Review Article

Human elephant conflict management and issues in Nepalese context: A review

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Abstract

Human Elephant Conflict has been an important conservation issue since decades in Africa and Asia. A comparative analysis was performed to identify the methods of the Human Wildlife Conflict management in African and Asian countries. Different studies from 1999 to 2018 in African and Asian Nations related to Human Elephant Conflict were obtained from reliable online sources such as published articles, policies and reports relevant to Nepalese context were synthesized. The different methods used in Human Elephant Conflict management in both continents were broadly classified into fifteen different categories and their effectiveness was compared based on economic viability, safety for elephants and humans while adopting the mitigation measures and the control of the Human Elephant Conflict after adoption of the measure. Land-use management is proposed in Nepalese context to reduce the Human Elephant Conflict centered on different social, financial and environmental conditions.

Key words: Biological deterrents, Electric fences, *Elephas maximus*, Land-use, Hunting

Introduction

Status of the Wild Elephants

The Asian elephant *(Elephas maximus)*, one of the oldest species once roamed throughout the terrestrial lands except Australia, was listed as Endangered (EN) in 2008 by the IUCN due to a 50% population decline over the past 60–75 (Choudhury et al., 2008; Yadav, 2007). The species that once ranged from Syria and Iraq to China is now extinct in much of the areas with around 40,000–50,000 individuals left in a highly fragmented population; mostly in India where the population of the species in western Ghats is reported to be increasing (Choudhury et al., 2008). African elephants *(Loxodonta africana)* have been reported from throughout the Central Africa and unlike its Asian counterpart are listed in IUCN as Vulnerable (VU) with around 415,000 of its kind roaming around the continent, yet with a sharp decline of more than 30% in number in the past decade (Thouless et al., 2016).

Human Wildlife Conflict

Human-Wildlife Conflict (HWC) which mainly arises due to loss, degradation and fragmentation of habitats through human activities has become one of the fundamental aspects of wildlife management and represents the most widespread and complex challenge for conservationists throughout the world (Fernando et al., 2005). As habitat gets fragmented, the length of 'edge' for the interface between humans and wildlife increases which leads to greater contact and conflict with humans as wild animals seek to fulfill their nutritional, ecological and behavioral needs (Sukumar, 1990). The term Human Wildlife Conflict has been defined as negative interaction and needs to be rephrased to establish a better and productive relationship between humans and wildlife which has otherwise been detrimental (Fernando et al., 2005; Peterson et al., 2010). Understanding the ecological and socio-economical context of the HWC is a prerequisite to bring about an efficient and long-term management of wildlife and its habitats (WWF-Nepal, 2007).

Human Elephant Conflict; Causes and Consequences

HWC caused damage includes, lack of freedom of choice, loss of life or injury, threats to economic security, reduced food security and livelihood opportunities, reduced local support for conservation, and increased retaliatory killings of wildlife causing increased vulnerability of wildlife populations (Barua et al., 2013; Doyle et al., 2010; WWF-Nepal, 2007). These consequences can be seen in different forms such as in India where on average every year 150 - 200 people were reported to have been killed by elephants during 1980 – 2000 (Sukumar, 2003) and parts of Nepal where people from the region of Jhapa faced economic loss from crop damages worth on an average USD 111.36 (NPR 12,250.7) per household per year (WWF-Nepal, 2007).

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Due to the wide ranging behavior, devotion to their home range, large appetite, propensity and ability to destroy properties, the destruction brought about by elephants is the most pervasive, but some of the impacts are poorly addressed (Sukumar, 1990). Continuous and hard labor in the fields, diverse food materials of elephants, lack of representation of HEC in international media, inadequate governance and lack of discussion of the underlying causes, presentation of the species as an evil animal in media and low level of awareness about migration of animals through corridors and methods of co-existence of human and elephants are leading causes for HEC after deforestation and other drastic changes in land-use patterns (Akenten, 2015; Barua, 2010; Baskaran et al., 2010; Doyle et al., 2010). Lack of clear understanding about nature and spatio-temporal patterns of elephants and their use in tourism, cultural aspects and the demand for female elephants in captivity might be a contributing factor to increasing HEC directing towards the need for study of Human Elephant Conflict and its management (Fernando & Pastorini, 2011; Koirala et al., 2016).

Human Elephant Conflict in Africa

African Elephants are responsible for crop raiding throughout Africa where thirty-seven African countries from all over the continent such as Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea, Zambia, Kenya, Uganda, Cameroon, Botswana have reported the problem of Human Elephant Conflict (King et al., 2017; Kioko et al., 2008; Mayberry, 2015; Naughton et al., 1999; Nyirenda et al., 2013; Sitati & Walpole, 2006; Thouless et al., 2016). The problem is further seen in these regions where more than 80% of the habitat of elephants lies outside of protected areas where the problem rises as the immigrants' inflow started to boost along with the added problems of political instability, lack of ownership of the problem, ongoing disputes over finances (Hoare, 1999; Hoare, 2012; Walpole et al., 2006). Some elephants in the region are reported to have developed an ease for raiding as there have been cases of repeated marauding time and again despite different measures adopted (Hoare, 2012).

Human Elephant Conflict in Asia

Different factors contributing to HEC in Asia have claimed the lives of more than 200 people and 85 elephants in mere 6-year period from 2003 to 2009 (Doyle et al., 2010; Fernando & Pastorini, 2011). While the expansion of Palm oil, which is causing destruction of elephant habitat and industrialization, in underdeveloped and developing countries like Indonesia is also a contributing factor to the rise in HEC. The highest number of Human Elephant Conflict cases reported from India and Sri Lanka where the largest number of elephants from the region (more than one third) reside (Fernando & Pastorini, 2011; Perera, 2009; Suba et al., 2017). Rapid boom in population of the Asian elephants in some regions such as Western Ghats is leading to problems in harboring the population in a single protected area can be related to large scale damages to human communities in the peripheries (Pradhan et al., 2011; WF-Nepal, 2007). This

comparative study between management techniques in African and Asian countries affected by HEC aimed on providing some inputs to the issue while identifying and comparing the effectiveness of conflict management techniques.

Review and Synthesis

The documents with specific focus on Nepal were selected from the time period of last 20 years from 1999 AD to 2018 AD based on elephant marauding were synthesized. The term 'Human Elephant Conflict Management' and 'Mitigating in Human Elephant Conflict' were used in different orders along with the terms 'Asia/South Asia/Africa' in Google Scholar to search relevant articles and reports. Government reports, dissertation and unpublished reports were obtained from online libraries. From the initial 95000 results shown, relevant journals articles based on primary objectives were shortlisted and 1200 journals articles were downloaded. A total of 51 journal articles and reports were finally considered for synthesis. These were further sorted into two categories of Asian and African cases. The identification of the methods of Human Elephant Conflict management in African and Asian countries, their comparison in terms of effectiveness of methods used and identification of the appropriate measures adopted for HEC management in African and Asian countries, and specifically in Nepal, are discussed.

Mitigation Measures for Reducing HEC

In African Nations, ten different mitigation measures have been used to reduce HEC. These measures include chili and tobacco based deterrents (Chelliah et al., 2010; Sitati & Walpole, 2006), use of fire in farms as deterrents, use of scare crows and guarding the farms, use of grease in the farms borders (Akenten, 2015; Sitati & Walpole, 2006), use of electric fences, use of traditional measures as noise and clapping, elephant drives (Davies et al., 2011), community based adaptive measures and use of governance and policy (Dublin & Hoare, 2004, Hoare, 2012), illegal hunting of elephants (Hill, 2004) and use of biological deterrents *Apis millifera* (King et al., 2017) (Table 1).

Likewise, in Asian Nations, fifteen different mitigation measures have been adopted (Fernando et al., 2008). These methods include use of fire, noise/alarms and throwing at the elephants, chili and tobacco based repellents (Hedges & Gunaryadi, 2010), guarding via motor patrol/vehicle patrols/koonkies, guarding via guard posts both temporary and permanent, use of log/wire/thorny plants and stone for construction of fence, cleared boundaries and demarcation of fields, electric fences, construction of ditches, land use planning, compensation and insurance via government policy, change in crop plantation pattern to buffer crops/unpalatable crops for elephants, supplementary feeding, translocation of single wild elephant from large group via chemical induction/large elephant drives, capture and domestication/semi wild management (Table 1). Effectiveness of measures adopted in Human Elephant Conflict management in African nations and Asian Nations have been broadly classified (Table 1).

Table 1: Effectiveness of HEC mitigation measures used in African and Asian Nations

S.N.	Mitigation measures	Use		Cost effectiveness	Safety (while using the method)		Control HEC	
		Af	As		Elephants	Humans	Af	As
1	Chili and tobacco based repellents	Y	Y	N	Y	Y	Y	N
2	Use of fire	Y	Y	Y	N	N	N	N
3	Noise/ alarms and throwing at the elephants	Y	Y	Y	Y	N	N	N
4	Guarding the farms via patrol, view towers, sleeping in the fields, scare crow	Y	Y	N	Y	N	Y	Y
5	Koonkies	N	Y	N	Y	N	NA	Y
6	Use of grease in farm borders and clearing boundaries/demarcation of fields (psychological barrier)	Y	Y	N	Y	Y	N	N
7	Use of fences and ditches	Y	Y	N	N	N	Y	Y
8	Large animal drives /single elephant translocation	Y	Y	Y	Y	N	N	N
9	Use of governance, policy, and community based adaptation along with Insurance (mostly adopted after HEC)	Y	Y	N	Y	Y	N	N
10	Illegal hunting and poaching	Y	N	Y	N	N	N	NA
11	Use of biological deterrents	Y	Y	Y	Y	Y	Y	NA
12	Land-use planning	N	Y	Y	Y	Y	NA	Y
13	Change in crop plantation	N	Y	N	Y	Y	NA	Y
14	Supplementary feeding	N	Y	N	Y	N	NA	Y
15	Capture and domestication/ semi wild management	N	Y	N	N	N	NA	Y

Af= African Countries, As= Asian Countries, Y= Yes, N= No, NA= Data Not Available

From the fifteen broadly classified HEC reduction methods (Table 1), eight methods were noted to have been adopted in both African and Asian countries while the others have been adopted in either of the continents for management of HEC. Some of the methods used to control or mitigate HEC were not considered to be economically viable. Among them, only two methods, i.e. use of biological deterrents *(Apis millefera)* in Africa (King, 2009; King et al., 2017) and land-use planning in Asia were found to be economically viable and effective solutions which did not put direct threat to either elephants or humans. Some methods such as use of Koonkies in Asia, a technique which involves the use of female elephants to drive away wild elephants, have their own demerits such as the high cost of domestication of elephants and the risk of wild elephants getting attracted towards female elephants and threats to the owners and property (Fernando et al., 2008).

One of the methods identified, i.e. illegal hunting to control HEC is a method described by Hill (2004) needs to be discouraged and stopped from practice, in all forms, while other methods such as use of grease had some demerits in addition to being financially unviable. Wild elephants became used to or irritated in the long run and aggravated marauding elephants more after perceiving the lack of actual threats from traditional methods such as making noise and throwing at elephants. While electric fences (Sapkota et al., 2014) are reported as expensive and costly for maintenance, elephants either found a way around other forms of fences or broke the fences and temporary guard posts and at times were damaged by the humans for illegal extraction of resources (Thapa, 2010). Use of ditches have been reported to be ineffective as the ditches are usually dug near rivers or water canals, filled up fast and caused a threat as trap to young elephants. Other methods such as large elephant drives, supplementary feeding (exclusively practiced in Sri Lanka), single elephant translocation, capture and domestication/semi wild management increased the chances of human contact with wild elephants which posed additional threat to humans and increases the chances of return of wild elephants (Fernando et al., 2008). The use of large elephant drives and changes in crop plantation led to reduction of elephant habitat which previously was dependent on the resources of a particular area whose productive patterns might change. Change in crop pattern to able

crop led to lower market values and overall finances of the farmers that are dependent on produce of a single harvest leading to be ineffective method.

Current State of HEC Management in Nepal

The elephants that reside in four distinct areas in Nepal with estimated numbers of 107-145 roaming freely in the wild have caused Human Elephant Conflict. Some extreme incidents such as in a single event more than 117 households were damaged (DNPWC, 2009; Pradhan et al., 2011; WWF-Nepal, 2007). Though, various mitigation measures such as electric fencing, ditches, watch towers, patrols and community based initiatives have been practiced in Nepal, Human Elephant Conflict problems still exist (Thapa & Dhakal, 2014). Some of the major causes for HEC in Nepal are reported to be habitat fragmentation and is persistent in all Eastern, Central and Western parts of Nepal (Koirala et al., 2016; Pant et al., 2016; Pant & Hockings, 2013; Pradhan et al., 2011; Yadav, 2007). The problems of conflict that occur due to large mammals is not new to Nepal and the government of Nepal has a policy of providing different types of compensation to damages caused by mammals, especially elephants (Acharya et al., 2016; DNPWC, 2015, 2016). The damage caused by elephants is the highest compared to all other human wildlife conflict, accounting for 40% of total Human Wildlife Conflict and 70% of wildlife related human casualties (Bajimaya, 2012; WWF-Nepal, 2007).

The highest level of conflict faced in Jhapa district, eastern Nepal is an example of low effectiveness of management practices such as land-use management and ineffective policy in the region. While some of the measures such as monitoring the wildlife and use of explosives were useful in western parts of Nepal, most measures including the use of capture of wild elephants by authorities were seen ineffective or only of fair use to the eastern and central parts (Pant & Hockings, 2013; WWF-Nepal, 2007). When other measures such as alternative crop plantation and use of electric fences is successful, it has negative financial impacts such as high maintenance cost of electric fences or low financial benefits that gained from alternative crops. Use of ditches and other forms of fences, except for the electric fences, has not been successful along with the use of noise and other traditional deterrents such as fire which the elephants got habituated to or did not work due to technical problems which could not be avoided. Ditches that were excavated near the banks of Mechi River also proved to be useless as the banks started to fill up along with the sediment deposit that the river caused.

There are some measures such as land-use planning, use of biological deterrents (use of bees), supplementary feeding and domestication of problem causing agent or semi wild management, driving (chasing away) of large groups (Omondi, 2004) which have not been adopted in large scales in Nepal for mitigation of HEC. All other methods discussed have been adopted in Nepal in one form or the other. Some mitigation measures have been successful whereas most have been unsuccessful for the mitigation of HEC. There is very less provision of insurance to damages caused by wild animals on the property of the victims in private level which can be related to the financial and technical inability of the Nepalese financial insurers to cover the large sector (Ghimire, 2013), while the compensation provided by government is insufficient for the damages caused to victims (DNPWC, 2015, 2016). Some of the possible measures, except for illegal hunting and poaching, that can be adopted in Nepal are discussed under the respective topics. Both the merits and demerits of the mitigation measures that can be adopted are discussed here with.

Supplementary feeding is not an option for the wild elephants as Nepal is deemed food deficit and imports food. There are other difficulties in addition to the process as discussed above, thus feeding a single elephant 300 kilograms of food materials as stated by Fernando et al. (2008) is not possible ruling out supplementary feeding process to mitigate HEC (Sanogo & Amadou, 2010). The process of domestication can be viable but challenging, while the process of semi wild management where large habitat of the elephants has to be managed partially is not possible. Domestication can be possible through the experienced trainers that are available in the nation in different parts such as elephant breeding center and different private elephant keepers (DNPWC, 2009). The habitats of elephants lie in the close proximity to human habitats; thus it is impossible to carryout large herding of elephants which requires large areas of land up to 100 km in range.

There are two feasible measures that are seen possible in Nepal for mitigation of HEC, which are land-use planning in areas such as Jhapa district which has not been practiced any land-use planning so far for the mitigation of HEC. The conflicts which have been reported as home activity or land-use specific worsen due to the existing conditions of land-use planning which are discouraging and do not provide clear boundaries for wild elephants (Neupane et al., 2017; WWF, 2005). There are possibilities of reduction in HEC via land-use planning which has no demerits reported so far and benefits the users and policy makers as well and have been recommended for different conservation areas such as Bardia National Park. The use of biological deterrents such as use of bees which has been proven to reduce HEC in African nations (King et al., 2017) can be beneficial to the farmers as well; but, there are some problems that need to be discussed before the use of bees as bio-deterrents in Nepal such as extreme natural conditions that result in flood which has not been discussed in African context (King, 2009). Despite different problems such as attacks from honey badgers, effect of drought and altitudinal effects for beehive fence have been evaluated in previous studies the climatic aspect such as effect of precipitation or natural calamities in areas with regular monsoon such as Nepal has not been discussed in previous studies (King, 2011). Every year more than 212295 households are affected in the habitat of elephants with more than 300 deaths and the loss of 3700 animals from Terai region of Nepal (KC, 2013). The extreme events can lead to questions for the implementation of beehive fence in affected regions. As the people are not able to maintain their homes in such extreme events, maintenance of beehive fence can be difficult. Thus, land-use planning as suggested by different previous research

(Neupane et al., 2017) can be considered as the best option, in addition to the existing systems in Nepal to mitigate HEC effectively. However, the conditions can be different depending on the local situations such as in western region, where the existing systems have been reported to be effective in visible scale (WWF-Nepal, 2007).

Conclusion

The current methods of mitigation of Human Elephant Conflict were found to be discouraging while it was effective in some parts of the nation. Out of the fifteen methods practiced between Asian and African nations, some methods were not adopted in Nepal for HEC management. As environmental conditions did not favor the use of biological deterrents and unproved field based experiments, the most appropriate method for mitigation of HEC in Nepal, in addition to the existing system, is identified to be land-use management which has not been implemented in all the HEC affected areas of the country and where adopted, the land-use management pattern are not implemented properly.

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