

**INTEGRATION OF THE INDIGENOUS KNOWLEDGE SYSTEM (IKS) FOR SUSTAINABLE
MANAGEMENT AND USE OF BIODIVERSITY IN SOUTH NGURU MOUNTAIN FOREST, TANZANIA:
THE INFLUENCE OF SOCIO-ECONOMIC AND POLITICAL FACTORS.**

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ABSTRACT

Using the South Nguru Mountain forest, this study explored the socio-economic and political factors influencing integration of the indigenous knowledge system (IKS) into biodiversity conservation methods and practices for sustainable management and use of biodiversity. Semi-structured and key-informant interviews, field observations and Focus Group Discussions (FGDs) were used for data collection. Lack of official recognition, motivation and capacity building of the indigenous social structures were limiting the wide use, application and integration of the IKS. Other factors include: age; sex; education level; household labour; household income; farm size and years of residency of respondents. The study recommends that official recognition, motivation and capacity building of indigenous social structures, training on the significances of the IKS and addressing the problem of household-level poverty while ensuring reciprocal relationships among actors is the cornerstone for integration of the IKS for sustainable management and use of biodiversity.

Keywords: Integration, Indigenous knowledge system, Sustainable management and use of biodiversity, Biodiversity conservation methods and practices, South Nguru Mountain Forest, Tanzania.

INTRODUCTION

Biodiversity is at the heart of sustainable development (Mc Neil and Shei, 2002 cited by Sajise, 2005), and one of the pillars of sustainable development, whereas, its overexploitation, inhibit its ability to support lives of the present and future generations (CBD, 2004). Despite the indigenous knowledge system (IKS) being widely known for its roles in conservation of biodiversity, the knowledge system has been considered primitive and barbaric, leading into its decline and decline of biodiversity (McGregor 2004; Sobrevilla 2008; Kajembe *et al.*, 2010). Quite recently, there have been an increasing call for the integration of the IKS into biodiversity conservation methods and practices as these 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; Kajembe *et al.*, 2010; Cobb, 2011 and Das Gupta, 2011). Apparently, such integration creates a mechanism of dialogue between indigenous people and scientists and design of programmes that reflect people's aspirations and are participatory (Eyong, *et al.*, 2007).

Despite several recommendations for the integration of IKS into biodiversity conservation methods and practices (Chambers, 1983 and Warren, 1992 cited by Kajembe, 1994; Msuya, 1998; Stevenson, 2005; Mokuku, 2007; Nganje, 2009; Kajembe *et al.*, 2010), very little of the findings on IKS have been implemented and very little is known about the practices and strategies involved in the integration of the IKS into biodiversity conservation methods and practices (Zazu, 2007 and 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). In a related view, Kideghesho (2008) and UNEP (2008) argued that despite several calls and suggestions for the wide use and application of indigenous practices, the social, economic and political realities in many parts of Africa limit its wide use and application, and ultimately to the lack of successful integration of IKS into biodiversity conservation methods and practices.

It is from these facts and recommendations that this study was carried out in South Nguru Mountain Forest of Tanzania to analyse the socio-economic and political factors limiting the integration of IKS into biodiversity conservation methods and practices for sustainable management and use of biodiversity.

DEFINITION OF KEY-TERMS

Indigenous knowledge system in this study, refers to a body of knowledge that has been generated, tested, improved overtime through human interactions with their supporting ecosystem, enhanced and safeguarded by norms, values, taboos, rituals and sacredness, that is interwoven with local politics, spiritual and socio-economic characteristics of the people concerned (Ruheza and Kilugwe, 2012), this definition suite the objective of this study. Biodiversity conservation methods and practices refer 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). This paper refers the biodiversity conservation methods and practices 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.

Integration of IKS into biodiversity conservation methods and practices is a process of blending these knowledge systems into a rational decision-making, sharing of information and understanding of different viewpoints between the indigenous people and the western trained professionals (Roba 2008 cited by Ruheza *et al.*, 2012). In this study a definition by McGregor (2004) on sustainable management and use of biodiversity, as being a mutual take and give back to nature for

the benefit of all components of the supporting ecosystem, and such duty is for each of the creation from the tiniest animals to the powerful sun and the spirits, is adopted by the study.

STUDY AREA

The South Nguru Mountain Forests (Figure 1) is situated roughly at the centre of the Eastern Arc Mountain chain of Tanzania, lying between S 05° 53' S - S 06° 17' and E 037° 27' - E 037° 45' in Mvomero District, Morogoro Region. The Mountain covers an area of 184 km² (DIIS, 2007), with an altitude ranging between 760 and 2400 meters above sea level (Menegon *et al.*, 2008).

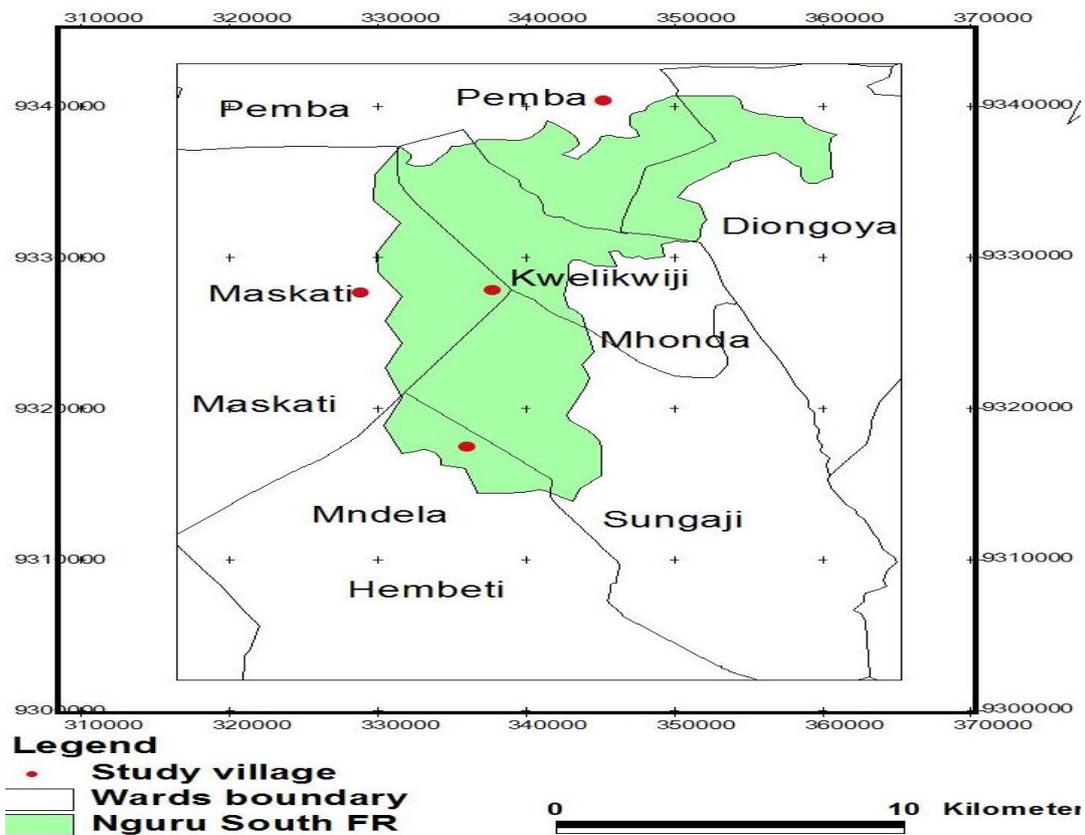


Figure 1: A map showing location of the study villages

METHODOLOGY

In this study, an exploratory cross-sectional research design was used. According to De Vaus (2002), a cross-sectional research design involves collection of information from representative population sample in one time duration at a single point. The choice of this research design is grounded on the fact that it is more flexible to provide opportunity for considering different aspects of a problem under study (Kothari, 2004).

Sampling procedures, data collection and analysis

A purposive sampling was used to select 4 villages out of 25 villages bordering South Nguru Mountain forests, each representing one ward within the landscape. Four villages were purposively selected, one village from the Northern, Southern, Eastern and Western parts of the mountain landscape, representing different socio-economic characteristics of the study population. The study village included Pemba (north), Mandela (south), Maskati (west) and Kwelikwiji (east) of the South Nguru Mountain forest.

Based on the criteria of being an indigenous person, as being a person who has lived in an area for more than 20 years; a sample of 60 interviewees was randomly selected from each of the villages using the 2005 voting lists, making a total of 240 interviewees. Semi-structured and key-informant interviews, field observations and Focus Group Discussions were used for data collection. Four, Focus Groups Discussions (FGD) (one in each of the four selected villages) that included *walukolo*, members of village environmental committees and the village chairperson and/or the Village Executive Officer (VEO) were held to complement the information collected through interviews field observations. Data collected in phase one were analyzed using both qualitative and quantitative methods. The Statistical Package for Social Sciences (SPSS) was used to analyze the quantitative data whereas content analysis was used to analyze the qualitative data.

Theoretical Orientation of the Study

The Political Ecology framework (Figure 2) was used to guide this study. Political ecology refers to a loose bundle of theories which analyze environmental issues from a wider political point of view that also investigates how the cultural, ecological, social and political issues conflate in environmental issues such as biodiversity decline (Korhonen, 2009). The author added that the recognition of different positions, perceptions, interests and rationalities among different actors interested in conservation of biodiversity is a prerequisite for a successful management and use of biodiversity. In fact, biodiversity being a broad concept that encompasses social, economic, ecological and political aspects, its management, uses and conservation should, therefore, consider the broad nature of the concept, which makes the political ecology model the most appropriate in critical analysis of the conservation of biodiversity.

The choice of the actor-oriented approach, among several other approaches of political ecology, gets support from Kajembe *et al.* (1999) and Schubert (2005) who argue that an actor-oriented approach is useful when dealing with several actors interested in a certain aspect such as biodiversity conservation, as it emphasizes discussions on plurality of actors who are related to conservation interventions as well as their socio-economic characteristics, perceptions and the political influence that occurs between the actors: these differences affect access to and control over biodiversity among different actors.

Korhonen (2009) puts it that conservation has to be regarded as a social processes in which there are different actors with different interests and unequal power among them which determine the outcome of the conservation process. Such relations, however, rarely have been taken care of. This suggests that power relation among members of a social group determines individuals and household level activities and actions and interactions with their supporting ecosystem.

Ignoring the perpetuation of unequal power relations between indigenous people and other actors has been limiting integration of the IKS into other forms of knowledge systems (Chapekie, 1995; Lukey, 1995; Stevenson, 1997 cited by

McGregor, 2004; Ossai *et al.*, 2010; Nadasdy, 1999 cited by Cobb, 2011), as such power imbalance has been fostering rejection of the IKS, its transformation and its integration into ways of knowing and doing (Ellis, 2000). Moreover, indigenous people have been obliged to present their knowledge in a scientific manner, using foreign languages, limiting their active participation (Holt, 2005).

The actor-oriented model was also used to take into account that the nature of the IKS varies among indigenous people of the same communities based on sex, age, social classes and other disparities in power relations (Sillitoe, 2002 cited by Roba, 2008), such as intellectual capability and profession (Ylhäisi, 2006; McGregor, 2004). Citing Pakhrel (2001), Shreshra *et al.* (2010) added that community heterogeneity has a great influence on conservation of biodiversity, as different ethnic groups, sex and economic classes have different interests and preferences on biodiversity.

According to the actor-oriented model, individual actions are embedded in value systems and social norms shaped by the social context, through a social standard of evaluation of actions, strategies and outcomes of their actions (Weismann, 1998 cited by Boillat, 2007). The authors added that actions and strategies of the social group were determined by social networks, social controls and social hierarchies aimed at ensuring social security balances necessary for the survival of the group and of their knowledge system. Based on that, the actor-oriented approach was used for critical analysis on the relationships between different actors within different socio-economic and political contexts that determined their interaction with their supporting ecosystem in the South Nguru Mountain Forest: such interactions determined the management and use of biodiversity at their disposal. Moreover, understanding of the existence of social structures, networks and power relation within and between actors is the cornerstone for collective and comprehensive strategies and practices for sustainable management and use of biodiversity.

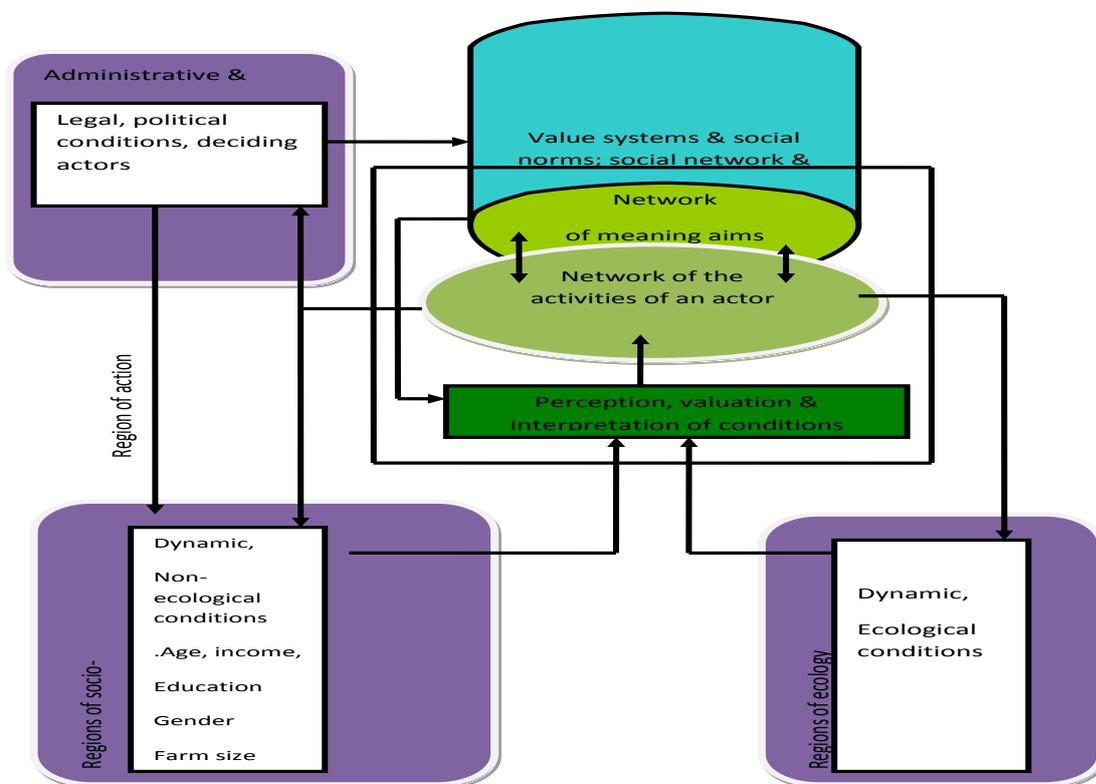


Figure 2: A General Structure of the Actor-oriented Model

Source: Adopted and modified from Wiesmann (1998)

A Conceptual Framework for the Study

A conceptual framework (Figure 3) was theoretized to guide the study on exploration of the socio-economic characteristics and political limiting integration of the IKS into biodiversity conservation methods and practices for sustainable management and use of biodiversity in the study area.

Arguing of the existing communication between the IKS and biodiversity conservation methods and practices, Ortiz (1999); Rahman (2000) and Sharva (2005) cited by Zazu (2007) put it that while there is informal and ad hoc exchange of knowledge and information between indigenous people and scientists, where the former has been used to enrich technocratic strategies, approaches and activities, such a relationship, at the same time is influenced by socio-economic and political contexts within which they are found. Chambers (1993) cited by Kajembe (1994) also argued that despite the synergistic relationships between the IKS and biodiversity conservation methods and practices, there are no clear lines of communications that have been effectively opened in either direction, limiting a meaningful development of these knowledge systems and their integration. More often, as the IKS has been perceived as being valueless, resulted into the persistence of power struggle between the indigenous and the western trained professionals, resulted into parallel application of these knowledge systems rather than Integrated Methods and Practices (IMP) in addressing the problem of unsustainable management and use of biodiversity. Therefore, while it has been widely argued and emphasized that integration of the IKS and biodiversity conservation methods and practices is an underutilized alternative in dealing with the worldwide challenge of biodiversity decline, lack of such integration among other factors, led to unsustainable management and use of biodiversity.

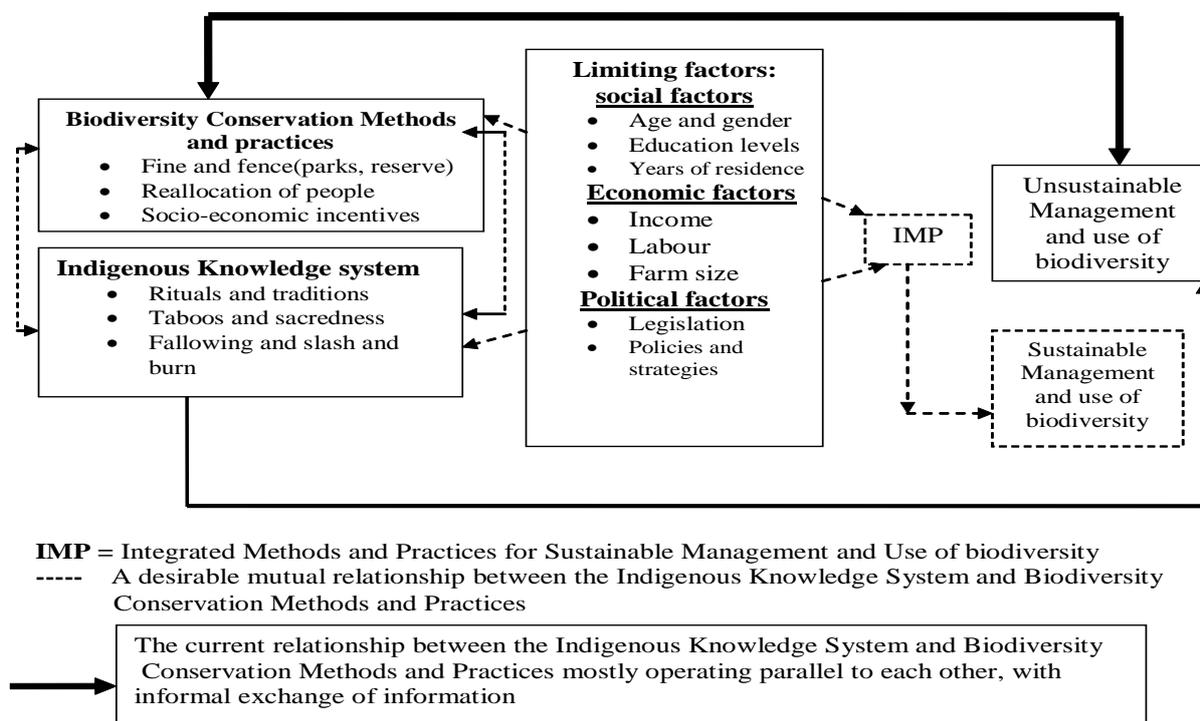


Figure 3: A Conceptual framework showing relationship between variables.

Source: Researcher (2013)

RESULTS AND DISCUSSIONS

Socio – economic and Political Characteristics of the Respondents and Obedience to IKS

Respondents' views on the relationship between sex and obedience to the IKS

Results (Table 1) show that most (62.0 %) respondents claimed that obedience to the IKS for the management and use of biodiversity varies with sex of an individual, while only 38.0 % of the respondents objected to the existence of the link between obedience to the IKS and sex of an individual. Of the respondents who argued for the link between obedience to the IKS and sex of an individual, 90.5 % of the respondents asserted that men were less obedient of the IKS's penalties, while 5.4 % of the respondents said that women were less obedient to the IKS, and only 4.0 % of the respondents claimed that women were mostly obedient of indigenous penalties.

It worth noting that variations in priorities exist between men and women on the management and use of species and as a result of sex division of labour (Joekes *et al.*, 1996 cited by Zweifel, 1997). For example, a study by Augustino (2006) observed that domestication of plants at homesteads was actively done by women while men were mostly involved in the management and use of forest reserves and its resources. Moreover, Zweifel (1997) further asserted that, in most cases, women had significant experience in sustainable management and use of biodiversity: avoided overuse of the supporting ecosystem, and cared for and conserved a wide spectrum of biodiversity.

Studies by PEMA (2006); DIIS (2007) also revealed that encroachments inside the South Nguru Mountain Forest were mostly for the production of cash crops, pit sawing, hunting and charcoal making, most of them being perceived as male activities. It is from both the findings and literature, this study argues that men were less obedient to the IKS compared to their female spouses: through encroaching into sacred forests, sacred groves and places mostly for income generating activities, made men perceived less obedient to the IKS.

Table 1: The respondents' views on the relationship between sex and obedience to the IKS

Response item	Frequency	Percentage (%)
Do both sexes obey IKS similarly? (n =240)		
Yes, they do	92	38.0
No, they don't	148	62.0
Total	240	100.0
Reasons for the difference between sex on obedience to IKS (148)		
Men are less obedient to IKS penalties	134	90.5
Women are mostly obedient to IKS	6	4.0
Female are less obedient to IKS	8	5.4
Total	148	100.0

Respondents' views on the relationship between household's level of income and obedience to the IKS

Results (Table 2) show that most (62.0 %) respondents claimed that obedience to the IKS varied with household's level of income, while 35.0 % of the respondents said that there was no such a relationship and only 3.0 % of the respondents said they did not know. Of the respondents who said there was a relationship between household level of income and obedience to the IKS, 85.1 % argued that in most cases; economically well off households perceived the IKS as an

obstacle: the IKS was founded on the subsistence livelihood: well off households were also perceived capable of meeting costs of encroaching sacred groves/places and/forests, such as offering a black goat/sheep, or paying government fines or bribes. The claim of bribery could not be confirmed.

Results (Table 2) show that 9.4 % respondents claimed that households with less economic wellbeing were the abusers of the IKS as they mostly encroached into sacred groves and/places and in natural reserve for their survival, and only 5.5 % of the respondents said that better off households were more obedient to the IKS as they were mostly satisfied with their economic wellbeing.

Table 2: The respondents' views on the relationship between income and obedience to the IKS

Does obedience to IKS vary with household level of income (n = 240)	Frequency	Percentage (%)
Yes	148	62.0
No	85	35.0
I don't know	7	3.0
Total	240	100.0
Reasons for the relationship between Income and Obedience to IKS (n = 148)		
Economically well off household's aim for more economic gains	126	85.1
Those with less economic wellbeing disobey IKS to make a living	14	9.4
Economically well off households were satisfied with their status	8	5.5
Total	148	100.0

Through FGDs, this study further revealed that the term “renting of farmland(s)” inside the South Nguru Mountain Forest was mentioned by most of the respondents, implying that some people were virtually renting farmland inside the South Nguru Mountain Forest reserve, through “annual payment of fines” to either village government and/ or the Forest and Bee-keeping Division officers, and therefore became affordable by the economically better off households. Moreover, emergence of the trading class in a communal society led into increasingly seeking exploitation of biodiversity, irrespective of their politico-religious rules (Mukamuri *et al.*, 1999 cited by Mbwambo, 2000), whereas, people began to compromise their indigenous conservation practices in favour of economic growth and social differentiation (Ylhäisi, 2006). For example, household level poverty do compels people to knowingly destruct their ecology (Loibooki *et al.* 2002, Kideghesho *et al.*, 2005; Himmelfarb, 2006 and Kingazi *et al.* 2008 cited by Kideghesho, 2009) or sell animal species which are taboo to other people, to whom such animal species are not taboo just to make a living (Kideghesho, 2009), thus, disobeying their IKS. This study argues that income was both, a push and a pull factor to people's obedience to their IKS which determined human's interactions with ecosystem. As a pull factor, economically better off households strive for more economic gains and as a push factor, poverty does compel economically poor households to deliberately abuse their IKS in order to make a living.

Respondents' views on the relationship between formal education and obedience to IKS

Results (Table 3) show that half (50.0 %) respondents indicated that obedience to IKS varied with the level of formal education of an individual, while 49.0 % of the respondents claimed that there was no relationship between obedience and the IKS and level of formal education of an individual and only 1.0 % of the respondents said they did not know. Results have further shown that, of the respondents who indicated existence of the relationship between obedience to the

IKS and the level of formal education, 63.3 % said that in most cases, people with formal education perceived the IKS as outdated, while 28.3 % of the respondents claimed that those with formal education are mostly obedient to IKS as they know the significance of biodiversity and only 8.3 % of the respondents said that those with no/less formal education were mostly respectful and obedient to IKS compared to those with formal education.

According to Zweifel (1997), the IKS has been declining because the formal education system has influenced the youth to perceive their IKS as primitive, and anyone practicing the IKS is perceived as being outdated and primitive (Msuya, 2007). That is why people with good quantity and quality of IKS normally have the least scientific education (Cunningham, 1991 cited by Zazu, 2007). For example, Sthreshra *et al.* (2010) observed that most species preference varied between the elite and non-elite (based on the western view of elite), with species mostly preferred by the elites were mostly retained in community forests. Therefore, a win-lose relationship between the IKS and formal education, whereas the IKS has been labeled as valueless, barbaric, pagan and primitive, spearheading its decline, and its integration with other knowledge systems.

Table 3: The relationship between formal education and obedience to the IKS

Does obedience to IKS varies with one's Level of formal education? (n = 40)

	Frequency	Percentage (%)
Yes	120	50.0
No	117	49.0
I don't know	3	1.0
Total	240	100.0

Reasons for the relationship between formal education and obedience to IKS (n = 120)

The educated perceive the IKS being outdated	76	63.3
Those with no formal education rely mostly on the IKS	10	8.3
Those with higher level of formal education respect the IKS	34	28.3
Total	120	100.0

Respondents' views on the relationship between household farm size and obedience to the IKS

Results (Table 4) have show that most (70.0 %) respondents claimed that obedience to IKS varied with household's farm size, while 29.0 % of the respondents said that there was no relationship between the size of household's farmland and obedience to IKS and only 1.0 % of the respondents express their ignorance on the relationship. Of the respondents who claimed that there was a relationship between obedience to the IKS and household's farm size, 57.0 % argued that households with large farmlands are normally economically better off: they produce commercially, and have financial capabilities to deal with penalties for abuses of the IKS, while 34.0 % said that households with smaller farmlands are mostly involved in encroachment and abuse of other IKS to expand their farmland and diversify their sources of their income. Of the respondents, 4.0 % claimed that generally, households with small farmland are normally poor, and agriculture was their major economic activities, therefore, they were perceived as concerned by the indigenous punishments, and 5.0 % of the respondents claiming that those with large farm sizes were satisfied with their farm sizes and higher economic status, and therefore were more obedient to the IKS.

It was further disclosed by this study that indigenous fines vary such as offering of a black sheep/ goats to a cock that has to be slaughtered as a way of pleasing the ancestral spirits. Similarly, a study by Saj *et al.* (2006) in Ghana added that breaking of a taboo requires ritual intervention and compensation so as to reduce the likelihood of supernatural punishment, such as sickness or sudden death. The authors, further, disclosed that an individual who violated a taboo had

to pay a fine in various forms: cash, bottles of schnapps, sheep, cows or goats (Ntiamao- Baidu, 1995 cited by Saj *et al.*, 2006), depending on the severity of the offense (Kweka 2004; Saj *et al.*, 2006). Based on these findings and literature this study argues that, in most of indigenous societies worldwide, there are different indigenous fines for someone disobeying the IKS, that vary not only based on the society concern but also on the severity of the offence. Moreover, economically better off households easily afford to pay such fines, making them less frightened of the IKS's fines.

Table 4: The respondents' views on the relationship between households' farm size and obedience to IKS

Do obedience to IKS varies with households' farmland sizes? (n = 240)	Frequency	Percentage (%)
Yes	169	70.0
No	69	29.0
I don't know	2	1.0
Total	240	100.0
Reasons for the relationship between farm size and obedience to IKS (n = 169)		
Households with large farmland are satisfied with their farm size	6	4.0
Households with small farmland need to expand their farm size	57	34.0
Those with large farmland need more farmland	96	57.0
Those with small farmland are normally poor and afraid of IKS punishments	8	5.0
Total	169	100.0

Respondents' views on the relationship between age group of the respondents and obedience to the IKS

Results (Table 5) show that most (89.0%) respondents claimed that there was a link between obedience to IKS while only 11.0 % of the respondents denied such the relationship. Of the respondents who claimed for relationship argued that, contrary to the subsistence livelihood view of the IKS, generally, youths struggled for economic achievements, and the knowledge system been perceived as an obstacle. In light of this finding, Ylhäisi (2006) argued that life expectation have changed among most youths, making them consider the indigenous restrictions as being meaningless. Likewise, Sibanda (1998) cited by Zazu (2007) also found that most youths in Binga area in Zimbabwe, believed that their community's IKS had little value as compared to the scientific knowledge system, with more youth seeking for scientific explanations on IKS (Tanyanyiwa *et al.*, 2011). Generally, the current study argues that youths are less obedient to indigenous knowledge as result of being less knowledgeable on the knowledge system at the expense of the biodiversity conservation methods and practices and changes in life style from subsistence to commercial production that attributes to overexploitation of biodiversity.

Table 5: The respondents' views on the relationship between age groups and obedience to the IKS

Does obedient to IKS vary with age group of an individual? (n = 240)	Frequency	Percentage (%)
Yes	214	89.0
No	26	11.0
Total	240	100.0
Reasons for the relationship between age group and IKS (n = 214)		
Youth are struggling for economic gains and perceive IKS as an obstacle	214	100.0
Total	214	100.0

Respondents' views on the relationship between years of residency and obedience to IKS

Results (Table 6) show that most respondents (91.0 %) agreed that obedience to the IKS varies with years of residency of an individual, while 8.0 % of the respondents said that there was no such relationship and only 1.0 % of the respondents

did not know. Of the respondents who claimed existence of the relationship between obedience to the IKS and years of residency, 95.0 % said that the longer one lives in an area the more he/she becomes more knowledgeable of the knowledge system, as the knowledge is gained through human interactions with their support ecosystem interwoven with people's culture, while of 5.0 % of the respondents said that immigrants from areas with quite different cultural contexts are less obedient to the IKS. Citing Dei (2002), Zazu (2007) argued that the IKS was associated with the long term interaction between humans and the supporting ecosystem of a given place, shaped by indigenous norms and social values, and the knowledge system manifested through local practices, belief systems, myths and built from historical events (Hirji *et al.*, 2002 cited by Zazu, 2007).

For example, studies by Holt (2005); Sarfo-Mensah *et al.* (2007) and Kalanda-Sabola *et al.* (2007) found that immigrants were not observing the indigenous fish restrictions, resulted into the decline of the indigenous rules, with indigenous people instigated to do the same, with lack of the spiritual beliefs attached to biodiversity in a particular community, which lack amongst the immigrants, has significantly contributed to the decline of biodiversity (Kweka, 2004; Saj *et al.*, 2006; Msuya *et al.*, 2009). It is from this view, this study argues that obedience to the IKS among others, depends on the years of interactions with the same or similar supporting ecosystem and socio-economic and political context within which members of a certain community, as well spiritual beliefs attached to different species of plants and animals, an important components that most of immigrants' lack, have been making the immigrants less obedient to the IKS.

Table 6: The respondents' views on the relationship between years of residency and obedience to IKS

Does obedience to IKS vary with years of residency in the village? (n = 240)	Frequency	Percent (%)
Yes	219	91.0
No	19	8.0
I don't know	2	1.0
Total	240	100.0
Reasons for the influence of years of residency on IKS (n = 240)		
Immigrants from different IKS, are less obedient to other people's IKS	11	5.0
Those who lived in the area for years are more knowledgeable and more obedient to IKS	208	95.0
Total	219	100.0

Respondents' views on the relationship between household labour and obedience to the IKS

Results (Table 7) show that most (86.0 %) respondents claimed that obedience to the IKS varied with size of household labour, while only 14.0 % of the respondents claimed that there was no relationship between the size of household labour and obedience to the IKS. Of the respondents who claimed the existence of relationship between the size of household labour and obedience to the IKS, 87.0 % said that those with a large household labour are more likely to be less obedience to indigenous restrictions, while only 13.0 % of the respondents said that households with least household labour are less obedient to the IKS as they are less productive, less economically better off, and mostly selling their labour to the better off households. Through personal communication, the study disclosed that in most cases households that had a large family size accompanied with limited resources, are mostly those selling their labour for practices such as

clearance inside the forest reserves, encroachment of sacred places, cutting of sacred trees and killing of sacred animals, to earn a living.

Based on these findings, two scenarios can be observed; firstly, for a household that can command enough labour mostly through hiring or using simple machines such chain saw, are normally economically better off households and are involved in commercial production. Secondly, households with adequate labour but with limited resources are expressly selling their labour in the commercial producers, to meet a high demand of resources to make a living, noting that hiring of labour is too expensive to be invested into production of food crops that are relatively less profitable. According to PEMA (2006) most people living in villages adjacent to the South Nguru Mountain Forest depend mostly on the labour intensive agricultural practices intermingled with labour intensive transportation of harvests to distant markets (further increasing the household's labour demand).

Table 7: The relationship between the size of household labour and obedience to IKS

Does obedience to IKS vary with household's labour? (n = 240)	Frequency	Percentage (%)
Yes	206	86.0
No	34	14.0
Total	240	100.0
Reasons for the link between household labour and obedience to IKS (n = 206)		
Those that command a large household labour power need for more income	179	87.0
Those with less household labour power are less obedient to IKS	27	13.0
Total	206	100.0

Respondents' views on the formulation of biodiversity conservation methods and practices and integration of IKS

Results (Table 8) show that most (95.0 %) respondents expressed their awareness on the existence of biodiversity conservation methods and practices (Village environmental by-laws) in their respective villages, while 2.0 % of the respondents claimed that there was no biodiversity conservation methods and practices in their villages and 3.0 % of the respondents said they did not know. Despite most of the respondents expressed their awareness on the existence of biodiversity conservation methods and practices in their respective village, most of them, including members of the environmental committees, were ignorant of the contents of the same. The study also revealed that there were less awareness creation forums for the local people on the contents of those by-laws that are why most of them were ignorant of the by-laws: a process of their formulation involved few members whom were believed to be representatives of their community. Sadly, the process of by-laws formulation did not consider different actors' interested on the management and use of biodiversity.

Table 8 also reveals that most (73.0 %) respondents mentioned that the village environment by-laws were formulated by their respective village governments with 15.0 % of the respondents claiming that they were formulated in collaboration between the Participatory Environment Management (PEMA) and 12.0 % of the respondents said that the by-laws were formulated by the Forest and Beekeeping Division (FBD). In fact, the process of by-laws formulation was facilitated by PEMA II project, under the implementation of TFCG and CARE. Such great variations of opinion as to who facilitated the formulation of those environmental by-laws among respondents might be due to the minimum level of participation of the local people.

Table 8: The Respondents' views on the formulation of biodiversity conservation methods and practices and integration of IKS

Does your village have by-laws for the management and use of biodiversity? (n = 240)	Frequency	Percentage (%)
Yes	227	95.0
No	5	2.0
I don't know	8	3.0
Total	240	100.0
Who facilitated formulation of the bylaw? (n = 227)		
PEMA and the village government	32	13.0
The village government	165	69.0
The forest department	27	11.0
Total	227	100.0
Is the IKS being integrated into the by-laws? (n = 240)		
Yes	57	24.0
No	183	76.0
Total	240	100.0
Why the IKS was not integrated into the village bylaw?		
I don't know	148	81.0
The knowledge lacks official recognition	22	12.0
The idea was not introduced by the facilitators	13	7.0
Total	83	100.0

Though most of the respondents viewed the process of by-laws formulation being participatory, such participation was questionable, as the process overlooked the custodians of IKS (in this case the *walukolo*) and other institutions interested in conservation of biodiversity, such as religious institutions, with none of the environmental by-laws in the four villages mentioned either *walukolo* or sacred groves/places: and all contexts of those by-laws were concerned with the conservation of the South Nguru Mountain Forest, with the same format and contents of the bylaw been used to formulate by-laws to all villages. Citing Gibson *et al.* (1999), Kweka (2004); URT (2009) also argued that lack of wide participation of the local people in the process of the formulation of by-laws has resulted into limited awareness and lack of ownership of the same by the local communities. Sadly, according to Woodcock (2002) and Wily (2002) cited by Vihemäki (2005), participatory approaches too often see local people just as “beneficiaries” and not as actual decision makers over forest management use.

Results (Table 8) show that most (76.0 %) respondents said that the IKS is not integrated into biodiversity conservation methods and practices (the village environmental by-laws) and only 24.0 % of the respondents claimed that the IKS is integrated into the biodiversity conservation methods and practices. Of the respondents (81.0 %) expressed their ignorance of the reason(s) for the exclusion of the IKS in their village environmental by-laws, while 12.0 % of the respondents said that because the knowledge system was not recognized by the government and 7.0 % respondents said that the idea was not introduced during the process of formulation of the by-laws. On enquiring from the Conservator of the Mkingu forest reserve in which the South Nguru Mountains forests exists, of why IKS was not integrated into the biodiversity conservation methods and practices, the conservator said that facilitators overlooked both the CBD of 1992 and the Tanzania Forest Act of 2002 that emphasizes on active participation of indigenous people and the wide use and application and their knowledge system, while ensuring mutual sharing of the benefits among actors.

Contrary to the findings of this study, a study by Ylhäisi (2006) found that in Simbomu and Vuchama Ngofi villages of Mwangi district, village by-laws were supporting protected indigenous forests, whilst the caretakers of the indigenous forests (*walukolo*, in the case of this study) are officially recognized and continue to protect their forests using their IKS. In cases where a caretaker of a certain sacred grove got converted into either Christianity or Islam, the management of the sacred groves would become the responsibility of the respective village government. Moreover, village governments have been responsible for all cases on destruction of the protected indigenous forests instead of the care takers of these forests (Ylhäisi, 2006) who in most cases are elders, unable to meet the costs and all other bureaucracy associated with dealing the offenders.

Integration of the IKS into biodiversity conservation methods and practices

A dummy multiple regression model was used to establish the relationship between the dependent and a set of independent variables, through explaining a proportion of the variance in a dependent variable at a significance level and can predict the influence of each of the independent variable to the dependent variable through comparing beta weight of the independent variable. It is worth refreshing that factors that have been limiting a wide use and application of the IKS have also been 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; Cobb, 2011). The dummy multiple regression models developed is shown below.

Specifically, the hypotheses tested were:

H_0 : ($\beta = 0$ (meaning that there is no relationship between integration of IKS into biodiversity conservation methods and practices and independent variables (sex, age, level of education, household income, years of residence, household labour, farm size and government policies and strategies).

H_1 : ($\beta \neq 0$ (meaning that there is a positive or negative relationship between dependent and independent variables).

A two-tailed t-test at 5 % level of significance was used to accept or reject the tested hypothesis, in this case, H_0 is rejected only when $P < 0.05$. To assess the goodness of fit of the regression model, a coefficient of determination (R^2) was applied. In light of this De Vaus (2002) elaborated that the higher the R^2 the more the powerful the model is. Information disclosed through context analysis was used to complement the quantitative data in capture the IKS based on its own ways of knowing and doing.

The general multiple regressions model used is in the form of:-

$$y_n = a + b_1x_1 + b_2x_2 \dots b_nx_n + e_i$$

Dependent variable was: Y_1 = wide use and application of the IKS

a = intercept

b = coefficient of the independent variables

e = random error

Whereas independent variables considered (x) were sex, age, level of education, household income, years of residence, household labour, farm size and government policies and strategies. Definitions and descriptive statistics of the socio-economic and political factors used are shown in Table 9.

Table 9: Variable definitions

Variables	Description	Mean	SD
Dependent variable	- Wide use and application of the IKS	1.22	0.418
Independent variables			
Age	- Number of years that a person has lived	53	1.32
Sex	- Male or female	1.27	0.44
Years of residency	- Number of years someone has lived in an area	54.50	1.68
Level of education	- Numbers of years in school	2.20	0.79
Household income	- an average household annual income in Tshs	274,250	9.60
Household labour	- Number of working people in a household	3.64	2.02
Household's Farm size	- A total household's farmland measures in acres	6.73	6.25
Government rules and regulations	- Presence of any government orders and strategies that influence people's livelihood strategies, practices and their knowledge system(e.g. Environmental bylaw)	1.76	0.43

A two-tailed t-test at 0.05 percentage level of significance was used to accept or reject the tested hypothesis, in this case, H_0 is rejected only when $P < 0.05$ percentage. To assess the goodness of fit of the regression model, a coefficient of determination (R^2) was applied, whereas, the higher the R^2 the more powerful the model is.

Results (Table 10) have shown that only age group of the respondents, years of residency and presence of government rules and regulations that recognize the IKS had a significant relationship with the wide use and application of the IKS for conservation of biodiversity. Of the factors that influence the dependent variable, years of residency had a higher contribution to the model (beta = 0.416), followed by age group of the respondents (beta = - 0.268) and government rules and regulations (beta = 0.145) (Table 10). In fact, a negative beta value of the age group of the respondents on the wide use and application of the IKS implies that there is decrease in pass on of the knowledge system from the elders to the youths, as most youths perceived the IKS being an outdated and an obstacle for their economic prosperity. Results further show that there was no significant relationship between most of the independent variables on the wide use and application of the IKS for the conservation of biodiversity ($F = 4.95$ percentage) with a weak model on the relationship between the independent and the independent variables ($R^2 = 14.7\%$). This might be due the fact that the low degree of variations among the respondents on their level of education, farm sizes and income (most being categorized as poor) might be contributing to the insignificance relationship between the dependent and the independent variables, and to the weak multiple regression model.

Table 10: A dummy multiple regression results to represent the relationship between the wide use and application of IKS and socio-economic and political factors

Independent Variables	B	Std error	Coefficient	t	95 %	Conf. Interval
constant	0.661	0.207		3.198	0.002	0.254
Age group	- 0.268	0.052	- 0.268	- 3.273	0.001	-0.274
Sex	- 0.080	0.059	- 0.080	- 1.273	0.204	-0.193
Years of residency	0.416	0.047	0.416	5.039	0.000	0.145
Level of Education	0.034	0.066	0.034	0.451	0.652	-0.101
Household income	0.067	0.104	0.067	1.012	0.312	- 0.100
Household labour	- 0.098	0.106	- 0.980	- 1.492	0.137	- 0.365
Farm size	0.065	0.036	0.065	1.015	0.311	-0.035
Inclusion of IKS into bylaw	0.145	0.061	0.145	2.317	0.021	0.021

df: 8 significance at < 5 %; F = 4.957 R² = 14.7 %

What should be done to facilitate integration of indigenous knowledge system?

Results show (Table 11) show that most (75.4 %) respondents contended that official recognition, motivation and active participation of the custodians of IKS (*walukolo*) were the cornerstones for the integration of the knowledge systems, while 8.5 % of the respondents said that income poverty had to be dealt as it do compel people to abuse their IKS knowingly, just to make a living. Results (Table 11) also show shows that of the respondents, 6.8 % said that there was need of a policy(ies) which necessitate(s) the integration of the IKS into biodiversity conservation methods and practices, while 4.3 % of the respondents said that documentation and training on the significance of the IKS mostly to youth, would facilitate a wide use and application of the knowledge system, and of its integration into other knowledge systems, and 5.0 % of the respondents expressed their ignorance on what should be done to facilitate integration of these knowledge systems.

Incidentally, in this study, only 4.3 % of the respondents proposed documentation and training on the significance of the IKS, as a strategy to facilitate its integration into biodiversity conservation methods and practices. This is in favour of Berkes *et al.* (2003) cited by Cobb (2011) who argued that documentation of the IKS using signs and codes used in formal education system is not effective in the IKS, as the knowledge is easily understood orally, with the amount of the IKS expressed in numbers and words is just a fraction of the knowledge system (Rahman, 2000), and therefore such documentation will further lead to its decline (Gupta, 1994 cited by Zazu, 2007). In light of the same findings, Cobb (2011) argued that creation of public awareness is the cornerstone for the wide use, application and integration of the IKS into other knowledge systems, so as to change people's negative attitude on the knowledge system, which has been negatively labeled as primitive, barbaric, archaic and superstitious (Reid *et al.*, 2004 cited by Kalanda-Sabola *et al.*, 2007; Ocholla, 2007; Zazu, 2007).

According to Metcalfe (1995) cited by Mbwambo (2000), recognition of the rights of the indigenous people is a fundamental policy strategy that would enhance integration of the knowledge system, whereas recognition and legitimatization of the custodians of and the IKS will trigger a wide use and application of the knowledge system, particularly on the enforcement of the indigenous restrictions and its integration for sustainable management and use of biodiversity, whereas lack of benefit sharing guidelines between potential actors and the bureaucratic process of signing

joint forest agreements were limiting the active and meaningful implementation of the Tanzania Forest Act of 2002, which emphasized on active participation of potential actors and on the sharing of benefits of such participation (URT, 2009). Several studies also argue that household poverty does compel people to knowingly abuse their IKS which would, otherwise, contribute to conservation of biodiversity (Oviedo *et al.*, 2007; Kideghesho, 2008; Nganje, 2009), whereas some tabooed species were sold to other people to whom such animals were not tabooed, just to earn a living (Kideghesho, 2009). This study therefore conclude that promotion rather than documentation of the IKS relevant to the conservation of biodiversity, using its own ways of knowing, teaching and learning, will ensure not only its wide use and application but also its integration into other knowledge systems.

Table 11: Respondents' views on what should be done to facilitate the integration of IKS into biodiversity conservation methods and practices?

Reasons for lack of integration of IKS (n = 240)		
	Frequency	Percentage(%)
- Custodian of IKS (<i>walukolo</i>) has to be identified, motivated and actively Involved	300	75.4
- There should be policy(ies) in place that insist on integration of IKS	27	6.8
- Documentation and trainings on IKS is highly needed	17	4.3
- I don't Know	20	5.0
- Poor income is a challenge for the wide use and application of IKS	34	8.5
Total	398	100.0

CONCLUSION

Conclusively, the integration of the IKS into biodiversity conservation methods and practices in the South Nguru mountain forest for sustainable management and use of biodiversity has been limited by lack of official recognition, valuation, promotion and capacity building of the indigenous social structures from which the indigenous knowledge system got evolved, enhanced and sustained over years. Moreover, lack of reciprocal relationships between pioneers of the biodiversity conservation methods and practices and the indigenous people in their socio-economic and political contexts, has been limiting the wide use and application of the IKS, and of its integration into biodiversity conservation methods and practices.

RECOMMENDATIONS

The following recommendations are put forward in the light of the stated problem:

- ❖ To the government and non-governmental organizations, official recognition, motivation, capacity building and promotion of indigenous social structures from which IKS relevant for conservation of biodiversity gets evolved, enhanced and sustained is a corner for successful conservation of biodiversity. The IKS should be used based on its own ways of knowing, teaching and learning to facilitate its wide use, application, sustainability and its integration into other knowledge systems.
- ❖ Biodiversity decline is at the center of household-poverty, and for sustainable management and use of biodiversity cannot be realized, unless otherwise, household-poverty is dealt with: poverty has been compelling people to abuse their knowledge system just to make a living.

ACKNOWLEDGEMENT

First and foremost, a credit should go to the local communities for their devoted time, kindness and cooperation during our research, and to the village government leaders, we are thankful for their cooperation, organization and support during our stay in the study villages. We are also thankful to Morogoro Catchment Officers for their support and information during field work.

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