Elephants, Border Fence and Human-Elephant Conflict in Northern Bangladesh: Implications for Bilateral Collaboration towards Elephant Conservation

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Abstract. We conducted a study on human-elephant conflict in northern Bangladesh. Approximately 70–80 elephants were found to move across 50 km of the international border between Meghalaya state of India and Sherpur-Jamalpur districts of Bangladesh. From 2000 to 2015, 78 people and 19 elephants died due to human-elephant conflict in this region. In addition, 228 houses were destroyed by elephants between 2013 and 2014, affecting 133 families in 25 border villages. Our study suggests that the permanent barbed wire fence on the Bangladesh and Indian border is a barrier to the normal movement of elephants, and contributes to the rise of human-elephant conflict.

Introduction

Asian elephants (*Elephas maximus*) are increasingly losing their habitats due to unprecedented human use of resources across their range. Intensity of human-elephant conflict (HEC) mounts where elephant needs and human demands overlap. In Bangladesh, Asian elephants are critically endangered (IUCN Bangladesh 2000) and protected by the Bangladesh Wildlife (Conservation and Security) Act of 2012. Elephant distribution in Bangladesh is limited to a few areas. Trans-frontier areas covering three administrative districts of northern Bangladesh, Sherpur, Jamalpur and Netrakona harbour several herds of non-resident elephants, coming from the neighbouring Meghalaya state of India (Islam *et al*. 2011). Approximately 200 elephants occur in the hilly areas of Chittagong, Cox's Bazar and Chittagong Hill Tracts (Aziz *et al*. 2005; Islam *et al*. 2011) in southeast Bangladesh.

A number of studies have been carried out on elephants in southeast Bangladesh, including their status and distribution (Islam *et al*. 2006, 2011), ecology and HEC (Aziz *et al*. 2002; Shamsuddoha & Aziz 2014), conservation

management (IUCN Bangladesh 2004, 2011; Islam *et al*. 2011) and human attitudes towards elephant conservation (Sarker & Roskaft 2010). However, no comprehensive information on HEC and related issues is available from northern Bangladesh. In this study, we identify HEC localities, elephant movement routes and trans-frontier elephant crossing points, and assess human and elephant losses in Sherpur and Jamalpur districts of Northern Bangladesh.

Materials and methods

Study area

Our study area encompassed two trans-frontier administrative districts, namely Sherpur and Jamalpur districts in northern Bangladesh. Both districts are bounded by the Meghalaya state of India to the north and Mymensingh district of Bangladesh to the south and east. The Garo Hills are situated in the northern parts of these districts adjacent to the western part of Meghalaya. We focused on three upazilas (mid-level administrative unit under district) from Sherpur (Sreebordi, Jhenaigati, Nalitabari) and one (Bakshiganj) from Jamalpur. Of the 606 villages

in these four upazilas, 54 remote border villages were selected for this study based on location and previous HEC incidents (Fig. 1). The overall human population density of the study area was 803 per km² (BBS 2011). Besides the dominant Muslims, Hindu and several ethnic communities such as Garo, Hazong, Hodi, Mandi and Koch live in these areas (BBS 2011). Most of the southern parts of the study area consist of human dominated landscapes while remnant degraded forest patches exist on the northern parts near the border. The area is predominantly agrarian and rice is the major crop cultivated. Other crops include mustard, jute, wheat, potato, pulses, vegetables, and tobacco. The major income for local people is from agriculture (70%) and commerce (10%) (BBS 2011).

The study area is located in the tropical monsoon region and its climate is characterized by high temperature, heavy rainfall and high humidity. The average temperature is 27°C and annual rainfall is approximately 2000–2500 mm. The topography is very rugged with series of ridges running in a north-south direction. The forest remnants consist of a mixture of tropical semi-evergreen and deciduous trees, bamboos and bushes.

Data collection

Data was collected through visits to conflict areas, focus group discussions, key informant interviews and secondary data sources. We conducted 25 focus group discussions with a total of 376 participants (with 7% of them being female) consisting of farmers, local traders, forest officials, NGO workers and local government representatives. We interviewed 94 key informants using a semi-structured questionnaire. We selected key informants and organized focus group discussions from 54 villages, covering all four upazilas and seven unions (lower level administrative unit under upazila). We selected these upazilas and unions based on a reconnaissance study and previous HEC incidents (Islam *et al.* 2011).

Major issues covered in focus group discussions and interviews included HEC localities, intensity, elephant movement points, herd size, damage to crops and houses, and injuries and death of humans and elephants. Data on death and injury of humans and elephants were obtained from Forest Department records from 2001 to 2015. Data collected from secondary sources and through focus group discussions were validated

Figure 1. Study area, showing location of villages, unions and upazilas.

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Figure 2. Gate between Bangladesh and India in northern Bangladesh.

Figure 3. Metal and barbed wire fence between Bangladesh and India.

by subsequent visits. Field data collection was done between 2013 and 2014.

We used Garmin eTrex GPS units to record locations of elephant movement routes and entry points across the border, crop and house damage, and death and injury of humans and elephants. To record movement routes, we followed tracks and signs (e.g. feeding and damage signs) of elephants, in addition to interview data. Repeated tracks (back and forth) noted during field visits were identified as elephant movement routes. GPS data was imported into ArcGIS 10.2 and Google Earth to delineate HEC hotspots. Microsoft Excel was used for data analysis.

Results and discussion

Elephant movement through the trans-frontier fence

Border areas of Sherpur and Jamalpur are separated from India by a strongly built fence across *ca*. 50 km of the border (Figs. 2 & 3). The fence has 44 'gates' within this area. The highest number of such gates was on the boundary of Sreebordi (n = 15), followed by Bakshigonj (n = 11), Nalitabari (n = 9) and Jhenaigati (n = 9) upazila. The gates are approximately 3 m width. Interview results indicated that the gates usually remained closed but were opened by the Indian Border Security Force (BSF) when a herd of elephants from Meghalaya appeared to want to move into Bangladesh and closed once they crossed. The BSF also opened the gates to

let them through to Meghalaya when elephants approached the fence from Bangladesh. Our focus group discussion participants stated that there were no 'gates' when the fence was built in 2007 and consequently elephants broke many parts of the fence to cross the border. This was also noted by Choudhury (2007), who mentioned that elephants broke the fence after repeated attempts. Therefore, such 'gates' were probably created to facilitate elephant movement across the border.

Our elephant movement track data and interview results show that elephants used the gates with varying intensity. Nine gates were used frequently, seven moderately and 28 occasionally. Besides the gates, elephants used 11 rivers and streams as underpasses (there is a motorable road on the Indian side approximately parallel to the fence and there are bridges and culverts where rivers and streams cross the border line), which cross the border from India to Bangladesh (Fig. 4).

Figure 4. Bridge and fence over river that crosses the India-Bangladesh border at Haligram village.
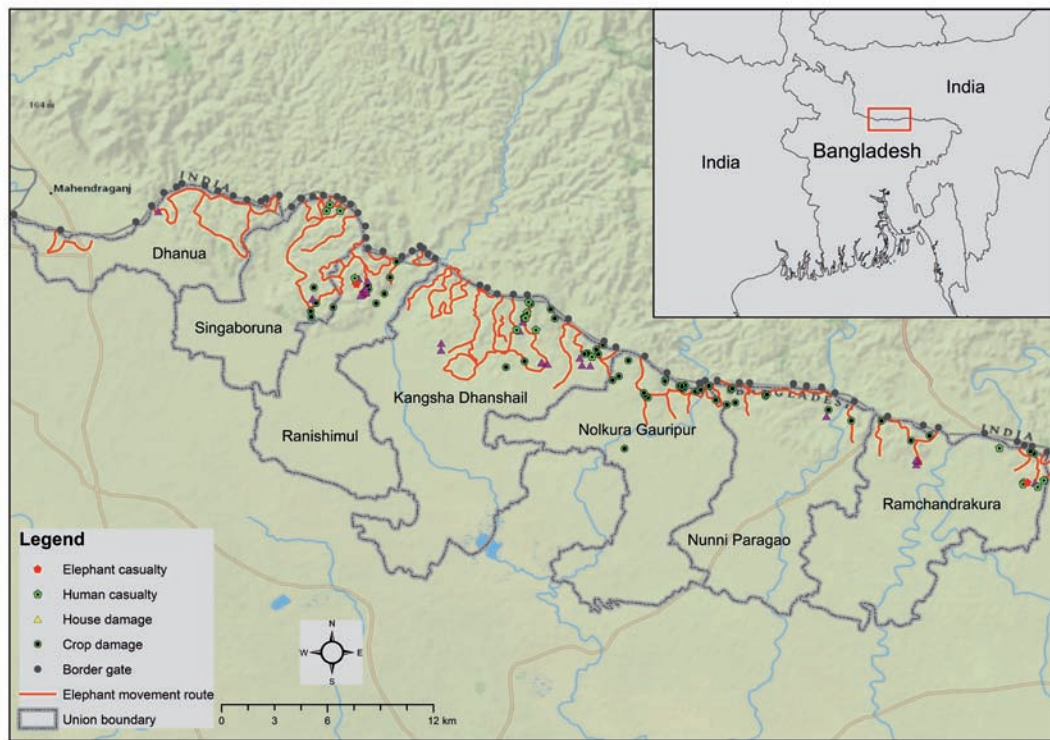
Figure 5. Map showing border entry points, elephant movement routes, and HEC incidents.

Based on observations and interview data, we estimate that 70–80 elephants make back and forth movements across the border between the two countries. Group size ranged from single individuals to a maximum of 13 elephants in a herd. The source populations of these elephants may be three major protected areas (Balpakram National Park, Siju Wildlife Sanctuary, Baghmara Reserve Forest) of Meghalaya located near our study area. These protected areas are thought to support about 1800 elephants (Marcot *et al*. 2011).

Based on 253 elephant signs detected (foot print, feeding and raiding signs) we identified 40 elephant movement routes in our study area which were linked with the 44 border gates (Figs. 2 & 5) and 11 rivers and streams. The average length of these routes was approximately 5 km (Fig. 5). We noted 18 such routes in Jhenaigati Upazila, 10 in Sreebordi, 9 in Nalitabari and 3 in Bakshigonj. Many of these routes or areas located in these upazilas were not used in the past but are now being used because elephants can access the other side only through certain points in the border. Thus, the permanent fence may restrict normal movement of elephants. Some villages did not experience HEC incidents in the past but elephants now raid their crops

and homes frequently because the border gates are next to the village. Thus the chances of HEC incidents around the border gates maybe increased. Overall, while HEC incidents were limited to a few localities in the past (Islam *et al*. 2011), we noted that HEC has increased in many areas of adjacent Jamalpur and Netrakona districts including in previously affected areas.

We found that elephants used adjacent areas of the border more than areas away from the border and moved a maximum of 7 km into Bangladesh. Our observations and information suggest that elephants cross the border from India to Bangladesh, raid for a few weeks and then move back across the border, crossing the fence through gates and underpasses. Elephants that use these trans-frontier areas may also be obstructed by the fence and remain in the Bangladesh side for a longer time. Our results confirm the findings of Choudhury (2007), who suggested that the barbed wire fence between the India-Bangladesh border could increase HEC.

Local people of Nalitabari, Bakshigonj, Sreebordi and Jhenaigati of Sherpur and Jamalpur districts affected by HEC are increasingly becoming intolerant towards elephants due to the rising trend of incidents (Fig. 6). Our interviews found
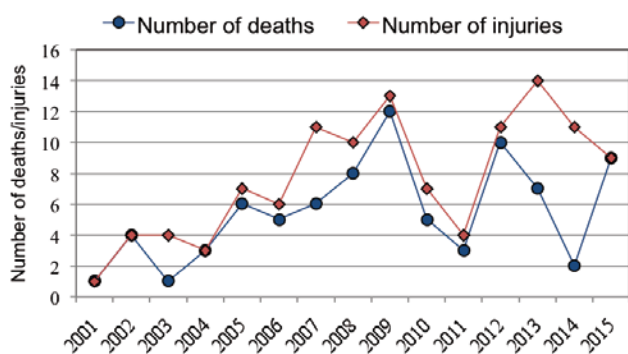
Figure 6. Annual human deaths and injuries caused by elephants between 2001 and 2015.

that 95% of respondents were frustrated with HEC incidents and wanted immediate mitigation. In our focus group discussions 63% of participants said that coexistence is impossible with the current state of HEC. However, 32% of focus group participants still believed in coexistence if the Forest Department took appropriate measures to protect their crops and houses from 'Indian' elephants.

Permanent fences along the international border in northern Bangladesh are an emerging threat to elephants (Islam *et al*. 2011) and have become barriers to the normal movement of wild elephants (Choudhury 2007). Our observations support these findings as many elephant movement routes have been cut off due to the construction of the permanent fence, resulting in geographic expansion of HEC over the years. Previous studies also suggest that HEC is strongly correlated with the disruption of elephant corridors by establishing human settlements and conversion to agricultural land (IUCN Bangladesh 2011).
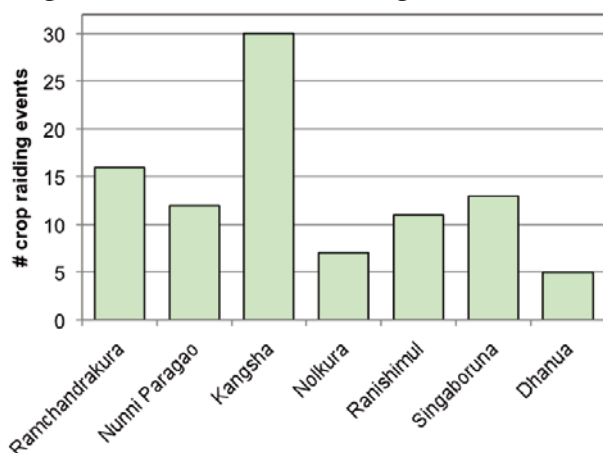

Figure 7. Raiding intensity of paddy in seven unions in the study area during 2013-2014.

Damage to crops and houses

Paddy cultivation was the most common agricultural practice in the study area and three paddy seasons covered almost the whole year: Three major paddy varieties were cultivated: *Aman* from December to January, *Boro* from March to May and *Aus* from July to August. Raiding paddy fields and other crops (e.g., cabbage, cauliflower, bean, potato), has become commonplace across 35 border villages located in the upazila of Sherpur and Jamalpur districts. Among them, Kangsha Union under Jhenaigati Upazila suffered the highest crop raiding incidents (30) in 2013, with a significant number of raids also in Ramchandrakura (16), Singaboruna (13), Nunni Paragao (12) and Ranishimul (11) (Fig. 7). On a more local scale, Balijuri of Sreebordi Upazila experienced 10 crop raiding incidents followed by Gajni (7), Nakshi (7), Gandhigao (6), and Jhulgao (6). *Aman* (40%) was the most affected paddy variety followed by *Boro* (31%) and *Aus* (29%) (Fig. 8). More incidents of crop-raiding were observed in 2013 (61%) compared to 2014 (39%).

A total of 228 houses were destroyed by elephants between 2013 and 2014 along with trampling of stored grain and other household material. Consequently, 133 families in 25 border villages were affected in these raids with a higher frequency of incidents in 2013 (n = 70). Types of houses destroyed were thatch-roofed (136), thatched (36), tin-shed (27), wooden (22) and brick built (7). Three houses of two forest stations and two temples and one grocery shop were also destroyed. Nalitabari Upazila (n = 120) experienced a higher frequency of house raids
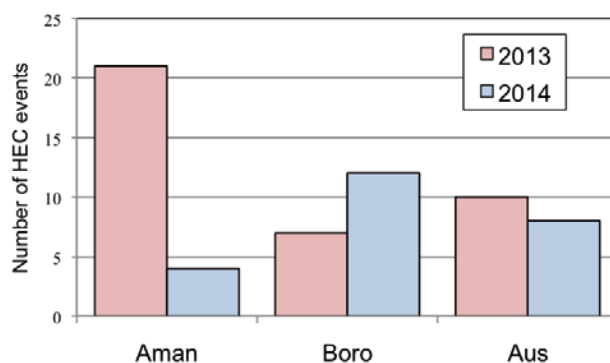

Figure 8. Raiding intensity by paddy variety in 2013 and 2014.

Table 1. Details of elephant deaths from 2008 to 2015.

Year	Village	Union	Upazila	Sex	Cause of death
2008	Dudhnoi	Kangsha	Jhenaigati	Calf	Unknown
2009	Bakakura	Kangsha	Jhenaigati	1 Female, 1 Calf	Unknown
2009	Boro Gajni	Kangsha	Jhenaigati	Male	Unknown
2009	Gandhigao	Kangsha	Jhenaigati	Unknown	Fallen into well
2010	Boro Gajni	Kangsha	Jhenaigati	Male (injured)	Shot at conflict situation
2010	Hatipagar	Poragao	Nalitabari	1 Male, 1 Female	Accidental electrocution
2011	Balijuri	Rani Shimul	Sreebordi	Male	Shot at conflict situation
2011	Gajni	Kangsha	Jhenaigati	Male	Unknown
2011	Gandhigao	Kangsha	Jhenaigati	Unknown	Unknown
2012	Shomnathpara	Dhanua	Bakshigonj	Male	Shot by poacher for tusks
2012	Panihata	Ramchandrakura	Nalitabari	Male	Unknown
2012	Gopalpur Beat Office		Nalitabari	Female	Unknown
2012	Nalitabari (Haluaghat)	Ramchandrakura	Nalitabari	Male	Shot by border guard at conflict situation
2014	Balijuri Office Para	Rani Shimul	Sreebordi	Male	Unknown
2014	Mayaghashi	Ramchandrakura	Nalitabari	Male	Fallen into well
2015	Hariakona	Ranishimul	Sreebordi	Female	Shot at conflict situation
2015	Halchati	Kangsha	Jhenaigati	Male	Shot at conflict situation
2015	Tawakocha	Kangsha	Jhenaigati	Unknown	Fallen in pond

followed by Sreebordi (n = 45), Jhenaigati (n = 33) and Bakshigonj (n = 16). On a local scale, Daodhara Katabari village in Nalitabari was severely affected by house destruction (n = 53) in 2014 while the highest number of house raids took place in Batkuchi village (n = 36) in 2013.
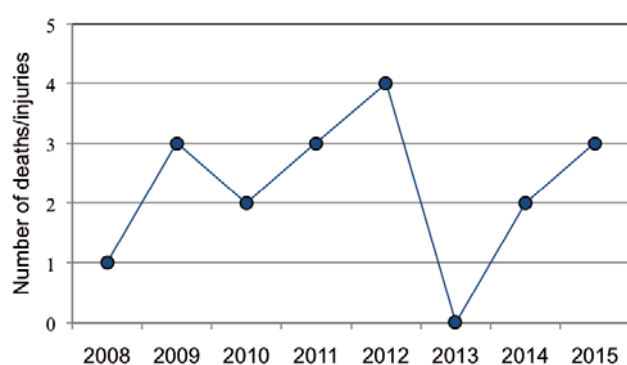
Human death and injury

From 2000 to 2015, at least 78 people died and 68 were injured in HEC incidents. The

Figure 9. Elephant deaths from 2008 to 2015.

highest number (15%) was in 2009 and only single deaths occurred in 2001 and 2003 (Fig. 6). Approximately 42% of people died in crop fields and 38% during house raiding. Most of the people (90%) who died or were injured were male, possibly because men were mainly involved with the protection of crops and houses from elephants.

Elephant death and injury

Observations and secondary data revealed that 19 elephants died due to HEC incidents from 2008 to 2015. The highest number of elephants died in 2009 and no deaths occurred in 2013 (Fig. 9). Many elephants were injured during people's attempts to prevent crop and property damage. Jhenaigati Upazila was the highest elephant-incident area with 50% of deaths. About 55% of elephants that died were males, although the sex of a few elephants was unknown. The Forest Department recovered tusks from two elephants, but poachers or local people removed

the tusks from six elephants, before detection. Six elephants were shot dead by law enforcement agencies during HEC incidents to stop further casualties, while several were accidental or due to unknown causes (Table 1).

HEC hotspots

We identified several HEC hotspots based on the number of crop and house raiding incidents, and human and elephant casualties. Of six HEC hotspots identified, three were in Jhenaigati, two in Sreebodri and one in Nalitabari Upazila (Fig. 5). Forest Department records show that elephants started coming into conflict with humans in these areas in 1997, although HEC was sporadic and minimal then.

Compensation and mitigation measures

A compensation policy was formulated under the Bangladesh Wildlife (Preservation) Order 1973 [revised as Bangladesh Wildlife (Conservation and Security) Act 2012] in 2010 to recompense the losses caused by elephants. The amounts allocated were, US$ 1400 for loss of life, US$ 700 for major physical injury and US$ 350 for loss of livestock, household property, trees, crops etc. (MoEF 2010). Most of our respondents (87%) appreciated this compensation scheme. However, 69% of respondents expressed apprehension of the bureaucratic process of approval of applications. Only 12% of respondents were happy with the current compensation approval process.

In terms of community effort, local people devised a number of traditional tools and approaches to deter elephants from raiding their crop fields and houses (Table 2). However, most of these measures were short-term solutions, which are largely ineffective. Many of these tools are lethal or often leave elephants wounded and enraged, resulting in more raiding incidents afterwards.

As in southeast Bangladesh (IUCN Bangladesh 2011; Shamsuddoha & Aziz 2014) encroachment of forest land, clear-felling through social forestry practices (forest plots are clear-cut at maturity), uncontrolled firewood collection, land conversion and uncontrolled grazing were commonplace in the study area. Remaining forest habitats in the region under government management have been severely degraded due to overexploitation and encroachment. People living in the study area are poor farmers and predominantly cultivate paddy. Rice being a crop frequently raided by elephants,

Table 2. Locally used tools and their effectiveness in deterring raiding elephants.

Tool	Preparation	Effectiveness and impact
Fire spear	Spear attached with a long stick and flammable natural fibres. Fuel (kerosene) is added to make it catch fire before use.	Often cause burn and injury to elephants. Very effective but makes elephants enraged.
Iron spear	Large iron spear attached to a long bamboo stick. Thrown towards elephants from a reachable distance.	Causes serious wounds and injury to elephants. Effective. However, often makes elephants aggressive leading to even more raids.
Stones & sticks	Villagers keep reserve of stones/bricks and sticks in their backyard to use when necessary.	Used to make elephants go away from a raiding spot but not so useful and effective now.
Fire crackers	Thrown towards elephants from short distance.	Used to scare elephants. Very effective but too costly to use on regular basis.
Sound maker	Empty plastic drum, hand mike, bullhorn, etc.	Used to gather people and to produce sound for deterring elephants. Moderately effective.
Setting fire	Dried fuel wood and bamboo is kept stored in backyard.	Set fire by adding fuel to it, close to crop fields and houses. Effective as short-term measure.
Flash light	High-powered flashlight with portable generator.	Very effective but not widely available being expensive to afford and maintain.
Chilli powder	Locally made dry chilli powder.	Thrown towards elephants from very close distance. Effective but often makes elephants furious.
Salt container	Salt put in container for setting outside crop fields.	Some ethnic communities put salt to attract elephants out of their crop fields; not much effective.

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alternative crops should be explored. For long-term conservation, afforestation with suitable plant species and stopping exploitation of forest resources is urgently needed to restore degraded elephant habitats. Grazing of livestock within the forest habitats should be stopped. The remaining forest patches should be preserved as a core elephant zone while lands under social forestry schemes can be used as buffer zones. Building relationships between Forest Department and local people is essential to better manage HEC and habitats in these areas.

Immediate collaboration between India and Bangladesh is necessary to identify and preserve elephant routes allowing free elephant movement across the fence.

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