Understanding Elephant-Human Interaction Patterns in a Human-Wildlife Conflict Landscape in North-eastern India

Final Report

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Contents

1. Introduction

1.1 Human-elephant conflict in India

Most of the elephant ranges overlap with human dominated landscape, where increasing human population density and resource competition inevitably give rise to 'Human-Elephant Conflict' (HEC). Presently, Asian elephants are distributed across 13 range countries across South and South-East Asia. India holds 24000-28000 Asian elephants, which is over 50% of the world population (Menon, 2003). These elephants are distributed across 18 states over an area of 1,09,500 sq.km (Santipillai & Sukumar, 2006), which accounts for 3% of India's geographical area (Lenin & Sukumar, 2011). IUCN lists Asian elephants as endangered. Wildlife (Protection) Act of India, 1972 provides highest protection to them through Schedule I status. Due to their widespread geographical distribution, ecological functions, and iconic status within religion, history and popular culture, Asian elephants are considered conservation flagship species (Madhusudan *et al.*, 2015). Unfortunately, protected areas, cornerstone of India's conservation practice, cover only 22% of elephant habitat (Project Elephant, n.d. as cited in Lenin & Sukumar, 2011). Across India, intensified land use and land cover changes (agricultural or industrial expansion) have caused massive fragmentation of habitat and blockage of traditional migration corridors and jeopardised long-term survival of the Asian elephants.

North-east states of the country, which forms part of Indo-Burma biodiversity hotspot, harbours around 11,000 Asian elephants in 14 discrete fragments (Choudhury, 2004), constituting 32.57% of India's elephant population (Assam Forest Department, 2009). Out of these states, Assam provides the key constituency for elephant conservation as it is home for 19.10% of total elephant population of the country. Both human and elephants are victims of HEC: During 2003-2015, in Assam 817 people have been killed by wild elephants while around the same period 255 elephants have been killed due to human activities (Kar *et al.*, 2016). MoEF (2010) estimates that although countrywide elephant population has increased by 70% between 1980 and 2002, elephant related incidences have killed 400 people annually in India and have caused damage to 500,000 families through crop depredation. Similarly, 100 elephants have been killed annually by retaliatory farmers, poachers and getting hit by trains (ibid). Controlling elephant depredation and payment of ex-gratia to affected people put an annual burden of Rs. 10 to 15 crores on the Central and State Govt. exchequer (Bist, 2002).

1.2 Drivers of human-elephant conflict

HEC is an integral part of history of human-elephant relationship. But the intensity and frequency of the conflict increases only when habitat loss crosses a critical threshold of 30-40% (Chartier *et al.* 2010). HEC is driven by a multi-causal system comprising of various ecological and social factors. Loss of access to quality habitat and decreased forage increase intrusion by elephant into human spaces, which results in crop raiding, aggressive behaviour and possible mortality (Bist, 2002; Sukumar, 2003). Human mortality and injury are mostly caused by sub-adult males and bulls (Sukumar, 2003).

Most of the conflict incidences happen within the forest and the human dominated fringe areas of the forest. While human mortality in forest may be caused by accidental encounters during firewood collection or livestock grazing, such mortality in settlements and agricultural fields are mostly due to aggressive elephant behaviour. Such behaviour may be generated from long term frustration due to continued harassment by humans during crop raiding and also when people get too close to the elephants which are injured or in *'musth'* or females with calves (Lenin & Sukumar, 2011). Properties like granaries, kitchens and water installations are also damaged during the conflict. Habitat loss or degradation leads to fragmentation of elephant's home range and shift in elephant diet to crops which are abundant as well as nutritive (Madhusudan, 2003). Blockage of traditional migration routes also force elephants to move through human settlements and clustered events of crop and property damage along the routes are often learned over generations (Sitati *et al.*, 2003). Other ecological factors such as proximity to forest (Nath *et al.*, 2007), rainfall (Osborn, 1998; Sukumar, 2003), bamboo in home

gardens (Lahkar *et al.*, 2007), reforestation (Naughton *et al.,*1999) etc. have also been found to have correlation with the conflict.

1.3 Short term and long-term mitigation of human-elephant conflict

The conflict mitigating measures broadly fall under two categories: short term tactical measures which are mostly reactive in nature and long-term strategic measures which address the ultimate causes of conflict (Lenin & Sukumar, 2011).

Short term methods involve traditional methods such as noise (shouting, beating of drums, clapping), light (fire, spotlight), stone pelting, looking out from raised or ground level platforms (*machans*), individual or collective crop guarding etc. Early warning systems, such as trip wire alarm, informants, SMS are also used to make people alert of elephants (Fernando *et al.*, 2008). Barriers like electric fencing, elephant-proof-trenches (EPT), stone walls etc. have also been tried with some success to physically separate humans and elephants. Experimentation with bio-fencing (chilli, citrus fruits, cacti), artificial water sources, long awned paddy varieties, chilli smokes and bombs, satellite telemetry has been done with simultaneous success and failures (Lenin & Sukumar, 2011). Forest department also do their bit by deploying *kunkis* (trained scaring squads) to drive away the elephant, relocating or culling the problem elephant, taking the elephant into captivity or paying compensation to the affected villagers. All of these methods have limited success, and only temporary solution. Elephants, too, tend to grow habitual to such deterring techniques unless these are often redesigned.

Long term strategies target long term survival and well-being of humans and elephants both. These methods include prudent land use planning through buffer zone management, relocation of human settlement and securing the corridor; habitat protection and forest management; and offsetting the costs of conflict through community based natural resource management (CBNRM), insurance programs, payment for ecosystem services (PES) etc.; long term education and awareness program.

1.4 Present study

The state of Assam, situated at Northeast India harbours close to 6,000 wild Asian elephants which is more than 20% of the total elephant population in India (Project Elephant, 2017). Rapid loss of habitats and anthropogenic land use changes have resulted into increase in occurrence and movement of elephants outside protected areas and thereby, increase in human-elephant conflict in the region.

Most of the previous studies on human-elephant conflict in this region are based in protected areas and are concentrated around documenting conflict incidences or understanding elephant ecology (Nath et al., 2009; Chartier et al., 2011; Goswami et al., 2014; Goswami et al., 2015; Wilson et al., 2015). Departing from this approach, my project intends to understand human-elephant interactions by holistically examining elephant ecology and behaviour, patterns of livelihood and lifestyle of local communities, behavioural interactions between human and elephants during encounters, and people's perceptions of and attitudes towards elephants. This project is situated in the Dhansiri forest division (26^0 46'N, 92^0 08'E) of Udalguri district in the state of Assam, India. This region has been experiencing extreme human-elephant conflict with 62 elephants and 155 humans having lost their lives to this conflict from 2010 to 2019. A documentation of human-elephant interactions in such a non-protected, mixed-use, human-dominated landscape also has important implications for the long-term conservation of Asian elephants in the region.

A documentation of human-elephant interactions in such a non-protected, mixed-use, human-dominated landscape also has important implications for the long-term conservation of Asian elephants in the region. In this context, the study proposes to assess:

1.   General behavioural activities of elephants in a mixed-use, human-dominated landscape
2.   Behavioural responses of elephants to human presence and activities
3.   Patterns of livelihood and lifestyle of the local human communities in the landscape

4.   Spatial and temporal patterns of human-elephant conflict in the landscape
5.   People's perceptions, attitudes and behaviour towards elephants

2. Methodology

2.1 Description of field site

The fieldwork was carried out in the Dhansiri forest division of Udalguri district in the state of Assam, India. Udalguri district is situated in western part of Assam and north of the Brahmaputra River, with a geographical area of 1852 km². Udalguri shares a state border with Arunachal Pradesh in the northeast and an international border with Bhutan in the north. The district is surrounded by Sonitpur district in the east, Darrang district in the south and Baksa district in the west. Agrarian settlements, forests and tea gardens are the three major land use land cover categories. Although the Bodos are the numerically major ethnic group of the district, Adivasis, Assamese, Bengali Hindu, Bengali Muslim and Nepalis form considerable part of the district population.

The Dhansiri forest division is a part of the Ripu-Chirang elephant reserve. This landscape is a mosaic of agricultural settlements, tea plantation, a wildlife sanctuary (Barnadi WLS), two reserve forests (Khalingduar RF and Bhairabkunda RF) and three proposed reserve forests (Newly PRF, Kundarbil PRF and Bhairabkunda PRF). Bhola, Nonoi, Kulsi, Lakhmi and Dhansiri are the major rivers flowing through the area. This present study is situated in two ranges of Dhansiri forest division: Nonai and Barnadi. The Dhansiri forest division experiences seasonal elephant movement from its adjoining hills in Bhutan. Elephant movement has majorly increased over the years in this landscape, from only 30 elephants in 1993 to more than 150 individuals in 2011 (Assam Forest Department, 2009). As a dire result of such movement, the region has been experiencing extreme human-elephant conflict incidences, with 62 elephants and 155 humans having lost their lives during the period 2010-2019 (N. Guha, pers. comm.).
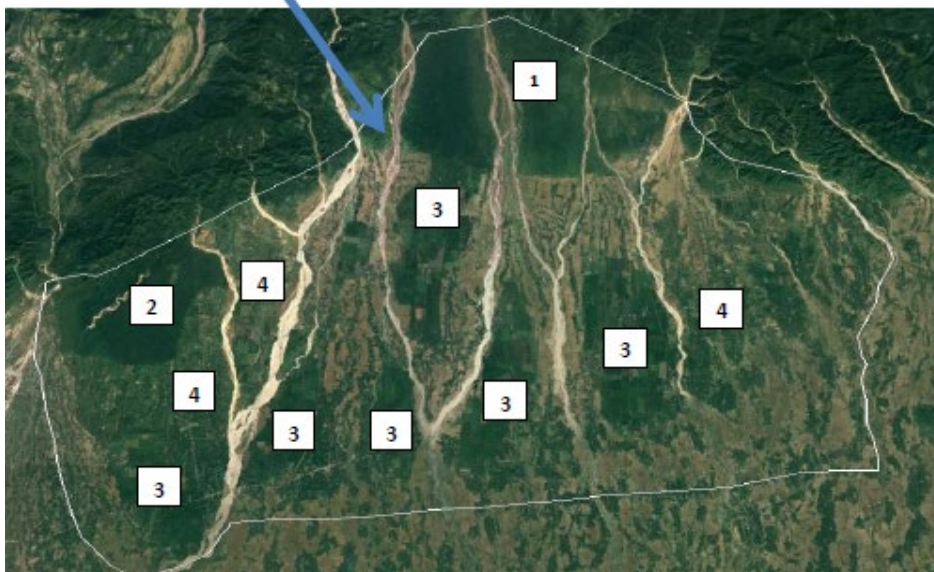

Fig 1 Study area: Dhansiri Forest Division, Udalguri, Assam. 1=Khalingduar Reserve Forest, 2= Barnadi Wildlife Sanctuary, 3= Large corporate owned tea estates, 4= Small tea growers

2.2 Methodology for LULC change detection

For land use land cover (LULC) change detection, LANDSAT satellite images for the study site from 1988 to 2022 were acquired from USGS earth explorer. The images were collected at an interval of 10 years and if cloud-free images were not available, images from the successive years were taken. LANDSAT 5 imageries of 2nd January 1988, 14th February 1998 and 11th January 2009 and LANDSAT 8 imagery of 16th February 2022 were used.

The acquired images were pre-processed for atmospheric correction. False Colour Composite (FCC) of Bands 5 (Near Infrared), 4 (Red) and 3 (Green) for Landsat 8 images and Bands 4 (Near Infrared), 3(Red) and 2 (Green) for Landsat 5 images were carried out for Land Use Land Cover classification. The images were then masked to the shapefile of the study site.

Supervised method for the classification was used for LULC change detection. The training samples of different classes were made using Google Earth. Maximum Likelihood Classification (MLC) in ArcMap 10.6 was used. The supervised classification classified the study site into Forests, Tea plantations, Built-up areas, River, Agriculture and Barren lands/Scrublands. The area for each class was calculated for the classified images across the time period.

2.3 Methodology for assessing spatio-temporal pattern of human-elephant conflict

Assessment of spatio-temporal pattern of human-elephant conflict was done through two methods which were triangulated with each other. First, the record on people's compensation applications for elephant related damages were collected from forest office. The records were not kept in a systematic manner, and it took quite some time to collate the data from 2012 to 2021. From the record, name of the person and village, date of damage and type of damage were noted for further analysis. Simple descriptive statistics was used to analyse the pattern of elephant related damages. Second, a rapid survey of house damage incidents from 2015-2022 (February) was done to understand the pattern and nature of such incidences. For the survey, five members from local villages were chosen and trained on collecting data through structured interview. The questionnaire was built after discussion with my PhD supervisor, as well as field assistants and surveyors. After piloting the questionnaire with 12 respondents, some questions were added as well as rephrased for clarity and ease of interviewing. The survey form consisted of two parts, demographic details of the respondent and nature of house damage incident. The respondents were at first chosen purposively, selected from surveyor's knowledge and the subsequent respondents were selected through snowball sampling. Through this method, 448 houses were surveyed from 36 villages in February-March 2022. For the survey, all the ethical protocols were followed. The respondents were informed about the purpose of the interview and only after obtaining oral consent, the interview was conducted. Simple descriptive statistics were used for data analysis.

2.4 Methodology for assessing people's attitudes and behaviours towards elephants and conflict mitigation

People's attitudes and behaviours towards elephants and human-elephant conflict mitigation were documented within a mixed methods design with survey, participant observation and semi-structured interviews as the key methods. The survey questions related to the attitudes and behaviours of people were tagged along the survey questionnaire that was described in the last section. The questionnaire consisted of close ended questions with some questions having an open-ended 'why do you think so?' question. The surveyors were trained on the questionnaire and the survey was conducted as described before. Participant observation and semi-structured interviews were more useful to elicit in-depth and rich responses from people. I participated in various activities pertaining to human-elephant interface, such as, elephant tracking, crop guarding in night, elephant drives, solar fence erection and maintenance, elephant watching in tea estates, handling elephant related damage incidents such as crop & house damage, human death & injury as well as elephant death. The observations were

documented as extensive field notes. Semi-structured interviews were carried out by myself with an interview guide with 65 respondents from 5 villages where I also happened to carry out most hours of participant observation. The interview guide consisted of questions related to respondents' experiences with elephants, their perspective on the causes and impact of this conflict, their adaptation strategies to minimise conflict and mitigation of this conflict. All the ethical protocols were followed as well. The respondents were selected through snowball sampling. The data was audio recorded with permission and later transcribed in English. The transcripts were coded to identify various themes. The themes were then compared and contrasted across transcripts.

2.5 Methodology for documenting elephant behaviour

2.5.1 Community-based monitoring of elephants

First, villages which experience frequent damages by elephants were ascertained from the record maintained by the local forest range office. Then, extensive travelling to those villages was carried out along with the local field consultant, Mr. Dibakar Nayak. We wanted to include people who would be active as well as interested to volunteer in this network. The choice of people followed a purposive as well as snowball approach. In the first round, some people were chosen directly from Mr. Nayak"s acquaintances and later, these people suggested us about others from other villages. All the members were male. We requested them to send information related to elephants in the vicinity of their villages. The information included, approximate herd sizes, time and direction of entry in and exit from the village and damage details, if any. Information started pouring in in the WhatsApp group and this network remained active. While we cannot claim to ascertain each elephant incursion event since they often happen in night, but the data generated showed how elephants were moving in the overall landscape. Also, in case of elephant incursion reported by one monitor, the monitor based in adjacent village could alert other villagers about it. Plenty of instances of advanced knowledge from the group chat, saving farm and properties were reported.

2.5.2 Identification of elephant movement paths

Whenever we received news of elephant movement or detection, we went to the location to ascertain the paths that the elephant(s) might have followed. We searched for visual tracks (footprint, loose soil, destroyed vegetation etc) and dung to understand the paths used. This exercise along with the information from the monitors and intimate knowledge of Mr. Dibakar about elephants helped in creating landscape level micro-maps of elephant movement.

2.5.3 Preparation of ethogram

Whenever elephants were detected, we enquired if they were observable or not. Systematic observation in the night and within a village was difficult. Major observations were done at the tea estate and in the daytime. All kinds of behavioural states and activities were documented. An ethogram was prepared.

3. Survey Team

Principal Investigator- Sayan Banerjee

Local Field Consultant- Dibakar Nayak, Nabajyoti Baruah

Survey enumerators- Jyotish Kalita, Ranjan Kumar, Banajeet Behera, Deepali Sawra, Ruby Karmakar, Uma Chetry, Gitanjali Saharia, Asmanand Ali, Manab Deka

4. Results

4.1 People and elephants in the study landscape

4.1.1 Historical events connecting people and elephants in the present

Assam was annexed to the British empire after the Treaty of Yandaboo was signed in 1826. The forest resource of Assam was initially undervalued as compared to the agriculture and so agricultural expansion was encouraged at the cost of forests (Handique, 2004). The administrators defined the vast tracts of forest, which was uncultivated and unsettled, therefore devoid of any imperial revenue generation, as wastelands. The discovery of tea, expansion of railways and timber and plywood industries made the administrators to rethink the unruly forests as potential production forests (Handique, 2004; Saikia, 2011; Sharma et al., 2012). Several forestry programmes were devised with setting up of reserve and protected forests for harvesting timber and non-timber products such as rubber, lac and khair. The forest department was set up with the aim to legitimately maximise profits from forestry and devise rules and regulations for access to these forests for maximising productivity of the valued trees (Handique, 2004; Saikia, 2011). The tea economy was particularly encouraged, and laws were notified to transfer vast tracts of forest lands to British tea planters who became the chief private proprietors of the forest.

The present Udalguri district was part of the erstwhile undivided Darrang district. Although Darrang was a major focus for the British forest managers, due to experimental rubber plantation set up at Chariduar (presently at Sonitpur district), the Khalingduar area which is the field site for the present project was a bit obscure. The Khalingduar reserve forest was set up with a 27 km2 area for protection of a small-scale *khair* plantation. The Khalingduar reserve at that time consisted of grass land with few trees, hilly tracts with mixed forest, few swampy areas and large evergreen forested tracts (Darrang District Gazetteer, 1905). The population density was low; the 1901 census calculated around 34 people per sq. mile over an area of 900 sq. mile. The population increased gradually, mostly from immigration by Adivasi workers from the nearby tea estates, Bengalis, Marwaris and Nepalis. The tea business was particularly profitable and productive in the Darrang district. Several tea estates, now located at Udalguri district, established during 1850-1910, enclosed more than 5,000 ha. These estates are still functioning.

The large-scale forestry programmes as well as military expansion in the state of Assam caused significant demographic changes due to immigration and settlement of agriculturalists from Bengal, labourers from tea estates and grazers from Nepal (Handique, 2004; Sharma, 2017; Saikia, 2011; Banerjee, 2011; Sharma et al., 2012). Such demographic shifts have been a contention for sub – national politics in the region, which was directly, reflected during the Bodoland as well as the Assamese agitation movements. In the case of Udalguri and erstwhile Darrang district, immigration of Nepalis has been well documented. Nepali ex-soldiers who were part of the British army were encouraged to settle down around the foothills and forest fringes, the spaces being gradually converted to thriving peasantry (Sinha, 2003). On the other hand, Nepali marginal farmers and pastoralists expanded the livestock frontier on the hilly and forest tracts of the district. Sharma (2017) noted that the district of Darrang was preferred due to vast expanse of forest and fodder and abundance of land. Chettry (2009) commented that old Darrang was home to the largest number of graziers since mid-19th century. The Assam Land and Revenue Regulation Act of 1886 recognized Gorkhas as graziers and cultivators (Sharma, 2017). The Adivasis from the tea estates also started to clear land take up cultivation in due course of time. While non-indigenous population of the region were expanding, the indigenous Bodo community got entrapped among the triage of commoditisation of forests, expansion of tea estates as restrictive boundaries and demographic shifts (Vandekerckhove & Suykens, 2008). Bodos were pushed from riverine fertile lands to less productive hillsides, causing large-scale land alienation (Banerjee, 2011).

Even though there were attempts to protect the interests of tribal groups of Assam, including the Bodos, through the notification of 'Tribal Belt and Blocks' in 1886, the Bodos had to share this protection along with other plain tribal communities, tea-garden labourers, Santhals, Nepali

cultivators-graziers and scheduled castes, thereby causing intense competition over resources (Banerjee, 2011). Such historical injustice became the frontline narrative for the Bodoland movement of the late 20th century. The movement resulted in large-scale violence, internal migration of several ethnic groups and large-scale deforestation for settlement of displaced people, ultimately culminating into the formation of the autonomous region of Bodoland.

The wildlife, especially the elephant, prominently featured in the British forest policies and practices. Saikia (2011) commented that wildlife apart from being favourite leisure subject, contested the survival of the forestry programme itself. This is firstly through damages of production forests by wildlife and secondly by working as a 'beast of burden' in the imperial capitalist industry. The Darrang District Gazetteer in 1905 commented that elephants were a common species near the hills, and they damaged crops during the harvesting periods, noting that they would continue to damage unless the elephant numbers are regularly kept down. Similar instances of crops damage by elephants and subsequent hunting orders were mentioned in various administrative reports. Capturing elephant was a revenue generating sector for the imperial forest department in Assam and the forests were divided into different *mahals* which were leased to private players for capturing elephants with a payment of royalty. Darrang had seven such *mahals*. The captured elephants were used in the timber and other industries. Handique (2004) opined that British policy on wildlife was based both on exploitation and conservation. Elephants were so valued that in 1878, hunting of elephants in government reserve forest was only permitted under strict conditions and restrictions prescribed by the Chief Commissioner.

The post-colonial era followed the colonial philosophy of production forestry and kept the forest management system intact. High rates of population growth and movement, land distribution among landless, impetus to agriculture to grow more food crops and increase in immigrant population caused overall decline in the forested areas (Sharma et al., 2012). The tea, coal and oil economy continued to thrive without significant increase in employment. Several ethnic agitations caused rapid movement and settlement of people at forested areas. This coupled with illegal natural resource economy converted many reserve and unclassed state forests as 'paper forests' (Sharma et al., 2012). The Assam government promoted small tea estates as self-employment measure and subsidised the development of this sector. Needless to say, the small tea estates were established at the forested patches after clearing the forest (Sharma et al., 2012; pers. obs.)

The landscape and its denizens, the humans and elephants have been in a flux for a long time. Land use and demographic shifts and changes in governance regimes have contributed significantly to the present nature of human-elephant encounters in increasingly human-dominated, mixed-use landscape.

The study landscape is multi-ethnic comprising of different communities such as Bodo, Adivasi, Nepali, Bengali and Assamese who have distinct social history related to living in this region. The villages near the forest area are dominated by Nepali and Adivasi communities, even though Bodos are the dominating community in the overall district. Tea estates have their own labour quarters, and the labours belong exclusively to the Adivasi community. Main occupation as reported by the villagers is farming, especially paddy farming. The average landholding size is less than 1 Hect. and so, farming is done mainly for subsistence and daily-wage based labour is taken up as secondary occupation. Men in the villages, especially the youths are moving out of the villages to find work in the urban centres. Forest dependency is mainly true for villages which are close to the forest boundary. Majority of the households collect firewood from the forest, for which there are restrictions imposed by the forest department. People could only collect twigs and broken branches and could not fell trees. However, timber felling continues illegally. Nepali families living near the forest boundary practice livestock rearing, for which grazing is done within the forest. Water for drinking is collected from different streams that flow down from the forest. Majority of the villagers in the study landscape belong to the BPL category. In the tea estates, tea plucking, and tea bush maintenance are the major activity for which mostly women are employed.

4.1.2 Encroachment

The Assam Forest Department (2009: 32) has noted that out of 240 km^2 of Dhansiri Forest Division, almost 45% is under homestead encroachment, making it the most encroached area within the Ripu-Khalingduar Elephant Range. Within this forest division, acute forest loss has been documented at one of the two forest ranges, the Nunoi range, where the present project will be located. All the reserve forests (RF) and proposed reserved forests (PRF) under Nunoi range, apart from Khalingduar reserve forest, have been encroached partially or fully (Table 1).

Table 1: Encroachment of select reserve forests (RF) and proposed reserve forests (PRF) in Assam

Sl No	RF/PRF	Total area (ha)	Area under encroachment	Percentage area under encroachment
1	Khalingduar RF	7033	1305	18.55
2	Third addition to Khalingduar RF	60	60	100
3	Newly PRF	568	568	100
4	Kundarbil PRF	592	592	100
5	Bhairabkunda PRF	2403	2403	100
Total		10,656	4,928	46.25

4.1.3 Elephant population at Nunoi range

Elephant population and elephant movement have considerably increased in the landscape in the last three decades. The population estimation in 1993 documented only 30 elephants in the landscape, the estimation in 2011 noted identified more than 150 elephants. Even though Olivier (1978) identified these forest tracts to be unsuitable for large scale elephant movement, Assam Forest Department (2009) pointed that the temporal increase in elephant population at our study landscape could be due to gradual encroachment and agricultural expansion at the forested tracts at Indo-Bhutan border in the Udalguri district and at Assam-Arunachal border in the adjoining Sonitpur district. Steep terrain at the Bhutan hills could be a deterrent as well, which pushed the elephants to the plains and foothills at the Nunoi range.

4.1.4 Elephant population demography

Although specific population demography at the Nunoi range is unavailable, the overall demography in the Ripu-Chirang elephant reserve showed that the male-female ratio and proportion of sub adult population in the overall population had decreased over the years (Assam Forest department, 2009). The current population is also ageing with more than 50% of the population belonging to the adult class.

4.2 LULC changes and ultimate cause of elephant related damages

Large scale land use land cover change often acts as an ultimate cause of sudden increase in elephant movement and related damages in the non-forest human-dominated spaces. Assam has been a prime example of this. The LULC pattern from 1988, 1998, 2009 and 2022 suggest that protected forests have been converted into human settlements and agricultural frontiers in the early 90's (see Fig 2, 3,4,5). Another major change in the landscape is the conversion of fallow lands, grass and scrublands as well as paddy fields into small tea growing fields in the early 2000's. This growth of small tea growers has also happened in the Neoli PRF and other non-PA forested areas. Recent field visits suggested that land clearing is going on even in the erstwhile forested hills for setting up such tea gardens.
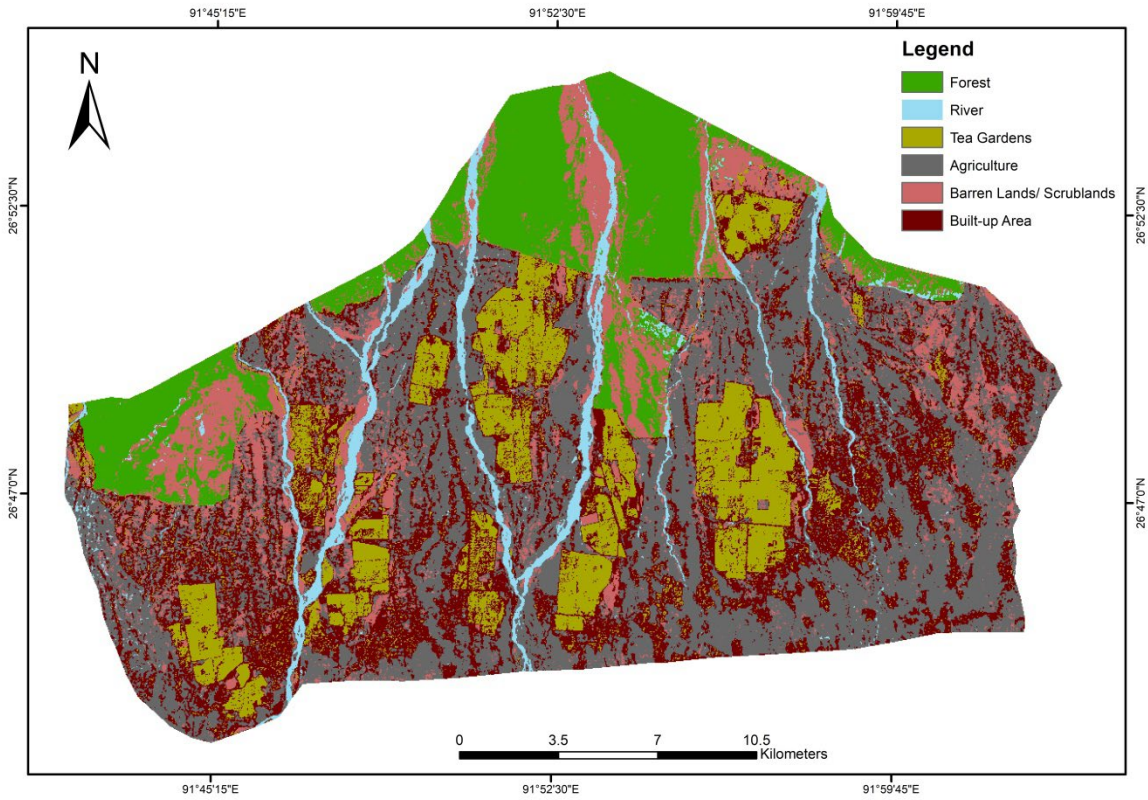
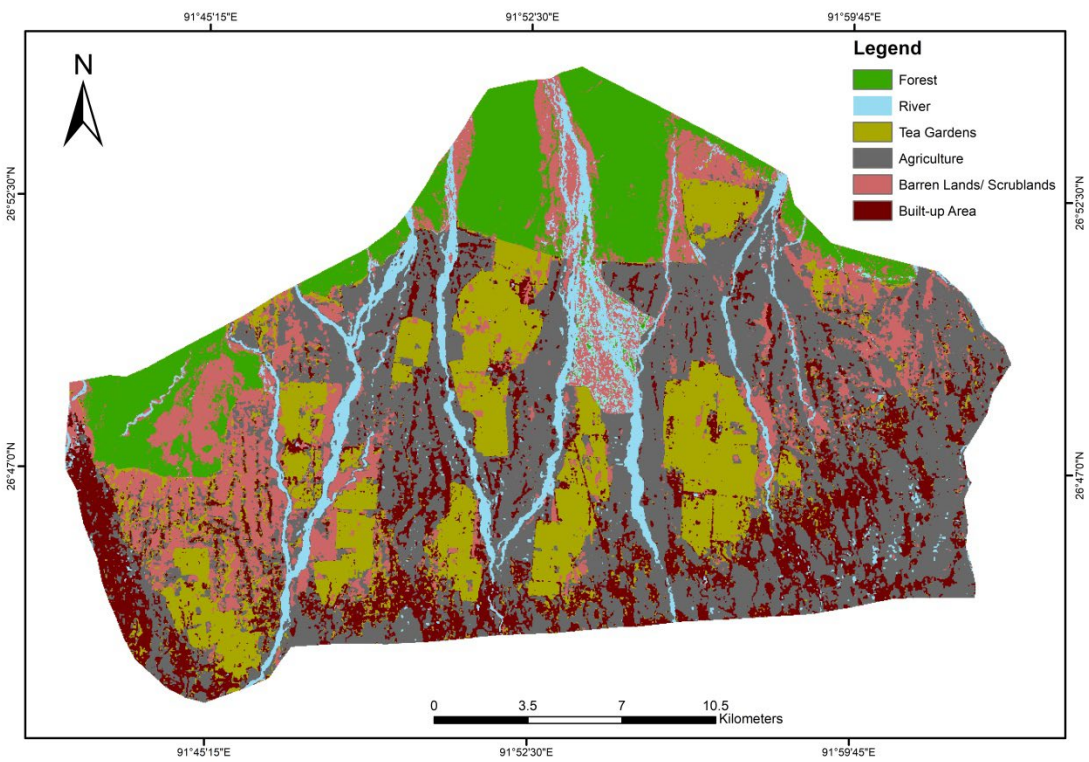Fig. 2 LULC status of study area in 1988

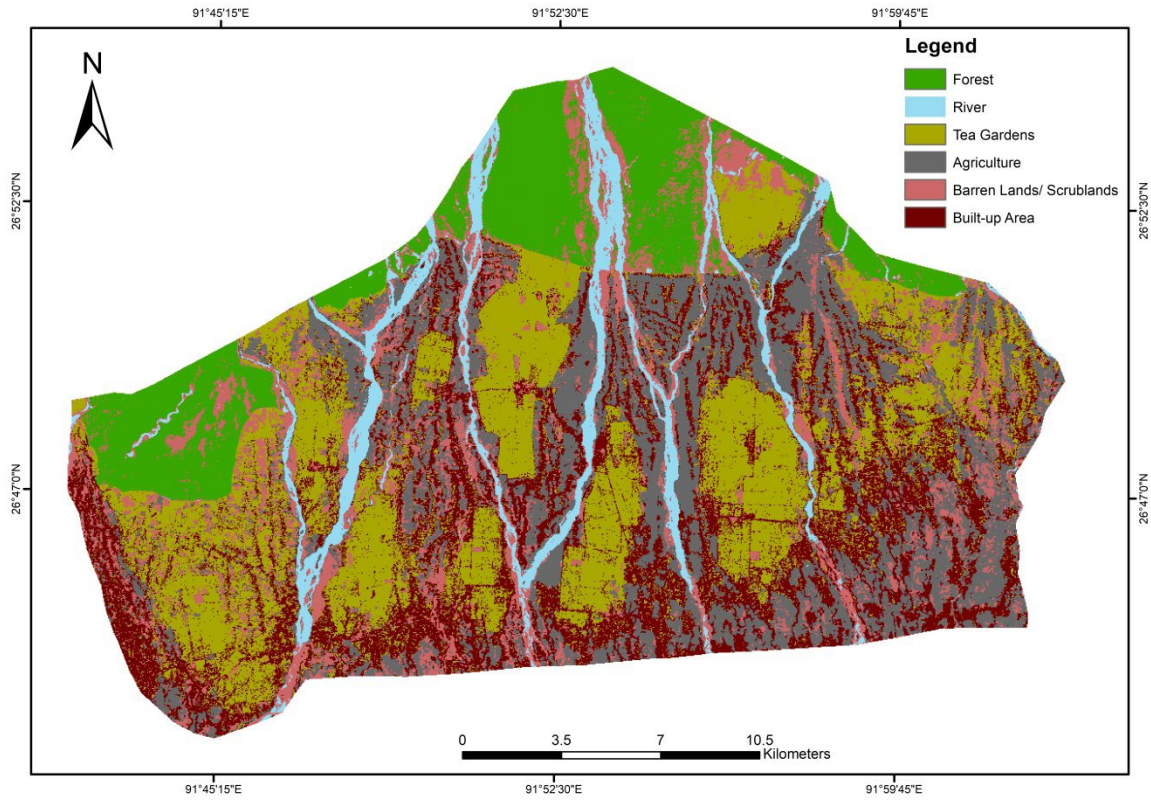Fig. 3 LULC status of study area in 1998
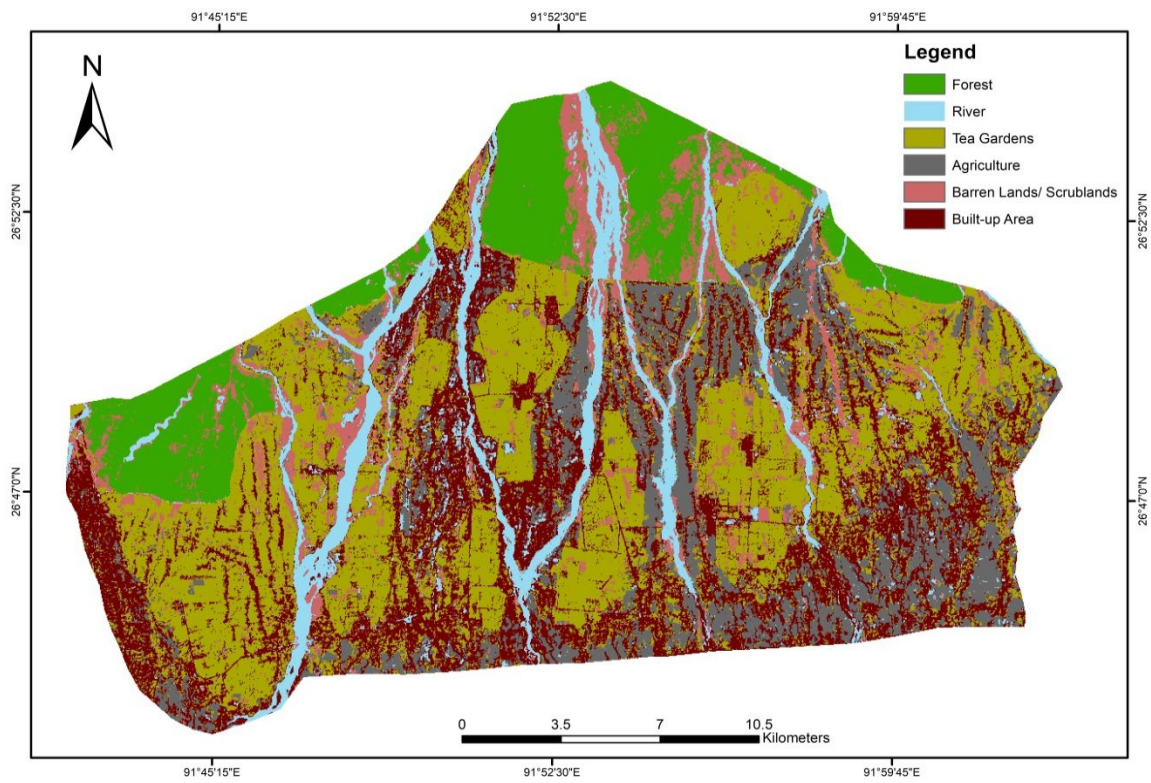
Fig. 4 LULC status of study area in 2009

Fig. 5 LULC status of study area in 2022

The following table provides the changes in area of all these land covers

Table 2 Change in area of different LULC classes in study area

Classes	1988 (sq. km)	1998 (sq. km)	2009 (sq. km)	2022 (sq. km)	% Change in area between 1988-2022
Tea Gardens	67.5801	87.6456	134.424	170.3196	+152.03
Agriculture	183.0141	186.8571	110.0439	75.6414	-58.67
Built-up Area	115.8579	71.8254	108.3177	121.8573	+5.18
River	21.8286	35.7282	30.3381	44.9253	+105.81
Barren Land	64.6092	76.5873	71.3133	47.6199	-26.30
Forest	68.1633	62.415	66.6162	60.6897	-10.96

Due to favourable government policy on tea growing outside large corporate-owned tea estates, significant increase in land under tea was observed at the cost of agriculture fields, homesteads, kitchen gardens and fallow lands (see Table 2). Increase in riverine areas has been attributed to erosion from annual small-scale floods in the region and few large-scale floods, particularly in the 2000-2010.

The quantification of change in LULC however, does not show the qualitative changes, especially with regard to the forests. People's testimonies suggest that the deforestation in early 1990's was carried out by the active and surrendered militants. As a result, economically and ecologically valuable species of trees have now almost become rare within the forest. A 2009 estimate by Assam Forest department showed that out of 240sq.km of forest area in the Dhansiri Forest Division, almost 45% has been deforested. Due to loss of trees and opening up of forest floor, invasive species, especially *Lantana camara* has proliferated, which may have caused food insecurity for elephants inside the forest. This may have caused the elephants to significantly spend time in human-dominated landscapes and mainly forage on paddy crops.

4.3 Spatio-temporal pattern of elephant related damages

In the last 12 years (2010-2021), 75 elephants and 176 people died at the Dhansiri forest division: 5301 houses and 2483 Ha. of crop area were damaged (see Table 3).

Table 3 Human-elephant conflict data 2012-2021

Year	elephant death	human death	house damaged	crop damaged
2010	1	2	73	28
2011	4	19	747	220
2012	9	10	655	180
2013	10	19	1053	210
2014	7	23	650	390
2015	5	21	420	320
2016	6	8	350	45
2017	8	7	380	260
2018	4	19	280	230
2019	8	27	370	260
2020	6	15	153	180
2021	7	6	170	160
Total	75	176	5301	2483

Compensation records from 2012-2021 were studied in detail to understand the spatio-temporal pattern of these damages. In these ten years, a total of 3064 incidents were reported with 2276 and 788 incidents at Nonai and Barnadi range respectively (see Fig 6).
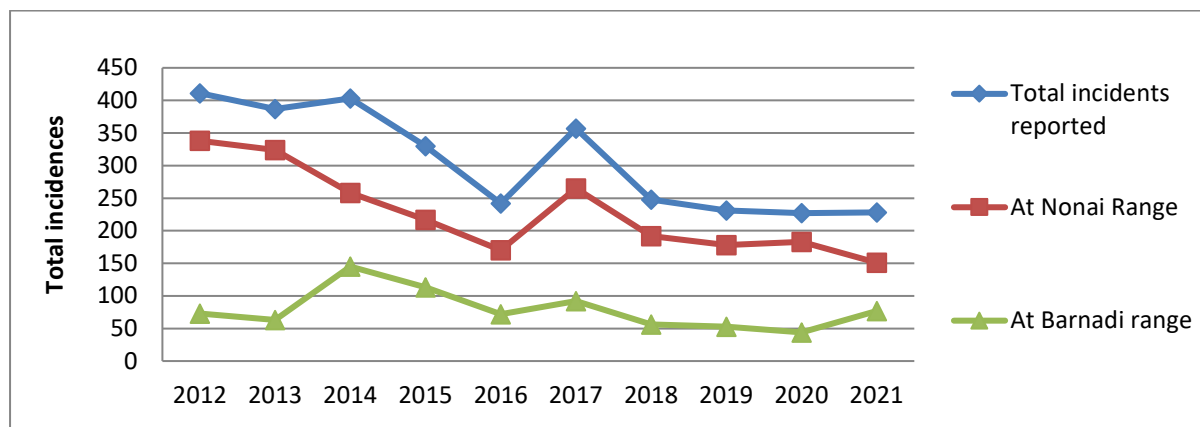

Fig 6 Yearly total elephant-related damages

Out of these 3064 incidences, 923 and 2141 incidences were reported as crop and house damages respectively (see Fig 7). Among the two forest ranges, i.e., Nonai and Barnadi, there is a significant difference between type of incidences. While, the Nonai range experienced 890 cases of crop damages, there were only 32 cases of such damages reported from Barnadi range. On the other hand, 1385 and 756 cases of house damages were reported from Nonai and Barnadi range respectively (see Fig 8).
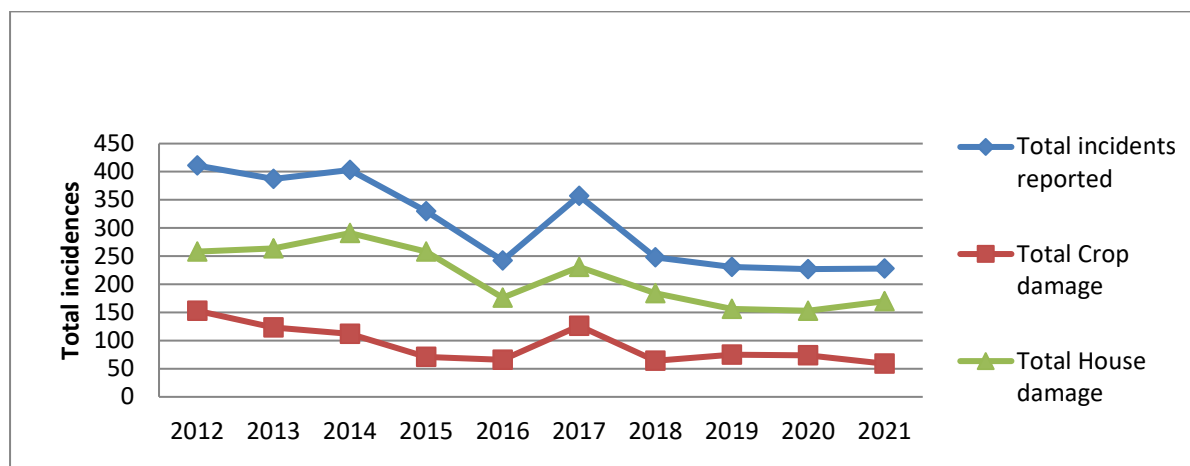
Fig 7 Total yearly House and crop damages
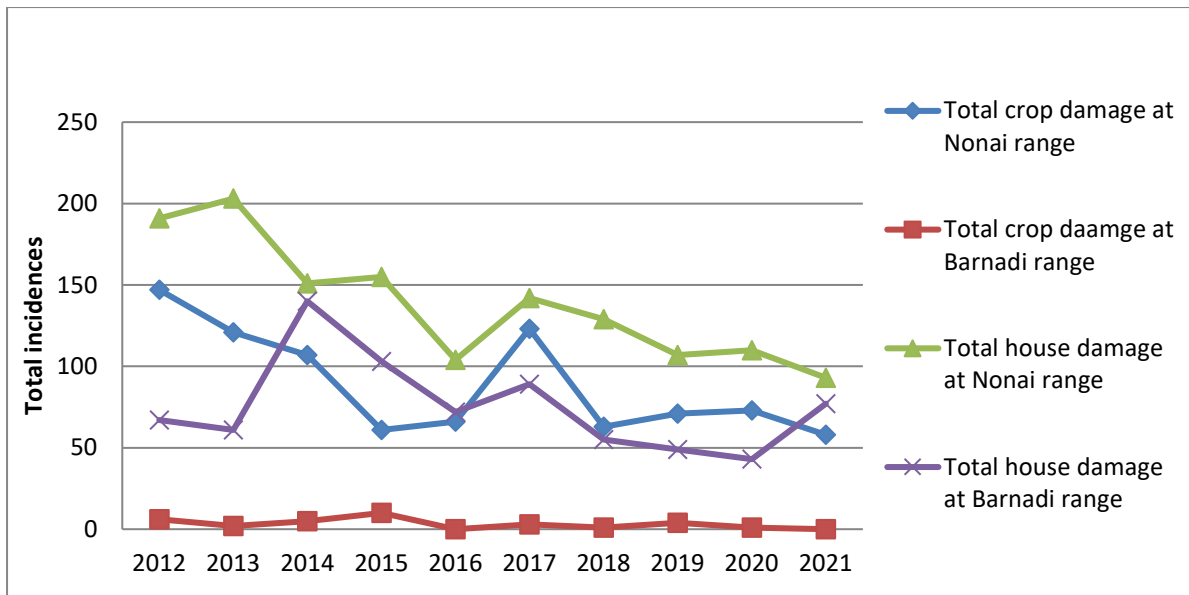
Fig 8 Range-wise yearly damages

Overall, across the region, the elephant-related damages started to increase with the onset of pre-monsoon in late May-June and reached a peak in August-September and then showed a declining trend from October-December (see Fig 9). Across, the ten-year period, the trend remained similar (see Fig 10).
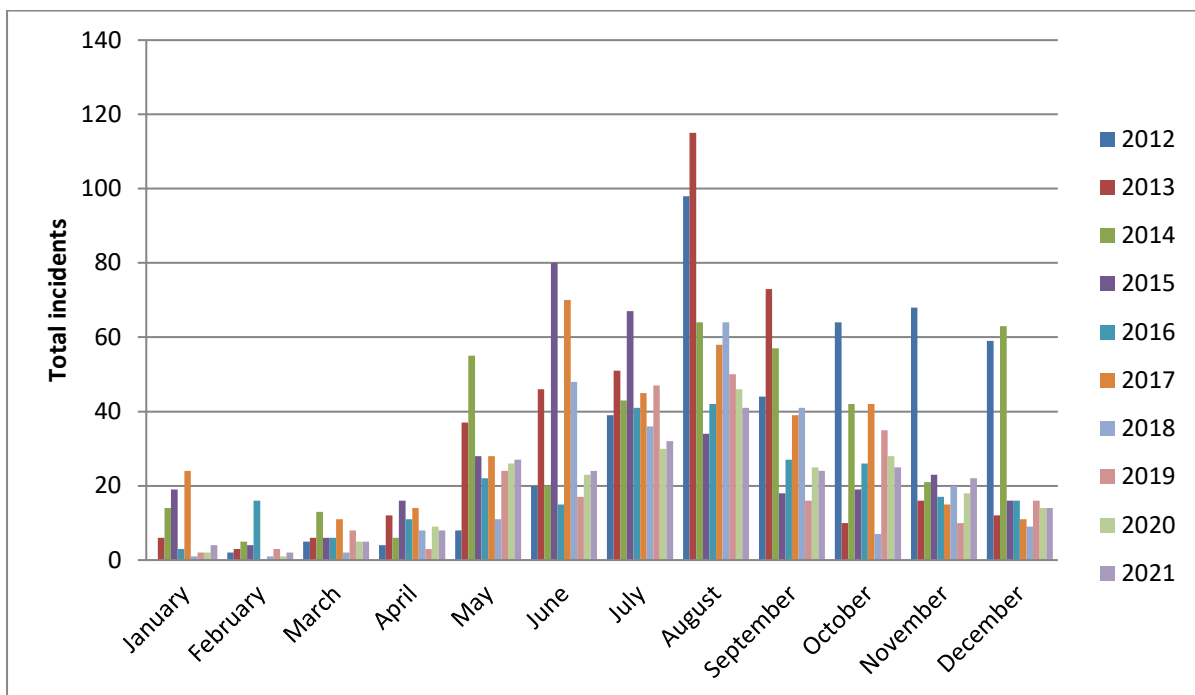
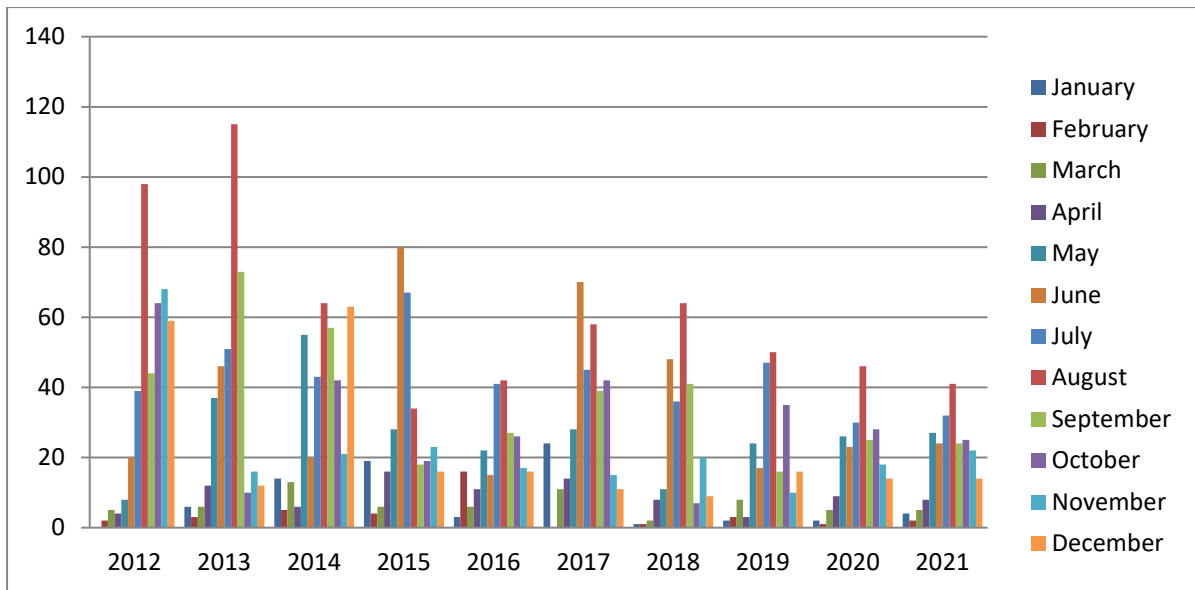Fig 9 Monthly variation of total crop and house damage incidences

Fig 10 Yearly variation of total crop and house damage incidences

The two ranges again showed different trends. At the Nonai range, major number of damages occurred in July-October (see Fig 11), whereas at Barnadi range, most incidences occur during June-August (see Fig 12). In the non-agricultural months (December-May), damages were found to be more regular in Barnadi range than Nonai range.
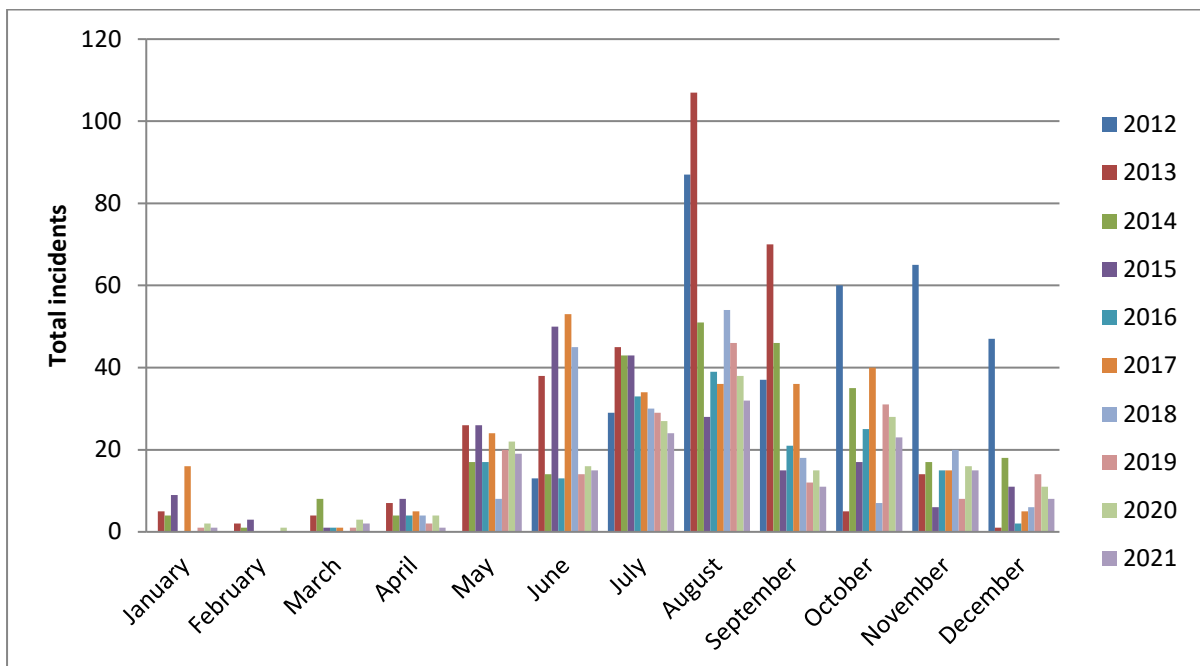
Fig 11 Monthly variation of crop and house damages in Nonai range
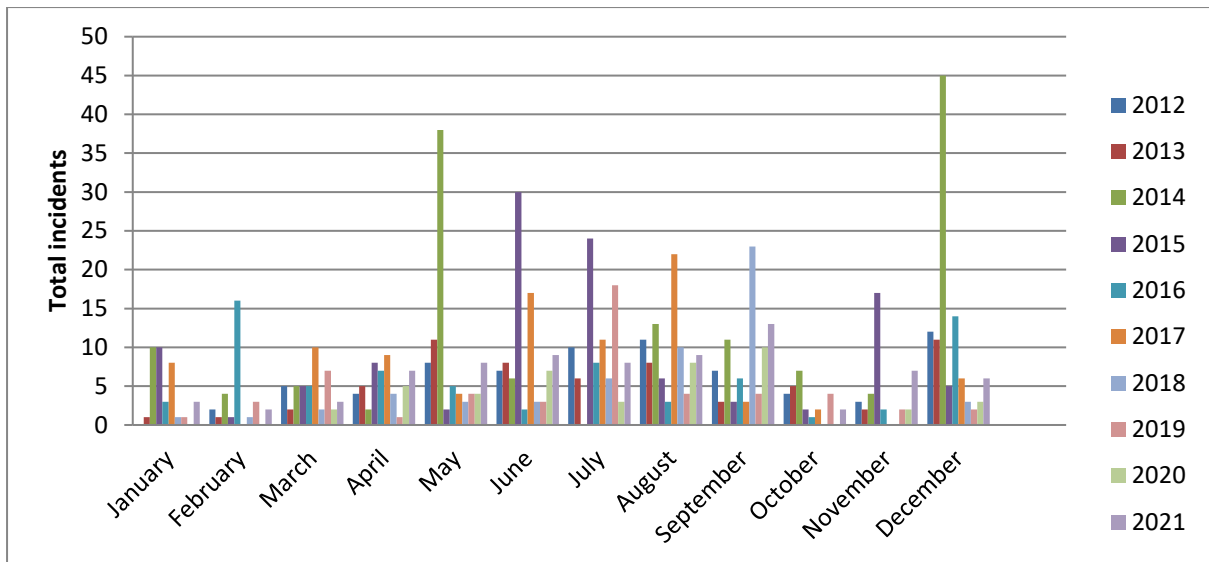
Fig 12 Monthly variation of crop and house damages in Barnadi range

Since both crop and houses damages were significantly more at Nonai range, the temporal difference between these two damages were analysed for this range. The crop damage incidents were more prevalent in the months of August-November (see Fig 13) and the house damage incidents were more during the May- August months (see Fig 14).
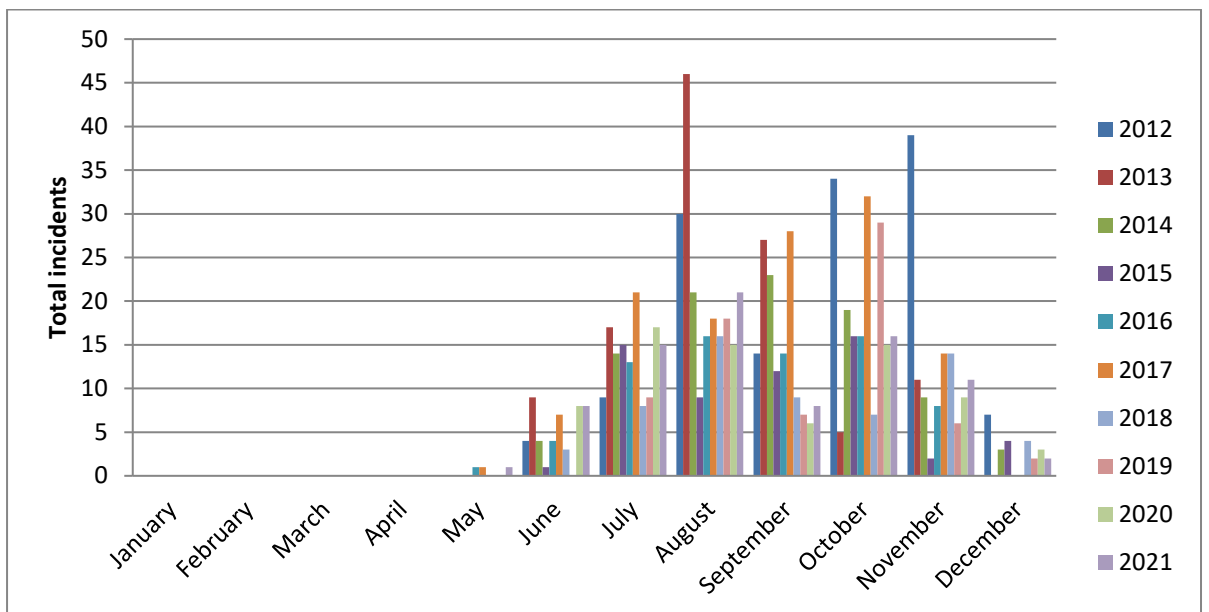

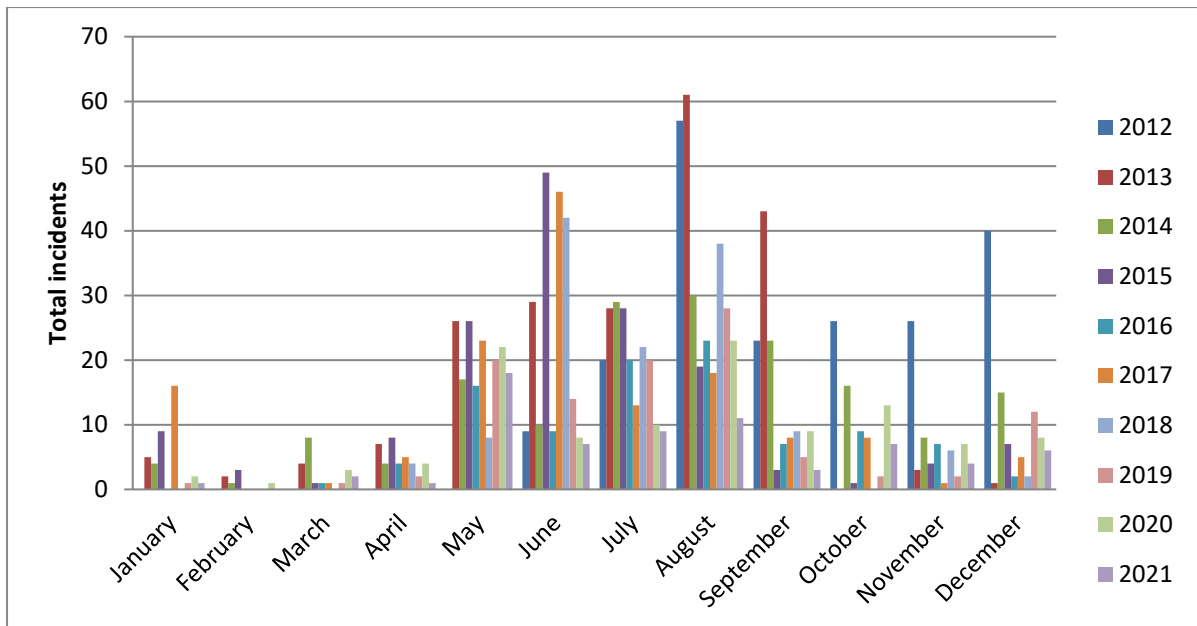Fig 13 Temporal trend of crop damage incidences in Nonai range

Fig 14 Temporal trend of house damage incidences in Nonai range

Even though the protected forest areas (Khalingduar RF and Barnadi WLS), situated at the northern and western part of the study site covers around 70 Sq. km, the elephant related damages occur over an area of approximately 500 sq. km. Movement of elephants in this large area is aided by the river courses and tea estates which act as movement conduits and refuges. The Udalguri-Tamulpur highway, situated in an East-West direction act as the major anthropogenic barrier. The damages were found to be significantly lesser in the villages at the South of this highway than the Northern part. Due to presence of a greater number of tea estates and rivers, elephants find it easier to damage crops and houses in the Nonai range. Also, due to more crop area under the Nonai range, elephants spend more time here than the Barnadi range during agricultural months. The herds were found to cause damages more near the boundaries of forest, river and tea estates and the loners or all-male small groups were found to raid crops or houses at these boundaries as well as at greater distances from these boundaries.

Survey results from 448 house damage incidences reveal that the house damages increase (64% of cases) in the pre-monsoon and monsoon months (May-September) and reduce with onset of maturing of paddy (see Fig 15, 16). These months also provide availability of water in the tea estates as well as rivers.
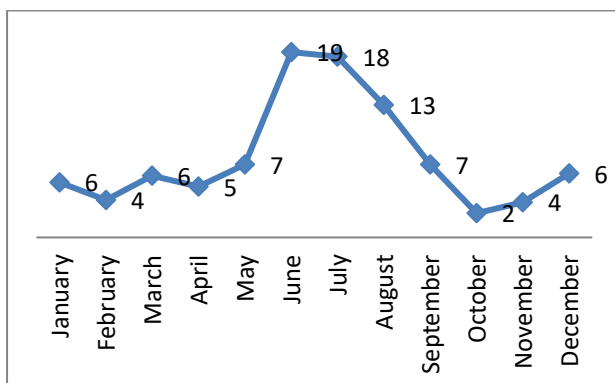

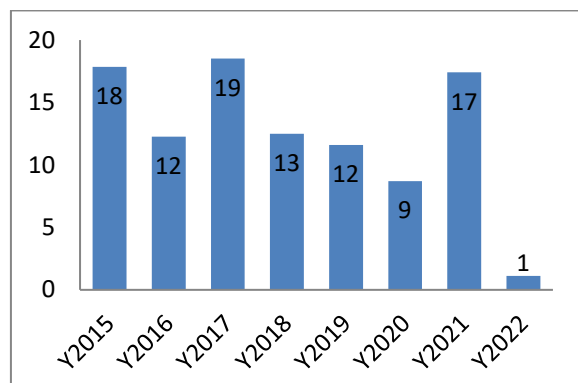Fig 15 Monthly %-house damage incidents

Fig 16 Yearly %-house damage incidents

No houses were found to be damaged in the daylight hours with 78% of incidences happening late in the night (see Fig 17). This is also the time of the day, when 84% of respondents reported that they were sleeping right before the incident happened (see Fig 18).
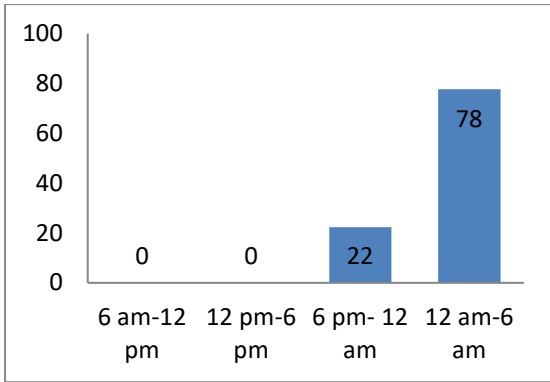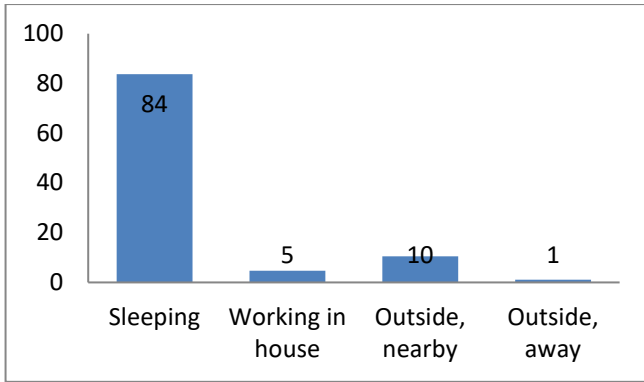
Fig 17 Time wise %-house damage incidences

Fig 18 Activity of respondents before damage

Houses made of mud and bamboo were more prone to be raided (77%) (see Fig 19) and so the extent of damage was found to be quite severe, with 85% houses facing severe structural damage to complete destruction (see Fig 20).
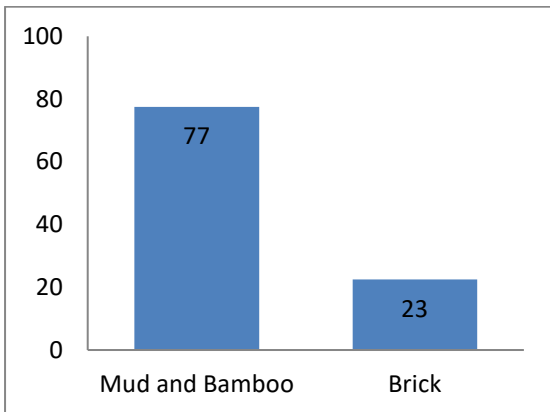

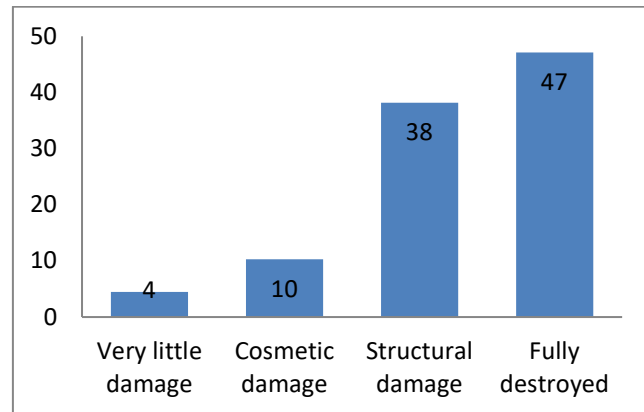Fig 19 Type of houses damaged

Fig 20 Extent of house damages

Among the elephants, loners, small groups (possibly all-male, as per my observation) and herds were described to be involved in the house damage incidences (see Fig 21). However, people also clarified that, the male adult or sub-adult elephants initiate raiding the house and if the house owners or other villagers are not successful in driving the elephants out, more elephants, including juveniles and calves from the herd join the former raiders. Even though the house raids happen as elephants search for food, the damaged houses may not always contain food in it (see Fig 22). Among the damaged houses, where food was present and fed upon by elephants, rice was found to be most common one, followed by salt and vegetables.
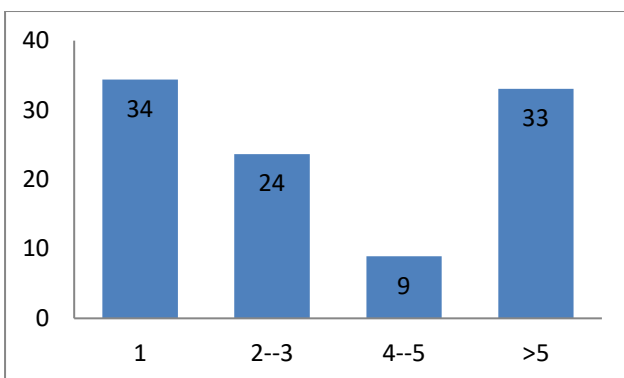
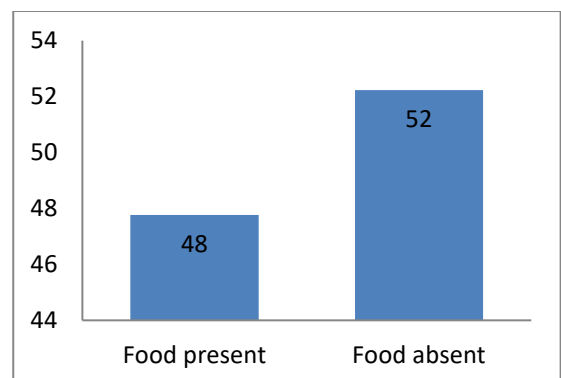

Fig 21 Number of elephants involved in incidences

Fig 22 Presence of food during house raids

66% respondents reported that they opted for driving out the elephant from the house premises rather than hide in other rooms or flee (see Fig 23). They also reported that hiding is a safer option than driving out elephants since it could have resulted in accidental encounters.
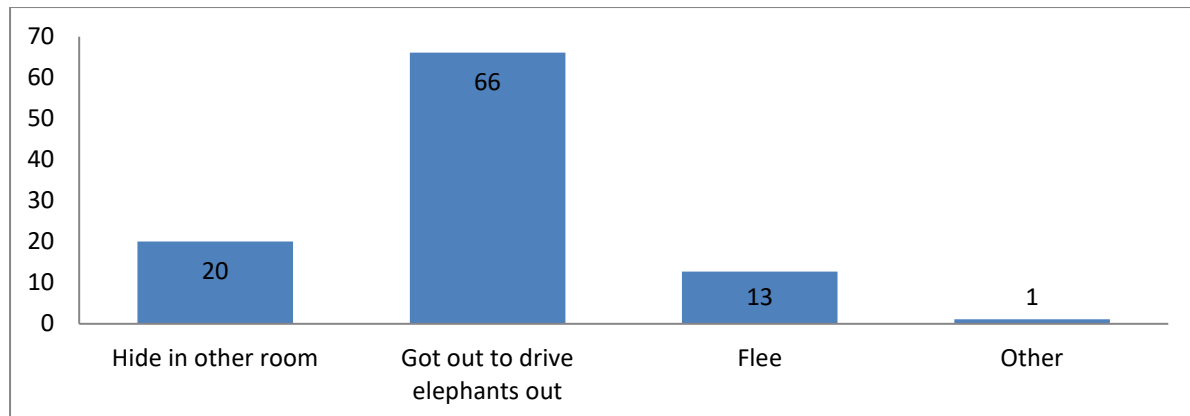

Fig 23 People's activity after damage incidences

House damage incidents even though less frequent than crop damage incidents, cause heavier financial as well as intangible toll on the victims. People claimed that if a house is broken, then it has to be fixed, no matter what, unlike crops. Crops can be grown again in another year, but a house has to be fixed as soon as possible. In case of labour quarters in tea estates, the houses are quickly built by the tea estate management and the victim does not have to pay for it. On the other hand, victims in the villages have to arrange money immediately. 68% respondents paid from their own savings and 14% took loan from local moneylenders at a high interest (see Fig 24). The houses that were damaged relatively to lesser extent (11%) almost fetched INR 10000 for repair, but for houses which were almost destroyed or received heavy structural damages (68%) caused an expenditure upto INR 30000 (see Fig 25). Brick-made houses caused more expenditure, even more than INR 50000 and often such houses or rooms were found to be either not built or put to some other use or covered with thatch or tin.
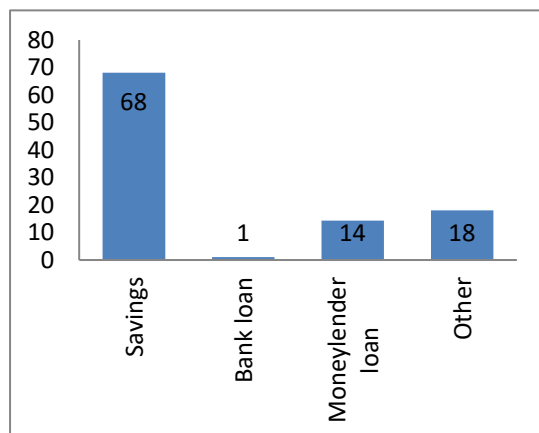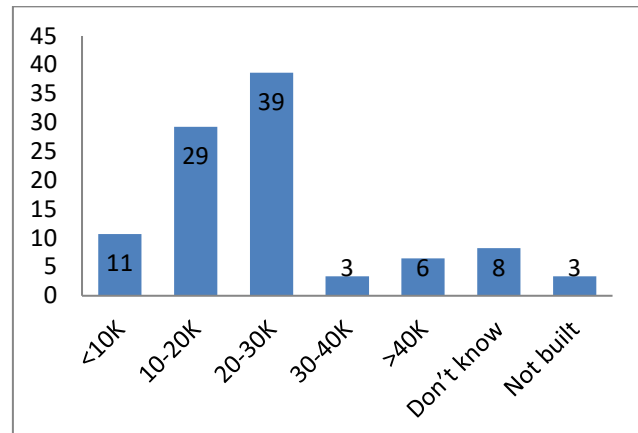

Fig 24 Source of money for building house

Fig 25 Total expenditure for rebuilding house (k='000)

75% of respondents claimed that they lost daily income due to repairing the house (see Fig 26), with majority of the damaged houses (73%) taking close to one week for rebuilding (see Fig 27). For poorer households, rebuilding took more than a week, sometimes more than a month. Almost all reported that they hired other people to rebuild the house, adding to the expenditure. However, even after such expenditures, 47% claimed that the structural integrity of the house is now worse than before (see Fig 28). Those who claimed that the rebuilt houses were better (17%) mostly received a replacement house under the governmental housing scheme for the poor.
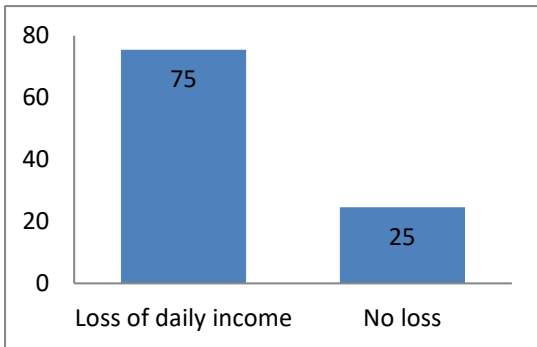
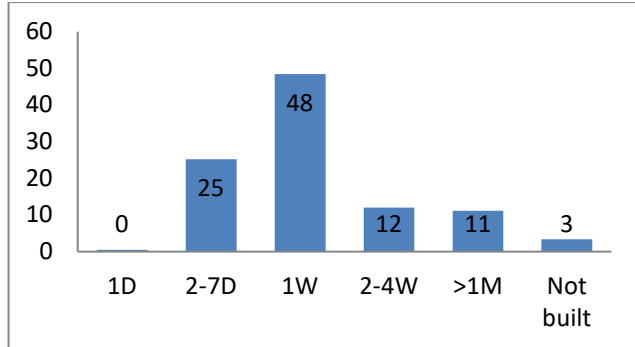Fig 27 Losing daily income due to damage (M=month)

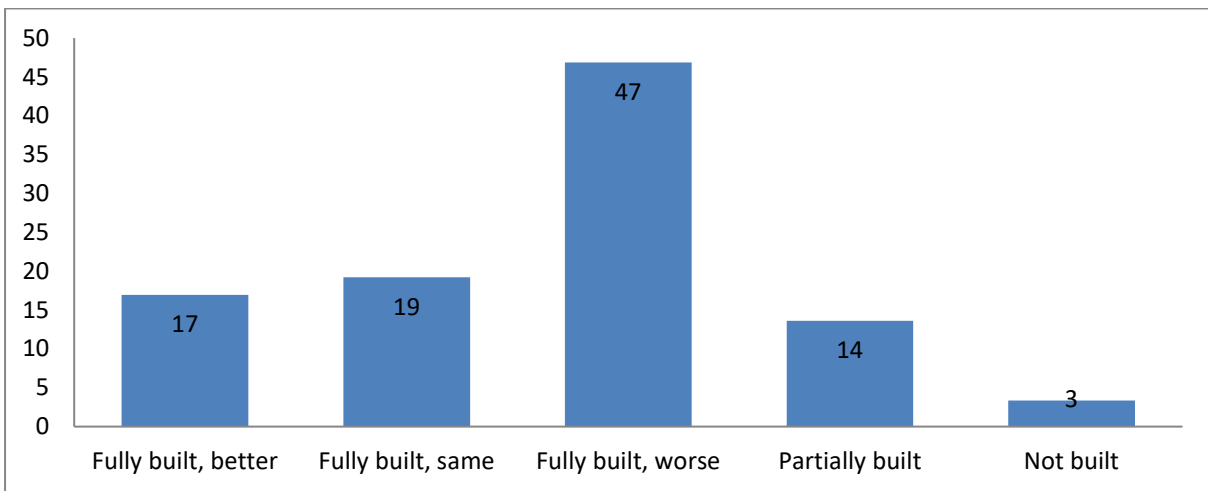Fig 28 Time taken to rebuild house (D=day, W=week, M=month)

Fig 29 Status of rebuilt house

Apart from the financial losses, people also reported intangible costs after this house damage event. 74% of respondents reported that the damage incident increased fear towards elephants (see Fig 30) and 39% reported that they were more anxious about similar incidents than before (see Fig 31). Thus, mental health repercussions of such incidences were also widespread.
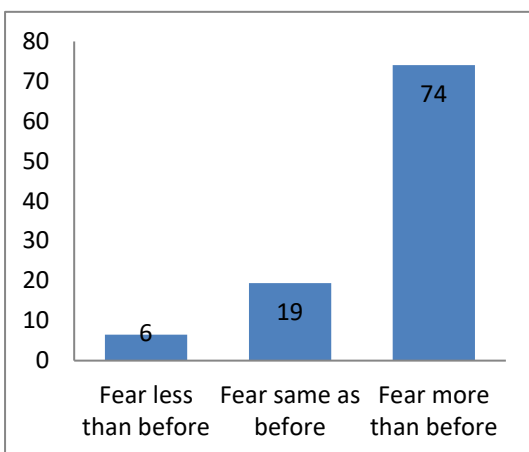
Fig 30 Post-incident fear status
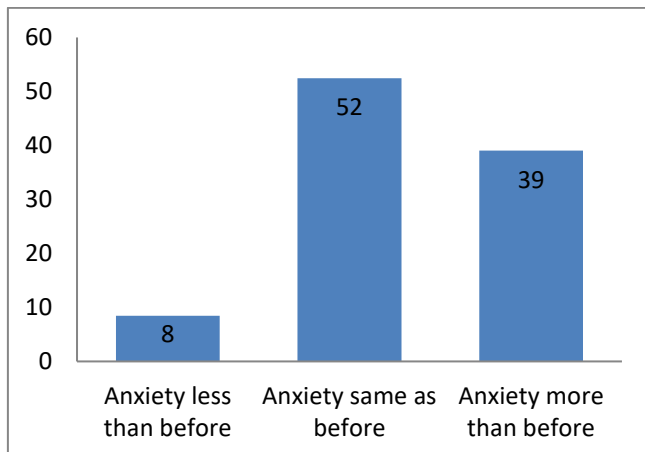
Fig 31 Post-incident anxiety status

Due to the financial as well as the intangible costs, 87% respondents informed that they took some sort of steps to safeguard the house after the incident (see Fig 32). 45% of the respondents bought torchlight after the incident, 20% kept awake in night and 12% put up non-electrified fences (mostly bamboo or sometime GI wire) (see Fig 34). However, irrespective of these steps, 79% claimed that they still did not feel safe (see Fig 33).
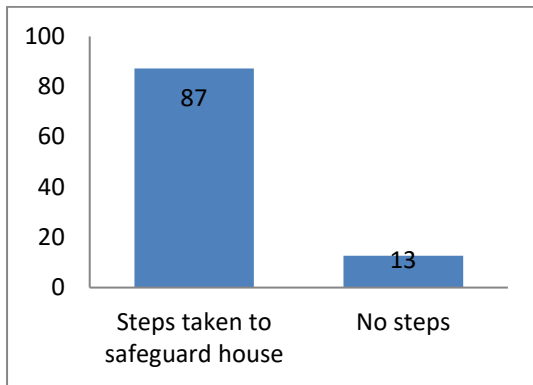
Fig 32 Steps taken to safeguard house
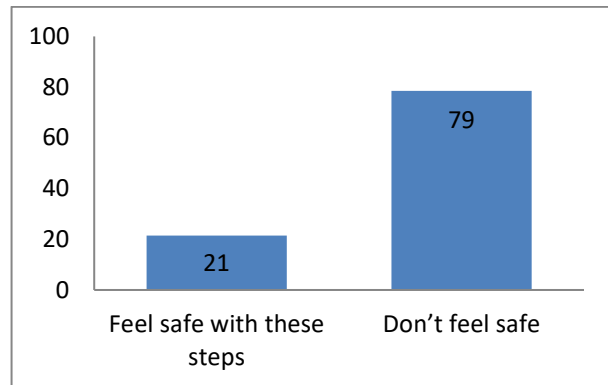
Fig 33 Feeling of safety after safeguarding house
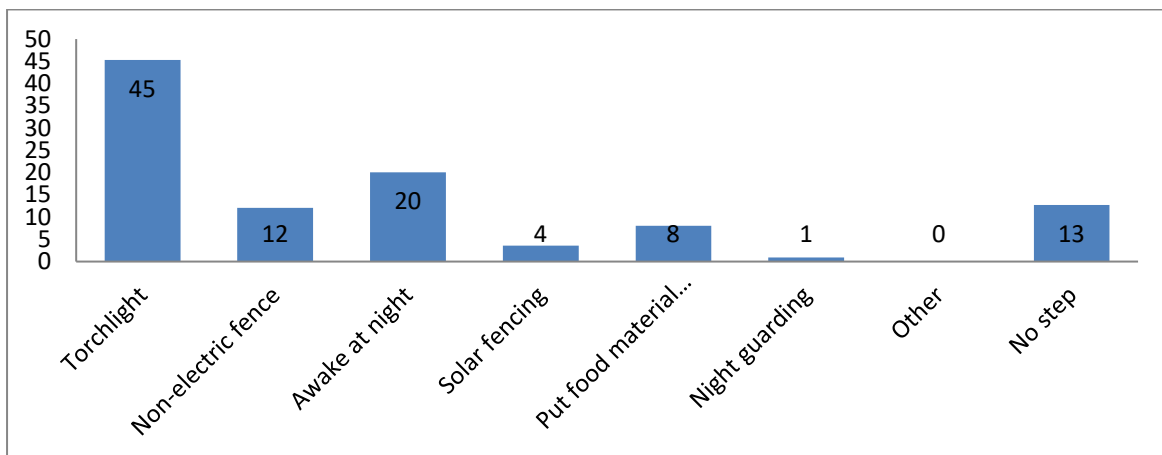
Fig 34 Steps taken by respondents to safeguard the house

4.4 People's attitude and behaviour towards elephants

From the survey, we see that elephants cause significant negative impact on people's lives. Apart from house damages, crop damages and human deaths and injuries can cause other kinds of impacts to people's lives.

Among the respondents, 91% of the respondents had applied for compensation for house damages to the forest department (see Fig 35); however, 94% reported that they did not receive any compensation till date (see Fig 36). Even though knowledge about availability of compensation was widespread, the knowledge about what documents were needed for application was less. 85% of the respondents claimed that they did not have prior knowledge about the documents and came to know about them only after the damage (see Fig 37).
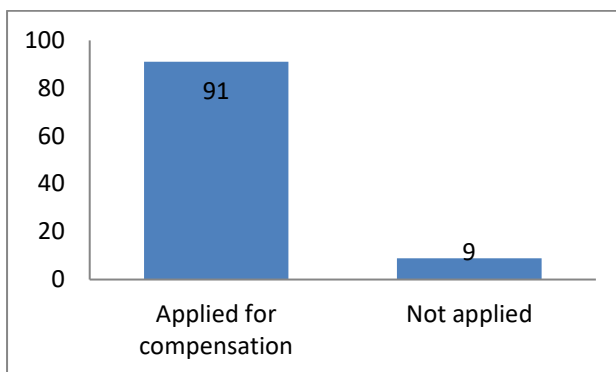
Fig 35 % of respondents applied for compensation
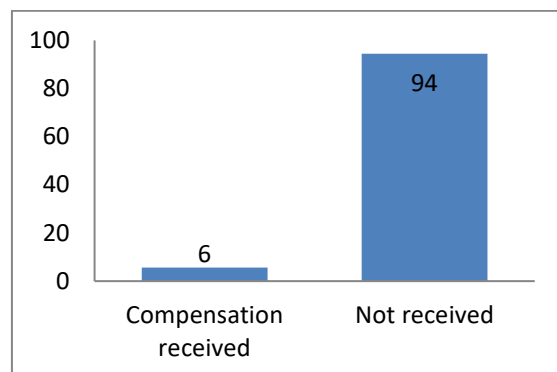
Fig 36 % of respondents received compensation

Fig 37 % of respondents having knowledge of documents for compensation

People also thought that elephants and elephant-related damages put barriers for progress of their families (for 72% respondents) (see Fig 38) and village (For 65% respondents) (see Fig 39). People considered sudden personal financial losses due to the house damage, repeated and regular damages, and restriction of movement in night due to elephants to be elephant-related causes for backwardness of their families. On the other hand, those who did not consider elephants as barrier to their family, thought 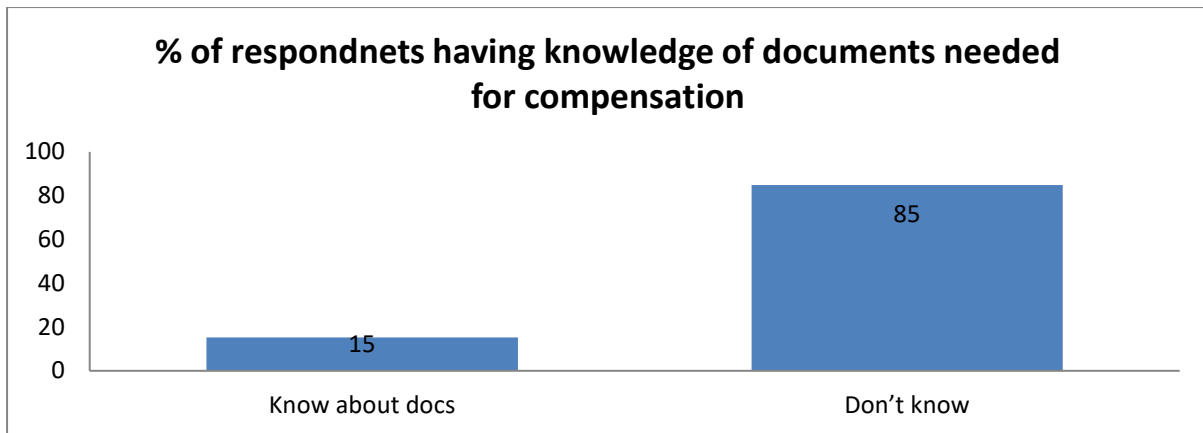so because for them, one could progress through hard work irrespective of such damages. In the case of progress of village, people thought that since majority households in the village had faced financial damages due to elephants and so, they could not plan or think about overall progress. However, some respondents felt that only the poorer households got affected more and not all and so the blame could not be imposed only on elephants for less progress of the village.
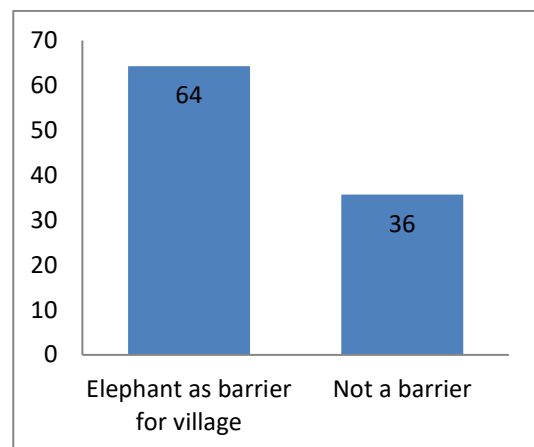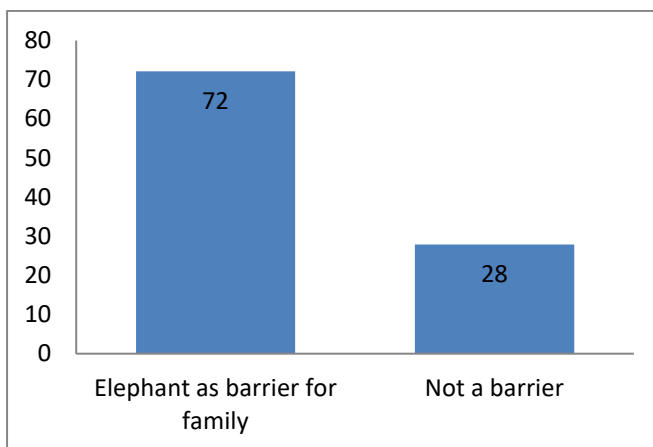
Fig 38 Elephants as barrier to family's progress   Fig 39 Elephants as barrier to village's progress

However, people felt empathetic for the elephants' life. 97% felt that elephants did not find enough food in the forest due to deforestation and incursion by illegal loggers (see Fig 40). 92% felt that the elephants have a right to exist in this area due to the existence of a forest near to the villages which could be better refuge for the elephants (see Fig 41). People also felt that elephants have more right to exist since they were the original inhabitants of the area and it is only due to human expansion into their space, they were now only restricted to the forest. On the other hand, 71% of the respondents felt that elephants do not have a right to come inside the village as they always cause some sort of damages in the village and so, should be restricted to the forest area (see Fig 42). Others thought that elephants have a right to come to the village in search of food since they were unable to get food in the forest. Even though people have faced many damages due to elephants, 68% considered elephants not to be cruel and the damages are only due to severe hunger felt by them (see Fig 43). Many also considered that elephants have become aggressive due to human actions, such as forest destruction, driving out elephants in a stressful environment etc.
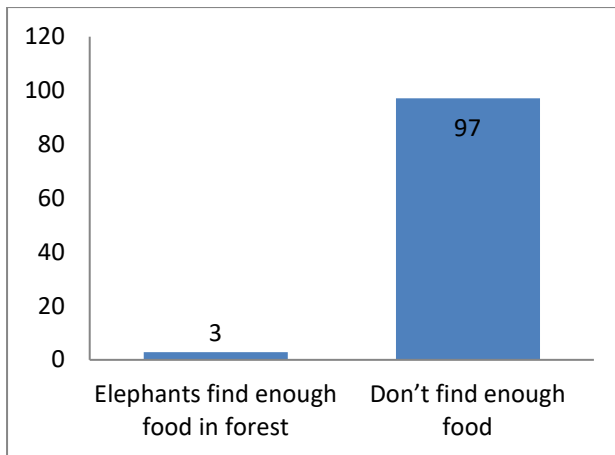
Fig 40 Perception of elephants' food availability
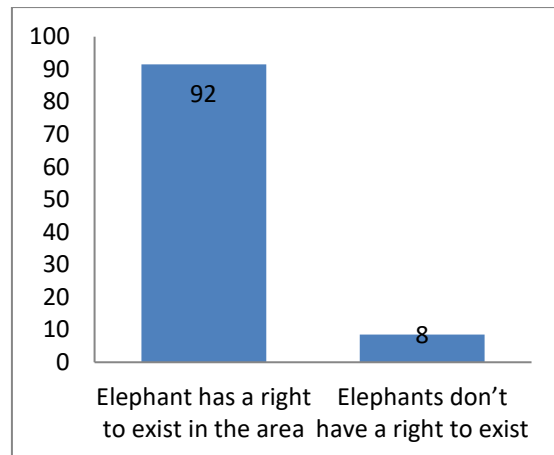
Fig 41 Perception on elephants' right to exist in the area
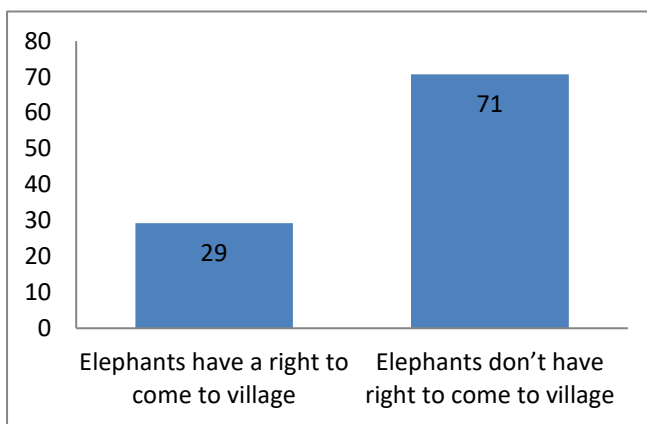
Fig 42 Perception on elephants' right to come to village
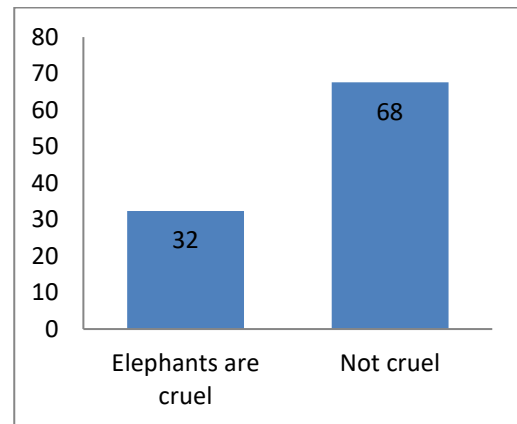
Fig 43 Perception on whether elephants are cruel

Majority of the respondents (96%) considered elephants to be important and in need of protection as they felt that elephants were both national and natural asset/heritage (see Fig 44). 66% reported that they enjoy watching elephants due to their majestic movement whenever they were spotted near the village (see Fig 45). Others did not enjoy watching elephant out of fear. 55% imposed the cause of elephants coming to villages on loss of food and shelter and 28% considered that elephants were able to find better and easier food in the villages (see Fig 46). Regarding the long-term temporality of such elephant-related damages, 70% respondents felt that frequency of elephant visitation near the villages have increased (see Fig 47) and 64% considered that the frequency of house damage incidents have increased over the years (see Fig 48). Those who thought that elephant related damages have decreased were majorly from two villages which had put up community-based solar fencing few years back.
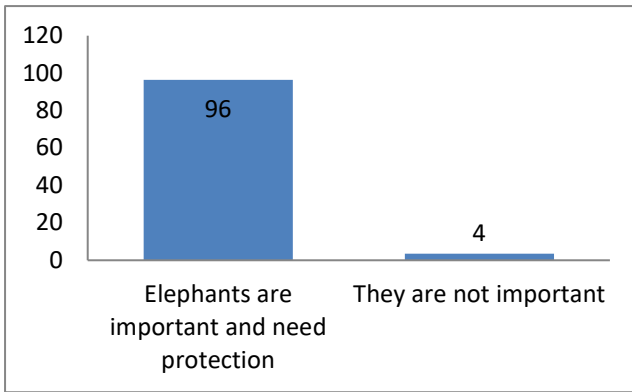
Fig 44 Perception on whether elephants are important   Fig 45 Perception on watching elephant
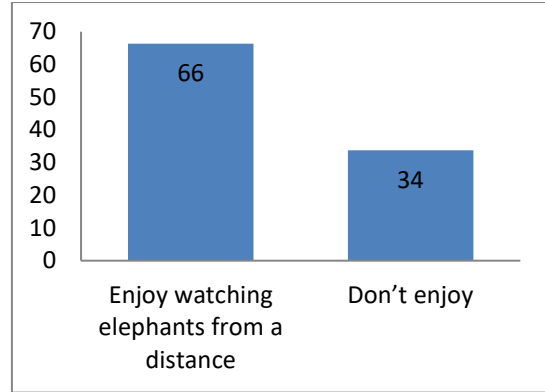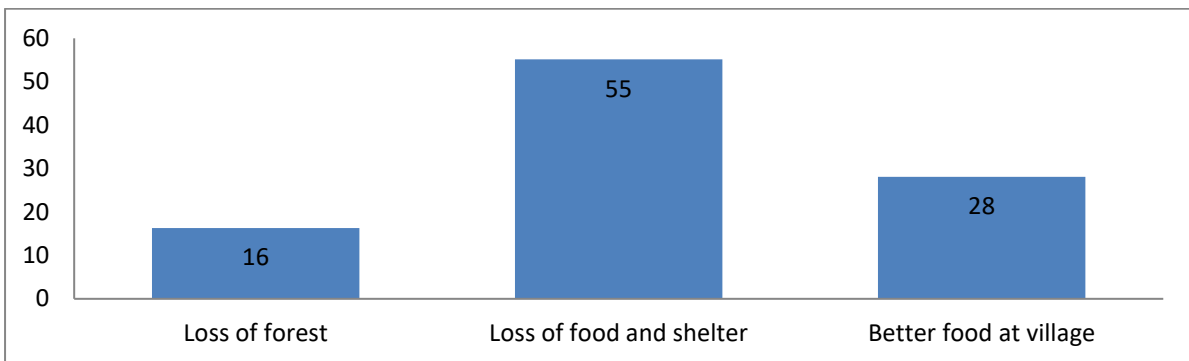
Fig 46 Perception on causes of elephants' visit to village
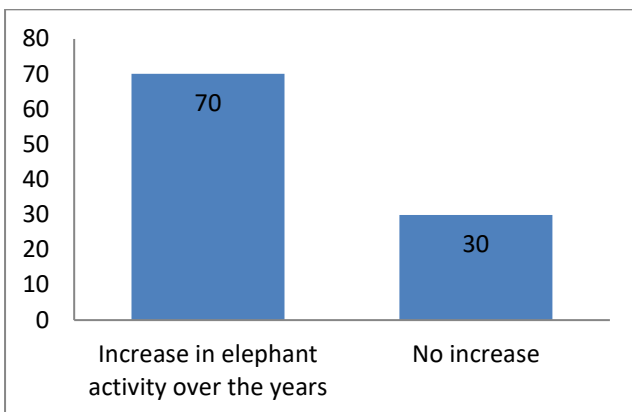
Fig 47 Perception on increase in elephants' activity Fig 48 Perception on increase in house damage
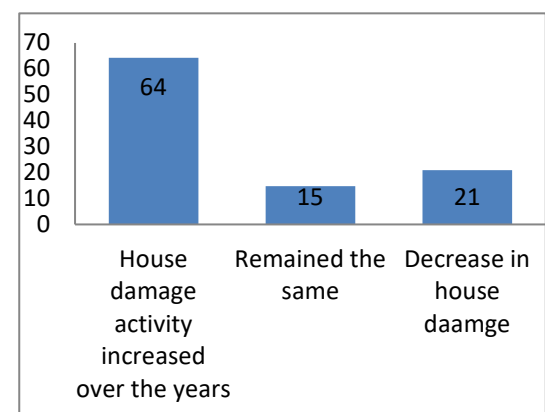
People's preferred actions towards elephants were mostly reactive, such as using torchlight (38%) and noise (42%) (see Fig 49). Light and loud sound was reported to be most useful to drive out elephants. However, people also found that elephants were now mostly habituated to these light and sound sources. Guarding crops at night was widespread, but not at all preferred as it caused loss of sleep and sickness. Guarding was also not done in the non-agricultural months. As a proactive measure to reduce house damages, few households have put up solar fence around their homestead.
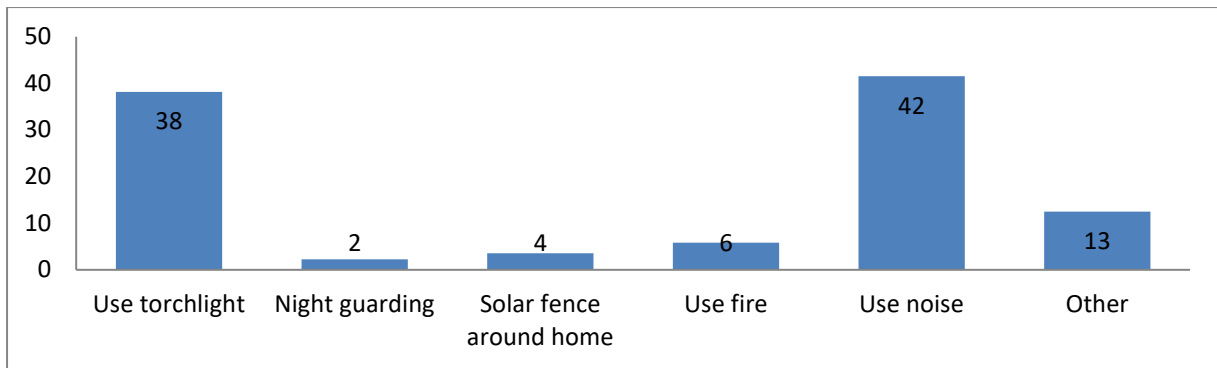
Fig 49 People's preferred actions to lessen elephant related damages

People identified three major institutions who should be responsible to reduce the elephant-related damages- forest department, village community and a cooperative management between forest department and village (see Fig 50). 63% thought that forest department should be solely responsible since they were the custodian of forest and wildlife and due to their inaction over the years, the forest had been destroyed. 15% of the respondents, most of which belonging to one particular village at the forest boundary thought that villagers should be responsible since they had destroyed the forest. 19% thought that without a co-operation between village communities and forest department, the problem cannot be solved.
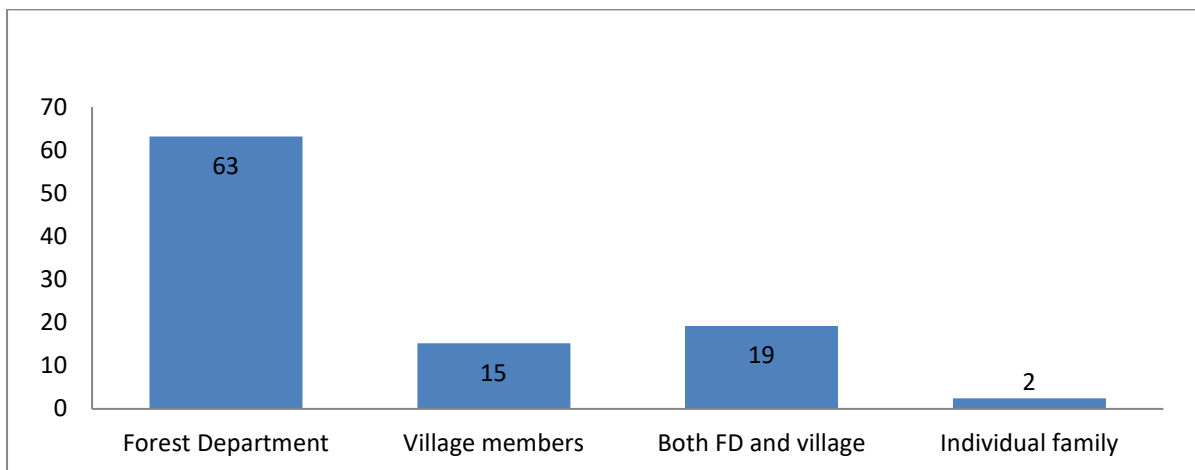
Fig 50 People's perspective on who should be responsible to reduce elephant related damages

An overwhelmingly 96% of respondents thought that the forest department had not been able to help the public to manage the situation (see Fig 51). People thought the forest personnel should be more engaged in protecting the forest from illegal logging, night patrolling, providing torchlight or electric fencing and planting trees in the forest (see Fig 53) Similar to the forest department, people (96%) also thought that other government departments such as district administration, agriculture department etc. had not been able to generate any step to reduce the problem (see Fig 52). People considered that these departments should pressurise the forest department to take adequate steps, provide torchlight, solar fencing and timely compensation (see Fig 54).
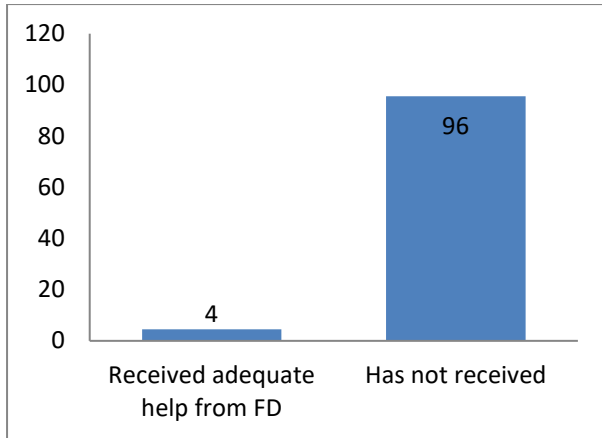
Fig 51 Perception on forest department
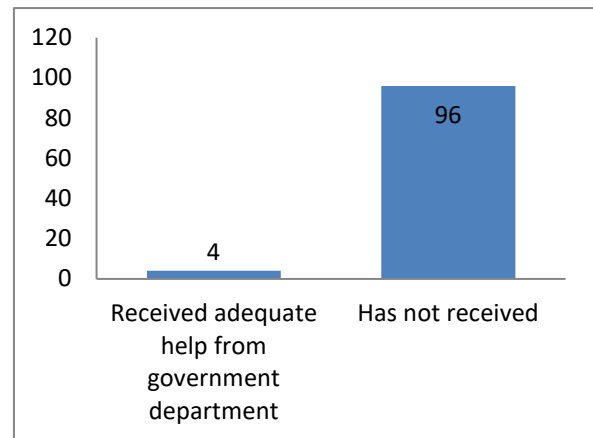
Fig 52 Perception on other government departments
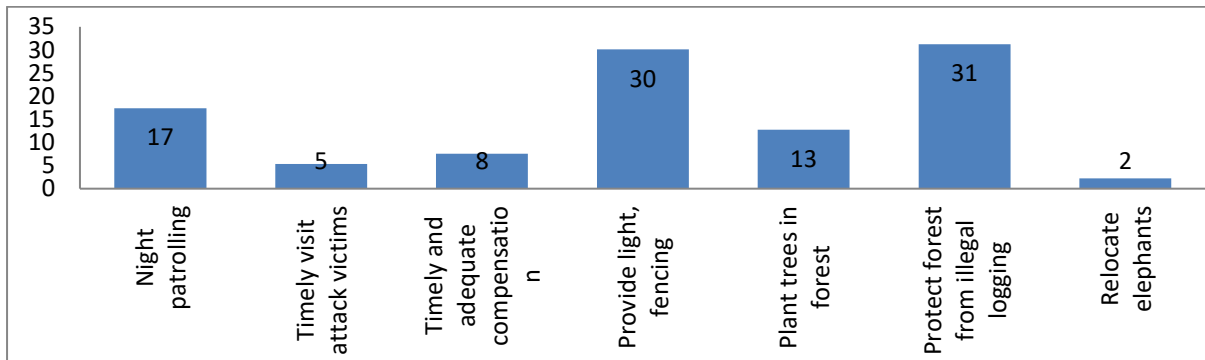
Fig 53 Perspective on how forest department should intervene
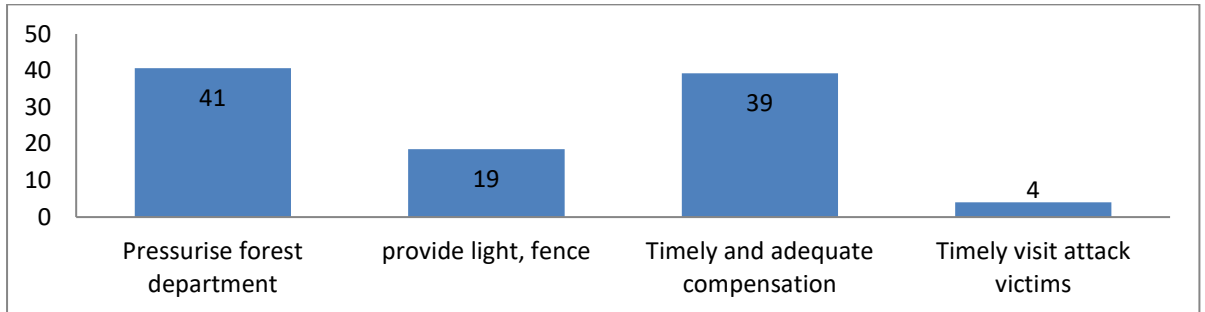
Fig 54 Perspective on how other government departments should intervene

60% of people thought even their own village community had not been able to come up with concrete steps to reduce the problem (Fig 55). Others thought that the village community at least could provide social support during the time of damages and post-damage recovery. People thought the overall village community could pressurise forest department for accountability or set up systematic crop guarding in night or contribute to a common fund to buy torchlight or solar fencing equipment (Fig 56).
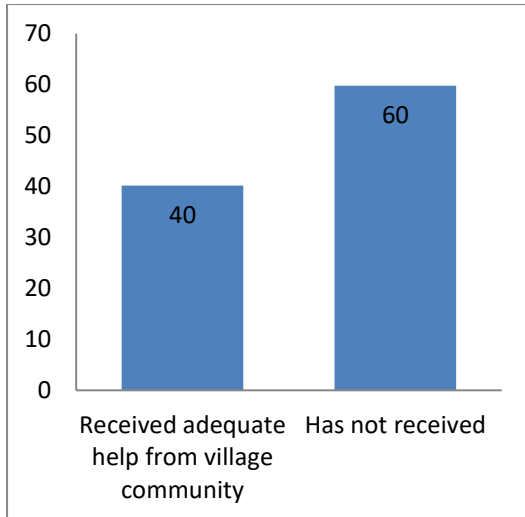
Fig 55 Perception on village community
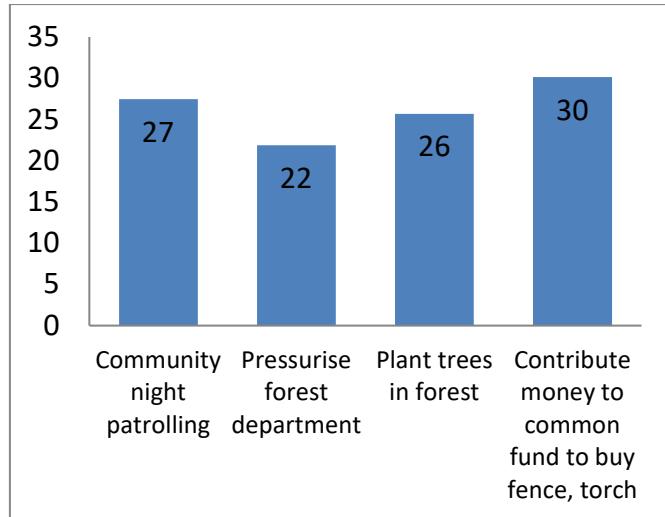
Fig 56 Perspective on how village community can intervene

Since compensation for damages and strict separation between elephants and people are the widely used mitigation action by the forest department, people were asked about the effectiveness of these measures. 59% respondents thought that getting a timely and adequate compensation does not necessarily increase comfort to share close space with elephants (see Fig 57). Others thought that none can restrict elephants and compensation would at least reduce heavy financial burden from the victims. An equal proportion of people perceived a strict separation scenario where people and elephants were separated through hard boundaries to be workable and not- workable (see Fig 58).
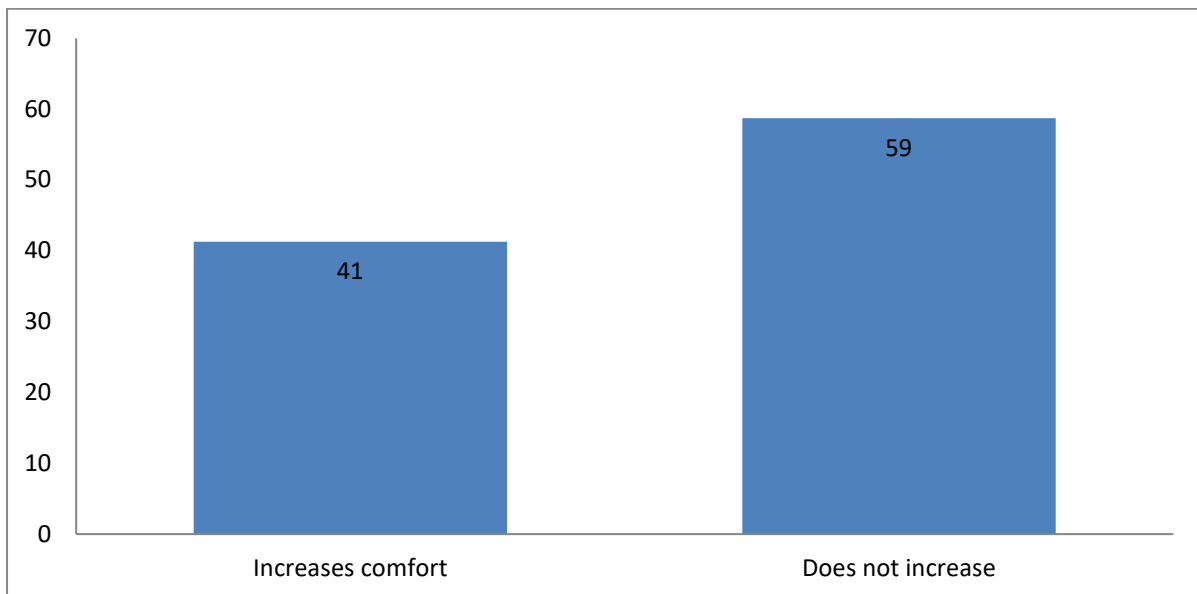
Fig 57 perception on whether compensation could increase comfort to share space with elephant
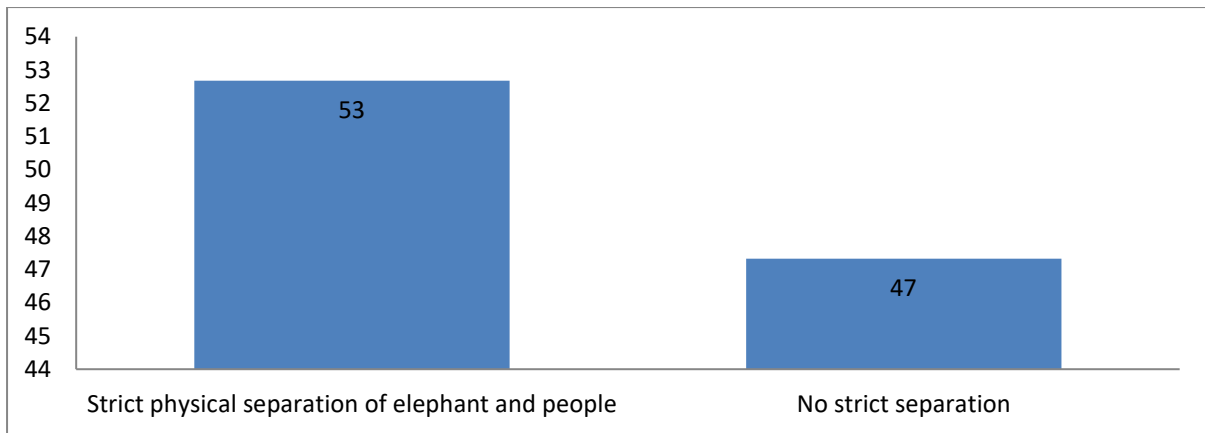
Fig 58 Perception on whether strict separation between elephant and people a mitigation option could be

As per the respondents, afforestation and providing a space with proper food and shelter was the best possible solution for this problem (see Fig 59). They thought that if elephants get enough food in the forest, they will not come to the villages for raiding houses and crops. Some respondents also suggested putting up solar fences around the village or the forest boundary.
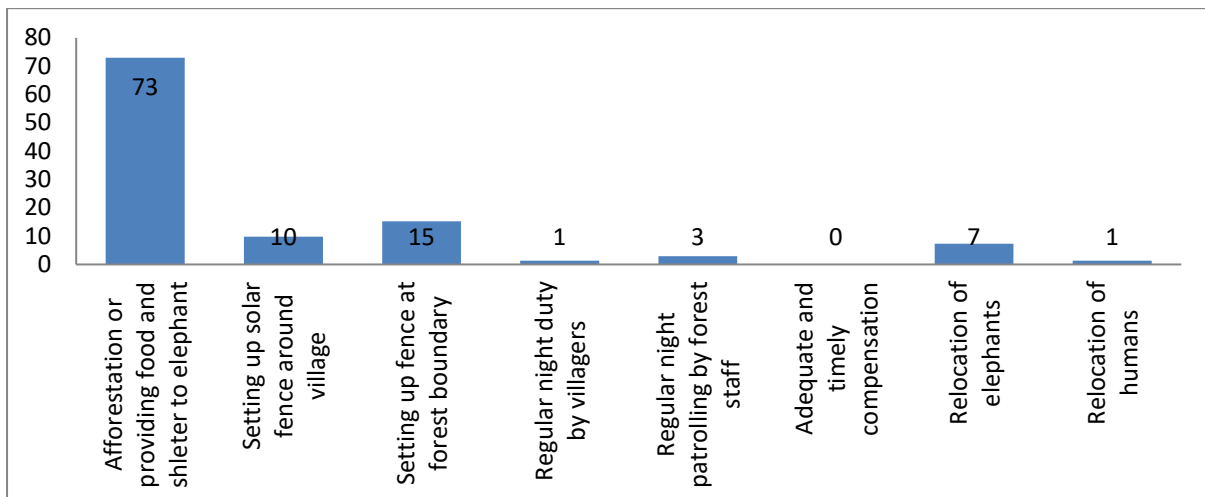
Fig 59 Perception on best solution to reduce elephant related damages

Respondents were also asked about their perspective on community-centric conflict mitigation techniques such as putting up community-based solar fence around the village. 85% respondents considered participating in such programme if that is led by the forest department (see Fig 60). In case of village-led programme, 69% considered participating (see Fig 61). Those who did not want to participate were mostly sceptical of corruption in the process, perceived incapability of the village and the forest department and dearth of time.
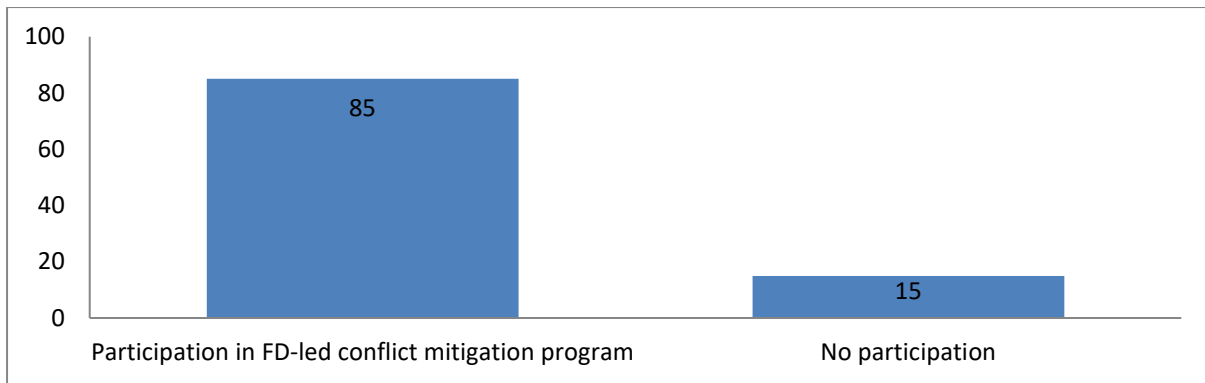
Fig 60 People's willingness to participate in forest dept-led community-based conflict mitigation program

Fig 61 People's willingness to participate in village-led community-based conflict mitigation program

Community-centric programmes often rely on small-scale monetary contribution from the community members so that community has a tangible ownership over the project. When asked about willingness to pay during community-based solar fence erection, 64% were found to be willing to pay (see Fig 62). They thought that solving a great problem in lieu of small quantity of money was acceptable and it was also virtuous to help each other. Others who were not willing to pay thought so because they considered the Government to pay for such programmes.
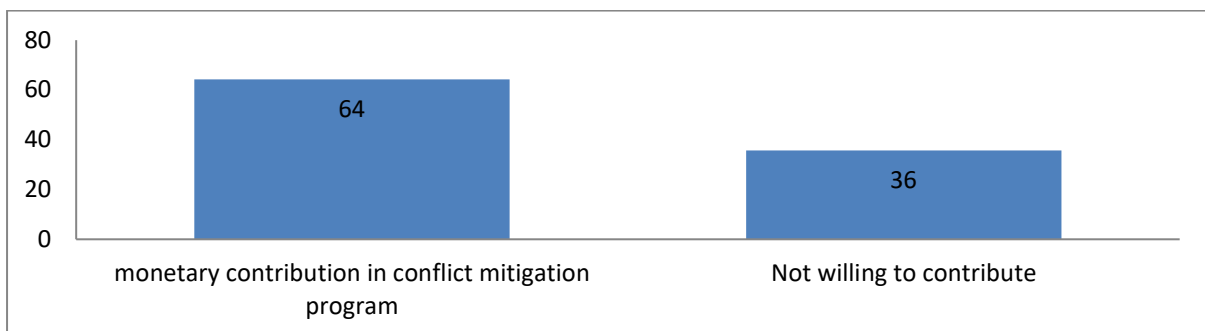
Fig 62 People's willingness to contribute money in community-based conflict mitigation programme

With the semi-structured interview and participant observation, I went deeper into people's perspectives about elephants. Regarding the severity of the conflict in this study area, it was noted that everybody had lost something due to elephant-related damages. Some had lost their relatives, some their limbs, some their assets and everyone, his/her good night sleep. Thus, qualities of life get diminished and in the long run, life chances get jeopardized.

Men experienced more direct encounters with elephants, mostly in a dark, hot and confusing atmosphere far from their houses. Their version of encounter stories mostly circled around the crop fields and how heroic or tragic were the outcomes. Their stories were of shorter duration, since they had experienced so many encounters that the vividness of the details of individual encounters got lost.

On the other hand, women shared a smaller number of conflict encounter stories but mostly concentrated around their houses. The stories were told with vivid details of what the elephant did, from where it entered and what men and women did at that situation.

The severity of conflict was often perceived through catastrophic events rather than continuous events. So, even though crop raiding was a chronic problem, respondents from Nonoikhuti (both men and women), situated at the vicinity of the forest boundary centred their responses around an incident where 4 young men, two Nepalis and two Adivasis were killed while crop guarding by a single elephant in a single night in the same field. Similar catastrophic events like, breaking of 22 houses by a drunk elephant in a single night or killing 3 people in a single night in different villages were a massive part of the elephant lore among the residents. The events were so catastrophic that crop raiding by wild boars or goat lifting by leopards did not even come to people's mind as conflict incidences.

Although direct impact incidences were the ultimate outcome of the HEC, but there were hidden impacts which created long term psychological stress among individuals. Sharing the same space with a powerful animal like elephant had caused restricted mobility and increase in workload and expenditure to overcome the recurring losses. Since elephants mostly visited the village and crop fields in the night, people had to stay up all night to guard the crops. Loss of sleep-in consecutive nights hampers major income generation during the daytime which in turn affects the person physically and financially. Fear, anxiety and disappointment accumulated day after day, thereby, deteriorating the mental health of the person. Catastrophic events such as losing someone to the elephant or accidental encounter with the elephant can destabilise one's mental condition.

Respondents have mentioned about different hidden impacts which were: loss of sleep, restricted mobility, harvesting unripe paddy, increase in workload and expenditure and deterioration of mental health.

Respondents did not consider the elephant as the sole responsible for the loss. They considered certain drivers which were acting behind the conflict. The drivers could be divided into two forms: proximate and ultimate drivers. Proximate drivers were associated mostly with elephant behaviours which were immediate causes of conflict. They were unavailability of food in the forest, elephants' preference of crops, elephants' preference of alcohol and an increase in elephant population. Ultimate drivers were those which control or aggravate such behaviours. They were humans encroaching into elephants, spaces, deforestation by certain group of people, habituation of elephants and destiny.

Elephants were revered to be godly creatures and people mostly used *Thakur* (God), *Baba* (Father) or *Maharaj* (King) instead of *Haathi* (Elephant) to address elephants. Even though women frequented elephants' space, they hardly held elephants to be aggressive, killing creatures. According to them, their respect towards the elephant had made them considerate of women's presence in the forest. While women across ethnic groups who interacted with elephants in the forest considered elephants to be calmer, in contrast, men, who had been responsible for guarding crops for a long time, thought that elephants in general have become more aggressive, fearless and strategic risk-takers than before. Men and women empathized with elephants' problems through analogies which mirrored their own lives and material reality. Most of the respondents equated their poverty with elephants' deprivation, primarily of food.

4.5 Elephant movement and behaviour in the human-dominated landscape

It was understood that elephants extensively use the river courses to move in the landscape. Major rivers in this landscape originated from the Khalinduar reserve forest in the North and elephants use them while exiting the forest to come Southwards. While returning back the elephants again take the river route. Such routes provide least resistance to elephant movement and using these conduits, elephants also enter tea estates and villages through specific locations (see Fig 63 and 64). These locations are associated with shrublands with open canopy, narrow water channel, plain and easy-to-

cross terrain and U-shaped ditches. In tea estates and in certain villages, elephants could stay up for many days. However, they again use specific locations for daytime refuge. The tea estates as well as the river channels also act as the Launchpad for elephants to raid crops and houses.

Out of the two forest ranges, movement of elephants is less restricted in the Barnadi range than Nonai range, since major land use category in Barnadi range is that of small tea growers which provide higher vegetation cover and less active guarding by people. Single bulls or small all-male groups move more through the villages than the large herds. Large herds only follow a single water channel to reach a tea estate. But this is less prevalent than the Nonai range.

4.5.1 Demographic and behavioural observation of elephants

Major movement of elephants outside the reserve forest and wildlife sanctuary areas, i.e., in the agriculture-plantation mosaic happen during late evening- early morning. Even though individual or small all-male groups enter village areas round the year, large elephant herds arrive and leave according to the rhythm of paddy farming season and availability of water in the rivers. While leaving the forests, elephants exclusively use riverine tracts and streams to move to larger distances in the landscape, in order to raid crops or reach a tea estate or simply move around. If the elephant fails to reach a tea estate through this strategy, they tend to go back to the forest by late night-early morning.

Elephants use particular locations for entry/exit to/from forest/ village or tea estate. According to the information received from the volunteers in the elephant tracking team, we extensively surveyed the areas and locations through which elephant moved whenever they were detected. We checked for elephant tracks and signs (footprints, dung piles, disturbed vegetation, feeding and soil disturbance) to ascertain the paths. Over the landscape we have been able to establish the paths and locations that elephants frequently use to navigate. This exercise is still continued. So far, the collected data shows that the entry/exit locations correlate with presence of water channels (river, stream, canal), dense shrublands with open canopy, low density housing, gentle slope and plain topographical features such as *kutchha* road. These locations are also frequented by humans with different intensity.

In the tea estates, the elephants do not move randomly, but have 'first-choice' areas. In all the tea estates, there are few locations which have not been farmed for tea and are therefore 'disordered' and full of dense shrubbery. Few of these locations were also afforested with monoculture trees with variably dense undergrowth. Apart from these sections, there are sections which are kept fallow with 'Guatemala' grass (*Tripsacum andersonii*); the grass being 3-4 meter high. Both these kinds of sections are preferred by elephants for refuge purpose during the daytime. Behavioural observation shows that elephants feed less in these locations and use them mainly for daytime refuge with major activities including resting, being alert and various social interactions. This is probably due to high number of people working or moving along the tea estate. In the early morning and the onset of evening, when number of people is less, they use other sections for feeding or moving. The tea estates provide good amount of grass which elephants feed on extensively. The estates are also good source of water, either piped or in canals and reservoir. They move more extensively and become more vocal with the onset of evening and in night they use the tea estates as a Launchpad to raid crops or houses. However, the elephants entering the village premises or in the crop field was found to be lesser than the number encountered in the adjoining tea estate. Adult males and sub adult males were found to be moving and exploring more than the females. Instances have been recorded when female led herd were mostly involved in crop raiding near the edges of tea estates or river channels, whereas lone male or small all-male groups were found to be raiding crops in middle of villages, much away from the boundaries of estates or rivers. Also, male or male-groups are exclusively involved in house damages and most of the deaths and injuries to humans. Probably due to exploratory nature, they also tend to break more fences and thus, in case of coming in contact with live fences, they tend to die more.

There is no stable or specific herd that could be ascertained. The groups that were detected in various tea estates were of different sizes and we also detected simultaneous presence of groups of more than 30 individuals in different tea estates. We also selected two easily identifiable sub adult tuskers to

understand the demographic and movement patterns of the group they belong. But each time they were detected, they group sizes were different, ranging from 12 to 65 and the groups were detected at different locations. There were also instances of individuals joining or leaving groups that was stationed in a tea estate. So, elephant groups in the human-use areas experience fission-fusion of individuals.
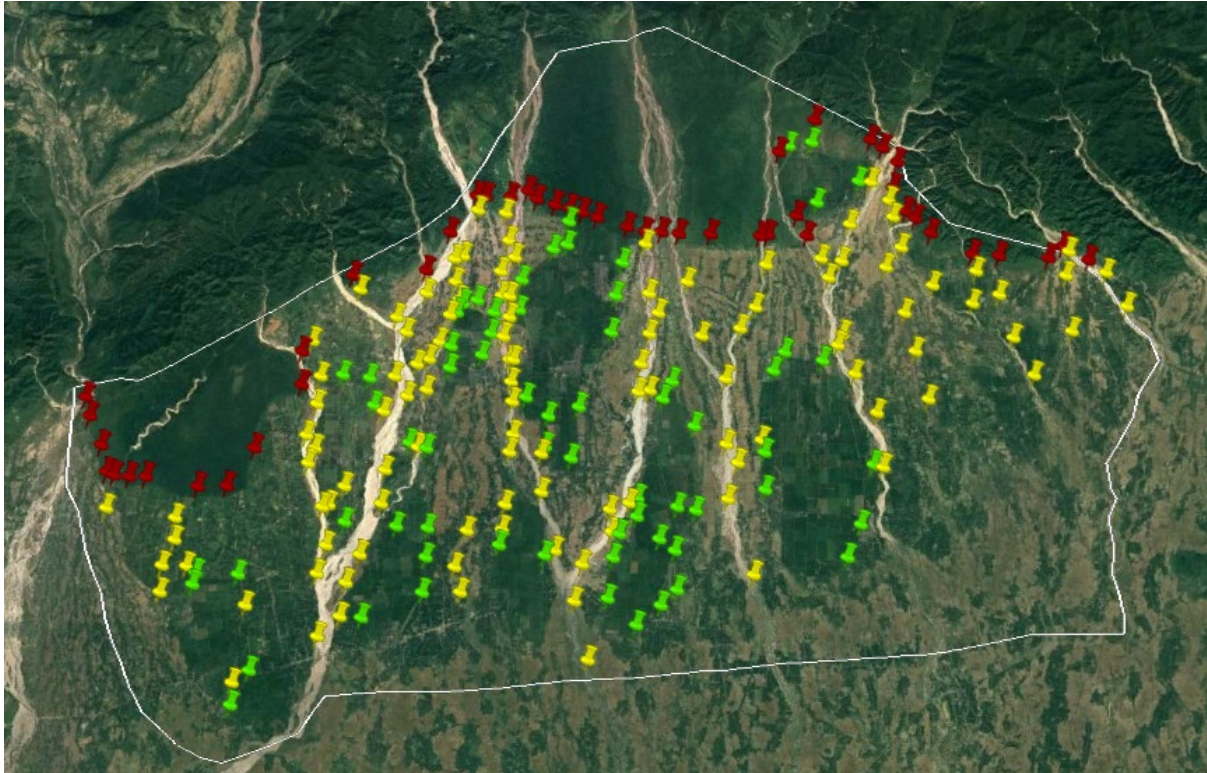
Fig 63 Entry and exit locations of elephants in the study landscape. Red, yellow and green placemarks denote such locations with respect to forest boundary, river & stream boundary and teas estate boundary respectively
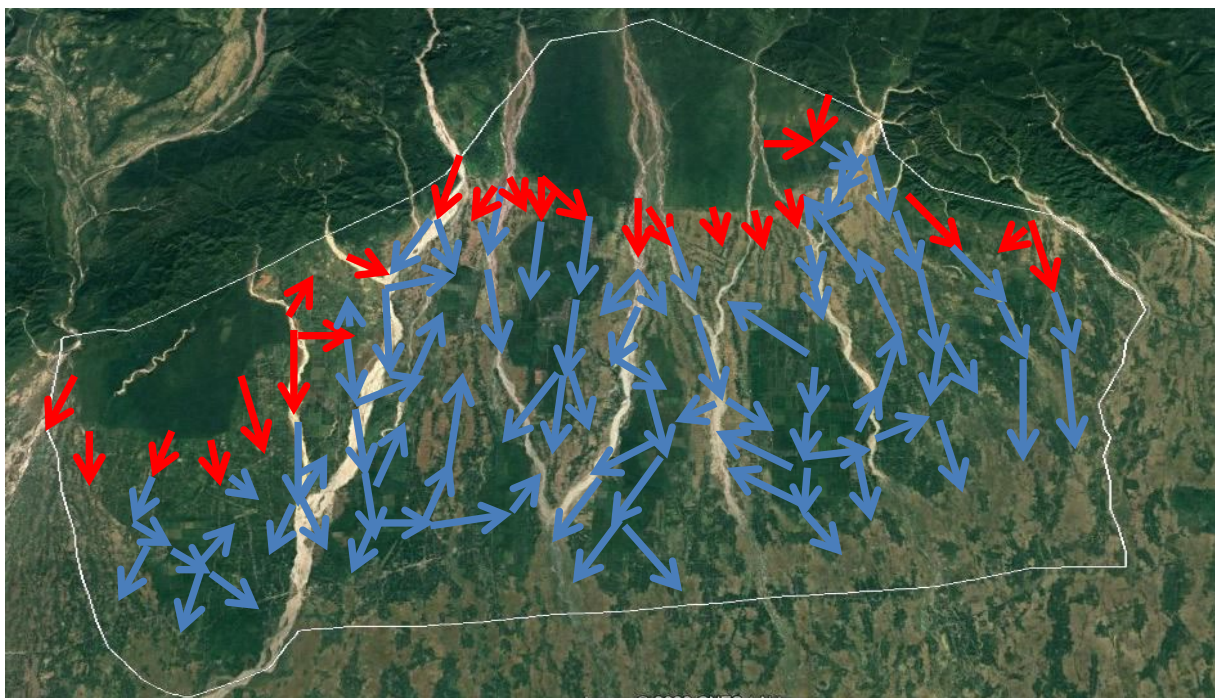
Fig 64 Patterns of elephant movements in the study area. Red arrows denoting starting points at the forest boundary and blue arrows denoting movement trails in the non-forest area

4.5.2. Ethogram of behavioural activities of elephants

The ethogram was constructed through ad libitum sampling of the elephant groups, majorly in the tea estates.

Behavioural states

Feeding:
searching for food, feeding including picking, cleaning, chewing and ingesting as well as throwing out from mouth; drinking water

Moving:
movement with the group or alone; towards the group or away from the group

Resting:
laying, sleeping or being stationery at one place without any other activity

Social interaction:
with both elephants, other animals and humans; contact and non-contact; including being alert and external cue-induced movement

Self-directed behaviour:
towards own body such as, dusting, water splashing etc

Behavioural events

Feeding:
1. Searching: exploring food options with trunk by touching
2. Picking: picking up intended food with trunk and sometimes feet
3. Cleaning: shaking food items to reduce mud with short rigorous trunk movement or thumping food item by trunk on feet
4. Chewing: putting food into mouth by trunk with subsequent mouth movement
5. Ingesting: Stoppage of mouth movement without throwing out the food
6. Throwing out: stoppage of mouth movement after throwing out the food
7. Drinking water: Pulling water through trunk, putting inside mouth and ingesting
8. Debarking: Using trunk, tusk and mouth to debark trees for feeding

Moving:
1. With the group: locomotion in accordance with larger group activity and speed
2. Alone: locomotion in absence of group or out-of-sync with the group

Resting:
1. Laying: short duration resting with eyes open and occasional trunk movement
2. Sleeping: long-duration resting without any body-part movement and eyes closed
3. Stationery: complete non-activity with standing at same position with no body part movement

Social interaction:

Towards conspecific individuals
1. Contact without play: more than one individual in contact with each other without any playful act
2. Contact play: more than one individual involves in playful acts with body contacts- trunk on trunk, trunk on head and back, playful mounting
3. Non-contact play: more than one individual involves in playful acts without body contacts- mutual trunk displaying, mutual running

4. Non-mutual contact play: one individual involves in play being in body contact with another non-involved individual- placing trunk on body of the non-reciprocating individual
5. Self-play: One individual playing on its own, occasionally with objects
6. Placing trunk over other: One or more than one individual puts their trunk on the back or mouth of the other in a non-playful act
7. Guarding calves: one or more adults guard the calf in between their legs in the face of perceived danger
8. Huddling: congregation in close proximity with heads outwards
9. Mounting: by a male to female for copulation
10. Vocalisation: Trumpeting, rumbling, squeaking, roaring directed at other individuals

Towards other animals (dogs, egrets)
1. Stare: looking directly towards the animal
2. Ears erect wide: ears spread without flapping while looking at the animal
3. Freeze: no body movement while looking at the animal
4. Trunk lifting: short-duration trunk lifting towards the animal
5. Approaching: slow movement towards the animal while looking at it
6. Mock Aggression: charging towards the animal and sudden stoppage if the animal retreats
7. Trunk throws and trumpet: post-stoppage directed towards the retreating animal
8. Turn away: Quick body rotation and fast-paced locomotion to join the group

Towards humans
1. Stare: looking directly towards the human
2. Ears erect wide: ears spread without flapping while standing and looking at the human
3. Freeze: no body movement while looking at the human
4. Trunk lifting: short-duration trunk lifting towards the human
5. Rigorous ear flipping rapid movement of ears either looking directly at the humans or after a retreat
6. Look away: body towards the human but head away
7. Turn away: whole body away from the human
8. Slow locomotion away: moving away slowly from the humans
9. Fast locomotion away: moving away in a fast-paced manner away from humans, occasionally tail erecting
10. Approaching: slow movement towards human, occasionally with ears spread and trunk lifted
11. Threat display: moving front legs back and forth with ears spread
12. Mock aggression: charging for less than 10 metre towards human with ears spread and tail erect, but stopping midway with or without retreat of humans
13. Chasing: Continued aggressive running for more than 10 metre towards humans with ears spread and tail erect until humans retreat to greater distance and stoppage
14. Trunk throws and trumpet: post-stoppage directed towards retreating humans
15. Guarding: One or more than one individual guard the calf in between the legs at the perceived threat
16. Huddling: forming close group with heads outwards, looking towards the humans with occasional trunk lifting and ear spreading
17. Redirected aggression: aggression towards non-human objects to display threat, such as uprooting tea bush or throwing twigs and stones, pushing tress or concrete poles
18. Vocalisation: trumpeting, squeaking, rumbling, roaring directed towards or away from the humans
19. Trunk on body/mouth: More than one individual putting their trunk on other's body or trunk while looking at humans

Self-directed behaviours
1. Digging mud: using trunk or forelegs to dig up mud
2. Mud-bathing: using trunk to throw mud or small vegetation over own bod
3. Ear-flapping: slow flapping of ear during resting or feeding

4. Tail swinging: Swinging tails in general while feeding or resting or swishing away flies
5. Water-splashing: Using trunk to splash water on own body

5. Discussion

5.1 Land use changes and human-elephant conflict in Assam

The forested areas at the study site underwent significant deterioration quantitatively and qualitatively in the last three decades. On the other hand, small forest patches, scrublands and tree patches have been significantly converted into small scale tea sector. Thus, elephants have been pushed towards spending significant time at the human-dominated landscape in order to find food and refuge. Such land use changes have been observed across Assam in the similar time period and a subsequent increase in elephant-related damages have been reported (Srivastava et al. 2002; Mahato et al. 2021). Change from paddy cultivation to small tea sector was promoted through falling agricultural income and policy support. Such a change increased house damage in the Barnadi range of the study area. While the herds were found to be indulging in crop damages, the loners or small all-male groups were majorly responsible for house damages. Reversing such land use changes probably is not possible now, especially inside the forest. This requires long term planning for restoration with long term financial and human resource commitment. Also, such changes happened due to political reasons, through militancy as well as rehabilitation of militants. Thus, a strong political will is necessary to restore what is left of the forested areas.

5.2 Patterns of human-elephant conflict incidences

Elephant related damages as well as elephant deaths in Dhansiri forest division are higher than many other forest divisions in Assam and India. Even though it seems total incidents are coming down, it may be due to several reasons. First, these are reported incidences and not actual number of incidences. I found actual number of incidences to be higher than reported for the year 2021. If the damage extent is less, people tend not to report. People also have higher tendency to report extensive house damages than crop damages. Due to unavailability of compensation for the last eight years for house and crop damage, people have reduced reporting. So, reduction of reported incidences could be because of this. Second, it could be actually a case of reduction in elephants damaging crop and houses due to increased vigilance and more successful drive outs. Third, visitation of elephants might actually have reduced due to deflection of these elephants to other areas such as neighbouring districts. This is hard to ascertain since there is no information on live elephant movements and individual identification of elephants.

The pattern of damages follows the agricultural calendar closely. Damages are more during July-November with slight variation in crop and house damages. This temporal pattern of elephant-related damages is similar with patterns observed in other studies (Nath et al. 2009; Wilson et al. 2015; Talukdar et al. 2022). Human death and injury as well as elephant deaths can happen anytime without showing any particular pattern. Spatially, the elephants cause damages over a large area covering villages which are at the boundary as well as villages which are 10-15 km away from the forest boundary. Tea estates were major refuge areas outside the forest and river courses acted as the conduits. Villages which are adjacent to such movement areas are more prone to regular visitation by elephants.

From the survey of house damages, we found that more house damages occurred during monsoon (June-August). With maturation of paddy, house damages decrease. This might be due to two reasons. First, During June-August, rain cause difficulty in guarding crops in night and along with long power cuts during these months, it becomes difficult to anticipate elephants' movement. People considered these months to be more problematic (due to darkness and noise of rain) than the subsequent months. Second, with the maturation of paddy, elephants might strategize to raid paddy in field rather than home, since probability of risk is lower, and success is higher. All the house damage incidents

happened during the night hours when the residents were asleep. So, indeed elephants are more comfortable to raid houses during certain time of the day.

House damage events create financial and emotional burden for victims. After such an event, people have to spend close to a week to rebuild the house and by this time they not only loose daily wages, but also spend an amount which is sometimes approximately half the annual income for the victim. For brick houses, the expenditure is more. These events also create severe intangible impacts of increased fear and anxiety. Even though one can rebuild the house, but the sense of safety is compromised. Buying a torchlight or a solar fence not only increase expenditure but also do not necessarily increase sense of safety. Such impacts remain uncompensated, unacknowledged and long term as seen in many studies, especially from India (Ogra 2008; Barua et al. 2013; Gogoi 2018).

5.3 People's perspective of elephants

Probably because of elephants' place in religious practices, people do not show extreme negative emotions towards elephants. Majority of the people felt empathetic towards elephants' plight and anthropomorphised elephants' behaviour which mirrored their own life. They equated elephants' loss to poverty and raiding crops and houses were equated as desperate effort to find food for oneself and family. Majority of the people did not find elephant to be intentionally cruel and thought that they have become like their present self-due to human actions. However, people indeed thought that elephants pose a greater problem, in terms of finances and restricted mobility. So, the balance between material and cultural perspective on elephants are currently balanced towards the positive side. With greater material losses, elephants could be regarded as pests.

Such positive view is not accorded to the perceived elephant managers, i.e., the forest department. People considered the forest department to be the responsible party to reduce this issue since the forest department exerts control over the forest areas and therefore, elephants. People often called elephants to be 'forest departments' animals' and during several instances of actual human-elephant encounters villagers asked the forest department personnel to take away 'their animals'. Women respondents were more vocal about restriction posed by the forest department in collecting firewood and thought that forest personnel were insensitive towards poor people. Such human-human conflict might exacerbate perception towards elephants. People thought that forest department should work on restoring the forest actively than taking any other reactive steps.

Community-centric human-elephant conflict mitigation has been a key working area for governments or NGOs (Zimmermann et al. 2009). Such programs critically depend upon community participation at different levels and community-based maintenance of mitigation techniques. People showed enthusiasm about participation in such programmes, but with a subordinated attitude. They thought that forest department or NGOs are larger and powerful players who could extend help in this regard. So, organisations who want to work with these people need to break that hierarchy and facilitate decision-making at the community level. It was also interesting to note that many respondents disagreed for a monthly payment system for maintaining community-owned solar fence. They considered it to be a governmental responsibility which further reiterates that people think solving human-elephant conflict is beyond community's capability.

5.4 Elephants' lives at the study landscape

Elephants have been found to be increasingly occurring over fragmented human-dominated landscape in India (Srinivasaiah et al. 2012; Kumar et al. 2018). It is of certainty that their lives will be different in such landscapes where they have to negotiate another ubiquitous species—humans. In Assam, it is now widely known that elephant's cross human-made landscapes and infrastructures such as highways, railways, tea plantations and agricultural lands to access different habitat patches (Vasudev et al. 2021). In South India, novel behavioural strategies have been developed by male elephants— building large all-male groups to increase success rate of crop raiding (Srinivasaiah et al. 2019). In my study site, the elephants' usage of the overall area denotes similar novel behavioural strategy. Using

rivers as conduits and tea estates as refuges are novel strategies for optimizing movement and feeding success outside the forest. Elephants also found to be reducing risk by restricting their larger movements during the night and increasing success rate of feeding by raiding crops and houses at night. Elephants were also found to be having significant fission fusion grouping which could be another behavioural strategy for optimizing feeding success outside the forest.

5. Recommendations

- Massive conversion of forest and tree areas into settlements in the past caused elephants to spend more time near the villages. Presently, such conversion is not there, but the forest department as well as the people need to be vigilant so that remaining forested areas are not converted into monocultures.
- Forest department needs to work closely with people. This is for two reasons. First, people who live day in day out with elephants know about these animals in great details. Such knowledge needs to be harboured for effective conflict mitigation techniques. Second, the mis/distrust about forest department will be minimized and a co-operative atmosphere could be created. Existing legal mechanisms such as establishing joint forest management or eco-development committees can be explored for forest restoration. Converging forest restoration with income generation schemes need to be looked at.
- Although timely compensation might not increase people's comfort of sharing physical space with elephants, it might increase legitimacy about the forest department among the people. This could again build better communication between the two parties.
- A better communication also lessens the perception of conflict where the local community might feel that they have some agency to fall back on during vulnerable situations. For this, as a proactive measure, joint committees could be formed before onset of farming season, during May-June to strategize crop protection measures across the area. This could be effective in managing resources, both human and material.
- While setting up solar fences at forest boundary seems a plausible idea since elephants do not use the area as 'corridor', but this could harm elephants since they spend significant time in tea estates using it as refuge and secondary food source. So, it will be better to build low-cost solar fences with community participation around villages which are just adjacent to the tea estates. This would keep elephants' paths open and also protect the people around the estates. Having said that, it will be probably better to put a solar fence at the forest boundary at Barnadi range. There is only one tea estate and elephants majorly use this range for house damage and not refuge. Barnadi wildlife sanctuary has good connectivity to Manas National Park in the west through Bhutan.
- People still revere elephants as godly creature, and this feeling needs to be promoted so that sudden negative shift in people's perception does not take place.
- Promotion of safe behaviour around elephants is necessary so that accidental encounters are reduced. A further exploration into livelihood diversification to offset losses and increase safety of the household is needed. SHG groups could be tapped in for promotion of elephant-friendly livelihoods.

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7. Acknowledgements

Appendix-1

Questionnaire for semi-structured interview				
Name of the village/hamlet:			GPS:	
Date:	Time:		Community/tribe:	Religion:
Name:		Age:		M/F:
Education:		Marital status:		Primary occupation:
Secondary occupation:			Yearly income from primary occupation:	
Yearly income from secondary occupation:			Total yearly income:	

Encounter with elephants
A. What are the places where you could potentially encounter elephants and at what times? Tell from your experiences. (Probe about forest, river, TE, cropland, roads etc.)
B. Why do you access these places? For what resources? What about alternative places and/or resources?
C. What do elephants do/get at these places?
D. What measures have you taken to not to encounter them in those places?
E. What kinds of damages have you experienced due to elephants? Please describe the incidents (time, month, quantity of loss).
F. What did you do immediately after the incident? (Probe deeper for house damage, injury or death: ind. Action and action by others)
G. What did you have to do to recover the losses?
H. What do you do to avoid repeat damage?
I. Do you know about people in your village who have suffered similar loss? What did they do to recover from loss?
Knowledge related to elephants
A. Why do you think elephants come to your village? (Probe about elephants' food in forest, crop preference, alcohol, revenge, increase in elephant population, other; ask series of why-questions)
B. Have you seen any changes in elephant's behaviour? What kinds of changes? Why do you think that has happened? Tell from your experiences.
C. What different behaviour have you observed for lone elephants and elephants in herd?
D. Can you identify male and female elephants? How? Are their behaviours same? Tell your observations.
E. Do you think elephants show different behaviour at different places? Why?
F. What do you observe when you encounter elephants from long range? What do you do then?
G. What do you observe when you encounter elephants from short range: What do you do then? Tell us some events.
H. What foods have you seen elephants to be consuming other than crops? Where have you seen them?
Forest department intervention
A. Do you have idea of the compensation system of the forest department? In last five years, how many times have you applied for it and for what damage? How many times have you received it? What was the process? What amount and which year?
B. What are the problems and improvements associated with the compensation system?

| C. What are the forest department's reactive/ preventive management activities? Do you think they are enough? How do you think they should improve? |
| D. What kinds of restriction do you face from FD? What do you do then? |
| E. If FD calls for meeting or any other intervention, will you participate personally? Why? |
| |
| **Adaptation/coping** |
| A. How do you think the elephants have changed your life? (Probe about increased workload, expenditure, changed livelihood, access to resources) |
| B. What steps are you taking to make your life better? |
| C. What kinds of measures have people in your village have taken up to reduce damage from elephants? Are they effective? How can they be improved? (Probe about night guarding/ noise/crackers/fire/alternate work or livelihood) |
| D. How do you think your children are affected by this problem? (Education, work and marriage) |
| **Attitude towards elephant** |
| A. Do you think elephant is solely responsible for your loss? How & why? |
| B. Do you consider elephant as the biggest problem in this place? How and why? What are the other problems? |
| C. Do you think creating separate space for animals and humans (forest & settlements) will solve the issue of HEC? |
| D. Do you think co-existence of human and elephant is possible? Why? |
| E. Whose responsibility is mitigation of HEC- i) FD, ii) FD+ village, iii) village only, iv) individual? How & why? |
| F. Does the conflict affect men and women differently? How & why? |
| G. Do men & women cope with HEC differently? How & why? |
| |
| **Participation in HEC handling activities** |
| A. Has there been any village level meeting on HEC? Have you participated in it? Why did/did not you participate? |
| B. If NGOs come and request you to participate in their activities, will you like to participate? Why? |
| C. What kinds of activities/ trainings do you think will be good for you so that you can live a better life? |
| D. Whom do you like to work with to reduce the elephant problem for you as well as for the village? |
| |
| **Attitude to conservation artefact (afforestation, solar fencing, trench etc.)** |
| A. Have you come across solar fencing or trenches or forest plantations meant for addressing the problem of elephants? Who created them? How do you think they address the problem? What do you think about their effectiveness? |
| B. Personally, how do you think the artefact affected you? Any kinds of restrictions? How do you personally address that? |
| C. Are they enough to stop elephant to come to your village? How do you elephants treat these artefacts? Tell us some instances. |

Appendix-2

Questionnaire for house damage survey			
Date:	Time:		Village:
A. DETAILS OF HOUSEHOLD			
Name:	Male / Female		Community:
1. What age are you?			
<18	18-25		26-35
36-45	46-55		56-65
>75			
2. What is the furthest you have gone in school?			
Class 5 or less	Class 6-10		Class 11-12
BA/BSc	MA/MSc		
3. What is your marital status?			
Married	Unmarried	Divorced	Widowed
4. How many people in total are in this family?			
1-2	3-4	5-7	more than 7
5. No. of children in the family?			
1-2	3-4		more than 4
6. Age of children			
7. What is your primary occupation?			
Farmer	Tea plantation worker	Small tea grower	Daily wage worker
Business/self-employed	Livestock production	Migration worker	Other
8. What is your secondary occupation?			
Farmer	Tea plantation worker	Small tea grower	Daily wage worker
Business/self-employed	Livestock production	Migration worker	Other
9. How much land do you own in total (including house, farm, and cash crop)?			
Less than 1 bigha	1-3 bigha	4-6 bigha	7-9 bigha
10-12 bigha	13-15 bigha		More than 15 bigha
10. How many livestock animals do you own?			
Cows	Goats		Pigs
Ducks	Chickens		Buffalo
11. What is your normal yearly household income?			
Less than 50,000	50,000-100,000		100,000-150,000
150,000-200,000	200,000-250,000		More than 250,000
12. Type of house?			
Own house	PMAY house		Other
13. What year was this house set up?			
14. Do you use the forest for any purpose?			
Collect firewood	Grazing of cow	Collect grass	Fishing

B. SURVEYOR RECORD				
1. Position of the house in the village:				
Middle of village			Village boundary	
2. Dense vegetation around house:				
4 directions	3 directions	2 directions	1 direction	No vegetation
3. What kind of vegetation is present?				
Bamboo		Areca		Natural trees
Tea bush and shade tree		Banana		Long weeds
Other				
4. Does the house have electrical lighting?				
Yes			No	
5. Is there electric lighting outside the house?				
4 directions	3 directions	2 directions	1 direction	No
6. GPS point of the house:				
C. QUESTIONS FOR HOUSEHOLD MEMBER				
1. Date of damage:				
2.Time of damage:				
3. Type of house damaged:				
Kutchha			Pucca	
4. Part of the house damaged:				
Whole house		Kitchen		Other rooms
5. How much damage was caused?				
Very little damage			Some cosmetic damage	
Significant structural damage			The house was nearly destroyed	
6. How many elephants were there?				
1	2-3		4-5	More than 5
7. Was any kind of food material stored in that damaged part?				
Yes			No	
7.1 What kind of food material was there?				
Rice	Vegetables		Fruit	Salt
Alcohol	Sugar		Other	
8. What were you doing before the damage happened?				
Sleeping			Working in house	
Outside, nearby			Outside, away from house	
9. How many people were in the house at the time of the damage?				
Adult men:		Adult women:		Children:
10. What did you do during the damage?				
Hide in other room		Go out to drive elephant		Flee
11. Has your house been damaged before?				
Yes			No	
11.1 How many times has your house been damaged in the last 5 years?				
12. Did you apply for compensation to FD?				
Yes			No	
13. Did you receive compensation?				
Yes			No	

14. Did you file the claim yourself?	
Yes	No
15. Did you know what documents were needed to file the claim?	
Yes	No, others told me
16. What was the total cost to rebuild the house?	
17. Did you receive any financial assistance to rebuild?	
Yes	No
18. From where?	
19. How did you arrange money for the rebuild?	
Own savings	Loan from bank
Loan from moneylender	Other
20. Did you lose daily income due to involvement in rebuilding the house?	
Yes	No
21. How is the condition of your house, compared to before the damage?	
Fully rebuilt, better than before	Fully rebuilt, same as before
Fully rebuilt, worse than before	Partially rebuilt
Not at all rebuilt	

22. How long did it take to rebuild?

1 day	2-7 days	1 week	2-4 weeks	>1 month

23. Who rebuilt the house?

Yourself	Hired labour	Friends/family/neighbours

24. In total, considering lost days of employment, cost of labour and materials to rebuild, how much did the damage cost you?

Less than 10000	10000- 20000	20000- 30000
30000-40000		
	more than 40000	

25. Did you take any step to safeguard your house after the incident?	
Yes	No
25.1 What kinds of steps?	
Bought torchlight	Put non-electric fences
Keep awake at night if elephants are around	Put solar fence
Put food materials away from main house	Go with others for guarding at night
Other	
26. Do you feel safer after you took those steps?	
Yes	No
27. Have you changed your livelihood due to elephants?	
Yes	No
27.1 What kind of change?			

Changed income source	Tea plantation	Cash crop	Daily wage
Moved	House	village	farmland
Migrated for job	within state	outside	
Other changes	e.g., sale of items to pay for repairs	other	

28. Have you experienced any other loss due to elephant?

Crop	self-injury	injury	death relative

29. After the incident, how afraid are you of elephants?

Less than before	Same	More than before

30. After the incident, how anxious are you of elephants?

Less than before	Same	More than before

31. After the incident, how much do you feel mental sickness due to elephants?

Less than before	Same	More than before

32. How did this incident with elephants impact your happiness and the wellbeing of your family?

32.1 Money:		
We have less than before	Same as before	More than before
32.2 Safety at home:		
We have less than before	Same as before	More than before
32.3 Health and happiness:		
We have less than before	Same as before	More than before

D. ATTITUDE TO ELEPHANTS

1. Do you identify elephants as a barrier to development of your family?

Yes	No
1.1 WHY	

2. Do you identify elephants as a barrier to development of your village?

Yes	No
2.1 WHY	

3. Do you think elephants are cruel?

Yes	No
3.1 WHY	

4. Do you think elephants find enough food and shelter in the forest?

Yes	No

5. Do you think elephants have a right to exist in this area?

Yes	No
5.1 WHY	

6. Do you think elephants have a right to come to your village?

Yes	No
6.1 WHY	

7. Do you think elephants are important and need protection?

Yes	No
7.1 WHY	

8. Do you enjoy watching elephants at a distance?

Yes	No
8.1 WHY	

9. Why do you think elephants come to your village?

loss of forest	loss of food and shelter
better food at village	other

10. Has the number of elephants near your village increased than before?

Yes	No

11. Has the problem of house damage by elephants in your village increased over the years?

increased	decreased	remained same

12. If elephants do not damage houses and crops or do not come to your village, will you be comfortable to have elephants near your village?

Yes	No

13. How often do elephants come to your village?

Every week	a few times a month	some months in the year	a few times a year)

14. If elephants reach your village, how often do they come near to your house?

Always	sometimes	very less

E. ATTITUDE TO CONFLICT MITIGATION		
1. What steps have you taken to mitigate the problem?		
Use torchlight	night guarding	solar fence around home
use fire	use noise	other
2. Who should be responsible to mitigate the problem?		
forest department	village members	both
individual family	others	
2.1 WHY		
3. Do you think you have received adequate help from forest department to reduce this problem?		
Yes	No	
4. What should forest department do to reduce this problem?		
night patrolling	timely visit attack victims	
timely and adequate compensation	provide light, fence etc.	
plant trees in forest	protect forest from illegal logging	
relocate elephants/	other	
5. Do you think you have received adequate help from government representatives to reduce this problem?		
Yes	No	
6. What should government representatives do to reduce this problem?		
pressurize forest department	provide light	
fence etc.	timely and adequate compensation	
timely visit attack victims	other	
7. Do you think you have received adequate help from village community to reduce this problem?		
Yes	No	
8. What should the village community do to reduce this problem?		
community night patrolling	pressurize forest department or government representatives	
plant trees in forest	contribute money to common fund to buy torch	
fence for common use	other	
9. If you receive adequate compensation due to house damage from forest department on time, will you be comfortable with elephants coming in your village?		
Yes	No	
10. Should such arrangements be made, that elephants could never enter villages and humans could never enter forests?		
Yes	No	
11. What could be the best solution to this problem?		
Afforestation or provide food, shelter to elephants	setting up solar fences around village	
fencing the forest boundary	regular night duty by villagers	
regular patrolling duty by forest staff	Adequate and timely compensation	
Relocation of elephants/	Relocation of humans	
Other		
12. If Forest department or other organisations develop community-based conflict mitigation techniques, will you be willing to participate in that programme?		

Yes	No
12.1 Why	
13. If the village members without the help of forest department or other organisations develop community-based conflict mitigation techniques, will you be willing to participate in that programme?	
Yes	No
13.1Why	
14. If such programmes ask you to pay certain amount monthly for maintenance, will you still be willing to participate in that programme?	
Yes	No
14.1Why	

Appendix-3

Fig Elephants in tea garden

Fig Crop damage by elephants

Fig House damage by elephants

Fig Adult elephant died due to suspected poisoning

Fig Watching elephants as leisurely activity

Fig Crop guarding shelter