



## A Review of the Visible and Hidden Opportunity Costs of Human-Wildlife Conflict in Kenya

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### Abstract

This paper reviews the Human-Wildlife Conflict (HWC) studies in Kenya with special interest on the hidden opportunity costs. The paper considered the negative implications to the victims of HWC and explores ways of ensuring full integration of all costs especially in regard to the search for more comprehensive compensation frameworks. One of the specific interests in the paper was to determine whether the hidden costs of HWC in Kenya are well considered in the Wildlife Conservation and Management Act 2013 (WCMA 2013) or whether there is need for a review and amendments. Data for this review was obtained from Google Scholar and Crossref references and citation-enhanced indexing databases. Content analysis from the two databases showed a lot of research interest on the cost of HWC to societies around conservation areas. Further content analysis revealed that most of the HWC costs estimation studies have mostly concentrated on the visible costs (127 publications and 1507 citations) without serious consideration of the hidden costs (33 publications and 893 citations). As such, more research is required on the hidden costs in order to formulate more effective HWC loss compensation frameworks as a strategy for ensuring sustainable co-existence between society and wildlife.

**Keywords:** Human-wildlife conflict; Visible costs; Hidden costs; Opportunity costs

### Introduction

Wildlife plays a major role in Kenya's economy as a key tourist attraction, which provides over 300,000 jobs locally and accounts for almost 10% of the country's Gross Domestic Product (GDP). For example, in 2010 alone, the tourism industry earned Kenya KES 97.9 billion (US\$ 9.79 billion) [1,2].

In 2017, the contribution of the sector to the GDP was 9.7% compared 9.3% in 2016. Despite these benefits, a wide range of problems associated with HWC continue to ruffle the relationship between people and wildlife. The HWC problem has continued to intensify in most part of Kenya due to human population growth, which is estimated to increase at an average of 2.7% annually [3].

Consequently, the people's livelihood demands are reducing the space and resources for wildlife use. Globally, it is estimated that only 14.8% of the terrestrial environment and 12.7% of marine areas have been designated as protected areas for wildlife use [4].

In Kenya, less than 13% of the land is reserved for this purpose within state, private and communal conservation areas [5]. Although this is slightly higher than some other countries such as South Africa's (6.1%), Mauritius (3.3%), Egypt (5.6%), South Korea (3.6%), and India (5.3%), it is lower than others such as Tanzania (42.4%), Uganda (32.6%), Botswana (30.9%), and Malaysia (30.7%).

It is likely that the lower the area reserved for wildlife use in a country, the higher the magnitude of HWC. It is estimated that 65%-70% of the wildlife population in Kenya is surviving in fragmented habitats which are scattered within communal and private land thereby escalating the level of HWC [6].

This is a dual challenge associated with the negative impact on people and/or their property by wildlife on one hand and the negative impact by people on wildlife or their habitats on the other. However, the problem is usually perceived differently by those defending wildlife conservation and those defending human livelihood rights [7].

This contrast has continued to generate strong argument in support of wildlife rights by the conservationists on one side and the protection of human livelihoods by human right groups on the other.

Peterson et al. have for example, explored the use of the HWC phrase through content analysis of wildlife conservation publications and highlighted the divergent interpretations [8]. Similarly, Dickman et al. have argued that HWC may be shaped by conflicts between stakeholders; economic, political, religious and cultural factors [9].

This paper undertakes a comprehensive review of HWC studies with special interest on the hidden opportunity costs of HWC within the wildlife areas around the protected areas in Kenya as well as other similar areas in Africa.

The hidden costs of HWC are losses that are uncompensated, temporarily delayed, or psychosocial in nature [10]. These are the costs which are excluded from economic assessments associated with living with wildlife [11].

In this paper "hidden opportunity costs" is considered as the loss of time and money from other alternative options due to the need of safeguarding livestock, crop, and other properties from wildlife attacks.

A major question in the paper is whether the hidden costs of HWC in Kenya are well considered in the listed wildlife species as stipulated in the third schedule of WCMA 2013 or whether there is need for a review and amendments to effectively capture such costs.

### Material and Methods

Data for the review of HWC studies was collected from Google Scholar and Crossref citation databases. These were selected over other data bases because of their capacity for automatic and cost-free search without the need for subscription to access their databases.

The keywords used in the search were limited to "hidden OR indirect costs" AND "human-wildlife conflict". The search was conducted by initially searching relevant titles of the articles by

ensuring that they were generally about HWC and contained at least one of the keywords.

Thereafter, the abstracts of the articles that met the first criteria were further screened for the other keywords. The articles that did not meet the two criteria were excluded. The Google scholar and Crossref year wise results were then downloaded using Publish or Perish software Version: 6.28.6197 (2018).

The Google Scholar and Crossref search were restricted to 12 years, ranging from 2006-2017. The timeframe was based on the fact that 2006 was the year during which the process of the reviewing the previous wildlife legal framework and formulation of WCMA 2013 as the umbrella wildlife law in Kenya started.

One of the key aims of reviewing the wildlife law was to ensure decentralized governance and introduction of innovative measures to mitigate HWC and adequate compensation for wildlife damages [12].

Data for all the target years were combined in a single Excel worksheet and any duplication deleted. Microsoft Excel 2016 was used to compile the data set and result for interpretation. One of the limitations of the literature search using the Crossref, was its inability to yield beyond 200 results at ago.

Consequently, some matches may have been missed from the search. However, Adams affirms that the missed results are normally

ranked lower than the ones returned and that the articles missed usually have few or no citations [13].

## Results and Discussion

The Google Scholar search for “hidden OR indirect costs” AND “human-wildlife conflict” provided only 33 results in form of articles, proceedings papers, and books reviews while the Crossref search provided a maximum of 200 results.

However, 114 results from the Crossref search did not meet the set criteria. The remaining 86 results included 76 articles, 2 books, and 8 book chapters.

Other documents such as meetings, editorial material, letters, and biographical items were excluded. In total, there were 119 results for comprehensive content analysis. The pattern showed that the number of publications on hidden costs of HWC increased over the years, with the highest publications in 2015 and 2016.

However, in 2017, the publication rate declined significantly with the Crossref database search returning 11 publications and the Google Scholar search providing only 5 publications (Figure 1).

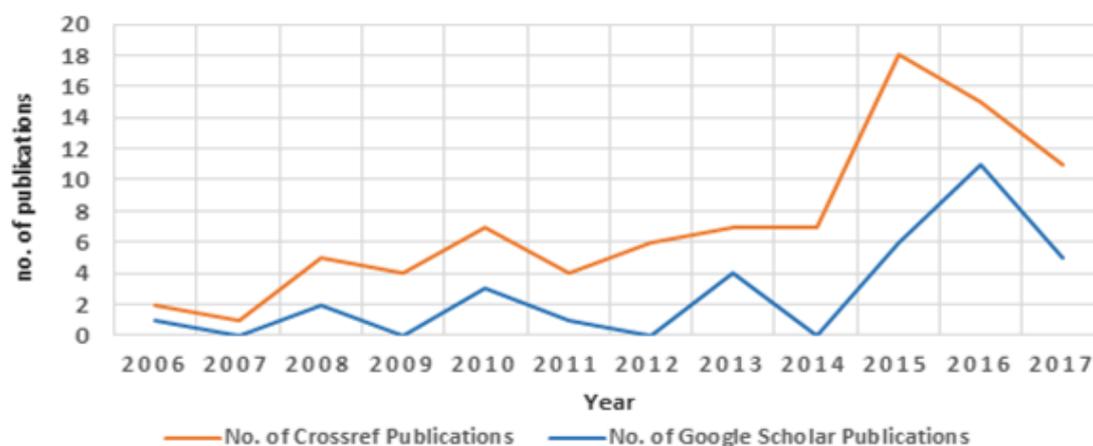


Figure 1: The 2006-2017 Google Scholar and Crossref publications of social impacts of HWC.

Contrary to the publication numbers, the citations per year fluctuated over the 12 year period, with the highest score in 2008 and 2010 as shown in Figure 2.

A Google Scholar search for “visible OR direct costs” AND “human-wildlife conflict” returned 127 publications and 1507 citations

compared to “hidden OR indirect costs” AND “human-wildlife conflict” result of 33 publications and 893 citations (Figure 2).

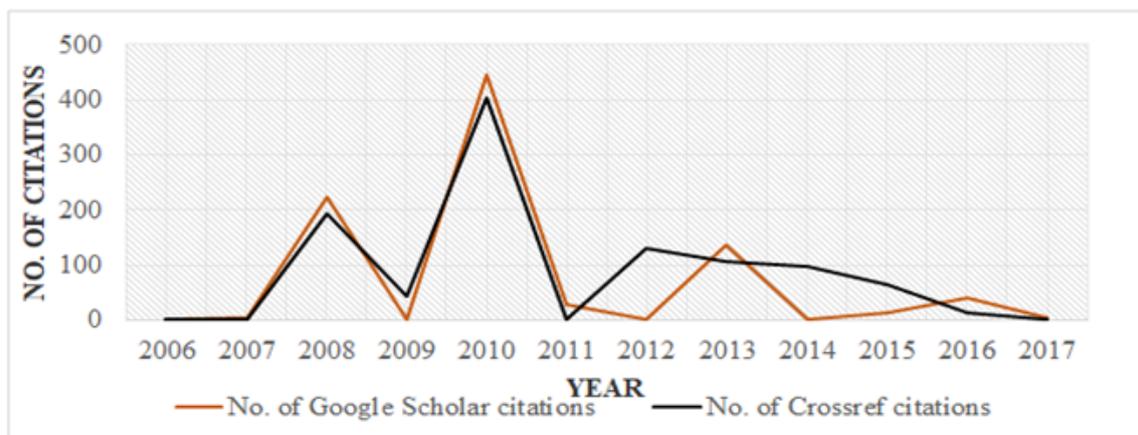


Figure 2: No. of Citations per year for Google Scholar and Crossref.

### Human-wildlife-conflict studies

A large number of informative studies on HWC have been undertaken in Africa including Kenya (Figure 1). The great interest on the subject in Africa is associated with the undisputable fact that the Afro-tropical realm especially in Sub-Saharan Africa stands out as one of the few biogeographic regions in the world which still support a wide range of fauna in their natural range compared to others like the Palaeartic and Nearctic realms where major transformation of the original wildlife species and habitats has taken place [14,15].

Okech has studied the HWC around the conservation areas in Kenya and established that the majority of the local people around protected areas have a negative attitude and hostile feelings towards wildlife [16]. This is largely attributed to the conservation policies adopted by the government which tend to favour wildlife rights more than society rights. There is sufficient evidence to show that the colonial legacy in Kenya was marked by the alienation of people from the resources they had traditionally associated with and relied on for their cultural practices especially wildlife [17,18]. After independence, wildlife heritage governance heavily adopted the colonial approach in terms of policy, legal and institutional frameworks [17]. Consequently, wildlife conservation areas were surrounded by hostile people who had no sympathy for wildlife which they consider as government property [18].

The above challenges have been experienced in other African countries such as Sierra Leone and Tanzania where HWC and people's negative attitude towards wildlife conservation has been documented by scholars such as Larson et al. and Mbise et al. respectively [19,20]. Similarly, Matema and Andersson have documented the problem of HWC and social discontent in Mbire District of Zimbabwe [21]. In Ethiopia, Atickem and Loe studied the problem of HWC in the Ethiopian highlands and identified a clear correlation between negative public attitude towards wildlife and livestock herd size in the Bale Mountains [22]. Public attitude was closely linked with intense competition for shared resources by wildlife and society especially with high livestock stocking rates.

A large section of the HWC research in Africa is centred on species-specific studies with the megafauna especially the elephant attracting a lot of interest [23-30]. Studies on the problem between society and

predator species are also quite common in Africa. For example, Gade studies in the Horn of Africa revealed that hyenas had previously killed livestock and people, and even consumed human corpses during armed conflicts [31]. Other predator-specific studies have centred on lions [21], leopards [32,33] and cheetahs [34] among others. The findings in most of the above studies have revealed that the population of predators in Africa is declining sharply and is projected to decline further by 50% in the next two decades without increased conservation effort and more popular strategies to deal with HWC issues like the ones highlighted above.

In Africa, crop raiding, livestock predation, property damage, human attacks and disease transmission are the most widely documented forms of HWC [35]. These generic problems have continued to heighten the tension between wildlife and African societies with an exception of a few areas where people are benefiting more directly from their wildlife heritage. For example, Mc Guinness [36] established that lack of adequate revenue sharing with the communities most exposed to the HWC in Rwanda has fostered ill feelings towards wildlife conservation due to the huge losses incurred through crop raiding.

The literature review indicates that some research interest has focussed on the cost of HWC to societies especially around conservation areas in Kenya. These include studies by Sitienei et al. [37], on the cost of human-elephant conflicts; Manoa and Mwaura [38] and Muriuki et al. [39] on the cost of livestock predation in community ranches around Amboseli National Park. Similar studies have also been undertaken elsewhere in Africa, such as the estimation of the labour cost of crop protection from wildlife destruction in Gabon by Walker [40].

It is quite clear from the available literature that most of the studies undertaken in Africa on the issue of losses incurred from HWC have mostly concentrated on the direct or visible costs without serious consideration of the indirect or hidden costs. This is clearly visible from the the Google Scholar and Crossref returns in this review. Barua et al. for example, noted that the hidden impacts of HWC remain poorly addressed around the world including Africa [41]. Barua's sentiments are in agreement with other researchers such as Ogra; Bond and [42]. Ignoring hidden costs of HWC is problematic in conservation because, in most cases the hidden costs can override the

visible costs. A study by Taylor et al. [43], for example, showed that the hidden costs for sheep depredations in South Utah USA was US\$1.2 million (KES 120,000,000) compared to visible costs which was US\$ 419,000 (KES 41,900,000). In Botswana, farmers are known to spend up to US\$ 30 (KES 3000) to employ 3.5 herders to prevent livestock predation by wild animals, which is part of the hidden costs of HWC. In Kenya, a study in communal ranches around Amboseli National Park by Manoa showed that a single pastoralist homestead spent an average of KES 40,530 (US\$ 405.30) to construct predator-proof enclosures in order to safeguard their livestock at night [44].

Although the wildlife heritage in Kenya is known to generate a lot of revenue through tourism as already indicated, societies in the frontlines of wildlife conservation areas suffer a lot of losses as result of HWC [1]. For example, between 2014 and 2016, the burden of the pending compensation claims for HWC related losses was estimated to KES 4.6 billion (US\$ 46,000,000). It is therefore important to consider wildlife heritage in a cost-benefit approach by determining both the visible and hidden costs associated with HWC. This is imperative for equitable sharing of tourism benefits including satisfactory compensation for incurred losses.

The Third Schedule of WCMA 2013 provides for compensation of HWC for a range of wildlife species including snakes, elephants, buffalo, lions, leopards and crocodiles through the County Wildlife Conservation and Compensation Committees (CWCCC). However, there was a recent move by the National Assembly to amend the law and withdraw snakebite compensation from the list due to hefty claim levels, which had reached KES 1.5 billion (US\$ 15,000,000) in December 2017. In the Third Schedule, the visible costs of HWC, namely, human death and injuries, crop damage, livestock predation and property damages, caused by the specified 30 wildlife species can be compensated by the government. However, this compensation is mainly centred on the visible costs of HWC which are quite easy to calculate using the market price method. The losses incurred from other wildlife species such as baboon, mouse birds and Quelea birds are ignored, yet they also cause significant damage by destroying crops at different levels, thus compromising yield both in quantity and

quality. For example, around the Simien Mountains National Park in Ethiopia, damages by the gelada baboon resulted in average annual crop loss of  $117 \pm 10$  Kgs per household and estimated the annual global agricultural losses due to the Quelea birds to be more than US\$ 50 million (KES 5,000,000,000) [45,46].

### Visible costs of HWC

Over the years, there has been increased overspill of agrarian communities from the congested humid areas in Kenya such as Nyeri, Muranga and Kiambu Counties to the rangelands such as Laikipia, Kajiado and Narok Counties. This has led to widespread sub-division of the communal land which previously provided viable wildlife habitats. The situation has escalated the HWC problem including the hidden costs, especially within the wildlife corridors and dispersal areas.

The problems associated with the visible costs of HWC in the wildlife corridors and dispersal areas have been documented in a number of studies (Table 1). For example, crop raiding by African elephants (*Loxodonta africana*) in areas adjacent to Meru National Park [47]; livestock predation in group ranches around Tsavo National Park [48]; and Human injury and deaths [49]. Unlike crop raiding and livestock predation, human death and injuries can seriously intensify negative attitude toward wildlife by the society. The valuation of the loss of human life due to wildlife attack is an emotional matter because; placing value to human life is both difficult and is often considered as immoral [50]. The compensation for loss of life and human injury in Kenya is KES 5 million (US\$ 50,000) and KES 2-3 million (US\$ 20,000-30,000), respectively based on the WCMA 2013 rates. These are the limits regardless of the age, gender, occupation and role of the victim in society. Despite this challenge, the HWC problem has continued to occur in many parts of the world including Africa where it is associated with a range of wildlife species including elephants. For example, a study by Kaipotok established that human injuries accounted for 5% of human-elephant conflicts while human deaths accounted for 4% around Tsavo National Park, while snake bites case in Kenya rose from 20 incidences in 2003 to 500 in 2015 [51,52].

VisibleHWC	Period	Location	Wildlife species involved	Economic loss/impacts	References
Livestock predation	June, 2009	Amboseli National Park	Lion	KES 29,968,240 (US\$299,682)	Muriuki, Ipara and Kiringe (2017)
	2008-2012		Lion, Cheetah, Hyena & Jackal	KES 28,000,000 (US\$28,000)	Okello, Bonham and Hill (2014) [53]
	4 years	Tsavo National Park	Lion	KES 699,920 (US\$6,999)	Patterson, Kasiki, Selempo and Kays (2004)
Crop raiding	2010-2011	Meru National Park	Elephant	KES 9, 624,640 (US\$96,246)	Sitienei, Jiwen and Ngene (2014)
	9 months	Marsabit National Park and Forest Reserve	Elephant	KES 16,705,120 (US\$167,051)	Ngene and Omondi (2009)
	2010-2013	Tsavo National Park	Elephant	KES 10,860,560 (US\$108,605.60)	Kaitopok (2015)
Human death and injuries	2000-2007	Entire Kenya	Elephant	200 people killed	WWF (2007)
	2000-2007	Entire Kenya	Various predators wildlife	250 people killed	Western and Waithaka (2005) [54]

	2010-2013	Tsavo National Park	Elephant	Pending compensation for human injuries, KES 440,000(US\$4400)	Kaitopok (2015)
				Pending compensation for human deaths, KES 1,250,000(US\$12,500)	

**Table 1:** Visible costs of HWC in selected parts of Kenya.

The costs involved in mitigating visible HWC are also prohibitive to majority of the people who live in wildlife zones, particularly in rangeland where 74%-97% of people live below the poverty line [55]. For example, the direct cost of installing protective elephant-proof fences to mitigate such losses from HWC was estimated to be KES 1,200,000 (US\$ 12,000) per Kilometre by King et al. [56].

### Hidden opportunity costs of HWC in Kenya

HWC has a wide-range of intangible negative social and psychological impacts including fear, loss of sleep and deviated focus [57]. One of the key hidden costs of HWC opportunity cost which is defined as the loss or sacrifice incurred by making a decision to take one action instead of other more preferred and beneficial alternatives [58]. Opportunity costs are part of the wider social problems encountered by societies living in or close to wildlife inhabited areas. Such areas may provide diverse and easily quantifiable benefits to the people such as easy access to consumptive goods (e.g. farming, fishing, grazing, and logging opportunities) and non-consumptive services (Environmental amenity through e.g. game watching, nature photography and worship) as highlighted by Mwaura [18]. However, the close interaction with wildlife also comes with the risk of encountering a number of hidden costs and foregone opportunities which are not easy to put into perspective [57]. The foregone goods and services include the inability to access resources inside conservation areas including wildlife for cultural rituals and direct financial gains [59,60]. The hidden losses might include the tangible effort needed to prevent crop raiding or livestock predation by wildlife. It may also include the distractive fear, uncertainty and psychological stress of such possibilities even if they do not happen. The costs associated with such distractions are not easy to quantify and vary from one victim to another. Consequently, scientific studies related to these kinds of losses are quite rare around the world including Kenya.

The study by Sitati et al., on the spatial aspects of human-elephant conflict in Trans Mara County uncovered the intangible negative psychological impacts of wildlife [61]. The findings showed that HWC opportunity costs are not just experienced by adults, but also by children of different age groups. For example, children aged between 6 and 15 years were found to report late to school in the morning (8:00-10:00 am) due to the perpetual fear of being attacked by elephants and had to leave school early (3:00-4:00 pm) for the same reason. As a result, teachers were not able to effectively complete the syllabus which could lead to poor performance in national exams and poor development of the children. Similar findings have been documented by Mwangi et al. in Nthongoni an area bordering Tsavo and Chyulu national parks. It is quite hard to estimate the total cost of such disturbance which can easily affect the entire life of a human being especially in terms of career foundation and progression [62].

A study on livestock predation around the Amboseli National Park in Kenya established that in order to minimise the problem, the

traditional homestead fence (boma) had to be upgraded to predator-proof status [44]. This requires the reinforcement of the enclosures where livestock are kept at night by rolls of chain-links and strong poles; others use solar powered night-time blinking lights to scare away predators. According to Sutton et al., the average resources needed to construct a standard fully-fortified boma in Western Mara region were [63]: four rolls of chain-link (KES 5,000 each or US\$ 50); treated wood posts (eight at KES 900 or US\$9); high tensile wire (1180 feet at KES 2 or US\$ 0.02/foot); one door (KES 2,000 or US\$ 20); steel corners (four at KES 2,500 each or US\$ 25); miscellaneous amounts: cement, sand, and rocks (approximately KES 1,000 or US\$ 100); one box of binding wire and 3 kg nails etc. (approximately KES 1,500 or US \$ 15). Additional costs include construction labour (two day labourers at KES 1,000 or US\$10 per day each), welding labour (one skilled labourer at KES 4,800 or US\$ 48) and transportation from Nairobi (approximately half a lorry at KES 50,000 or US\$ 500). According to Sutton et al., the total cost to build a fully fortified boma in to be approximately US\$ 890.13 (KES 89,013). The funding agencies provided KES 55,860(US\$ 558.60), leaving an average cost of KES 22,000 (US\$ 220) to Maasa livestock owners.

For homesteads to own a predator-proof boma in Amboseli, they had to contribute 25% of the total cost while the rest was covered by conservation agencies such as the Born Free Foundation and African Wildlife Foundation. This entails selling about eight sheep/goats or two cattle to deal with the HWC. The same could instead have been spent on buying food, cloths, medicine and paying school fee if the HWC was not there. The foregone amount can be considered to be significant for an area where majority of the people are considered to be poor. Those who had not adopted the predator-proof boma, had to guard their livestock against predators almost every night, especially during the rain seasons. This exposes people to danger of contracting malaria from mosquito bites, loss of sleep and thus not being able to actively engage in other social and economic activities [38]. The findings resemble the study conducted in Mahiga "B" village in Nyeri County in 2005 which revealed that within five months, nine households spent 470.1 hours and 78.94 hours guarding their farms against various wildlife species at night and during the day respectively [64]. Although the predator-proof bomas reduces livestock predation at night, the presence of stinking urine and dung in the enclosure increases the risks of diseases outbreak that can compromise growth rates of calves [65]. This can lower livestock production and hence raise financial losses.

Some studies have disclosed that the destruction of property and infrastructure by wildlife can also results to hidden opportunity costs. Mariki for example, clearly explained that wildlife species such as elephants can destroy water pipes thereby forcing people to walk longer distances to fetch water at the expense of other important chores such as land cultivation [66]. Crop raiding by elephants also increase field guarding time thereby leading to reduced sleep and increased stress levels. In Narok County of Kenya, Korir, for example,

reported that soya bean farmers were forced to employ at least three workers to guard their farms against zebras and gazelles [67]. This forced each farmer to spend an average of KES 18,000 (US\$180) per month on employee wages. The money could instead have been used to improve crop production through buying insecticides, weeding or even investing in other profitable crops. The farmer's investments in other potential income generating projects are therefore compromised when money is diverted to guarding the farm.

This review established that very few studies have been conducted on the hidden cost of HWC. In Africa, only a few scholars such as Emerson; Khumalo and Young; Muyoma; Mayberry et al., have examined hidden costs of HWC but mostly from qualitative perspectives [68-71]. These studies mostly dwell on identifying the nature of hidden costs and documenting the percentages of the affected people, with some studies focusing on the economic competition between protected areas and agricultural land. Although some studies have considered opportunity costs, most of them did not quantify the level of loss especially at household level. This review also established that in most African countries where mega fauna such as elephants exist, several scholars have mainly documented and quantified the direct costs of HWC. Yet to be able to get the actual cost of HWC, both the visible and hidden costs must be considered. Dickman emphasises the need for researchers to consider the wider socioeconomic, ecological and cultural conditions under which intense conflicts arise, rather than the conventional way of focusing on species based conflict analysis [72]. In Kenya, recent studies by Mwangi et al. and Bond and Mtuku, have attempted to document the hidden cost of HWC in Laikipia County and the Nthongoni area in Makueni County, respectively. Bond and Mtuku study attempted to quantify the losses but does not compare the resultant hidden costs to the visible costs [42].

## Conclusion

The review of previous studies presents a gap especially with regard to characterization, quantification and comparison of opportunity costs and other hidden costs of HWC in rangeland and forest ecosystems which are associated with high wildlife density. It is important to determine how the hidden costs affect society and livelihood systems. Another area that has received little attention is the modalities for compensating hidden costs of wildlife related damages. This could be attributed to the continued adherence by many African governments to the colonial wildlife management policies which seem to consider wildlife as more important than people.

Although some countries including Kenya have recently increased the compensation amounts, for wildlife related losses, the payments are not inclusive of the hidden costs and can therefore be considered as under-compensation. At the same time, it is still difficult for victims of HWC to get compensation due the bureaucratic nature of the process, and the laws compel people to use their own resources to mitigate HWC. The poor understanding of the hidden costs of HWC undermines the people's well-being. This problem is attributed partly to the scarcity of wildlife economists probably due to the slow take-off of environmental economics around the world including Kenya.

It is recommended from the findings of this review that additional and comprehensive research be undertaken to address the following pertinent questions:

- What is the economic magnitude of the opportunity, transaction and health costs of HWC in different wildlife ecosystems?

- Is there any significant difference between visible and hidden costs of HWC in rangelands, forest and aquatic ecosystems?
- Are there alternative strategies and mechanisms for sustainable compensation for wildlife damages?

The answers to these questions will inform policy decisions in incorporating the hidden costs in wildlife conservation and management in Kenya.

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## References

1. Valle E, Yobesia MN (2009) Economic Contribution of Tourism in Kenya. *Tour Anal* 14: 401-414.
2. Ojwang GO, Wargute PW, Said MY, Worden JS, Davidson Z, et al. (2017) Wildlife Migratory Corridors and Dispersal Areas: Kenya Rangelands and Coastal Terrestrial Ecosystems. Kenya Vision 2030 Flagship Project, Securing Wildlife Migratory Routes and Corridors.
3. United Nations, Department of Economic and Social Affairs, Population Division (UN DESA) (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables.
4. UNEP-WCMC and IUCN (2016) Protected Planet Report 2016. UNEP-WCMC and IUCN: Cambridge UK and Gland, Switzerland.
5. National Coordinating Agency for Population and Development (NCPD) (2009) Population dynamics and climate change: Implications for the realization of the MDGs and the goals of vision 2030, Nairobi.
6. Ogutu JO, Kuloba B, Piepho HP, Kanga E (2017) Wildlife population dynamics in human-dominated landscapes under community-based conservation: The example of Nakuru Wildlife Conservancy, Kenya. *PLoS ONE* 12: 1-30.
7. Redpath S, Bhatia S, Young J (2014) Tilting at wildlife: Reconsidering human-wild life conflict. *Oryx* 49: 222-225.
8. Peterson MN, Birckhead JL, Leong K, Peterson MJ, Peterson TR (2010) Rearticulating the myth of human-wildlife conflict. *Conserv Lett* 3: 74-82.
9. Dickman AJ, Hazzah L (2016) Problematic Wildlife. In: Angelici F (eds.) Money, Myths and Man-Eaters: Complexities of Human-Wildlife Conflict. Springer, Germany, pp: 339-356.
10. Ogra MV (2008) Human-wildlife conflict and gender in protected area borderlands: A case study of costs, perceptions, and vulnerabilities from Uttarakhand (Uttaranchal), India. *Geo forum* 39: 1408-1422.
11. Hunter M, Hitchcock R, Wyckoff-Baird B (1990) Women and wildlife in Southern Africa. *Conserv Biol* 4: 448-451.
12. GoK. (2007) Draft Wild life Policy 2007. Ministry of Tourism and Wildlife.
13. Adams D (2017) Warn Max results, p: 1.
14. Williams PH, Burgess ND, Rahbek C (2000) Flagship species, ecological complementarity and conserving the diversity of mammals and birds in sub-Saharan Africa. *Anim Conserv* 3: 249-260.

15. Klerk HM, Crowe TM, Fjeldsa J, Burgess ND (2002) Patterns of species richness and narrow endemism of terrestrial bird species in the Afrotropical region. *J Zool* 256: 327-342.
16. Okech RN (2010) Wildlife-community conflicts in conservation areas in Kenya. *African Journal on Conflict Resolution* 10: 65-80.
17. Waitthaka J (2012) The Kenya Wildlife Service in the 21st Century: Protecting Globally Significant Areas and Resources; Historical Factors that Shaped Wildlife Conservation in Kenya. *George Wright Forum* 29: 21-29.
18. Mwaura F (2016) Conservation of Natural and Cultural Heritage in Kenya. In: Deisser A, Njuguna M (eds) *Wildlife heritage ownership and utilization in Kenya: Past, present and future*. UCL Press, London, pp: 125-142.
19. Larson LR, Conway AL, Hernandez SM, Carroll JP (2016) Human-wildlife conflict, conservation attitudes, and a potential role for citizen science in Sierra Leone, Africa. *Conserv Soc* 14: 205-217.
20. Mbise FP, Skjærvø GR, Lyamuya RD, Fyumagwa RD, Jackson C, et al. (2018) Livestock depreciation by wild carnivores in the Eastern Serengeti Ecosystem, Tanzania. *Int J Bio Conserv* 10: 122-130.
21. Matema S, Andersson JA (2015) Why are lions killing us? Human-wildlife conflict and social discontent in Mbire District, northern Zimbabwe *J Mod Afr Stud* 53: 93-120.
22. Atickem A, Loe LE (2013) Livestock-wildlife conflicts in the Ethiopian highlands: Assessing the dietary and spatial overlap between mountain nyala and cattle. *Afr J Ecol* 52: 343-351.
23. Sitati NW, Walpole MJ, Smith RJ, Leader-Williams N (2003) Predicting spatial aspects of human-elephant conflict. *J Appl Ecol* 40: 667-677.
24. Dublin T, Hoare RE (2004) Searching for solutions: The evolution of an integrated approach to understanding and mitigating human-elephant conflict in Africa. *Hum Dimens Wildl* 9: 271-278.
25. Naughton-Treves L, Treves A (2005) Socio-ecological factors shaping local support for wildlife: Crop-raiding by elephants and other wildlife in Africa. *Conservation Biology Series Cambridge* 9: 252-277.
26. Sitati NW, Walpole MJ (2006) Assessing farm-based measures for mitigating human-elephant conflict in Transmara District, Kenya. *Oryx* 40: 279-286.
27. Barua M (2010) Whose issue? Representations of human-elephant conflict in Indian and International Media. *Sci Commun* 32: 55-75.
28. Kibue GW, Karachi MK, Maara NT, Cheboi EK (2011) Perpetuated human-wildlife wars: A case study of the marauding elephants in Mbuvi Small Scale Farms, Embu, Kenya. *East Afr Soc Sci Res Rev* 27: 33-48.
29. Pinter-Wollman N (2012) Human-elephant conflict in Africa: The legal and political viability of translocations, Wildlife Corridors, and Transfrontier Parks for Large Mammal Conservation. *J Int Wildl Law Pol* 15: 152-166.
30. Hoare RE (2015) Lessons from 20 Years of Human-Elephant Conflict Mitigation in Africa. *Hum Dimens Wildl* 20: 289-295.
31. Gade DW (2006) Hyenas and humans in the Horn of Africa. *Geogr Rev* 96: 609-632.
32. Constant NL, Bell S, Hill RA (2015) The impacts, characterisation and management of human-leopard conflict in a multi-use land system in South Africa. *Bio Divers Conserv* 24: 2967-2989.
33. Gaworecki M (2017) Human-wildlife conflict is decimating leopard numbers in one of their last African strongholds. *Mongabay News, California, United States*.
34. Marker LL, Boast LK (2015) Human-wildlife conflict 10 years later: Lessons learned and their application to cheetah conservation. *Hum Dimens Wildl* 20: 302-309.
35. Thirgood S, Woodroffe R, Robinowitz A (2005) The impacts of human-wildlife conflict on human lives and livelihoods in People and Wildlife or Coexistence? Cambridge University press, Cambridge, UK, pp: 13-26.
36. Mc Guinness SK (2016) Perceptions of crop raiding: effects of land tenure and agro-industry on human-wildlife conflict. *Anim Conserv* 19: 578-587.
37. Sitienei AJ, Jiwen G, Ngene SM (2014) Assessing the cost of living with elephants (*Loxodonta africana*) in areas adjacent to Meru National Park, Kenya. *Eur J Wildl Res* 60: 323-330.
38. Manoa DO, Mwaura F (2016) Predator-Proof Bomas as a Tool in Mitigating Human-Predator Conflict in Loitokitok Sub-County, Amboseli Region of Kenya. *Nat Res* 7: 28-39.
39. Muriuki MW, Ipara H, Kiringe JW (2017) The cost of livestock lost to lions and other wildlife species in the Amboseli ecosystem, Kenya. *Eur J Wildl Res* 63: 60.
40. Walker KL (2012) Labor costs and crop protection from wildlife predation: The case of elephants in Gabon. *Agr Econ* 43: 61-73.
41. Barua M, Bhagwat SA, Jadhav S (2013) The hidden dimensions of human – wildlife conflict: Health impacts, opportunity and transaction costs. *Biol Conserv* 157: 309-316.
42. Bond J, Mkutu K (2018) Exploring the hidden costs of human-wildlife conflict in northern Kenya. *Afr Stud Rev* 61: 33-54.
43. Taylor RG, Workman JP, Bowns JE (1979) The Economics of Sheep Predation in South-western Utah. *J Range Manag* 34: 317-321.
44. Manoa DO (2015) Perceptions toward cost-sharing projects in hard times: Lessons from Amboseli, Kenya. *Int J Rec Res Soc Sci Human* 2: 173-178.
45. Yihune M, Bekele A, Tefera Z (2009) Human-gelada baboon conflict in and around the Simien Mountains National Park, Ethiopia. *Afr J Ecol* 47: 276-282.
46. The Food and Agriculture Organization (FAO) (2007) *Paying Farmers for Environmental Services*, In: *The State of Food and Agriculture 2007*, FAO Corporate Document Repository.
47. Ngene SM, Omondi P (2009) The costs of living with elephants in the areas adjacent to Marsabit National Park and reserve. *Pachyderm* 45: 77-87.
48. Patterson BD, Kasiki SM, Selempo E, Kays RW (2004) Livestock predation by lions (*Panthera leo*) and other carnivores on ranches neighbouring Tsavo national parks, Kenya. *Bio Conserv* 119: 507-516.
49. WWF (2007) *Human Animal Conflict*.
50. Zhang L, Wang N (2003) An initial study on habitat conservation of Asian elephant (*Elephas maximus*), with a focus on human elephant conflict in Simao, China. *Biol Conserv* 112: 453-459.
51. Kaitopok JP (2015) Assessment of economic cost of human/elephant conflict in Tsavo conservation area, Kenya. M.Sc Thesis, University of Pretoria, South Africa, pp: 1-65.

52. Mutai E (2016) MPs plan law change to cut snake bites from compensation list as claims rise to Sh4.5bn. Daily Nation, Nairobi, Kenya.
53. Okello MM, Bonham R, Hill T (2014) The pattern and cost of carnivore predation on livestock in Maasai homesteads of Amboseli ecosystem, Kenya: Insights from a carnivore compensation programme. *International Journal of Biodiversity and Conservation* 6: 502-521.
54. Western D, Waitthaka J (2005) Policies for reducing human-wildlife conflict: A Kenya case study. In Woodroffe R, Thirgood S, Rabinowitz A (Eds.) *People and Wildlife, Conflict or Co-existence?* Cambridge University Press, Cambridge. *Conservation Biology* pp 357-372.
55. GoK (2015) National Policy for the Sustainable Development of Northern Kenya and other Arid Lands 'Unlocking Our Full Potential for Realization of the Kenya Vision 2030'. Ministry Of Devolution And Planning.
56. King L, Lala F, Nzumu H, Mwambingu E, Douglas-Hamilton I (2017) Beehive fences as a multidimensional conflict-mitigation tool for farmers coexisting with elephants. *Conserv Biol* 31: 743-752.
57. Hoare RE (2001) A decision support system for managing human-elephant conflict situation in Africa. The African Elephant Specialist Group, Species Survival Commission and The World Conservation Union, Nairobi, Kenya.
58. Fauna and Flora International (FFI) (2014) Opportunity Cost Analysis. Lessons learned from REDD+ and other conservation strategies. Cambridge, England, pp: 1-5.
59. Dickman JA (2008) Key Determinants of Conflict between people and wildlife particularly large Carnivores, around Ruaha National Park, Tanzania. PhD Thesis, University College London and Institute of Zoology, Zoological Society of London, United Kingdom, pp: 1-373.
60. Goldman MJ, de Pinho JR, Perry JE (2010) Maintaining complex relations with large cats: Maasai and lions in Kenya and Tanzania. *Hum Dimens Wildl* 15: 332-346.
61. Sitati N, Nalpole M, Leader-William N, Stephen PJ (2012) Human-Elephant conflict: Do elephants contribute to low mean grades in schools within elephant ranges? *Int J Biodivers Conserv* 4: 614-620.
62. Mwangi DK, Akinyi M, Maloba F, Ngotho M, Kagira J, et al. (2016) Socioeconomic and Health Implications of Human-Wildlife Interactions in Nthongoni, Eastern Kenya. *S Afr J Wildl Res* 46: 87-102.
63. Sutton AE, Downey MG, Rinaldi M, Pimm S, Kamande E, et al. (2017) Boma fortification is cost-effective at reducing predation of livestock in a high-predation zone in the Western Mara Region, Kenya. *Conserv Evid* 14: 32-38.
64. Musyoki C (2014) Crop defense and coping strategies wildlife raids in Mahiga "B" village in Nyeri District, Kenya. *Afr Stud Monogr* 35: 19-40.
65. Ogada MO, Woodroffe R, Oguge ON, Frank GL (2003) Limiting depredation by African carnivores: The role of livestock husbandry. *Conserv Biol* 17: 1521-1530.
66. Mariki SB (2016) Social Impacts of Protected Areas on Gender in West Kilimanjaro, Tanzania. *Open J Soc Sci* 4: 220-235.
67. Korir K (2015) Farmers count losses as wildlife invade farms. Kenya News Agency.
68. Emerton L (1999) Balancing the opportunity cost of wildlife conservation for communities around Lake Mburo National Park, Uganda. *International Institute for Environment and Development, United Kingdom*, pp: 1-27.
69. Khumalo KE, Yung LA (2015) Women, human-wildlife conflict and CBNRM: Hidden impacts and vulnerability in Kwendu Conservancy, Namibia. *Conserv Soc* 13: 232-243.
70. Muyoma PJ (2016) The hidden costs of Human-wildlife conflict in Mukungule Game Management Area, Mpika District, Zambia. The University of Zambia, Zambia.
71. Mayberry AL, Hovorka AJ, Evans KE (2017) Well-Being Impacts of Human-Elephant Conflict in Khumaga, Botswana: Exploring Visible and Hidden Dimensions. *Conserv Soc* 15: 280-291.
72. Dickman JA (2010) Complexities of conflict: the importance of considering social factors for effectively resolving human-wild life conflict. *Anim Conserv* 13: 458-466.