Socio-Economic Factors Influencing the Conservation of Cherang'any Forest in Elgeyo-Marakwet County, Kenya

*Mang'ira K. Solomon, Koske K. James and Kerich K. Richard
School of Environmental Studies, Kenyatta University, P.O Box 43844 - 00100, Nairobi

***Corresponding author's email address:** smangira@gmail.com

Abstract

Globally, forests make up an approximately 30% of the world's total land area with an estimated 11% being traditionally managed production landscapes. Presently, Kenya forest cover is about 7.5% which is significantly smaller than the desired minimum of 10.0% land areas. Forest ecosystems face significant challenge from a combination of human – ecological factors arising from the confluence between the andropological and environmental factors. Due to the depletion in the forest cover in Kenya, the study examined the various socio-economic factors influencing the conservation of Cherang'any forest, Elgeiyo-Marakwet County, Kenya. The study targeted 343 individuals from 343 households from which 300 individuals were randomly sampled from the boundaries of the forest zone and purposively sampled 43 key informants. The study instruments comprised of observations, interviews and questionnaires. The qualitative data obtained from the study was analyzed thematically and used to develop a questionnaire from which quantitative data was drawn. Based on a Cronbach's coefficient value ≥ 0.70, the questionnaire was considered reliable. The findings indicated that socio-political factors that are largely related to the historical colonial legacy of protectionist environmental policies have largely influenced the current conservation policy and this has led to communal conflict and ethnic identification with conservation. The study recommends that the Forest Conservation and Management Act of 2016 of Kenya, should help the Sengwer community in the establishment of Community Forest Associations. The research recommended a further inquiry into the influence of socio-economic variables on the low sense of forest ownership and management among local communities in Kenya.

Keywords: Forest Management, Indigenous Environmental Knowledge, Indigenous Knowledge, Natural Resource Management (NRM)

INTRODUCTION

Forested areas are approximately 30% of the world's total land area but have declined dramatically due to human population growth (Youn *et al.,* 2017). Indigenous peoples comprise 370 million, roughly 5% of the world's population, occupying more than 20% of the land surface area which holds an estimated 80% to 85% of the biodiversity (Finn, Herne & Castille, 2017; Waller & Reo, 2018; Sirima, 2015). Central America in particular holds about 80 indigenous ethnicities who occupy almost 40% of land and waters (Pásková, 2017).

There are over 96 million hectares (10%) of cultivated land and about 377 million hectares (11%) of global forests in the traditionally managed production landscapes. In these agroecological zones, cultural background and contextual attachment are relevant to the particular localities (Bremer *et al.,* 2018), thus, it is estimated that local communities manage 13% of the world's forests (Oldekop *et al.,* 2019).

Forests contribute to the social, cultural and environmental status of the planet and people. For instance, tropical forests play a critical role in the livelihoods of rural communities by

contributing to their physical needs (food, fuel and medicine) and provision of services through moderation of weather, air quality and land erosion (Gross-Camp, 2018). Forests are also critical in promoting sustainable development practices by regulating climate, sequestering carbon, harbouring biodiversity, and contributing to local livelihoods and national incomes (Oldekop *et al.,* 2019). Further, more than one billion of the extremely poor people on the planet depend on forest resources for their livelihoods (Sharma *et al.*, 2015).

Forest resources play important roles that include two services; ecosystem services which help maintain the critical biophysical systems crucial for the sustenance of human life, that is, those that relate to the provision of goods and services, regulation of the environment and supporting life and cultural ecosystem services which help sustain human non-material benefits: cultural identification; recreation and tourism; heritage, and spiritual values or spaces; knowledge systems and socio-cultural relations(Pyke *et al.,* 2018).

Because of the importance of the forest to humans, there is an increase in environmental conservation efforts geared towards the management of natural habitat, the protection of biodiversity from extinction and the sustenance of biotic interactions (Wali *et al.,* 2017). The interest in conservation has geographically expanded from the protected areas and nature reserves to territories managed and controlled by indigenous peoples (Barber & Jackson, 2017). This trend towards the decentralized system of management and conservation of forest resources as the main philosophy guiding human activities also directly impacts the natural habitat (Daniel *et al.,* 2017).

The management and conservation of forests have been largely influenced by the inaccessibility and remoteness of most forests thus making it difficult and challenging for government agencies to maintain a visible presence and exercise full control. This is coupled with conflicts from forest communities thus placing impediments to forest conservation and sustainable development goals (Foncha & Ewule, 2020). Further, the concerns arising from global issues such as hunger, poverty and climate change have elevated the stature of natural resource management (Desta & Smithson, 2016).

The growth in human population is the main driving force behind deforestation (Youn *et al.,* 2017) this has led to the overexploitation of natural recourse driven sustainability and in turn, this has an increasing number of social conflicts leading to the unsustainability in resource usage (Rammel, Stagl & Wilfing, 2007). Therefore, over-utilization of the forests has been the main approach to protecting forests but this has largely been unsuccessful in the centralized government forest policies due to the lapses in the monitoring and enforcement of rules and regulations (Lestari, Kotani & Kakinaka, 2015). Further, on a global scale, the growth in human population coupled with rising per capita consumption of products generated from natural resources will lead to growing pressure on land and forest resources (Lambin & Meyfroidt, 2011).

Forest degradation can be arrested through secured ownership and access to forest resources and benefits accrued to the community through empowerment. However, the long-established top-bottom conservation practices and approaches to forest resource management are inadequate and inconsistent in the enforcement of the law (Foncha & Ewule, 2020). The scope, pattern and intensity of forestry activities also interrupt the natural habitat (Wu *et al.,* 2018). The management of huge forested areas may at times result in the partitioning of core habitat or habitat losses, thus threatening the conservation of habitat and the survival of species (Wu *et al.,* 2018).

The rainforest in the tropical zones is the most diverse habitat and the most threatened ecological unit on the planet. The first issue to be considered is that these forests have been inhabited by indigenous communities since time immemorial, well before the establishment

of modern state structures. Each of these communities had precise knowledge of their territorial boundaries, and the land resources owned and managed (Rantala & German, 2013). Too often, the presence of indigenous people and/or communities in these traditionally managed production landscape systems is perceived negatively rather than as a possible asset and thus they are not consulted when the tropical rainforests are being carved out or protected (Cox & Elmqvist, 1994).

For instance, In Indonesia, the forestry department has forcefully removed and evicted individuals from areas that are classified as state forest land while in Africa, the most significant efforts from the government have been put into the creation of protected areas that take the form of Game parks and reserves with little involvement from the local indigenous people or communities, leading to conflict with the indigenous communities, for instance, the Maasai Mara Game Reserve in Kenya (Cox & Elmqvist, 1994). For instance, the establishment of the Ngorongoro Conservation Area, and the Serengeti, Manyara, and Tarangire National Parks as protected areas in Tanzania has placed restrictions on these important land resources to the Maasai community, thus impacting how the community uses and manages the land resource (Woodhouse & McCabe, 2018).

This indicates that the simultaneous struggle over resources takes meaning and invokes symbolic aspects such as opposition to dialogue, pacification and conservation efforts (Li, 2000). Due to these reasons, several environmental challenges facing many communities cannot be resolved by the conventional scientific approaches, thus environmental management aspects must take cognizance of the inter-relatedness in the ecosystem, that is, a system view that includes humans into the ecological equation. Thus, the notion that planet earth has to be considered to be a socio-ecological system at different levels (Berkes, 2004).

As Brondizio *et al.*, (2014) noted, appreciating the sociological interactions helps in unravelling the embedded social capital within communities living adjacent to the forested areas and aids in promoting sustainable livelihoods and the conservation of forests. Thus, communities' perspectives on forest resources should be considered as input during the decision-making process. More so, community efforts should not be concentrated on conservation efforts but also the regulated access to the conserved resources (Singh & Sureja, 2006) and due to this, Hughey, Jacobson and Smith (2017) observed that forested areas in the tropics, that are maintained by local communities are far better than those in strictly protected areas.

Community-led conservation efforts are believed to lead to sustainable and equitable outcomes. Thus, the new modern western-based knowledge systems of NRM which seek to incorporate concepts of sustainable development or socio-ecological resilience show greater similarity with the holistic attributes of IEK (Prober, O'Connor & Walsh, 2011). The hands-on resource use combined with community-specific knowledge systems helped support a sustained commitment to sustained ecosystem and resource conservation (Stephenson *et al.*, 2014). This has necessitated the stature of human identity as an extension of the environment (Durie, 2004).

Problem statement

There is a need for conservation practices to shift from the human–nature dichotomy if conservation efforts are to have a meaningful impact. Therefore, the bio-cultural approach pairs ecological and human well–being into conservation practices and include the interactions between local knowledge and practices, while recognizing the interrelationships between humans and the environment (Caillon *et al.*, 2017). Therefore, successful environmental management requires the holistic engagement of communities, industry and government (Hughey *et al.*, 2017).

Consequently, the recent themes on forest conservation have been on the collaborative

processes which augment the robustness of decisions regarding the managing of ecosystems by applying indigenous ecological knowledge; increasing the community's participation in the implementation of decisions taken; and moving away from the state-controlled, centralized decision–making process to participatory approaches that are well suited to addressing the needs of local people and their cultural specificities (Li, 2000). Thus, there is a need to improve the capacities of government officials to appreciate the cultural, ecological, and economic significance of forest resources to the community (Desta & Smithson, 2016).

Ecosystems worldwide, are experiencing a decline despite the increased awareness and conservation efforts (Caillon *et al.,* 2017) with many government agencies concerned with conservation efforts in many developing countries being left to weakened institutions (Berkes, 2004). In Kenya, forest management has experienced poor performance in the past because of the increasing forest encroachment, destruction and widespread exploitation of forest resources for commercial purposes without due regard for sustainability (GoK, 2013). Due to the persistent conservation conflict in the Cherang'any forest ecosystem, the study examined the socio-economic factors influencing the management of forest resources in the Cherang'any forest ecosystem in Elgeyo-Marakwet County, Kenya.

LITERATURE REVIEW

There are several social and economic factors influencing the management and conservation of forests. The major economic factors influencing conservation include land tenure systems (Gómez-Baggethun *et al.,* 2013), land-use policies (Warren *et al.,* 2011) such as the displacement of persons from the protected areas (Muhumuza & Balkwill, 2013) and other factors. The main social factors include the cultural ways of the community (Campbell, 2005), economic status, social well-being of the community, participation in forest governance (Persha *et al.,* 2011) and many other factors. In their study, Warren *et al.,* (2011) examined the social and institutional factors influencing conservation efforts in the state of Massachusetts in the US. The study established that the economic status of the community largely influences conservation as the wealthier communities were more likely to invest efforts and energy towards the protection of the forested lands than their poor compatriots. Furthermore, the study reported that land-use policies on a greater path influenced the protected forested lands.

In Bangladesh Islam *et al.* (2013) examined several forest projects to establish their sustainability. The study noted that forest conservation is largely influenced by the economic empowerment of the communities living around the forest had a significant effect on the conservation by determining the nature of extractive activities in the forest. The study indicated that the provision of alternative livelihood strategies had a positive impact on the sustainability of forest management practices.

In Ghana, Campbell (2005) observed that the socio-cultural factors that took the form of sacred groves had an important role in the preservation and conservation of forest spaces. The study compared the vegetation in the culturally sacred groves and unprotected tree stands and found that there were fewer tree losses in the sacred groves than in the unprotected forested areas. Muhumuza and Balkwill (2013) analysed several studies to examine the success of habitat conservation in protected areas. The study showed the main factors influencing conservation are socio-economic and cultural in nature. The factors largely influence conservation through the displacement of the people or the community, the lack of economic alternatives to the displaced communities and the high human population density arising from the displacements. The factors mutually interact to drive the losses in the biodiversity in the protected areas.

In a cross-country study, Persha *et al.,* (2011) examined the different paths to the

conservation effort using data sets from six countries in South Asia and East Africa. The study observed that institutionalized local participation regimes in forest governance issues through local forest user associations had a positive outcome in forest conservation. Local participation is a key mechanism that incentivizes the communities to sustainably use the forest resources. Also, Tenge, De Graaff and Hella (2004) examined the socio-economic factors influencing conservation in Usambara highlands in Tanzania and observed that insecure land tenure, field location, expansion of off-farm activities and a lack of short-term benefits conservation efforts negatively influence the conservation efforts among farmers living in the highlands.

As Gómez-Baggethun *et al.,* (2013) observed, the insecurity of land tenure systems and the competition for land and resources in the forested lands results in the loss of economic and socio-cultural access to forest resources. This conflict results in community protest and non-cooperation towards new schemes of sustainable forest management. In cases where government–forested land overlaps the forest-dependent communities, serious adverse impacts are likely to occur on the local communities (Li, 2000). They acknowledge that various socioeconomic and ecological factors that contribute to conservation efforts have convinced government agencies to pursue policies that would improve livelihoods and conservation outcomes (Persha *et al.,* 2011).

Generally, IEK is viewed as an alternative way to promote conservation in rural communities. Several challenges are in the way of the use of IEK and this includes its focus on artefactual, its conflict with conventional western knowledge systems, its romanticisms and lastly, its decontextualization (Briggs, 2005). The identification of what counts as evidence of customary knowledge and practice and is therefore, becoming a critical issue in the struggle over rights (Li, 2000). Such NGOs participating in the documentation of indigenous environmental knowledge in support of conservation agendas are also conferring the communities with an opportunity to strengthen their legal positions. Thus, the shifting definition of indigenous environmental knowledge in Indonesia is proving room for donors and NGOs to manoeuvre.

Many indigenous people have petitioned for the recognition of their cultural and sovereignty rights, a right that is drawn from the usage and possession of the land. However, in the colonized lands this right is denied (Ford & Martinez, 2000). It is only the US constitution that has recognized the indigenous communities as nations and thus created tribal lands and ensuing autonomy over the lands. Unfortunately, most indigenous people outside the United States have not been recognized.

METHODOLOGY

The study used a descriptive research design with mixed – methodology using both qualitative and quantitative design. The study was carried out in the catchment area of Cherang'any Hills Forest in several administrative locations. The study targeted one member of each of the identified households living within the forest ecosystem and environs and key informants drawn from the Sengwer community, non-governmental organizations, community-based organizations, Kenya Forest Services, and administrative officers. Based on a sampling formula by Barlett *et al.,* (2001), the sample size comprised 343 individuals drawn from respective households from different forest zones that include Kapyego, Kaptich, Kapcherop, Embobut, Kamoi and Kapkochur. The respondents were sampled through cluster sampling while the key informants were sampled through the snowballing method. The study used interviews, focus group discussions and questionnaires as the main research instruments. Data was analysed qualitatively and descriptively and the output was presented in different formats.

RESULTS AND DISCUSSION

The study used a mixed-method approach to discern the nature of the socio–economic factors influencing the management of the forest resources at Cherang'any Forest. First, the study used both interviews and focus group discussions to gauge the state of the forest, natural resource management within the forest and the socio-economic factors influencing forest management. The interviews and focus group discussions were held at Maron – Marichor Primary school which is located in the western part of the forest and involved more than 24 informants.

After deciphering the main themes of the study, then a questionnaire was developed that was administered to the respondents living in the forest ecosystem and the surrounding environs. The qualitative analysis gives a synopsis of the events that preceded the destruction of the forest and thus introduced the important drivers influencing the management of the forest resources at Cherang'any forest. For simplicity, the study used the acronym 'SEN' to denote the SENGWER community who live in the vicinity of the forest.

Qualitative Analysis

The Colonial Intricacies of the Forest and its Inhabitants

The history of Cherang'any forest is traditionally known as a natural indigenous forest that has been in existence for longer periods of history. The story begins in 1914 during the British Colonial period. The forest as is currently known covers large tracts of land in three counties of Elgeiyo – Marakwet, Trans- Nzoia and parts of West Pokot counties. One informant SEN012 said that "The history of the demarcation of the forest as a conservation area started in 1914 when the then colonial government upon realizing the potential of the three counties of Trans- Nzoia, West Pokot and Elgeiyo – Marakwet for large scale farming decided to demarcate the uneven and mountainous regions as 'conservation or protected areas. This is because they considered any venture by the white men into the forest as an insignificant event. After all, the forest was not considered as farmland because of the nature of the terrain".

SEN003 avowed that "They found us there as forest inhabitants and did not move and based on our social structure they introduce some registration aspects where family units were registered as bona fide dwellers of the forest land where they were living in. They did not remove us from the forest and instead allowed us to continue living our lives as before". The informants further affirmed that a change occurred in the Cherang'any Forest way back in 1922 when a white man by the name Mr. 'Cobal' set up various sawmills to extract natural timber from the forest. Mr Cobal set up many sawmills in the forest and continued extracting the timber until the independence period".

The cases of the gazettement of the protected forested areas in Kenya started in the colonial period were indicated by Wass (1995) whose study focused on indigenous forest conservation and management. He alluded to a historical fact that by 1932, the then colonial government had gazetted a total of 43 forests and re-defined them as government forests with a land size area of 830,000 hectares. The gazette of the protected areas through a land ordinance (Kenrick, 2014) was consequential as it did not involve the forest inability community (FIC) and thus prohibited any persons from residing in the forest or engaging in any economic or settlement activities without the Government's authority. Though considered a protected area, the Sengwer community as forest dwellers continued to live in the forest but moved deeper into the gazetted forest to evade detection and prosecution by the colonial administration.

The Post-Independence Significant Events and Influences

In June 1963, the community thought that independence signalled liberation and thus 'they would be allowed back to enter and live and roam in the forest. However, that was not the case because the forest was still gazetted as a protected area and a government forest. In 1974, when the then first president of Kenya H.E Mzee Jomo Kenyatta of the Republic of Kenya, during a visit to Tot, gave a public declaration that *"Kamata jembe, shoka na panga na ulime"* to mean 'grab your hoe, axe and machete and cultivate". This initiated an invasion of the forest by the neighbouring communities for timber, charcoal and cultivation and thus the Sengwer community was forced deeper into the forest to protect their cultural ways of life.

According to SEN012, "Further waves of invasion continued in 1979, 1980, 1988, 1994, and even 2008. Every time, the invaders came, they would be chased by the security officers but once, the security officers were gone, the invaders would stay around for some time before returning to the forest to continue with timber, charcoal burning and cultivation of potatoes in addition to rearing goats without being concerned with the IEK of the Sengwer community. It became a game of 'cat and mouse' with complacency from the government officials, particularly, the forest rangers and security forces who were being bribed by the invaders to turn a blind eye to the detriment of the natural forest.

The subsequent invasion and destruction of the forest have made the community feel marginalized and unprotected from their forest and livelihood. Currently, the blame game continues and SEN017 said that "The subsequent government officers have been coming to try and evict them from their ancestral homes. When they burn our houses, we go to the forest to bring more building materials to construct new ones and every time they burn, we go back again to get new materials as such so we are all involved together with the authorities in destroying the indigenous forest."

The implication of the post–independent political influence has been highlighted by Kenrick (2014) who affirmed that the indigenous forest in Kenya was further destroyed by the haphazard gazettement and proclamation. The author observed that more destruction of the indigenous forest occurred in 1992 when the government allowed communities to settle in the forest without the due legal process of degazetting the forested areas. As Wass (1995) puts the excision of the forest and forested areas are occurring at around 5,000 hectares per year and excised land is purposed for settlement of people and agricultural purposes.

From this historical perspective, it is evident that the main socio-economic influences that impact the management and conservation of the Cherang'any forest include the establishment of the protectionist conservation paradigm as illustrated by the gazettement of the protected areas as a forest management paradigm started with the first land ordinance in 1922. Second, the deliberate alienation of the forest-inhabiting communities from the conservation practices leads to communal conflict. This led to more aggravated destruction of the forest by the FIC who lacked livelihood options. Third, the developmental paradigm was propelled by the post–independent leaders who called for agricultural development as opposed to conservation efforts. Later, own political influence of excisions of forest and consequent gazettement of settlement areas carved out of the forested areas. Lastly, the illicit settlement of the forested areas by communities living within the forest boundaries and ecosystem became the norm.

Regarding the protectionist conservation paradigm, Himmelfarb (2006) observed that the paradigm originated from the establishment of Yellowstone National Park in 1872 as a protected area whose objective was to 'reserve and withdraw the land from settlement, occupancy or sale…and set apart as a public park or pleasuring ground for the benefit and enjoyment of the people'. The creation of Yellowstone National Park as a protected area meant that human settlement was prohibited and thus numerous Native American

populations including Bannock, Crow, Sheepeater and Shoshone Native Americans who had access to resources within the gazetted area were evicted. The antithesis is that it is the Native Americans had a significant historic role in shaping the "Natural" Yellowstone landscape.

In 1896, the British colonialist established the first game reserves in Kenya without local participation or consideration of historical and indigenous local land-use/tenure practices (Borgerhoff et al., 2005). The land ordinances that created the protected areas, African livelihoods such as livestock grazing, hunting, gathering of food and medicinal plants, and harvesting of timber were illegalized in many areas across Africa (Igoe 2002). This conservation legislation negated the traditional land uses and attitudes and centralized the management and control of natural land and forest resources in the hands of the state (Fisher 2002).

Later on, the post-independent governance systems adopted these colonial conservation programmes which largely shaped contemporary biodiversity protection practices. This meant that the same protectionist legal conservation paradigm remained with minimal revisions (Igoe, 2002). Despite the acceptance of alternate community-based conservation approaches, the post–independent African leadership structures have maintained the colonial protectionist conservation practices and have therefore involuntarily displaced forest inhabitant communities and local populations in the name of conservation (Cernea & Schmidt-Soltau, 2003).

Quantitative analysis

Based on the qualitative analysis, the study adopted the socio-economic aspects of forest resources (Obua, Banana & Turyahabwe,1998) which used a 7 – point Likert scale, where 0 represented no value and seven represented the highest value according to an individual's value or communal value attached to forest resources. The study administered a questionnaire to the respondents and the responses to the questionnaire as shown in Table 1 below.

Table 1: Socio-Economic Aspect of Forest Resources

Variable	N	Mean	Std. Deviation
Building materials	212	5.3665	2.27382
Medicinal plants	212	5.4031	2.04677
Grazing land	212	4.4000	2.75988
Food source	212	2.8085	2.69194
Commercial timber	212	2.7872	2.82983
Energy sources	212	6.1518	1.78384
Cultural preservation	212	4.2234	2.56114
Aesthetics value	212	4.4731	2.33928
Employment	212	3.0947	2.88610
Way of life	212	3.9524	2.54175

Source: Field Data (2022).

The mean statistics show that the respondents' views could be grouped into three clusters highly useful, moderately useful and least useful for the mentioned uses. The aspects with the highest value attached to the forest resources include energy source (Mean = 6.1518, SD = 1.7838), medicinal plants (Mean = 5.4031, SD = 2.0468) and building materials (Mean = 5.3667, SD = 2.2734). The aspects having moderate value are the aesthetic value attached to the forest (Mean = 4.4731, SD = 2.3394), availability of grazing land for animals (Mean = 4.4731, SD = 2.3394), site for cultural preservation for the community (Mean = 4.2234, SD = 2.5611). Lastly, aspects with low value included maintenance of the forest as a communal way of life (Mean = 3.9524, SD = 2.5417), source of employment for the community (Mean = 3.0947, SD = 2.8861), source of commercial timber for economic purposes (Mean = 2.7872, SD = 2.8298) and food sources (Mean = 2.8085, SD = 2.6919).

It is evident from the descriptive statistics that the high-value items were critical to the survival of the indigenous people and communities, thus this community were more likely to obtain medicine and construction materials from the forest, however, the use of the forest for energy source drew heavily from the changes in the communal way of life. These findings illustrated that indigenous people held different values to the forest resources and were able to derive ecologically sustainable livelihoods from their ancestral lands. According to Bohensky and Maru, (2011), these socio-economic aspects are part of the socio-economic systems which enhanced the resilience of the inhabitant and therefore, it could be inferred that the customary tenure system enabled communities to manage their land and resources efficiently (Li, 2000). For instance, Sirima (2015) observed that among the Enguserosambu tribe in Tanzania, communal beliefs indicated a cultural connection with the forest and the forest, in turn, provided the livelihood for the community. In other instances, the community seemed to hold the forest highly concerning its natural aesthetics and cultural attachments to its usage (Berkes, Colding & Folke, 2000).

Park and Yeo-Chang (2021) noted that forests can help communities generate income from various sustainable sources such as the production of timber and NTFPs. Forest resources provide low-cost energy such as wood fuel and charcoal and fodder and nutrients for livestock and crop production. Forests also play a role in the reduction of vulnerability and external shocks to the forest–dependent communities during natural disasters and crises.

Change Drivers in Forest Management

The study then used the themes drawn from the qualitative analysis to develop indicators touching on the change drivers influencing the management of forest resources using a five-point Likert type scale: Strongly Agree (SA); Agree (A), Undecided (UN); Disagree (D) and Strongly Disagree (SD). Because of resourcefulness and knowledge, the study administered a questionnaire to the key informants as a way of validating the responses to the qualitative analysis. The interpretation was based on the statistical distribution of the levels of affirmation and/or disaffirmation with the statements based on the scale.

Table 2: Drivers of Changes in Forest Management

Variable		SD	D	UN	A	SA	Total	Mean	SD
Population increase	F	4	0	1	8	7	20	3.681	1.498
	%	20.0	0.0	5.0	40.0	35.0	100.0		
Energy Demands	F	0	2	2	8	8	20	4.103	0.970
	%	0.0	10.0	10.0	40.0	40.0	100.0		
Changes in the communal way of life	F	1	0	1	13	5	20	3.944	0.873
	%	5.0	0.0	5.0	65.0	25.0	100.0		
Economic growth and development	F	0	0	5	7	8	20	4.511	0.832
	%	0.0	0.0	25.0	35.0	40.0	100.0		
Political machinations	F	4	3	3	8	2	20	3.235	1.252
	%	20.0	15.0	15.0	40.0	10.0	100.0		
Failure in traditional conservation practices	F	6	8	2	4	0	20	2.553	1.115
	%	30.0	40.0	10.0	20.0	0.0	100.0		
Inadequacy in modern management methods	F	2	6	3	7	2	20	3.158	1.167
	%	10.0	30.0	15.0	35.0	10.0	100.0		

Source: Field Data (2022)

The statistics in Table 2 show that the factors with major impacts include economic growth and development (Mean = 4.5111, SD = .8323), energy demands (Mean = 4.1026, SD = .9703), changes in community way of life (Mean = 3.9444, SD = .8726) and population increase (Mean = 3.6816, SD = 1.49854) while those factors with minor influence on the

forest included; political machinations (Mean = 3.2353, SD = 1.2515), the inadequacy of modern management techniques (Mean = 3.1579, SD = 1.1673) and lastly, failure in traditional conservation practises (Mean = 2.5529, SD = 1.1147).

These results in table 2 showed that changes that occurred in the external environment such as population growth, economic development and energy demands influenced the forest conservation practises efforts. This found support in Schroeter, Polsky and Patt (2005) who observed that major environmental drivers typically resulted in large changes in ecosystem service supply. Foncha and Ewule (2020) observed that forest degradation was caused largely by logging services, agriculture activities, energy sourcing, pastures, extraction of NTFPs, wild fires and hunting. The activities with the most severe impact are logging and agricultural activities while hunting and natural disasters such as wild fires had minimal effects on the forest resources. These interactive changes are complex across time and space and thus appropriate methods to manage the effects required some trade-offs (Chen *et al.*, 2013). Further, Desta and Smithson (2016) noted that under-utilization of IKS could have led to the loss of IEK, with the consequent effect on resource distribution.

CONCLUSION AND RECOMMENDATION

The study sought to find out how socio-economic variables influenced the application of IEK in forest management among the Sengwer Community. The study revealed that the Sengwer community considered medicine and construction materials as high-value items that were critical to the survival of the indigenous people. However, the forest resources are facing significant challenges arising from the settlement activities within the forest boundaries. The study found that the issues of employment, source of timber for construction and food held the least value to the Sengwer community. The Sengwer themselves had expressed concerns that conservation could be done well by the indigenous communities who understand the importance of the forest and argued that others who did not understand the importance of the forest might deplete it for commercial purposes. These socio-economic aspects were part of the socio-economic systems which drew indigenous knowledge systems to enhance the resilience of the inhabitants in forest management.

The study recommended that the established Sengwer community forest association be financially and socially empowered and mandated with the responsibility of reviving, documenting and publicizing the traditional conservation practices as well as integrated forest management methods. Empowerment has to take education, social and economic aspects as well as knowledge management skills.

REFERENCES

Barber, M., & Jackson, S. (2017). Identifying and categorizing co-benefits in state-supported Australian indigenous environmental management programs: international research implications. *Ecology and Society*, 22(2).

Barlett, J. E., Kotrlik, J. W., & Higgins, C. C. (2001). Organizational research: Determining appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal*, 19(1), 43.

Berkes, F. (2004). Rethinking community-based conservation. *Conservation biology*, 1*8*(3), 621-630.

Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, 10(5), 1251-1262.

Bohensky, E. L., & Maru, Y. (2011). Indigenous knowledge, science, and resilience: What have we learned from a decade of international literature on "integration"? *Ecology and Society*, 16(4).

Bremer, L., Mandle, L., Trauernicht, C., Pascua, P., McMillen, H., Burnett, K., & Chock, P. (2018). Bringing multiple values to the table: assessing future land-use and climate change in North Kona, Hawai'i. *Ecology and Society*, *23*(1).

Briggs, J. (2005). The use of indigenous knowledge in development: problems and challenges. *Progress in development studies*, 5(2), 99-114.

Brondizio, E. S., Siqueira, A. D., Vogt, N., & Padoch, C. (2014). 27. Forest Resources, City Services: Globalization, Household Networks, and Urbanization in the Amazon Estuary. In *The social lives of forests* (pp. 348-361). University of Chicago Press.

Caillon, S., Cullman, G., Verschuuren, B., & Sterling, E. (2017). Moving beyond the human–nature dichotomy through biocultural approaches: including ecological well-being in resilience indicators. *Ecology and*

Society, *22*(4).
Campbell, M. O. N. (2005). Sacred Groves for forest conservation in Ghana's coastal savannas: assessing ecological and social dimensions. *Singapore Journal of Tropical Geography*, *26*(2), 151-169.
Cernea, M. M., & Schmidt-Soltau, K. (2003, September). National parks and poverty risks: Is population resettlement the solution. In *World Parks Congress* (pp. 1-31).
Cox, P. A., & Elmqvist, T. (1994). Ecocolonialism and indigenous knowledge systems: village controlled rainforest preserves in Samoa. *Pacific Conservation Biology*, 1(1), 6-13.
Daniel, C. J., Ter-Mikaelian, M. T., Wotton, B. M., Rayfield, B., & Fortin, M. J. (2017). Incorporating uncertainty into forest management planning: Timber harvest, wildfire and climate change in the boreal forest. *Forest Ecology and Management*, 400, 542-554.
Desta, A., & Smithson, S. (2016). Indigenous knowledge in the context of natural resource management: an information systems perspective.
Durie, M. (2004). Understanding health and illness: research at the interface between science and indigenous knowledge. *International journal of epidemiology*, 33(5), 1138-1143.
Finn, S., Herne, M., & Castille, D. (2017). The value of traditional ecological knowledge for the environmental health sciences and biomedical research. *Environmental health perspectives*, 125(8), 085006.
Fisher, E. (2002). Forced resettlement, rural livelihoods and wildlife conservation along the Ugalla River in Tanzania. *Conservation and Mobile Indigenous Peoples: Displacement, Forced Settlement and Sustainable Development. New York: Berghahn Books*, 119-141.
Foncha, J. N., & Ewule, D. M. (2020). Community Forest Management: A Strategy for Rehabilitation, Conservation and Livelihood Sustainability: The Case of Mount Oku, Cameroon. *Journal of Geoscience and Environment Protection*, 8(02), 1.
Ford, J., & Martinez, D. (2000). Traditional ecological knowledge, ecosystem science, and environmental management. *Ecological Applications*, 10(5), 1249-1250
Gómez-Baggethun, E., Corbera, E., & Reyes-García, V. (2013). Traditional ecological knowledge and global environmental change: research findings and policy implications. *Ecology and society: a journal of integrative science for resilience and sustainability*, 18(4).
Government of Kenya (2016). The Forest Conservation and Management Act of 2016. Government Printer, Nairobi
Government of Kenya (2010). The Constitution of Kenya 2010. Government printers, Nairobi
Government of Kenya (2016). National Environmental Policy 2013. Government Printer, Nairobi
Gross-Camp, N. (2017). Tanzania's community forests: their impact on human well-being and persistence in spite of the lack of benefit. *Ecology and Society*, 22(1).
Himmelfarb, D. (2006). Moving people, moving boundaries: the socio-economic effects of protectionist conservation, involuntary resettlement and tenure insecurity on the edge of Mt. Elgon National Park, Uganda. *Agroforestry in Landscape Mosaics Working Paper Series. World Agroforestry Centre, Tropical Resources Institute of Yale University, and The University of Georgia*, *7*.
Hughey, K., Jacobson, C., & Smith, E. (2017). A framework for comparing collaborative management of Australian and New Zealand water resources. *Ecology and Society*, 22(4).
Igoe, J. (2002). The Challenge to Community Conservation: A Case Study from Simanjiro, Tanzania. *Conservation and mobile indigenous peoples: displacement, forced settlement, and sustainable development*, *10*, 77.
Islam, K. K., Rahman, G. M., Fujiwara, T., & Sato, N. (2013). People's participation in forest conservation and livelihoods improvement: experience from a forestry project in Bangladesh. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 9(1), 30-43.
Kenrick, J. (2014). The case of the Cherangany Hills, Kenya - State Forest protection is forcing people from their lands Forest Peoples Programme,
Lambin, E. F., & Meyfroidt, P. (2011). Global land-use change, economic globalization, and the looming land scarcity. *Proceedings of the National Academy of Sciences*, 108(9), 3465-3472.
Lestari, S., Kotani, K., & Kakinaka, M. (2015). Enhancing voluntary participation in community collaborative forest management: A case of Central Java, Indonesia. *Journal of environmental management*, 150, 299-309.
Li, T. M. (2000). Locating indigenous environmental knowledge in Indonesia. *Indigenous Environmental Knowledge and Its Transformations: Critical Anthropological Perspectives*.
Muhumuza, M., & Balkwill, K. (2013). Factors affecting the success of conserving biodiversity in national parks: A review of case studies from Africa. *International Journal of Biodiversity*, *2013*.
Obua, J., Banana, A. Y., & Turyahabwe, N. (1998). Attitudes of local communities towards forest management practices in Uganda: the case of Budongo forest reserve. *The Commonwealth Forestry Review*, 113-118.
Oldekop, J. A., Sims, K. R., Karna, B. K., Whittingham, M. J., & Agrawal, A. (2019). Reductions in deforestation and poverty from decentralized forest management in Nepal. *Nature Sustainability*, 2(5), 421-428.
Park, S. H., & Yeo-Chang, Y. (2021). Impact of Collaborative Forest Management on Rural Livelihood: A Case Study of Maple Sap Collecting Households in South Korea. *Sustainability*, 13(4), 1594.
Pásková, M. (2017, December). Local and indigenous knowledge regarding the land use and use of other natural resources in the aspiring Rio Coco Geopark. In *IOP Conference Series: Earth and Environmental Science* (Vol. 95, No. 5, p. 052018). IOP Publishing.
Persha, L., Agrawal, A., & Chhatre, A. (2011). Social and ecological synergy: local rulemaking, forest livelihoods, and biodiversity conservation Science *331*(6024), 1606-1608.
Prober, S. M., O'Connor, M. H., & Walsh, F. J. (2011). Australian Aboriginal peoples' seasonal knowledge: a potential basis for shared understanding in environmental management. *Ecology and Society*, 16(2).
Pyke, M., Toussaint, S., Close, P., Dobbs, R., Davey, I., George, K., Oades, D., Sibosado, D., McCarthy, P., Tigan, C., Angus, B., Riley, E., Cox, D., Cox, Z., Smith, B., Cox, P., Wiggan, A. & Clifton, J. (2018). Wetlands

need people: a framework for understanding and promoting Australian indigenous wetland management. *Ecology and Society*, 23(3).
Rammel, C., Stagl, S., & Wilfing, H. (2007). Managing complex adaptive systems—a co-evolutionary perspective on natural resource management. *Ecological Economics*, 63(1), 9-21.
Rantala, S., & German, L. A. (2013). Exploring village governance processes behind community-based forest management: legitimacy and coercion in the Usambara Mountains of Tanzania. *International Forestry Review*, 15(3), 355-367.
Rantala, S. E., Vihemäki, H., Swallow, B. M., & Jambiya, G. (2013). Who gains and who loses from compensated displacement from protected areas? The case of the Derema Corridor, Tanzania. *Conservation and Society*, 11(2), 97-111.
Sharma, D., Vergara-Asenjo, G., Cunampio, M., Cunampio, R. B., Cunampio, M. B., & Potvin, C. (2015). Genesis of an indigenous social-ecological landscape in eastern Panama. *Ecology and Society*, 20(4).
Singh, R. K., & Sureja, A. K. (2006). Community knowledge and sustainable natural resources management: learning from the Monpa of Arunachal Pradesh. *TD: The journal for transdisciplinary research in Southern Africa*, 2(1), 73-102.
Sirima, A. (2015). The Contribution of Indigenous Ecological Knowledge in Conservation of Enguserosambu Community Forest, Tanzania. (Doctoral dissertation, Clemson University).
Stephenson, J., Berkes, F., Turner, N. J., & Dick, J. (2014). Biocultural conservation of marine ecosystems: examples from New Zealand and Canada. *Indian Journal of Traditional Knowledge*, 13:257-265.
Tenge, A. J., De Graaff, J., & Hella, J. P. (2004). Social and economic factors affecting the adoption of soil and water conservation in West Usambara highlands, Tanzania. *Land Degradation & Development*, 15(2), 99-114.
Turner, N., & Spalding, P. R. (2013). "We might go back to this"; drawing on the past to meet the future in Northwestern North American Indigenous communities. *Ecology and Society*, 18(4).
Wali, A., Alvira, D., Tallman, P., Ravikumar, A., & Macedo, M. (2017). A new approach to conservation: using community empowerment for sustainable well-being. *Ecology and Society*, 22(4).
Waller, D. M., & Reo, N. J. (2018). First stewards: ecological outcomes of forest and wildlife stewardship by indigenous peoples of Wisconsin, USA. *Ecology and Society*, 23(1):45
Walsh, F. J., Dobson, P. V., & Douglas, J. C. (2013). Anpernirrentye: a framework for enhanced application of indigenous ecological knowledge in natural resource management. *Ecology and Society*, 18(3).
Warren, P. S., Ryan, R. L., Lerman, S. B., & Tooke, K. A. (2011). Social and institutional factors associated with land use and forest conservation along two urban gradients in Massachusetts. *Landscape and Urban Planning*, 102(2), 82-92.
Wass, P. (1995) Kenya's Indigenous Forests Status, Management and Conservation. IUCN Forest Conservation Programme
Woodhouse, E., & McCabe, J. T. (2018). Well-being and conservation: diversity and change in visions of a good life among the Maasai of northern Tanzania. *Ecology and Society*, 23(1).
Wu, W., Li, Y., Hu, Y., Xiu, C., & Yan, X. (2018). Impacts of changing forest management areas on forest landscapes and habitat patterns in northeastern China. *Sustainability*, 10(4), 1211.
Youn, Y.-C.; Choi, J.; de Jong, W.; Liu, J.; Park, M.S.; Camacho, L.D.; Tachibana, S.; Huudung, N.D.; Bhojvaid, P.P.; Damayanti, E.K. & Othman, M. S. (2017). Conditions of forest transition in Asian countries. *Forest Policy and Economics*, 76, 14-24.