Knowledge About Environmental Dynamics and Attitude Towards Conservation of Saiwa Wetland, Trans-Nzoia County, Kenya

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Abstract

Wetlands are important ecosystems for ecological, social and economic value. Despite their importance, wetlands are under serious threat due to anthropogenic factors, such as intensified agriculture. We conducted a study to assess the knowledge and attitudes towards conservation of Saiwa Swamp in Trans-Nzoia Couny Kenya. The study used a mixed-methods approach to collect data through household surveys, key informant interviews and Focus Group Discussions (FGDs). Household survey data were analyzed using descriptive statistics and Chi-Square while key informant and FGDs data were analyzed under thematic areas. The findings reveal that the respondents are aware of the interrelatedness of their activities and the natural resources of the environment. They understand that besides biodiversity conservation, the swamp plays an important role in providing the community with livelihoods, cultural and economic needs. The findings also establish they are aware that their livelihood activities threaten the swamp. Therefore, protecting and managing the Saiwa swamp ecosystem is essential for the well-being of both present and future generations. For sustainability of both the swamp and community livelihoods, the County and National government should work together with all stakeholders to create and establish a culture of stewardship and collective responsibility among local communities. More importantly, the community should be involved in designing conservation interventions as a key to ensuring adoption and implementation.

Keywords: Saiwa Swamp, Human-Wildlife Conflicts, Wetlands, Livelihoods, Kenya

Introduction

Wetlands are places with a distinct ecosystem that are flooded with water either permanently or seasonally, and where oxygen-free processes prevail(Balwan & Kour, 2021; Mandishona & Knight, 2022; Soni, 2020). Under the Ramsar international wetland conservation treaty (Ramsar, 2011), wetlands are defined as are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (Ramsar, 2011). Wetlands may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands. There are four main types of wetlands namely swamp, marsh, bog, and fen based on the salinity of the water or the type of soil. Wetlands are also classified on the basis of wetland plants into four categories i.e. Emergents, floaters, submerged and amphibious plants (Balwan & Kour, 2021; Butt *et al.*, 2021; Nayak & Bhushan, 2022).

Wetlands are among the most productive ecosystems in the biosphere for their ecological and economic value. They support, permanently or periodically, biologically diverse communities ranging from forests, mammals, fishes, birds (Arya & Syriac, 2018; Balwan & Kour, 2021; Costanza *et al*., 2021; S. Sharma, Phartiyal, Madhav, & Singh, 2021; Smith *et al.*, 2019). Besides, wetlands mitigate floods, provide as nurseries for aquatic and terrestrial life, improve and preserve water quality, control shoreline erosion, recharge groundwater aquifers, produce food and energy for human use and opportunities for recreation and aesthetic appreciation and natural products(Arya & Syriac, 2018; Balwan & Kour, 2021; Nayak & Bhushan, 2022; Spieles, 2022).

Despite their ecological and economic importance, wetlands are under serious threat due to anthropogenic factors, such as intensified agriculture, rapid urbanization and the construction of transport networks (Gardner *et al*., 2015; Mitsch, Bernal, & Hernandez, 2015; S. Sharma *et al.*, 2021). Increase in human population and its consequent substantial pressure on natural resources leading to severe degradation of terrestrial and aquatic resources and their associated biodiversity (Maja & Ayano, 2021; Ogidi & Akpan, 2022; Wang, 2022). This is further confounded by climate change as it has been shown to have severe influence on weather patterns, food production, ecosystem health, species distributions and phenology, and human health (IPCC, 2022; Maja & Ayano, 2021; Ogidi & Akpan, 2022).

Most of the African wetlands are threatened by her growing population and her dependency on natural resources. A study (Mandishona & Knight, 2022) established that wetlands in Africa are threatened by human activities. These activities include but not limited to water abstraction, changes in the natural flood regime, land reclamation, pollution, over-utilization of natural resources, and poaching (Abebe, Degefu, Assen, & Legass, 2022; Alemu, Seleshi, & Meshesha, 2022; Nayak & Bhushan, 2022). All these activities affect the environment and lead to land use land cover (LULC). These land use and land-use changes lead to human encroachment on wildlife habitats, escalating range degradation, reclamations and developments and overuse of the wetlands resources by local populations and human-wildlife conflicts (Ogutu, Piepho, Said, & Kifugo, 2014; D. Sharma & Sinha, 2022). At the root of these conflicts is the fact that numerous stakeholders of wetlands with different interests lay claims on the wetlands functions that don't always coincide (Ishak, 2023; Schuijt, 2002). High habitat diversity and a pronounced natural disturbance regime make some of the wetlands vulnerable to invasion by exotic species (Hovick, Adams, Anderson, & Kettenring, 2023; Jhariya *et al*., 2022; Lázaro-Lobo & Ervin, 2021).

In Kenya, intensification of agriculture and especially flower farming, has had a significant impact on the environment, altering habitats and posing a major threat to biodiversity. Of the 28,000 species assessed as being at risk of extinction on the IUCN Red List, agriculture is identified as a threat for 24,000 of them (IUCN, 2019). According to Kenya Wildlife Service (KWS) most of the wetlands are facing threats of extinction. The threats are fueled largely by increasing demand for land as the human and wildlife populations continue growing, extreme pollution from agricultural practices, urbanization, industrialization, illegal abstraction from Feeder Rivers and springs, deforestation, and unplanned grazing patterns (KWS 2022; (Mohamed, 2002). Saiwa Swamp, one of Kenya's crucial wetlands, for reasons ranging from ecosystem services, education and research, cultural heritage to tourism and recreational services. It is mostly famous for the semi-aquatic Sitatunga (*Tragephalus spekei*), which is endemic to the wetlands, and variety of birds and other mammals. The vegetation in the park consists of three communities: gallery forest (39%), open grassland (24%) and wetland vegetation (37%). Besides, it is a source of two rivers that flow to Lake Victoria that are exploited for water by the communities around the swamp and beyond (Mohamed, 2002). It is also a tourist attraction and a study site for the researchers who seek to understand wetland ecosystems and biodiversity conservation. However, the wetland is exposed to threats of extinction because of both direct and indirect impacts from a growing human population, particularly due to farming and urbanization (Mohamed, 2002).

Understanding the community's knowledge about interlinkages between their activities and the wetland is important in promoting actions/practices that can help the community to live harmoniously with the natural systems while safeguarding their livelihoods. Therefore, we conducted this research to assess knowledge and perceptions of the community regarding the environmental changes and conservation of the swamp.

Research Methodology

Study Area

This study was conducted in Saiwa Swamp (Sinyerere and Sitatunga) in the Trans-Nzoia County in the Western part of Kenya (Figure 1). Part of this swamp contributes Saiwa National Park (1°6′N 35°7′E / 1.100°N 35.117°E). It is the smallest national park in Kenya (3 km2) and was established in 1974 as a habitat of the rare and endangered semi-aquatic Sitatunga antelope (*Tragelaphus spekei*) (Kenya Wildlife Services [KWS] 2024). The park has both swamp and forest vegetation and is a home to a variety of wildlife, birds, insects and reptiles. The wetland is fed by Sinyerere and Kapenguria rivers and is drained by Saiwa and Sitatunga rivers that feed the Nzoia river system which flows into Lake Victoria.It is surrounded by farming activities. The existence of this swamp is threatened by inputs of agricultural chemicals transported by runoff from the adjoining farms, encroachment by farmers neighbouring the swamp, erosion of the banks of the two rivers that feed into it and the subsequent changes in vegetation. Agriculture is the predominant economic activity in the county and is the leading sub-sector in terms of employment, food security, income earning and overall contribution to the socio-economic wellbeing of the people, large maize and wheat farming characterize the major use of land in the county. Main food crops grown in the county are maize, wheat, tea, coffee, beans and potatoes (Mbuni *et al.*, 2020).

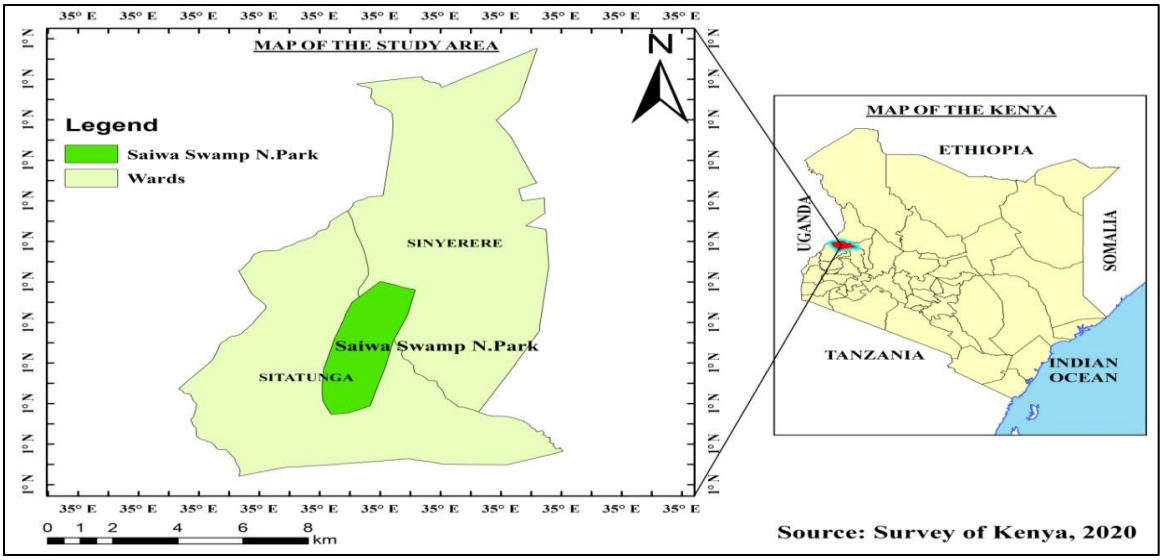

Figure 1: Map of Study Area

Research Design

This study adopted a mixed methods design to provide a better understanding of the research problem and multiple viewpoints (Fetters, Curry, & Creswell, 2013). Quantitative primary social data was obtained through use of semi-structured questionnaires that were administered face-to-face with the help of enumerators who were trained before conducting interviews. Face-to-face interviewing was chosen because it yields highest response rates in survey research and it gives room for the researcher to clarify ambiguous responses (Bernard, 2013).

Sampling Procedure and Sampling Size

Prior to the actual field data collection, the questionnaire was pretested to allow for restructuring of questions and solving all questionnaire-related problems before the actual data collection (Simon, 2006). In addition, focused group discussions and key informant interviews were conducted to give more insight to issues that were not well captured in the questionnaires and guide and highlight the differences between participants (Van Eeuwijk & Angehrn, 2017). A checklist was used to moderate the discussions (Lloyd-Evans, 2006) while the field assistant was taking notes. Questions on awareness, attitude and practices/actions taken to promote conservation of the swamp were presented as a statement and put on a five-point Likert scale (Kibue, Pan, Zheng, Zhengdong, & Mao, 2015; Marshall, Park, Howden, Dowd, & Jakku, 2013) and other questions were closed- and open-ended. Before the commencement of interviews, respondents were briefed about the purpose of the study and asked if they were willing to participate. After giving consent, all interviews and discussions were recorded. Secondary data was collected throughout the research period from government sources, annual reports, journals, books and any other relevant literature.

Data Analysis

The data was analyzed for reliability using Cronbach's alpha reliability coefficient of r=> 0.7 which is considered sufficiently reliable (Radhakrishna, 2007). Descriptive analysis was used to show summary and distribution of the data. This included use of frequency tables and figures that were generated using Excel

software. The analytical procedures were used to determine the relationships among variables to enable easy interpretation of data. In order to do this, all scores for statements that were assessing each of the variables (awareness/knowledge, willingness and attitude) were summed up for ease of analysis. Chi-square tests were used to test the relationship between variables. Qualitative data from key informant interviews was analyzed using thematic analysis.

Results and Discussions

Demographic Characteristics

The socio demographic characteristics of the respondents in our study are shown in Table 1. The respondents were nearly balanced by gender (Female 49% and Male, 51%). In regard to education, majority of the respondents (43%) have attained secondary education, 36 % primary, 13% university while 8% have not attained any formal education. Majority of the respondents (48%) were self-employed, 40% were casual laborers while 12 % had formal employment. Majority (50%) had lived in the study area for more than 20 years.

Table 1: Summary of demographic and socio-economic characteristics of respondents

Variable	Category	Frequency (%)
Gender	Male	51
	Female	49
Age (Years)	<30	32
	31 – 40	27
	41-50	19
	>50	22
Education level	No School attended	9
	Primary	36
	Secondary	43
	University	13
Employment status	Employed	12
	Self employed	48
	Unemployed	40
Land size (Acres)	Up to 1	57
	1.1-2.0	21
	2.1-3.0	11
	3.1-4.0	6
	4.1-5.0	4
	Above 5.1	2
Time of residency **(**Years)	Up to 5	3
	6-10	9
	11-15	21
	16-20	17
	Above 20	50

Community Awareness of Environmental Changes in the Study Area

The respondents are aware of the changes that have occurred in the study area. They mainly referred to rainfall, temperature and vegetation cover (Figure 1). They made the following observations: decrease in rainfall (51%), increase in temperature (37%) and decline in vegetation cover (74%).

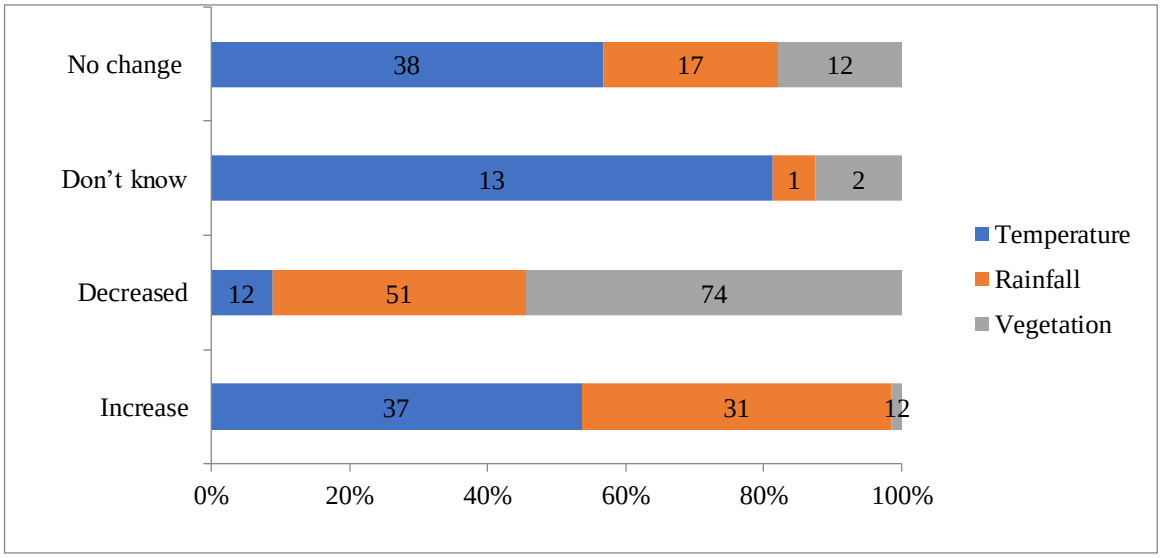

Figure 2: Changes in environmental parameters

Socio-demographic factors have been found to play a role in shaping public perceptions of wildlife conservation and management strategies (Jew & Bonnington, 2011; Miao *et al.*, 2021). Research indicates that respondents' characteristics, perceived benefits, and interest in wildlife can influence their support for funding options for conservation efforts (Henderson, Riley, Pomeranz, & Kramer, 2021; Nepal & Spiteri, 2011; Ntuli, Jagers, Linell, Sjöstedt, & Muchapondwa, 2019). Focus group discussions attributed the changes to human population increase. According to the discussants the population has been growing rapidly from the time when the government declared it a settlement scheme in 1969. Consequently, environmental resources have been overexploited to meet the needs of the growing population. When asked to identify the causes of the environmental changes, majority of the respondents cited deforestation (90%), human settlement (51%) and agricultural activities (39%). These findings are similar to other studies that relate increase in human population to rapid urbanization and intensified agriculture, placing substantial pressure on natural capital leading to severe degradation of terrestrial and aquatic resources and their associated biodiversity (Maja & Ayano, 2021; Ogidi & Akpan, 2022; Wang, 2022).

Knowledge of the Swamp Resources and Importance of the Swamp

Community awareness of wildlife species is crucial for effective conservation efforts. Research has demonstrated that engaging local communities and raising awareness about the impacts of human activities on wildlife can lead to more positive attitudes towards conservation (Bitanyi, Nesje, Kusiluka, Chenyambuga, & Kaltenborn, 2012; Govind & Jayson, 2021; Miao *et al.*, 2021). The study revealed that all the respondents were aware of the various wildlife species in the area (Table 2).

Table 2: Community awareness of various wildlife species

	Frequency	**Percentage**
Sitatunga	141	100%
Cranes	175	53%
Monkeys	138	98%
Snakes	136	97%

Cross tabulation analysis of the level of education of the respondent and knowledge of the environment showed a significant association; X^2 (df=3, n=141) =16.046, p=0.014). This finding is similar to other studies (Espinosa & Jacobson, 2012; Larson, Conway, Hernandez, & Carroll, 2016; Makumbe, Mapurazi, Jaravani, & Matsilele, 2022; Nkansah-Dwamena, 2023) that education and environmental awareness among local communities have been associated with reduced incidences of human-wildlife conflicts, as educated individuals are more equipped to minimize risks and damages caused by wild animals.

Discussants affirmed that the swamp is important to their livelihoods because they obtain water, firewood, earns them business and employment through tourism, offers educational and research opportunities and acts as cultural and spiritual connections to the land. They also stated that the swamp has gone through serious transformation in terms of its size, vegetation and wildlife because of encroachment and agricultural activities. They said that there are efforts by the government and other stakeholders to restore the wetland.

Agriculture, being the mainstay of economy of the study area, has resulted in substantial pressure on natural resources and particularly the Saiwa Swamp. Consequently, cases of human-wildlife are on the rise. Nearly all respondents have experienced conflict with wildlife. The main type of conflicts in the study area is reported is crop raiding. Group discussions revealed that attacks on humans and livestock rarely occur and the most problematic animals are monkeys. The group discussions further indicated that the monkeys damage mostly maize crops.

The discussants said that they employed a combination of the traditional methods, and a few used the KWS officials to deter animals from their farms. They noted that these methods were not effective because the monkeys got used to them and the KWS officers were rarely available when needed. The KWS officials also indicated they could not effectively carry out their operations due to shortage of human and material resources.

The presumed young generation viewed wildlife in terms of how much money they could make from their presence citing benefits from tourism and employment while the more mature viewed them in terms of cultural heritage and value for future generations. This observation is similar to (kibIhemezie, Nawrath, Strauß, Stringer, & Dallimer, 2021; G. Kibue, Karachi, Maara, & Cheboi, 2011; Mosse, Odadi, & Kibue, 2024) who established that that people's attitude varied depending on individual values, situations and the community value of wildlife. Discussions revealed that women more than men disliked wildlife. This negative attitude could be partly attributed to the women's inability to defend themselves and their vulnerability to consequences of crop raids by the monkeys (Hill, 2005; P. C. Lee & Priston, 2005). Moreover, given that majority of the respondents (57%) own a maximum of 1 ha of land (Table 1), a single raid can cause substantial damage.

Risks/Threats Associated with Changes in Environmental Parameters

Perception of risks associated with human activities vary widely based on their impacts on livelihood and other factors (Kibue *et al.*, 2016; Malakar, Mishra, & Patwardhan, 2018; Mwangi, Kirui, & Kibue, 2022). According to our study, most respondents agreed with all the statements about risks associated with human activities on the environments. Majority of the respondents strongly agreed or agreed that the environmental changes will cause: Adverse effects on agriculture (95 %), Land degradation (83%), Severe droughts and floods (91 %), Decrease in water quantity and quality (92 %), Change in vegetation composition (89 %), and Conflicts between human and wildlife (77 %) (Table 3).

Table 3: Risks associated with the environmental changes (rainfall, temperature and vegetation

Risk/threats	SD	D	NS	A	SA
Adverse effects on agriculture	0	5	0	82	13
Land degradation	0	14	3	79	4
Land cover change	0	26	18	56	0
Land fragmentation	0	33	20	46	1
Decreased sitatunga population	0	19	19	57	5
Change in water quality & quantity	0	5	3	91	1
Severe drought & floods	1	6	2	90	1
Change in vegetation cover	1	6	4	88	1
Human wildlife conflict	2	21	0	75	2
SD= Strongly Disagree D=Disagree NS= Not Sure A= Agree SA= Strongly Agree					

These findings can be explained by the fact that the respondents largely depend on agriculture for livelihood and agriculture is interrelated with environmental resources. Moreover, both droughts and floods have negative impacts on agriculture and by extension food security. Other studies (Castillo-Huitrón, Naranjo, Santos-Fita, & Estrada-Lugo, 2020; Georgiou, Hadjichambis, & Hadjichambi, 2021; Gifford & Nilsson, 2014; Kollmuss & Agyeman, 2002; K. Lee, Gjersoe, O'neill, & Barnett, 2020; Tam & Milfont, 2020) have shown that perceptions vary depending on such as cultural background, personal experiences, education, and media influence. Some activities may be perceived as highly risky by some individuals or groups or regions depending on their while others may view them as relatively safe.

Attitudes/Perceptions Towards Management and Conservation of the Swamp

According to our study, most respondents agreed with all the statements about conservation of the swamp and its environment. Majority of the respondents strongly agreed or agreed that; Planting trees can restore the wetland environment (93%); Traditional farming practices restore the wetland environment (40 %); I have a duty to sensitize community about importance of the wetland (78%); I am prepared to follow laws to minimize human impacts on the swamp (100%); It is the Government duty to reduce human-wildlife conflicts (99%); Government policies can adequately address wildlife conflicts (28%); Involving community in formulation of policies can reduce human-wildlife conflicts (99%) (Table 4). There was a significant relationship between education and Involving community in formulation of policies to reduce human-wildlife conflicts; X^2 (df=3, n=141)= 10.33, p=0.016); age and the following statements: traditional farming practices can restore the wetland; X^2 (df=9, n=141)= 17.48, p=0.042; planting trees can restore

the wetland X^2 (df=6, n=141)= 15.34, p=0.018 and I have a duty to sensitize the community about importance of the swamp; X^2 (df=6, n=141)= 12.82, p=0.016);.

Table 4: Attitudes/perceptions towards management and conservation of the Swamp

Statement	**Level of agreement**				
	SD	**D**	**N**	**A**	**SA**
Afforestation	0	4%	3%	86%	7%
Traditional agricultural practices	1%	55%	4%	39%	1%
Sensitization of community	0	16%	1%	78%	5%
Obeying the laws	0	1%	0	99%	1%
Government duty to reduce human-wildlife conflict	0	1%	0	88%	11%
Government policies	0	71%	1%	24%	4%
Community involvement in policy formulation	0	11%	0	85%	4%
SD = Strongly Agree D= Disagree N= Neutral A= Agree SA= Strongly Agree					

Management and conservation of natural resources has certainly become a big challenge in the face of fast-growing populations and associated pressure on environmental resources. In the face of massive land fragmentation, habitat destruction, biodiversity loss and climate change, positive attitudes towards conservation is crucial (Eriksson & Klapwijk, 2019; Halkos & Matsiori, 2017; Hanski, 2011; Queiroz, Beilin, Folke, & Lindborg, 2014; Skogen, Helland, & Altenburg, 2018).

Conclusion and Recommendations

This study reveals the complex relationship between human behavior and the natural environment. Therefore, understanding of human-environmental dynamics is crucial for fostering positive attitudes towards conservation efforts. Protecting and managing the Saiwa swamp ecosystem is essential for the well-being of both present and future generations. Besides biodiversity conservation, the swamp plays an important role in providing the community with livelihoods, cultural and economic needs. Besides, the County and National government should work together with all stakeholders to ensure that the community is sensitized about existing policies and laws of conservation in order to shape individuals' perceptions and actions towards protecting the wetland and other environmental resources. This will breed a culture of stewardship and collective responsibility among local communities and thereby guarantee sustainability of the swamp.

The study recommends community involvement in designing conservation interventions as a key to ensuring adoption and implementation of conservation strategies that not only preserve environmental resources for sustainable livelihoods of both current and future generations. It also recommends formulation of customized conservation strategies that not only address environmental threats but also consider the socio-economic aspects of the region. The KWS should consider development of policies to introduce trade in wildlife and wildlife products to ensure both consumptive and non-consumptive utilization of wildlife resources. The government should support initiatives by communities' natural resources management groups through giving proper tools and incentives to successfully manage and benefit from natural resources utilization

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Disclosure of Conflict of Interest

There is no conflict of interest declared by the authors in regard to the findings of this research

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