Asian Journal of Conservation Biology, December 2020. Vol. 9 No. 2, pp. 362-366 AJCB: SC0053
ISSN 2278-7666 ©TCRP Foundation 2020

Short Communication

Efficacy of different traditional methods in mitigating human-elephant conflict in Rani-Garbhanga area of Assam, India

Biren Ch. Borah[1], Prabal Sarkar[2] and Anindita Bhattacharya[1*]
[1]*Department of Earth Science, University of Science & Technology, Meghalaya, India*
[2]*Department of Zoology, University of Science & Technology, Meghalaya, India*

(Received: September 20, 2020; Revised: November 13, 2020; Accepted: November 24, 2020)

ABSTRACT

Conservation of elephants has become a challenging issue due to ever-increasing human-elephant conflict throughout its distribution range. The economic loss incurred by the farmers along with the manslaughter creating negativity towards elephants that leads to retaliatory killing of elephants. So, the conservation success depends on the mitigation measures of human-elephant conflict. All the high-tech methods are highly cost-effective as well as not at all effective under different landscape. Hence, the use of traditional methods along with the high-tech methods is globally suggested for mitigation of human-elephant conflict. Therefore, a study was conducted in the fringe villages of Rani-Garbhanga Reserved Forests of Assam, India to find out the traditional methods of conflict mitigation using both field survey (Night Stay) and questionnaire method during 2016-2019. The study found that the elephants were prevented by 12.2% from crop damage whereas for 46.5% the villagers were partially successful while another 41.3% completely failed to prevent elephant. The most commonly employed intervention methods were noise (100%) followed by beating drum (91%), use of fireball (65%), spotlight (24%), and firecracker (18%). However, when either was used in combination with noise their efficacy was compromised (interactions between noise and fire, noise and spotlight, noise and fences). Noise also works as an intervention technique, but only when used on its own. The study further suggested for use of modern technologies along with the traditional methods to take long-term measures to mitigate human-elephant conflict in this area.

Key words: Rani-Garbhanga RF, human-elephant conflict, elephant conflict mitigation.

INTRODUCTION

Human-elephant conflict (HEC) is a significant danger to elephant protection (Mukeka *et al.,* 2019). The issue of the contention among natural life and individuals is not kidding particularly when individuals are executed by wild creatures and retaliatory killing brings about the demise of untamed life (Acharya *et al.,* 2016; Ling *et al.,* 2016). However, crop depredation by elephants is a key conservation issue across their distribution range that severely affects the livelihood option that ultimately hampers on the elephant conservation globally. The circumstance is antagonistic to such an extent that the conservation of elephants relies upon the finding of HEC alleviation measures (Kangwana, 1995; Gross, 2019). Hence, both the conservation authorities and non-governmental agencies all over the world are attempting to find out some mitigation measures of HEC to give the wellbeing and security of humans as well as the conservation of elephants in the wild (MoEFCC, 2017; Panda *et al.,* 2020).

The challenge to conservationists is discovering intends to lessen the expenses of people living with elephants (Kangwana, 1995). Numerous natural life the board specialists and protection organizations have been engaged with the advancement of contention lessening programs, yet gauges at present being used don't address the issue completely (Lahm, 1996). There are numerous approaches to relieve struggle among elephants and farmers however, none are acceptable as the dynamic and degree of HEC contrasts with the landscape.

The commonest way to deal with managing struggle has been the improvement of yield security methodologies through various aggravation techniques. Across provincial farmers utilize a wide scope of conventional techniques to pursue the elephants. These incorporate pounding drums and consuming flames. Famers depend chiefly on dynamic relief techniques (e.g., actual obstructions, impediments, or heading out elephants) to battle HEC, although it has been proposed that these strategies might be inadequate over the long haul (Fernando *et al.,* 2008). Moreover, these problematic and on occasion forceful methods can bring about an expansion of HEC and may expand the number of assaults on people by elephants.

The issue is that elephants are profoundly versatile and quickly adjust to hindrance techniques (those which alarm, however motivation no actual damage). The viability of an obstacle is in this way decreased whenever elephants are presented to it on different occasions. This issue likewise applies to cutting-edge strategies that are expensive and needs normal upkeep. Subsequently, a compelling and monetarily feasible moderation strategy is needed to limit HEC to give alleviation to enduring ranchers just as advancing more uplifting perspectives towards elephant protection. In this way, the customary techniques are again a subject of study to comprehend the site explicit viability of various strategies in forestalling elephant so current innovations can be executed corresponding with the conventional strategies.

**Corresponding Author's E-mail: anindita_bhattacharya1@rediffmail.com*

As the degree of HEC varies with temporal and spatial features, no single mitigation strategy works in all circumstances (Osborn and Parker, 2003). Subsequently, the network receives the particular relief estimates dependent on the fleeting and spatial examples of yield plunder by elephants and the social variables (Naughton-Treves, 1998). Therefore, a study was conducted in the Rani-Garbhanga area of Assam to understand the site-specific HEC mitigation practices and their efficacy so that a holistic approach can be formulated to safeguard the life of human being and conservation of elephants in this landscape.

MATERIALS AND METHOD

Rani-Garbhanga Reserve forest lies (26°55' to 26°0.5' N latitude and 91°35'E to 91°49'E longitude) on the south bank of the river Brahmaputra, which is adjacent to Guwahati, the capital city of Assam in Northeast India (Figure 1). This reserve forest falls under the East Kamrup Forest Division of Assam, India having an area of 232 sq. km (Garbhanga range: 188.86 sq. km area and Rani Range: 45 sq. km). The climate of the Rani-Garbhanga Reserve forest falls within the temperate climate zone The reserve harbors 'Assam Valley Tropical mixed moist deciduous' forest with bamboos and categorized as 'Khasi Hill Sal' [3C/C1 a(ii)] and 'Kamrup Sal' [3C/C2 d(ii)] (Champion and Seth, 1968). The common species of mammals are tiger *(Panthera tigris),* leopard *(P. pardus),* Hoolock Gibbon *(Hylobates hoolock),* barking deer *(Muntiacus muntjak),* wild boar *(Sus scrofa),* Assamese macaque *(Macca assamensis),* pangolin *(Manis pentadactyla),* etc.

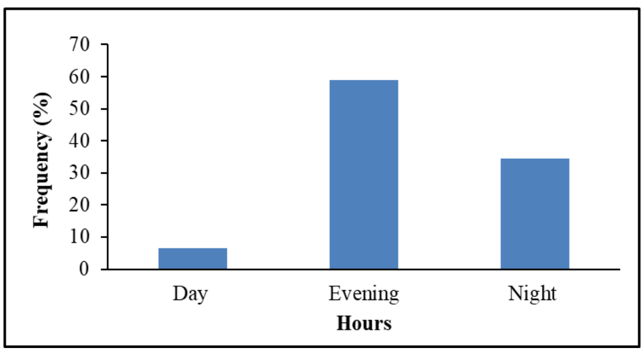

Figure 1. Diurnal variation of elephant visits during 2016-17 to 2018-19.

The study was conducted using field survey methods (Night Visit) (Varma et al, 2008) and questionnaire methods (precise and closed and (ii) broad and open methods as per Balakrishna and Ndhlovu, 1992; Ramakrishnan, 2008; Sarkar et al., 2008). Data on elephant visits and efficacy of different deterrent methods were collected through field survey while the farmers' expectations were recorded through the household questionnaire survey between 2016 and 2019.

RESULTS

Diurnal variation of elephant visits

During 2016-17, 2017-18, and 2018-19, it was observed that the elephants visited mostly (57%) in the evening hours followed by night hours (25.5%) and daytime (3.5%) (Figure 1).

The diurnal variation in the number of elephant visits was observed during 2016-17, 2017-18, and 2018-19. Elephant visits reached its peak at 6 pm (19.25%) whereas it was least (0.75%) at 4 am. At evening time i.e. 5-10 pm, maximum visit was observed (Figure 2). This further indicates that the farmer should keep alert between 5 -10 pm as the maximum elephant visit was taken during that period. The diurnal variation in the number of elephant visit was found to be statistically significant during the study period ($t=4.379$, $p\leq 0.05$).

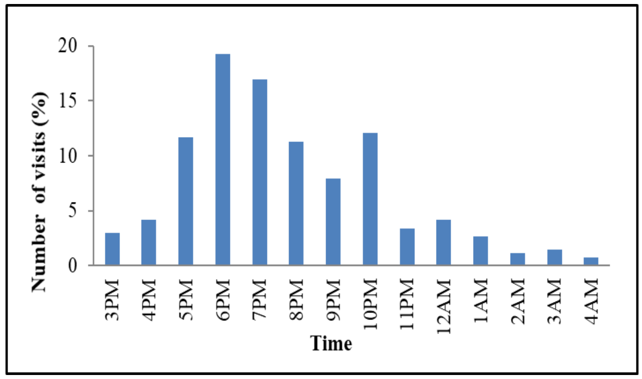

Figure 2. Diurnal variation on numbers of elephant visits during 2016-17 to 2018-19.

Preventive method applied

The most commonly employed intervention methods were noise (100%) followed by beating drum (91%), use of fireball (65%), spotlight (24%), and firecracker (18%) (Figure 3). However, the *kunki* elephant was used to chase the elephant in a very exceptional case by the forest department.

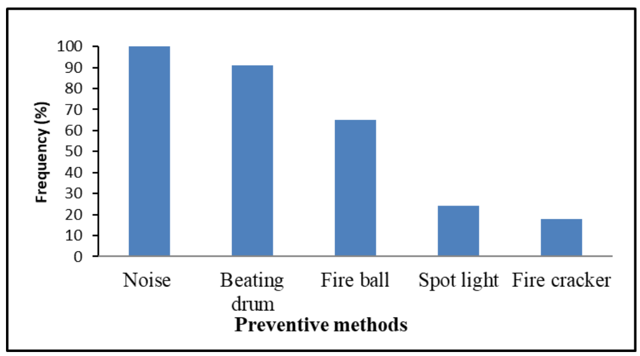

Figure 3. Different traditional methods applied for preventing elephants

Prevention success

It was observed that elephants were prevented by 12.2% from crop damage whereas for 46.5% the villagers were partially successful while another 41.3% completely failed to prevent elephant (Figure 4).

There was a variation in success attempts by different villages in preventing elephants to do any kind of damage during 2016-17 to 2018-19. Maximum success attempt (19.2%) was observed for Bakrapara whereas it was minimum for Puransukurberia (7.77%). Joypore, Upardani, Beloguri, Gorakhhaniyapara and Patgaon villages success attempts were 14.3%, 13.1%, 12.6%, 10.1%, and 9.3% respectively whereas for Satargaon, Ganapati, and Damilla-Garopara villages, the successful attempt was 11.7% (Figure 5). A significant difference between different villages in the successful attempt for preventing elephants was observed during the study period ($t=12.266$, $p \leq 0.05$).

There was a variation in partial success attempts by the villagers in preventing the elephants during 2016-17 to 2018-19. Patagonia village achieved the maximum (49.3%) of partial success attempt and Ganapati village the least (43.9%). 48.1% of the partial success was achieved by both Upardani and Satargaon villages for preventing elephants from creating any damage. Damilla -Garopara, Beloguri, Puransukurberiya, Joypore, Garakhhoniyapara, and Bakrapara villages had 47.9%, 47.3%, 46.4%, 45.1%, 44.7%, and 44.3% of partial success attempt respectively for preventing elephants to do any sort of damage (Figure 6). Partial success attempt in preventing elephants was significantly different among different villages during the study period ($t=77.554$, $p \leq 0.05$).

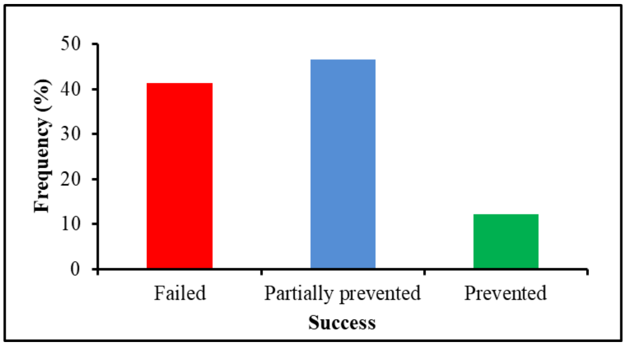

Figure 4. Overall success rate of elephant prevention during 2016-17 to 2018-19.

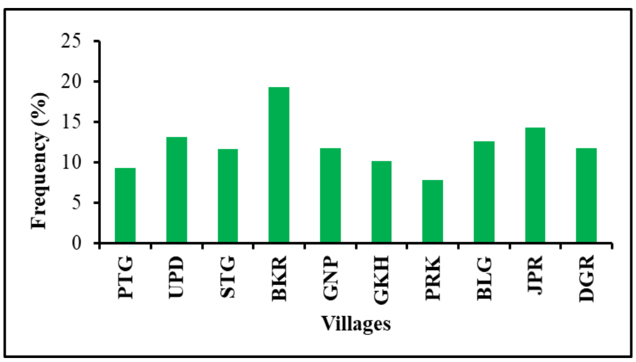

Figure 5. Village wise the success attempt (%) in preventing elephants during 2016-17 to 2018-19. PTG: Patgaon, UPD: Upardani, STG: Satargaon, BKR: Bakrapara, GNP: Ganapati, PRK: Purasukuberiya, BLG: Beloguri, JPR: Joypur and DGR: Damilla-Garopara

Figure 6. Village wise the partial success attempt (%) in preventing elephants during 2016-17 to 2018-19.

Variation in the incident of failure attempts by different villages was also observed during 2016-17 to 2018-19. Maximum failure attempt was observed in Puransukurberiya village (45.9%) and minimum (36.5%) in Bakrapara village. For certain cases, the village namely Garakhahaniya (45.3%), Ganapati (44.4%), Patgaon (41.5%), Jopore (40.7%), Damilla-Garopara (40.4%), Satargaon (40.3%), Belguri (40.1%), and Upardani (38.8%) failed to prevent elephants to do any kind of damage (Figure 7). The failed attempt in preventing the elephant was also found to be statistically significant among different villages during the study period ($t=44.003$, $p \leq 0.05$).

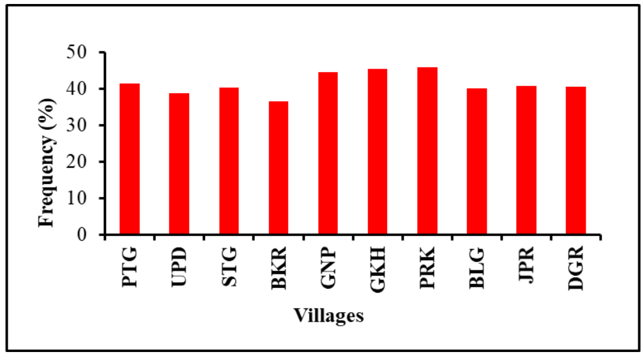

Figure 7. Village wise the failure attempt (%) in preventing elephants during 2016-17 to 2018-19.

Time Vs elephant prevention

About 89% of elephant visits occurred by lone and very small herd (one to 3 elephants). The remaining 11 incidents were done by a large elephant herd (Figure 8).

Intrusion of large herd (highest up to 35 numbers) occurred between late evenings to till early morning. However, no incident of large herd visit was reported till 4 pm (Figure 9). There was a significant variation in elephant visits among different times under the study irrespective of the herd size ($t=4.274$, $p \leq 0.05$).

Success rate for driving out the lone/ small herd was more consistent (CV of lone/ small herd=84.8; CV of large herd=126.3) and better (μ lone/ small herd=44.8; μ large herd=17.3) than the large herd (Figure 10).

However, it was the time factor (afternoon and early morning) due to which some of the attempts (36.3%) could not be prevented and unnoticed by them (Figure 11). A statistical difference in successful prevention among different timings i.e. between afternoon and early morning was observed ($t=3.211$, $p \leq 0.05$).

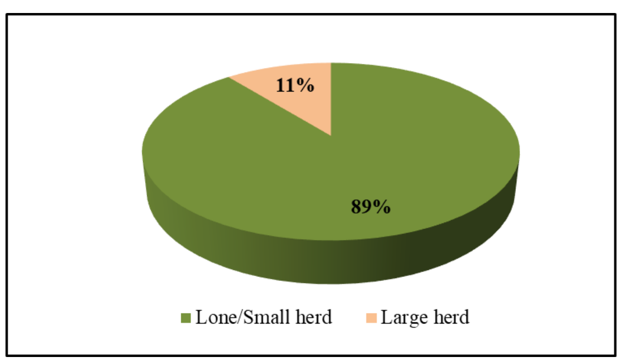

Figure 8. Herd size of the elephant intruder

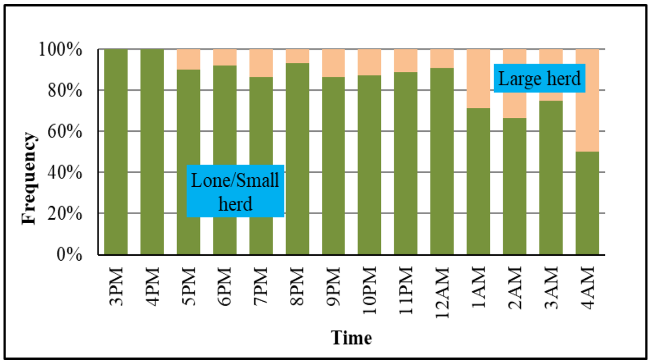

Figure 9. Diurnal variation of comparative elephant intruders herd size (large and lone/ small herd)

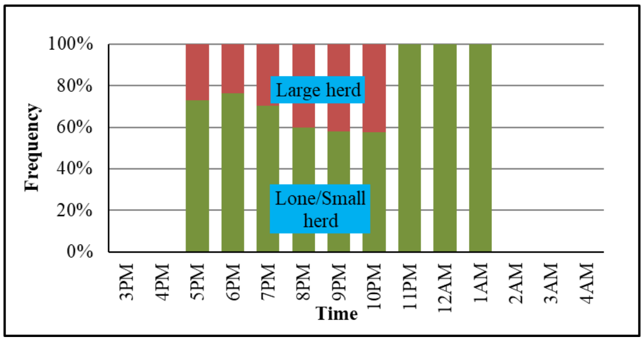

Figure 10. Diurnal variation of lone/ small elephant herd intrusion and the success rate of prevention

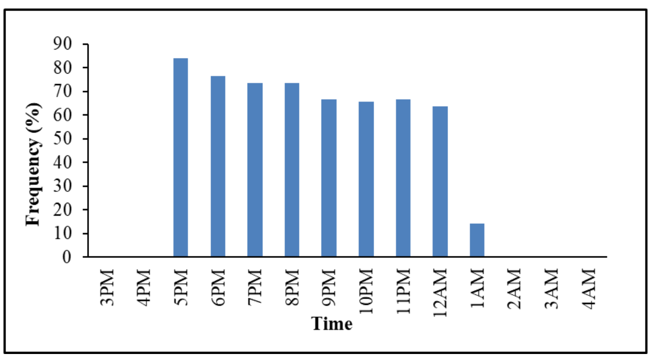

Figure 11. Diurnal variation of the successful attempt of elephant prevention

Farmer expectation and suggestions

Fifty-nine percent of the farmers revealed that there was no response from the forest department concerning the crisis call of the resident to alleviate elephants. In any case, 40.5% of respondents expressed that the woodland staff occasionally come, and their response was past the point of no return. In the majority of the cases, when the forest staffs come, they provide crackers to the farmers, and the number of crackers was very less compared to requirements. A significant difference (χ^2=52, p<0.05) in different respondents' views was there on forest department response to human-elephant conflict call. On the other hand, 94% of the farmers were not very happy with the procedure, delay, and non-payment/ minimum payment of ex-gratia paid, and the remaining 6% did not know anything about it. The non-payment of ex-gratia for crop damage may result in no faith in ex-gratia payment leading to a lack of interest in filing complaints for ex-gratia to crop damage. Maybe the disappointment concerning the ex-gratia dispensing framework is hence one of the significant explanations behind the negative attitude towards elephant conservation.

The majority of the farmers (46%) expressed for construction of rubble wall along the forest boundary followed by 22.5% trench, 22% electrified barrier, and 0.5% bio-shield. They likewise proposed a mix of various techniques as a moderation measure. Trench along with rubble wall was proposed by 5% of respondents followed by 3% electrified barrier and rubble wall, 0.5% each for trench and electrified barrier, and rubble wall and bio-shield together. Views of the respondents in different villages on different preventive measures were found to be statistically significant (**x^2**=1.463E2, p≤0.05).

DISCUSSION

There are several suggested methods to mitigate HEC (Panda *et al.,* 2020; FAO, 2008) which needs special exercise to verify in different landscape. In 2017, the Govt. of India provided some technical guidelines for application in the field for mitigating HEC in India (MoEFCC, 2017). They generally utilize obstacle strategies incorporate noise-making devices, tripwire-activated alarms, thunder flashes, strobe lights, trenches, non-lethal electric fencing, playback of infrasonic calls of elephants, and pheromone repellents (Gorman, 1986; Thouless and Sakwa, 1995; Osborn and Welford, 1998). In the present study, the utilization of conventional strategies in alleviating the HEC is the more prominent Rani-Garbhanga area of Assam. All the deterrent methods though found partially successful and, in some cases, a complete success, are short-term use. The noise was the most well-known type of preventive measure in this area which was found to be successful somewhat if the presence of the elephant was known ahead of time by the farmers. The other form included making noise by beating drum and utensil and firecrackers However, the use of firecrackers in less frequency maybe because of cost that cannot be incurred by the poor farmer of this area.

All these methods applied by the community are time-consuming, risky, and further leads to health-related issues among the farmers those who guard their paddy field on consecutive nights (Sarkar *et al.,* 2008). All the previously mentioned mitigation measures antagonistically impact on the financial condition (Karanath et al., 2013; Madhusudan, 2003) that proceeds to influence mentally and, in their practices, too. The conservation authorities of the world have acknowledged that before planning and executing any conservation plans for the Asian elephant, the financial state of the fringe villagers must be perceived (Sengupta *et al.,* 2020). Since no single technique is found successful, a mix of organic, physical, and administration issues should be applied together (Hoare, 2012). Alongside current modern strategies like methods like trench digging, electric fencing, early warning system (animal monitoring/detection technique, non-invasive radiofrequency technique) etc. (Santiapillai *et al.,* 2010), the conventional techniques can be utilized in blend to expand the adequacy of elephant counteraction.

HEC mitigation and serene conjunction on a long -term basis lies on synchronous focusing of the management endeavours on site-specific concern along with detailing and use of vital plans at the landscape level which straightforwardly address fundamental anthropogenic drivers and their spatio-temporal variety (Shaffer *et al.*, 2019). However, a holistic approach that incorporates the ideas under the umbrella of the community-based program should be initiated toward finding enduring solutions to this problem (Nayak and Swain, 2020). The three principal ideas might be applied here for legitimate administration of HEC, obligation regarding crop security being moved to farmers, and giving financial motivating forces to these farmers co-existing with elephants and present-day advances ought to be utilized in keeping elephants secured in this region.

ACKNOWLEDGEMENT

The authors would like to extend their gratitude to the villagers of the entire Rani-Garbhanga area of Assam and staff of the forest department for extending their help and support during the study period. The authorities of the University of Science and Technology, Meghalaya is also highly acknowledged for their encouragement.

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