The Journal of Animal & Plant Sciences, 27(5): 2017, Page: 1678-1688
ISSN: 1018-7081

DETERMINANTS OF COMMUNAL FARMERS' WILLINGNESS TO PAY FOR HUMAN-WILDLIFE CONFLICT MANAGEMENT IN THE PERIPHERY OF SAVE VALLEY CONSERVANCY, SOUTH EASTERN ZIMBABWE

P. Mhuriro-Mashapa[1], E. Mwakiwa[1] and C. Mashapa[2*]

[1]Department of Agricultural Economics and Extension, Faculty of Agriculture, University of Zimbabwe, P. O. Box MP 167, Mt Pleasant, Harare, Zimbabwe; [2]School of Wildlife, Ecology and Conservation, Chinhoyi University of Technology, Private Bag 7724, Chinhoyi, Zimbabwe
[*]Corresponding author: clayiemashapa@yahoo.co.uk

ABSTRACT

Human-wildlife conflicts are a concern in communal areas adjacent to protected areas in Zimbabwe. The objectives of the present study were to (i) investigate the determinants of farmers' willingness to pay for human-wildlife conflict management and (ii) estimate the opportunity cost of human-wildlife conflict management in the periphery of Save Valley Conservancy, south eastern Zimbabwe. Interviews with individual household heads, key informants and focus group discussions were done. A stratified random sampling technique basing on distance from Save Valley Conservancy was used in selecting the households for data collection. Data collection was done in July 2015, using semi-structured questionnaires administered to a stratified and randomly selected 300 households and 20 key informants. Elephants, buffaloes, hyenas and lions were most problem wild animals in the study area. The following factors were significant in explaining the household's willingness to pay for human-wildlife conflict management, namely, education level of household head (p = 0.006), household income (p = 0.001), distance from Save Valley Conservancy boundary (p = 0.036) and awareness of human-wildlife management. Despite the absence of an active formal agricultural insurance institution, farmers were willing to pay about USD157.67 annually per household, for human-wildlife conflict management in the study area.

Key words: communal areas, crop raids, livestock predation, livelihood, Save Conservancy, wild animals

INTRODUCTION

Wildlife is often a more appropriate form of land use option in arid and semi-arid sub-Saharan African environments (Romero, 2012). Wildlife is unique because it is a mobile resource and some wild animals are dangerous for people to live with. Crop raiding and livestock predation by wild animals occurs all over the world with different species being perpetrators (Kassilly *et al.,* 2008; LeBel *et al*., 2011). Gandiwa *et al.* (2013) ascertains that human-wildlife conflicts are undermining what have been, to date, quite successful conservation programmes, such as the Communal Area's Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe. Managing human-wildlife conflict has become an important aspect of most communities in the periphery of wildlife protected areas in southern Africa (Le Bel *et al*., 2011). For instance, as wild animals trespass from protected areas in Zimbabwe, sometimes they destroy crops, kill livestock, property and occasionally kill people in adjacent communal areas (Kahuni *et al*., 2014). Sometimes human-wildlife conflicts can result in farmers killing wild animals, or passively or actively permits poaching in retaliation for the agricultural loss/damage they would have experienced. For instance, in the Hwange National Park, western Zimbabwe, elephant (*Loxodonta africana*) disaster where poachers poisoned salt licks with cyanide killing about 140 elephants and several other wild animals in 2013 is associated with retaliatory actions by local communities among other factors (Muboko *et al*., 2014). These factors, among others can degenerate into human-wildlife conflicts.

Agricultural communities bordering Save Valley Conservancy in south eastern Zimbabwe, is a case study scenario with many of the factors affecting human-wildlife conflicts in areas near protected areas (Mhuriro, 2016). To fully understand these issues, humans and wildlife must be studied, especially in areas experiencing human-wildlife conflicts, in the case of Save Valley Conservancy and adjacent communal village areas, i.e., Mutema and Musikavanhu communal village areas, in south eastern Zimbabwe. The study objectives were based on the assumption that factors precipitating human-wildlife conflict are not homogenous, but can reflect general factors affecting most local communities adjacent to protected areas with high wild animal population densities and closed or non-existent wild animal movement corridors (Gandiwa *et al*., 2013; Gandiwa *et al*., 2014). The study objectives were two fold, namely, (i) to assess factors determining farmers' willingness to pay for wildlife damage prevention, and, (ii) to estimate

the opportunity cost the farmers are willing to pay to prevent wildlife damages. Understanding relationships between local people settlement and wildlife protected area management is critical in designing and sustaining effective conservation strategies.

MATERIALS AND METHODS

The study area falls within the semi-arid agro-ecological zone of south eastern Zimbabwe (Figure 1), with a hostile crop environment caused mainly by variable annual rainfall with a range of 450-600mm, which usually comes as infrequent heavy storms (Moyo *et al*., 1993). In this drought prone semi-arid area, wildlife management, irrigation agriculture, rain-fed dry land agriculture and livestock production are ideal and common livelihoods activities (Vincent and Thomas, 1960; Gandiwa *et al*., 2014) with most people relying on subsistence farming and development relief from humanitarian donor organizations in collaboration with the government of Zimbabwe for survival (Mashapa *et al*., 2013, 2014). Save River being a common boundary between Save Valley Conservancy and the adjacent communal village areas is a shared water resource. Save Valley Conservancy is home to sizeable wildlife populations, including several species of conservation significance (see Table 1). There are now nine packs of African wild dogs, occurring at one of the highest densities of that species in the world (Creel and Creel, 2002; Pole, 2006), which had been effectively eradicated from Save Valley Conservancy during the cattle ranching era of pre-1993. Save Valley Conservancy also has the largest rhinoceros population in Zimbabwe. Lions re-colonized the conservancy from the nearby Malilangwe Conservancy in the south of Save Valley Conservancy and the population is increasing rapidly. The geographic distribution of elephants within Zimbabwe was boosted by approximately 6 per cent following the Save Valley Conservation translocation of elephants from Gonarezhou National Park, Zimbabwe (Dunham, 2012).

Table 1. Estimated Wildlife populations in Save Valley Conservancy, as at 2011 (ZPWMA, 2013).

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

Save Valley Conservancy now represents a mosaic of natural habitat used for wildlife production and adjacent communal farming, resulting in conditions conducive to human–wildlife conflict. About 4000 people have settled in southern part of Save Valley Conservancy (Joubert and Joubert, 2006). The removal of portions of the perimeter fence by the settler farmers has greatly increased human-wildlife conflicts in adjacent communal village lands (Kahuni *et al*., 2014). At the interface of Save Valley Conservancy and adjacent communal village areas, the conflict has been manifested by fatal encounters between humans and wildlife (at least 40 human deaths in or near Save Valley Conservancy due to wildlife since 2000), crop damage and livestock predation (Lindsey, 2007). In response to crop damage, several elephant bulls are killed in problem-animal control operations every year, significantly reducing potential revenues from trophy hunting each year (Lindsey, 2007; Martin, 2007). Small-scale irrigation crop production and livestock production (cows and goats) are the main livelihood activities for the local farmers in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe.

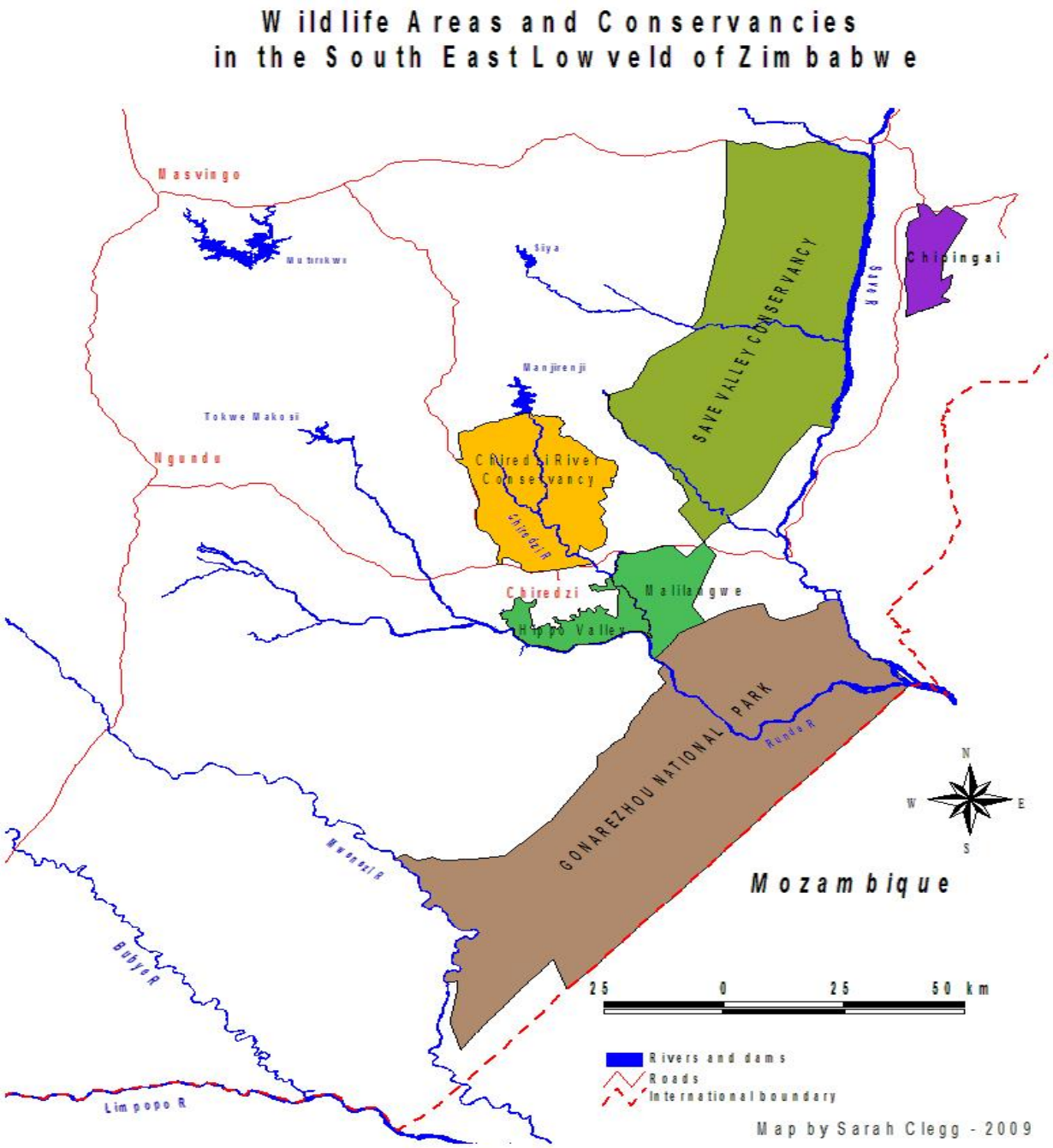

Figure 1. Study area location showing Save Valley Conservancy and the adjacent communal areas, south eastern Zimbabwe

Research design: Chipinge Rural District has 11 communal villages in the periphery of Save Valley Conservancy with a population of 130 420 people and a total of 29 426 households (ZimStat, 2013). However, the study was restricted to Mutema and Musikavanhu communal village areas adjacent to Save Valley conservancy. The population size of the total two communal village areas was 29 163 and a total of 7 054 households (ZimStat, 2013). Since the study area only cover part of Mutema and Musikavanhu communal village areas (15km zone from the Save Valley Conservancy protected area boundary), the exact number of households found within the study area was estimated using Traditional village Chiefs' registers that was plus/minus 1100 households as per the preliminary reconnaissance information with Zimbabwe national

census of 2012 (ZimStat, 2013). The two communal village areas were first purposively selected for sampling and referred to as the two study strata. The distance from the conservancy protected area boundary across the study area was divided into three study site zones 0-3 km, 3-7 km and >7 km. Each study site zone's households were then randomly sampled as an independent sub-population. Hundred (100) household questionnaires were administered to each distance zone.

The lists of farming households randomly selected for sampling was verified by the Chipinge District Agriculture, Research and Extension Service Department office (Chipinge Agritex), south eastern Zimbabwe, in collaboration with the local traditional leaders. A stratified random sampling technique basing on distance from Save Valley Conservancy boundary was used in selecting the households as research unit for the study, the farmers whose names were on the list obtained from Chipinge Agritex. Interviews with individual household heads, key informants and focus group discussions were done. Only household heads were targeted as study respondents. In a case of the household head being absent, the eldest member of the household present was the study respondent.

Data collection: Semi-structured interviews, were conducted in communal village areas adjacent to Save Valley Conservancy that adjoin the irrigation schemes and concurrent *in situ* interviews were done as designed to elicit information on household demographics, general farming practices, together with experiences of losses due to wild animals raiding crops/livestock predation and distance from Save Valley Conservancy boundary. Information on efforts to resolve local human-wildlife conflicts were gathered from the study respondents. Respondent households were asked to assume that a reputed institution, would introduce an appropriate programme so that the trend in human-wildlife conflicts could be managed and that the support of the general public would be needed to establish a trust fund to undertake it. In this case a non-obligatory, specific voluntary contribution mechanism to determine the survey households' likely willingness to pay for human-wildlife conflict management to the proposed institutional fund was adopted. Data were collected in July 2015. The willingness to pay (WTP) elicitation question was that; for the next five years how much will you be willing to pay from the monthly income of your household starting January 2017 towards the establishment of the proposed trust fund to implement the programme and conserve wildlife and reduce agricultural produce damages and farming household losses? In order to eliminate potential problems/human-wildlife conflicts of the local farmers giving hypothetical responses and having zero responses on WTP as described by Carson (1997), local farmers were asked a series of probing questions. Such questions included required labour input and willingness to contribute to own preventive and mitigation measures of human-wildlife conflicts.

Three hundred household heads were targeted as respondents regardless of them being men or female. Direct observation, desk research (July 2014-July 2015 on human-wildlife conflict reports from the Zimbabwe Parks and Wildlife Management Authority), focus group discussions (4) and key informant interviews (20) were done. The key informants purposively selected included: 2 communal village councilors, 2 traditional communal village leaders, 2 Chipinge Agritex officials, 2 Zimbabwe Republic Police officers, 2 Parks Senior Wildlife officers, 1 District Administrator, 2 Save Valley Conservancy workers, 1 Member of Parliament, 4 Farmer Association Committee members and 2 Shareholders (Operators) in Save Valley Conservancy. Extensive compilation and consolidation of data from Save Valley Conservancy and the Zimbabwe Parks and Wildlife Management Authority on Problem Animal Control reports and other scientific documents/reports were also done. Data on all human-wildlife conflict incidents for the years 2014 to July 2015 was collected from the nearby local office of the Chipinge-Chipangayi National Parks and Wildlife Management Authority and summarized.

Data analysis: Chi-Square homogeneity tests and Kruskal-Wallis test were used to determine association among variables such as gender, age, knowledge about wild animals, and attitudes towards people's willingness to pay for human-wildlife conflict management. Kendall's tau correlation tests were used to determine the attitudes of respondents towards wild animals. Spearman rank correlation was used to check for relationships between number of human-wildlife conflicts and distance from the boundary of Save Valley Conservancy. Two tailed non-parametric Chi-square (χ^2) tests were conducted to determine if there were differences on human-wildlife conflicts prevalence across the two study strata using the Statistical Package for Social Sciences (SPSS) version 17.0. Prevalence rate of problem animal species and nature of human-wildlife conflicts were qualitatively analysed. WTP bids were regressed against a range of independent variables for instance gender, distance from Save Valley Conservancy boundary, awareness of human-wildlife management, wildlife damages on crops and livestock, age of household head, study site, household income, education level of household head, and occupation of household head. A hypothetical market was established to assess the households' WTP to avoid agricultural losses from human-wildlife conflict. Binary logistic regression was conducted to determine which independent variables were significant predictors of household's non-WTP (coded as 0) or WTP (coded as 1) for human-wildlife conflict management programs.

RESULTS

Human-wildlife conflict prevalence across local communal areas adjacent to Save Valley Conservancy, south eastern Zimbabwe: The proportion of households who had experienced or witnessed human-wildlife conflicts reported that human-wildlife conflicts had increased by 96% (n = 288) as from July 2010 to July 2015. The study recorded a significant difference in human-wildlife conflicts prevalence across the study area (χ^2 =51.84; df = 1, $p < 0.05$) with more households 92% (n = 276) from Mutema communal village area and less households from Musikavanhu communal village area 80% (n = 240) reporting that they had encountered problem animals from Save Valley Conservancy. All key informants 100% (n = 20) reported that human-wildlife conflicts were on an increasing trend, of which 64% (n = 12) of key informants felt human-wildlife conflicts were increasing due to human and wild animal population growth and the absence of a complete restrictive fence around Save Valley Conservancy. Human-wildlife incidences or encounters were also assessed by summarizing all problem wild animal control cases reported from July 2014 to July 2015 in the study area, where 70% of the cases involved were of frequent raids of agricultural crops such as maize (*Zea mays*), sorghum (*Sorghum bicolour*) and bananas (*Musa sapientum*) destroyed by African elephants (*Loxodonta africana*), African buffalo (*Syncerus caffer*), whereas spotted hyenas (*Crocuta crocuta*) and lions (*Panthera leo*) were reported to kill cattle (*Bos taurus*), donkeys (*Equus asinus*) and goats (*Capra aegagrus*) (Table 2). There were significant differences in animals causing human-wildlife conflicts (i.e., elephants (χ^2 =2.560; df=1, p<0.05) buffalos (χ^2 =3.840; df=1, p<0.05), lions (χ^2 =4.842; df=1, p<0.05) and spotted hyenas (χ^2 =4.840; df=1, p<0.05) in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe.

Households reported crop raiding and livestock predation to occur primarily (95.8%) once to multiple times a month. A significant proportion of the households perceived both the frequency and level of crop raiding and livestock predation to have increased over the past years (χ^2=507.51, df=2, $p < 0.001$). As earlier reported by Wells (2003), a few explanations of increased trend of human-wildlife conflicts were repeatedly provided by the households: *"The level of crop raiding and livestock predation has increased in the last few years maybe because prior to 1993, Save Valley Conservancy used to be a commercial cattle ranch, thus, the shift into game ranching with the introduction of wild animals which are ever increasing in population could be causing more incidences of human-wildlife conflicts ".*

Table 2. Wild animals causing human-wildlife conflicts in communal areas adjacent to Save Conservancy, south eastern Zimbabwe.

Species	Musikavanhu communal village area (n = 150)	Mutema communal village area (n = 150)
Elephants (*Loxodonta africana*)	33%	9%
Buffalos (*Syncerus caffer*)	6%	1%
Lions (*Panthera leo*)	31%	20%
Spotted hyenas (*Crocuta crocuta*)	19%	42%

Factors determining farmers' willingness to pay for human-wildlife conflict prevention: From the nine-predictor variables fitted in the binary logistic regression model, four variables, namely; household income, education level of household head, distance from Save Valley Conservancy boundary and general awareness of human-wildlife management, had a significant impact on influencing household's WTP for human-wildlife conflict management, while five variables (gender, wildlife damages on agricultural produce, study site and occupation of household head) were not significant in influencing household's WTP for human-wildlife conflict management (Table 3). The binary regression model is statistically significant, $F = 17.47, p < 0.01$. This indicated that, overall, the model applied can statistically and significantly predict the dependent variable, household willingness to pay for human-wildlife conflict management.

The negative value of coefficient β (see, Table 3) implies a decrease in likelihood of household's WTP for human-wildlife conflict management, while a positive value implies an increase. Household income, education level of household head and general awareness of human-wildlife conflict management were significantly and positively correlated to household's WTP for human-wildlife conflict management. Distance from Save Valley Conservancy boundary was significantly and negatively correlated to household's WTP for human-wildlife conflict management. As the distance from Save Valley Conservancy boundary decreases households are more likely willing to pay for human-wildlife conflict management, whereas, as distance increases people are less likely willing to pay.

Direct cost of wild animal crop raiding and livestock predation in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe: Table 4 records the opportunity costs, projected gain for anticipated change of agricultural produce (crop and livestock) and WTP for human-wildlife conflict management by local farmers in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe for the period 2014/15. The average household financial loss in revenues on mono-specific crop field and livestock herd unit was USD 588.71 ± 91.15 (range: USD 88.61 to USD 2 193.80) from perceived wildlife damage on agricultural produce by local household farmers. On the same household farming plots USD 216.62 ± 52.00 (range: USD 18.61 to USD 1 174.60) were lost from actual wildlife damage at net present value for 2014 and 2014/15 farming seasons in communal village areas adjacent to Save Valley Conservancy. Difference from the cost of actual agricultural damage as compared to perceived damage by local households was approximately 63.2% (Table 3).

Table 3. Binary logistic regression of the factors affecting household's willingness to pay or unwilling to pay for human-wildlife conflict management in adjacent communal village areas of Save Valley Conservancy, south eastern Zimbabwe

Independent Variable	Coefficient (β)	Std. Error	*t*	*p* - value
Gender (Dummy variable, 1 = Male, 2 = Female)	-0.72	0.72	-1.40	0.314
Distance from Save Valley Conservancy boundary	-1.42	0.68	2.11	0.036**
Awareness of human-wildlife management (Dummy variable, 0 = not aware, 1 = aware)	0	0	-1.76	0.025**
Wildlife damages (Crops & Livestock)	-0.99	0.70	-1.40	0.154
Age of household head	0.04	0.03	3.33	0.145
Study site (Dummy variable, 0 = Musikavanhu, 1 = Mutema)	0.01	0.02	-1.36	0.727
Household income	0	0	1.69	0.001***
Education level of household head	1.75	0.65	-1.91	0.006***
Occupation of household head (Dummy variable, 0 =less training, 2 = more training)	0.05	0.08	2.54	0.151

Notes: * -Significant at 0.1, ** - Significant at 0.05, *** - Significant at 0.01

Table 4. Opportunity costs, projected gain for anticipated change of agricultural produce (crop and livestock) and willingness to pay by local farmers in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe, 2014/15.

Opportunity cost	Sample size (*n*)	Rank	Loss (USD) Mean ± SE	Projected gain for change of agricultural produce (USD) Mean ± SE	Willingness to Pay (USD) Mean ± SE
Loss of sleep	120	1	202.20 ± 61.00	648.00 ± 114.00	283.80 ± 96.40
Increased risk of contracting diseases (e.g., malaria) and medical costs	22	4	54.80 ± 79.10	955.00 ± 323.00	206.00 ± 233.00
Loss of time for other chores	70	2	758.00 ± 228.00	1221.00 ± 34.00	216.00 ± 124.00
Travel restriction	26	3	29.80 ± 5.00	163.60 ± 76.30	43.30 ± 67.00
Disruption of schooling because children are needed to help guard family fields and/or herding livestock	120	1	201.10 ± 61.00	648.00 ± 113.00	283.80 ± 96.40
Increased need to guard fields and/or herding cattle, which can creates labour bottlenecks	22	4	53.80 ± 88.10	644.00 ± 112.00	305.00 ± 122.00
Increased need to pay for risk of HWC management of crop/livestock loss at household level	165	1	1101.00 ± 90.00	1395.00 ± 115.00	157.67 ± 138.00

Measures that communities and the government are implementing to reduce the wildlife damage on agricultural produce in communal areas adjacent to Save Valley Conservancy, south eastern Zimbabwe: Majority of the respondents, 55% (n = 165) suggested killing of wildlife animals and the complete installation of an electric powered fence to border the whole of Save Valley Conservancy to reduce human-wildlife contact (Table 5). However, a few key informants, 45% (n = 9) objected as they were of the view that fences exclude local communities from access to natural resources in protected areas e.g fuel wood, fodder, grazing land, thatch grass, timber, medicinal plants and wild fruits.

Table 5. Suggestions to reduce human-wildlife conflicts in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe.

Suggestions to reduce human-wildlife conflicts	Musikavanhu communal village area (n = 150)	Mutema communal village area (n = 150)
Electric fence erection	17%	33%
Local leadership and Save Valley Conservancy officials working together	66%	46%
Guarding own livestock and fields	3%	2%
Problem animals should be killed	37%	73%
There should be issuing of guns to guard agricultural produce	2%	3%

Farmer's willingness to pay to prevent wildlife damages in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe: The majority of households reported that they are not aware of agricultural insurance and they have never purchased agricultural insurance, 86% (n = 258), whereas, a few households, 14% (n = 42) heard from friends and relatives about agricultural insurance but did not purchase, sighting that agricultural insurance package was too expensive. However, 55% (n = 165) of the households were willing and likely to purchase agricultural insurance at an average annual premium of US$157.67 of agricultural produce per household (Table 4). The establishment of an insurance scheme for losses to human-wildlife conflicts was welcomed by over 76% (n = 228) of the farming households, with a significant difference among occupations (χ^2 = 3.05, df = 3, p < 0.05) and study area (χ^2 = 2.93, df = 2, p < 0.23) whereas there was no significance difference across the study strata. The formally private-public employed household heads preferred to pay for community based human-wildlife conflict management than the informally employed majority.

DISCUSSION

Determinants of farmers' willingness to pay for human-wildlife conflict management in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe: Education level of household head, income and household perception of human-wildlife conflicts were singled out as significant in determining or influencing households' willingness to pay for human-wildlife conflict management in communal areas adjacent to Save Valley Conservancy, south eastern Zimbabwe (Table 3). Households with high income have more resources and might be actively participating in farming and as such need to safeguard their agricultural assets. They in turn are willing to pay for insurance to prevent damage to their crop and livestock assets. Education level of household head implies awareness of importance of safeguarding and insuring agricultural production, hence a positive relationship between education level and WTP. A positive relationship between general awareness of human-wildlife conflicts management and WTP means those who are aware and conscious about the severity of human-wildlife conflict are more likely to pay for wildlife damage than those who are not. There is a negative relationship between willingness to pay and distance from the boundary of Save Valley Conservancy. This is because the closer to the Save Valley Conservancy, the more the wildlife damage experienced, hence need for agricultural produce to be insured against that damage.

There could be need to train communal village farmers on the importance of agricultural insurance thereby transforming farmers mindset towards farming as a agri-business as opposed to subsistence farming. With improved household income due to market driven agricultural activities, farmers in communal village areas adjacent to Save Valley Conservancy are likely to pay for the management and control of human-wildlife conflicts, their annual mean willingness to pay being at USD157.67 (Table 4). This high level of household willingness to pay is an opportunity for all relevant stakeholders of communal agriculture and wildlife management in south

eastern Zimbabwe to formalize and strengthen local agricultural insurance schemes backed by insurance awareness campaigns across farmers so as to reduce human-wildlife conflicts.

It has been reported that the common failure of most agricultural insurance schemes is attributed to bureaucratic inadequacies, corruption, cheating, fraudulent claims, moral hazards and the practical barriers that less literate households must overcome to discuss about or submit these financial insurance packages (Marchand, 2002). All these factors discourage farmers from willing to pay for wildlife damage prevention. A study of elephant damages carried out in the region of Boromo in Burkina Faso in 2001–2002, for example, revealed that 98% of the damages caused by elephants were not reported to the administration because the farmers knew there would not be any form of compensation (Marchand, 2002). The present study results revealed with concern, the absence of a compensation systems to local human-wildlife conflict victims in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe. Elsewhere, in Zimbabwe these compensation schemes rely on giving out permit to locals in the form of Communal Area Management Programme For Indigenous Resources (CAMPFIRE) to exploit natural resources, through communal tourism, hunting or collecting fuel wood, timber, mushrooms, fodder, etc (Gandiwa *et al*., 2013). This type of compensation scheme was recommended for communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe. This compensation scheme could be also known as the "settlement of rights" for communal people affected by wildlife protected areas to use natural resources and this appears to be a more practical solution than monetary payment. Indeed, the benefits derived from the legitimate use of natural resources influence the attitudes and perceptions of rural residents to pay for human-wildlife conflict management (Sekhar, 1998).

Opportunity cost and communal village farmer's willingness to pay for human-wildlife conflict management with Save Valley Conservancy, south eastern Zimbabwe: The loss of sleep due to guarding agricultural produce was an incurred opportunity cost, and its forgone economic activities during the time they were making up for the lost sleep was valued at US $202.20 per year, but with the perceived change of agricultural produce, the projected gain was reported to be higher than the loss at US$ 648.00 per year (Table 4). As such, local farmers were prepared to contribute in the range of US$ 283.80 per year, including in-kind contributions towards crop and livestock raiding preventive and mitigation measures. However, it is important to note that there were problems with the accuracy of the estimate, not least because of the real difficulties that farmers have in quantifying loss (a proportion of which may have been lost in any case, in the absence of crop raiding and livestock predation, through other variables not measured like weather conditions, edaphic factors, pests and diseases) but also because an increased awareness of the possibility of compensation for crop raiding and livestock predation losses may have led to inflated estimates (Karanth *et al.,* 2012). However, the loss was high for all opportunity costs associated with crop raiding and livestock predation by wild animals (Table 4). Other than the losses of livestock, crops (Kolowski and Holekamp, 2006) and human life (Prashant, 2004), human-wildlife conflicts has less visible effects, such as increased incidences of some diseases (Thirgood *et al*., 2005) and opportunity costs (Hill, 2000; Hoare, 2000), including children forgoing school-time in order to guard planted fields and/or herding livestock (Linkie *et al*., 2007). Crop raiding and livestock predation has been identified as a key form of human-wildlife conflict and the most important perceived disadvantage of agricultural production close to protected areas in Zimbabwe (Fritz *et al*., 2003; Le Bel *et al*., 2011; Gandiwa *et al*., 2013) as was the case with communal village areas adjacent to Save Valley Conservancy, south eastern Zimbawe.

WTP towards counter-measures of human-wildlife conflicts like electric fence erection was modest. Travel restriction was a perceived opportunity cost (Table 4). Travel restrictions were not only limiting local farmers from gaining external assistance for their livelihoods but could also hinder their ability to engage in other productive economic activities. The malaria, bodily harm and medical costs were the fourth ranked perceived opportunity cost. Although loss during the farming season was modest at US$ 54.80, the projected gain (US$ 955.00) was relatively high if there was a change in the crop and livestock but local farmers preferred traditional counter-measures to any other counter-measure that they were willing to pay a higher price of US$ 206.00 to improve them. A recognized and locally appropriate response was suggested to mitigate people's perceptions of the situation as a conflict.

Benefit-sharing among protected areas and communal areas was recommended within this broader approach of human-wildlife conflict management which provides tangible benefits to communal land owners in recognition of the role they play in hosting wildlife on adjacent land and covering associated costs. In this way wildlife can become a valuable resource rather than a liability to communal people. In Mozambique, for instance, the law stipulates that local communities living in adjacent village areas where natural resources are exploited should receive 20% of the income resulting from this exploitation, particularly through tourism in community protected areas and hunting in buffer zones (Government of Mozambique, 2005). This measure

ensured that about US$32 000 each year is distributed to the communities concerned in Mozambique. Several modes of wildlife valorization can be used to provide income to compensate populations affected by human-wildlife conflict.

In sub-Saharan Africa, some agricultural insurance schemes for farming household losses caused by wildlife damage exist (Muruthi, 2005). However, as highlighted by the present study results, there is lack of formal payment for agricultural insurance and compensation of human-wildlife conflicts management in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe. The present study recommends an agricultural insurance scheme, which is an innovative compensation approach where farmers pay a premium for cover against a defined risk, such as crop raiding and livestock predation. The premium can be set at the true market rate or be subject to subsidy provided by conservation organizations and/or the government (Muruthi, 2005). Although the insurance scheme can impose certain practices which need to be undertaken by participating farmers to avoid human-wildlife conflict, overall the method seems promising for the case of communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe. Human-wildlife conflict can lead to household poverty given that the households' reliance on crop and livestock production; and reduced yields due to wildlife damages. This is turn could have devastating impact by reducing food security and livelihood options for household income generation. In the case of communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe, the vulnerable households lacked resources in the first place and were facing further economic constraints as a result of damages from wildlife and thus there is need also to invest into protection measures such as the suggested installation of an electric powered fence to reduce trespassing of wild animals into human settlement (Kahuni *et al*., 2014).

Conclusion: The study sought to investigate determinants of farmers' willingness to pay for wildlife damage prevention and to estimate the opportunity cost the farmers are willing to pay to prevent wildlife damages on their agricultural produce. Household socio-economic status like education level of household head, improved household income and household perception of human-wildlife conflicts were singled out as significant in influencing households' willingness to pay for human-wildlife conflict management in communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe. There was a high level of household willingness to pay about US$157.67 annually, for human-wildlife conflict management and thus an opportunity for all relevant stakeholders of communal agriculture and wildlife management in Zimbabwe to formalize and strengthen local agricultural insurance schemes to manage human-wildlife conflicts.

Implications for human-wildlife management: Since funds from locally generated revenues from wildlife management are often limited for distribution to individuals (Degeorges and Reilly, 2009), other innovative payments for ecological services in form of the well adopted CAMPFIRE model in Zimbabwe (Gandiwa *et al*., 2013, ZPWMA, 2013) need to be explored for a case of communal village areas adjacent to Save Valley Conservancy, south eastern Zimbabwe. There is need to set up a fund to assist victims of wildlife damages in communal village areas adjacent to Save Valley Conservancy and related communities to protected areas in Zimbabwe. This can be confined to a particular class of loss, for example loss of a granary, crop damage, livestock predation, injuries or deaths of people caused by wild animal. The agricultural insurance schemes can also be funded by Save Valley Conservancy since government funding schemes do not exist. This can be done to prevent the affected people taking personal action themselves, which would usually involve killing the individual wild animals, when killing is not the appropriate solution in the circumstances. A solar powered electric fence was recommended for installation to reduce human-wildlife contact.

Acknowledgements: The study was supported by the Zimbabwe Parks and Wildlife Management Authority. Our special thanks go to the Mutema and Musikavanhu local communal village chieftainship for the logistical support for data collection. This research project was supported by a grant from the African Economic Research Consortium funding the Collaboration of Masters in Agricultural Economics and Extension through its Kenya Office and the University of Zimbabwe.

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