project in the greater Durban area in South Africa, using the established, multi-branch public library system consisting of a network of urban, peri-urban and rural libraries within the municipal boundaries. In this project Web 2.0 technology is playing critical role, for instance, the wiki is used to share ideas, content, images, oral histories and videos between members of the local community. In providing an online, contextually-based information service to local communities, public libraries in Africa will ensure future-oriented access to cultural heritage resources through 21st century information communication technologies (ICTs) (Greyling & Zulu, 2010).

According to Oppenneer (2010) the use of current ICTs to meet the needs of Indigenous communities will create a computer-mediated neo-colonialism and that a new way of approaching the design of memory technologies is necessary to avoid that outcome – one that explores traditional Indigenous memory technologies as starting points for ICT design. Oppenneer further argues that it is sensible for people who associate facts with knowledge to use memory technologies such as computers and databases. In his opinion the relationship between Westernized concepts of the mind and of the computer are fairly clear: they view the computer as an extension of their individual minds. They store phone numbers, documents, videos, photos on our memory technologies so that they can access them instantly should their human memory need reminding.

Most recently Rodil et al (2011) came up with a new ICT concept of visualization technology arguing that people can more easily identify cultural icons and visualizations than using text-based technologies. The article discusses the dichotomy between western and indigenous cultural preservation, the lack of contextual design when providing technologies in indigenous communities and the importance of indigenous participation in ICT development. They suggest several visualizations techniques to depict IK for example, report on an elaborate 3D geospatial representation built for traditional custodians of the land to tell their stories by allowing users to step, virtually, into the Aboriginal dream world. However, this visualization is mediated by design teams and lacks facilities for Aboriginal people to add their own stories and evaluations of visualizations designed to assist communities assume that visualization will be experienced by a user alone. Rodil et al come up with a New Visualization Approach to Re-Contextualize Indigenous Knowledge in Rural Africa through a 3D visualization prototype of Omaheke region in Eastern Namibia as part of a long-term research programme aiming to implement Indigenous Knowledge Management systems to sustain the content, structure and communication of the IK of rural people of the Herero tribe. This village was chosen because this community can be engaged continuously. Over the past three years, valuable design knowledge has been acquired by mutual learning and discovery. The aim in creating a 3D visualization prototype is to produce a structure in which users can store, organize and retrieve an expanding corpus of user-generated videos in ways that are compatible with their knowledge system. This should enable rural elders as knowledge holders to transfer information and to rural-to-urban migrants, considered to be knowledge assimilators.

Within universities, strong executive support for IKS researchers needs to be supportive rather than prescriptive, of the kind that encourages the emergence of innovative forms of research and teaching. Such support might include university-wide seminar series on knowledge studies; the enabling of co-supervision of PhD research across faculties; support for cross-faculty courses at graduate and undergraduate level; and engagement with people who have a deep understanding of forms of traditional knowledge (Green, 2007).

Greyling (2008) suggested a model for community participation in African libraries to preserve indigenous knowledge. The model comprises of the public library, the community and current information ICT technologies and all are inter-dependent upon one another. The model is fully adaptable in a single library, resource centre or community centre, if there is internet connectivity. Through this model communities will be able to preserve and manage their own indigenous knowledge in an economically viable and sustainable manner. Local communities will have global exposure and attract international economic, scientific and cultural interest and grow tourism, agriculture etc. A sustainable people-centred, Afro-centric digital library service will bring social change and African cultural values will be known globally.

However, there are several types of IKS of which, Agriculture and medicine are well-existed for several years. In the next section Let us now review some of the IK systems in Africa.

IK systems in Africa
There are substantial issues in IK management in Africa. There is a threat of IK extinction due to various reasons; lack of recording, preservation, and protection problems; often oral transmission of IK from one generation to another; focus is more on IK that has cash value for example, medicinal plants. Also, IK is not much used by young generation, there is more western influence. African leaders have recognized the importance of protecting and promoting indigenous knowledge and technologies to solve specific problems and improve the continent's socio-economic development (Kaya, 2010). Kaya further notes an increasing realization among scientists, development agencies, academics of the fact that development strategies not based on local knowledge, practices and experiences cannot be sustainable. Consequently, IKSs were identified as one of the major flagship areas of New Partnership for Africa's Development (NEPAD)/ Southern African Network of Biological Sciences (SANBio) Regional Initiative. So, NEPAD framework document is devoted to the protection and promotion of IK and related technological innovations (NEPAD, 2010-2012).

Tanzania has taken several initiatives towards IK preservation and protection. Tanzania Development Gateway database of the Economic and Social Research Foundation (ESRF) has developed a database on IK to enhance capturing, storing, sharing and dissemination of IK information, experiences and practices in Tanzania and integrate it with modern science and technology to enhance the dissemination of information (Msuya, 2007).

The communities, particularly those in hazard-prone areas, have generated a vast body of indigenous knowledge on disaster prevention and mitigation, early warning, preparedness and response, and post-disaster recovery (Steiner, 2008). To provide a home for Africa's Professional Knowledge Community there is KM Africa that facilitates creation, sharing and

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use of knowledge vital for Africa's sustainable development. KMAfrica Knowledge Hub provides Africa's Knowledge community with new ways to Connect, Participate, Contribute, Share and Benefit. Through various forums Knowledge Hub encourages stronger connections, networks and local climate solutions for Africa (KMAfrica KnowledgeHub, 2011). There is an independent bilingual network (French/English) AfricaAdapt, which focuses exclusively on Africa. It is aimed to facilitate the flow of climate change adaptation knowledge for sustainable livelihoods between researchers, policy makers, civil society organisations and communities who are vulnerable to climate variability and change across the continent. It has four partner organizations; Environment and Development in the Third World (ENDA-TM), Forum for Agricultural Research in Africa (FARA), IGAD Climate Prediction and Applications Centre (ICPAC), and Institute of Development Studies (IDS). **Enda Tiers Monde** is active in 21 countries and based in Dakar, Senegal improves the tools of knowledge for initiatives linked to the environment and local development and contributes to identify alternative development possibilities. **FARA** complements the activities of African national, international and sub-regional research institutions to promote agricultural innovation and aims to reduce poverty in Africa through sustainable broad-based agricultural growth and improved livelihoods, particularly of smallholder and pastoral enterprises. **ICPAC** enables East African countries to cope better with risks associated with extreme climate variability and change through the provision of climate early warning information and supports specific sectors to poverty alleviation efforts, environmental management and sustainable development by improving systems to share climate information. **IDS** is a global organisation for research, teaching and communications on international development and maintains programmes of multidisciplinary research programmes, research and action networks and consortia and hosts a number of knowledge services (AfricaAdapt, 2011). With the rise of IKS, herbal products are regaining their original position within the world health system. South African indigenous communities have been practicing bioprospecting and product development for millennia. All over the Africa African Traditional Medicines [ATMs] are gaining more importance especially given high or of HIV/AIDS, Malaria, TB, Cancer, Diabetes and hypertension. Aiming to officially integrate traditional healing into the National Health System The South African government developed and approved legislative tools to regulate both Traditional Health Practitioners [THPs] and Traditional Medicines (Chabalala, 2008). To improve agricultural productivity by providing reliable, relevant, and timely agricultural knowledge and information Ethiopian Farmers (IPMS) project initiated ten Woreda Knowledge Centers (WKCs) in four regions of Ethiopia in 2005 to set Successful Knowledge Management (KM) system and the centres are using ICTs in knowledge capturing, storing, sharing, and managing. ICT tools are used in documentation, preservation, in minimizing the cost of disseminations and easy understanding of the agricultural knowledge content in all WKCs (Lemma, 2009).

In South Africa Indigenous Knowledge Systems Policy was approved by Cabinet in 2004 , and the National Indigenous Knowledge Systems Office (NIKSO) was opened in the Department of Science and Technology in 2006 (Green, 2007). There is an International student conference: Climate Change and Indigenous Knowledge Systems (IKS) on 15-17 August 2011, in Johannesburg, South Africa.

To promote IK in Africa, Botswana had organized a conference themed, "African Indigenous Knowledge Systems Protecting, Preserving & Managing African Indigenous Knowledge" from 10- 11 March 2010 at Gaborone Sun Hotel (Gaborone, Botswana, 2010). There is Center for Indigenous Knowledge Systems (CEFIKS) in Accra, Ghana, which is an independent not-for-profit, non-governmental organization and has an affiliate branch in the United States. CEFIKS is to establish IKSs in Africa, specifically Ghana and empower disadvantaged groups in rural and urban areas in gaining access to and in utilizing both indigenous and emerging ICTs for capacity building to improve socio-economic development in both rural and urban areas of Ghana and all through the West African region (CEFIKS, 2010).

ICT, IKS & poverty alleviation
There is a direct link between ICT, indigenous knowledge systems, poverty alleviation/eradication, and sustained people's livelihoods which are derived from the natural environment (Lekoko and Morolong 2007). Failure to undertake programmes that are meant to improve livelihoods within communities or programmes meant to eradicate poverty may lead to environmental degradation, and resultantly disappearance of the indigenous knowledge systems which are highly dependent on the human experiences with their environment. As stated by Hambira (2009: Online) "the environment is a source of goods and services on which the poor rely for their livelihoods" and therefore protection of the environment needs to be factored in poverty reduction policies and programmes. According to Hambira (2009) it is important to protect the environment because it is a source of livelihoods for poor people as they depend on the forests, land, water, and other natural resources.

The Government of Botswana took a deliberate decision in line with its Vision 2016 goals and in alignment with the Millennium Development Goals, to focus on poverty eradication. A national Strategy for Poverty Reduction was created in 2003,

> "primarily through broad based labour- absorbing economic growth, the provision of basic quality social services to the poor, the promotion of cost-effective pro- poor social safety nets, an enhanced effective response to the HIV/AIDS epidemic, and strengthening institutions for the poor" (Hambira, 2009).

The main focus being to provide sustained livelihoods through small scale horticulture, crop production; small stock production, Natural Resources Management Programme, and building various capabilities and skills among the poor communities as well as providing opportunities for self employment and strengthening capacities for government departments, land boards, and councils to deliver services to the communities.

Given this scenario, development of ICT is meant to bridge the gap between the rich and the poor by providing equal access to the same information and knowledge that enable people to improve their lives. Duncombe and Richard Heeks (2005) note that the ICTs being employed for the poor should be compatible with community livelihoods to enable community members to manage their lives. The authors identify the contribution of ICT in poverty reduction as increasing access to local and regional markets, improving contacts with suppliers, access to pricing information for items and goods, financial services, tax and

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legal information, and information on a number of other micro-enterprises that include agriculture, horticulture, forestry, fishing, household cultivation, and brick making among others.

If poverty is to be eradicated it means that appropriate ICTs must be applied on the local knowledge, practices and experiences, rather than being imposed without understanding the needs of the communities. Global Knowledge Partnership (2002) believes that ICT is an essential poverty reduction tool when applied appropriately and sensitively to the specific information and communication needs of the poor" and that ICT should be used to increase communication and information sharing. Global Knowledge Partnership (2002) emphasis the fact that application of ICTs for improved livelihoods should be determined by community needs, which can be identified through a bottom-up approach that involves communities in all poverty eradication programmes, as well as indigenous knowledge management systems

Indigenous knowledge systems in Botswana
Botswana like other countries in the world has indigenous knowledge derived from the cultural life of the local people and applicable to the available natural resources, as well as activities and practices within the environment. Based on the definition, it is clear that IK is unique traditional knowledge specific to a local culture or society (UNESCO, MOST and - Nuffic -CIRAN (2001-2002; Averweg & Greyling 2010). Indigenous knowledge is generally based on the cultural or societal livelihoods practices and experiences that have been passed from generation to generation. Indigenous knowledge in Botswana revolves around local people's livelihoods in the areas of range management, crop production, handcraft production, fishing, wild plants, primary healthcare, herbal medicines, (Kgathi, Ngwenya & Wilk, 2011). Communities in Botswana highly depend on natural resources for their livelihoods and use their indigenous knowledge to ensure sustainability of the resources. The local communities use IK systems for poverty alleviation through communal fields, work parties, and share cropping, storage and protection of seed products, food preparation for nutritional value. Kgathi, Ngwenya & Wilk (2011) in their study of indigenous knowledge in the Okavango Delta found that the local people are acquainted and adaptive to the environment to the extent of surviving floods, drought, livestock and human disease outbreaks, and that the communities use IK for livelihoods that include "fishing, basket making, cultural tourism, conservation of natural resources, using mekoro/dugout canoes, water diving, and use of fire" (Kgathi, Ngwenya & Wilk, 2011: Online). Knowledge of plants by indigenous people of Botswana has contributed to people's livelihoods in terms knowing the food plants, determining soil fertility for food production, knowing herbal plants for medicine, and conserving the environment. Traditional health practices are common in Botswana. They range from knowledge of medicinal plants and taboos for protection of children from birth to maturity; protection of adults from illness, hatred, witchcraft, and bad dreams.

Botswana is keen to develop its indigenous knowledge systems, which have been orally/verbally passed from generation to generation. Given modern technologies, there is a

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need to find better ways of capturing, storing, preserving, and providing access to the country's IKS for socio-economic development. As a result Government has established the Department of Research, Science and Technology (DRST) under the Ministry of Infrastructure Science and Technology, charged with the responsibility of carrying out research in indigenous knowledge systems (IKS) in the country. Botswana recognizes the value of indigenous knowledge given the need to participate competitively in a knowledge-based economy at global level (Joseph, 2010).

Development of IKS policy in Botswana
Botswana is currently formulating policies for natural resources including indigenous knowledge (Cassidy, 2011). In order to achieve this DRST has been tasked with coordination IK research and formulation of IKS policy focusing on traditional knowledge. This will help to guide identification, preservation, and access to indigenous knowledge which is valuable for improvement of livelihoods of local communities. To further enhance research on IKS the Ministry of Infrastructure, Science and Technology, through DRST has partnered with the University of Botswana Centre for Scientific Research Indigenous Knowledge and Innovation (CESRIKI) in the formulation of IKS policy and collaborative research (Republic of Botswana, 2011). CESRIKI is currently undertaking research project on biological activities of medicinal plants through involvement of traditional medicine practitioners from rural communities. The research partnership is in line with the New Partnership for Africa's Development (NEPAD) initiative that is undertaken by the Southern African Network of Biological Sciences (SANBio) which include universities and research centres coordinated by the North-West University (Mafikeng Campus) as a regional node that include 12 countries namely: Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Zambia and Zimbabwe (Kaya, 2010). Botswana's CESRIKI focuses on research areas that include indigenous plants for health and food and how these can be used to cure various diseases. Research centres in Botswana are planned to multidisciplinary in nature to bring all stakeholders, including traditional healers to share indigenous knowledge systems and benefit from the skills and technology from the local people.

ICT Policy Initiatives and Implementation in Botswana
African Information Society Initiative (AISI) recognizes information and knowledge as strategic resource for socio-economic development of African countries. As a result the Economic Commission for Africa (ECA) through AISI expects all African states to "take advantage of ICTs and implement comprehensive and integrated ICT-led socio-economic development policies, strategies and plans" (AISI, n.d.). AISI oversees the development of national e-strategies, or the National Information and Communication Infrastructure (NICI) plans. It assists countries to develop national ICT policies and strategies that will help to harness ICTs for socio-economic development at both local and national levels. Development of ICT infrastructure is believed to be key to "enabling citizens' access to affordable telephones, broadcasting, computers and Internet.
The New Partnership for African Development (NEPAD) has responded to this call by identifying projects and initiatives for ICT development in the African region. Similarly

Botswana has responded to the call through the formulation of the National ICT Policy for Botswana to "create an enabling environment for the growth of an ICT industry in the country and provide access to information and communication facilities in the country". Through the National ICT policy Botswana plans to provide information and knowledge that will help improve livelihoods of Botswana society in terms of socio-economic development. Development of ICT will enhance access to e-governance and local information relevant to communities.

The development of National Maitlamo ICT Policy is in line with the national vision 2016 of growth in ICT to achieve the "social, economic, political and cultural transformation within the country". Based on the ICT Benchmarking and Best Practices Report Botswana is yet to provide information and communication technology benefits to the wider society. The benchmarking identified areas of need for ICT, which include, among others, ICT usage in homes and communities; a national ICT programme providing an opportunity to extend AIDS/HIV awareness and access to information and assistance; and public education and basic education to enable citizens to actively participate in the information economy. The National Maitlamo ICT policy aims to provide relevant ICT skills among children and young adults as an active group that will benefit from ICT connectivity in the country. With developed telecommunications infrastructure and ICT connectivity, Botswana will ensure provision of information in areas such as employment opportunities, youth projects, education, health, which directly impact on the youth development

Botswana has a well developed modern telecommunications infrastructure, which remain underutilized (Sesigo Project, 2011). The fixed line and fibre optic infrastructure is adequate to provide wired telephone lines, mobile telephone, radio, and television to communities in Botswana, even though equipment and connectivity costs are prohibitive. However initiatives have been taken to integrate ICT use in people's livelihoods and provide free access to information through development of ICT build public libraries. The development of ICT connectivity has been initiated through a collaborative partnership between the Sesigo Project, Ministry of Youth Sport and Culture (MYSC), the Bill &Melinda Gates Foundation and coordinated by ACHAP (Sesigo Project, 2011) in establishing internet connected public libraries with computers. ICT connectivity of public libraries is a major step in providing free access to information and e-government services in communities in Botswana. Public libraries are expected to collect, store, and provide access to different types of information including indigenous knowledge for all people in society.

How Botswana can Use ICT in indigenous knowledge system management
Indigenous people the world over and in Botswana in particular have relied heavily on indigenous knowledge and related technologies to sustain their livelihoods. Infusing indigenous knowledge with modern knowledge is ideal if poverty alleviation is to be achieved. Indigenous knowledge is dynamic and it evolved overtime (Adam, 2005) based on human experience with the natural environment. However, in such circumstances IK is bound to be lost as those who have the knowledge die or as different generations come into

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contact with other cultures. The infusion between IKS and modern knowledge need to be properly managed for According Adam (2005) there are a number of Information and communication technologies which can be used to manage availability and access to indigenous knowledge systems, amongst them computers, Internet, networks and software, satellite and radio. These ICTs can be used to capture, store, disseminate, and provide access to indigenous knowledge information systems for all people for socio-economic development

Farrell etal (1999) argue that any application of ICTs in managing indigenous knowledge, without first understanding how IKS is gathered, stored and shared is bound to create some conflict or misunderstanding in local communities. Proper application of ICTs should start with understanding of indigenous people's needs and then determine the suitable ITCs to be applied to help the local communities to capture, store, disseminate, access and use their IKS to improve their livelihoods. Botswana has adopted this approach by recognising the importance Dikgosi (Traditional leaders) play in protecting, nurturing, and preserving indigenous knowledge, and as a result DRST and CESRIKI have agreed to consult Dikgosi and other institutions involved in IKS.

Formulation of IKS Policy and identification of the characteristics of indigenous knowledge through involvement and consulting the local people should help Botswana to apply appropriate ICTs in managing IKS. Given the dynamic nature of indigenous cultures and strong relationships within the indigenous environment, Oppenneer (2011) suggests that development of modern ITCs to manage indigenous knowledge must involve participation of the local communities to inform the design of technologies and databases relevant to community needs and in accordance with indigenous knowledge. Involvement of communities in the design of appropriate technologies for capturing, storing, preservation, and providing access to indigenous knowledge can follow the community structures. Adam (2005) identified a number of community structures that can be used to promote IKS. These include market places, community resource centres, libraries, schools, clinics, worshiping places, community centres. Botswana is well known for its strong traditional structures in the form of Kgotla custom; a public meeting place led by Kgosi/traditional leader, where communities share ideas, information, knowledge, as well as performs cultural activities. According to Oppenneer (2011) there are a number of modern technologies "using analog and digital video and audio recording devices as well as a constellation of computer and Internet-related technologies, to capture, store, and make available to future generations important aspects of their languages, arts and understanding". Digital technologies developed with shared understanding and participation of communities is more likely to be used by members of the community to capture, store, and disseminate their knowledge.

Botswana's kgotla system has been used as a place where communities are encouraged to share their traditional knowledge. As stated by Oniango etal (2003) "Indigenous knowledge and practices are important aspects of a society's culture and its technology" derived from interaction with their environment and shared through various community structures. Traditional structures are used as community gatherings to share ideas and knowledge on community rituals, and undertake community projects for the benefit of the community. In

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Botswana, kgotla structures are used to knowledge related to community livelihoods such as agriculture, health, and management of the environment. Involvement of traditional leaders and their communities in the application of appropriate ICTs in managing Indigenous knowledge is crucial as communities are the custodian of valuable knowledge of herbal plants, food plants, their preservation, and conservation of the environment. If capturing and sharing of knowledge is acceptable to traditional leaders, this will make identification of individuals with valuable knowledge and willing to use digital technologies to record their knowledge of medicinal plants, food plants and their storage/packaging, products from plants, rituals, and tribal histories. Communities could be made aware of the economic benefits they could derive from sharing the knowledge and applying such knowledge in managing the environment.

Public Libraries play an important role in providing public access to information and knowledge. In order to manage indigenous knowledge, Botswana need to develop ICT connected libraries providing access to computers, and digital technologies for capturing, storing/arching, preservation, and dissemination of indigenous knowledge. Public libraries should be established in all communities in Botswana to serve as public meeting places for different cultural activities, as well as places where people meet to receive or share information and knowledge. In addition Botswana can establish youth information centres in cities, and communities around the country where information can be stored and accessed by all members of society. Community libraries, in Ethiopia, serve as information resource centres where people interact irrespective of age or status to exchange traditional and modern knowledge as way of empowerment Adam (2005). Digital databases of cultural lives of the Botswana communities can be developed by the Public library system for preservation and accessibility to all members of the society. Certain information and knowledge may still be copyright protected based on the requirements of indigenous knowledge or a particular culture. Development of ICT connected Public libraries should accommodate community structures by providing spaces for group meetings or performances along the lines of cultural setting environment that allow community group activity. Group spaces should have computer workstations and television broadcasting and also allowing community members to do their self recording of stories and narratives, as well as share their knowledge in the areas of range management, crop production, handcraft production, fishing, wild plants, primary healthcare, herbal medicines, and societal taboos. Having a shared understanding of copyright issues and how individual members in society can benefit from their knowledge, can members of society, especially traditional healers, to willingly share their knowledge with the rest of society. Such an environment will encourage group sharing of knowledge, as well as continual retelling and recording of indigenous knowledge systems. As stated by Greyling and Zulu (2010), Public libraries, by virtue of their position within local communities, they are well place provide content of local relevance to the needs of communities, and therefore "well positioned to provide a platform for public engagement in the collecting and disseminating of indigenous knowledge in the communities they serve". Where Public Libraries and Community information centres have developed indigenous knowledge databases, a Wiki website can be used for interactive sharing of ideas, content, images, oral histories and videos between members of the local community

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Botswana's telephone system has developed to cover major population centres and rural communities in the country. This has been made possible a digital system of fiber-optic cables and a system of open-wire lines, microwave radio relays links, and radiotelephone communication stations. The major source of communication includes the national radio network, privately owned radio stations (Duma FM, Yarona FM and Gabz FM), the national television, and mobile telephones. In addition government has provided internet connectivity in a number of areas, including some rural communities. These digital systems provide communication channels through which indigenous knowledge in Botswana can be shared amongst local communities.

Availability of computers and internet allow for creation of indigenous knowledge databases to capture, store texts, photos, videos, maps, and speeches, which can be used by both adults in their livelihoods and school children for educational purpose where they can learn indigenous languages and knowledge either in formal or informal settings. The Government of Botswana could consider developing an indigenous knowledge systems database that is based on understanding of how indigenous knowledge is communicated and shared. Given the need to eradicate poverty using indigenous knowledge systems, Botswana's ICT development should begin to develop technologies that are meant to manage indigenous knowledge in terms of its capturing, dissemination, storage, and accessing the information resources to improve community livelihoods.

 As part of the initiative to provide ICT connectivity for purposes of accessing information and knowledge, Botswana, through the Nteletsa II, has connected telecommunications services to 197 villages by establishing 69 Kitsong Centres (Tele Centres) around the country using Botswana Post infrastructure. These centres need to be located within the community structures such as community centres, kgotla, youth centres, and community/public libraries as places where members of communities can share knowledge using various technologies such as mobile phones, PDAs, community radios, and television. Digital technologies and equipment can be made available in the centres to enable capturing, recording, preserving, and providing access to indigenous knowledge, hence the centres will serve the dual role of capturing and sharing knowledge.

With regard to indigenous knowledge contained in research documents which are in print and other multimedia formats, Public Libraries can use the appropriate digital technologies to digitize such materials for preservation and ease of access to members of the community. Translation can be done, from English into local languages or from text to speech in order to promote knowledge sharing. Public Libraries are capable of re-packaging information in different formats. In order to re-package indigenous knowledge professional translators can be hired to translate knowledge contained in print documents, as well as translating knowledge available in digital formats into Botswana's local languages. Local communities in Botswana can use modern technologies such as Wikipedia to publish their indigenous knowledge in their own local language on the web where it will become available to all communities.

Digital technologies in the form of web based and networked technologies can be used to develop databases of indigenous knowledge systems. In Botswana CESRIKI developed a Database of Indigenous Knowledge Practices in Botswana, Dingaka Database, to store information on medicinal plants, types of diseases, traditional healers, and works together with Matwetwe Expert System which is an interactive database that captures information from traditional healers and can be used by patients to ask questions on diseases and provide treatment (GEF Small Grants Programme, 2008). The database also contains information about medicinal plants and food plants. Databases of this nature can be made accessible through public libraries, community information centres, youth information centres, and kgotla to help provide information for the communities to improve their daily livelihoods.

Challenges of applying ICTs to IK systems
Adam (2005) identified a number of challenges in applying ICT to indigenous knowledge systems, among them being costly in terms of time and process of doing it; difficulty of capturing all indigenous knowledge as artefacts; unwillingness by community members to share knowledge; and difficulty in setting up databases in usable formats; applying intellectual property rights or copyright for individual and community benefit. These challenges are not without solution. If application of ITCs in IKS is based on the needs of communities and shared understanding of benefits, communities will be more than willing to use both indigenous technologies and modern technologies in managing IKS. CESRIKI in Botswana used this approach with traditional healers in Botswana by making them understand the "the importance of the knowledge they possess and demonstrated the potential that it has in contributing towards innovation" and hence their willingness to actively participate in sharing indigenous knowledge. Nowadays technology is very innovative to the extent where text, voice, and video can be converted to speech or text (and back) via either the PSTN or the Internet (Meryl Glaser, 2004).

Further, CESRIKI (GEF Small Grants Programme, 2008) found out that communities are willing to protect indigenous knowledge through their Dikgosi/traditional leaders who will identify the useful natural resources to be preserved and access controlled from unlicensed individual harvesters or outsiders, although currently Dikgosi/traditional leaders do not have such powers. Empowering traditional leaders to take care of their environment, can help to a large extent, to protect indigenous knowledge systems, while at the same time providing required access to these resources for sustained livelihoods.

Ownership of knowledge is another big issue, which hampers IK initiatives. Existing patent laws are clearly biased towards western methods of knowing. Patents are essentially instruments that *prevent access* to a particular technology or information until there is compensation to its 'owner' (Ranganathan, 2005).

Putting local content on the web: Low local content on the Web impedes buy-in from local communities into digital resources and inhibits development of digital skills (Greyling & Zulu, 2010).

Obsolescence of use of ICTs devices and media*:* used in the service of preservation are another big challenge. Consequently, the communities will be stemming the tide of obsolescence by preserving machinery and media as well as aspects of their culture (Oppenneer, 2011).

Western biases in design and erroneous assumptions*:* about the universality of concepts, methods, theories and models have led to many inappropriate decisions. Also, Western and Indigenous people lie deep tensions between the epistemologies of IK and those that underlie technology design have led to many inappropriate decisions;
 (Bidwell & Browning, 2009, Oppenneer, 2010, Rodil et al, 2011).

Dichotomy between western and indigenous culture and user and developer: obstructs proper designing of IK systems. The lack of contextual design and the lack of indigenous participation in ICT development are hinders and challenges. This makes difficult for indigenous people to understand the contents fully (Oppenneer, 2010, Oppenneer, 2010, Rodil et al, 2011).

A lack of National ICT policy: which is fundamental in order to utilise ICT to its full potential (jain, 2006).

A lack of Legal and regulatory framework: Without a legal and regulatory framework ICT cannot fully take off (jain, 2006).

A lack of National Indigenous system policy: Absence of such policy lacks the standards and guidelines to IK management.

Conclusion
This paper discussed the role of ICTs in gathering, storing and disseminating indigenous knowledge for economic development in Africa and Botswana in particular. From the foregoing it is apparent that ICTs are critical to indigenous knowledge management and Botswana is making several initiatives like other African countries in areas of ICT development and indigenous knowledge systems research.

Recommendation
In order to utilize ICTs to its optimum prospective in capturing, storing, preserving, dissemination and sharing indigenous knowledge the following recommendations are put forward:

> Given the extent to which IKS is important in sustained livelihoods of communities and the role it can play in eradication of poverty, there is a need for strong partnership between Government of Botswana, through the Department of Research, Science and Technology (DRST) under the Ministry of Infrastructure Science and Technology; the University of Botswana; Non-Governmental Organizations; Dikgosi/traditional leaders; Botswana National Library Services representing Public Libraries; Botswana National Youth Council (BNYC); and other stakeholders to work together in developing the National IKS Policy. Such a

partnership will ensure effective consultation and full participation by all communities.

Development of appropriate ICTs for managing indigenous knowledge systems in Botswana should be based on partnership with all relevant stakeholders within communities to ensure fully understanding of community needs and how they make use of indigenous knowledge for their sustained livelihoods.

Development of ICTs and the use of computers and other digital technologies are dependent on electricity supply and telecommunication infrastructure. In order to integrate appropriate ICTs into indigenous knowledge systems, priority for power supply and telecommunication infrastructure should be given to rural communities to help speed up poverty eradication. Providing ICTs will help communities to share information and knowledge and hence improve their livelihoods.

There is a need for legal and regulatory framework based on the local environment and needs and with the consensus among stakeholders and which provides protection to intellectual law.

Empowerment of local people through their participation in IK creation and by ensuring that their knowledge will not be misused.

In order to promote the use of indigenous knowledge systems to improve socio-economic development for the local people especially in rural communities, Government of Botswana should integrate Indigenous Knowledge Systems (IKS) in the school curriculum starting from primary to tertiary education. This will help to ensure that both indigenous knowledge and modern knowledge are applied in people's livelihoods in areas of agriculture/food production, health, business, and environmental management.

As research has already started on indigenous knowledge systems in Botswana establishing a National Indigenous Knowledge Systems database should be a priority to ensure effective and efficient capturing, storing, disseminating, and accessing indigenous knowledge for socio-economic improvement of lives of Batswana in general.

There is need for active involvement of informational professionals, since they deal with the provision of information every day, and can appreciate the importance of information better on individual, communal and national levels, and facilitate its management, protection and dissemination.

References

Adam, L. (2005). Information and Communication Technologies, Knowledge Management and Indigenous Knowledge: Implications to Livelihood of Communities in Ethiopia

AfricaAdapt (2011). About AfricaAdapt. Available at: http://www.africa-adapt.net/aa/AboutUs.aspx

AISI (n.d.). African Information Society Initiative. Available at: http://www.uneca.org/aisi/policies.htm).

Kaya, H.O. (2010). The indigenous knowledge systems (iks) regional node of the nepad/southern African network of biosciences initiative - north-west university (South Africa). Available at: http://www.nepadst.org/sanbio/download/brochure_iks_2010.pdf

Averweg, U.R. & Greyling, E.H. (2010). Some challenges for Information and Communication Technologies in Indigenous Knowledge preservation. Available at: http://www.ulwazi.org/docs/Averweg%20and%20Greyling%2010th%20June%202010.pdf

Bidwell, N J & Browning, D (2009). Pursuing Genius Loci: Interaction Design And Natural Places. Pers. Ubiq. Comp. 217 .

Bray, R.J.C., & Els, G. (2007). Unpacking 'ethno-finance': an introduction to indigenous 'financial' knowledge systems. *South African Journal of Information Management.* Vol. 9, No. 1. Online. Available at: http://www.sajim.co.za/index.php/SAJIM/article/viewFile/15/15

CEFIKS (The Center for Indigenous Knowledge Systems) (2010). Welcome to the Centre For Indigenous Knowledge Systems. Available at: http://www.cfiks.org/

Cassidy, L, et al. (2011). Indigenous knowledge, Livelihoods and Government Policy in the Okavango Delta Botswana. Available at: https://www.novapublishers.com/catalog/product_info.php?products_id=24491

Chabalala, H. (2008). African Traditional Medicines: The Role of Indigenous Knowledge Systems in Bioprospecting and Product Development in South Africa. Available at: http://www.scribd.com/doc/12529434/African-Traditional-Medicines-The-Role-of-Indigenous-Knowledge-Systems-in-Bioprospecting-and-Product-Development-in-South-Africa-by-HLUPHEKA-CHABALAL

Duncombe, R. & Heeks, R. (2005).Information & Communication Technologies (ICTs), Poverty Reduction and Micro, Small & Medium-scale Enterprises (MSMEs). *A framework for understanding ICT applications for MSMEs in developing countries.* Available at: http://www.unido.org/fileadmin/media/documents/pdf/Services_Modules/ict_brochure_report.pdf

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GEF Small Grants Programme (2008). Ethno-survey and Promotion of Indigenous Knowledge System-based Solutions for Botswana (BOT/OP3/2/07/08. Available at: http://sgp.undp.org/web/projects/11658/ethno_survey_and_promotion_of_indigenous_knowledge_system_based_solutions_for_botswana.html

Gaborone, Botswana (2010). African Indigenous Knowledge Systems Protecting, preserving & managing African Indigenous Knowledge. Available at: http://www.indigenouspeoplesissues.com/attachments/4140_african%20indigeous%20knowledge%20systems.pdf

Glaser, M. & William D. Tucker (2004). Telecommunications bridging between deaf and hearing users in South Africa. Available at: http://scholar.google.com/scholar?q=converting+voice+into+text+%2BICT&hl=en&btnG=Search&as_sdt=1%2C5&as_sdtp=on

Global Knowledge Partnership (GKP) (2002). DIGITAL DIVIDENDS FOR THE POOR: ICT for Poverty Reduction in ASIA. UNDP: Human Development Report. Available at: http://ict4peace.org/pubs/poverty.pdf

Global Voices (2009). ICTs and the spread of indigenous knowledge. Available at: http://globalvoicesonline.org/2009/10/05/icts-and-the-spread-of-indigenous-knowledge/

Gourlay, S. (2002). Tacit Knowledge, Tacit Knowing or Behaving? 3rd European Organizational Knowledge, Learning, and Capabilities Conference, Athens, Greece, 5-6 April.

Government of Botswana (2011). Available at: http://www.gov.bw/en/Ministries--Authorities/Ministries/MIST-Events/Tools--Services/News/IKS-for-Economic-Diversification/

Green, L. J. F. (2007). The Indigenous Knowledge Systems Policy of 2004: Challenges for South African Universities. *Social dynamics*. Vol. 33, No. 1, pp. 130–154.

Grenier, L. (1998). Working with Indigenous Knowledge: A Guide for Researchers. *International Development Research Centre* (IDRC) Ottawa, Canada. [Online]. Available at: http://www.idrc.ca/es/ev-3219-201-1-DO_TOPIC.html

Greyling, B. (2008). Preserving Indigenous Knowledge: A Model for Community Participation in African Libraries. Available at: http://www.ulwazi.org/index.php?option=com_content&view=article&id=5:a-model-for-community-participation-in-african-libraries-to-preserve-indigenous-knowledge-&catid=3:publications&Itemid=10

Greyling, E. & Zulu, S. (2010). Content development in an indigenous digital library: A case study in community participation. *International Federation of Library Associations and Institutions (IFLA) Journal. Vol.* 36, No. 1, pp. 30-39.

Hambira, L. (2009). Poverty reduction strategies and the environment: the case of Botswana. Available at: http://www.iaia.org/iaia09ghana/documents/cs/CS6-4_Hambira_Poverty_Reduction_Strategies.pdf

Jain, Priti (2006). Empowering Africa's development using ICT in a knowledge management approach, *The Electronic Library*. Vol. 24, No. 1, pp. 51 - 67.

Jain, Priti (2008). Indigenous Knowledge Systems, in *Africa in Information and Knowledge Management in the Digital Age: Concepts, Technologies and African Perspectives.* Third World Information Services Limited, Ibadan: Nigeria. ISBN: 978-978-084-723-4, Pp. 300-331.

Joseph, B.K. (2010). Towards a Knowledge-Based Economy – the Case of Botswana A Discussion Article. *International Journal of Sociotechnology and Knowledge Development*, Vol. 2, No. 2, pp. 53-62,

KMAfrica KnowledgeHub (2004-2012). Knowledge: Participate. Contribute, Share. Benefit. Available at: http://www.kmafrica.com/about.kmafrica

Kaya, H.O. (2010). The indigenous knowledge systems (IKS) regional node of the NEPAD/South African network of biosciences initiatives-North West University (South Africa). Available at: http://www.nepadst.org/sanbio/download/brochure_iks_2010.pdf

Kgathi, D.L., Ngwenya, B.N., & Darkoh, M. B.K. (eds). Rural Livelihoods, Risk and Political Economy of Access to Natural Resources in the Okavango Delta, Botswana. Nova Publishers. ISBN 978-1-61122-302-6. Online. Available at: at: https://www.novapublishers.com/catalog/product_info.php?products_id=18873

Kok, J.A. (2005). Can models for knowledge management be successfully implemented to manage the diversity of indigenous knowledge? *South African Journal of Information Management.* Vol. 7, No. 4. Available WWW: http://www.sajim.co.za.

Lekoko, R. and Morolong, B. (2007). Poverty reduction through community- compatible ICTs: Examples from Botswana and...other African Countries. In M. Gascó-Hernández, F. Equiza-López, M. Acevedo-Ruiz (Ed.) Information Communication Technologies and Human Development: Opportunities and Challenges. IGI Global

Lemma, F. (2009). The Role of ICT on Agricultural Knowledge Managmeent in Ethiopia: A case study on Woreda Knowledge Centers in Bure, Goma, Alaba and Alamata. Available at: http://www.ipms-ethiopia.org/content/files/Documents/publications/MscTheses/FinalThesis_FraolLemma.pdf

Lieberman, A.E. (2002). Taking Ownership: Strengthening Indigenous Cultures and Languages Through the Use of ICTs. Available at: http://www.guidestarinternational.org/documents/Taking%20ownership%20-%20Strengthening%20Indigenous%20Cultures%20and%20Languages%20through%20the%20Use%20of%20ICTs.pdf

Merriam-Webster Online. (2006). Available at: WWW: http://www.webster.com.

Msuya, J. (2007). Challenges and opportunities in the protection and preservation of indigenous knowledge in Africa. In Chapter 38, Pp. 344-349. Available at: http://www.africainfoethics.org/pdf/african_reader/46%20ICIE%20Chapter%2038%20page%20343-349.pdf

NEPAD (New Partnership for Africa's Development). (2010-2012). NEPAD Planning and Coordinating Agency: A technical body of the African Union. Available at: http://www.nepad.org/about

Ngulube, P. (2004). Strategies for managing and preserving indigenous knowledge in the knowledge management era. Proceedings of the 15th Standing Conference of Eastern, Central & Southern African Library & Information Associations, Johannesburg, 15-19 April 2004.

Nyumba, J.B. (2006). The role of the library in promoting the application of Indigenous Knowledge (IK) in development projects. Proceedings of the 72nd International Federation of Library Associations Conference, held in Seoul, 20-24 August 2006.

Oniang'o, Ruth; Allotey, Joseph; and Malaba, Serah J. (2003). Contribution of Indigenous Knowledge and Practices in Food Technology to the Attainment of Food Security in Africa. The Food Chain. Available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2621.2004.tb13346.x/pdf

Oppenneer, M. (2010). Memory Technologies: Indigenous Knowledge and ICT Design. 27 February. Available at: http://www.ethnosproject.org/site/?p=77

Oppenneer, M. (2011). Using ICTs for Indigenous Cultural Preservation: Challenges and Strategies. Available at: http://www.ethnosproject.org/site/?p=123

Ranganathan, A. (2005). Using ICT to place indigenous knowledge systems at the heart of Education for Sustainable Development. Paper submitted to the Education for a Sustainable Future International Conference, 18-20 January, Ahmedabad, India. Available at: http://www.ceeindia.org/esf/download/paper47.pdf

Rasoanaivo, P. (2010). African Traditional Medicines and Indigenous Knowledge Systems. Available at: http://www.codata.org/10Conf/abstracts-presentations/Sessions%20H/H1/H1-Rasoanaivo.pdf

Riggs, M. (2011). e-Bario Knowledge Fair on ICT for indigenous technological innovation. Available at: http://www.e-agriculture.org/en/events/e-bario-knowledge-fair-ict-indigenous-technological-innovation

 Rodil, K. et al. (2011). A New Visualization Approach to Re-Contextualize Indigenous Knowledge in Rural Africa. Available at: http://vbn.aau.dk/files/50971813/Rodil_et_al_2011_A_New_Visualization_Approach_to_Re_Contextualize_Indigenous_Knowledge_in_Rural_Africa.pdf

SESIGO PROJECT (2011). The makings of a Botswana information society through access to information communications technologies. Available at: http://www.sesigo.org.bw/assets/files/sesigo_project.pdf

Steiner, A. (2008). Indigenous knowledge in disaster management in Africa. Available at: http://www.unep.org/IK/PDF/IndigenousBooklet.pdf

UNEP (United Nations Environment Programme) (2008). Indigenous knowledge in disaster management in Africa. Available at: http://www.unep.org/IK/PDF/IndigenousBooklet.pdf

UNESCO, MOST and - Nuffic –CIRAN, (2001-2002). Best Practices on Indigenous Knowledge. Available at: http://www.unesco.org/most/bpindi.htm#definition

World Bank (1998). *Ingenious knowledge for development: a framework for action*. Available at: http://www.worldbank.org/afr/ik/ikrept.pdf