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Is Elephant Proof trench an effective mitigating measure against human – elephant conflict?

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Abstract

Human-Elephant Conflict (HEC) is one of the challenging issues posing on elephant conservation in all its ranges. Therefore, goodwill and tolerance level is decreasing among the affected people over time that could lead to animosity towards the elephant conservation. Various methods include traditional farm-based deterrents (the use of watchtowers, fires, ditches and loud noises) and novel farm-based deterrents have been tried to reduce HEC. The Elephant Proof Trench (EPT) is recognized as a potential means of reducing HEC. The effectiveness of EPT in controlling HEC (particularly by large species such as elephants) depends on various factors which have not been looked so far. This paper describes the effectiveness of EPT in three different geographical landscapes in Tamil Nadu, South India. In a total 470.48 km of EPTes studied in Coimbatore Reserve Forest Division (CRFD), Gudalur Reserve Forest Division (GRFD) and Grizzled Giant Squirrel Wildlife Sanctuary (GGSWS) altogether. Entire EPT length was walked by foot to record wild animal and livestock crossing points. Line transect method was deployed to find out extent of use by wild animals along the EPT and questionnaire method was used to understand the people's perception on EPT. The result revealed that there were 727 animal crossing points and 909 othern than animals crossing points. The Elephant (0.63 ER/Km) was the frequently used animal species which was followed by Wild boar (0.52 ER/km) and Gaur (0.24 ER/Km). The people opined that there was no change in area of cultivation (96%) and cropping pattern (96%) after the establishment of EPTes. Most of the people (85%) have perception that the maintenance is the duty of forest department. Huge amount is being spent for digging EPT every year by the forest department is ending with poor result is unfortunate. This present study is envisaged that policy level change is urgently warranted for successful use of EPT grant against HEC.

Key words: Elephant, EPT, effectiveness, HEC, Tamil Nadu.

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INTRODUCTION

Human-Elephant Conflict (HEC) causes significant loss of human lives, property and livelihoods each year around the world. At present the number of wild Asian elephants (*Elephas maximus*) is between 35,000 and 50,000 (www.elephantcare.org). The trend in almost all Asian range states has been a drastic decline in wild elephant numbers, due to the degree of various anthropogenic factors related to increasing human population, loss and degradation of habitat, fragmentation of breeding populations due to loss of corridors and increasing HEC. The Asian elephant is categorized as an 'endangered' species in the Red List of the World Conservation Union (IUCN, 2008: www.iucnredlist.org) and is classified with the Convention for International Trade of Endangered Species (CITES, www. cites.org) under Appendix I. In Asian countries the elephant is being closely associated with the social and cultural aspects of people. Elephants play an important role as 'keystone species', maintaining biodiversity of the ecosystems they inhabit (Ramakrishnan and Saravanamuthu, 2012). Due to their requirement for large areas of forest habitat, conservation of elephants will automatically ensure the conservation of other species that co-exist in the same habitat. However, they can also modify the environment in positive as well as negative ways by their actions.

The Project Elephant of the Government of India (http://envfor.nic.in/pe/pe.html) estimates the present number of wild elephants in India to be 27,669-27,719. This project has declared 26 elephant reserves with an area of 60,000 km^2 to protect elephants, their habitats and corridors. Each year, HEC results in about 300 human deaths and damage to 10,000-15,000 houses and 8-10 million hectares of crops, while over 200 elephants die due to human-related activities, which include poaching for ivory or meat, poisoning,

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cattle-borne diseases, electrocution and collision with trains (Bist 2002). Many studies have been carried out on HEC both in Asia (Sukumar 2003; Ramakrishnan and Saravanamuthu, 2012) and Africa (Sitati, 2005; Walpole and Linkie 2007), despite the lessons learnt and the wide range of measures and management strategies that have been employed to mitigate HEC (Nelson *et al*., 2003; Osborn and Anstey 2007; Fernando *et al.* 2008), the intensity of the problem is clearly increasing. The full range of traditional and modern measures for mitigation of HEC is used by the state institutions and villagers, with varying degrees of success (Fernando *et al.,* 2008).

The Government of Assam has formed an Elephant Task Force, and several NGOs are actively assisting in HEC management. WWF-India (www.wwfi ndia.org) is implementing the AREAS (Asian Rhino and Elephant Action Strategy) programme, and has evolved a model for HEC management (the Sonitpur Model) that uses high tech tools like GIS and remote sensing along with traditional methods like elephant monitoring, guarding key depredation tracks employing kumkies (trained tame elephants) and chasing off wild herds. Longer term measures include maintaining contiguity of habitats and elephant populations in the critical areas by working with and supporting the state departments and communities (Amit Sharma, pers. comm.). Other NGOs that are active include 'Aaranyak' (www.aaranyak.org), which is working with the support of the US Fish and Wildlife Service to minimize HEC by encouraging villagers to adopt alternative cropping and livelihood options, and Ecosystems India and Green Guard, which work mainly on developing early warning systems and experimenting with chilies and other biotic deterrents. Since the HEC is posing a major challenge to the conservation of Asian elephant, resolving HEC is the major concern among the conservation communities.

Various methods have been tried to reduce HEC (Sitati and Walpole, 2006; Graham and Ochieng, 2008; Walpole and Linkie, 2007). These include traditional farm-based deterrents (the use of watchtowers, fires, ditches and loud noises), novel farm-based deterrents and Elephant Proof Trenches (EPTes) has become an increasingly important strategy used nowadays for reducing HEC. EPTes are costly to maintain, but are recognized as a potential means of reducing conflict by preventing access to vulnerable land, or by separating people and elephants at a landscape scalee. Although huge amount is being spent every year by the Project Elephant, a centrally sponsored scheme of the Government of India, the effectiveness of EPT in controlling crop raiding (particularly by large species such as elephants and Gaur) depends on a number of factors. This paper describes on the effectiveness of EPT dug around three different geographical locations of southern Western Ghats with the following objectives such as to assess the efficacy of EPT, to find out extent of use by various mammalian species along the EPT, to know the peoples' perceptions on EPT and to suggest feasible management implications to the managers.

STUDY AREA

Coimbatore Reserve Forest Division (CRFD)

The Coimbatore Forest Division covers an area of 694 km² and is situated in the Coimbatore district of Tamilnadu, Southern India. The Coimbatore Forest Division is also part of Nilgiris and Eastern Ghats Landscape, which is holding single largest Asian elephant population in the world. This division lies between latitude 10°51' and 11°27' and longitude 76° 39' and 77° 4' (Fig.1). This forest division has wide range of altitude from 450m to 1450m Mean Sea Level (MSL). Innumerable streams originate and drain the plateau. This network of streams resolves itself into Bhavani and Noyyal river. The vegetation types range from tropical thorn forest at the foothills to evergreen relation to terrain, altitude and rainfall.

Gudalur Reserve Forest Division (GRFD)

The Gudalur division, situated at the convergence of Kerala, Karnataka and Tamil Nadu, lies between 11°22'and 11°34' N and 76°32' and 76°15'E covering an area of 484.4 sq.km with more than 100 fragments. This forest division is surrounded by Sigur Plateau on the east, Nilambur-Wynad on the west, Mudumalai-Wynad on the north and Nilambur forest on the south (Fig.1). The tropical wet evergreen and moist deciduous are the major forest types of Gudalur division which form part of the Nilgiri Biosphere Reserve.

Grizzled Giant Squirrel Wildlife Sanctuary (GGSWS)

The Srivilliputhur Grizzled Squirrel Wildlife Sanctuary lies in the Western Ghats falling in the revenue districts of Virudhunagar and Madurai between North latitude 09° 23' 38" to 09° 49' 51" N and between longitude 77° 21' 51" to 77° 47' 20" E, This forest area with an extent of 476.65 Sq Km was declared as a sanctuary in G.O. Ms. 399 Environment and Forests (FR.V), dated, 26-12-1988. Srivilliputhur Grizzled Squirrel Wildlife Sanctuary is the meeting place of two distinct geographical regions of biodiversity landscape Western Ghats of Tamilnadu and Kerala (Fig.1). It is sharing its western boundary with important landscape for elephant conservation programme in Periyar Tiger Reserve (PTR).

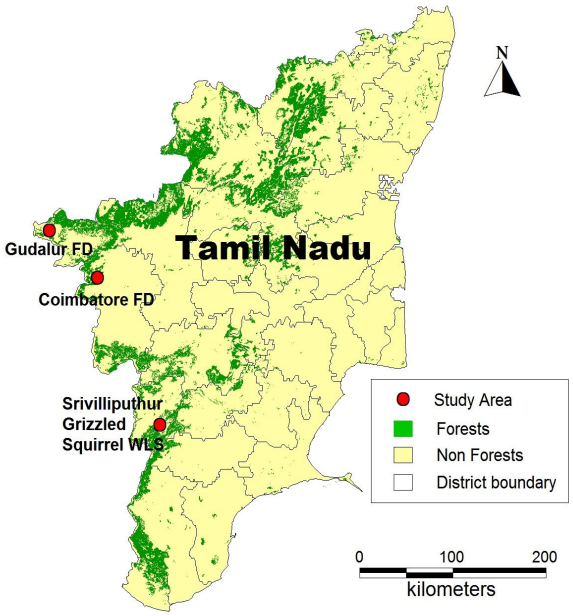

Fig.1. Locations of focused study areas in the southern Western Ghats

METHODOLOGY

The effectiveness of EPTes was assessed by foot survey method (Ramakrishnan, 2008). The entire perimeter was walked and geographical locations of damaged points, animal crossing points, river/nullahs/dry stream beds crossing points and rock or root of trees crossing over the EPTes were taken using GPS besides mapping them using a Global Positioning System to superimpose on the division map. The data were compiled for each range separately to obtain the percentage of farmers cultivating various crops and crops damaged by elephants, loss to properties, etc. The variables such as year of establishment, length and cost were collected from the office records.

Animal density estimation along the EPTes

Both direct and indirect methods were carried out to get an abundance of animals used near EPTes. Line Transect (Burnham *et al.,* 1989) method is considered to be the best method to study large mammals. Parameters such as starting time, ending time, sex, number of individuals sighted for each species was recorded while walking on the transects. Encounter rate, relative abundance was calculated for each species. Quadrate method also deployed as indirect count in order to find out the extent of use of cryptic and less density animals along the EPTes. Totally 48, 17 and 10 km transects were laid in CRFD, GRFD and GGSWS respectively. Similarly 96, 34 and 20 quadrates were laid to study indirect evidences in CRFD, GRFD and GGSWS respectively. The length of each transect was 2 km and size of each quadrat was 50m x 20m.

People's perception on EPTes

The questionnaire comprised both "Precise and closed" and "Broad and open ended" questions were used to understand people's perception on EPTes. The questionare was conducted from 311 personnel. The questions such as name, occupation, how long living in this area, how long elephants visiting the villages, status of forest/vegetation over the years, about agriculture, etc. were collected by using "Precise and closed" method. The information on reason for elephants visits to the villages, how to avoid HEC and effectiveness of EPTes were collected using "Broad and open ended" method. Totally 110 personnel from CRFD, 95 from GRFD and 106 persons from GGSWS were met for questionnaire survey. The "Precise and closed" method was a set of questions that has been asked for direct answers from the respondent (Ramakrishnan and Saravanamuthu 1997). The "Broad and open ended" questions were given to the respondent as an opportunity to express his/her views freely without any inhibition (Balakrishnan and Ndhlova, 2008) (Photo plate 1).

RESULTS

Table.1. Total kilometres and amount sanctioned for EPTes in the study areas

S. No.	Name of the Forest Division/ Sanctuary	Amount Sanctioned (in Rs.)	Total Kilometres of EPTes
1	Coimbatore Reserve Forest Division	8,34,91,000/-	358.48
2	Gudalur Reserve Forest Division	1.21,71,000/-	38
3	Grizzled Giant Squirrel Wildlife Sanctuary	2,38,88,000/-	74
	Total	**11,95,50,000/-**	**470.48**

Totally Rs.11,95,50,000/- was spent to dug 470.48 kilometre of EPTes in three focused study areas (Table 1). In an average 39.33 lakhs of rupees was spent to dug one kilometre of EPT. Among the three study areas, the CRFD utilized huge amount (8,34,91,000/- crores) of money followed by GGSWS (2,38,88,000/- crores) and GRFD (1.21,71,000/-).

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Table.2. Year wise (2010 - 2016) amount allocation and length of EPTes dug in focused study areas.

S. No.	Year	Name of the Forest Division / Sanctuary			Total km of the EPTes	Amount spent (Rs.)
		CRFD	GRFD	GGSWS		
1	2010-11	5.5	3.2	1	9.7	23,57,340
2	2011-12	85	6.8	16.03	107.83	2,25,96,000
3	2012-13	111	5.3	6.5	122.8	3,06,33,800
4	2013-14	66.59	7.5	31.39	105.48	4,06,75,000
5	2014-15	21	8.2	15.08	44.28	1,44,94,000
6	2015-16	10.98	7	10	27.98	88,94,060
Total		**358.5**	**38**	**74**	**470.48**	**11,95,50,000**

Six years (2010 - 2016) data was collected from the three focused study areas. It is quite interesting to note that the amount of rupees sanctioned to dig out EPTes has gradually increased year after year between 2011-12 and 2013-14. On the contrary the trend was decreased in the year between 2014-15 and 2015-16 (Table 2).

Table.3. Locations of wild and domestic animal crossing points and other than animals damaged points recorded along the EPTes in three focused study areas

S. No.	Name of the Forest Division/ Sanctuary	Total kilometres of EPTes	Total number of wild and domestic animal crossing points	Total number of damages caused due to nullahs, soil erosions, rocks and foot paths
1	Coimbatore	358.48	582	680
2	Gudalur	38	41	115
3	Srivilliputhur	74	104	114
		470.48	**727**	**909**

Totally 1636 damaged locations were recorded in a total of 470.48 kilometres length of the EPTes in all three focused study areas altogether. Of which 727 points were identified as animal crossing points (Fig.2) and 909 points were identified and categorized as other than animal damaged points caused by nullahs, rocks, soil erosions and foot paths created by local people to enter into the forest areas (Fig.3). The damages caused by wild as well as domestic animals and damages caused by other than animals have increased with the proportionate of the length of EPTes (Table 3).

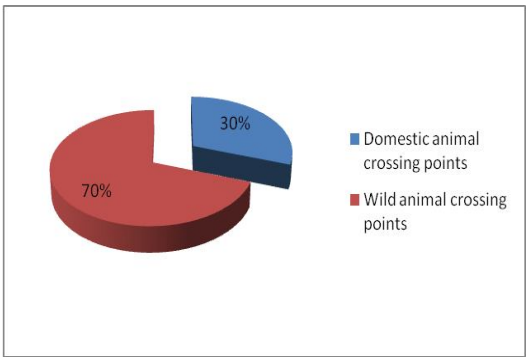


Fig.2. Wild and domestic animal crossing points versus length of EPTes in three focused study areas

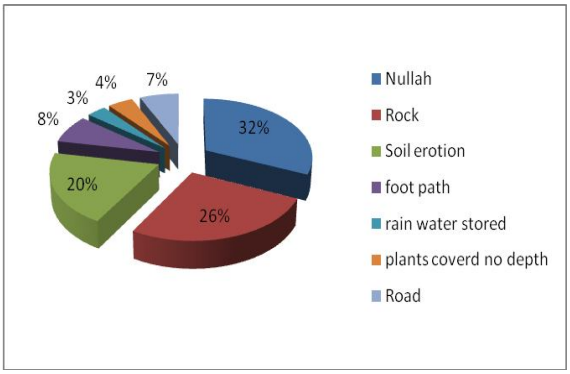


Fig.3. Other than animal crossing points versus length of EPTes in three focused study areas

Direct Count

Table.4. Encounter rate of wild animals along the EPTes in three in three focused study areas

S. No.	Common Name	Scientific Name	Total number of individuals sighted	Demography				ER/KM
				AM	AF	Y/C	UI	
1	Elephant	*Elephas maximus*	189	68	101	18	2	0.63
2	Gaur	*Bos gaurus*	72	19	41	9	3	0.24
3	Wild boar	*sus scrofa*	157	23	90	39	5	0.52
4	Sambar deer	*Rosa unicolor*	67	21	36	8	2	0.22
5	Monitor lizard	*Varanus bengalensis*	26	-	-	-	13	0.09
6	Black-naped hare	*Lepus nigricollis*	21	-	-	-	13	0.07
7	Wild dog	*Cuon alpinus*	17				17	0.06
8	Spotted deer	*Axis axis*	98	19	65	8	-	0.33
9	Barking deer	*Muntiacus muntjak*	33	-	-	-	33	0.11

Adult Male (**AM**); Adult Female (**AF**), Young ones / Calf (**Y/C**), Un Identified (**UI**) Encounter Rate (**ER**)

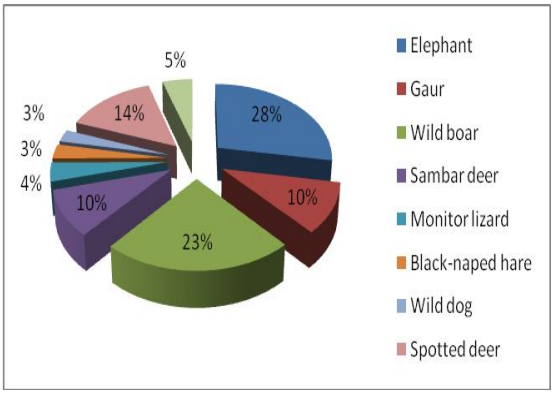


Fig.4. Direct sightings of wild animals recorded along the EPTes in the three in three focused study areas.

Totally one hundred and fifty transects were laid in three focused study areas altogether according to their EPTes length. All these transects were surveyed once in the morning (06.00 - 09.00 hours) and once in the evening (14.00 - 16.00 hours) during the study period. A total of three hundred kilometer was sampled by transect method during the study period.

The direct sightings data revealed that Elephant was sighted in highest numbers (n=189) and the Encounter Rate (ER) was (0.63 individuals / Km) followed by Wild boar (n=157; ER 0.52 / Km), Gaur (n=157, ER 0.24 / km) and Spotted deer (n=98; ER 0.33 / km). On the other hand Wild dog (n=17, ER 0.06 / km), Black-naped hare (n=17, ER 0.07 / km) and Monitor lizard (n=26, ER 0.09 / km) were recorded in few numbers during the survey (Table 4 and Fig.4).

Indirect Count

Table.5. Indirect evidences of wild animals recorded along the EPTes in the in three focused study areas

S. No.	Common name	Scientific Name	Indirect evidences			Total number sighted	Relative Density %
			Scat	Dung/ Pellet	Track/ feeding sign		
1	Elephant	*Elephas maximus*		387	197	584	33.77
2	Wild boar	*sus scrofa*	93		238	331	19.17
3	Indian gaur	*Bos gaurus*		136	117	253	14.65
4	Sambar deer	*Rosa unicolor*		97	62	159	9.19
5	Spotted deer	*Axis axis*		83	37	120	6.94
6	Barking deer	*Muntiacus muntjak*		59		59	3.41
7	Black- naped hare	*Lepus nigricollis*		79		79	4.56
8	Sloth Bear	*Melursus ursinus*	13		8	21	1.21
9	Leopard	*Panthera pardus*	54		28	82	4.74
10	Tiger	*Panthera tigris*	19		7	26	1.5
11	Wild cat	*Felis silvestris*	11		4	15	0.86

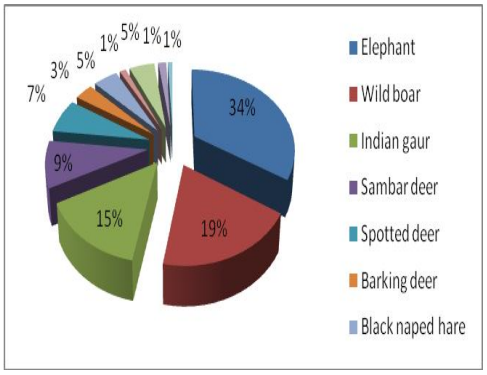
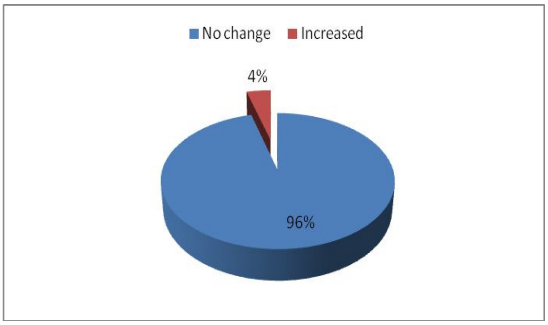


Fig.5. Percentage of indirect evidences of of wild animals recorded along the EPTes in three focused study areas

Indirect count was attempted in order to find out the usage of nocturnal and cryptic habit animals based on their left over evidences such as scats, pellets, scarp marks and foot prints (hoof marks, Pug marks, Pad mark), etc. Totally eleven wild animals were used along the EPTes in three forest divisions altogether. Of which Elephant dung piles were found in highest proportionate (33.77%) followed by Wild boar (19.17%), Gaur (14.65 %) and Sambar deer (9.19%). Although it was very few the indirect survey count recorded nocturnal and cryptic animals such as Tiger, Leopard, Sloth bear and Jungle cat during the survey in three forest divisions altogether (Table.5 and Fig.5).



People's perception on the effectiveness of EPT

Fig.6. People's perception on the change of cropping pattern after the establishment of EPT in the study areas.

Totally three hundred and eleven people were interviewed in three study areas altogether. The questionnaire was issued to the people and enquiries were made in order to understand whether the cropping pattern has increased or decreased after the establishment of EPT. The result revealed that most of them (96%) answered that there was no change in their cropping pattern after the establishment of EPT. On the contrary, very few (4%) of them opined that few changes were made in their cropping pattern (Fig.6).

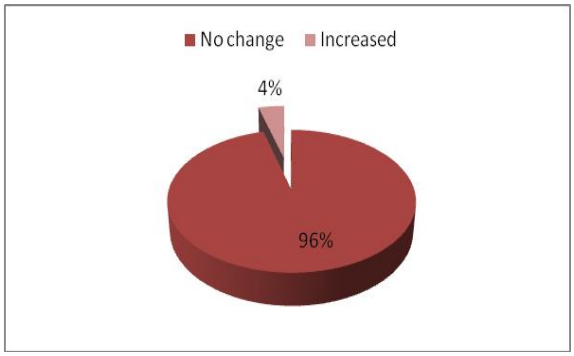


Fig.7. People's perception on the increase of cropping area after the establishment of EPTes in the study areas.

The questions were asked to the people in order to understand whether the cropping area has increased or decreased after the establishment of EPT. The result revealed that the answers of most of the respondents (96%) were that there was no change in cropping area after the establishment of EPT except few (4%) (Fig. 7).

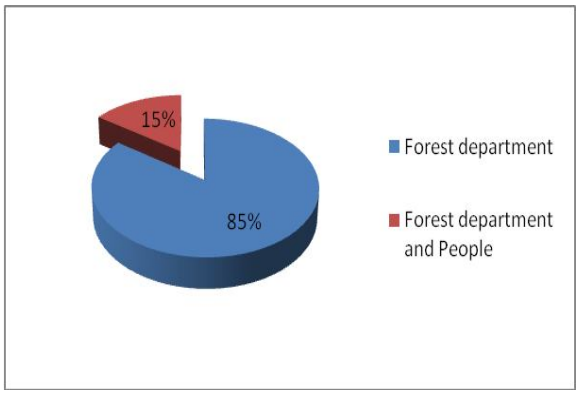


Fig.8. People's perception on the responsibility of EPTes maintenance

The question regarding the person who was responsible for the annual maintenance of EPTes was asked to three hundred and eleven people who were living in the fringes of EPTes during this survey in all the three forest divisions altogether. 85% of them replied that it should be the duty of forest department and few (15%) of them opined that it is should be the cooperation between forest department and local people (Fig. 8).

DISCUSSION

Farmer measures to protect crops and household vary from zero cost to very expensive barriers like electric fencing. The current approaches in dealing with the conflict has largely been a problem, and proved futile because of inappropriate application of the methods, lack of involvement of local people, lack of monitoring of conflict and conflict mitigation measures, and inadequate understanding of elephant ecology (IUCN 2006). Lack of a policy also leads to an inordinate focus on the symptoms rather than the causes of the problem.

Fig.9. Picture showing the herd of elephants crossing EPT

No single solution is effective and different approaches need to be integrated to address the effectiveness of HEC mitigating measures. Every year huge amount is being spent for various measures of mitigation against HEC. Of which the EPTes are also found as the methods for which mostly Government fund is being allocated. Although most of the methods and its effectiveness were studied by various researchers in all the elephant ranges, the EPT was not much focused so far in which huge amount is being spent. Considering the lacunae this short term study was attempted in three different legally geographical areas.This study was conducted in 407.48 km length of EPT dug out for the past six consecutive years from 2010 to 2016. An average 39.33 lakhs per kilometre and altogether Rs.11,95,50,000/- was spent to dug 470.48 kilometre of EPTes in three focused study areas. When compared to any other mitigating measures such as solar power fencing, battery charged fencing or any traditional methods, the cost involved in EPT is very high.

In the present study totally 1636 damaged locations along 470.48 kilometres length of the EPTes in three focused study areas altogether have been recorded. Of which 727 points were identified as animal crossing points (Fig.9) and 909 points have been identified and categorized as other than animal damaged points caused by nullahs, rocks, soil erosions and foot paths created by local people to enter into the forest areas. This shows that there was cooperation of local people though having huge amount of money has been spent by the Government the benefit has reached the local people. This was mainly because of the lack of people's participation. This need to be addressed for the successful implementation of such huge amount incurred schemes.

In the present study it was recorded that the Elephant had been the frequently used wild animal species rather than others along the EPTes. This was mainly because of attractive crops or blockage of corridors or water source inside the villages. The reasons for crop damage caused by elephants have been debated in several forums. Some of the popular explanations

provided include (i) degradation of crucial microhabitats, (ii) competition for water and vegetation, (iii) loss and blocking of traditional corridors that elephants have used for many years, (iv) new rehabilitation settlements, and (v) new cropping patterns and having of roads. The present scenario witnesses any one of such or combination of many attributes could be the reason for the elephants to frequently visit the EPTes. Ramakrishnan and Saravanamuthu (2010) found that there was high intensity of crop damages caused by elephants in some of the villages located in the fringes of traditional corridors due to the fact that the animals pass through these regions in search of their traditional sources for its survival in the Nilgiri Biosphere Reserve.

This present study reveals that neither cropping area nor cropping pattern has not changed after the establishment of EPTes. This situation clearly explains that the EPTes have no effectiveness to stop the wild animals, and hence no change was noticed in cropping area as well as cropping pattern of the villages. This was mainly because of poor maintenance of EPTes. This present study clearly states that the maintenance is the duty of the forest department as expressed by 85% of local people. The forest department has no provision for annual maintenance. Conflict mitigation reduces the risk of presence of wild elephant in the farmer neighborhood and that includes minimizing possible elephant damage also. In a nutshell, this present study concludes that the excavation of EPTes by spending huge amount of money either should involve strong people's participation with sufficient annual maintenance provision. A separate committee also is to be formed for all EPTes which were dug earlier and forth coming EPTes include forest officials, panchayath presidents or head man of the villages, farmers including elephant researchers for the long run sustenance of EPTes with the appropriate policy level changes.

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