



Crop Damage by Asian Elephants *Elephas maximus* and Effectiveness of Mitigating Measures in Coimbatore Forest Division, South India

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Abstract

A short term study on crop damage by elephants and effectiveness of mitigating measures was carried out from November 2008-April 2009 in Coimbatore Forest Division, Tamilnadu, South India. Totally 438 persons were interviewed from the forest fringe villages of six forest ranges of the Coimbatore Forest Division. This study revealed that 32 Grama Panchayaths were affected by elephant crop raids. Total frequency of elephant's attempt to raid the crop fields ($n=438$) were recorded as 2124. Crop raiding attempts and success was highest in Odanthurai panchayath. Lowest attempts were recorded in Madukarai panchayath. Totally 31 crop species were recorded during the study period, of which 24 species were raided by elephants at various intensities. Banana (*Musa paradisica*) (139.49 acres), Sorghum (*Sorghum vulgare*) (122.35 acres), Areca nut (*Areca catechu*) (18993 trees), Coconut (*Cocos nucifera*) (4701 trees) were the most raided crops by elephants. Crops such as Marigold (*Tagetes erecta*), Sappota (*Pouteria sapota*) Pearl millet (*Pennisetum glaucum*), Millet (*Panicum sp.*), *Jatropha* (*Jatropha curcas L.*) and Brinjal (*Solanum melongena L.*) were not raided by elephants. Totally eight different mitigating measures were used by the local people to prevent the elephants. Among the methods elephant proof trench only found to be the most successful mitigating measure. This present study revealed that family herds were highly responsible for crop damage (66 – 75 %) than solitary males (25 – 34 %).

Keywords: Crop raid, elephants, mitigation measures, Coimbatore, economic loss.

Introduction

The asian elephant (*Elephas maximus*) is a highly endangered and keystone species categorized under Schedule I and Part I of the Indian Wildlife (Protection) Act 1972¹. The Asian Elephant is once found throughout the Asia and is now restricted to few localities in the Indian Subcontinent due to various reasons. Of late, management of human–elephant conflict is one of the important challenges to the wildlife researchers, conservationists and forest managers. The major reason for human–elephant conflict could be due to invasion of agriculture fields on the forest fringe areas and various developmental activities in forest region^{2,3}. Across its home range various anthropogenic pressures led to loss habitat quality, which forced elephants to extend their traditional range and raid crops to meet out their daily requirements. During such forays elephants invade into human properties and confrontations become inevitable. Fragmentation of habitat leading to trapping of elephants in isolated patches with cultivation all around are mentioned as the factors responsible for crop raiding in South India⁴. Further, factors such as degradation of habitat, competition for water, movement pattern, palatability and nutritive value of crops also led to crop depredation^{4,7}.

The Coimbatore Forest Division has a sizeable elephant population and viable habitat. More than 20% of the area of the reserve forest serving as viable corridor for the movement of

elephants between Silent Valley National Park (Western Ghats, Kerala) and Eastern Ghats and vice-versa⁸. Apart from ecological factors there are several developmental activities reasoned for human–elephant conflict issues in and around the Coimbatore Forest Division. Due to these obstacles human elephant conflict incidents are notably on the increasing trend. Over the past few decades many developmental and destructive activities of humans have severely fragmented the forests. Of which, the Asian elephants, as they require large areas of natural range than other mammalian species in tropical Asia, are one of the main animal to suffer the consequences of developmental activities⁹. There is a big question arises now that in future how best elephant and human beings can live in a human induced environment like Coimbatore Forest Division.

Unlike the Wildlife Sanctuaries and National Parks in the Western Ghats the Coimbatore Forest Division gets less attention in dealing with the human–elephant conflict issues and its mitigation measures though it is part of the Nilgiri Biosphere Reserve (NBR) and is also part of the Elephant Reserve No.8. The Coimbatore Forest Division shares its boundary at the length of about 350 km between human habitations and farm lands. Therefore the villages adjoining the reserve forest boundary are more prone to elephants' visits. The movement of elephants in this division is mostly restricted to foot hills due to escarpment of steep slope on the west and human habitations on the east. Therefore human–elephant conflict is higher level

compared to other largely populated elephant habitats in South India.

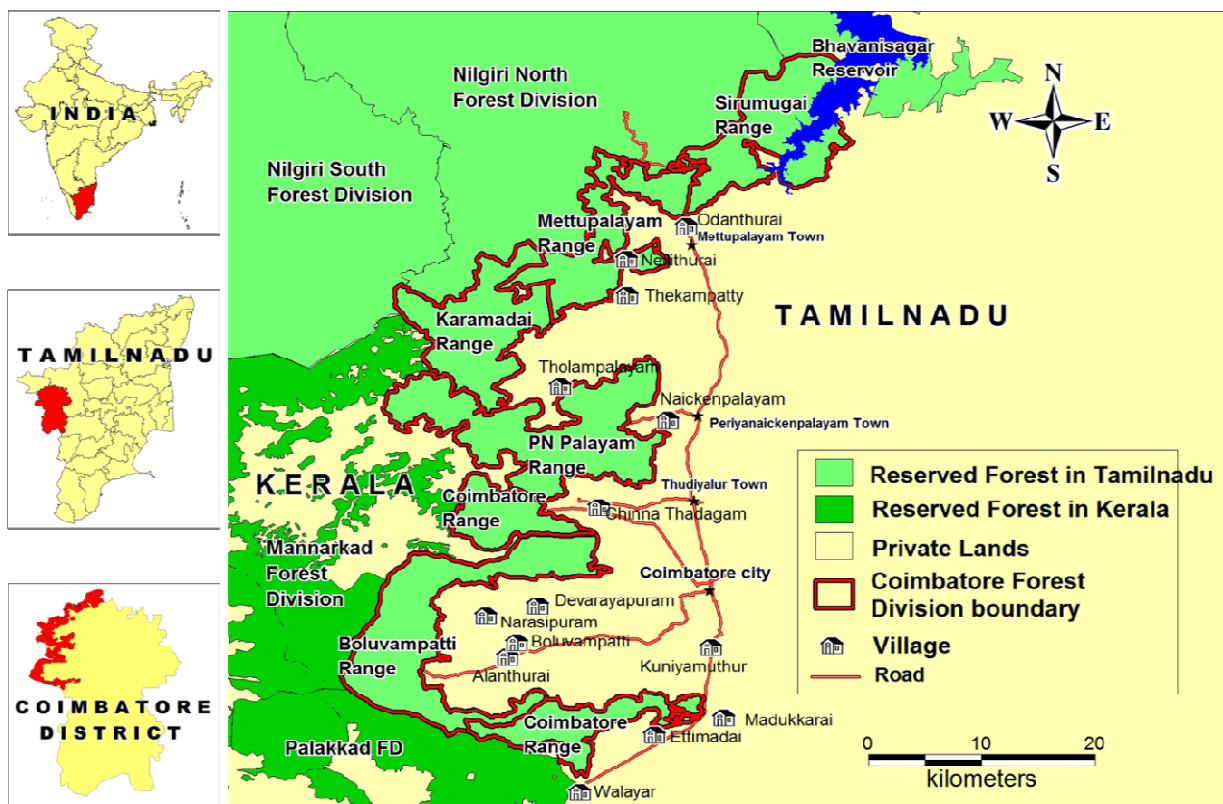
Information on man-elephant conflict and effectiveness of different kinds of protection methods to deter elephants has been well documented in Asia^{4,7,10-15}. Crop raiding and man-wildlife conflict has been documented in Kerala^{16,17}. Gopinathan¹⁸ has mentioned on crop raiding problems in Wayanad Wildlife Sanctuary. Crop raiding and economic loss due to elephants were reported from Bihar^{19,20}. Similar studies were also conducted in the Western Ghats, especially in Nilgiris^{5,7} and in Eastern Ghats²¹. However the Coimbatore Forest Division gets less attention in terms of scientific study except Ramakrishnan² and no detailed information is available on these aspects. Therefore this study was initiated to assess the overall pattern of crop damage by elephants with the objectives of survey and quantify the crop damage by elephants on agriculture crops and to evaluate the efficiency of mitigating measures used against crop depredation by elephants.

Material and Methods

Study area: The Coimbatore Forest Division covers an area of 694 km² and is situated in the Coimbatore district of Tamilnadu, 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 forest division has

six ranges namely Sirumugai, Mettupalayam, Karamadai, Perianaickenpalayam (PN Palayam), Coimbatore and Boluvampatti, map 1. This division lies between latitude 10°51' and 11°27' and longitude 76° 39' and 77° 4'.

This forest division has wide range of altitude from 450m to 1450m Mean Sea Level (MSL). The Pillur slopes are the steepest, a shear drop is observed as the ground falls from 450m to 1530m MSL suddenly. The Melur slopes, Hulical Durg and Nellithurai forests are on the lower hill mountains. The Boluvampatti hills elevation ranges from 450m to 530m MSL. Above 530m the ground rises sharply to the crest of the hill range to the north, west and south, the maximum elevation is 1986m MSL on the Velliangiri Peak. Apart from these sloping hillocks, this reserve has Velliankadu Valley, Nayakkan Palayam Valley, Thadagam Valley, Boluvampatti Valley and the Walayar Valley. The Nayakkan Palayam rises sharply from 460m to 1614m on the Nadukondanboli forming a tri junction point for the entire three valleys. 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 forest, in relation to terrain, altitude and rainfall. The present study was carried out in the villages located all along the foot hills of six forest ranges.



Map-1
 Study Area

Assessment of crop damage and mitigating measures: The Coimbatore district has many grama panchayaths in its limits. To study the human-elephant conflict issues, selected panchayaths which are located adjoining to the forest fringe areas were visited. Questionnaire method was followed to assess the crop damage by elephants and adopted mitigating measures. Elephant raided crop fields were visited in all villages and thereby information was gathered through "broad and open ended" questions giving the respondent an opportunity to express their views freely^{22,23}. The questionnaire survey was conducted over a period of six months from November 2008 to April 2009. Totally 438 persons were interviewed from the six forest ranges of the Coimbatore Forest Division. Information such as number of elephant visits and raids, economic loss caused by elephants, intensity of crop damages, preventive measures used to drive away the elephants were collected. These data were pooled together to quantify human-elephant conflict status.

Results and Discussion

Crop raiding attempts and success of elephants: This study was conducted in 438 crop fields belonged to 32 Grama Panchayaths, table 1. Among 32 panchayaths, highest number of crop fields were affected in Odanthurai (n=32) followed by Mathavarayapuram (n=25), Nanjundapuram and Veerapandi

(n=23 each). Conversely, the least was recorded in Madukarai panchayath (n=1).

Total frequency of elephant's attempt to raid the crop fields (n=438) were recorded as 2124. Of which crop raiding success was calculated as 59%. An average elephant's attempt for crop raiding calculated as 4.85/crop field. Among the panchayaths crop raiding attempts and success of raids were highest in Odanthurai panchayath. Out of 173 attempts, 102 were ended with successful raids of which family herds accounted for 71% and solitary males 29%. Lowest attempts were recorded in Madukarai as 5, of which successful raid was 60%. Among the ranges, PN Palayam attributed more number of grama panchayaths (n=10) and affected more number of crop fields (n=136) followed by Boluvampatti 9 grama panchayaths and 127 crop fields affected. In Sirumugai and Mettupalayam only two grama panchayaths each were prone for elephant depredation. Among the forest range, frequency of successful crop raid was high in P N Palayam (n=461) followed by Boluvampatti (n=336), Mettupalayam (n=154), Coimbatore (n=144) and Karamadai (n=93). Least frequency of successful raid was recorded in Sirumugai (n=65). Family herds were highly responsible for the crop damage (66 – 75 %) rather than solitary males (25 – 34 %) irrespective of crops and forest ranges, figure 1.

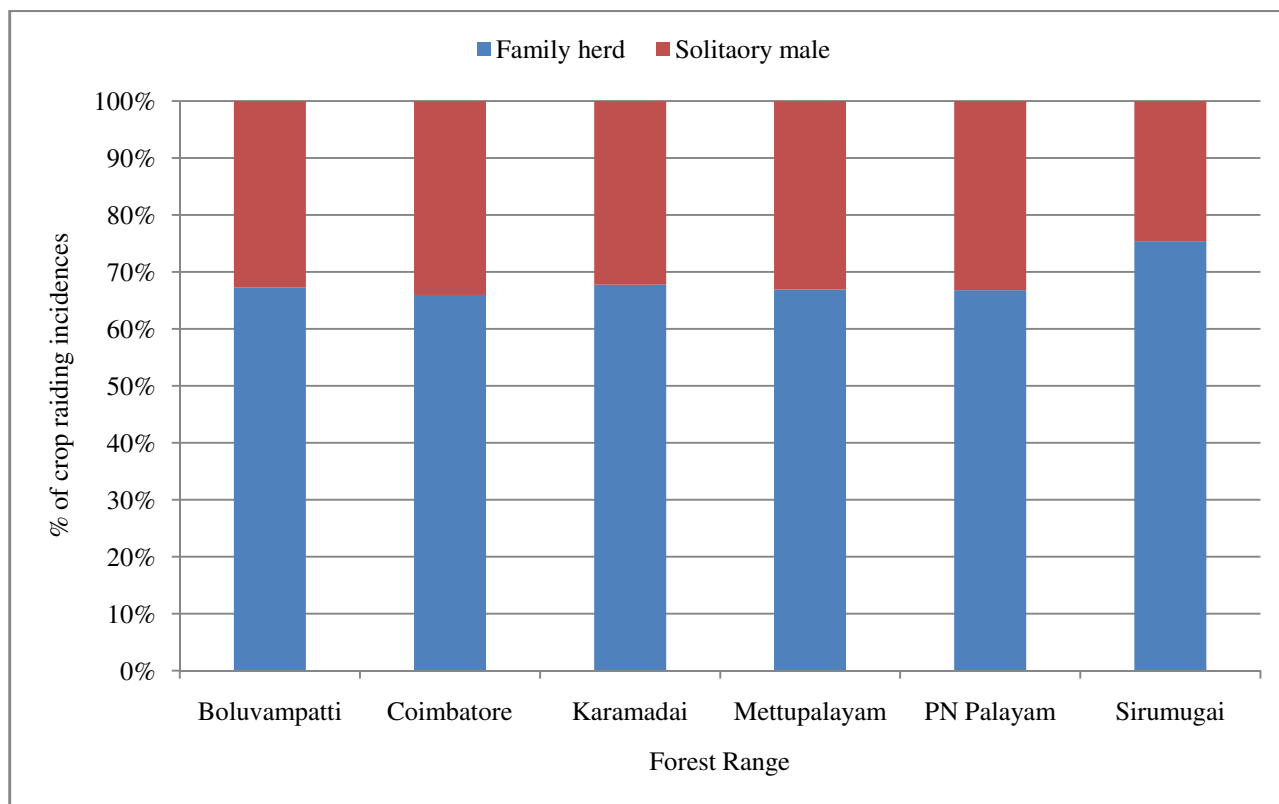


Figure-1
 Category of elephants responsible for crop damage

Table-1
Frequency of crop raids by elephants

S. No.	Range name	Panchayath name	Total No. of Attempts	Successful Raids	Category of elephants responsible for the successful crop raids	
					Family herd	Solitary male
1	Boluvampatti	Alandurai (n=22)	105	62 (59 %)	42 (68%)	20 (32%)
2	Boluvampatti	Devarayapuram (n=18)	91	32 (35 %)	21 (66%)	11 (34%)
3	Boluvampatti	Ikkarai boluvampatti (n=10)	66	47 (71 %)	32 (68%)	15 (32%)
4	Boluvampatti	Mathampatti (n=5)	47	18 (38 %)	13 (72%)	5 (28%)
5	Boluvampatti	Mathavarayapuram (n=25)	99	52 (53 %)	38 (73%)	14 (27%)
6	Boluvampatti	Narasipuram (n=8)	55	21 (38 %)	15 (71%)	6 (29%)
7	Boluvampatti	Boluvampatti (n=11)	50	30 (60 %)	18 (60%)	12 (40%)
8	Boluvampatti	Thenkarai (n=16)	76	43 (57 %)	27 (63%)	16 (37%)
9	Boluvampatti	Thondamuthur (n=12)	52	31 (60 %)	20 (65%)	11 (35%)
10	Coimbatore	Ettimadai (n=16)	60	32 (53 %)	21 (66%)	11 (34%)
11	Coimbatore	Kuniamuthur (n=4)	23	11 (48 %)	8 (73%)	3 (27%)
12	Coimbatore	Madukarai (n=1)	5	3 (60 %)	2 (67%)	1 (33%)
13	Coimbatore	Mavuthampatti (n=14)	99	67 (68 %)	43 (64%)	24 (36%)
14	Coimbatore	Perur chettipalayam (n=3)	18	9 (50 %)	6 (67%)	3 (33%)
15	Coimbatore	Theethipalayam (n=15)	48	22 (46 %)	15 (68%)	7 (32%)
16	Karamadai	Thekampatty (n=16)	36	23 (64 %)	17 (74%)	6 (26%)
17	Karamadai	Tholampalayam (n=17)	60	42 (70 %)	28 (67%)	14 (33%)
18	Karamadai	Velliyankadu (n=16)	56	28 (50 %)	18 (64%)	10 (36%)
19	Mettupalayam	Nellithurai (n=20)	83	52 (63 %)	31 (60%)	21 (40%)
20	Mettupalayam	Odanthurai (n=32)	173	102 (59 %)	72 (71%)	30 (29%)
21	PN Palayam	Belichi (n=13)	54	22 (41 %)	16 (73%)	6 (27%)
22	PN Palayam	Chinna Thadagam (n=11)	76	48 (63 %)	32 (67%)	16 (33%)
23	PN Palayam	Gudalur (n=14)	85	60 (71 %)	38 (63%)	22 (37%)
24	PN Palayam	Kurudanpalayam (n=3)	24	16 (67 %)	12 (75%)	4 (25%)
25	PN Palayam	Naickenpalayam (n=15)	78	42 (54 %)	28 (67%)	14 (33%)
26	PN Palayam	Nanjundapuram (n=23)	112	73 (65 %)	47 (64%)	26 (36%)
27	PN Palayam	Narasimmanaickenpalayam (n=10)	63	43 (68 %)	31 (72%)	12 (28%)
28	PN Palayam	Pannimadai (n=10)	56	45 (80 %)	33 (73%)	12 (27%)
29	PN Palayam	Somaiyampalayam (n=14)	58	28 (48 %)	17 (61%)	11 (39%)
30	PN Palayam	Veerapandi (n=23)	120	84 (70 %)	54 (64%)	30 (36%)
31	Sirumugai	Chickkarasanpalayam (n=9)	51	37 (73 %)	26 (70%)	11 (30%)
32	Sirumugai	Sirumugai (n=12)	45	28 (62 %)	23 (82%)	5 (18%)

Economic loss of crops: Crop diversity was recorded more in Boluvampatti (n=17) followed by PN Palayam (n=13), Coimbatore (n=12), Karamadai (n=8) and Mettupalayam (n=4), table 2. In Sirumugai, Banana (*Musa paradisica*) was the only crop cultivated and it accounted for 39.54 acres damage with an economic loss of 9885.00 US \$ per year. In Mettupalayam, Banana (*M. paradisica*) accounted for 32.51 acres damage with an economic loss of 8127.50 US \$ per year.

Among tree plantations, Areca nut (*Areca catechu*) (5826.10 US \$) and Coconut (*Cocos nucifera*) (3917.50 US \$) was most damaged. Teak (*Tectona grandis*) and Mango (*Magnifera indica*) was cultivated to a less extent and the damage was also less. Maximum number of areca nut trees (n=1720) was

damaged in Mettupalayam range, Boluvampatti (n=1238) followed next and Coimbatore had no such plantations. Whereas coconut (*C.nucifera*) trees were damaged high in Boluvampatti (1813) preceded by Mettupalayam (1481). Tree saplings of Eucalyptus and Teak was trampled rather than eaten and they were damaged only to a small extent.

Sorghum (*Sorghum vulgare*) was the most cultivated crop in PN Palayam range followed by Boluvampatti range and Coimbatore range. Incidentally PN Palayam range witnessed the highest successful raids, with 275 family herd raids and 151 solitary bull raids followed by Boluvampatti range with 259 family herd raids and 135 solitary bull raids.

As overall, 31 crop species were cultivated during the assessment period. Of which 24 species were damaged by elephants to varying extents. Overall crop damage by elephants in all forest ranges revealed that Banana (*M. paradisia*) (139.49 acres) was the most damaged crop followed by Sorghum (*S. vulgare*) (122.35 acres) and Sugarcane (*Saccaram officinarum*) (59.14 acres).

Among the cash crops, Banana (*M. paradisia*) and Sugarcane (*S. officinarum*) was the most preferred crops by elephants. The overall economic loss in a year was recorded high in Banana (*M. paradisia*) (34872.50 US \$) followed by Sugarcane (*S. officinarum*) (27598.67 US \$), Sorghum (*S. vulgare*) (8156.67 US \$), table 3. Among the 24 crop species, highest percentage

of economic loss recorded in Banana (*M. paradisia*) (39.13 %) followed by sugarcane (*S. officinarum*) (30.96%) and remaining crops were accounted only for below 10 %, figure 2. However, it can be noted that the economic value was dependent on the value of the crop rather than the extent of area cultivated. Samai (*Panicum miliare*), Grapes (*Vitis vinefer*), Cotton (*Gossypium sp.*), Mango (*M. indica*), Turmeric (*Curcuma longa*) were cultivated to a less degree and damaged to an extent of only one acre each due to crop raiding and trampling by elephants. Crops like Marigold (*Tagetus erecta*), Sappota (*Pouteria sapota*), Pearl millet (*Pennisetum glaucum*), Millet (*Panicum sp.*), Jatropha (*Jatropha curcas L.*), Brinjal (*Solanum melongea L.*) were not raided by elephant.

Table-2
Economic loss of crops by different category of elephants

Name of the Range	Name of the Crop	Scientific Name	Extent of Damage (acres)	Total Economic loss (US \$)	Category of elephants responsible for the loss (%)	
					Family herd	Solitary male
Boluvampatti	Areca nut	<i>Areca catechu</i>	1238 (trees)	2393.47	65.74	34.26
	Ash Gourd	<i>Benincasa hispida</i>	1	208.33		
	Banana	<i>Musa paradisia</i>	9.54	2385.00		
	Black gram	<i>Vigna mungo</i>	0.75	100.00		
	Coconut	<i>Cocus nucifera</i>	1813 (trees)	1510.83		
	Eucalyptus	<i>Eucalyptus sp</i>	0.25	16.67		
	Fodder grass	<i>Pennisetum purpureum</i>	0.04	0.67		
	Groundnut	<i>Arachis hypoea</i>	1	83.33		
	Lady's finger	<i>Anthyllis vulneraria</i>	1	116.67		
	Maize	<i>Zea mays</i>	30.5	5083.33		
	Paddy	<i>Oryza sativam</i>	12.25	3062.50		
	Pigeon Pea	<i>Cajanus cajan</i>	1.75	233.33		
	Samai	<i>Panicum miliare</i>	1	83.33		
	Sorghum	<i>Sorghum vulgare</i>	32.5	2166.67		
	Sugarcane	<i>Saccaram officinarum</i>	7.5	3500.00		
	Teak	<i>Tectona grandis</i>	50 (Saplings)	25.00		
Tomato	<i>Lycopersicon esculentum</i>	13.75	920.83			
Turmeric	<i>Curcuma longa</i>	1	41.67			
Coimbatore	Banana	<i>Musa paradisia</i>	1.24	310.00	65.97	34.03
	Black gram	<i>Vigna mungo</i>	2	266.67		
	Coconut	<i>Cocus nucifera</i>	10.21	638.33		
	Cotton	<i>Gossypium sp.</i>	1.5	87.50		
	Finger millet	<i>Eleusine coracana</i>	1	8.33		
	Grapes	<i>Vitis vinefer</i>	1	33.33		
	Groundnut	<i>Arachis hypoea</i>	8	83.33		
	Maize	<i>Zea mays</i>	1.5	250.00		
	Pigeon Pea	<i>Cajanus cajan</i>	2	266.67		
	Sorghum	<i>Sorghum vulgare</i>	24.5	1633.33		
	Sugarcane	<i>Saccaram officinarum</i>	0.5	233.33		
	Tomato	<i>Lycopersicon esculentum</i>	7.25	250.00		
Karamadai	Areca nut	<i>Areca catechu</i>	500 (trees)	96.67	67.74	32.26
	Banana	<i>Musa paradisia</i>	16.02	4005.00		

	Coconut	<i>cocus nucifera</i>	379 (trees)	315.83		
	Lab lab	<i>Lab lab purpureus</i>	2	100.00		
	Maize	<i>Zea mays</i>	1	166.67		
	Paddy	<i>Oryza sativam</i>	0.5	125.00		
	Sorghum	<i>Sorghum vulgare</i>	6	400.00		
	Sugarcane	<i>Saccaram officinarum</i>	14	6533.33		
Mettupalayam	Areca nut	<i>Areca catechu</i>	17205 (trees)	3326.30	66.88	33.12
	Banana	<i>Musa paradisia</i>	32.51	8127.50		
	Coconut	<i>Cocus nucifera</i>	1481 (trees)	1234.17		
	Sugarcane	<i>Saccaram officinarum</i>	1	466.67		
PN Palayam	Areca nut	<i>Areca catechu</i>	50 (trees)	9.67	64.55	35.45
	Ash Gourd	<i>Benincasa hispida</i>	1	208.33		
	Banana	<i>Musa paradisia</i>	40.64	10160.00		
	Black gram	<i>Vigna mungo</i>	2	266.67		
	Coconut	<i>Cocus nucifera</i>	263 (trees)	219.17		
	Grapes	<i>Vitis vinefer</i>	1	150.00		
	Lab lab	<i>Lab lab purpureus</i>	1	50.00		
	Maize	<i>Zea mays</i>	5.5	916.67		
	Mango	<i>Magnifera indica</i>	1	106.67		
	Sorghum	<i>Sorghum vulgare</i>	59.35	3956.67		
	Sugarcane	<i>Saccaram officinarum</i>	36.14	16865.33		
	Tapioca	<i>Berghia major</i>	1	133.33		
	Tomato	<i>Lycopersicon esculentum</i>	1.25	312.50		
Sirumugai	Banana	<i>Musa paradisia</i>	39.54	9885.00	75.38	24.62

Table-3
Overall economic loss of crops by elephants

S.No.	Name of the crop	Scientific name	Extent of damage (acres)	Total economic loss (US \$)
1	Areca nut	<i>Areca catechu</i>	18993 (trees)	5826.10
2	Ash Gourd	<i>Benincasa hispida</i>	1	208.33
3	Banana	<i>Musa paradisia</i>	139.49	34872.50
4	Black Gram	<i>Vigna mungo (L.) Hepper</i>	4.75	633.33
5	Coconut	<i>cocus nucifera</i>	4701 (trees)	3917.50
6	Cotton	<i>Gossypium sp.</i>	1.5	87.50
7	Eucalyptus	<i>Eucalyptus sp</i>	0.25	12.50
8	Finger Millet	<i>Eleusine coracana</i>	1	8.33
9	Fodder Grass	<i>Pennisetum purpureum</i>	0.04	0.67
10	Grapes	<i>Vitis vinefer</i>	1	150.00
11	Ground Nut	<i>Arachis hypoea</i>	9	750.00
12	Lablab	<i>Lab lab purpureus</i>	3	150.00
13	Lady's Finger	<i>Anthyllis vulneraria</i>	1	116.67
14	Maize	<i>Zea mays</i>	38.5	1083.33
15	Mango	<i>Mangifera indica</i>	1	106.67
16	Paddy	<i>Oryza sativam</i>	12.75	3187.50
17	Pigeon pea	<i>Cajanus cajan</i>	3.75	500.00
18	Samai	<i>Panicum miliare</i>	1	83.33
19	Sorghum	<i>Sorghum vulgare</i>	122.35	8156.67
20	Sugarcane	<i>Saccaram officinarum</i>	59.14	27598.67
21	Tapioca	<i>Berghia major</i>	1	133.33
22	Teak	<i>Tectona grandis</i>	50	20.83
23	Tomato	<i>Lycopersicon esculentum</i>	22.25	1483.33
24	Turmeric	<i>Curcuma longa</i>	1	41.67

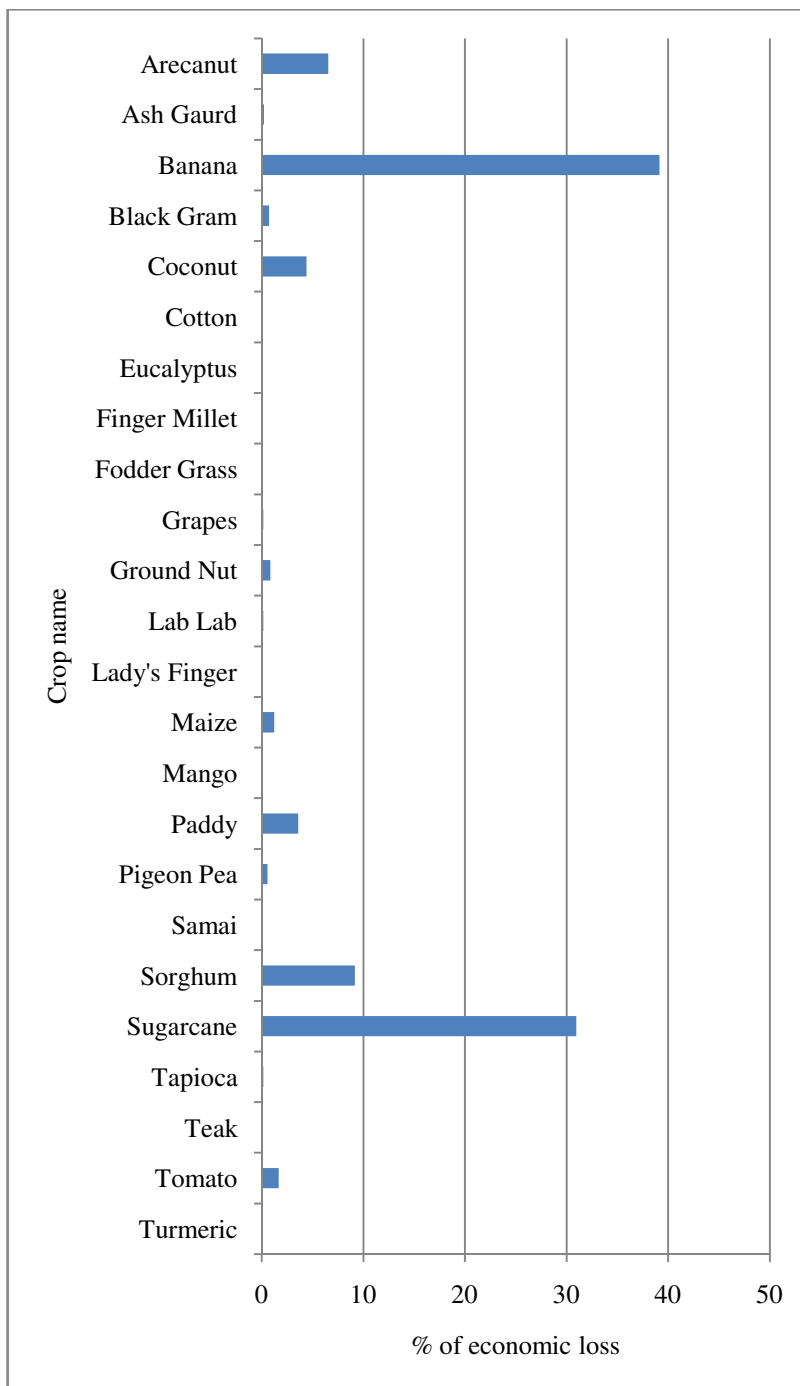


Figure-2
Percentage of crop economic loss caused by elephants

Effectiveness of mitigating measures: This study revealed that eight types of mitigating measures were used by villagers to prevent crop depredation by elephants. Totally 138 battery fences, 60 Solar fences, 23 fake electric fences, 9 barbed wire fences, 1 thatched fence and 1 elephant proof trench (EPT) were recorded during study period. Among the mitigating methods, traditional methods were highly adopted by villagers (46.2 %) followed by battery operated fence (31.6 %), figure 3. High

efficiency was noticed in EPT (100 %) towards preventing elephants into the crop fields followed by Forest department's battery operated fence (84 %), Battery operated fence (58.94 %), Barbed wire fence (54.55 %) and Solar power fence (50.89 %) and interestingly fake electric fence showed 50 % of effectiveness, table 4. However, other than EPT, all mitigating measures were unsuccessful irrespective of the crops.

Table-4
Effectiveness of mitigating measures towards crop raid by elephants

Type of mitigating measures	Crops cultivated	No. of crop fields	No. of attempts to crop raid	No. of successful raid	% of successful raid	% of efficiency to prevent elephants
Solar power fence	Areca nut, Banana, Coconut, Sorghum, Sugarcane, Maize, Lablab	60	112	55	49.11	50.89
Elephant Proof Trench (EPT)	Coconut	1	00	00	0.00	100
Battery operated fence	Banana, Coconut, Areca nut, Sugarcane, Sorghum, Maize, Paddy, Lablab, Mango Sapling, Brinjal, Cotton, Finger Millet, Black gram, Pigeon Pea, Groundnut, Lady's Finger, Tomato, Turmeric.	138	302	124	41.06	58.94
Fake electric fence*	Banana, Coconut, Areca nut, Sugarcane, Sorghum, Maize, Paddy, Turmeric, Lablab, Tomato, Groundnut	23	46	23	50.00	50
Thatched fence	Banana	1	4	3	75.00	25
Barbed wire fence	Banana, Coconut, Teak, Tomato, Sappota	9	11	5	45.45	54.55
Traditional methods	Banana, Coconut, Areca nut, Sugarcane, Sorghum, Maize, Paddy, Arasani, Lablab, Eucalyptus, Fodder Grass, Grapes, Groundnut, Jatropa, Tapioca, Samai, Teak, Millet, Pearl Millet, Mango sapling, Black gram, Pigeon pea	202	494	231	46.76	53.24
Forest Department's battery operated fence	Banana, Coconut, Maize, Pigeon pea	3	25	4	16.00	84

*Fake electric fence: A wire fence without current similar to battery fence, used to deceive the elephants, which thinks it as an electric fence.

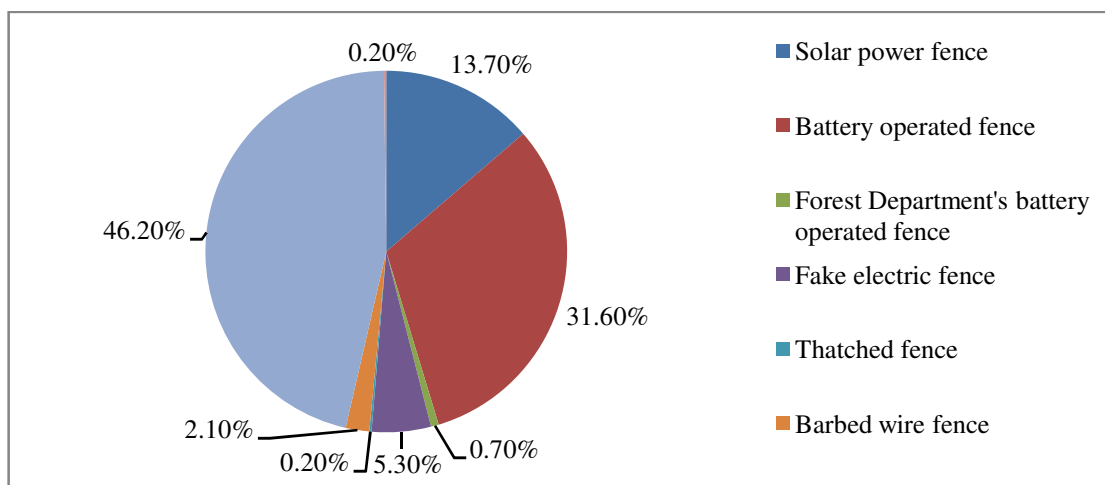


Figure-3
Percentage of mitigating measures adopted by villagers

Discussion: Crop raiding by elephants has been reported from almost all elephant ranges in Asia as well as Africa, where elephants survive in fragmented and disturbed habitats. India has a long history of human-elephant conflict. Competition over space and resources by ever growing human population has made the problem severe. In many places, exploitation of forest resources beyond its safe use capacity has led to habitat degradation and altered the habitat quality drastically. Depleted resources across its home range have forced elephants to forage outside the protected areas thus finding themselves in human dominated landscapes.

Crop depredation by elephants is a critical problem among the human-elephant conflict issues in India. During the study 32 grama panchayaths were visited, of which Odanthurai experienced high crop damage incidences (32 crop fields). This could be attributed due to constructional developments such as Sachidananda Jothi Nikethan International School, Black thunder theme park and others considerably reducing the width of the corridor coupled with two linear developments such as road and railway track passing through the Kallar corridor which located in the Odanthurai causing serious impediment to elephant movement. Incidentally Sachithanandha and Black thunder recorded the second highest (61) crop damage incidences around them. Joel²⁴ pointed out crop damage also occurs when elephants move from one area to another in search of water or wild food²⁴.

Least crop damage was recorded in the Madukarai Grama panchayath due to the extent of area under cultivation is very less and also more lands were fallow due to lack of interest in farming caused by more profitable opportunities in the nearby mining industry. A herd of elephants frequently cause havoc in Madukarai by venturing far in to human settlements. Eventually the problem ended on 4th February, 2008 when a tragic train collision caused the death of three elephants of that herd. The reason for such long distance wandering also could be ascribed to the non availability of foraging opportunities, even in the crop fields.

In Sirumugai and Mettupalayam only two grama panchayaths were often prone to elephant raids due to the location lies in the increased proximity to the narrow Kallar corridor. Highest crop raiding incidences were recorded in the PN Palayam range with 136 affected crop fields spread along the 10 grama panchayaths. This can be attributed to i. The presence of six constructional development activities. ii. Topography of the forest area is hilly and suitable elephant habitat only exists along the foot hills. iii. Family herds with calf usually prefers to use the less gradient foot hills in which the developments causes a hindrance and sometimes leads them in to crop fields. iv. Sorghum is cultivated in more area, which is an elephant attracting crop. The third argument is supported by the fact that, large number of successful family herd raids (n=308) than solitary males (n=153) in the total successful raids (461).

Even though the crop raiding successes is more (n=231), Still most farmlands (n=209) were using traditional mitigating measures. As modern mitigating measures requires a high initial implementation cost, affordability of economically backward farmers is very less.

Twenty four species of crops were prone to elephant damage. According to Sukumar¹⁵ Balasubramanian⁵ and Rameshkumar²¹ raggi and paddy were major crop items raided by elephants in the forests of Karnataka and Nilgiris. Jayson²⁵ pointed out that coconut palm, sugar cane, cocoa, areca nut and paddy were the main crops raided by elephants in Kerala. But our present study found that areca nut, coconut, banana, sorghum and sugarcane were the major crops raided by elephants in Coimbatore Forest Division.

The elephant preferable crops were cultivated in large extent, along all the forest ranges which inevitably attracts more conflicts. Banana (139.49 acres), was the widely cultivated crop across all ranges, it accounted for more economic loss. The presence of large rain fed areas resulted in wider cultivation of sorghum. Even though the cultivated area of sugarcane (59.14 acres) is comparatively less than sorghum (122.35), due to high market value, it accounted for more economic loss. Crops like marigold, sappota, jatropa etc. was found to be avoided by elephants.

Joel²⁴ pointed out that more or less all elephants indulge on crop raiding whenever they get an opportunity. It is not entirely understood why wild animals raid crops but it is believed they prefer the taste of cultivated plants to that of wild plants. Crops are higher in sugars and lower in fibre and secondary defense chemicals than their wild counter parts²⁴.

This study revealed that 59% of the attempts were ended as successful raids irrespective of the age and sex of the elephants in all panchayath. Family herds were frequently attacked the crop fields rather than solitary males (tusker and makhna) irrespective of ranges. The availability of perennial crops, water in the adjoining areas throughout the year as well as the blockage of elephant paths due to construction reasoned for the unusual crop raiding strategy in (age and sex) the elephants.

In Coimbatore Forest division, both traditional and modern methods are employed as the mitigating measures against the crop raiding animals. Solar and battery fences as well as traditional mitigating measures were frequently breached in a high proportion by elephants (family herds as well as solitary males). The crop raiding success rate was fairly similar in these three most used mitigating measure indicating a high degree of perseverance to raid crops, which might invariably arises out necessity and completion caused due to various factors including confinement of elephant with in a small area for longer time. All preventive methods can be considered as only short term, which may provide some immediate relief. As long term measure, intensive management of elephant migratory

routes will be needed. A recent review on Human Wildlife Conflict (HWC) in West Bengal suggested that an integrated approach comprising both short term preventive measures and long term mitigating measures is crucial to address HWC problems also innovative mechanisms such as livestock and crop insurance; settlement of rights and incentive programmes have proved successful in managing HWC scenarios including changing perceptions about wildlife conservation²⁶.

Conclusion

Blockage of elephant migratory routes due to constructions coupled with cultivation of elephant highly preferred crops such as areca nut, coconut, banana, sorghum and sugarcane in large extent along the all forest ranges and availability of water in the villages throughout the year inevitably attracts more human-elephant conflicts in the Coimbatore Forest Division. All preventive methods used by villagers and forest department provided only short term relief. As long term measure, intensive management of elephant migratory routes will be needed. Also management strategies in this division should be aimed at regulating land use changes at least 2 km from forest boundary and exhaustive research on resolving human – elephant conflict. Crop insurance schemes also should be practiced extensively.

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