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SOCIO-ECONOMIC IMPACT OF HUMAN-WILDLIFE CONFLICTS ON AGRICULTURE BASED LIVELIHOOD IN THE PERIPHERY OF SAVE VALLEY CONSERVANCY, SOUTHERN ZIMBABWE

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ABSTRACT

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.

Key words: agriculture, conflicts, communal area, livelihood, protected area, Save Valley Conservancy, wild animals

INTRODUCTION

Humans and wildlife share resources in natural habitats and there is need to understand their interface to inform strategies to combat human-wildlife conflicts (Gandiwa *et al*., 2013). Human-wildlife conflict is increasing in severity worldwide (e.g. Kassilly *et al.,* 2008; LeBel *et al*., 2011; Gandiwa *et al.,* 2012). In 2010, the Southern African Development Community (SADC) Technical Committee on Wildlife pronounced that human-wildlife conflict was a challenge for southern Africa's rural populations in terms of personal security and household economic loss (LeBel *et al*., 2011). In Zimbabwe, agricultural activities enhance food security and improve standard of living for communal farmers (Rukuni *et al.,* 2006; Mashapa *et al*., 2013; Mashapa *et al.,* 2014 a, b). However, about 60% of the Zimbabwe´s land area is under semi-arid climate hence not favorable for rain-fed agricultural production save for wildlife management (Thomas and Vincent, 1960; Rukuni *et al*., 2006). Thus, the Government of Zimbabwe together with donor community support communal farmers to ensure agricultural productivity aimed at improved household food security (Mashapa *et al*., 2013). Investment in communal agriculture schemes has been increasing but most existing schemes fail to perform well due to several challenges faced by communal farmers, inclusive of human-wildlife conflicts (Gandiwa *et al*., 2013; Kahuni *et al.,* 2014; Mhuriro-Mashapa *et al*., 2017).

Crop raiding and livestock predation is considered a key form of human-wildlife conflict and perceived a disadvantage of farming close to protected areas in southern Zimbabwe. Human-wildlife conflict is a term frequently used in the wildlife literature to describe a subset of human-wildlife interactions that lead to negative outcomes for either wildlife or people (Cumming and Jones, 2005). In southern Zimbabwe, the land use of Save Valley Conservancy was initially planned for cattle ranching which are compatible with close proximity of human settlement, however, its conversion into a wildlife conservancy in the early 1990s pose socio-economic challenges to the local farming communities of Mutema-Musikavanhu villages. Increasing densities of people in Mutema-Musikavanhu communal area (ZimStats, 2013) and increasing populations of large wild animals in Save Valley Conservancy (Dunham, 2012) coupled with the agrarian land reform (Zisadza-Gandiwa *et al*., 2014), is perceived to increase human-wildlife conflicts in communal areas adjacent to Save Valley Conservancy, as humans and wild animals share resources in close proximity (Kahuni *et al*., 2014; Mhuriro-Mashapa *et al*., 2017).

Empirical studies in Zimbabwe often fail to grasp the socio-economic implications of human-wildlife conflicts, and perceptions of this conflict often deviate from actual incidences of crop/livestock damage and its impact on the food security status of the affected communal farmers. Despite an increase in the extent of human-wildlife conflict situations in Zimbabwe (Gandiwa, 2013; Gandiwa *et al*., 2013; Mhuriro-Mashapa *et al*., 2017), it is still difficult to reliably estimate the socio-economic and financial implications of human-wildlife conflicts on affected livelihood (Sitati *et al*., 2003; Hegel *et al*., 2009). The present study attempted to gain insights into communal farming and the effects of crop and livestock damage by wild animals and to assess current coping strategies adopted, including those advised by conservation organizations. The objectives of the study were two-folds, (i) to assess household economic value of crop/livestock loss as caused by wildlife damage across Mutema and Musikavanhu communal areas, in the periphery of Save Valley Conservancy, southern Zimbabwe and, (ii) to identify drivers of human-wildlife conflicts and explore measures to combat human-wildlife conflicts across the study area.

MATERIALS AND METHODS

Study Area: Save Valley Conservancy (central coordinates 20° 22′ S and 31° 56′ E) is located along Save River stretching from Birchnough Bridge in Chipinge District to Chiredzi District, southern Zimbabwe. Mutema and Musikavanhu communal areas are located parallel and adjacent to Save Valley Conservancy, the communal areas are situated to the eastern side of Save River (Fig. 1). A perennial Save River boarder Save Valley Conservancy and human communities, this river tends to attract wild animals to trespass towards human resettlements. Save Valley Conservancy has a total area of approximately 3,490 km² (Wels, 2003) and it is overpopulated with large wild animals listed in Table 1 (Dunham, 2012; Mhuriro-Mashapa *et al.*, 2017). Mutema and Musikavanhu communities have stretches of small-scale agricultural irrigation schemes, namely Taona, Bwerudza/Mashapa, Mutema, Chibuwe and Musikavanhu located along the Save River bordering Save Valley Conservancy and the communal lands. These local communities practice a combination of smallholder farming activities, i.e., cash crop farming and livestock rearing. Save River is the source of pumped water supply for irrigation agriculture, whereas, the same river is the main water source for high population of wildlife in Save Valley Conservancy (Mhuriro-Mashapa *et al*., 2017).

Table 1. Estimated wildlife populations in Save Valley Conservancy, southern Zimbabwe (adopted from Mhuriro-Mashapa *et al*., 2017).

Species	Total
Impala (*Aepyceros melampus*)	19 191
Zebra (*Equus burchelli*)	5075
Wildebeest (*Connochaetes taurinus*)	4927
Elephant (*Loxodonta africana*)	1117
Eland (*Taurotragus oryx*)	1424
Buffalo (*Syncerus caffer*)	1725
Warthog (*Phacochoerus africanus*)	1426
Kudu (*Tragelaphus strepsiceros*)	1150
Waterbuck (*Kobus ellipsiprymnus*)	735
Girraffe (*Giraffa camelopardalis*)	781
Sable (*Hippotragus niger*)	214
Black rhino (*Diceros bicornis*)	120
White Rhino (*Ceratotherium simum*)	31
Tsessebe (*Damaliscus lunatus*)	79
Nyala (*Tragelaphus angasii*)	65
Lion (*Panthera leo*)	56
Spotted hyenas (*Crocuta crocuta*)	34

Population sampling frame and sample size: The population size of Mutema and Musikavanhu communities was 29 163 people and a total of 7 054 households according to the 2012 census (ZimStat, 2013). The study area covered the 15km zone from the Save Valley Conservancy boundary, the exact number of households found within this study area (Mutema and Musikavanhu communal areas) was estimated using Traditional Chiefs' registers that was ±1100 households as per the preliminary reconnaissance information. The distance from Save Valley Conservancy boundary towards the study area was divided into three study site zones of 0-3 km, > 3 to 7 km and >7 km. Each study site zone's households were then randomly sampled as an independent sub-population. Hundred (100) questionnaires were administered to each distance zone, thus, the cumulative total sample size for the present study was 300 household heads.

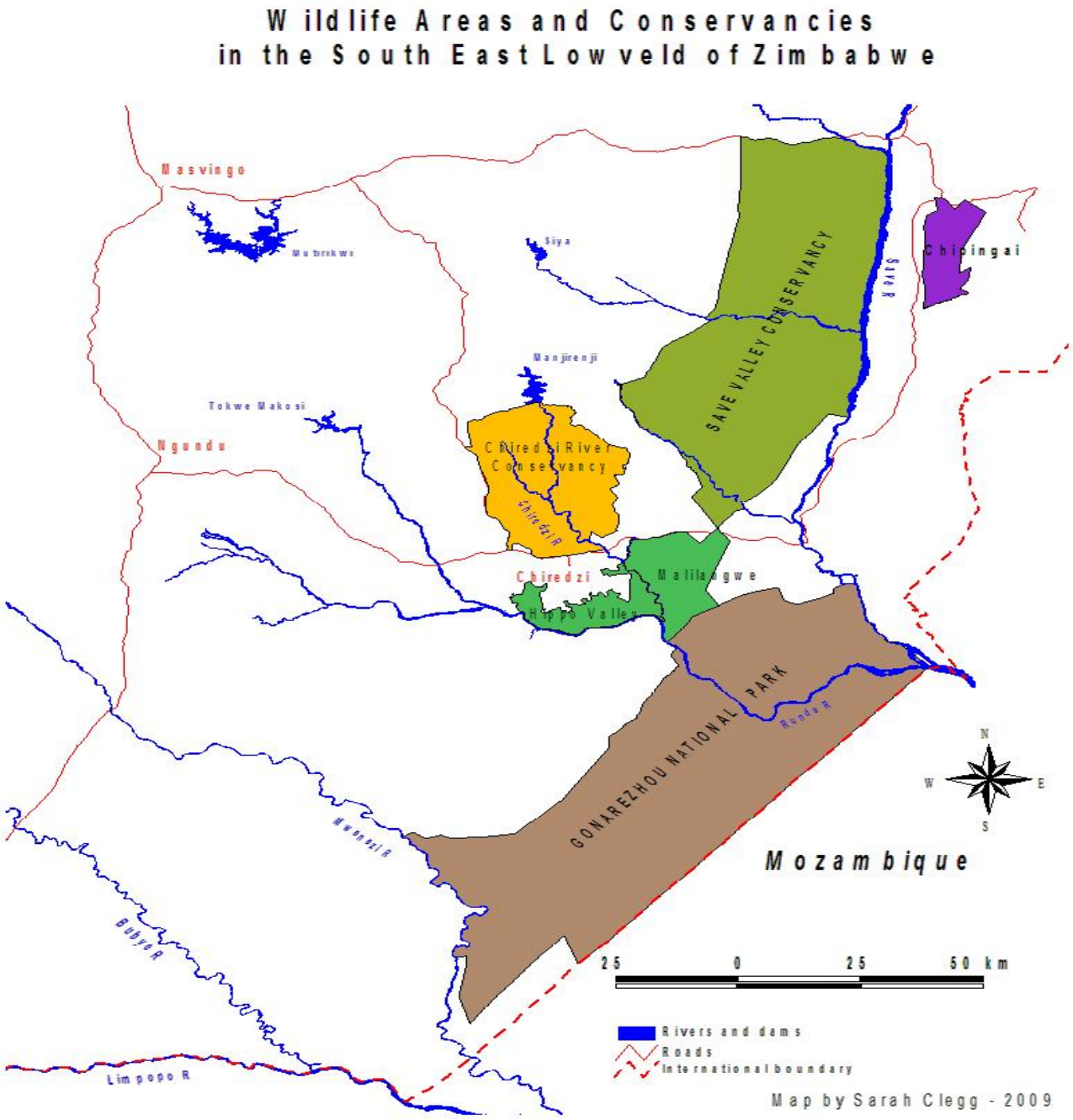

Fig. 1. Study area location showing Save Valley Conservancy and the surrounding local communities including Mutema and Musikavanhu communal areas, southern Zimbabwe (adopted from Mhuriro-Mashapa *et al.,* 2017)**.**

Data collection: Data on opportunity and direct costs of wildlife raided crop and livestock predation was collected during the 2014/16 farming season spanning from October 2014 to October 2016. Specific interview questions addressed the encountered incidences of crop raids and livestock predation on a monthly and seasonal basis and mitigation measures adopted by farmers. Economic value of crop/livestock loss was estimated based on market value. Furthermore, the following data collection tools were used to collect data; 20 key informants were purposively interviewed and these included the locals, namely; 2-Ward Councilors, 2-Traditional leaders, 2-Agriculture Officials, 2-Zimbabwe Republic Police (ZRP) Officers, 2-Parks Senior Wildlife Officers, 1-District Administrator. 2-Save Valley Conservancy Senior Rangers, 1-Member of Parliament,

4-Farmer Association Committee members and 2-Shareholders (Operators) in Save Valley Conservancy. Extensive compilation of literature review and consolidation of the data from Save Valley Conservancy and the Zimbabwe Parks and Wildlife Management Authority on local Problem Animal Control reports and other scientific documents/reports were also done as desk review of available literature and information triangulation.

Data Analysis: Contingent valuation (CV) analysis was adopted for determination of household economic cost value of crop and livestock loss due to human-wildlife conflicts in Mutema and Musikavanhu communities. Univariate analysis of variance was used to determine if household total economic loss varied with distance from the park boundary of Save Valley Conservancy to the farming communities. Direct costs at net present value were given by making comparison of spatial dimensions of perceived and actual crop and/or livestock losses. These direct costs were derived from area dimensions in respect to crop type grown or livestock reared. At the household base level, the spatial dimensions of agriculture damage were associated with the amount of crop and/or livestock expected to be harvested if not impacted upon by natural hazards as suggested by Bell and McShane-Caluzi (1986) and O'connell-Rodwell *et al*. (2000). Based on knowledge of local smallholder farmers, perception on magnitude of damage incurred was obtained (Mashapa *et al*., 2014a; Mhuriro-Mashapa *et al*., 2017). Determination of costs assumed homogeneity of crops, livestock and market prices in Mutema and Musikavanhu communal areas as there was uniformity in crops/livestock and their associated prices across the study area (Mashapa *et al*., 2014a; Mhuriro-Mashapa *et al*., 2017). Moreover, study responses on recorded drivers of human-wildlife conflicts and mitigation measures were summarized, then content and descriptive analyses were performed. Wilcoxon's (rank sums) test was performed, comparing incidences of human-wildlife conflicts between wet and dry season. Fisher's exact test analysis was performed to compare percentage damage of all crops and livestock types across the two study stratum. All statistical analyses of data were done using the Statistical Package for Social Sciences (SPSS version 17.0, Chicago, USA.).

RESULTS

Socio-economic impact of human-wildlife conflicts on agro-based livelihoods in Mutema-Musikavanhu communities adjacent to Save Valley Conservancy, southern Zimbabwe: In terms of livelihood activities 97.9% (n = 294) of the study respondents households reported that they were agriculture farmers producing crops and livestock for a living. The other 2.1% (n = 6) households stated that they were dependent on wild food, remittances from employed relatives and selling of bush meat amongst others. Across the two study strata over 80% (n = 240) of study respondents reported incidences of crop and/or livestock damage by wild animals (Fig. 2).

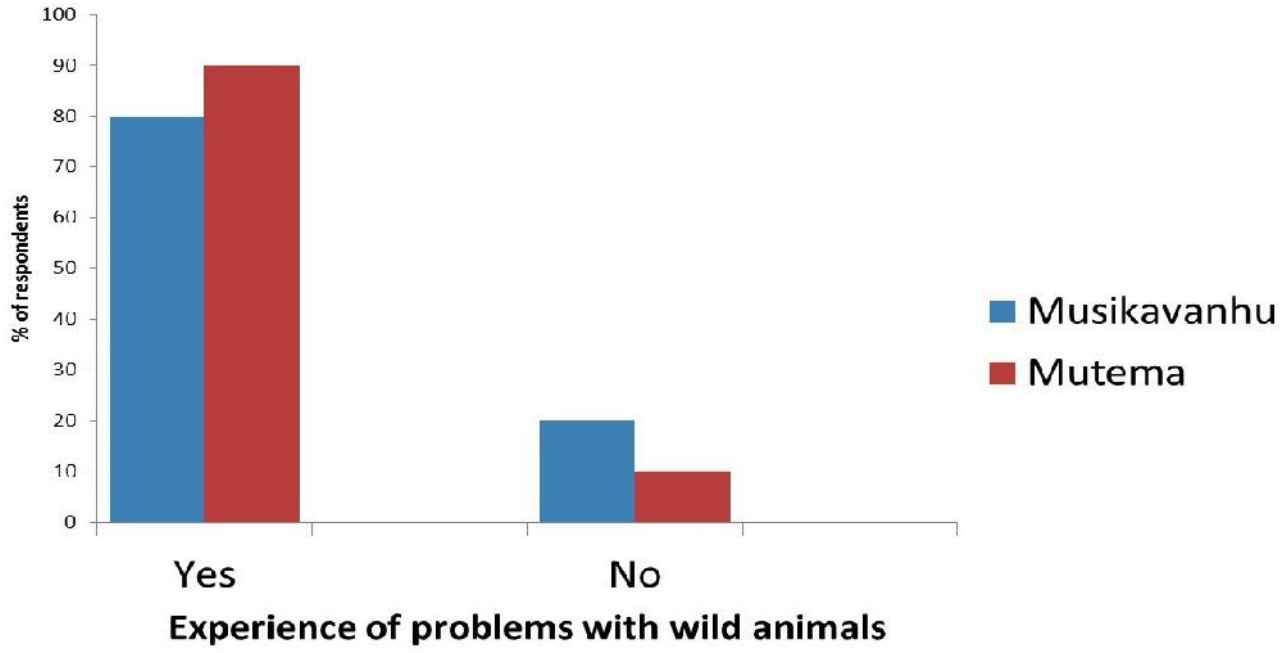

Fig. 2. Human-wildlife conflicts prevalence across Mutema and Musikavanhu communal areas adjacent to Save Valley Conservancy, southern Zimbabwe

Common agriculture enterprises reported to be highly prone to wildlife damage in Mutema-Musikavanhu communities are shown in Table 2. High severity of human-wildlife conflict was recorded in all of the two study strata, mainly driven by selected large herbivores, namely; elephants and buffalo raiding crops like banana (*Musa sapientum*) and maize (*Zea mays*), respectively. Whereas, selected carnivores like lion (*Panthera leo*) and African wild dog (*Lycaon pictus*) mainly driving livestock predation, killing cattle (*Bos taurus*) and goats (*Capra aegagrus*).

The nature of human-wildlife conflicts reported in the study area is shown in Table 3. High incidences of both crop raid and livestock predation were reported across the study strata. Records from literature review and 80% (n = 16) of key informants also indicated that the total number of people killed by elephants, buffalos, hippopotamus, and Nile Crocodile (*Crocodylus niloticus*) per annum was increasing in Mutema-Musikavanhu communal areas where 7 people were reported killed and 16 people wounded by wild animals for the period 2010 to 2016.

Table 2. Severity of human-wildlife conflict as driven by problem wild animals in Mutema-Musikavanhu communities in the periphery of Save Valley Conservancy, southern Zimbabwe.

Agriculture produce affected by wild animals	Main problem wild animals	Severity of human-wildlife conflict in Musikavanhu study stratum	Comments on severity of human-wildlife in Mutema study stratum
Cattle (*Bos taurus*),	Lion	High	High
Goats (*Capra aegagrus*),	African wild dogs and Spotted hyenas	Moderate	Moderate
Maize (*Zea mays*),	Elephant and buffalo	High	High
Bananas (*Musa sapientum*)	Elephant	High	High
Sugar beans (*Phaseolus vulgaris*),	Elephant and Warthog	Moderate	High
Pumpkins (*Cucurbita* sp.)	Elephant and Warthog	Low	High
Sorghum (*Sorghum bicolour*),	Elephant and buffalo	Low	High
Wheat (*Triticum aestivum*)	Elephant, warthog and hippopotamus (*Hippopotamus amphibious*)	Moderate	Moderate
Sugar cane (*Saccharum officinarum*).	Elephant	Low	Low
Tomatoes (*Solanum lycopersicum*)	Elephant	Moderate	High

Table 3: Nature of human-wildlife conflicts in Musikavanhu and Mutema communal areas, southern Zimbabwe.

Nature of human-wildlife conflicts across the study area	Musikavanhu (n = 150) %	Mutema (n = 150) %
Crop raids by large herbivores	68	43
Livestock predation by carnivores	40	74
People killed by wild animals	4	3

Majority of study respondent households across the study strata (96%, n = 288) had incurred household economic losses. Total household economic losses were significantly different across the distances between the Save Valley Conservancy boundary and human settlement (Table 4). The highest households mean economic loss was within a radius of 3 km between Save Valley Conservancy boundary and the human settlement, and the lowest was over 7 km from the Save Valley Conservancy boundary into the human settlement. About 88% (n = 264) of the study respondent households within the 0-3 km radius zone from the Save Valley Conservancy boundary indicated that they had been negatively affected by wild animals, 63% (n = 189) and 53% (n = 159) reported that they were negatively affected by wild animals within the > 3 to 7 km and > 7 km radius zones across the study area, respectively. There was a correlation between the distance from the Save Valley Conservancy boundary and the number of households affected by wild animals (R^2=0.986; p <0.01). Statistics indicates that as you move away from the Save Valley Conservancy boundary, incidences of human-wildlife conflicts decreases.

Table 4. Relationship between household economic and financial (US$) loss and distance from the boundary of Save Valley Conservancy to Mutema and Musikavanhu communal areas, southern Zimbabwe.

Distance between the community and Save Valley Conservancy boundary	household annual mean economic and financial loss ±SE		
	Musikavanhu study stratum	Mutema study stratum	Communal study strata
3 km	971.10 ±21.02[b]	1 025.48 ±35.17[b]	998.29 ±77.35[b]
> 3 to 7 km	703.96 ±113.35[a]	668.16 ±103.23[a]	686.06 ± 128.92[a]
> 7 km	617.80 ±177.97[a]	724.20 ±17.98[a]	671.00 ± 182.32[a]

Means within the same column with the same superscript were not significantly different at p>0.05. Means within the same column with different superscript were significantly different at p<0.05

Drivers of human-wildlife conflicts and mitigation measures implemented by local communities to reduce human-wildlife conflicts across the study area: A review of the Zimbabwe Parks and Wildlife Authority and Save Valley Conservancy records showed that more than 87% (n = 65) of human-wildlife conflicts reports of 2010 to 2016, were recorded during the dry season, this was also confirmed by 80% (n = 16) of key informants who further cited Save River as a common shared water resource for both wild animals and human settlement and this river is considered the main pulling factor driving human-wildlife conflicts. Wilcoxon's (rank sums) test, showed that there is significant difference on human-wildlife incidences between wet and dry season (z = 0.032; p = 0.031). Table 5 show a summary of reported outcomes of perceived major drivers of human-wildlife conflicts in the study area. Key informants highlighted that absence of a buffer zone, lack of communal grazing ranges and frequent drought/dry season induced water shortages for animals drive both people and wild animals to overlap the interface between human settlement and Save Valley Conservancy. Additional, it was reported that, availability of plant species palatable to wild animals within the peripheral of crop fields attracts large herbivores, such trees include; marula (*Sclerocarya caffra*), dunks or Indian plum (*Ziziphus mauritiana*), tamarind or Indian date (*Tamarindus indica*) and African palmyra palm (*Borassus species*) which attract herbivores like elephants.

Percentage damage of all crops and livestock types differed significantly between sites indicating households in Mutema communal area experienced the most agricultural damage and households in Musikavanhu experienced the least amount of agricultural damage (Fisher's exact, F=128.40, df = 5, *p<0.01*). Key informants suggested that there should be an increment of the size of the buffer zone area bordering Save Valley Conservancy and the surrounding study area, since wild animals easily stray into human settlement and straight into crop fields and livestock vicinity of communal grazing lands. Most study respondents (96%, n = 288) reported that there is no plan from either Save Valley Conservancy or Zimbabwe government's Parks and Wildlife Management Authority to compensate victims of human-wildlife conflicts. In that regard, study respondents suggested that local government, local traditional leaders and Save Valley Conservancy management should work together in order to help reduce human-wildlife conflicts. Few households (2%, n = 6) from the study area suggested that farmers should guard their crop fields and livestock to reduce human-wildlife conflicts. Also few households, (2%, n = 6)) suggested the issuance of guns or any means necessary to kill every trespassing wild animal to reduce human-wildlife conflicts.

Table 5: Major drivers of human-wildlife conflicts in Mutema and Musikavanhu communal areas, southern Zimbabwe (n = 300).

Human-wildlife conflicts driving factor	Musikavanhu study stratum (n = 150) %	Mutema study stratum (n = 150) %	Communal study strata (n = 300) %
Human population growth	38.9	31.3	35.1
Type of crops cultivated	26.1	27.5	26.8
Distance of community from Save Valley Conservancy boundary	28.8	20.6	24.7
Absence of electric fence boundary to protect Save Valley Conservancy from communities	13.7	13,1	13.4

Preventative measures such as setting fires around crop fields at night, children scaring wild animals by beating drums, guarding crops, herding and kraaling livestock were the common methods employed by local communal farmers to minimize damage of agricultural produce from wild animals. Over 18% (n = 54) of the

study respondent households indicated that they would retaliate to the extent of killing the wild animals after a crop and/or livestock damage or any other serious form of human-wildlife conflicts. To compensate for crop and livestock damage, most local farmers (57%, n = 171) expanded their crop fields. Some study respondent households (25%, n = 75) spatially segregated fields by cultivating several smaller fields in various locations in order to spread risks of crop damage. Other study respondent households (9%, n = 27) avoided cultivating and herding livestock near wildlife inhabited zones altogether. Direct compensation to local people by way of distributing meat from problem animal control operations by Parks and Wildlife Management Authority and Save Valley Conservancy management was less preferred by study respondent households (2%, n = 6) because even owners of unscathed crop fields and livestock benefited from the distribution of such meat.

DISCUSSION

The present study recorded that household annual economic and financial loss due to human-wildlife conflicts within Musikavanhu and Mutema communities were enormous, ranging from US$ 671.00 to US$ 998.29 per household (Table 4). This could cause food insecurity at household level across the agro-based communities in the periphery of Save Valley Conservancy, southern Zimbabwe. Similarly elsewhere, concerns for household food insecurity triggered by human-wildlife conflicts were recorded as primates raid crops of communal farmers around Gishwati Forest, northern Rwanda; these represented a substantial proportion of household mean income loss that was around US$540 per household, this was even lower than the household mean income loss recorded by the present study as shown in table 4 (Bush *et al*., 2010). Ironically, the study area which is in Chipinge District of southern Zimbabwe is largely covered by low-veld marginal lands under semi-arid climate suitable for wildlife management and has a record of high prevalence of food insecurity among households, due to high frequency of drought events with related seasonal failures of livestock and crop production (Vincent and Thomas, 1960; ZimVAC, 2017). This household food insecurity trend could likely be exacerbated by wild animal destruction of local staple crops (e.g. maize and sorghum), cash crops (e.g. bananas and sugar beans) and livelihood assets (e.g cattle and goats) by prevalence of problem wild animals from Save Valley Conservancy, the nearby Chipinge National Park and Gonarezhou National Park (Fig.1) where human-wildlife conflicts were reported to be on the increase (Gandiwa *et al*., 2012, 2013, Kahuni *et al*., 2014; Mhuriro-Mashapa *et al*., 2017)**.** Increased household food insecurity can be a consequence of crop raids and livestock predation by wild animals causing household economic losses (Barua *et al*., 2013).

Human-wildlife conflicts have a wide range of consequences including indirect economic and financial losses incurred by affected households, such as socio-economic costs that include the loss of human life (Table 3), human threats and damage to community infrastructural property (Dickman, 2010). It is important to note that crop and livestock losses to wild animals are not just an economic and financial drain on farming households but such losses can also generate and trigger other socio-economic costs to household members (Barua *et al*., 2013), including but not limited to: (1) an increased need to guard crops, livestock herding and kraaling, which can creates labour bottlenecks for other household chores, (2) disruption of schooling because children are needed to help guard crop fields and herd livestock, (3) increased risk of injury from wild animals, and (4) increased risk of contracting diseases (e.g., malaria) if people are required to guard their crops at night in the fields (Hill, 1997; Hill, 2000; Naughton-Treves, 2001). Agriculture protection measures against wildlife damages represent a significant investment in terms of money and time for the households (Barua *et al*., 2013). It is therefore necessary that the local government, Save Valley Conservancy management, Zimbabwe Parks and Wildlife Management Authority and the local traditional leaders work together for the common good to combat human-wildlife conflicts thereby reducing household socio-economic and financial losses in Mutema and Musikavanhu communities in the periphery of Save Valley Conservancy, southern Zimbabwe (Hegel *et al*., 2009; Gandiwa *et al*., 2013; Mhuriro-Mashapa *et al*., 2017).

The study recorded driving factors linked to the increasing severity of human-wildlife conflicts for the period 2014 to 2016 and this concerns the people of Mutema and Musikavanhu communal areas, southern Zimbabwe. Elephants and buffalo were reported key problem wild animals driving human-wildlife conflicts and these large herbivores are likely attracted by nutritious and palatable crops (maize, banana, legumes) grown by communal farmers, hence, high incidences of crop raids were recorded during the dry season when forage is limited. On the other hand, lions were reported a menace with livestock predation, these carnivores are exposed to livestock communal grazing land, in this case within Save riverine habitat (Fig.1) where cattle are likely concentrated to evergreen forage of riverine vegetation during the dry season. The pattern of human-wildlife conflicts was likely influenced by distance between the boundary of Save Valley Conservancy and the Mutema-Musikavanhu communal area (Table 4 & 5). Perennial Save River which is within the boundary of Save Valley Conservancy and the local communities (Fig. 1) was reported by key informants as a driving pull factor of

human-wildlife conflicts as the river is a shared water resource for both wild animals and human settlement. Wells *et al.* (1992) observed that the nature of human-wildlife conflicts tend to show an increasing trend wherever humans and wildlife requirements overlap over natural resources, mainly land, forests and water. There might be need for the Zimbabwe Parks and Wildlife Management Authority and Save Valley Conservancy management to consider relocating the conservancy boundary in a way to create a buffer zone to caution or combat potential human-wildlife conflicts given that the original land use plan for Save Valley Conservancy was for cattle ranching which is compatible with farming communities as opposed to the present wildlife land use (Well, 2003, Pole, 2006; Mhuriro-Mashapa *et al*., 2017).

Considering that crop and livestock damages often represent a serious threat to household food security, local farmers employ a number of measures in mitigating these damages. Many local solutions to human-wildlife conflicts are available as reported, varying in cost, efficacy and feasibility contexts. Deterrents such as setting fires around crop fields at night, use of bees, burning chilli pepper mixed with elephant dung, scaring animals by beating drums, linearization of huts as a fort to block wild animals from accessing the crop fields, herding and kraaling livestock are the common methods employed to minimize human-wildlife conflicts in southern Zimbabwe (Gandiwa *et al*., 2013). There was a widely felt need for Save Valley Conservancy and human settlement to be carefully segregated. Use of electric fencing was frequently suggested as being the best means of achieving a solution to this problem. However, a few residents objected strongly as they were reluctant to be restricted by fences since this may lead to exclusion from natural resources like grazing land, fuel wood, timber and wild fruits (Mashapa *et al*., 2014b) from Save Valley Conservancy. Local rural land use planning has a profound bearing both in the present and in the future of Zimbabwe to plan for wildlife corridors, buffer zones and electric fencing, whenever, wildlife interfaces human settlement to combat human-wildlife conflicts (Archabald and Naughton-Treves, 2001; Kahuni *et al*., 2014; Mhuriro-Mashapa *et al*., 2017).

There is still room for improvement in regards to management of human-wildlife conflicts by the Zimbabwe Parks and Wildlife Management Authority, Save Valley Conservancy management and the local government to the victims of human-wildlife conflicts in communities in the periphery of Save Valley Conservancy, southern Zimbabwe. People will often tolerate significant levels of crop/livestock damage by domestic animals yet are intolerant of comparatively smaller losses from wildlife (Hill, 1998; Naughton-Treves *et al*., 1998). When domestic animals damage crops/livestock there are culturally mediated compensation schemes in place, whereby the farmer is compensated (Naughton-Treves, 1999). The important point is that in Mutema and Musikavanhu communities, there is an established, recognized, and acceptable system in place for dealing with crop/livestock damage by domestic animals. In that regard, from the Mutema and Musikavanhu communal farmer's perspective, the Zimbabwe Parks and Wildlife Management Authority and the management of Save Valley Conservancy behave like an irresponsible domestic animal owner as far as problem wild animals are concerned. Government laws determine what people can or cannot do with respect to wild animals, and the Zimbabwe Parks and Wildlife Management Authority and Save Valley Conservancy management enforce those laws. Yet, the same Zimbabwe Parks and Wildlife Management Authority and management of Save Valley Conservancy do not ensure that the wild animals are prevented from raiding crops and livestock predation, as is required by a responsible domestic animal owner. Neither do Zimbabwe Parks and Wildlife Management Authority and Save Valley Conservancy provide compensation when crop/livestock losses do occur. Thus, the local people of Mutema and Musikavanhu communities expressed their dissatisfaction with this situation by referring to Save Valley Conservancy as an arrogant neighbour who transformed its formerly co-existing cattle ranch into a conflicting wildlife habitat post 1993 with no electric fence to reduce trespassing of wild animals into human settlement (Wells, 2003; Mhuriro-Mashapa *et al*., 2017).

Ogra (2008) stated that in the absence of viable alternatives to household economic and financial losses due to human-wildlife conflicts, local people tend to passively accept the social and economic costs of conservation imposed upon them by institutions of protected areas – this was the case of Mutema and Musikavanhu communities in the periphery of Save Valley Conservancy, southern Zimbabwe. With the recorded increasing trend of incidences of human-wildlife conflicts in the study area, when that imposing system breaks down or people transgress the socially acceptable rule of such arrangements, the degree to which people are prepared to accept such losses can decline dramatically. However, as in other places, people may retaliate against wild animals in protest or seek to implement solutions of their own design instead, as evidently suggested by some study respondents that wild animals should be killed in retaliation of human-wildlife conflicts. Wild animals can cause destruction to crops, livestock, infrastructure and human lives. It is important to picture the kind of farmers we are reporting about - these farmers are vulnerable people, with farms only about 0.4ha average size per household (Mashapa *et al*., 2013, 2014a; ZimVac, 2017). When an elephant trespass and tramples a crop field, and eats all of a household's field crops that will be the end of

seasonal source of food and household income for a particular household as a victim. The situation is worse when a woman is the head of the household, because crop production for women is greatly linked to female headed household food security, essential to feed families, as opposed to cattle which is kept for wealth and usually raised by men for showing status and occasionally disposed for household income in times of food shortage (Gwetsayi *et al*., 2016).

Zimbabwe's growing human and associated livestock populations can cause great problems for the survival of predators like lions for the same reasons that bears African wild dogs as they prey on small livestock like goats, these carnivores are commonly poisoned and killed in Africa (Tchamba, 1996; Woodroffe and Frank, 2005; Bauer *et al*., 2010). A lion was found dead in Musikavanhu communal area and the local Zimbabwe Republic Police (ZRP) records at Chipangayi station suspected intentional poisoning. Such retaliation killing of wild animals can be ongoing and persistently unreported despite some legislation prohibiting this killing. Elsewhere, data from Kenya suggested that 17 of 18 radio-collared lions in Laikipia were killed as retribution for livestock predation (Woodroffe and Frank, 2005).

A recognized and locally appropriate response to human-wildlife conflicts, probably in the form of Communal Area Management Programme For Indigenous Resources (CAMPFIRE) (Gandiwa *et al*., 2013) is suggested to mitigate local people's perceptions of conservation as a conflict, while aiming for mutual benefits for local wildlife management and agro-based livelihood. CAMPFIRE on communal areas adjacent to wildlife areas was considered to be one of the key initiatives adopted to generate benefits, promoting conservation, and empowering local communities (Murphree, 2009; Gandiwa *et al*., 2013). The CAMPFIRE approach was instrumental in instilling pride and management of wildlife in Zimbabwe while at the same time creating opportunities for local employment and community common resource property development in communal areas adjacent to protected areas (Balint, 2006; Gandiwa *et al*., 2013). The CAMPFIRE approach seemed a missing link for co-existence of wildlife and people in the case of Mutema and Musikavanhu communities in the periphery of Save Valley Conservancy, southern Zimbabwe (Patel, 1998; Murphree, 2001; Gandiwa *et al*., 2013)

Conclusion: The present study assessed factors driving human-wildlife conflicts and its impact on household economic and financial income of communal farmers in Mutema and Musikavanhu communities in the periphery of Save Valley Conservancy, southern Zimbabwe. Agriculture based livelihoods in the periphery of Save Valley Conservancy incur economic and financial loss of annual average US$ 834.65 per household, which is likely detrimental to household food security in a long run. The main drivers of human-wildlife conflicts in the study area were damage inflicted by selected problem wild animals on crops or livestock, injure and/or cause death to human life. Basing on the study findings it was suggested that managing human-wildlife conflicts should be part of the larger conservation and development objectives for the benefit of both wild animals and people's well-being in the present study area and this can replicate the CAMPFIRE approach which proved viable elsewhere across Zimbabwe (e.g Patel, 1998; Mutandwa, E and Gadzirayi, 2007; Murphree, 2009; Gandiwa *et al*., 2013).

Implication for management: *Use of a multi-action approach* - Managing human-wildlife conflicts could be integrated within the management objectives of different wildlife management strategies such as law enforcement, pro-poor wildlife, effects on agriculture so that benefits accrue to both the protected area management and the adjacent communal farming areas (Balint, 2006). *Erection of electrified fencing around Save Valley Conservancy and proper segregation from communal lands* - Zimbabwe Parks and Wildlife Management Authority and management of Save Valley Conservancy could consider erection of electrified fencing to reduce trespassing of wild animals from the protected area into human settlement. In addition, with the land use shift from cattle ranching to wildlife management by Save Valley Conservancy and its close proximity to communal lands it is suggested to consider land use re-plan to move the present boundary of Save Valley Conservancy so as to expand the almost non-existing buffer zone to caution human-wildlife interface. *Mutual benefits and compensation fund* - Chipinge Rural District Council, southern Zimbabwe can pursue the application of a recognized and locally appropriate response to human-wildlife conflicts, like setting up a CAMPFIRE for Mutema and Musikavanhu communities in the periphery of Save Valley Conservancy, southern Zimbabwe. Alternatively, as suggested by Mhuriro-Mashapa *et al*. (2017), the present study proved the need for local government to consider setting up a compensation fund to assist poor vulnerable victims of human-wildlife conflicts in Mutema and Musikavanhu communities in the periphery of Save Valley Conservancy, southern Zimbabwe. This can be confined to a particular class of loss, for example loss of crop and livestock, injuries or deaths of human life caused by wild animals.

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