

Resources Management and Human-Wildlife Conflicts in Ngorongoro Tanzania

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ABSTRACT

The study aimed to establish the status of human-wildlife conflicts over resources in the Ngorongoro Conservation Area in Tanzania. The study used a questionnaire and guiding questions to collect data. The data were analysed using descriptive statistical analysis and content analysis approaches. The findings indicate that Human-Wildlife Conflict (HWC) persists in the NCA. Wild animals exposed to harassment exhibited aggressive behaviors compared to others, and wild animals prowling at night predated all NCA-related domestic animals. Competition over resources between human beings, livestock, and wild animals causes HWC in the NCAA. In minimizing HWC, the villagers constructed strong fences around bomas and introduced zoning for grazing in some areas suitable for wild animals. The study concludes that the NCAA must continue providing conservation knowledge to the natives, promoting livestock predation compensation schemes, advocating building bomas using solid fences, and employing participatory treatment of WHC-related cases. The study recommends that natives in the NCAA area take precautions to avoid grazing their livestock in areas with a high degree of predation. In addition, relevant authorities should address rabid cases in the NCA.

Keywords: *Human-Wildlife Conflict, Ngorongoro Conservation Area, livestock predation, mitigation measures*

INTRODUCTION

Conflicts between wildlife and people, particularly those sharing the same ecosystem and those in immediate surroundings of the protected areas, are

a common global phenomenon (Shemwetta and Kideghesho, 2000).

These conflicts occur when there is either a need or behaviour of wildlife to negatively impact human livelihoods or, conversely, when humans pursue goals that negatively impact wildlife needs (Stanley *et al.*, 2014). For example, in Africa, human-wildlife conflicts tend to be rife in areas where large herds of big mammals such as elephants and lions roam in marginal rangelands and protected areas (Matindi *et al.*, 2015). As a result, conflicts between people and wildlife currently rank among the main threats to conservation efforts in Africa (Stanley *et al.*, 2014).

In Tanzania, wildlife resources constitute a unique natural heritage and resources with significant national and global importance (NINA Report, 2005). However, the costs inflicted by wildlife conservation on people and the human problems constraining the wildlife sector in Tanzania have made human-wildlife conflicts one of the significant challenges demanding the attention of conservationists (Shemwetta and Kideghesho, 2000). Since 1959, the NCA was designated a conservation area to provide multiple land-use areas for residents, migratory wildlife, and the natives. Initially, pastoralists wandered traditionally throughout the NCA, with their livestock sharing the same ecosystem with wild animals. Although human beings and livestock populations did not endanger the coexistence between human activities and wildlife conservation, they caused minimal human-wildlife conflict.

However, things have since changed. There has been a rapid increase in the human population in the Ngorongoro Conservation Area since 1959, when the conservation was first established (Swanson, 2007). According to the NCA (2013), by 2012, the human population had increased by 5.6%. Increased human and livestock populations have threatened the existence of wildlife in the NCA. Hence, zoning of the area was undertaken to restrict access to some areas for pastoralists, including the Ngorongoro crater and realms of the Embakai crater. Native pastoralists perceived these restrictions as a threat to livestock keeping; that perception sparked the serious human-wildlife conflict (Swanson, 2007, p 66).

Furthermore, the extension of the designated protected areas forced evictions, and restrictive access to resource use for local communities from the area, coupled with incompatible land-use practices, have further

exacerbated the human-wildlife conflict (Kideghesho, 2006). The question, which remains unanswered thus far, is: What are the effects of such human-wildlife conflicts on conservation? This study was undertaken to address four specific objectives, to determine the types of human-wildlife conflicts in the NCA; to establish causes of human-wildlife conflicts in the NCA; to examine perceptions of human-wildlife conflicts in the NCA, and finally, to assess the community opinions on the potentially viable mitigation measures for combating human-wildlife conflicts in the NCA.

METHODOLOGY

The study area

The NCA is located in Northern Tanzania (340 52 - 350 58 E, 2030 – 3038 S) and covers 8,283km² (Elliott, 2010) (Figure 1). It borders Loliondo Game Controlled Area (LGCA) to the North, the Serengeti National Park to the west, Lake Eyasi to the south, and agricultural communities on the south-eastern border at Karatu district (Elliot, 2010). The area has five ecological zones: the Crater highlands, Salei plains, Gol Mountains, Serengeti plains, and Kakesio/Eyasi escarpment. Rainfall in the area is seasonal and highly variable, ranging from 400 to 600 mm in the lowland plains to more than 1200 mm per annum in the highland areas. The borders of the NCA encompass a great variety of ecosystems, including montane forest, swamp, marsh, and dry forest, as well as long and short grasslands that are extensions of the Maasai Mara and Serengeti ecosystems Swanson (2007). The NCA is endowed with a complex community of large grazing mammals accompanied by various large and small predators (IUCN, 2017). Water resources are limited; borehole water sources, which could otherwise add on consumable water, are frequently blackish and mostly saline, making the water unpalatable. The Maasai pastoralists inhabit the area.

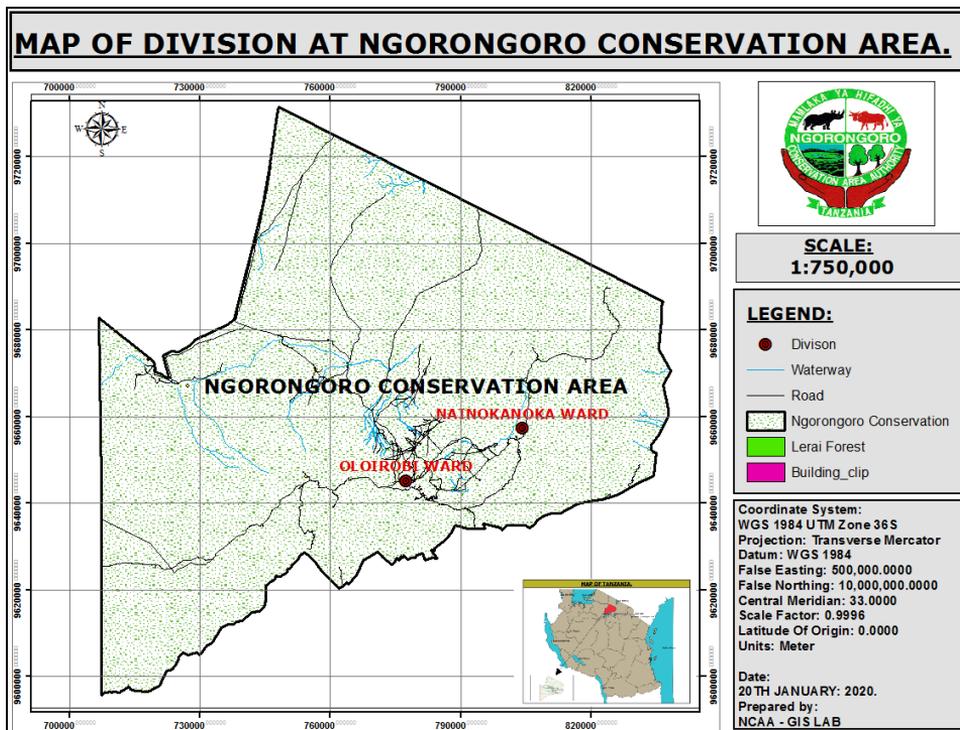


Figure 1: Map of Ngorongoro Conservation Area Authority

Methods

The study used both quantitative and qualitative research approaches. The study calculated the sample using the following formula:

$$n = \left(\frac{1/E}{\sqrt{pq}} \right)^2 (z)^2$$

Where n=sample size needed

E=desired margin of error

pq=variance of hypothesized proportions

z= z score of confidence level

The desired margin error is 5%, with an expectation that 90% of the respondents voluntarily agreed to participate; therefore, a .95-confidence level was used to calculate the sample size for this study. Hence the sample size for this study was calculated as follows:

$$n = \left(\frac{1/0.05}{\sqrt{0.9 \times 0.1}} \right)^2 (1.96)^2$$

$$n = 139$$

A random sampling technique was used to get a representative sample. A list of all the villages in the Ngorongoro division constituting the NCAA was prepared to form a villages sampling frame. Ten (10) villages were randomly selected in the village sampling frame. A list of heads of households in the randomly selected villages formed the village respondents' sampling frame. In order to come up with 139 research participants, in the first nine (9) randomly selected villages, 14 respondents were selected from the established villages. From the last randomly selected village sampling frame, only 13 respondents were randomly selected, making 139 randomly selected respondents for this study. The study used a questionnaire to collect quantitative data. A checklist of guiding questions was used to collect qualitative data through Focus Group Discussions (FGD). The groups comprised village government leaders, NCAA senior officers, traditional leaders, and influential people from the study villages. Descriptive statistics, including percentages and frequencies, described the study population. Data from focus group discussions were analysed using the content analysis approach.

FINDINGS

Types of Human-Wildlife Conflicts in the NCA

Respondents were asked to indicate whether there was any prevailing Human-Wildlife Conflict (HWC) in the study area; all of them (100%) affirmed the existence of the conflict. Moreover, when they were asked about the most prevailing HWC in the area, most of them (95.7%) cited wildlife confronting humans. Only 4.3% of the respondents indicated the type of conflict to be confronting human wildlife. Respondents were also asked to cite cases of HWC indicating the main types of conflicts. The findings show that cases of wild animals attacking livestock were higher (66.9%) than those of wild animals attacking humans (33.1%). When respondents were asked to indicate the most prevalent wild animals that attacked humans, they cited buffaloes (31.7%) followed by elephants (26.6%), leopards (22.3%), hyenas (17.3%), and lion (2.2%) in descending order.

During FGDs, participants were asked to explain why buffaloes were the wildest and most attack-minded animals against human beings in the NCA when the same animals mainly were observed around NCA headquarters offices to be the most pacific. The FGD participants pointed out that wild animals not exposed to harassment like those found around

NCAA headquarters exhibited the least hostile conduct against humans, but usually, buffaloes were dangerous. One of the discussants had the following to say:

Buffaloes are dangerous animals to human beings. Unlike other wild animals, when buffaloes hear human voices, they move close to the path where the human beings would pass and abruptly attack them. As a result, we have many cases of human beings being hurt and even killed by buffalo.

As far as the most affected livestock by wild animals, the respondents indicated that sheep (35.97%) and goats (35.25%) were the most affected livestock, followed by cattle (20.14%) and donkeys (2.88%). Concerning most wild animals that attacked livestock, respondents indicated that hyenas accounted for the most significant proportion (46%), followed by lions (33.1%), leopards (14.4%), and cheetahs (4.3%). Other wild animals that attacked livestock accounted for a negligible percentage (2.2%). During FGDs, discussants pointed out that in addition to wild animals infamous for attacking livestock, animals such as baboons, jackals, and buffaloes also pose a threat to domesticated animals. They indicated that lambs were primary targets for baboons and jackals. Although, in addition, buffaloes were reported to fight cattle, on some occasions, cattle were seriously injured. During FGDs, participants believed that livestock was mostly attacked during late evenings when livestock was heading back home and during early mornings. During the late evenings, the most vulnerable livestock was reported to be those lost on the way and those trailing behind. However, though rarely, the lion, leopards, hyenas, and jackals attacked livestock even during the daytime.

When the respondents were asked to indicate which wild animals attacked livestock mainly during the night, their responses indicated that hyenas (46.0%) topped the chart, followed by leopards (30.2%) and lions (23.0%), others made only 0.7 percent.

Causes of Human-Wildlife Conflicts in the NCAA

During the study, respondents were also asked to indicate the causes of HWC. The leading reason cited by the respondents was competition over resources (33.1%), change in human behaviour (20.1%), change in wild animals' behaviour (19.4%), and native traditions (11.5%). During FGDs, participants believed that the increase in the human population

contributed to the escalation of HWC in the study area mainly because the human population increase prompted the invasion of wildlife habitats. One of the discussants had the following to say:

Most former grazing land has been converted into settlements. However, due to the population increase, there is no more land for settlement; hence people have built their houses in areas meant for pastures, and the grazing land is diminishing. As a result, herders are invading game habitats for pastures.

Exploring further how native traditions escalated the HWC, the study found that youth killing lions accounted for 42.4 percent, youth killing birds for 24.5 percent, whereas others accounted for 33.1 percent.

FGD members noted that the tradition that requires youths to kill either a lion or bird contributes to HWC. In the past, killing the former occurred when lions attacked livestock. Nowadays, however, youth kill lions only for the sake of traditions. Concerning feathers worn during the circumcision period, one member of the FGD said:

Due to punishment imposed on causalities found guilty of killing wild animals, including birds, youth usually collect feathers shaded by ostriches in bushes. In a few cases, colorful birds can be killed. Nevertheless, generally, people have been educating youth to abandon the tradition of killing animals.

As far as HWC caused by behavioural change, the findings show that sick carnivores accounted for the most significant proportion (47.5%) of the prevailing conflicts caused by wildlife behavioural change, followed by injured wild animals, lactating wild animals (15.4%), old carnivores (8.6%) and others (5.8%). During the FGDs, the research participants identified sick wild carnivores, particularly those suspected of suffering from rabies, as threats. They pointed out that since rabies is a zoonotic disease, transmission could occur from sick wild carnivores to domestic carnivores, particularly dogs, and vice-versa, compounding the human-wildlife conflict in the study area. Respondents were also asked to indicate causes of HWC which are most prevalent in the study area. The results show that poor treatment, including corporal punishment of the natives by the NCA authority, topped the chart of responses, followed by the belief that there is a low native benefit accruing from conserving wildlife (Table 1).

Table 1: Causes of HWC

Respondents' choices	Respondents	Percent
Persistence in compensation delays	17	12.2
Low compensation packages	25	18.0
Assumed poor native benefits accruing from conserving wildlife	36	25.9
Poor native treatment by the NCA authority	37	26.6
Others	24	17.3
Total	139	100.0

Respondents were asked to give their views on whether HWC has increased in the past ten years. The results show that 33.1 percent disagreed with the statement, whereas 33.8 percent strongly agreed. Table 2 presents the results:

Table 2: Responses on whether HWC has increased over the past ten years

Respondents' choices	Respondents	Percentage
Moderately disagree	46	33.1
Agree	24	17.3
Moderately agree	22	15.8
Strongly agree	47	33.8
Total	139	100.0

When respondents were asked whether the NCA had adequately addressed HWC, the results show that about 33.8 percent strongly agreed, 22.3 percent moderately disagreed, 26.6 percent agreed, and 17.3 percent moderately agreed with the statement (Figure 2).

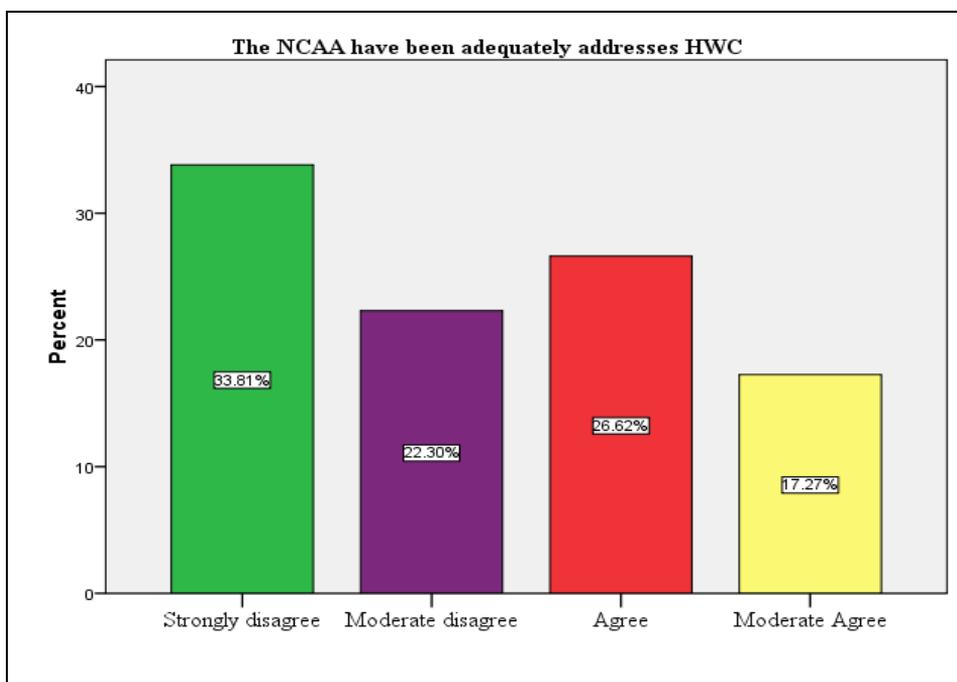


Figure 2: Responses on whether NCAA has been adequately addressed HWC

As a means for double-dipping the existence of native tradition in lion killing, most respondents strongly disagreed with the statement, followed by those who moderately disagreed with it (Table 2).

Table 2: Level of agreement on whether Native Youth Tradition of killing lions has Increased

Respondents' choices	Respondents	Percentage
Strongly disagree	69	49.6
Moderately disagree	62	44.6
Moderately agree	8	5.8
Total	139	100.0

During FGDs, research participants revealed that the mechanism for reducing HWC that has been instituted in the past 10years includes the construction of solid bomas using poles instead of tree branches that wild animal quickly destroy to get access to livestock. The other strategy has been avoiding using children in herding livestock in areas of high risk of attack by wild animals. Furthermore, the FGD members explained that a recent lion conservation project in the area named Mama Simba had discouraged lion killing. The project seems to be successful partly because the community members know that the community will be awarded if lion numbers increase in their area. One FGD member said:

Nowadays, residents have been using solid poles in constructing bomas fencing off their livestock as these be strong enough to prevent wild animals such as hyenas from preying on livestock at night.

During FGDs, the NCAA had introduced natives' wildlife conservation motivation schemes for undertaking collaborative development projects such as building schools, supporting individual students, and providing safe and clean water. However, when respondents were asked to indicate whether the gravity of HWC was more severe than documented, most respondents agreed with the statement (Table 3).

Table 3: Gravity of HWC Bigger than Documented

Respondents' choices	Respondents	Percentage
Strongly disagree	31	22.3
Moderately disagree	37	26.6
Agree	23	16.5
Moderately agree	16	11.5
Strongly agree	32	23.0
Total	139	100.0

Issues of genuine community participation in addressing HWC are paramount for sustainable conservation. When respondents were asked to indicate whether the community has been adequately involved in addressing HWC in the NCAA, it was found that opinion varied, but the majority agreed with the statement (Table 4).

Table 4: Adequate Community Involvement in Addressing HWC in NCAA

Respondents' choices	Respondents Percentage	
Strongly disagree	40	28.8
Moderately disagree	30	21.6
Agree	54	38.8
Moderately Agree	8	5.8
Strongly agree	7	5.0
Total	139	100.0

Concerning whether the laws are more in favour of wildlife than native inhabitants, hence fuelling HWC, it was found that most of them (66.9%) strongly agreed with the statement, followed by agreed (16.5%), moderately disagreed (10.8%) and the least being those whose opinion follow under moderately agreed (5.8%). Additionally, the study respondents were asked to indicate whether cases of retaliatory killing of wild animals in the NCAA recently had increased. The results are presented in Table 5, where the majority of the respondents strongly disagreed with the statement.

Table 5: Levels of Agreement on Increase of Cases of Retaliatory Killing of Wild Animals

Respondents' choices	Respondents	Percentage
Strongly disagree	44	31.7
Moderately disagree	40	28.8
Agree	31	22.3
Moderately agree	16	11.5
Strongly agree	8	5.8
Total	139	100.0

Mitigation Measures for Combating Human-Wildlife Conflicts in the NCAA

The respondents were asked whether providing conservation knowledge to natives is the best way to combat human-wildlife conflict in NCAA. The results indicated that 48.9 percent strongly agreed, 39.6 percent agreed, 5.8 percent moderately agreed, and 5.8 percent moderately disagreed. The respondents were also asked to indicate whether the

provision of timely compensation was the best way of fighting HWC in the NCAA. Responding, 39.6 percent of all respondents agreed, 33.1 percent strongly agreed, 21.6 percent moderately agreed, and 5.8 percent moderately disagreed with the statement.

When respondents were asked whether the use of solar lighting was one of the best ways of combating HWC in the NCAA, they moderately agreed with the statement (46%), strongly agreed (25.9), percent moderately disagreed (17.3), agreed (5%) and moderately disagreed with the statement (5.8%). During the focus group discussions, the research participants pointed out that initially, they had used solar lighting at the beginning. It works, but afterward, wild animals got used to it so much that it no longer helps repel the wild animal at night as initially intended. Respondents were further asked to indicate whether solid fences around their bomas constituted the best means of combating HWC in the NCAA. The results show majority agreed with the statement in Table 6.

Table 6: Use of Strong Fences as Best Means for Combating HWC in NCAA

Respondents' choices	Respondents	Percentage
Moderately disagree	8	5.8
Agree	31	22.3
Moderately agree	39	28.1
Strongly agree	61	43.9
Total	139	100.0

Regarding whether the provision of artificial feathers for youth during the circumcision period can reduce HWC related to bird-killing, the results show that 33.8 percent of the respondents strongly disagreed, 28.1 percent strongly disagreed, 27.3 percent simply 5.8 percent moderate disagreed, and 5.0 percent strongly agreed. The study also solicited responses on whether the provision of sports and games to youth during the circumcision period could reduce their engagement in the traditional killing of wildlife. Responding, 44.6 percent of the respondents moderately disagreed, 28.1 percent others agreed, 15.8 percent strongly agreed, and 11.5 percent moderately agreed with the statement on sports and games mitigating wildlife killings by youth. Also, the study sought to establish whether controlling the number of livestock could help reduce HWC in the area. The results show that 37.4 percent of the respondents

strongly disagreed, 34.5 percent others agreed, 17.3 percent moderately disagreed, and 10.8 percent strongly agreed with the statement on controlling the number of herds as a mitigating measure.

Furthermore, the study sought to determine whether reducing wild carnivores in the NCA via relocation to other areas could reduce HWC in the area. The results show that 43.2 percent of the respondents strongly disagreed, 23.0 percent others moderately agreed, 16.5 percent agreed, 11.5 percent moderately disagreed, and 5.8 percent strongly agreed with the statement that relocating wild carnivores reduces human-animal conflict. The study also asked respondents to indicate whether the laws to deal with HWC in NCAA need an amendment to reduce HWC in the area. Again, the results show that 42.4 percent of the respondents strongly agreed, 28.8 percent agreed, 23.0 percent moderately agreed, and 5.8 percent moderately disagreed with the statement on the need to amend the laws to deal with HWC.

DISCUSSION

Types of Human-Wildlife Conflicts in the NCA

When respondents were asked to indicate whether there was any prevailing Human-Wildlife Conflict (HWC) in the study area, 100 percent of those interviewed confirmed such existence of the conflicts. This finding is consistent with Billé *et al.* (2012), who found that material conditions promoting human welfare while conserving biodiversity are incompatible. According to Shemwetta and Kideghesho (2000), "Conflicts between wildlife and people," especially when "sharing the same ecosystem" with those in "boundaries with protected areas," is a universal problem. Stanley *et al.* (2014) noted that conflicts between people and wildlife are the main threats to conservation in Africa. However, Swanson (2007) noted that NCAA had been meant for multiple land use for people, livestock, and wildlife to co-exist with a high degree of HWC tolerance by the pastoralists since its establishment.

When respondents were asked to account for HWC whereby wildlife confront humans, they indicated that cases of wild animals attacking livestock were higher (66.9%) than those of these beasts attacking humans (33.1%). Implicitly, the residents in the study areas did not only lose their livestock but also ended up being victims themselves. The Wildlife Policy 1999 stipulates: "There is a necessity of controlling wildlife, which poses or causes damage to human life and property." In

other words, the wildlife-human conflict can be tolerable only to a certain extent.

When the respondents were asked to indicate which wild animals attacked humans mostly, the results show that the buffaloes featured much more prominently (31.7%) than others, followed by the elephants (26.6%), the leopards (22.3%), and the hyenas (17.3%). The least were lions (2.2%). This finding is consistent with Matindi *et al.* (2015), who documented that human-wildlife conflicts are prevalent, with large numbers of big mammals such as elephants, buffaloes, and lions still roaming freely in marginal rangelands and protected areas. The NCA is “endowed with a complex community of large grazing mammals accompanied by an equally impressive diversity of large and small predators including as many as 7,500 hyenas, 3,000 lions, 1,000 leopards, 225 cheetahs, and wild dogs” (IUCN (2017)).

This study found buffaloes to be the wildest animal that attacked humans in the NCA. On the other hand, animals observed mainly around the NCAA headquarters behaved less aggressively. Participants pointed out that those wild animals not exposed to harassment like those found around NCAA headquarters exhibited tame behaviour, but buffaloes were usually dangerous. However, it was unknown whether buffaloes behaved tame or hostile due to human interaction with wildlife. In this regard, Patana *et al.* (2018) observed:

An impact, positive or negative, results from a wildlife-related event that causes a human reaction and results in human behavior. The author noted that both the human reaction to an event (positive versus negative) and the resulting behaviour from an impact affect wildlife and are influenced by complex interactions among humans.

In other words, the human-wildlife interaction in such scenarios remains rather complex and needs carefully planned and executed intervention measures.

Causes of Human-Wildlife Conflicts in the NCAA

During the study, respondents were asked about the causes of HWC. The results show that most of the responses indicated competition over resources (33.1%) to lead the causes of HWC in the study area. The other causes are changes in human behaviour (20.1%) and changes in wild animals' behavior (19.4%). In the meantime, native traditions accounted

for 11.5 percent. As Biru *et al.* (2017) contend, "For a long period generally pastoralists have lived in harmony with wild animals." Similarly, Niamir-Fuller *et al.* (2012) proffer: "Pastoralists believe that livestock has to live in coexistence such that they can live alone." Peterson *et al.* (2010), on their part, explain this dilemma this way:

Although the conservation benefits of the terministic shift are debatable, a significant shift occurred nonetheless. Terministic screens become problematic in biodiversity conservation contexts when they frame the needs of humans and wildlife as arising from conscious antagonism. Cases where the resource demands of humans and wildlife must be balanced could be described as human-wildlife coexistence, human-wildlife competition, or human-human conflict.

Chardonnet *et al.* (2010) also noted that the fast "encroachment of human activities on lion habitat – the reduction of wilderness as a whole – increases the interface between humans and lion." This development, consequently, makes the coexistence of large predators such as lions with humans, their potential prey, rather tricky. During focus group discussions, research participants indicated a rise in the population of both humans and animals to contribute to the escalation of HWC in the study area. According to Swanson (2007, p.15), the human population explosion in Ngorongoro Conservation Area from 1959 when the conservation was incepted (p 15). According to the NCA (2013), the human population in the NCA swelled from 26,743 in 1988 to 87,851 in 2012, a 5.6 percent human population increase. The conflicts, then, are in this small area grow as wildlife and the Maasai livestock compete for valuable resources crucial to their survival (Swanson, 2007). The increase in human beings and livestock threatened the existence of wildlife conservation in the NCA as per its establishment, leading to the area's zoning, which restricts accessibility for pastoralists in some areas, including the Ngorongoro and reams of the Embakai crater. Native pastoralists perceived these restrictions as threatening their livestock keeping, igniting human-wildlife conflict.

Exploring how the indigenous people's traditions escalated HWC, the study found that youth killing of lions accounted for 42.4 percent, and killing of birds stood at 24.5 percent. Meanwhile, other youthful killings accounted for 33.1 percent. Traditionally, at a certain age, youths are obliged to participate in hunting some wild animals as part of ceremonial deeds (Gardner, 2016; Tian, 2016). In addition, at 14 years, Maasai youth

undergo circumcisions that are accompanied by the making of crowns using birds' feathers (Hodgson, 2001; Bruner & Kirshenblatt Gimblett, 1994).

During the FGDs, research participants hinted that the tradition of youth killing either lions or birds was diminishing. It is mainly observed that retaliatory cases occurred when lions attacked livestock. However, nowadays, it is challenging to observe youths killing lions only to fulfill traditions. According to Ikanda and Packer (2008, p. 72), the Maasai tend to kill lions in "retaliation for livestock depredation" in the pastoralist NCA. Additionally, though the short grass plains serve as ritual hunting grounds", Maasai warriors tend to kill nomadic Serengeti lions during the wet season. Based on the study by Ikanda and Packer (2008), it was difficult to get information on cases related to the Maasai killing of lions in the NCAA as part of their tradition. They illustrate using a case of a group of Maasai that had just speared a radio-collared Serengeti female and claimed that it was a retaliatory attack as the feline creature had mauled cattle 30 km away the previous day. Nevertheless, the radio-collared lion could not have killed their livestock, and neither had this group of Maasai traveled 30 km overnight (Ikanda & Packer, 2008, p. 72).

The respondents were asked to state what, among those HWC caused by the change of behaviour of wild animals, was the most compelling in this area. In their responses, it was noted that sick carnivores accounted for the most significant proportion (47.5%), followed by injured wild animals, lactating wild animals (15.4%), and old carnivores (8.6%), and others (5.8%). During the FGDs, research participants cited sick wild carnivores as a threat, particularly those suffering from rabies. They said that cases of rabid hyenas and jackals attacking livestock were experienced in the Ngorongoro Conservation Area. They pointed out that since rabies is a zoonotic disease, it was possible for transmission from ailing wild carnivores to domestic carnivores, particularly dogs, and vice-versa, hence escalating the human-wildlife conflict in the study area.

Community perception of the trends of HWC in the NCA

The study also explored whether HWC had increased in the past ten years. Responding, 33.1 percent of the respondents moderately disagreed, whereas 33.8 percent strongly agreed with the statement. In this regard, a study by Ikanda and Packer (2008) indicated that wildlife killing at the

hands of the Maasai in the study area was little documented. However, as Gardner (2016) and Tian (2016) noted, ceremonial wildlife killing persisted, signalling the prevalence of HWC.

This study established that they are the untold story of the level of HWC in the study area. One research participant expressed doubt on whether the NCAA residents were not killing wild carnivores in retaliatory scenarios in an unreported manner. As noted earlier, Ikanda and Packer (2008) contend that it was difficult to get information on cases related to the Maasai killings of lions in the NCAA to fulfill traditional demands. Residents did not tolerate HWC in the study area to a certain degree. A considerable number of respondents confirmed that the presence of less tolerance with HWC is worth it. According to Swanson (2007), "Although Maasai pastoralists in the NCA exerted a high degree of tolerance with livestock predation by wildlife, the conflict between the two does exist. That unsolved HWC threatens the sustainability of the wildlife conservation as per NCAA establishment in 1959."

As a means of double-dipping on the existence of native traditions of lion killing, when respondents were asked for their opinion on whether the level of native youth traditions of killing lions had increased, the results show that about 49.6 percent strongly disagreed with the statement, 44.6 percent moderately disagreed, and 5.8 percent moderately agreed with it. Different scholars (see, for example, Gardner, 2016; Tian, 2016) have established that Maasai youths participate in hunting wild animals as part of the rite of passage at a certain age.

The study has also established that more means of reducing HWC have been devised over the past ten years. For example, the NCAA has undertaken various projects to reduce HWC to motivate indigenous peoples in fostering wildlife protection. Moreover, the NCAA has introduced natives' wildlife conservation motivation schemes by undertaking communal development projects such as building schools, supporting individual students, and providing safe and clean water.

Means for reducing HWC that have been instituted include the construction of solid bomas using poles instead of tree branches that wild animal quickly destroy to maraud on livestock. In addition, they said that the presence of Mama Simba (a recent lion conservation project in the area) has served as a means of discouraging lion killing as the community

gets rewarded when the population of lions increases in their area. According to Elmqvist *et al.* (2010), the interactions in the communities of organisms at the population and community level play a significant role in determining the stability and resilience of the ecosystem. Thus, community education on conservation has reduced HWC in the study area.

Also, issues of genuine community participation in addressing HWC are paramount for sustainable conservation. When respondents were asked to indicate whether the community had been adequately involved in addressing HWC in the NCAA, opinions varied. About 38.8 percent of the respondents agreed with the statement, whereas 28.8 percent strongly disagreed and 21.6 percent moderately disagreed with it. This result contradicts the Wildlife Policy of 1999, which recognises the need to change how wildlife resources are managed and conserved and promote local community participation in conserving and utilizing wildlife resources.

When the respondents were asked to indicate whether the laws in place favour wildlife at the expense of native inhabitants, hence fuelling HWC, the study found that most of them (66.9%) strongly agreed with the statement, some agreed (16.5%), others (10.8%) moderately disagreed with, and the least (5.8%) moderately agreed with the statement. Peterson *et al.* (2010) insist on all human experience being grounded in material reality as “materiality alone is insufficient to motivate social action.” People's experiences, beliefs, and values tend to frame their perceptions. When the NCAA residents perceive the laws to favour wildlife, they are likely to be silent on the human killing of wildlife.

Mitigation Measures for Combating Human-Wildlife Conflicts

There are two basic approaches to managing human-wildlife conflicts: Prevention and mitigation (Muruthi, 2005). Preventive measures can prevent or ease the risk of conflicts between people and animals, including completely removing either the people or the animals, separating the two using barriers, and deploying various scaring and repelling techniques. During this study, respondents were asked to ponder whether providing conservation knowledge to natives is the best way of combating NCAA. Most of them (48.9%) agreed strongly, 39.6 percent agreed, 5.8 percent moderately agreed, and 5.8 percent moderately disagreed. The provision of conservation education to NCA residents

would be part of prevention measures as recommended by Muruthi (2005). According to FAO (2010), to prevent the happening of HWC, the first step is to raise people's consciousness that they were in a wildlife area and of the potential consequences.

When respondents were asked to indicate whether the provision of timely compensation is the best way of dealing with HWC in the NCAA, the study established that 39.6 percent agreed, 33.1 percent strongly agreed, 21.6 percent moderately agreed, and 5.8 percent moderately disagreed with the statement. According to Chardonnet *et al.* (2010), victims seek compensation to recover payment for the losses in uncontrolled remote areas where wildlife damage occurs. However, compensation is not a priority means for dealing with HWC in the NCAA (Swanson, 2007), The place has been established for multiple land use, allowing humans, their livestock, and wildlife to co-exist in the same area.

When the respondents were asked to indicate whether they used solar light to combat HWC in the NCAA, 46.0 percent moderately agreed, 25.9 percent strongly agreed, 17.3 percent moderately agreed, and 5.8 percent moderately disagreed with the statements. This finding is consistent with Manoa and Mwaura (2016), who noted:

Deterrent solar lights, installed around pastoralist bomas, prevent predators from entering the boma and raiding the livestock during the night. However, the effectiveness of retaliating light works in the first days of installation in the area. During the focus group discussion, research participants pointed out that the use of retaliating light at the beginning worked, but afterward, wild animals got used to them to the point that it did not help in repelling the wild animal during the night.

When the respondents were asked whether solid fences around the bomas are the best means of combating HWC in the NCAA, most respondents (43.9%) strongly agreed, and 28.1 percent moderately agreed. This finding supports Chardonnet *et al.* (2010), who indicated that "the best way to avoid conflict with lions is through lion-proof *bomas*. When I say 'lion-proof', I mean *bomas* which are sufficiently high and strong to prevent cattle from breaking out of them and lions from jumping in."

When the respondents were asked to indicate whether participatory treatment of cases related to WHC is the best way of combating HWC in the NCAA, 44.6 percent of the respondents agreed, 28.1 percent

moderately agreed, and 27.3 percent strongly agreed. This finding is consistent with The Wildlife Policy of 1999, which was formulated to recognize the need to change how wildlife resources are managed and conserved but must promote local community participation in conserving and utilising wildlife resources.

On whether the provision of sports and games to youth during the circumcision period could reduce chances for youth to engage in the traditional killing of wildlife, 44.6 percent moderately disagreed, 28.1 percent agreed, 15.8 percent strongly agreed, and 11.5 percent moderately agreed with the statement. According to Richardson *et al.* (2017), the use of sport as an intervention to reduce crime in the community and prisons in recent years and to reduce the radicalization of young adults has become common. Studies suggest that participating in sports may improve self-esteem, enhance social bonds, and provide participants with a feeling of purpose. In addition, the introduction of an education element can improve outcomes following the completion of the programs, providing participants with a pathway towards employment. Although it is recognized that sport may form only one element towards reducing crime and radicalisation, effectiveness may be enhanced by a combination of other services such as religious re-education and assistance with housing.

When the respondents were asked whether controlling the number of livestock is the best means of reducing HWC in the area, 37.4 percent of the respondents strongly disagreed, 34.5 percent agreed, 17.3 percent moderately disagreed, and 10.8 percent strongly agreed. The idea of reducing the livestock population may sound practical in reducing HWC. However, according to FAO (2010), to prevent the occurrence of HWC, the first step is to raise people's awareness that they are in a wildlife area and of the potential consequences: living, working, or travelling in areas with large carnivores called for preparedness. The same idea of dealing with a wildlife population was indicated to affect dealing with HWC. When respondents were asked whether the reduction of wild carnivores in the NCA by relocation to other areas is the best means of reducing HWC in the area, it was established that 43.2 percent strongly disagreed, 23 percent moderately agreed, 16.5 percent agreed, 11.5 percent moderately disagree, and 5.8 percent strongly agreed. However, it should be remembered that the NCA has been established as multiple land use allowing humans, livestock, and wildlife to share the same ecosystem.

The question is how much of each of the elements initially meant to use in the areas is supposed to be maintained to maintain the purpose of its establishment.

When the respondents were asked to indicate whether the laws in place dealing with HWC for the NCAA have to be amended to ease HWC, it was found that 42.4 percent strongly agreed, 28.8 percent agreed, and 23.0 percent moderately agreed, and 5.8 percent moderately disagreed. The findings indicate that NCA residents were not happy with the current governing laws in the study area. This restriction tends to annoy the pastoralists and trigger the need to amend the current laws. In this regard, Kipuri *et al.* (2008) note:

Under the NCA Ordinance, the NCAA is mandated to control all land use, commercial activity, entry, and residence within NCA. The author noted that, despite recognizing pastoralism as a sustainable land-use system, the NCAA has restricted pastoralist grazing and is excluded from prime grazing sites in various parts of NCA and must get permits to take livestock to the Ngorongoro crater to access mineral salts.

CONCLUSION

Based on the study findings, it is evident that HWC persists in the NCAA. Livestock is more prone to wild animal attacks than human beings. Buffaloes were found to threaten human beings in addition to elephants, leopards, hyenas, and lions. The study also found that wild animals not exposed to human harassment like those found around the NCAA headquarters exhibited less aggressive behaviour than others. All the domestic animals found in NCAA (cattle, sheep, goats, donkeys, and domestic dogs) were preyed on by wild animals. Sheep and goats were mainly victims of HWC, with more cases at the hands of hyenas at night. Lion's predations are mainly observed early in the morning and late evening, most victims being livestock at the back when herding back home and those lost in the rangeland. The study also found that human-wildlife conflict in the NCAA was mainly occasioned by competition over resources by human beings, their livestock, and wild animals. The increase in the human population has resulted in the invasion of areas used chiefly by wildlife. There was an observable threat in HWC due to wild animals' change of behavior when they are sick, especially rabid carnivores. Injured wild animals exhibited abnormal aggression. Additionally, the NCA natives were not happy with the degree of participation in the HWC management in the area, hence causing silent retaliation.

Although the Maasai pastoralists in the NCAA used to have a high degree of tolerance of livestock predation, silent retaliation against wild carnivores persists as in the past, with the bit of traditional killing of wild animals when compared to the past. In the meantime, more means of reducing HWC have been established, including the use of solid fences around native bomas and the introduction of zoning whereby the indigenous peoples were not allowed to graze their livestock in some areas such as the Ngorongoro crater preserved for wild animals. In addition, the NCAA has introduced native wildlife conservation motivation schemes entailing undertaking community development projects such as building schools and supporting individual students and provision of safe and clean water. Furthermore, some projects have been introduced on Livestock predation compensation schemes that focus on the existence of wild carnivores (lions) in the community rather than relying on the number of livestock predated. The mitigation measures include inculcating conservation knowledge among the indigenous peoples, promoting livestock predation compensation schemes, advocating for building bomas using solid fences that are wildlife proof, and implementing participatory retreatment of WHC cases. The provision of sports and games to youth could also reduce chances for practicing traditional wild animal hunting. Also, livestock predation could be reduced when young children were not left alone to tend to livestock in areas inhabited by dangerous wild animals.

The Ngorongoro Conservation Area Authority has been designed to serve as a multipurpose place for wildlife and humans to share the same ecosystem and thrive. In this regard, precautions must be taken by natives to avoid grazing their livestock in areas with a high degree of predation. To prevent their livestock from being killed at night, bomas should be strong enough to bar wild animals from attacking their livestock. Additionally, people should avoid herding their livestock early in the morning and late in the evening to reduce the chances of their livestock being attacked by lions. Furthermore, natives must be encouraged to diversify enterprises, particularly those with little competition with wild animals. Relevant authorities need to pay special attention to addressing rabid carnivores' issues and minimizing incidences that may end up with injuries to wild animals to reduce HWC due to sick and injured wild animals. In this regard, the NCAA must improve the relationships with natives by increasing their participation in dealing with HWC.

Overall, several means for reducing HWC have been evident in the past ten years and are applicable in the NCA. These approaches include building poles to construct strong fences for preventing wild animals from entering the bomas. However, these have had adverse effects on the environment. As such, the NCAA has to find an alternative to using poles while maintaining the idea of building strong fences around the bomas. Moreover, the study area residents need to promote compensation schemes that focus on the availability of wild animals in the native environment rather than relying on the number of livestock predated.

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