HUMAN-ELEPHANT CONFLICTS IN CHANGED LANDSCAPES OF SOUTH WEST BENGAL, INDIA

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Introduction

In recent years, increasing human-elephant conflict has been a major issue for managing wild elephant populations in India (Sukumar, 1990; Dey, 1991; Johnsingh and Panwar, 1992;Daniel *et al.*, 1995; Nath and Sukumar, 1998). In South West Bengal (South W.B.) elephants were abundant in dense *Shorea robusta* (Sal) forests of Midnapore District (West Bengal) and its adjoining areas in early 1900s (O'Malley, 1911). However, they became rare until 1980s due to forest losses and poor cover quality of coppice Sal forests (Palit, 1991; Malhotra, 1995; Panda, 1996). In the corresponding period prevailing interaction between elephants and human was only known from Patamda and West Midnapore (Shahi, 1980), West of the Kangsabati river bordering Bihar and West Bengal.

The reappearance of elephant in South W.B. started beyond mid-1980s probably coinciding with revival of forest cover as a result of the decade old participatory forest protection initiatives (Palit, 1991; Malhotra, 1995) with local communities. A change detection study based on 1988 to 1991 satellite data for Midnapore, Bankura and Purulia districts of South W.B. confirmed positive increase (315 km^2) in forest cover (Sudhakar and Raha, 1994).

Conflict between man and elephants began since 1987 with successive yearly intrusion of elephants from Dalma Wildlife Sanctuary (DWLS), Bihar, crossing further eastward beyond the river Kangsabati (Datye and Bhagwat, 1995). In later years the progressions deepened in the eastern part of the Midnapore and adjoining Bankura and Purulia districts (Chowdhury *et al.*, 1985; Datye and Bhagwat, 1995). The gradual prolonging of the stay of elephants ever since has remained a source of concern for the local residents because of loss of human life and property. Similar concerns also affected sustained elephant conservation by the Forest Department on account of heavy drain on the State exchequer to pay compensations for crop/property damage, loss of human life and anti-depredation measures.

The present study was conducted to know the movement and ranging patterns of resident and migratory elephants in South W.B. for various conflicts and habitat utilization. The attributes of landscapes were correlated with crop depredation intensity to understand influence of land mosaics. Crop availability and depredation frequencies were analyzed to understand seasonal conflict pattern for loss of crops, property and human life. All this information was important and fundamental to managing elephants and

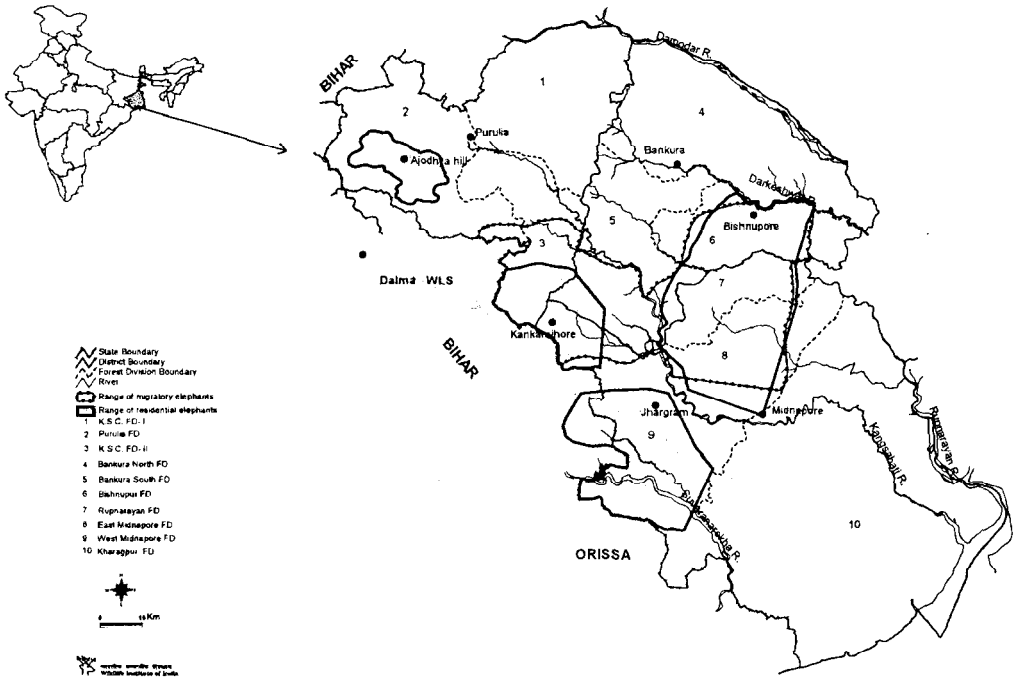
suggesting possible solution to minimize *human-elephant conflicts.*

Study Area

The study area is located between 21° 30' N to 23° 42' N and 85° 49' E to 88° 15' E and is spread over three administrative districts – Midnapore, Bankura and Purulia of South W.B. (Fig. 1). The hilly undulating western part of the study area is an extension of Chotanagpur Plateau of Deccan peninsula while the eastern part consists of flat Gangetic plains (Rodgers and Panwar, 1988). The general topography varies from 200 m to 670 m. The soil is mainly red sandy, lateritic and alluvial type with red and black soils in a few pockets (Ghosh, 1992). There are four major river catchments: Subernrekha, *Kangasabati, Silabati and Darkeshware.* The area has innumerable man-made waterbodies and ponds in the villages created for the purpose of soil-moisture conservation. Kangasabati dam with its canal network is a major source of irrigation in the region.

The maximum temperature fluctuates between 42° C and 46° C during summer, while minimum varies between 8° C - 13° C during winter. The monsoon period is from mid-June to end of September. The average annual rainfall in the study area varies from 1,180 to 1,428 mm. The rainfall from June through September constitutes 75% of the total annual precipitation. Winter is less severe with occasional frost.

Fig. 1



Study area showing ranges of migratory and residential elephants in South West Bengal

The overall vegetation type is Tropical Dry deciduous dominated by Sal (Champion and Seth, 1968). Forests are divided into four broad categories : Sal coppice, open scrub, open scrub with sporadic sal, and plantations. The composition of sal in coppice forest varies from 82% in western hilly tract to 95% in the eastern undulating plains (Anon., 1985).

The human population in three districts of South W.B. was reported to be 12.33 million with varying density of 355-591 persons/km^2. Arable land marginalization is a major constraint for the local communities for their dependency on forest resources (Anon., 1985). The district agriculture data 1996 showed marginal farmers cultivating on an average 0.2 - 1 ha; constituting 87.86, 75.88, 62.30 and 62.29% in Midnapore (East), Midnapore (West), Bankura and Purulia respectively.

Methods

The study was conducted from September 1995 to August 1997. Elephant locations were obtained from radio-collared male, other sighted and confirmed locations through fresh footprints or feeding signs. Locations were marked on topographic maps (1:50,000 scale) or Global Positioning System (GPS) for inputting in GIS domain.

Digital data of IRS-IC, LISS-III was used for creating the spatial database. Image classification for land-use and land-cover was done through Maximum Likelihood Classification (MLC). Major land-use and land-cover categories were identified from the multispectral classification. Input layers for analysis in GIS/ARC INFO domain were generated from the topographic maps (1:50,000 scale) on various themes i.e., contour, drainage, human habitations, forest boundaries and elephant locations, etc. A 500-m point buffer was generated on 421 elephant locations to extract habitat utilization by overlying it on classified map. The utilized range of the elephant was quantified from the plotted locations.

The damage to paddy was assessed in the field at six different sites by taking 23 randomly selected plots constituting a total area of 2.99 ha. Measurements of damaged area within the sampled plots were recorded to obtain mean percentage damage in the sampled area. Information on climatic data, agricultural land-use, demography and economic profile of local residents, human deaths and property loss were collected from the records of various concerned agencies.

Chi-square test was performed to analyze significant utilization of various habitats by elephants and finding significant frequency of crop depredations. Regression analysis for best-fit model in SPSS (Anon., 1998) was generated for finding relationship between landscape features and crop depredation by elephants.

Results

Present Elephant Status, Movements and Habitat Utilization : Table 1 presents composition of elephant population in South W.B. There were 36 migratory and 26 residential (in 4 sub-groups) elephants. The entire population is represented through 22 adult males, 19 adult females, 6+2 [a] sub-adult males and 5 sub-adult females, 6 juveniles and 2 calves (Table 1).

Table 1

Composition of migratory and residential elephants in South West Bengal.

	Groups	FU/MG	Adult		Sub-adult		Juvenile	Calf	Total
			M	F	M	F			
Migratory : Seasonally from DWLS	1	FU	6[t]	14	4[t]	5	5	2	36
Residential :									
Ajodhya hill subgroup	2	FU	2[t]	3	1[a]		1		7
		MG	2[t]						2
Jhargram subgroup	2	FU	3[t]	2	1[a]				6
		MG	2[t]						2
Banspahari-Belpahari subgroup	1	MG	2[t]+1[m]						3
East of Kangasabati subgroup	1	MG	4[t]		2[t]				6
Total	7		22	19	6+2[a]	5	6	2	62

M : Male; F : Female; FU : family unit ; MG : Male Group; [t] tusker ; [m] tuskless male; [a] either tuskless male or female; DWLS - Dalma Wildlife Sanctuary.

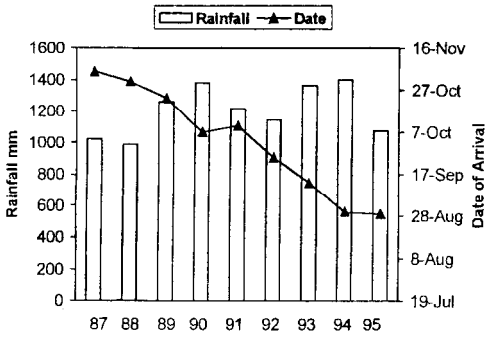
Residential elephants mostly constitute the adult male (tusker or tuskless) or a group of males except Jhargram and Ajodhya hill sub-groups (Table 1). The exact date of entry of migratory elephants East of the river Kangasabati in South W.B. was on 29th and 21st August in 1995 and 1996 respectively through Kankrajhore corridor of West Midnapore Forest Division (Fig. 1). This journey of 70 km is covered overnight to reach East Midnapore Forest Division mostly through the croplands. The migratory elephants are usually forced to leave South W.B. in an organized drive after paddy harvest season between January to March, when it is easy to do so.

Annual arrival dates of migratory elephants and occurrence of cumulative rainfall in four months (June to September) from 1987 to 1995 was plotted in Fig. 2. This shows a gradual progression in dates of arrival of elephants without any significant correlation with rainfall.

The locations of migratory and residential elephants in various districts and forests divisions based on 279 randomly sighted records are presented in Table 2. The fidelity of migratory elephants were higher in Midnapore (86.45%) followed by Bankura (12.26%) and Purulia (1.29%) districts. However, the fidelity of residential elephants was nearly equal in Midnapore (50.81%) and Bankura (49.20%) districts.

Table 3 presents the data on elephant habitat availability and utilization extracted from GIS analysis. Elephants occupied an overall area of 3368 km^2 but intensive range utilization was restricted

Fig. 2



Rainfall (mm) between June to September and elephant arrival in South West Bengal from 1987 to 1995

to 243 km^2. The habitat utilization pattern showed selective usage (χ^2 =29.00; df= 10; p <0.005) of different forest and non-forest habitats. However, habitat utilization of cropland was significantly less ($p< 0.01$) in proportion to its availability. The overall utilization pattern was 41.86 % for cropland, 37.34% for forests.

Landscape Attributes and Crop Depredation : Seven elephant depredation zones (Z_1 to Z_7) were delineated in GIS on the clustering pattern of 273 locations of elephant out of total 421. Balance 148 elephant locations (35%) were scattered. Table 4 presents the analysis of land composition ratio of forest and crop queried through GIS and depredation rate/km^2 in each zone. The ratios of forest and cropland were plotted against the depredation / unit area to develop a quadratic term of regression through best-fit model { $y = 0.077 + (0.32 * x) + (-0.15* x^2)$; $r^2 = 0.327$; df = 4; p =0.453 }. This showed a decreasing trend of crop depredations with the response of increasing crop field or forest cover above 1 : 1 ratios (Fig. 3). However, this regression is limited through the statistical values for r^2 and p, which need further revalidation of this model with large sample size of forest and cropland matrices.

High crop depredation above the rate

Table 2

Elephant fidelity in various Forests Divisions of three districts in South West Bengal : K.S.C.D - II, Kangasabati Soil Conservation Division II.

District	Forest Division	Herd		Localized group	
		Location	%	Location	%
Midnapore	West Midnapore	29	18.71	*	*
	East Midnapore	48	30.97	6	4.84
	Rupnarayan	57	36.77	57	45.97
Bankura	Bishnupure	12	7.74	50	40.32
	Bankura (S)	7	4.52	8	6.45
	Bankura (N)	-	-	3	2.42
Purulia	K.S.C.D.- II	2	1.29	*	*
Total		155		124	

* locations incomplete; - denotes absent

Table 3

Land categories and their utilization by elephants in South West Bengal.

Land categories	Area available (km^2)	Area utilized (km^2)	Proportional usage		
			Expected	Observed minimum	Observed maximum
Landcover :					
Dense sal	122.66	15.49	*0.036*	*0.019*	*0.108*
Dense mixed	62.77	4.45	0.019	0.000	0.043
Open sal	217.18	25.67	0.064	0.050	0.161
Open mixed	12.93	1.17	0.004	0.000	0.017
Open mixed (Sal dominated)	359.22	39.85	0.107	0.097	0.231
Plantation	51.34	4.13	0.015	0.000	0.040
Landuse :					
Degraded Area	330.04	23.11	0.098	0.042	0.148
Wastelands	231.35	21.10	0.069	0.036	0.138
Croplands	1840.36	101.73	0.546	0.329	0.508*
Sandy area	16.39	0.33	0.005	0.000	0.008
Water bodies	123.80	5.98	0.037	0.000	0.053
Total	3368.04	243.01			

* Denotes significat use

Table 4

Land-cover and land-use composition ratios and rate of crop depredation

Depredation Zones	Land composition in the zones				Elephant locations (n)	Depredation rate/km^2
	Total area (km^2)	Forest area (km^2)	Crop area (km^2)	Forest to Cropland ratio		
Z_1	304.59	110.66	133.60	1 : 1.2	96	0.31
Z_2	391.12	113.35	195.58	1 : 1.7	69	0.18
Z_3	117.22	21.90	65.83	1 : 3.0	23	0.20
Z_4	118.31	21.22	74.15	1 : 3.5	19	0.16
Z_5	107.18	52.17	34.05	1 : 0.6	18	0.17
Z_6	149.86	11.67	114.98	1 : 9.9	20	0.13
Z_7	325.84	73.61	154.10	1 : 2.1	28	0.09
Total	1514.12				273	

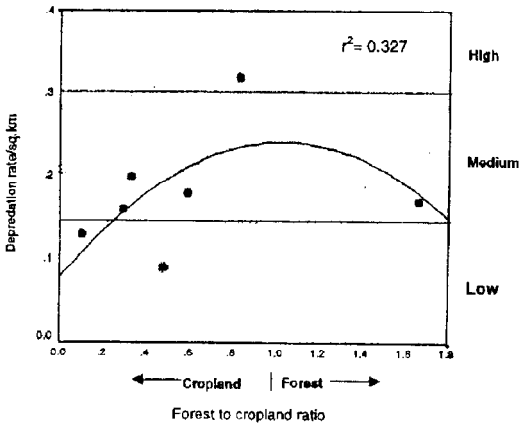
of 0.3/km^2 took place when forest to cropland ratio was 1 : 1.2 respectively. Moderate depredation to a rate of 0.15 - 0.03 /km^2 took place when forest and cropland ratios fluctuated between 1 : 3.5 to 1 : 0.6 respectively (Fig. 3). Low depredation at a rate of 0.13 - 0.09 /km^2 occurred when forest and cropland ratios move further on either side through increased forest or cropland.

Cropping Pattern and Regimes of Crop Depredation : South W.B. has three distinct cropping seasons – June/July to October/November - Kharif; November/ December to February/March - Rabi, and January / February to May/June - summer crops. Three varieties of Paddy *Oryza sativa* (Aus, Aman and Boro) are cultivated year round in different seasons. Aman constitutes the major paddy in terms of extent and production during the monsoon season. The combination of crops grown in different seasons are : Aus, Aman and vegetables in Kharif, Wheat *Triticum aestivum*, Potato *Solanum tuberosum*, vegetables and Boro paddy in Rabi; and Boro paddy (in low lands) and vegetables in Summer.

The agriculture pattern in South W.B. has undergone changes from rain dependent to irrigated cropping for cash crops. Data collected on crop pattern, extent and its changes between 1987-88 and 1995-96 of Midnapore and Bankura are presented in Table 5. The Aman (Monsoon) paddy has not much increased in its extent whereas other two Aus and Boro have shown substantial growth with increase in irrigation facilities. Cash crops such as oilseeds, potato and vegetables also increased substantially over the years (Table 5). The transformation of traditional cultivation pattern to cash oriented cropping was found to be related to net profit through the input and output cost as has been presented in the Fig 4. Though input cost of the cash crops is higher than the traditional crops, the output determines their selection by the majority of the marginal farmers.

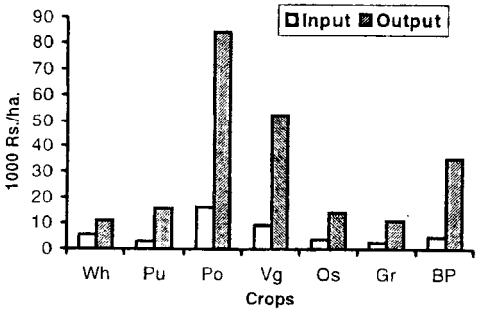
The frequencies of crop damage by elephants during the three cropping

Fig. 3



Landscape attributes (forest to cropland ratio) and crop depredation relationship

Fig. 4



Input-output costs of various crops in South W.B.

Wh - Wheat; Pu - Pulses; Po - Potato; Vg - Vegetables; Os - Oil seeds; Gr - Gram; Bp - Boro paddy.

Table 5

Changes in the crop pattern in two districts of South W.B. between 1987/88 to 1995/96.

Crop	Midnapore (W)			Bankura		
	Cultivated area*		%	Cultivated area*		%
	1987/88	1995/96	Change	1987/88	1995/96	Change
Aus Paddy	34.4	69.2	+101.2	29.8	38.8	+30.2
Aman Paddy	429.1	442.4	+3.0	312.8	338.1	+8.0
Boro Paddy	52.8	96.0	+81.8	18.3	61.2	+234.4
Wheat	7.3	16.8	+130.1	13.8	15.8	+14.5
Maize	1.5	2.4	+60	2.6	2.1	-19.2
Pulses	14.0	16.4	+17.1	12.7	7.0	-44.9
Oilseeds	21.2	43.4	+104.7	35.1	54.1	+54.1
Fibre	3.0	3.0	0	1.9	1.9	0
Potato	16.3	44.9	+175.4	12.4	31.6	+154.8
Vegetables	31.1	41.4	+33.1	26.3	36.1	+37.2

* in '000 ha
Source : District Agriculture Offices of Midnapore (W) and Bankura

seasons are presented by taking 378 incidences for such cases in Table 6. The paddy is frequently damaged (68%) followed by potato (16%), vegetables (10%), Wheat (5%) and Maize (1%). Crop depredation showed selective usage ($\chi^2 = 88.45$; df = 4; $p < 0.001$) on an annual basis. However, arable land extent of paddy crop is significantly less utilized ($p < 0.001$) in proportion to its availability (Table 6). A reverse trend was seen in case of potato cultivated area, which was significantly more utilized ($p<0.001$) to its availability. The seasonal crop damage pattern was greater in September to December (51.8%) followed by January to April (33.6%) and May to August (14.5%). The damage to orchard and granary occurred more in both the seasons except for September to December (Table 6).

Seasonal Conflict Patterns : Data collected from the records of the Forest Department indicates that between 1976 to 1986, 13 people were killed by elephants, all from the bordering areas of South West Bengal with Bihar. Since 1987-97, 126 people were killed in the deeper areas of South West Bengal showing an upward trend of man-elephant conflicts. Data for human kill and injuries during different crop periods are presented in Table 7. The human kills between January to April were high both during the study period (1995-96) and 1988-94, 48% and 52% respectively. The human killing between Sept - Dec. was low when extensive crops were available. The patterns of human kill in respective months of different years between 1987 and 1997 are shown in Fig. 5. Information on 36 cases out of 123 for the period 1987 to 1996 are known explicitly about the sex of elephants involved in human killing. This showed 33 (91.6%) human kills were by male elephants and remaining by females in the herd. Seasonal analysis

Table 6

Crop depredation frequencies no of elephants in 3 cropping seasons in South West Bengal.

Crops	Depredation frequency				Cultivated area ('000 ha)	Proportional depredation		
	Jan.-Apr.	May.-Aug.	Sep.-Dec.	Total		Expected	Observed minimum	Observed maximum
Paddy	57	24	177	258	1045.6	0.846	0.621	0.744*
Wheat	20	-	-	20	32.6	0.026	0.023	0.083
Maize	-	2	-	2	4.5	0.004	0.000	0.015
Potato	47	-	13	60	76.4	0.062	0.110	0.207*
Vegetable	3	29	6	38	77.4	0.063	0.061	0.140
Total	127	55	196	378	1236.5			
(%)	33.6	14.5	51.8					
Others :								
Jack fruit	2	18	-	20	-	-	-	-
Granary	10	20	2	32	-	-	-	-

* Denotes significant depredations

Table 7

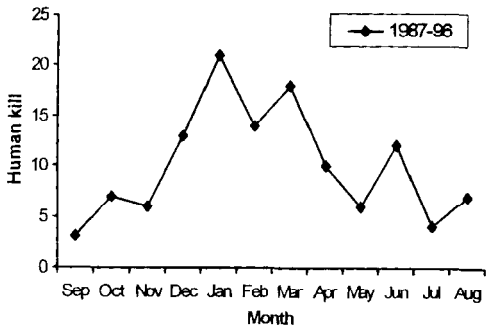
Seasonal pattern of human kill and injuries by elephants in South West Bengal between 1988-1996.

Conflict/year	Period						Total
	Sep.-Dec.		Jan.-Apr.		May.-Aug.		
	No.	%	No.	%	No.	%	
Human kills :							
1988-94	26	25.7	53	52.4	22	21.7	101
1995-96	3	14.2	10	47.6	8	38.0	21
Human injuries :							
1995-96	10	43.4	8	34.7	5	21.7	23

further reveals that 26 (72.2%) human kills occurred by residential males, 7 (19.4%) through males either from migratory herd or residential elephants.

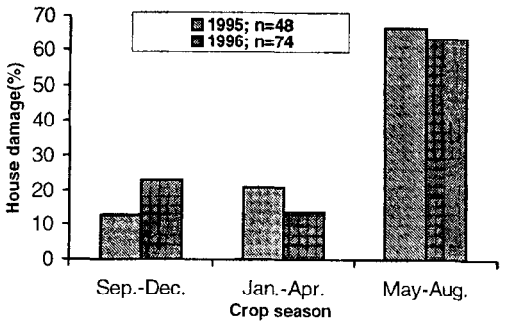
During the study period in 1995 and 1996, 110 and 133 houses were damaged in 48 and 74 incidences respectively. The incidences of house damage in three seasons are depicted in Fig. 6. Maximum house damage (60%) took place between May to August through residential elephants during availability of fewer crops in the field.

Fig. 5



Human kills by elphants during various months in South West Bengal

Fig. 6



House damage incidences in three seasons in South West Bengal

The elephant deaths in South W.B. during the study period (1995 and 1996) were combined with the previous available official records (1987 to 1994) and are presented in the Table 8. There were total 24 elephant deaths in different size classes and the reasons ascertained were 3 due to pesticide poisoning, 6 due to varied reasons, 8 due to natural death, 4 due to rogue elimination and 3 due to capturing.

Discussion

It is seemingly evident that the displacement of elephants from South W.B. has been related to the diminished land-cover in past. Recovery in land-cover and subsequent land-use changes in the recent years have created a habitat less-than-favourable to elephants for recolonization. The elephant's sensitivity to this kind of habitat for crop depredation on broad spatial scale was mainly related to the arrangements of the landscape through forest and agriculture matrices. This variable alone explained 33 % ($r^2 = 0.327$) influence on crop depredation (Fig. 3). The remaining unexplained factors on small spatial scale might have been through landscape built related to patch sizes, edge density, contagion and proximity indices (Wallin *et al.*, 1994; McGarigal and Mark, 1995; Gustafson and Parker, 1992; Hargis *et al.*, 1998). These, however, were beyond the scope of the present study.

High depredation resulted in the areas where forest and cropland ratio matrices were near equal or in favour of increased cropland (1:1.2). Availability of moderate to high forest cover in such fragmented situation is a strategic requirement for elephants to avoid human induced interference. Crop depredation in low intensities resulted when forest and cropland ratios were inadequately represented either through their increase with vast crop areas or enlarged forest cover (Fig. 3). While the former is a desired farming scenario without elephants, the latter is essential to conserve them in an intact or less fragmented habitat.

The long-distance movements of elephants are so as to be energy efficient in keeping with their large body need (Eisenberg, 1981). Therefore, elephant incursions of this kind are only possible with the onset of monsoon and availability of crops. Occurrence of increased rainfall

Table 8

Elephant deaths due to various reasons in South West Bengal from 1987 to 1996.

Elephant deaths	Death due to conflicts					Natural death	Total
	Rogue killing	Pesticide poisoning	Capturing	Other	Total		
Adult male	4	1	1	1	7	3	10
Adult female	-	1	1	-	2	3	5
Sub-adult	-	-	1	1	2	1	3
Juvenile	-	1	-	-	1	-	1
Calf	-	-	-	4	4	1	5
Total	4	3	3	6	16	8	24
%					66.67	33.33	100

may initiate early incursion. The forest divisions of Midnapore district were more prone to crop depredation and conflicts by migratory herd movements compared to the other two districts. This was primarily because of the better juxtaposition of the large forest patches with crop fields. Small range requirements of males (Chowdhury *et al.*, 1997) enable them to remain localized even on marginal forest habitat to do crop raiding. Both the districts of Midnapore and Bankura were equally affected through the movements of residential males for high man-elephant conflicts even after retrieval of migratory herds to DWLS, Bihar.

Conflict between elephants and human is a key issue in South W.B. in terms of recurring economic losses of crop and property and killings of human beings. For the conservation agency, it is an annual drain on the State exchequer to provide anti-depredation measures for gaining local community support, crop compensation and compensation to the loss of human life. The estimation through GIS analysis indicated that only 5.5% of total cultivated area (1840 km^2) within the elephant range is currently affected through elephant depredation. An evaluation of 23 sampled plots (2.99 ha) at six different sites revealed occurrence of average 40% crop loss within it. The projection of this damage to the total affected area with current cost of paddy per unit area estimated a total economical loss of Rs. 3.2 crores. Though this economic loss is not a very severe concern in the provincial and national perspectives but it matters at local level to the majority of the farmers (<60-88%) tilling small land holdings. However, despite this hardship, the majority of the local people still maintain high regards for elephant conservation except for a few cases of elephant mortality due to poisoning.

Local strategies for keeping the elephants out of the crop areas are mostly tactical. The most common among them are beating drums, scaring them with fire

crackers, chase them away through lit torches and often by domestic elephants. All these have only limited affect since the elephants soon get habituated to this. Uses of effective barriers have also their limitations due to excessive interspersion of crop field and forests in core areas of depredation. However, a good possible solution could be developing electric fences through reinforced trenches in border areas with Bihar, thereby denying the accesses of migratory elephants into West Bengal. Although the option of power fencing was tried but it has been a failure due to lack of proper maintenance and social problems associated with stealing of fence materials. Local level cooperation and participation for such an activity through regular monitoring of fence line and its maintenance is extremely essential. The present expenditure on deterring elephants from crop depredation which is to the tune of Rs. 40 lakhs annually is high and unsustainable in terms of available budgetary provisions.

Recorded human kills by elephants (on an average 13 persons/year) are high in comparison to the present size of elephant population. In majority of the cases (72%) the males of the localized sub-groups were involved. Selective removal of males from the localized sub-groups seems to be the only alternative for reducing the current human casualties. However, other options for controlling populations through contraception has its limited scopes with current available knowledge (Whyte *et al.*, 1997).

Management Implications

Understanding arrangements of spatial elements in a landscape sensitive to the elephants for conflicts is important for planners, designers and land managers. Our study has clearly shown that the interspersion ratio of forests and croplands is a major factor for increased depredation to take place on a landscape. Land-use planning with proper coordination by involving local farmers and the Agriculture Department will be essential in selecting the crops, which are not vulnerable to elephant depredation (e.g., several kinds of lentils and Jute, *Corchorus capularis*). Cultivation of such non-vulnerable crops in very interspersed areas can reduce elephant fidelity and thus the depredation. This is not an easy option and will largely depend on the acceptance of the farmers and their economic return. It is worth exploring such options through adequate economic support for the losses. Curbing the over-riding market forces in land-use decision need to be handled carefully.

The finding of the study also indicate reduction of adult males from the localized sub-groups to reduce manslaughter. The present provisions under the Wildlife (Protection) Act, 1972 provide capture options for managing such ecological dislocates. However, suitable strategies need to be firmed up to utilize such captured resources through proper training of elephants and integrate these to the overall national planning.

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SUMMARY

The human-elephant conflict study conducted between 1995 to 1997 records occurrence of 62 elephants in South West Bengal, inhibiting 3,368 km², in four localized sub-groups (n=26) and the group (n=36) that seasonally migrates from adjoining Dalma Wildlife Sanctuary, Bihar. Occurrence of intense crop depredation was only 5.5% of the total cultivated area available within the movement range of elephant. Landscape mosaic with cropland to forest ratios of 1.2 :1 respectively had high depredation. Intensity of crop damage was higher between Sept. to Dec. (51.8%) followed by Jan. to Apr. (33.6%), and May to Aug. (14.5%). The estimated crop loss was Rs. 3.2 crores. On an annual basis 13 people are being killed most of which occurred between Jan. to Apr. (48-52%) in post paddy season. Adult males in localized sub-groups were responsible for most (72%) of the human kills. Population management of these elephants through translocation or removal must be seen and integrated with the overall national planning for elephant management.

दक्षिणी पश्चिम बंगाल, भारत के परिवर्तित भूदृश्य में मानव–हाथी संघर्ष

अनिल कुमार सिंह, रीना आर० सिंह व सुशांत चौधुरी

साराशं

1995 से 1997 के दरम्यान किया गया मानव-हाथी संघर्ष का यह अध्ययन चार स्थान सीमित बने उपसमूहों (n=26) और समूहों (n=36) में दक्षिणी पश्चिम बंगाल के 3368 किमी² क्षेत्र को बधित करते 62 हाथियों का मिलना आलेखित करता है जो विशेष मौसम में साथ लगते दाल्मा वन्यप्राणि अभयारण्य, बिहार से इधर आ जाया करते हैं । हाथियों की आवागमन परिसीमा में पड़ने वाले कुल कृषिकृत क्षेत्र के केवल 5.5% भाग में ही सघन फसंल विनाश उनसे होता देखा गया। जिस भूदृश्य का चित्र फसलभूमि से वन तक क्रमशः 1.2:1 अनुपात में था वहां उनका विनाशकार्य अधिक था । फसलहानि की चण्डता सितम्बर से दिसम्बर के बीच की अवधि में अधिक (51.8%) रही, इसके उपरान्त जनवरी से अप्रैल तक (33.6%) और मई से अगस्त तक की (14.5%)अर्वधियों रही । अनुमानित फसलहानि 320 लाख भारतीय रुपये या 761 हजार अमेरिकी डालर वार्षिक रही । वार्षिक आधार पर 13 लोग हाथियों ने हर वर्ष मारे जिनमें से अधिकांश की हत्या धान की फसल वाले मौसम के उपरान्त जनवरी से अप्रैल के मध्य (48-52%) हुई । मानव हत्याओं के अधिकांश (72%) के लिए स्थानसीमित, उपसमूहों के व्यस्क नर हाथी जिम्मेदार थे । इन हाथियों को वहां स्थानांतरित कर हटा देना ही इनका प्रबन्ध करना समझा जाना चाहिए और उसे हाथियों का प्रबन्ध करने की समग्र राष्ट्रीय योजना के साथ मिलाया जाना चाहिए ।

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