

INTEGRATION OF THE INDIGENOUS AND THE SCIENTIFIC KNOWLEDGE SYSTEMS FOR CONSERVATION OF BIODIVERSITY: SIGNIFICANCES OF THEIR DIFFERENT WORLDVIEWS AND THEIR WIN-LOSS RELATIONSHIP

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ABSTRACT

Conservation of biodiversity to meet needs and aspirations of the present and future generations is a cornerstone for sustainable development. Apparently, integration of the indigenous and the scientific knowledge systems for conservation of biodiversity has been overemphasized as their integration would achieve more than either in their separation. Despite significant documentation of the indigenous knowledge system on conservation of biodiversity, and the emphasis for the integration of the two knowledge systems for sustainable management and use of biodiversity, struggle for power and legitimacy and a win-loss relationship have been constraining their integration.

This paper observes that survival, flourish and integration of the two knowledge systems for sustainable management and use of biodiversity rest on recognition, enhancement and promotion of the indigenous knowledge system, and its accommodation into the scientific knowledge system in its way of knowing and doing, while considering cultural, spiritual and local political aspects of the knowledge system.

Key words: Indigenous, Scientific, Integration, Conservation of biodiversity, Sustainable development

INTRODUCTION

Biodiversity decline is increasingly becoming one of the major concerns of humankind since the last quarter of the 20th century (Hens, 2006; Meffe *et al.*, 2006 cited by Fitzgerald *et al.*, 2009). In highlighting this view, the 2002 World Summit on Sustainable Development, held in Johannesburg - South Africa, declared that despite significant efforts, the decline of biodiversity worldwide is continuing at an unprecedented rate and that a reversal in this ongoing decline should urgently be realized (Hens and Nath, 2003 cited by Hens, 2006). Similarly, UNESCO, (2010) argued that the reversal of biodiversity decline has become one of the major challenges that the world faces today. It is from such reality that biodiversity decline is increasingly becoming a worldwide challenge that requires collective and urgent efforts at local, national, regional and international levels.

Biodiversity is the heart of sustainable development and the life insurance in itself (Mc Neil and Shei, 2002 cited by Sajise, 2005). According to FAO, (1995) cited in Young, (1997), sustainable development is the management and conservation of the natural base in such a manner as to ensure the attainment and continued satisfaction of human needs for the present and the future generations. The author further argued that such development has to conserve land, water and biodiversity, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable. Sustainable development is determined among other factors, by the interaction of key three elements that are appropriate and adequate knowledge and experience, biodiversity and socio-economic elements (Sajise, 2005). This implies that overexploitation biodiversity will result into increasingly incapability of biodiversity to support lives and thus is why the use of appropriate technology that is no-degrading has been overemphasized.

To date, the increasing emphasis on the integration of the indigenous and the scientific knowledge systems for sustainable management and use of biodiversity stems from the fact that the two knowledge systems complement each other in their strengths and weaknesses, and their combination may achieve what neither would achieve alone (Stevenson, 2005; Nganje, 2009; Fitzgerald *et al.*, 2009 and Kajembe *et al.*, 2010, Cobb, 2011; Das Gupta, 2011).

Despite the over-emphasized integration of the two knowledge systems for the conservation of biodiversity, such integration contains very few examples of the process and very little evidence of how these knowledge systems could be integrated (Zazu, 2007; De Kruist *et al.*, 1998, Caheiros *et al.*, 2000, Hunting *et al.*, 2000, Mackinson, 2001, Klooster, 2002, Davis and Wagner, 2003, Ericksen and Woodley, 2005, Schutz *et al.*, 2007 cited by Ballard *et al.*, 2008).

Currently, there have been substantial examples of such integrations in other fields like medicine (Mascarenhas, 2003, Sibisi, 2004 cited by Hens, 2006; Msuya, 2007; Das Gupta, 2011). This may suggest that there might be some factors underpinning the integration of these knowledge systems for conservation of the biodiversity. In a related view, Kideghesho, (2008) and UNEP, (2008) argued that the social, economic and political realities in many parts of Africa may have been limiting wide use and application of the indigenous knowledge system, thus limiting its integration with the scientific knowledge system. It is from the above background, this paper aimed at answering the following question; how do the different worldviews and the win loss relationship between the indigenous and the scientific knowledge systems influence their integration?

CONCEPTUALIZATION OF KEY TERMS AND CONCEPTS

The Indigenous Knowledge System

The indigenous knowledge system, in its broadest sense, encompasses cultural knowledge; social, political, economical and spiritual; kinship, local politics and other factors which are tied together and influence one another (Tanyanyiwa *et al.*, 2011), whereas its spiritual nature influences how resources are managed and used by the people of that society (Berkes, 2008; Turnbull, 2007; IIRR 1996b in Tanyanyiwa, *et al.*, 2011; Cobb, 2011). In this paper, the indigenous knowledge system refers to a body of knowledge that has been generated, tested, improved overtime through the indigenous people interaction with

their supporting ecosystem, and that has been enhanced and safeguarded by norms, values, taboos, rituals and sacredness; that is interwoven within the context of local politics, spiritual and demographic characteristics of the people concerned.

The Scientific Knowledge System

Scientific knowledge system refers to all methods and activities that are driven by theoretical models and, governed by testing of hypotheses and not necessarily utilitarian, often generalizable and not always location-specific (Charnley *et al.*, 2007), contrary to the indigenous knowledge system that is mainly based on one's experience (Ellis, 2005). While the scientific knowledge system tends to consider humans as manager and superior to other living and non-living organisms (Jostad *et al.*, 1996 cited by Charnley, *et al.*, 2007; Berkes, 2008), the indigenous knowledge system considers humans being part and parcel of the supporting ecosystems and, each of the ecosystem components, including humans are interconnected and affect one another, and therefore deserve equal valuation. It is from the above conceptualization, this paper refers the scientific knowledge system to all scientific principles, strategies, and approaches and institutions such as conventions, government policies, strategies, rules and regulations that altogether govern humans' interaction with their livelihood supporting ecosystems.

Biodiversity and Biodiversity Conservation

The term biodiversity has been perceived and conceptualized differently by different people, resulting into plentiful conflicts among different stakeholders, on the goals and means for its conservation (Charnley *et al.*, 2007). For example, according to Wilfred *et al.* (2007), biodiversity refers to variety of life forms (animals, plants and micro-organisms), ecosystems and the ecological process in which these components are interacting. According to the indigenous American Indians, biodiversity refers to a reciprocal relationship between human and non human entities that include plants, animals, minerals; and the spiritual consciousness of the people concerning such relationship (Kimmerer, 2002). This implies that, for indigenous people, biodiversity is much broader than the scientific view of ecosystem as it includes spiritual values of nature through creation. In this paper, biodiversity conservation is perceived as abundance and number of different species of plants, animals and the non-living organisms, in a given geographical area, living in spiritual and reciprocal relationships between the living and the non living things, whereas humans are perceived as part and parcel of the supporting ecosystem

Integration of the Indigenous and the Scientific Knowledge Systems

According to Roba, (2008) integration of the indigenous and the scientific knowledge systems is a process of blending these knowledge systems resulting into rational decision making, sharing of information and understanding of different viewpoints between the indigenous communities and the scientifically trained technicians. Using the term co-management (another term for integration), (Berkes, 2007; Berkes *et al.*, 2007) argues that integration of indigenous and the scientific knowledge systems is a process of active participation of indigenous people and their knowledge and equal sharing of power and responsibilities between scientists and the indigenous people. In this paper, the integration of the indigenous and the scientific knowledge systems refers to a wide use and application of the indigenous knowledge system in its own forms of knowing and doing in a reciprocal relation with the scientific knowledge system without any forms of subordinations.

THE FINDINGS

Indigenous Knowledge System and Conservation of Biodiversity

To date, several academics professional are still not appreciating on the significance of the indigenous knowledge system, among others, on sustainable development, that is why most of initiatives have been relying on formal scientific knowledge (Bisong, *et al.*, 2010), biodiversity conservation initiatives being among such initiatives. In light of the same view, despite several vivid examples on the significance of indigenous knowledge system on conservation of biodiversity (Berkes *et al.*, 1994; Berkes, 2000; Minnis and Elisen, 2000; Peacock and Turner, 2000; Carson and Maffi, 2004; Anderson, 2005 cited by Charnley *et al.*,2007), and notable geographical overlap between the world's biodiversity and cultural diversity hotspots (UNESCO, 2007; Shresthra *et al.*, 2008), the significance of the indigenous knowledge system for conservation of biodiversity is increasingly being debatable.

Opponents of the significance of the indigenous knowledge system argue that, for any practice to be considered as conservational, such practice has to be intended for such conservation activities (Alvard, 1998 in Kideghesho, 2008). So being conservational is, both, a practice and an ideology (Cunha and Amelada, 2000 cited by Kideghesho, 2009). For example, (Alvard, 1998; Mwilomeke *et al.*, 1998; Saj *et al.*, 2006; Lean, 2006; WFF, 2006 cited by Kideghesho, 2008) maintain that, although sacred groves and forests and taboos contribute to conservation of biodiversity, they cannot be considered as conservational as they were not intended for such conservation.

Contrary to the opponents of the indigenous knowledge system, Berke *et al.* (2000) argued that conservation of biodiversity should not necessarily be the objective of the practice but the consequences of it. Moreover, several vivid examples show that the indigenous knowledge system has been intentionally and significantly contributing to conservation of biodiversity. For example, restriction on over fishing, freeing of surplus fish during spawning season and expulsion of offenders of traditional rules and taboos (Mwale and Malekano, 2000 cited by Kalanda-Sabola *et al.*, 2007), have been significantly contributing to sustainable management and use of biodiversity. Kideghesho, (2008) in his study also found that indigenous conservation regulations such as hunting of adult and male animals and restriction of hunting wild animals during breeding seasons have been contributing to conservation of biodiversity. This implies that restrictions of fishing during spawning season, hunting of adult male animals and hunting during breeding season had a conservation ideology; otherwise those restrictions could have not been on a specific period of the year and specific sex of an animal.

Summing up the discussion whether the indigenous knowledge system was conservational or not, Kideghesho, (2008) argued that whether traditional and mythical values are conservation-oriented or not, its influence on conservation of biodiversity should not be ignored, as what matters is the success of whatever system is used. Moreover, at this era of biodiversity decline, to keep arguing whether the indigenous people and their knowledge system is conservational or not, rather than fostering them, is valueless (Holt, 2005). It is from this background this paper argues that the indigenous knowledge system on its holistic nature of the knowledge and on its own ways of knowing and doing is conservational.

Synergy between the Indigenous and the Scientific Knowledge Systems

A synergetic relationship between the indigenous and the scientific knowledge systems is widely accepted and relatively well documented. For example, a study carried out in Xishuangbanna, Southwest China from 1993 to 1999 revealed that reduction of taboos practices resulted in decline in revered plant species, despite the legislations for their conservation (Hongmao *et al.*; 2003 cited by Nganje, 2009). Similar findings were reported by Nganje, (2009) in his study carried out around the Ankassa, Bia and Kakum forest conservation areas in Ghana. The study revealed that neither the scientific knowledge system nor taboos alone conserved biodiversity; rather their combination achieved what neither could alone. Similarly, Stevenson, (2005); Fitzgerald *et al.* (2009); Cobb, (2011) and Kajembe *et al.* (2010) insisted that the indigenous and the scientific knowledge systems do complement each other on their strengths and weaknesses and their integration would achieve more than neither in their separation. Conclusively, with no doubt this paper suggests that the indigenous and the scientific knowledge systems are synergetic and do complement each other on their strengths and weaknesses, and their integration might achieve what cannot be achieved by either in their separations.

A Theoretical Process of Integrating the Indigenous Knowledge System

According to Tanyanyiwa *et al.* (2011) adaptive characteristics of the indigenous knowledge system can be capitalized to facilitate its integration with the scientific knowledge system for conservation of biodiversity. Of recent, several theoretical models and processes have been proposed as a result of the failure of the scientific knowledge system. For example, Ossai, *et al.* (2010) proposed six steps for the integration of indigenous knowledge system into Information Communication Technology (ICT) that include recognition and identification of indigenous knowledge system, validation and recording and documentation. Others include storage in retrievable repositories, transfer and dissemination. Contrary to Ossai's six steps on integrating indigenous knowledge system, Cobb, (2011) proposed four steps for the integration of the indigenous knowledge system for climate change adaptation and mitigation of its effects that include documentation, valuing, stewardship and co-management and discourse.

Of the two theoretical processes of integration of the indigenous knowledge system, the Cobbs' four stage process is adopted in this paper, based on the following reasons. Firstly, validation of the indigenous knowledge system using scientific approaches is highly criticized, as these knowledge systems are originating from different worldviews, having different principles and each being a complete knowledge on its own, therefore, validating one using the other knowledge methods and approaches is unacceptable. Similarly, Maila *et al.* (2003) persuasively put it that illiterate people are illiterate based on the scientific standards of evaluating their knowing, but based on indigenous standards, indigenous people are also intellectuals in their own worldview of knowing and doing, and that is why several intellectuals and academics do consult traditional healers whom it is assumed that are illiterate according to scientific standards (Ntuli, 1999 cited by Maila *et al.* 2003).

According to Ossai *et al.* (2010) a validation process involves an assessment of indigenous system knowledge's significance and relevance, functionality, effectiveness and transferability of such a knowledge system. However, based on wholeness of

the indigenous knowledge system, which include but not limited to indigenous legal systems, norms, values, beliefs, sacredness, rituals, just to name a few (Robert, 1996 cited by Macgregor, 2008), a meaningful validation of the indigenous knowledge system in its wholeness nature is almost impossible.

Secondly, while Ossai *et al.* (2010) consider transferability of a knowledge system beyond its area of origin being one of prerequisite for its meaningful integration with other knowledge systems, the indigenous knowledge system is location-specific, thus, it cannot effectively and meaningfully be applied into a quite different context, as the knowledge is a product and part of humans' interaction in a particular supporting ecosystem. In light of this contention, Thrup, 1989 cited by Tanyanyiwa *et al.* (2011) very clearly pointed out that the indigenous knowledge system that was adopted in a particular environment become inappropriate in a drastically changed environment, implying that indigenous knowledge system can only be meaningfully transferable in the same or similar context to which that knowledge system has evolved. Moreover, most of scientific knowledge system that have mostly introduced based on "one fit all" ideologies have been less successful, once introduced in a quite different ecosystem.

Similarly, Ossai *et al.* (2010) argued that indigenous knowledge system is rooted into particular cultural traditions, and transferring it to other places could result into dislocation of the same knowledge system. It is therefore, from the above argumentations and similar views from other researchers and scholars on the indigenous knowledge system, that the Cobb's four steps of the integrating indigenous knowledge system is adopted by this paper to guide the discussion around the theoretical integration process.

Step one: Documentation

It has been widely argued that documentation of the indigenous knowledge system will motivate wide use, application and easy integration of such knowledge system into other forms of knowledge systems (Msuya, 2007; shresha *et al.*, 2008), whereas, lack of documentation has been contributing to its decline: elders have been dying without passing on their knowledge system to their grandchildren (Ellis, 2005; Kalanda-sabola, *et al.*, 2007), threatening its wide use, application and its integration with other forms of knowledge systems (Msuya, 2007). Apparently, documentation of the indigenous knowledge system using signs and codes that are used in the documentation of the scientific knowledge system is not effective (Beckes and Ghimire, 2003), as the former is normally gained and easily understood orally. Such documentation may weaken the social process of teaching and learning (Gupta, 1994 cited by Zazu, 2007).

According to Rahman, (2000), the amount of the indigenous knowledge expressed by indigenous people in words and number represents just a fraction of the knowledge, and therefore, its documentation using scientific codes and signs will capture only such a fraction, leading into further declination of the knowledge system. Furthermore, based on the holistic and interwoven nature of the indigenous knowledge system, that include taboos, beliefs, sacredness, myths, indigenous politics and gods, just to name a few, will further complicate the documentation process. Arguably, promotion rather than documentation of the indigenous knowledge system using its indigenous ways of teaching and learning with consideration of both teaching and learning context and process will ensure sustainability of the knowledge system.

Step two: Valuing the indigenous knowledge system

Among others, equal valuation of the indigenous knowledge will increase its wide use and application and, thereof, its integration into other forms of knowledge systems: as stigmatization has been significantly influencing its decline (Cobb, 2011). Similarly, lack of integration of the indigenous knowledge system has been a result of the indigenous people themselves not accepting usefulness of their own knowledge system as a result of their knowledge being labelled valueless by colonial system (Le Roux, 1999 cited by Zazu, 2007). Equal valuation of indigenous knowledge system as a complete body of knowledge system, therefore, will stimulate its wide use, application and its integration with the scientific knowledge system.

Step three: Stewardship and co-management

Sharing of power and benefits has been one of worldwide agenda between the indigenous people and other potential actors. For example, Article 8(j) of Convention of Biological Diversity of 1992 in Rio De Janeiro, among other issues, insisted on equitable sharing of the benefits accrued from utilization of the indigenous knowledge system. Unequal power relations between the indigenous people and scientists have been underpinning integration of these knowledge systems (Chapekie, 1995; Lukey, 1995; Stevenson 1997 in McGregor, 2008; McGregor, 2008; Ossai *et al.*, 2010; Nadasdy, 1999 cited by Cobb, 2011). Such power imbalances have been fostering rejection of the indigenous knowledge system (Ellis, 2005). The indigenous knowledge system advocates sharing of power, responsibilities, rights and duties between the indigenous people and other potentials actors, and this capital can effectively be utilized to facilitate its integration (Berkes, *et al.*, 2003; Msuya *et al.*, 2009).

Step four: Discourse

Creation of public awareness on the significances of indigenous knowledge system is a cornerstone for its integration into other forms of knowledge systems (Cobb, 2011). As indigenous knowledge system has been considered valueless and being equated with primitiveness, backwardness, archaic, paganism and barbaric, thus, a community or a person mostly relying on such a knowledge system being supposedly inferior to those who practice the opposite (Ocholla, 2007; Zazu, 2007), and therefore limiting its wide use, application and its integration into other forms of knowledge systems. As a matter of fact, public awareness is necessary to change people's attitudes and perceptions on the significances of the indigenous knowledge system, as the knowledge has been badly labeled (Cobb, 2011).

Several studies have revealed that factors that have been underpinning a wide use and application of the indigenous knowledge system have been also limiting its integration into other knowledge systems (Egneus *et al.*, 2000 cited by Knutsson, 2006; Charnley *et al.*, 2007; Ocholla, 2007; Darr *et al.*, 2009; Ossai *et al.*, 2010; Cobbs, 2011). Arguably, in a society in which, indigenous knowledge system is widely used and application has to be such a society with a relatively strong indigenous social solidarity, that among other responsible things for indigenous knowledge system for conservation of biodiversity. In such a situation, effective adoption of new knowledge system, such as the scientific knowledge will effectively and successfully be through such social solidarity, otherwise, it would lead into several conflicts among these

knowledge systems. Such a process of introducing the scientific knowledge system if will observe the above four steps of knowledge integration, such integration is more likely to be realized.

It is from the above argumentations, it is argued that equal respect, acceptability and applicability of the indigenous knowledge system with mutual benefits with other forms of knowledge systems, such biodiversity conservation methods and practices, is a necessary pre-requisite for the prosperity of the indigenous knowledge system and to its integration into other knowledge systems. This paper, therefore argues that integration of the indigenous and the scientific knowledge systems can be realized if power imbalance between these knowledge systems is dealt with.

NEXUS BETWEEN THE INDIGENOUS AND THE SCIENTIFIC KNOWLEDGE SYSTEMS: IT'S SIGNIFICANCE ON THEIR INTEGRATION

Juxtaposing worldviews and belief systems between the indigenous and the scientific knowledge systems

Several studies provide evidence on the existence of the indigenous worldview as characteristically rational, spiritual and mystical (Emereole *et al.*, 2001, Fakudze 2003a, 2003b cited by Mokuku *et al.*, 2004). However, the western worldview (scientific worldview) has been regarding the traditional worldview as naive, superstitious and magical. For many local communities, the planet and its resources are considered sacred and deserve the utmost respect, and that is why management and conservation of these resources have based on and the influenced by spiritual norms and constitutions (Steiner, 2004).

According to Morgan, (2003), the indigenous knowledge system makes no distinction between the physical and spiritual fields of understanding, and despite its dynamic and diverse nature, the indigenous knowledge thinking is mostly holistic and contextual. The scientific worldview differs with the indigenous worldview, among others, by its classifying species diversity as being hierarchical and into different families and level of sophistication, with human perceived as distinct from and superior there to (Ani's 1994 cited by Mokuku *et al.*, 2004). This implies that while the indigenous worldview gives full respect to all living and non-living things, and believes that their conservation is a duty of all the organisms from tiny to large animals, the scientific worldview considers other species being inferior, have no spiritual value and are for human utilization and management.

Arguing on the perceptions of the indigenous people on other species biodiversities, T'seleie, 1997 cited McGregor, (2008) elucidates that to be a human is to be able to understand the world and to live in it, to be part of it, to learn to understand the animals, for they are our brothers and they have much to teach us, as we are part of this world. This implies that while the scientific worldview considers human beings as superior to other creations, and as manager of other creatures, the indigenous worldview considers all creations being God's creations: all deserve equal respects without any kind of subordination. Such difference in the worldviews has been attributing to the endless conflicts between the indigenous people and scientists as a result of different approaches in achieving the same vision of attaining sustainable management and use of biodiversity (Holt, 2005).

Of several eminent examples on the conflicts between the indigenous people and scientists, on the sustainable management and use of biodiversity, were reported by Holt, (2005) who found that, while indigenous people of the Amazon believed that biodiversity is “a God given resource”, and has to be used, otherwise, they will not be provided. Kweka, (2004), in his study in the Usambara Mountains in Tanzania, found that during the pre-colonial period management of natural resources (biodiversity) were governed based on customary laws that have been allowing people to use biodiversity such as entering into forests after performing some ritual practices. The colonial and post colonial era is considered as the most destructive period as forests rules were enforce with vigour, whereas the indigenous people were restricted from entering into the forests and, clear boundaries were demarcated to separate the forest reserves and farms. Such conflicts and different approaches and strategies between the indigenous people and scientists have been hampering the wide use, application and integration of these knowledge systems, despite their synergistic relationship, resulting into more destruction of natural resources: indigenous people were intentionally destroying these resources as their incursion against the imposed unpopular rules (Mbwambo, 2000; Mapara, 2009).

THE INDIGENOUS AND THE SCIENTIFIC KNOWLEDGE SYSTEMS: A WIN LOSS RELATIONSHIP

Subsistence and commercially oriented livelihood strategies and their significance on management and use of biodiversity

The indigenous knowledge system is embedded in the culture and religion of the poor than by the economically affluent communities (Ocholla, 2007), and it is a social capital of the people needed for their struggle for survival (the World Bank, 1998 cited by Ocholla, 2007). Similarly, rich biodiversity hotspots normally overlap within areas where people are poor and struggling hard for their livelihoods (UNESCO, 2007 and Shresthra *et al.*, 2008), implying that there is clear correlation between people’s economic wellbeing and biodiversity richness.

Indigenous livelihoods’ strategies have been perceived by market oriented economies as being less profitable (Mutta *et al.*, 2009; Das Gupta, 2011), even though they have been helpful in attaining environmental sustainability, such as sustainable conservation of biodiversity (Das Gupta and Saha, 2009 cited by Das Gupta, *et al.*, 2011). Arguably, this reality might have stemmed from the fact that the indigenous knowledge has been guided by a subsistence livelihood economy, to meet human subsistence needs. For example in his study Kweka, (2004) found that before the colonial era, forests were much intact and their consumption was confined only to domestic subsistence use. The author further found that, during the colonial era, much of these forests were destructed as a result of increased commercial exploitation of forests resources, such as timbering.

Poverty affects the traditional economy, transforming it from subsistence to becoming commercial, resulting into increased pressure on natural systems and altering social structures that generate, safeguard and enhance the indigenous knowledge system, leading into decline of the indigenous knowledge system and the ecosystems they used to conserve (Oviedo *et al.*, 2007). Along a similar argument, in their study, Kideghesho, (2008) and Njanje, (2009) also found that poverty has been compelling indigenous people to act against their indigenous beliefs and practices in order to make a living, leading into decline of both the knowledge system and biodiversity. Very little attentions on non-cash indigenous knowledge aspects such as traditional dances, rituals, taboos and sacredness just to name a few, as compared to indigenous medicines that have been a

major concern of the global pharmaceutical companies for economic gain (Lin, 2002; Mishra, 2002 cited by ICSU, 2002; Msuya, 2007; Shresthra *et al.*, 2008), significantly resulting into declining of the non cash indigenous knowledge system and of biodiversity that have been managed by the same.

From the above observations, this paper argues that income is both a solution and a problem for the wide use, application and integration of the indigenous knowledge system into other knowledge systems. As a solution, income is an incentive for researches, documentation, wide use and application and the integration of the indigenous knowledge system with the scientific knowledge system, as in scientific medicine. Nevertheless, there is less interest in the non-cash indigenous knowledge such taboo and rituals integration into the scientific knowledge system for sustainable management and use of biodiversity. Moreover, commercialization of livelihood strategies: conversion of subsistence livelihood strategies to commercial livelihood and strategies has been increased demand on natural resources, resulting into decline of both the indigenous knowledge system, and biodiversity as the two are interwoven.

Globalization of the scientific knowledge system

A win-loss relationship between the indigenous and the scientific education systems has been widely reported. For example, Msuya, (2007), in his study, found the existence of conflict of interests among the sons and daughters of the Sambia and Zigua medicine men and women, on whether to abandon the scientific education system or become a traditional medicine man or the vice versa. Similarly, student get confused that what they learnt in the scientific knowledge system is contradicts with what they learnt in the indigenous knowledge system (Zazu, 2007), further complicating the learning process, resulting into decline of the latter as it has been labeled valueless.

The new generation is mostly exposed to the scientific education system at expenses of the indigenous knowledge system and, any one practicing indigenous knowledge is perceived outdated and primitive (Msuya, 2007). That is why people with good quantity and quality of indigenous knowledge system normally have the least scientific education (Cunningham, 1991 cited by Zazu, 2007). According to Greiner, 1998 in Tanyanyiwa *et al.* (2011) the scientific education system has been contributing to the decline in the indigenous knowledge system through harmonizing the world's culture, resulting into dilution of the indigenous cultural system which has been generating and safeguarding the former, resulting into incomplete knowledge base.

Arguably, a win-loss relationship between the indigenous and the scientific knowledge systems that has been mainly dominated by the scientific approaches, strategies and methods and practices for the conservation of biodiversity, has resulted into the harmonization of the teaching and learning processes based on the scientific knowledge system, therefore, underpinning the integration of these knowledge systems.

Harmonization of the global cultural system

The indigenous knowledge system has been gained through human interactions with their environments in a given cultural context, and such a knowledge system tends to disappear as people's culture deteriorates (Warren and Rajasekan, 1993). In light of this view, Barbossa, 1996 cited by Becker and Ghimire, (2003) argued that much of the indigenous knowledge system has been severely eroded by interaction with the western culture.

In the indigenous knowledge system philosophy, kinship with other creatures on earth makes the foundation of the indigenous worldview (Kassa, 2002 cited by Mokuku *et al.*, 2004). For example, Sarfo-Mensah *et al.* (2007), in their study in Ghana, Parkin, (1972); and Githito, 1988 cited by Mutta *et al.* (2009) in their studies in Kaya forests in the Coast Region of Kenya, revealed that as a result of increased influence of the western education, there have been increased encroachments of sacred groves, one of several components of the indigenous knowledge system resulting into its decline. Related finding was reported by Tanyanyiwa *et al.* (2011) who found that people aged above 40 years were more interested in the indigenous knowledge system as compared to those aged below 40 years, as those aged above 40 were raised in a system with less influence of the scientific education system.

Struggle for power and legitimacy

Article 8 (j) of Convention on Biological Diversity (CBD) of 1992 in Rio De Janeiro emphasised on the need of respecting, preserving and maintaining the knowledge, innovations and practices of the indigenous people while ensuring equitable sharing of benefits between the indigenous people and other stakeholders (Rand *et al.*, 2010). It is widely envisaged that mutual sharing of benefits accrued from the use of the indigenous knowledge system could ensure its development, sustainability and to its integration with the scientific knowledge system (Ocholla, 2007; Zazu, 2007).

In Africa, both, the colonial and post colonial government policies and regulations have been used to marginalize indigenous knowledge system, triggering struggle for legitimacy between the knowledge systems (Mutta, *et al.*, 2009, Kideghesho, 2009; Ossai *et al.*, 2010). For example, a study by Mutta, *et al.* (2009) in the Kaya forest in Kenya revealed that replacement of the indigenous knowledge system by government biodiversity conservation methods and practices has resulted into the decline of sacred forests by as low as 20 % of their original size, while other sacred forests disappeared (Githito, 1998 cited by Mutta *et al.*, 2009). It is worth noting that sacred groves and forests have been widely reported to have high biodiversity as compared to conventional conservation forests (Msuya, 1998; Mapara, 2009; Jaryan *et al.*, 2010).

Power imbalance that has been attributed by political power and legitimacy struggle between the indigenous people and scientists has been significantly contributing to the failure of integrating the indigenous knowledge system into the scientific knowledge system (Chapekie, 1995; Lukey, 1995; Stevenson 1997 cited by McGregor, 2008; McGregor, 2008; Chernley *et al.*, 2007; Nadasdy 1999 cited by Cobb, 2011), resulting into rejection of indigenous knowledge system (Ellis, 2000). Moreover, successful policy interventions are those that consider cultural and spiritual values of the supporting ecosystems and the local politics, from which the indigenous knowledge system evolves, is enhanced and sustained (Msuya *et al.*, 2007). For example,

despite the Tanzanian environmental Act of 2002 emphasis on active participation of primary stakeholders such as indigenous people, Mattee, (2007) observes that most of policies in Tanzania are assumed to be formed for the public interest, while they are normally formulated through a centralized systems with exclusion of the indigenous people resulting into conflict of interests. Similar observation was also reported by Bisong *et al.* (2010), who argue that establishment of protected areas has been creating numerous conflicts between the indigenous people and the scientists, as a results of their difference on how such areas have to be used, whereas the indigenous people argued that natural resources have to be used otherwise they will not be provided while scientists emphasis on strictly prohibition for their uses.

It is therefore argued by this paper that survival, flourish and integration of the indigenous knowledge system and the scientific knowledge system, among others factors, rest on the presence and application of appropriate policies and strategies at all levels that support the context from which the indigenous knowledge system evolved and safeguarded and enhanced, as well as ensuring equitable sharing of power and legitimacy between the indigenous people and scientists.

CONCLUSION AND RECOMMENDATIONS

It can be concluded that integration of the indigenous and the scientific knowledge systems to be realized, paradigm shift and paradigm change are inevitable. While in paradigm shift, indigenous knowledge system has to be recognized, valued and widely used in a reciprocal relationship with scientists. Paradigm change insists changes in the scientific knowledge system (conventions, policies and strategies) so as to be able to accommodate the indigenous knowledge system based on its own way of knowing and doing things.

For that integration to be realized, the following are the recommendations: -

- The problem of power imbalance between the indigenous knowledge system and the scientific knowledge system has to be addressed
- Indigenous knowledge has to be understood and promoted based on the indigenous knowledge of knowing and doing, rather than being documented: as documentation using scientific codes and validation will further distort the indigenous knowledge system.
- Policies, strategies and practices have to be developed with active participation of all primary stakeholders, among others, to catch views, cultural contexts, needs, interests and strategies on management and use of biodiversity by the indigenous people.

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