Socio-economic status of human-elephant conflict: Its assessment and solutions

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Abstract: The study was made to examine the effect of human-elephant conflict (HEC) on socio-economic vulnerability in corridors of northern Chhattisgarh. Incidents relating to conflicts were observed and analyzed to understand the socio-economic status of the people, their attitudes towards elephant, the way people and elephants were affected along with different aspects of conflicts. The records whatsoever available on HEC of forest department were also took into consideration during analysis. It was found that majority of respondents involved in farming besides other sources like livestock (63.0%), NTFPs collection (42.50%) etc. Paddy (57.50%) and sugarcane (40.0%) constitute major crops which likely favours the incidence of HEC in the region. Nearly 112 houses and 939.02 acre of crops were damaged along with 06 human deaths. It was found that 46% of the respondents respected the animal as a religious figure while 30% fear them and most of the respondents (77.50%) were in favour of compensation. This necessitated a detailed assessment of habitat suitability and dispersal corridor for elephants in the area. Therefore, an attempt has been made to present various aspects of HEC along with management implications.

Keywords: Conflicts, Corridor, Crop damage, Habitat, HEC

INTRODUCTION

Human-elephant conflict (HEC) is a key concern and emerged now as a major issue both in terms of conservation and socioeconomic significance (Sukumar, 1994; Easa, 2002; Singh *et al*., 2002; Kushwaha and Hazarika, 2004; Thakur *et al*., 2015; Borah and Bhuyan, 2016). Elephants are mega-herbivores and commonly raid crops, causing economic losses, death and injury to people. Elephants were known to coexist with humans for centuries but then there were fewer humans and more land and therefore, more carrying capacity of habitats for elephants. Conflicts were known to be present in the past also due to agricultural damage and crop invasion (Wisumperuma, 2003).

HEC is a symptom of inappropriate land use practices such as permanent human settlements and growing irrigated food crops adjacent to elephant range lands (Hoare, 2001; Treves *et al*., 2006; IUCN, 2006; Fernando *et al*., 2008; Gubbi, 2012). Loss or fragmentation of habitat and blocked traditional routes restrict elephants' access to forage, water etc. It is reported that they compensate for this loss by eating crops and stored grain (Sukumar, 1989). Elephants are increasingly caught in the pincer grip of habitat loss/fragmentation and retaliation caused by increasing conflict. Diversion of forests into agriculture, fragmentation, settlements, shrinkage and degradation resulting in increased HEC (Sukumar, 1994; Singh *et al.,* 2002; Singh, 2002). Elephants, in search of food and water tend to enter into human habitations and in the process, often come into direct conflicts (Sukumar, 1994; Kush-

waha and Hazarika, 2004). Corridors are narrow strips of forests connecting two larger forest areas and thereby facilitating movement and dispersal of animals between these patches (Beier and Noss, 1998). Preservation and restoration of corridors are an important aspect of reducing the negative effects of habitat fragmentation (Khanna *et al*., 2001; Venkataraman, 2002; Nandy *et al.,* 2007; Thakur *et al*., 2015).

Asian elephants were found in northern Chhattisgarh (central India) since historical times, however, in the early part of the 20th century they became locally extinct. Since then, incidents of HEC have been increasing and became alarming in the corridors due to straying of migratory elephants (Singh, 2002). Long stay of elephants in this corridor may due to better forest cover (44%), and migration of elephants from Jharkhand and Orissa (Singh, 2002; Earth Matters Foundation, 2008; Thakur *et al*., 2015). The Sarguja division is primarily inhabited by tribal communities which are dependent largely on agriculture and forest produces. So, any incidence related to HEC has direct impact on socioeconomic status and livelihood of the people and posing challenges for conservation. Therefore, the present study was undertaken to assess the scenario of HEC, their assessment and possible solution to reduce the conflict between human being and wildlife along with conservation and management perspectives.

MATERIALS AND METHODS

The study on socio-economic status of HEC, their assessment and solutions of northern Chhattisgarh was

carried out at four blocks viz., Lundra, Batouli, Sitapur in Sarguja district and Farsabahar in Jashpur district, respectively. The study area lies between 23°37'25'' to 24°6'17'' north latitude and 81°31'40'' to 84° 4'40'' east longitude. Sarguja forest division bounds to the Badalkhol, Semrasot, Tamorpingla sanctuary and Guru Ghasidas national park which support a substantial number of wild elephants. Neighboring villages of the corridors are oftenly visited by the elephants during the year and causes subsequent loss of crops, property and life. The climate of the region reflects hot summer and well distributed rainfall during the monsoon season. The chief feature of climate is long dry period; average monthly temperature rising over 18°C, through maximum summer temperature may even go up to 46°C (Sinha *et al.*, 2014 & 2015; Yadav *et al.*, 2015; Jhariya and Yadav, 2016). The flora of these areas are changing frequently with the human interferences and land-use. Physiographically, they are remarkable land-forms and average height of area varies from 600 meter and more.

The field study was conducted in forest fringe areas where migrated elephants were encountered. Incidents relating to conflicts such as crop and house damage, human death and injury, elephant death, cause of all such conflicts were observed. After preliminary survey of the HEC affected areas collection of information from the respondents were taken by informal interviews, questionnaire method, participatory rural appraisal and personal observations (Chambers, 1994). Local people of the affected villages/forest areas including victims of conflict were interviewed to understand their socioeconomic status, their attitudes towards elephant, the way people and elephants were affected and different aspects of conflicts. The records whatsoever available on HEC of forest department were also took into consideration during analysis. Data collected on various aspects of HEC from different blocks were compiled and analyzed after getting opinion and expression of the respondents.

RESULTS AND DISCUSSION

Socio-economic profile: Sarguja district of Chhattisgarh is mainly inhabited by different tribal communities whose main occupation is agriculture and collection of forest products. Out of the 40 households interviewed 33 respondents were male while 07 were female. The survey targeted to interview the head of the household as they were more informative and reliable source for data. In their absence other members of the households were interviewed. Majority of the respondents (47.50%) belonged to young age group (up to 35 years), followed by 37.5% middle age group (36 to 55 years), whereas 15.0% respondents belongs to old age group (more than 55 years). The family size in the study sites comprised 60.0% small family size (up to 5

members) and 40.0% large family size (above 5 members). During the field study it was found that about 41.0% of respondents had primary to middle school education, followed by 23.0% which had high school education, 18.0% had gained higher secondary and above education, while 18.0% were found to be illiterate.

Source of income: During the study it was found that the main source of income was farming. Besides farming people also generate income from other enterprises like livestock rearing (63.0%), NTFPs collection (42.50%), employed (2.50%), business (22.50%) as well as wage labors to neighbors fields (Table 1). Agriculture and livestock rearing is not practiced commercially but only for household consumption. Therefore, any damage caused by elephant raid had direct consequence on the livelihood of the people.

Major crops grown: Paddy and sugarcane are the major crops grown in study site which constitutes 57.50% and 40.0%, respectively while the other crops grown are maize, wheat, sesame, black gram etc (Table 2).

Land holding and land use pattern: It was found that 37.50% respondents have more than 10 acre of land. While 32.50% respondents have 5-10 acre net cultivated area and 35.0% have less than 5 acre uncultivated land (table 3).

Source of irrigation: Majority of the people depends upon rain (57.50%) as a source of irrigation, while the other sources are shown in table 4.

Farm assets: Majority of people have their own land (82.50%) and other farm assets are shown in (table 5).

House and crop damage: The information collected from HEC region revealed that nearly 112 houses and total 939.02 acre of crops were damaged by elephant in different seasons during the study period (2014-2015).

Human death: A total of 06 human death occurred as a result of HEC during the year 2012-2015 recorded by Forest Department of Sarguja. During the study period 3 human deaths and 12 human injuries were observed. An analysis of intensity of conflict over a period of 04 years, showed that the maximum number of human death was occurred in 2014-2015.

Elephant (*Elephas maximus*) death: There is dearth of information from forest department regarding elephant deaths. Secondary data collected and compiled from the local newspaper reveals that 02 adult elephants and 02 calves were found dead during the study period.

Attitude and perceptions of the people towards the elephant: The elephant is highly respected and worshiped among the people as it is a culturally important species and having a religious status among the people. Respondents were asked to choose between Like, Fear, Hate and Respect in order to see their attitude towards the elephant. It was found that 46% of the respondents respect the animal as a religious figure and pray although at the same time 30% fear the animal. Although, most of the respondents have referred to the animal as a religious figure but at the same time they also

Table 1. Distribution of respondents according to their source of income in Sarguja.

Source of income	Contribution (in %)
Agriculture	100.00
Livestock	62.50
NTFP collection	42.50
Business	22.50
Hunting	12.50
Employed	2.50

Table 2. Major crops grown in the Sarguja area.

Major crop grown	(%)
Paddy	57.50
Sugar cane	40.00
Maize	32.50
Sesame	27.50
Black gram	10.00
Wheat	7.50

Table 3. Land holding and land use pattern in Sarguja area.

Land - Total area (Acre)	(%)
0 -5	42.50
5-10	20.00
<10	37.50
Net cultivated	
0 -5	45.00
5-10	32.50
<10	22.50
Uncultivated	
0 -5	35.00
5-10	20.00
<10	2.50
Fallow land	
0 -5	7.50
5-10	10.00
<10	0.00
Irrigated area	
0 -5	17.50
5-10	10.00
<10	0.00

Table 4. Source of irrigation in Sarguja area.

Source of irrigation	(%)
No available (Rain fed)	57.50
Well	22.50
Others	12.50
Tube well	12.50
River	10.00

Table 5. Farm assets of respondents in the Sarguja area.

Farm assets	(%)
Katcha house	92.50
Land	82.50
Cattle shed	60.00
Well	47.50
Plough	45.00
Animals	41.50
Cows	35.00
Tube well	27.50
Buffaloes	22.50
Pakka house	12.50
Electronic motor	9.50
Farm shed	7.50

seemed a bit frustrated with the problems of HEC.

Compensation: The study included few aspects to know how the people felt about compensation that experience loss directly. Most of the respondents (77.5%) felt that compensation was necessary for those who had experienced crop and property damages. However, 22.5% of the respondents felt that compensation should be awarded only in cases of severe damage. The compensation provided by the forest department of Sarguja on different incidents *viz.*, house, animal, crop damage etc., is presented in table 6.

In the study it was found that 60% household belonged to joint family while 40% were nuclear family (on the basis of members of family). Majority of respondents (42.50%) had small size of land holding. The division of land from one generation to another generation resulted in nuclear structure of families in the community and marginal and small size of land holding (Pal, 2009). The main source of occupation is farming in the study area. Similarly, Geetha and Devi (2008) in the line of agreement with the present study reported that agriculture being the prevailing main occupation and back bone of the economy in the area, most of the households. Similarly, farming and allied activities being major source of livelihood of the households, the

Table 6. Compensation provided by Sarguja forest department for different incidents during the year 2012-2016 (Source: District Forest Department, Ambikapur, Sarguja).

Year	Compensation amount (Rs.) and Number of incident			
	Human damage	Animal damage	Crop damage	House and other
2012-13	0.00	29000.00 (3)	4409687.00 (1225)	930480.00 (359)
2013-14	200000.00 (1)	0.00	5989939.00 (909)	523368.00 (104)
2014-15	300000.00 (1)	15000.00 (1)	4865345.00 (1563)	930404.00 (121)
2015-16	1600000.00 (4)	15000.00 (1)	3627346.00 (895)	1701230.00 (325)

Values in parenthesis are compensation amount (in rupees) and the number of related incidents (Shown in brackets) in the study area.

possession of minimal farm implements is indispensable (Chaudhary and Panjabi, 2005). The families engaged in wage labour, business, service, caste occupation and other activities as their main occupation were also doing agriculture as their subsidiary occupation (Pal, 2009). Livestock rearing (62.50%) ranks second occupation after farming in the study area. Holding good number of livestock could be attributed to the fact that livestock rearing was the most preferred secondary occupation (Pal, 2009). Livestock support agriculture and allied activities besides providing nutritional, social, economic, religious and recreational benefits to the people (Bijalwan *et al.,* 2012). The families engaged in wage labour, business, service, caste occupation and other activities as their main occupation were also doing agriculture as their subsidiary occupation (Pal, 2009). Low agricultural production due to lack of irrigation facilities, scientific know -how, improved equipments and machinery, mono-cropping system, low fertility of land and erratic climatic condition accrue paltry income to the farmers (Krishnamoorthy *et al.*, 2003). Similarly, majority of the wage labourers are unskilled, they are not getting consistent income due to irregular employment and underpayment (Kumar *et al*., 2010). The low housing status (92.50% katcha house) in the study area could be attributed to low socioeconomic condition, poverty, lack of infrastructure, rural environment etc. (Lakra and Cardenas, 2002).

Degradation of forest areas due to increasing human pressure tend towards HEC. When the interactions between elephants and human beings become very close certainly there would be a conflict between man and elephant. Elephants cause crop damage and attacks people which lead to severe injuries and ultimately to death. Besides this elephants also damage to human properties. Crop (939.02 acres) and house (112 Nos.) damage by elephants was reported to be main consequence of HEC in the study site. Fernando and Pastorini (2011) found that the HEC as the main threat to Asian elephants and describe crop raiding as the primary reason for HEC. Therefore, many workers identified Asian elephant as a serious agricultural pest (Bandara and Tisdell, 2002; Jarungrattanapong and Sajjanand, 2011; Sarker and Roskaft, 2012).

The crop raiding mainly in case of rice and sugarcane, which is generally liked by the elephants in this region, starts right from initial growth to its final harvesting. However, the intensity and frequency of crop raiding attains peak level as the crops comes under maturation stage. The HEC was found to be higher during the riping of paddy which is in line agreement with previous reports (Bal *et al*., 2011; Gubbi, 2012). However, the incidence of crop raiding was not uniformaly distributed, as few villages suffering significantly more damage (especially forest fringes) than the others

which revealed the distance from corridors or elephant habitat increases the conflict gradually decreases.

Household and property damage by wild elephants is major aspect of HEC after crop raiding. The main cause behind majority of the house damage cases was for stored paddy and other feeding materials. Likewise, house damage and human injury are due to the habitation in forest fringe areas and availability of palatable tree species nearby their homestead, farm lands etc. and the tribals of this region store the rice, wheat and local made liqueur (mahua wine/daru, Mudh, Kosna/Usna, rice bear, tadi, sulfi, hadiya etc.) in house which attracts the elephant as a result of which severe incidences takes place (Thakur *et al*., 2015). Similar findings were also reported by Sarker and Roskaft, 2011; Sukumar, 2006). Damage to households and property occurred more or less throughout the year with a peak in cropping season especially in rainy and winter season (Sarkar and Roskaft, 2010).

Human injury and death due to HEC is one of the very crucial aspects conflicts. Although the number of human injury and death incidence by elephants in northern corridors is comparatively less. In the present investigation the death of elephant was low. Likewise IUCN (2004) showed that seven elephants dead in south-eastern of Bangladesh during 2000-2001. It was found in the present investigation that most of the respondents respected the animal as a religious figure. The general reverence towards plants and animals in some Indian religions has often been reported to be the main reason for a positive attitude towards elephant, wildlife and nature reserves (Gurung and Lahiri Choudhury, 2000 and 2001).

Cost of human-wildlife conflicts is of three types: direct, indirect and opportunity costs (Thirgood *et al.*, 2005; Hoare, 2001). Direct cost which is of serious concern is imposed by crop, property and life damages and investment on capital and raw materials. Subsistence farmers may require direct compensation for survival but the amount compensated should not be the full amount lost, as this may encourage complacency. This can be expressed as annual income loss as a result of HEC (Naughton *et al.*, 1999). In order to impose economic losses by HEC government provides monetary compensations to the victims. Compensation is generally a non-preventive mitigation measure that does not reduce the HEC (Hoare, 2001). Now there is a steep increase in claims by farmers depicting either an increase in conflict or increased awareness to claim compensation (Gubbi, 2012). In contrary to this Bal *et al.* (2011) noted that it could be an underestimate due to farmers not claiming compensation. The compensation paid in the study area was very low for the losses undergone by farmers. Meagre payments have been an important factor in creating animosity amongst farmers against wildlife. Nevertheless, this scheme has come under severe criticism as compensation payments are

often too meagre, delayed and the procedures to avail of these compensations are time-consuming.

Conservation and management: The Asian elephant (*Elephas maximus*) is listed as an endangered species under Schedule-I of Indian Wildlife Protection Act (1972), which enables high protection priority under Indian law. No single solution is effective and different approaches need to be integrated to address HEC proactively. Lack of a robust policy also leads to an inordinate focus on the symptoms rather than the causes of the problem. With the increase in population and land use changes resulting in further conversion of elephant habitat into agricultural land, there would not be an end to the problem of HEC. The encroachment of its natural habitat and conversion to settlement is of primary concern which results in conflict. A participatory approach on the basis of the forest's need and existing pattern is essential which needs to be adapted to check the problem of HEC. Establishing good communication network along with awareness programmes involving local people, forest dwellers and forest department (Thakur *et al.*, 2015).

According to IUCN (2006), the current approach dealing with conflict has largely been adhoc, and predisposed to failure because of inappropriate application of methods, lack of involvement of local people, lack of monitoring of conflict and conflict mitigation measures and inadequate understanding of elephant ecology. Some suggestions are forwarded to mitigate the problem of HEC in the study region which includes: facilitate food and shelter to the elephants, proper emphasis should be given to develop a more variable and feasible dense forest cover, open up the elephant corridors for free movement of elephants, alternatives should be given to the livelihood of the affected villages, proper zonation of corridors can be created, incorporation of unpalatable crops like chilly, citrus and tobacco, etc in cropping systems along with live fencing, emphasis should be given to develop permanent drinking water facility across the corridors, local people along with forest officials should be imparted proper training by the experts, so that they can drive away the elephants using proper scientific methods. In northern parts of Chhattisgarh, elephant corridors are being blocked due to the excessive pressure from deforestation, elicit felling, poaching, land use change, fragmentation, infrastructure development, expanding farming activities as well as illegal encroachment by local people. A viewpoint from both sides indicates that the human being is the key indicator for such a conflict rather than the elephant. There is a need for a clear policy and strategic planning to resolve elephant-human conflict and elephant conservation. Sarguja forest department is taking several initiatives which include awareness among the local people, *Haathi Sahayata Kendras*, workshops, seminars, trainings, compensations etc. (Thakur *et al.*, 2015).

Conclusion

HEC in the study region have not been so intensive as compared to other parts of country. Crop raiding is arguably one of the defining challenges in HEC. From the findings it is quite clear that HEC in the region is an outcome of the biotic interference. The land-use change and shrinkage of corridors are a product of the diminishing area of elephant habitat and shortage of food and water in the area which favour the more incidence of crop raid. Conflicts happen directly when elephants damage crops, infrastructure/properties or attack people and cause injuries or even death. Hence, such incidence affects socio-economic development of the residing people. Addressing the root causes of such conflict is a basic first step towards HEC mitigation. Effective management of corridors would go a long way in ensuring symbiotic relationship between elephants and human being. Therefore, present findings will be useful for the government and non-government bodies for the improvement of the corridors, their conservation, management and livelihood of the tribal.

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