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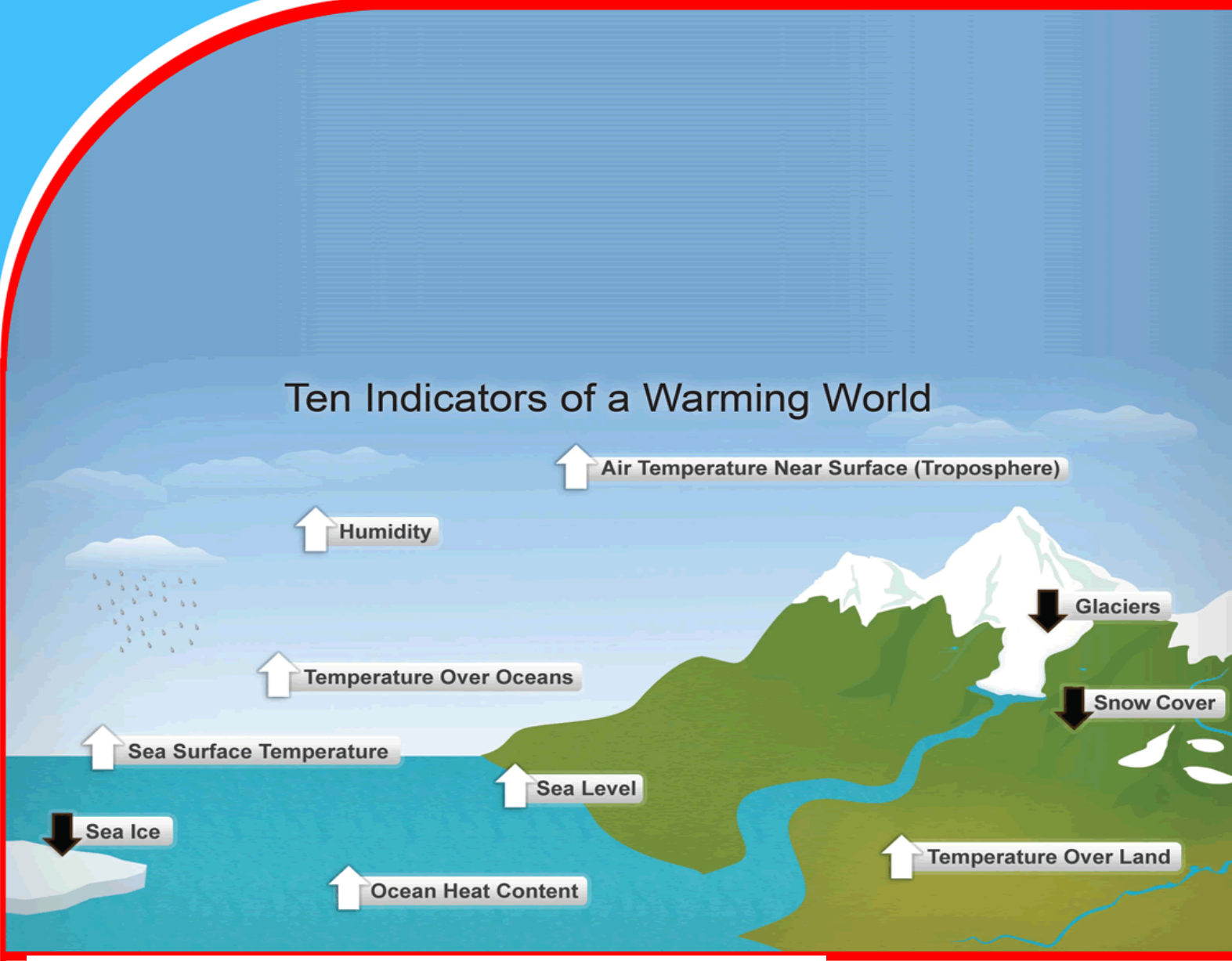

ASSESSMENT OF THE IMPACT OF HUMAN-WILDLIFE CONFLICT ON SOCIO-ECONOMIC LIVELIHOODS OF COMMUNITIES BORDERING BOUR-ALGY GIRAFFE SANCTUARY IN GARISSA, KENYA

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ABSTRACT

Purpose: In the recent years, human-wildlife Conflicts have been increasing and its implications on biodiversity conservation and livelihood is significant in the drylands of Kenya especially in Garissa County. The link between these conflicts and socio-economic livelihoods has however been less explored in northeast Kenya, which prompted an investigation into the impact of human-wildlife conflict on socio-economic livelihoods of communities bordering Bour-Algy Giraffe Sanctuary in Garissa County.

Methodology: A survey was conducted on the locals from the location as well as other stakeholders such as local administration that is village elders and chiefs, Kenya Wildlife Service as well county government officials from the department of Agriculture, Environment and Livestock. Both qualitative (KII) and quantitative (Structured questionnaire) were used. The qualitative data was analyzed through thematic analysis. The impact of Human Wildlife conflicts on socio-economic livelihood was established through Pearson correlation while the moderating effect of legal framework was established through a multivariate moderated regression model.

Findings: The results indicated that resource competition between livestock and wildlife is associated with a significant decrease in socio-economic livelihood, crop raids and predation were associated with an insignificant decrease in socio-economic livelihood, human intrusion affected socio-economic livelihood in a negative and significant manner. The findings led to the conclusion that increasing HWC was associated with economic losses, reduced income and increased costs which deteriorated socio-economic livelihood.

Unique contribution to theory, practice and policy: The study recommends the county government of Garissa to work hand collectively with the local community to ensure minimization of resource competition by building more watering points, passing laws to prevent land encroachment, implementation of policies that aim to penalize and discourage hunting and poaching the wildlife, expanding the grazing land towards the sanctuary, intruding the sanctuary in order to harvest honey, massive deforestation activities to expand the human territory towards the sanctuary and cutting down trees to get fuel and expanding agricultural land.

Key Words: *Resource Competition, Livestock and Wildlife, Crop Raids, Predation, Human Intrusion, Socio-Economic Livelihood*

INTRODUCTION

Human and wildlife co-existed for many years and conflicts between them occurred when their interactions impact negatively on human livelihoods or on the necessities of wildlife (KWS, 1995). The Kenya Wildlife Service connects the conflicts between human and wildlife to comprise the controversies relating to obliteration, loss of human life, people's property, and intrusion of individuals or groups of wild animals into farms or drinking water point. Human-wildlife conflicts are widespread in the Africa where huge numbers of big animals such as hyenas, giraffes, baboons, bush warthogs, hippopotamus (hippos), antelope, and lion still wander without much restrictions in peripheral rangelands, community grazing lands and farmlands (Kangwana,1993). Livelihood diversification and increase in human population has occasioned the intrusion into more peripheral lands previously occupied by wildlife that are in one way or the other a key area for their survival. These factors led to the disintegration and transformation of land, for instance, to sedentary farming and other uses incompatible with wildlife (Conover, 2002) and (Okello *et al.*, 2003).

In Kenya, for example, where most of the wild animals live outside designated protected areas, Western (1995) observes that the individuals who are mostly found in these areas heavily rely on natural resources and find it difficult to tolerate wild animals in their living areas specially when they think the animals are a danger to their livestock, people's lives and livelihoods. The existing conflict between human and people is a major challenge to biodiversity and global wildlife conservation (Musiani *et al,* 2003). These negative effects will increase as population growth increases, development of land for farming and infrastructure expands, climatic conditions worsen and other anthropogenic activities increases causing direct confrontation for limited resources. For example, in the united states bears are involved in damaging waste collection bins within the national parks and attacking people in the nearby town centers (Musiani *et al*,2003). It was reported that Deer causes damage to motor vehicles and attack more than twenty thousand people in a single year prompting the government to spend more than 1 billion US dollars in form of compensation (USDA, 2006). For more than ten years' wolves have been responsible for the death of 2,806 domesticated dogs, cattle, Goats and birds in Canada (Musiani *et al.*,2003).

In Kenya human-wildlife conflict is frequently reported in the drylands where there is incredible population of diverse wildlife. The counties that have reported severe incidents of human - wildlife conflict include; Taita Taveta, Laikipia, Kajiado, Narok and Lamu with Elephant being the most problematic animal (Ogutu, 2019). The leading problems that wildlife in the Kenya causes are crop damage, competition for water resources and pasture, livestock predation, transmission of diseases to domestic animals, numerous inconveniences to people such as protecting the crops at night, and even human fatalities (KWS, 1992; Norton-Griffiths, 1996; Campbell *et al.*, 2000; Muruthi, 2005). The wild animals, majority of which are either threatened or endangered are always on the receiving end when the communities' revenge by injuring them or killed in retaliation to property damage, death, livestock predation or sometimes to prevent future conflicts (KWS, 1992). Concrete coping and impact reduction measures of the adverse impact resulting from the interactions of human and wildlife is paramount to the success of conservation and reduction of conflict in the community Giraffe sanctuary and its adjacent agro-pastoralist communities. A lot of deterrent mechanism have been used in an effort to reduce and manage human - wildlife conflicts by different communities around and within wildlife sanctuaries. Conversely, there has been an escalation in the human and

wildlife interface problem reports, with serious damages to crops and loss of critically endangered species and other wildlife (KWS, 1992)

The local communities are predominantly livestock keepers who practice nomadic pastoralism by constantly moving their camels, cattle, goats, sheep and donkeys from one area to another in search of pasture and water. The community is regarded as one of the indigenous African communities to embrace co-existence and conservation of wildlife within their grazing lands with minimal conflict (Goodland, 1992; McNeely & Pitt, 1985). However, there has been a remarkable transition from pastoralism to agro-pastoralism. This is because of the intensified and recurrent drought, livestock diseases and clan conflict that has claimed pastoral livelihoods rendering a huge number of the community members to be pastoral drop-out (Githuru *et al.*, 2007). This has resulted the movement of the pastoral drop-out from the hinterlands to the flood plains of the River Tana to change the lifestyle from pastoralism to small scale farming. The start of irrigation happened in areas that have previously been considered to be a key wildlife habitat, wildlife watering points or natural wildlife dispersal area. In an effort to get adequate food, water, shelter and space, both wild animals and people started competing for the limited resources mentioned above. The Giraffe sanctuary and its adjacent areas was selected as the site for the study due to its ecological and economic importance. It is a unique ecosystem that form important areas of natural resource management as it is habitat for the critically endangered species such as Reticulated Somali Giraffe, gravy Zebra and African Wild Dogs. Although many studies relating to human wildlife conflict was carried out in other parts of Kenya, no similar research in human - wildlife conflict has been done in the context of agro-pastoralist communities living adjacent to the Giraffe sanctuary in Garissa County.

Statement of the Problem

In the recent years, Human-Wildlife Conflicts (HWC) have been increasing and its implications on biodiversity conservation and livelihood is significant (Mukeka *et al.* 2019). Crop raiding, livestock depredation and property losses have negative socioeconomic impacts on rural households who mostly derive livelihoods from crop production and livestock rearing (Mojo *et al*., 2018; Mukeka *et al*. 2019). Human-wildlife conflict statistics in Kenya indicate that between the year 2014 and 2018 alone, more than 470 people were killed by wild animals, and more than 1,263 people were seriously injured, 501 properties damaged and 735 animals killed in 2018 (RoK, 2018a). In Garissa County, HWC is a problem acknowledged in the County Integrated Development Plan (CIDP) 2018-2022 (RoK 2018b). In addition, human population expansion, increasing livestock numbers and climate change jointly exacerbate human-wildlife conflicts in Garissa County (Long, 2020). This is putting considerable pressure on available land as the demand for settlements and food rises, reducing wildlife habitat and increasing competition between livestock and wildlife for resources.

The fact that livestock rearing is the mainstay of the local livelihood in Garissa, it is aggravated by HWC. According to the Agriculture department of Garissa County, there has been an increase in HWC around Bour-Algy Giraffe Sanctuary. Farmers along the riverine belt have frequently reported damages to crops by wildlife through crop raid, damage to irrigation infrastructure, death of livestock, injury and human death over the years (RoK, 2018b). Understanding the link between HWCs and socio-economic livelihood is thus important in order to help in better management of the conflicts and to reduce the negative impacts on both biodiversity and livelihoods of the rural

communities. This is because the increasing demand and competition for land, water and forage between human and wildlife, conflict between them will remain to be a challenge in the future.

Objectives of the Study

i. To establish the impact of resource competition between wildlife and livestock on socio-economic livelihoods of communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya
ii. To determine the impact of wildlife predation and crop raids on socio-economic livelihoods of communities bordering Bouralgy Giraffe sanctuary in Garissa County, Kenya
iii. To assess the impact of human intrusion on socio-economic livelihoods of communities bordering Bouralgy Giraffe sanctuary in Garissa County, Kenya

LITERATURE REVIEW

Resource Competition between wildlife and livestock and Socio-Economic Livelihoods

Competition between living organisms is a fundamental concept in ecology (Sommer & Worm, 2002). Different scholars from various disciplines have suggested, implied, or stated that domestic livestock compete with wildlife over natural resources (Averbeck *et al*. 2009). The high demand for land to increase food productivity, raw material for construction and for settlement lead to the conversion of key wildlife areas into settlement and farmlands that has significantly reduced wildlife habitats and dispersal areas such as grasslands, woodlands and wetlands (Lamarque *et al,*2009). The continuous competition for these land-based resources between people and wildlife and fragmentation of wildlife habitat is believed to be the major causes of human wildlife conflict which also contribute to the significant reduction of wildlife populations (Hill, 2000). Madden (2008) observed that any further conversion of this prime wildlife habitat to sedentary agriculture and settlements by communities living adjacent to wildlife will escalate the incidents of HWC.

The local communities have co-existed with wildlife in the same patches of land with no or minimal conflict due to resources abundance and much lower human population (Musyoki, 2007). However, the community lifestyle has changed from pastoralism to small scale farmers due to recurrent drought that caused reduction in livestock (Githuru *et al* 2007). The riverine ecosystem a prime land for wildlife was encroached since it was the only area where irrigation was possible. The change of the community lifestyle has led to wildlife and people living in close proximity leading to HWC that impact on livelihoods and wildlife populations (Githuru *et al* 2007). The farming community face a lot of problems with Giraffes specially during the drought season due to reduced forage in their area and farmers consider this period as a season of low income due to giraffes feeding on mangoes during flowering (Githuru *et al* 2007; Burke, 2008).

HWC also occurs between livestock headers and wildlife mainly inform of predation, competition for pasture and watering point (Patterson, 2004). Although many water points are placed in the hinterland, overuse and drought leads to drying up of this source forcing the community to look for water in permanent sources (Patterson, 2004). He further observes that people will heavily depend on sources such as rivers and spring for domestic people use and livestock watering, these sources are invested with dangerous predators such as the crocodiles that may kill livestock and even people thus increasing incidence of human wildlife conflict (Fergusson, 2002; Bissonette & Dair, 2008; Hamilton *et al*, 2005; Kagiri, 2000).

In their interrogation of resource competition between wildlife and pastoral livestock in East Africa, Butt and Turner (2012) argued that both wild ungulates and domestic livestock are mobile and competition between them can only occur if their grazing occurs at the same place. Vegetative change is most associated with grazing during the growing season - a time when forage availability is less limiting to animal nutrition. Whenever such competition occurs, predation increases and that affects livelihood of pastoralists in a negative manner. In another interrogation, Okello, Buthmann, Mapinu and Kahi (2011) assessed the community opinions on wildlife, resource use and livelihood competition in Amboseli and demonstrated that indeed such competition exists on critical resources such as water, pasture, plant resources and space. Its impact was summarized as negative in that it led to poverty and reduced socio-economic benefits of natural resources and thus suggestions to communally manage ranches.

Wildlife Predation and Crop Raids and Socio-Economic Livelihoods

Large carnivores such as lions, Hyenas and leopards causes devastating loss of livestock through predation (Kissui, 2008). This has been observed in different parts of the world and may include predation on ranched and free ranging domesticated animals and attacks on pastoral livestock (Boitani *et al,2010;* Lance *et al,* 2010*).* Wild animals sometimes cause damage to people's properties and this is observed to be one of the leading causes of human wildlife conflict in many wildlife populated areas leading to negative impact on the community's livelihoods and wildlife injuries and deaths (Thomassen *et al, 2001;* Ogra, 2008; Thapa 2010). These damages are done on houses, fences, irrigation infrastructure and sometimes vehicles (Found & Boyce, 2011; Neuman *et al, 2012).* Crop raiding implies the act of intruding into an irrigated land by an animal that leads in the depletion or destruction of domesticated plant life within the cultivated region. It was observed until recently that, environmentalists have not focused so much on the effect vertebrate species on farming activities apart from big mammals, birds and rodents, mainly giving little attention to incidents involving small-scale subsistence farmers (Hill, 1997). However, sufficient evidence indicates to the existence of this phenomenon having occurred and recorded since history (Hill, 1997).

With disintegration and reduction of ordinary environment progressively on the rise, it became clear that animals will be forced to encounter people with increasing frequency. Therefore, wild animals will unintentionally damage crop, as a way of surviving, resulting into conflicts between indigenous communities and wildlife conservationists (Kaswamila *et al.* 2007). Local farmers see native animals as "pests" and they often use dangerous means to defend their land which can sometimes be lead to serious reduction in animal populations (Breitenmoser *et al.* 2005). Revengeful killing was observed to be the greatest observed reason for previous extinction of many big carnivores in the entire world (Breitenmoser *et al.* 2005). Human-wildlife conflicts are a concern in southern Zimbabwe which is part of Greater Limpopo Transfrontier Conservation Area. Study objectives were to assess cost value of crop/livestock loss incurred by farmers as well as to identify drivers of human-wildlife conflicts and explore mitigation measures on agro-based communities of Mutema-Musikavanhu, adjacent to Save Valley Conservancy in southern Zimbabwe. Data collection was done in November 2016, using questionnaires administered to randomly selected 300 households and 20 key informants.

Majority of farmers (86%, n = 258) had incurred annual household economic loss ranging from US$ 671.00 to US$ 998.21 per household, though perceived and actual losses differed by 63.2% for mono-specific stands of crops and livestock herds for the period October 2014 to October 2016. It was concluded the main drivers of human-wildlife conflicts were African elephants (Loxodonta africana) raiding crops like maize (Zea mays), bananas (Musa sapientum) and legumes (Cucurbita sp.), whereas, lions (Panthera leo) kill livestock, mainly cattle (Bos taurus). Ineffective deterrents such as setting fires around fields at night, guarding crops and herding livestock were methods employed to minimize human-wildlife conflicts. Local people suggested erection of an electrified fence to reduce trespassing of wild animals from protected area to human settlement. In their study, Mhuriro-Mashapa, Mwakiwa and Mashapa (2018) while interrogating the socio-economic impact of human-wildlife conflicts on agriculture-based livelihood in the periphery of Save Valley Conservancy, southern Zimbabwe indicated that they had incurred massive economic losses from crop and animal raids by the wildlife animals. In another interrogation, Mfunda and Røskaft (2011) who focused on the dilemma of crop raids and human livelihoods in Serengeti, Tanzania indicated that extreme cases of crop destruction affected livelihood and fod security of the locals significantly.

Human Intrusion and Socio-Economic Livelihoods

The communities that lived before the agricultural and industrial revolution lived by away of hunting and gathering (Musyoki, 2007). Wild animals and people co-existed peacefully with minimal impact as there were abundant quality natural resources at their disposal. During the agrarian revolution, society begun to cultivate land to produce crops and domesticate animals as a means of reliable food base. While the new way of life ensured reliable food sources throughout the year, people registered significant losses of livelihoods in terms of crop damage and livestock predation by wild animals since they started sedentary farming and domestication of wildlife (Naughton-Treves, 1998). Anthropogenic activities expanded into the boundaries of wildlife conservation areas including key areas used for migration and dispersal as population increased due to high demand for settlement and crop farming (Musyoki, 2007). Other scientist like Wanjau, (1999) asserts, that increase in the demand for fertile land is a major factor contributing to human wildlife conflict which is worsen by the ever-increasing human population and poverty levels. He observed that, where human wildlife conflict was driven by people's demand conflict between the people and animals can be managed through economic development initiatives.

Gachugu (2006) stated that, the challenges facing wildlife and conservation areas continue to rise as people continue to improve their livelihoods as poverty and human population increases every year. There is link between challenges facing the environment and natural resources and poverty, increase in human population and people's desire to improve their livelihoods (Malik 1994). He believes that the desire of human beings to develop land and reduce the poverty level will put a lot of pressure on the environment and the natural resources. Engaging in activities that increase income generation in wildlife habitat increase pressure on habitat resources and stimulate the start of human wildlife conflict (Yaro *et al,* 2015). According to KWS (2017) wildlife habitat was invaded by individual persons, groups of people and organizations whose activities cleared land to use it for other development purposes. Activities such as unsustainable charcoal production, clearing of woodlands and forests, burning of bushes, illegal hunting, poor settlement and over-grazing of livestock (KWS, 2017). The report by the service indicates 96% of wildlife hunting that

occurred in 2017 took places in wildlife conservation areas. It further shows that ecosystem disturbance resulting in human wildlife conflict such as human injuries, property destruction and killing of wild animals happened in 82% of the country's national parks, game reserves and sanctuaries.

Anthropogenic activities resulting in human wildlife conflict as a result of human invasion into wildlife conservation areas caused human wildlife conflict in 72% of National parks, game reserves and wildlife sanctuaries. Transformation of the landscapes and the likelihood of conflict arising between wildlife and people will be on the rise as long as local communities who practice farming and livestock keeping continue to reside close to wildlife protection areas according to the report.

According to Hoffman and O' Riain (2010) people invasion into wildlife conservation areas led to the loss of livelihoods as a result of asset destruction, livestock predation and raiding of agricultural farms. Wildlife habitats are greatly altered by anthropogenic activities such as keeping of livestock, crop farming and development activities like construction of roads (Kate, 2012). Wild animals are migratory in nature and species such as Giraffes and zebras destroy properties and fences during their migration cycles due to innate knowledge on ancestral migratory route (Kate, 2012). Human wildlife increased where wild animals' population is more than people who sub-divided land into smaller plots to do small scale farming in the country (KWS, 2009).

Theoretical Framework

The study was anchored on the Social Conflict Theory and Stakeholder Theory. The social conflict theory was established by Karl Mark in the year 1971. He claimed that in a community individual members and groups are not based on unity but rather on conflict. Certain members will get many resources in different ways. Karl claims that conflict is a continuous event within the society because of the scare nature of the resources at the disposal of the different members of the community. The developer of the theory thought that, conflict was an integral part of the development of the community without which the community will not be successful. He displayed to the people to consider conflict as a lifestyle that does not require to be feared. He claims that conflict will always be there as long as there are variations in goals between members in the society. The concept of social conflict theory was used by Woodroffe (2005) to explain human - wildlife conflict as a situation of conflicting states among people and wildlife in farmlands through crop raids, livestock predation, killing of wild animals, human injuries and death.

On the contrary, Stakeholder Theory was adopted since the subject of human - wildlife conflict management and mitigations involve many stakeholders. The theory was brought forward by Freeman (2003) who suggested that the happening of an event is defined by its connection with a number of other related groups and individuals who are in one way or the other are affected by its actions. For instance, a legal stakeholder has the right and capabilities to drive and take part in a process; a stakeholder has the right to minimize the impact caused to him by the decision and actions of another stakeholder that affect him, the stakeholder should have the resources and skill so as to take part in the process (Esterling, 2004). In this theory the stakeholders in Bour-Algy are KWS, which is the main stakeholder involved in wildlife conservation and management of the conflict, the community living around the sanctuary, Others are Directorate of County Environment, Agriculture and Livestock, farmers and livestock keepers whose views were taken and put into

consideration. It is deemed necessary to satisfy the key stakeholders at list on the minimum otherwise institutions, communities, policies and nations will fail (Bryson *et al*, 2004). Therefore, fruitful methods are those that integrate the views and wellbeing of other stakeholders instead of raising the rank of one group through the restriction of the other groups. In order to achieve a good balance and the successful management of human - wildlife conflicts for ecosystem integrity and improved livelihoods, a range of stakeholders must be involved in the process (Philips and Freeman, 2003).

RESEARCH METHODOLOGY

The study was carried out in areas adjacent to the borders of Bour-Algy Community Giraffe Sanctuary, Bour-Algy Location, Garissa County (Figure 1).

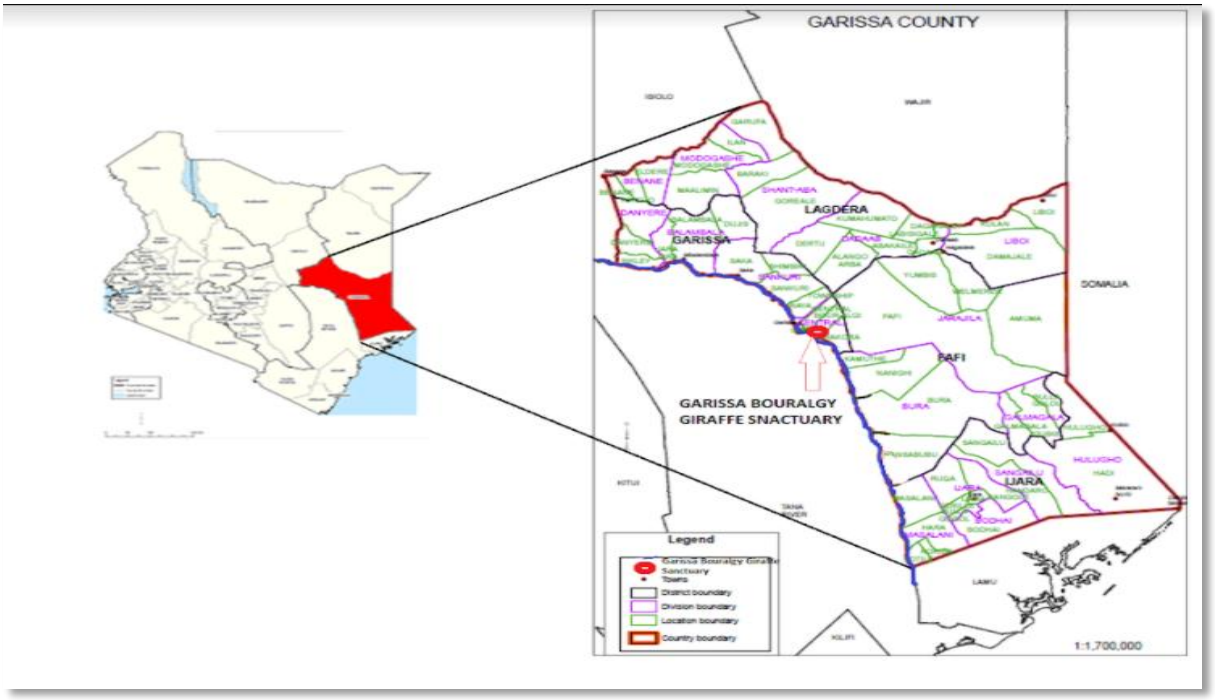

Figure 1 Map of the study area

The sanctuary, which was established in 1995, is a government and community managed conservation area with the intention of conserving giraffes and other wildlife. It is found in Garissa Township Sub-county, in the area around the village of Bour-Algy, some four kilometers south of Garissa town. The sanctuary borders the River Tana to the southwest, is estimated to covers a land area of around 64 km^2, and has an incredible indigenous flora and fauna. The local communities neighboring the sanctuary practice small-scale irrigation farming along the River Tana and livestock keeping. The sanctuary is rich with biodiversity that includes arid Acacia woodlands and the most common animals in the sanctuary are giraffe and gerenuk. Others wild animals' species found in in the sanctuary include Kirk's dik-dik, lesser kudu, warthog, baboons, waterbuck, hyenas, hippos and sometimes elephants. To date, the sanctuary hosts over 400 Giraffes (KWS, 2018).

The scope of this study covered Bour-Algy Giraffe Sanctuary and its neighborhoods including the adjacent areas of interest that relate to human - wildlife conflict. The study population involved the households from the location as well as other stakeholders such as local administration that is village elders and chiefs, Kenya Wildlife Service (KWS) as well Garissa County Government Officials who participated in a Key Informant Interview (KII). In this study, random sampling procedure was used to sample the households around the sanctuary to participate in the study. However, to determine the sample size of the households around the sanctuary, Yamane formula, suggested was adopted. The study targeted 97 households who were sampled randomly through simple random methods. However, KWS Officials, Village Elders, Chiefs and County Government officials who participated in the KII were purposively sampled. This study employed mixed methods where both qualitative and quantitative data were used.

Quantitative data was collected from structured questionnaire while qualitative data was collected through Key Informant Interviews (KII). The qualitative data which was collected from the KII was analyzed through thematic methods. To analyze the quantitative data, both descriptive and inferential statistics were used. In descriptive statistics, means, percentages, frequency and standard deviation were used to describe the data. Pearson correlation was used to establish the impact of HWC.

RESULTS

Main Economic Activity

The study interrogated the main economic activity among the households around the Sanctuary. The main economic activity of the households was livestock rearing (58.7%) as well as mixed farming that involved the combination of livestock rearing and crop farming (21.3%). (Plate 1). Since the households mostly reared livestock and executed crop farming, conflicts with wild animals were thus not avoidable because of the competition for grazing land as well as expansion of land for crop farming. Some of the conflicts led to killing of the wildlife animals as shown in plate 1. This therefore demonstrates the high human-wildlife conflicts in the area. In their assessment, Lamarque *et al.* (2009) argued that high demand for land to increase food productivity, raw material for construction and for settlement lead to the conversion of key wildlife areas into settlement and farmlands that has significantly reduced wildlife habitats and dispersal areas such as grasslands, woodlands and wetlands thus resulting to conflicts. Plate 1 shows some of the economic activities among the households surrounding the sanctuary. There is livestock rearing as well as crop farming. The second plate indicates a mango tree. In the area, monkeys raid mango trees when flowering.

Plate 1 Economic Activities

Economic losses experienced through Human-Wildlife Conflict

The losses faced due to HWC were also investigated. Up to 89.3% of the households surrounding Bour-Algy Giraffe Sanctuary had experienced losses as a result of HWC specifically on livestock predation, crops raids, damage of properties and injuries to community members but no human deaths were reported. The wildlife animals also destroy properties such as the irrigation canals around the sanctuary as shown in plate 2. Sometimes when HWC escalates, the households are forced to kill the wildlife animals as shown in plate 2. The respondents further indicated the number of losses in monetary terms arising as a result of HWC. It was established that the least amount of losses was USD. 1000 to USD. 4300 per annum. On average, the respondents suffered losses amounting to an average of USD. 2,068 annually due to HWC. Similarly, Mashapa *et al.* (2018) established that farmers in Zimbabwe experienced economic losses due to HWC. The losses came from destroyed crops, livestock death and diseases. The stud estimated that farmers lose between US$ 671.00 to US$ 998.21 annually as a result of HWC.

Plate 2 **An irrigation Canal destroyed by a Giraffe as well as a dead giraffe**

Mitigation Practices

The mitigation practices against crop raids and livestock attacks were established. The results indicated that some of the deterrence measures put in place to mitigate the losses experienced through HWC were fencing with dead fence, opening up of migration / watering corridors (locally known as "Malkas") for wildlife and livestock from the hinterland to access the river water and pastures, growing of early maturing crops, destocking in drought periods and expansion of wildlife feeding areas through migration. The fact that majority of the households still experience losses despite mitigation measures imply that the measures put in place are not effective. Similarly, Mashapa *et al.* (2018) established that farmers in Zimbabwe used fires around fields at night, guarded their crops and livestock and erected fences to reduce trespassing of wild animals from protected area but some of these practices were ineffective.

Wild Life Animals responsible for Attacks and Crop Raids

The wild animals that were considered as drivers of crop raids and livestock predation in the area by all the respondents were giraffes and hyenas. Giraffes break dead fences around farms and have special preference to mango especially at flowering stage. Hyenas prefer goats and sheep although it also predates on cattle, camels and donkeys. In addition, more than 50% of the respondents indicated that baboons and Gerenuck were the main animals involved in crop raids. Problematic Baboons has preference for maize, pawpaw, tomatoes, mangoes, guava, beans and cowpea while legumes are preference for Garenuck, On the other hand, 29.3% of the respondents considered wild pigs as also considered problematic in the area around the sanctuary. Wild pigs adversely impact banana fruits and maize. Mhuriro-Mashapa *et al.* (2018) similarly established that farmers in Zimbabwe suffered losses from wild pigs and baboons in addition to elephants. In addition, a FAO (2018) report placed elephants, baboons, wild pigs, giraffes and Gerenuck as the main drivers of crop raids in developing economies.

Crops Mostly Affected

The crops most affected in the area were mangoes, bananas, citrus, tomatoes and kales as agreed by more than 50 percent of the households. In a related study, Mhuriro-Mashapa *et al.* (2018) established that the most raided crops were Maize (*Zea mays*), Bananas (*Musa sapientum*) and legumes in the Zimbabwean context.

Extent of attacks in Varied Seasons

The extent of attacks during varied seasons, that is dry, wet as well as both dry and wet seasons was established. Majority of the respondents (More than 50%) stated that attacks during both dry, wet and both dry and wet seasons were high. It was however highest during wet season. This is because during this season, more crops are planted which encourages frequent crop raids. In the dry season, there is scarcity of pasture and water which increases the competition for these resources thus raising the number of HWC and attacks on both crops and livestock. Similarly, during both dry and wet season, similar trends are observed.

Table 2 General Information

Factor	Category	Response			
		No		Yes	
		Number	%	Number	%
Experienced losses as a result of HWC	Experienced losses as a result of HWC	8	10.70%	67	89.30%
Type of Losses Experienced	Attacks on crops	29	38.70%	46	61.30%
	Livestock predation	23	30.70%	52	69.30%
	Damage of property	51	68.00%	24	32.00%
	Human life / injuries	46	61.30%	29	38.70%
	Death of the Wildlife	75	100.00%	0	0.00%
Mitigation Practices	Fencing (dead fences)	0	0.00%	75	100.00%
	Opening migration/watering corridors (locally known as “Malkas”) for wildlife and livestock from the hinterland to access the river water and pastures	37	49.30%	38	50.70%
	Expansion of wildlife feeding grounds	75	100.00%	0	0.00%
	Expansion of wildlife breeding grounds	75	100.00%	0	0.00%
	Compensation	75	100.00%	0	0.00%
	Growing early maturing crops	44	58.70%	31	41.30%
	Destocking of livestock during droughts	60	80.00%	15	20.00%
	Giraffes	0	0.00%	75	100.00%

Problematic Animals	Baboons	37	49.30%	38	50.70%
	Gerenuck	37	49.30%	38	50.70%
	Hyena	0	0.00%	75	100.00%
	Wild Pig / Warthog	53	70.70%	22	29.30%
Crops Mostly Affected	Mangos when Flowering	8	11%	67	89%
	Bananas	1	2%	74	98%
	Citrus Fruits (lemon)	31	42%	44	58%
	Tomatoes	0	0	75	100%
	Kales	4	5%	71	95%
Action against the wild Animals	Avoiding through Migration	23	30.70%	52	69.30%
	Killed	38	50.70%	37	49.30%
	Relocated by KWS	75	100.00%	0	0.00%
	Chased by residents	0	0.00%	75	100.00%
	Trapped by villages / KWS	31	41.30%	44	58.70%
	Extent			**Frequency**	**Percentage**
Attacks during Dry Season	High			35	53%
	Moderate			20	27.0%
	Low			15	20%
Attacks during Wet Season	High			45	60%
	Moderate			30	40%
	Low			0	0.00%
Attacks during both Dry and wet season)	High			40	53%
	Moderate			30	40%
	Low			5	7.0%
Value of Losses	USD. 1000 - 2500			46	61%
	USD. 2501 - 4500			29	39%

Impact of Resource Competition between Wildlife and Livestock on Socio-Economic Livelihoods

The respondents rated likert scale questions on resource competition using a perception index where 5 is Greater Extent, 4 is Great Extent, 3 is Moderate Extent, 2 is low extent and 1 is No extent. The descriptive statistics results are presented in Table 2. It was established that there has been a high demand for land and grazing space which has increased HWC to a very high extent. The driving factors behind this high demand is increased population over the years, increased number of livestock as well as the need for diversification into crop and mixed farming. As a result, the farmers around the sanctuary have been forced to migrate or compete with the grazing lands with wild animals. It was also established that there has been a high demand for water, pasture and fodder which has increased HWC at watering points to a very high extent. In addition, the quantity of pasture availability has been decreasing to a very high extent. Since the household's population and livestock size has increased, the households around the sanctuary face stiff competition for water and pasture with the wild animals. In addition, the area being an ASAL area, escalates the competition. Therefore, the farmers have had to compete for these resources which has increased competition. In cases where farmers have diversified to crop farming, the wildlife animals have raided their crops destroying it.

Similarly, the KII discussants indicated that stiff competition for pasture and water exists between the wildlife animals and the domestic animals in the area. Being an ASAL, there is scarcity of both water and livestock which has greatly affected the relationship and escalated HWC in the area. In their interrogation, Lamarque *et al.* (2009) also cited high demand for land to increase food productivity, raw material for construction and for settlement currently across the neighborhoods surrounding sanctuaries which lead to the conversion of key wildlife areas into settlement and farmlands that has significantly reduced wildlife habitats and dispersal areas such as grasslands, woodlands and wetlands in turn leading to HWC.

Table 2 Descriptive Results of Resource Competition between Wildlife and Livestock

Statement	Mean	Standard Deviation
There has been a high demand for land which has increased HWC	4.81	0.39
There has been a high demand for water which has increased HWC at watering points	4.71	0.46
There has been a high demand for fodder which has increased HWC	4.59	0.50
There has been a high demand for grazing space which has increased HWC	4.79	0.41
The quantity of pasture availability has been decreasing	4.80	0.40
Average	**4.74**	**0.43**

The impact of resource competition on socio-economic livelihoods was established through Pearson correlation. The correlation results are presented in Table 3. The correlation results indicated that resource competition between livestock and wildlife is associated with a significant decrease in socio-economic livelihood of communities bordering Bouralgy Giraffe Sanctuary (r = - 0.675; Sig < 0.05; R-Square = 0.456). The findings further indicated that resource competition accounts for up to 45.6% of the variation in socio-economic livelihood of the communities bordering the Sanctuary. This implies that increasing resource competition between wildlife and livestock leads to a deteriorating socio-economic livelihood in a significant manner.

Competition for resources such as water, pasture and land between the households surrounding the sanctuary and the wildlife animals leads to increased HWC, which results to losses of lives, increased crop raids, increased costs of mitigation, destruction of property and loss of livestock thus threatening the socio-economic livelihood of the households. These findings are consistent with that of a study by Hill (2000) which indicated that continuous competition for land-based resources between people and wildlife and fragmentation of wildlife habitat is believed to be the major causes of human wildlife conflict, which also contribute to the significant reduction of wildlife populations. In addition, Madden (2008) observed that any further conversion of prime wildlife habitat to sedentary agriculture and settlements by communities living adjacent to wildlife would escalate the incidents of HWC.

Table 3 Correlation between Resource Competition and Socio-Economic Livelihoods

		Resource Competition	Socio Economic Livelihood
Resource Competition	Pearson Correlation	1	
Socio Economic Livelihood	Pearson Correlation	-.675**	1
	Sig. (2-tailed)	0.000	
	N	75	75

** Correlation is significant at the 0.01 level (2-tailed).

Impact of Wildlife Predation, Crop Raids on Socio-Economic Livelihoods

The respondents first rated likert scale questions on Wildlife Predation and Crop Raids. A perception index where 5 is Greater Extent, 4 is Great Extent, 3 is Moderate Extent, 2 is low extent and 1 is No extent was adopted. The descriptive statistics results are presented in Table 4 indicated that communities bordering the Sanctuary experienced wildlife predation occasionally, crop raids by wildlife occasionally, crop failures due to raids to a high extent (Mean between 3.83 – 4.89) as well as property damage by wild animals occasionally to a moderate extent (M = 3.00). Livestock predation was highly experienced since there was high competition for water and pasture with the wild animals. The area being an ASAL, it was prone to high risk of water and pasture scarcity which prompted competition for the little that is available. Such competitions increase HWC. In regard to crop raids, the fact that most of the animals in the sanctuary are herbivores facing starvation due to in availability of enough food, crop raids are always on the increase. Giraffes and Monkeys take

advantage of the crops nearby as they view it as an alternative for them. In most cases, the crop raids lead to crop failures which in the long run, increase the losses, reduces yields and increase crop failures.

These findings imply that communities bordering the Sanctuary experienced wildlife predation and crop raids such as crop destruction, predation and property damage to a high extent. Considering that the households are engaged in both livestock rearing and crop farming, they are susceptible to these damages more frequently. In addition, their efforts to deter seems to be ineffective given that these cases of crop raids and predation are experienced to a high extent which calls for an assessment of better and effective measures. The respondents who participated in the KII similarly agreed that crop raids and predation occurred on a weekly basis in the area. Crops such as tomatoes, banana, mangoes, kales and citrus fruits were mainly raided by baboons, Gerenuck and wild pigs at night. This confirms the quantitative findings earlier established that crop raids and predation are experienced to a high extent. Related results were ascertained by Kissui (2008) who indicated that large carnivores such as lions, Hyenas and leopards causes devastating loss of livestock through predation. Ogra (2008) also indicated that wild animals sometimes cause damage to people's properties and this is observed to be one of the leading causes of human wildlife conflict in many wildlife populated areas leading to negative impact on the community's livelihoods and wildlife injuries and deaths. These damages are done on houses, fences, irrigation infrastructure and sometimes vehicles.

Table 4 Descriptive Results of Wildlife Predation and Crop Raids

Statement	Mean	Standard Deviation
We experience wildlife predation occasionally	4.89	0.31
We experience crop raids by wildlife occasionally	4.43	1.18
We have experienced crop failures due to raids	3.83	0.96
We experience property damage by wild animals occasionally	3.00	0.00
Average	**4.04**	**0.61**

The impact of crop raids and predation on socio-economic livelihoods was established through Pearson correlation. The correlation results presented in Table 5 showed that crop raids and predation were associated with an insignificant decrease in socio-economic livelihood of communities bordering Bouralgy Giraffe Sanctuary ($r = - 0.006$; $Sig > 0.05$; R-square = 0.000036). The findings further indicated that wildlife predation and crop raids account for up to < 1% of the variation in socio-economic livelihood of the communities bordering the Sanctuary. This demonstrates that increasing predation leads to a deteriorating socio-economic livelihood but the effect is not significant.

It can be ascertained that even though the households surrounding the sanctuary experience crop raids and predation, its impact was not yet significant on their socio-economic livelihood. This can perhaps be attributed to some of the deterrence measures they have put in place. In addition, even

though predation and crop raids occur frequently, its impact may not be as huge to warrant significant economic losses.

Table 5 Correlation between Crop Raids, predation and Socio-economic Livelihoods

		Crop raids and Predation	Socio Economic Livelihood
Crop raids and Predation	Pearson Correlation	1	
Socio Economic Livelihood	Pearson Correlation	-0.006	1
	Sig. (2-tailed)	0.959	
	N	75	75

** Correlation is significant at the 0.01 level (2-tailed).

Impact of Human Intrusion on Socio-Economic Livelihoods

The respondents rated likert scale questions on human intrusion using a perception index where 5 is Greater Extent, 4 is Great Extent, 3 is Moderate Extent, 2 is low extent and 1 is No extent. The descriptive statistics results are presented in Table 6. It was established that communities bordering Bour-Algy Giraffe Sanctuary in Garissa County have used large pieces of land for development purposes leading to scarcity to a high extent. In addition, they tend to expand their grazing land through migration towards the sanctuary to a high extent. The demand for land has been caused by increased population in the area as well as increased livestock. Increased population has led to high pressure on the scarce resources including land since most of it has been used to build structures, cultivation as well as livestock grazing. This limits the wildlife animals from roaming freely in the area in search pf pasture due to increased hostility from humans.

It was also indicated that there were massive deforestation activities to expand the human territory towards the sanctuary, energy demand has forced the community members to cut down trees to get fuel and the demand for agricultural land has forced the community members to intrude the wildlife grounds to a high extent. An increase in population is accompanied by an increase in fuel demand which leads to cutting of trees. Furthermore, the need for crop farming to diversify sources of income lead to a higher demand for land. In the area, most households practice irrigated farming and mostly experience damages on their irrigation infrastructure. Conversion of more land into irrigated farms reduces the amount of vast land for roaming wild animals and whenever the animal's trespass, it leads to HWC. The extent to which the local communities hunt and poach the wildlife as well as intrude the sanctuary in order to harvest honey was very low. This shows that most of the households around the sanctuary prefer a harmonious relationship with the wildlife and respect regulations on encroachment. Such moves help to reduce direct confrontations with the wildlife thus putting HWC under control.

In addition, the participants in the KII discussed the changes in land use in the area in the recent past and confirmed that currently, compared to a decade ago, households had invested in crop farming to complement livestock rearing which was dominant a decade ago. This was considering that drought was a problem and its impact was harsh on livestock thus a need to diverse sources of

income. As a result, increased sources of livelihood also increased the pressure on resources thus increasing competition and HWC.

These findings imply that indeed there has been some human intrusion practices by the community members on the sanctuary which have increased HWC. While land development for cultivation, expansion of grazing land, deforestation, cutting down trees to get fuel has been conducted to a high extent other such as hunting and poaching wildlife as well as harvesting honey have been advanced to a low extent. Nevertheless, human intrusion is live in the community and this speeds HWC. The findings are consistent with that of a study by Yaro *et al,* (2015) which indicated that engaging in activities that increase income generation in wildlife habitat increase pressure on habitat resources and stimulate the start of human wildlife conflict. In addition, KWS (2017) also showed that activities such as unsustainable charcoal production, clearing of woodlands and forests, burning of bushes, illegal hunting, poor settlement and over-grazing of livestock are on the increase around sanctuaries which escalate negative impacts of HWC.

Table 6 Descriptive Results of Human Intrusion

Statement	Mean	Standard Deviation
The community has used large pieces of land for development purposes leading to scarcity	3.89	0.31
Most of the community members hunt and poach the wildlife	1.61	0.68
Most community members try to expand their grazing land towards the sanctuary	4.20	0.40
Most community members intrude the sanctuary in order to harvest honey	1.91	0.55
There are massive deforestation activities to expand the human territory towards the sanctuary	4.71	0.46
Energy demand has forced us to cut down trees to get fuel	3.91	0.29
The demand for agricultural land has forced the community members to intrude the wildlife grounds	4.21	0.41
Average	**3.49**	**0.44**

The impact of human intrusion and socio-economic livelihoods was established through Pearson correlation. The correlation results are presented in Table 7. The correlation results indicated that human intrusion affected socio-economic livelihood of communities bordering Bouralgy Giraffe Sanctuary in a negative and significant manner ($r = -.437$; $Sig < 0.05$; R-square = 0.191). The findings further indicated that human intrusion accounts for up to 19.1% of the variation in socio-economic livelihood of the communities bordering the Sanctuary. This demonstrates that increasing human intrusion practices such as clearing land for agricultural development, hunting, poaching,

cutting down trees for fuel energy, expansion of grazing land and deforestation led to increased HWC such as raids, property destruction, loss of lives and predation which in turn led to a significant decrease in socio-economic livelihood of the community members.

In their study, Hoffman and O' Riain (2010) showed that people invasion into wildlife conservation areas led to the loss of livelihoods as a result of asset destruction, livestock predation and raiding of agricultural farms. Wildlife habitats are greatly altered by anthropogenic activities such as keeping of livestock, farming and development activities like construction of roads. In addition, Kate (2012) showed that wild animals are migratory in nature and species such as giraffes and zebras destroy properties and fences during their migration cycles due to innate knowledge on ancestral migratory route.

Table 7 Correlation between Human Intrusion and Socio-economic Livelihoods

		Human Intrusion	Socio Economic Livelihood
Human Intrusion	Pearson Correlation	1	
	Sig. (2-tailed)		
Socio Economic Livelihood	Pearson Correlation	- .437**	1
	Sig. (2-tailed)	0.000	
	N	75	75

** Correlation is significant at the 0.01 level (2-tailed).

CONCLUSIONS

The study concludes that an increase in resource competition between wildlife and livestock leads to a significant decrease in socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya. This implies that practices such as high demand for land, high demand for water at watering points, high demand for fodder, high demand for grazing space as well as decreasing quantity of pasture escalates HWC and reduces socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya. Another conclusion is that an increase in human intrusion leads to a significant decrease in socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya. An increase in practices such as using large pieces of land for development purposes, hunting and poaching the wildlife, expanding the grazing land towards the sanctuary, intruding the sanctuary in order to harvest honey, massive deforestation activities to expand the human territory towards the sanctuary, cutting down trees to get fuel and expanding agricultural land is associated with deterioration in socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya.

The study also concludes that even though an increase in predation and crop raids can lead to a decrease in socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya, this impact is not significant. High cases of wildlife predation, crop raids by wildlife occasionally, crop failures due to raids and property damage by wild life animals occasionally are associated with an insignificant decrease in socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya. In addition, it was

concluded that the existing legal and institutional framework provides an improvement in the link between the two variables. Effective compensation policies for losses from wildlife, punitive measures for encroachment into wildlife ranch, translocation policy by KWS, encroachment policies, national laws and international agreements regarding protection of wildlife are effective as well as wildlife-friendly and agricultural policies are effective are associated with a reduction in HWC which leads to an improvement in socio-economic livelihood of the neighboring communities.

RECOMMENDATIONS

Given that resource competition between wildlife and livestock leads to a significant decrease in socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya, the study recommends the county government of Garissa to work hand in hand with the local community to ensure minimization of resource competition by building more watering points, passing laws to prevent land encroachment as well as allocating more community grazing space.

Based on the findings that human intrusion leads to a significant decrease in socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya, the study recommends the county government of Garissa in conjunction with KWS to ensure implementation of policies that aim to penalize and discourage hunting and poaching the wildlife, expanding the grazing land towards the sanctuary, intruding the sanctuary in order to harvest honey, massive deforestation activities to expand the human territory towards the sanctuary and cutting down trees to get fuel and expanding agricultural land.

Based on the findings that an increase in predation and crop raids can lead to a decrease in socio-economic livelihood among communities bordering Bour-Algy Giraffe Sanctuary in Garissa County, Kenya, the study recommends the communities surrounding the sanctuary to come up with mitigation practices that aim to reduce high cases of wildlife predation, crop raids by wildlife occasionally and crop failures due to raids and property damage by wild life animals. Given the findings that the existing legal and institutional framework provides an improvement in the link between HWC and socio-economic livelihood, the study recommends the county government of Garissa together with the national government through KWS to ensure there is effective compensation policies for losses from wildlife, punitive measures for encroachment into wildlife ranch, translocation policy by KWS, encroachment policies as well as national laws and international agreements regarding protection of wildlife.

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