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Research Article

HUMAN-ELEPHANT CONFLICT AND ITS IMPACT ON RURAL HOUSEHOLD ECONOMY IN RAJDA MOUZA OF SONAMUKHI C.D. BLOCK, BANKURA DISTRICT, WEST BENGAL

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ABSTRACT

The study tries to explore the impact of Human-Elephant Conflict (HEC) on the rural household economy in Rajda mouza of Sonamukhi block of Bankura district. Although the household income of the residents mainly depend on agricultural activities but various agricultural products like paddy, wheat, potato, grounds, cauliflower and other vegetables are damaged by wild elephants and decline the household income of the native people in the study area. About 99% of the respondents reported that crop damage problem due to elephants is increasing day by day because of insufficient food and water in the forest area and the changing land use pattern of the people. Besides agricultural activity, collection of Non-Timber Forest Products (NTFPs) are also measured as the source of rural household economy in the study area. NTFPs collectors are also directly (death, injury) and indirectly (fear of death, injury) influenced by elephants in concerned mouza. This research article is an empirical investigation to chalk out how agro-based and forest-based rural household economy of the poor villagers is significantly affected due to HEC.

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INTRODUCTION

Asian Elephant is categorized as an endangered species in IUCN list 2009, due to the causes of habitat loss and fragmentation (Thirunavukarasu, 2014) and the development programme in and around areas of elephant habitat implies encroachment of habitat, slash-and-burn shifting cultivation and settlement over the corridors lead to loss of traditional passage ways of elephants and blocking the immigration routes of elephants. All of these have contributed to increase H.E.C., which often results in loss of both human & elephant lives and property (Das, 2013; Okello, 2014; Choudhury, 2004; Sukumar, 1990, 1992). In India, over 100 people are killed by elephants attacked each year (Negese, 2015). The human killed by elephants were mostly in forest and village sites. Occurrence of these incidences was perhaps related to availability of crop and their subsequent harvest and storage to the village sites. In south West Bengal 91.6 % human kills were through loner or male elephants (Singh *et al.*, 2006). Human-Elephant Conflict is now emerging as a dangerous problem to the study area. Elephants seem to feed in the forest during the day and forage in agricultural areas during the night. There were a number of incidences when elephants had broken into houses for feed on stored paddy, much to the shock and dismay of the occupants (Santiapillai *et al.*, 2010 a). Paddy is the principal crop

damaged by elephants (Dey *et al.*, 1991). Elephants especially attractive to eat paddy just before and during the harvest time. Elephants are more likely to raid crops in areas that lie just next to the forests than those at some distance away. (Santiapillai *et al.*, 2010 b) Elephant herd have extended its habitat from inside forest into outside forest and changed its food habits from agricultural crop (Paddy and wheat) in to juicy and palatable Horticultural crops (vegetable and fruit crops) like Cucurbits, Cabbage, Cauliflower, Potato, Brinjal, and Jack fruit etc. those are commercial cash crop which are very vital to the local villagers economy (Kulandaivel, 2010). When elephants damage food and cash crops, they affect a rural farmer's livelihoods. Crop damage not only affects a farmer's ability to feed his or her family, it also reduces cash income and has effects for health, nutrition, education and ultimately development. (Negese, 2015).

Singh, Singh and Chowdhury, 2002 observed that the frequencies of crop damage by elephants during the three cropping seasons e.g. January to April, May to August, and September to December. Elephant eats 10% of their body weight each day, which for adult is between 170-200 k.g. and requires 80-200 litres of water for drinking and bathing purposes (Nature Indian, 2011). The Migratory population had member of 36 individuals constituting of 6 adult tuskers, 14

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adult females, 4 sub-adult male tusker, 5 sub-adult females, and 5 juvenile and 2 calves. The residential populations were constituted of 4 sub-groups i.e. Jhargram sub-group, Ajodhya hill sub-group, Banspahari-Belpahari sub-group and east of Kangsabati sub-group (Singh *et al.*, 2002; Chanda, 1996). Human-elephant conflict may be categorised as either 'direct' or 'indirect' according to its impact upon people. Direct HEC impacts upon the physical and economic wellbeing of rural communities by causing damage to crops, livestock and property, as well as human injury and death where Indirect HEC causes broad and indirect social impacts upon people, for example through the effort required to protect crops and property, the disturbance of normal activities such as walking at night, and the fear of injury or death. Such indirect costs may form a major component of the conflict perceived by local people. (Dharmaratne, 2014). The migratory herd come from Dalma hills which consist of 60-90 elephants and the another residential herd of 23-24 elephants, the migratory elephant herds have damage some around 1000 hectares crops each year and there are 12-15 people have already been killed by the wild elephants at Sonamukhi alone (Nature Indian, 2016) .The forced movement led to extensive damage of crops, houses and other properties. Many farmers even have left their land without cultivation to avoid damage by elephants and some time the villagers harvest their crops prematurely (Santra *et al.*, 2007).Crop-raiding by wild elephants is influenced by various proximate factors such as density of elephants in the vicinity of the villages, phenophase of the agricultural crops, area of crop cover, density of certain preferred browse species, availability of shade, incidence of wood cutting, water availability, rainfall, cattle grazing, abundance of weed and occurrence of forest fire (Daniel *et al.*, 1995).

The concept of rural economy is the study of rural economics, including economic growth, development and farm, non-farm industry. The size of spatial distribution of production, the household units, interregional trade and landuse are all about the study of rural economy (<https://en.m.wikipedia.org>, 2017). Poor people of the mouzahave devoted their physical efforts in the agricultural land, but when the elephants destroyed their crops that's mean the bolt from the blue to the farmer. Most of the villagers are collecting various forest products from deep sal forest. Sometimes they use the products as domestic need or marketization of some products for earning money. When the elephants are coming from Dalma range and entering into the dense sal forest of Sonamukhi block (Panja *et al.*, 2018), it is very much challenging condition for the cultivators and the NTFPs collectors either their income level remain same or to be changed. During the time of elephant's wandering in the forest, people have totally stopped their collecting activities. So the production and marketing system havegradually decreasedwhich impact or reduced the household income level of the poor farmers of the affected mouza.

Study Area

The study area (Rajda) comes under the region of the *Rarh Bengal* with unique physio-cultural trait complex. The Latitudinal extention from 23°15' N to 23° 16' 20" N and the longitudinal extention from 87°26' 20" E to 87°28' 15" E and Jurisdictionally belongs to Dhansimla Grampanchayat (G.P.) under Sonamukhi C.D. Block of Bankura district (Figure 1 and 2).The concern mouza situates under tropical monsoon climate

with mixed Laterite ,red and alluvial soil of sandy-clay- loam and clay-loam in texture (Malley, 1908; District Disaster Management Plan, 2016, Bankura).The study area is sourounded by densed forest with sal, palash, mahua etc. trees(Figure 3).The surface elevation is 68 meters from the Mean Sea Level (M.S.L). Total area of the selected mouza is 224 hectare, among them 89.73% (201 hectare), 6.25% (14 hectare), and 4.02% (9 hectare) areas are under forest, waste & fallow land and agricultural land respectively. 43.33% area in respect of total useable agricultural land is affected by the migratory and local elephants throughout the years. The total number of households is 75 consisting 375 inhabitants, among them 40% families are engaged for making sal leaves plate (Table 1). More than 80% people are engaged in agricultural activities, agricultural labour and rest population are engaged in collecting of sal, kendu leaves and other forest products.

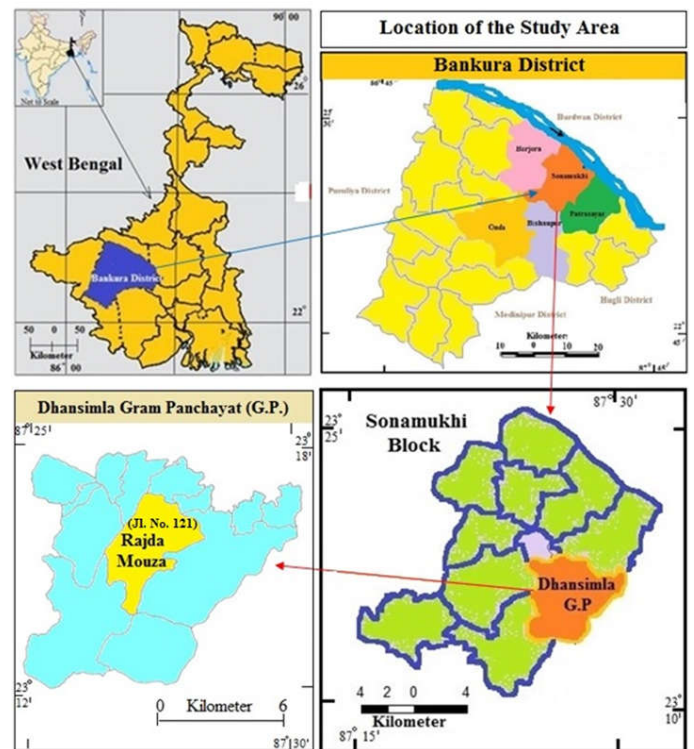


Figure 1 Location of the Study Area

Source: Prepared by author with the help of GPS points during field survey, 2017

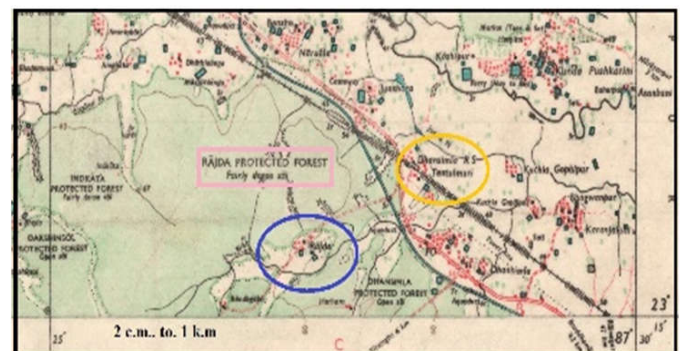


Figure 2 Location of Rajda Mouza within Topographical Map

Source: Topographical Map number 73M/7

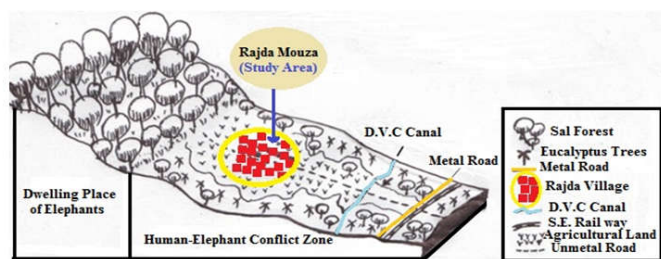


Figure 3 Small Settlement unit (Rajda Mouza) within the Forest Environment

Source: Prepared by author, 2017

Objectives of the Study

This research article will examine the status of household income and the impact of human-elephant conflict on agro-based as well as forest based household economy in the concerned study area.

Table 1 Profile Picture of the Rajda Mouza

Parameter	Name /No./Quantity
* Extension	23°15'N to 23° 16' 20"N and 87°26' 20" E to 87°28' 15"E
* Surface elevation	68 m
* Total Area	681.1 Hectare
* Occupation	Agriculture, Agricultural labour, NTFPs collector
* Total Agricultural land	9 Hectare (1.32%)
* Area affected by Wild Elephants	3.9 Hectare (0.57%)
* Total no. of settlement	75
* Total Population	375
* Total Forest area	426 Hectare (62.55%)
* Total no. of ponds	Five
* Major plant species	Sal, Palash, Mahua, Kendu, Eucalyptus, Akashmoni
* Total waste & Fallow land	14 Hectare (2.06%)
* Degraded plant species	Tamarind, Hartaki, Kalmegh
* Degraded animal species	Hare, Pithon, Vulture
* No. of families engaged on making sal leaves plate	30 (53.33%)
* Forest dependency (Directly and indirectly)	85%

Source: Prepared by author based on primary data during field survey, 2016-17 District Statistical Hand Book (2013-14) and Census of India, 2011

MATERIALS AND METHODS

This research work was established with the help of both primary and secondary data. The primary data has been collected through field survey and face to face oral interview based on structured questionnaire of 75 households. The survey has designed on the basis of the stated stratified random sampling method (Figure 4). The secondary data has been collected from Divisional Forest Officer (D.F.O) of Bankura district, Forest ranger officer and the Block Development Officer (B.D.O) of Sonamukhi block. District Gazetteer, statistical hand book, census report, books, different journals, newspaper and e-articles are also used as secondary information. Face to face household survey helps to identify the status of household income and also shows the original picture of the elephant affected agro-based and forest-based poor households. Through field observations and narrating method it has been find out their way of life based on agricultural crops through production, consumption and marketization system in one hand and on the other collecting and marketing of NTFPs of the native villagers. The perception study have been applied to identify the feeling of the residents about the relation between HEC and household economy. Proper charts and models are used to develop the entire work. Correlations and scatter diagram have been used to establish the relationship between dependent and independent variable and also judgments the relationship with Student 't' test at 99%

significant level. The household income of the residents have been shown in a charts through system analysis. At the same time the damage patterns by the elephants have been calculated through weighted average score. The plot to plot survey based on mouza map helps to identify in detail the land use patterns and the destruction patterns by elephants in the mouza.

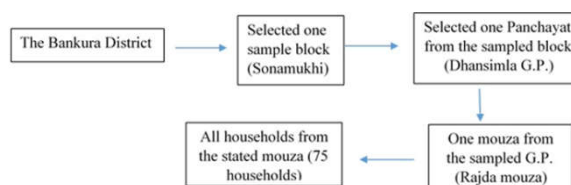


Figure 4 Stratified Random Sampling Method

RESULT AND DISCUSSION

Rural Economy in Rajda mouza

Rajda, a small village, is surrounded by sal, palash, kendu, mahua, eucalyptus, and akashmoni trees. This village is situated under Dhansimla Gram Panchayat (G.P.) of Sonamukhi block in Bankura district. The village is developed in the natural forest ecological unit. Most of the villagers work as farmer, NTFPs collector, agricultural labourer, worker, service, *rajmistri* (built up pucca houses), company's work, cattle business and the mixed activities which consists two or more stated activities throughout the year.



Figure 5 Engagement of Family (%) in different sources of income in Rajda village, 2017

Source: Prepared by author based on primary data during field survey, 2016-17

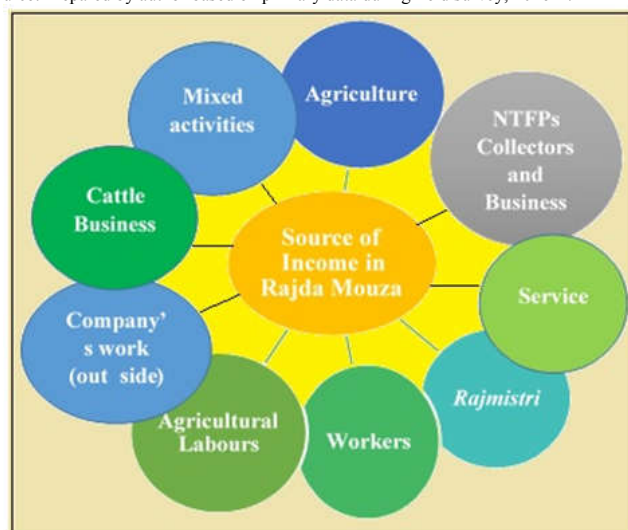


Figure 6 Source of income in Rajda village, 2017

Source: Prepared by author based on primary data, 2017

Here the source of income has categorised on the basis of monthly people' involvement for their own work. The people who have engaged for their work in more than four month are regarded as major source of income and below four month are under mixed source of income (Figure 5, 6 and Table 2).

Table 2 Involvement of people in different source of income in Rajda village

Sl. No.	Source of Income	Number of Families Engaged	% of Families Engaged
1	Agriculture	10	13.33
2	Agricultural Labours	5	6.67
3	Workers	7	9.33
4	NTFPs Collectors and Business	9	12
5	Rajmistri	2	2.67
6	Service	2	2.67
7	Company's work (out side)	5	6.67
8	Cattle Business	3	4
9	Mixed	32	42.67
	Σ	75	100

Source: Prepared by author based on primary data during field survey, 2016-17

The rural economy in Rajda mouza is basically depend on agricultural activities and the collection of NTFPs from the dense sal forest (Mondal, *et al.*, 2018). Near about 4.02% (9 hect.) area are used as agricultural practices out of total area (224 hect.) of the mouza. Here the rural economy is solely agricultural based. Agriculture is the main stay of rural economy. Besides agriculture, mixed activities, NTFPs collector, agricultural labour, workers and *rajmistri* have been playing an important role for economic development and social growth of the study area. Here 13.33%, 12%, 42.67% families are involved in agricultural activities, NTFPs collection and mixed activities respectively. The main agricultural products that controls the fate of the rural economy of the stated mouza are as follows (Table 3).

Table 3 Major Agricultural Products

Sl. No.	Agricultural Products	Name
1.	Food grain	Rice, Wheat, Oil seed, Pulses
2.	Fruits	Banana, Mango, Papaya
3.	Vegetables	Potatoes, Tomato, Onion, Grounds, Pumpkin, Chilies

Source: Prepared by author based on primary data during field survey, 2016-17

The *aman* paddy cultivation is the major profession of the villagers. The residents gather sal leaves for making plates, collect kendu leaves for making biri, stockpile fuel wood to use as fuel, amass mahua flower to use as liquor, and collect mushroom for household use and for selling. The inhabitants accumulate all this things from the dense forest and selling in the local market and earning some money throughout the year (Figure 7). From this earning the villagers keep utmost quantity and endow it for *aman* paddy cultivation. As this area is placed under the low water potentialities region so, the monsoonal rainfall is the key for paddy growing. But in recent time due to the causes of abnormality and unreliability of monsoon the *aman* paddy cultivation is much more affected. Not only irregularity of monsoonal rainfall but also attack of wild elephants in the agricultural field is now up-and-coming as a crucial trouble in this area (Figure 8). The visiting of elephants

in the crop field is considered as an immense intricacy to the local inhabitants.

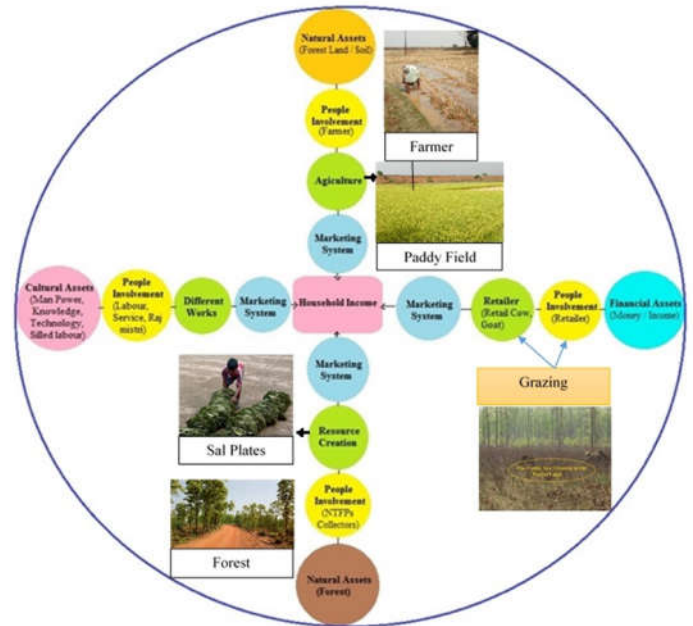


Figure 7 Household income system in Rajda Mouza

Source: Prepared by author based on perception study of the respondents, 2017

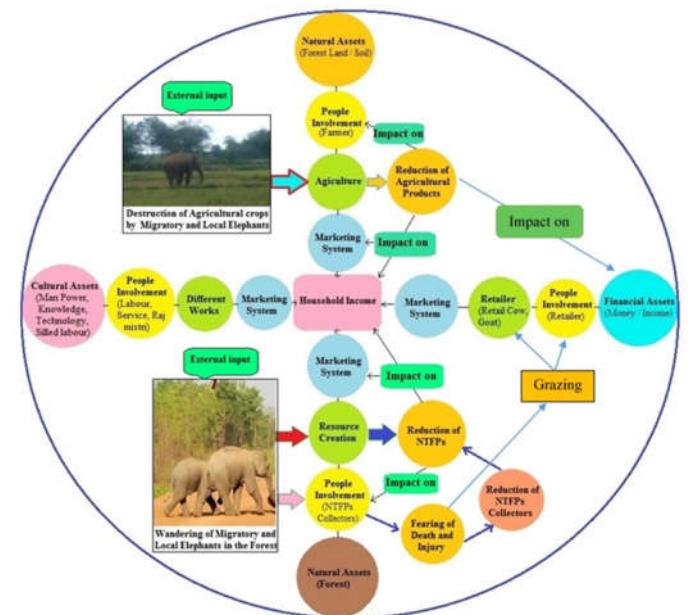


Figure 8 Impact of Human-Elephant conflict on household income system in Rajda Mouza

Source: Prepared by author based on perception study of the respondents, 2017

Impact of Human-Elephant Conflict on Rural Economy in Rajda mouza

The elephants containing 70-90 in number have been coming from Dolma hills of Jharkhand and attract the crops near to maturity or milky stage, turbulence of every day human activities and happening of human demise and injuries (Panja *et al.*, 2018). The men want more agricultural production, more gain not only survives but also contemporary life style where elephants attract the crops field to remove starvation and for stay alive. The modern techno centric men can think and take decision to change the land use, modify the cropping pattern and crop combination to protect the destruction from the wild elephants. In this circumstances how the elephants can subsist?

It is not forget that *we are all the members of the Spaceship Earth.*

Elephants have attacked the agricultural lands and household storage because in the forest area, there is an immense paucity of proper or adequate fodder for survives and deficiency of abundance water to remove thirsty. The rational human being encroached dense sal jungle by expansion of agricultural land and settlement through indiscriminately cutting and clearing sal trees for money-making purposes and in the empty forest area the economic man planted eucalyptus and akashmoni trees. These are not suitable fodder of the elephants. In the one hand, the elephants have no free space for wandering, no fodder for alive, no water for remove thirst, and in the other hand the economic men gradually modify the land use pattern where man can alive with plenty of other alternative crops, which are not sustain for elephants herd and the herd slowly but surely abolish due to the absence of proper and adequate fodder. In this way the rational man gradually change the forest environment and the elephants are compelled to raid the house hold storage and attack the huts for searching food (Figure 9).

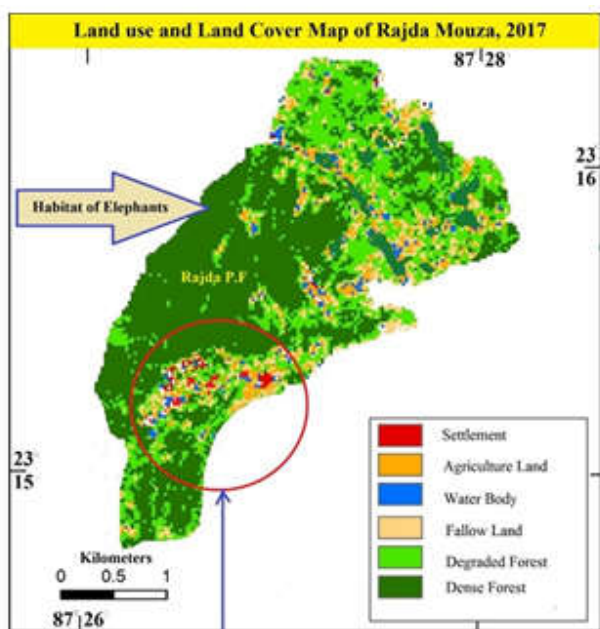


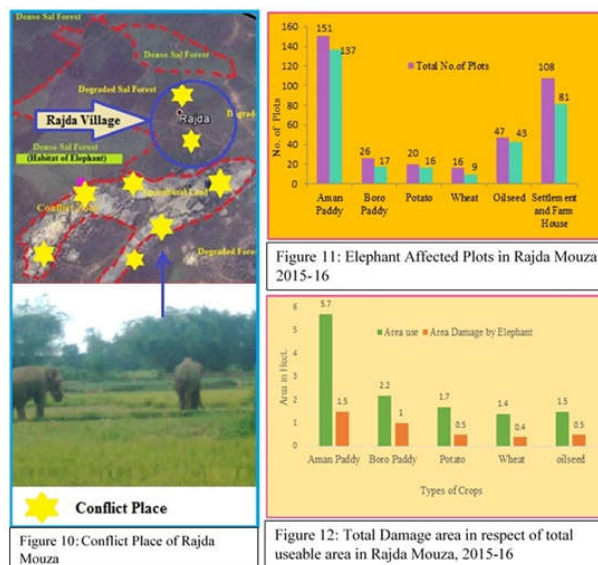
Figure 9 Land use Land cover Map of Rajda Mouza, 2017 and Overview of the HEC

Source: conflict place recorded by the author with GPS during field survey, the photograph retrieved by the author, 2016

As a consequence, the household income from agricultural sector has been greatly reduced. Because, in one hand the paddy field are damaged during milky and mature stage and on the other the storage paddy are also raid by the elephants. So, the farmers have nothing left for selling.

Destruction of Crops by the Elephants

In forest based Rajda mouza, the people are seriously affected by the elephants. Here 6.5 hectare area has damaged by migratory and local elephants in 2015-16. The destruction rate of aman paddy is greater than the other crops. Vegetables and fruits are also preferred to the elephants. In the study area there are 137 number of plots are affected due to these conflict (Figure 10, 11, 12, 13, 14 and Table 4).



Source: Prepared by author based on field survey, 2015-16 and conflict place recorded by the author with GPS during field survey, the photograph and Google image retrieved by the author, 2016

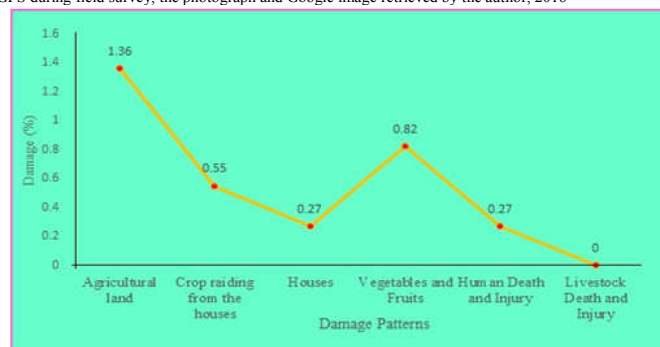


Figure 13 Destruction Patterns of the Elephants in Rajda Mouza, 2015-2016

Source: Prepared by author based on collected data from field survey, 2015-16

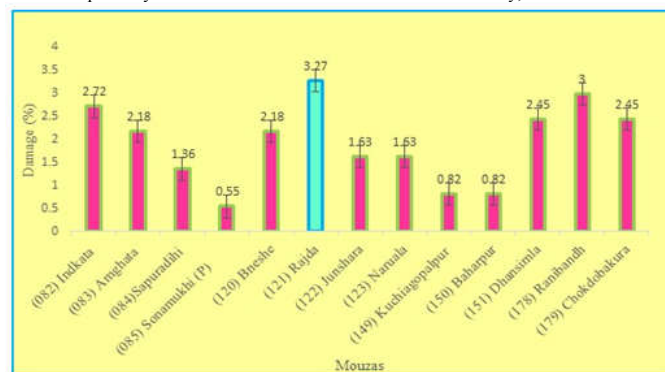


Figure 14 Destruction Patterns of the Elephants in Dhansimla G.P., 2015-2016

Source: Prepared by author based on collected data from field survey, 2015-16

Human-Elephant Conflict in Rajda village

Most of the conflict have been occurred in the cropping field within 1-2 k.m far from the forest area and the frequencies are gradually decreased far away from the forest area (Figure 15). From the scatter diagram the trend line is purely negative and the correlation (r) value is - 0.9577. So, there is strong negative relation between forest frontage and the depredation frequency of migratory elephants in Rajda village. It can also be stated that the calculated 't' value (17.37) is greater than the tabulated 't' value (3.37). So, the relation is significant at 99% significant level. (Figure 16).

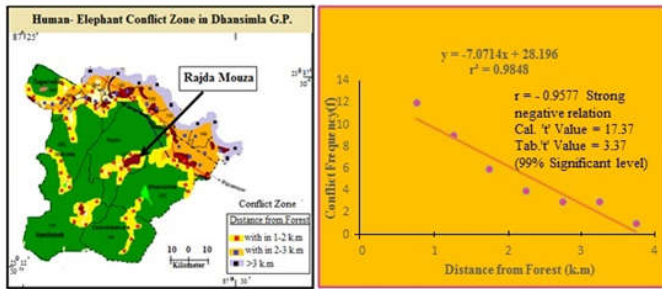


Figure 15 Human-Elephant Conflict Zone in Dhansimla G.P.

Figure 16 Relationship between Forest Frontage and Conflict Frequency by the Migratory and Local Elephants in Rajda Mouza

Source: Prepared by author based on primary data, 2017

Relationship between Elephant Sighting and Anthropogenic Activity

In Rajda village, most of the villagers are involved in different primary activities like agriculture, *rajmistri*, and agricultural labours, NTFPs collectors throughout the year. As the NTFPs collectors and the labours are mostly depend on forest but the villagers, who have massive agricultural land, partly depend on the forest. The forest-based and agro-based rural livelihood is greatly influenced by the elephants. The villagers, who have low income status, are always engaged / interact with forest either NTFPs collection or grazing (Figure 17). They have collected fuel woods not only their domestic uses but also it is the source of their earning money. In the study area most of the female population are involved for the collection of fuel woods rather than the male population (Mondal *et al.*, 2018). When the elephants are haunting in the forest the female people are very much frightened and stopped to go to the forest for NTFPs collection in one hand and on the other the male people are entering into the forest and cutting sal trees randomly and marketization in the local market like Sonamukhi or Kashipur etc. This incessant process is continuing year after year. As a result the eco-balance is very much disturbed day by day and the animal as well as the plant species are not adapted with the changing forest ecology. So, the forest animals have faced much food, water and even space crisis like elephants and the fuel woods collectors, NTFPs collectors are significantly reduced their activities during the wandering of elephants in the forest. There is strong negative relation ($r = -0.90$) between the percentage of elephants sighting and the percentage of fuel woods collectors in the study area. It can also be stated that the calculated 't' value (6.70) is greater than the tabulated 't' value (2.72). So, the relation is significant at 99% significant level.

The grazing activities as well as the collection of NTFPs are much influenced by the roaming of the elephants. Those are the

indirect effect of the conflict. There is a strong negative relation between the percentage of elephants sighting and the percentage of grazing ($r = -0.83$) and the percentage of NTFPs collectors ($r = -0.85$). The first relation is strongly significant at 99% significant level because the calculated 't' value (4.98) is greater than the tabulated 't' value (2.72) and the second relation is also significant at 99% Significant level because the calculated 't' value (5.29) is also greater than the tabulated 't' value (2.72) (Figure 18).

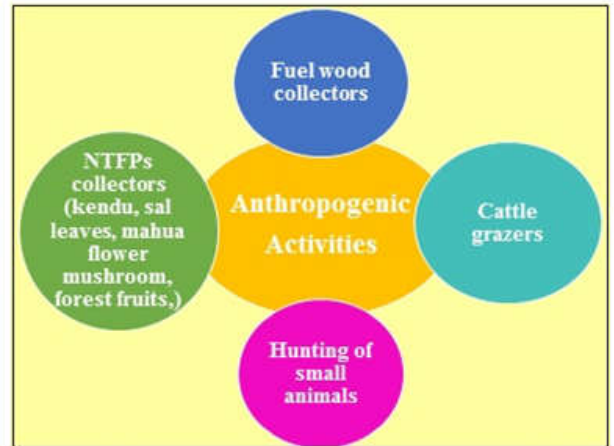


Figure 17 Anthropogenic activities in Rajda mouza, 2017

Source: Prepared by author based on field survey, 2017

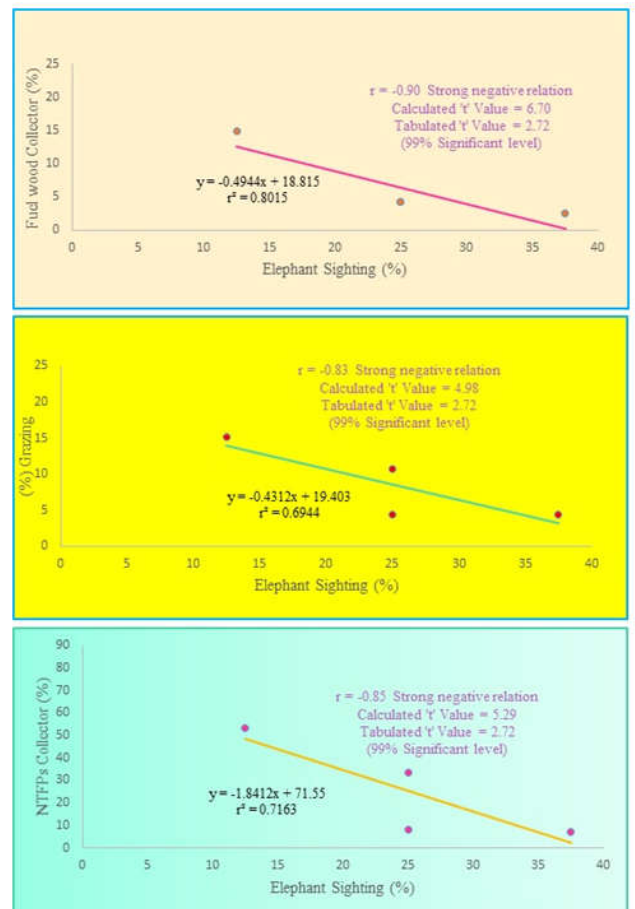


Figure 18 Relationship between Elephant sighting (%) and Percentage of Fuel wood collector, Grazing and NTFPs collector

Source: Prepared by author based on collected data from field survey, 2017

Table 4 Destruction of Agricultural Products by the Elephants, 2015-2016

Land use type	Plots under land use	Total Plots		Plots attract by elephants			Coming seasons	No. of elephants	
		No.	Area (H)	Plot No.	Total No.	Area (H)		Resident	Migratory
Agriculture	Aman paddy	11-16,41-43, 61,188-199,216-218,229,230,232-235 237-243,245-253,255-282,284-287 288-342,370-372,377-391,397	151	5.7	11-16, 188-199 216-218 237-243,245-253,255-282,284-287 288-342, 377-391	137	1.5	Sept. To Oct.	80-100
	Boro paddy	11-16,41-43,188-199,216-218,,228-230,	26	2.2	188-199,216-218,228-230,	17	1.0		
	Potato	232-235 237-243,245-253,	20	1.7	237-243, 245-253	16	0.5	Dec. To Janu.	8-10
	Wheat	330-342,370-372,397	16	1.4	337-342 370-372	9	0.4		
	Oilseed	255-282,284-287, 377-391	47	1.5	255-282 377-391	43	0.5		
Settlement, Farm House and others	17-37,54,62-71 85-95, 220-228, 233-235, 238,257-263, 267-281,295-298,312-314, 323-325,333, 350-369,374-377	108	3.3	17-37, 54,62-71 85-95, 267-281 350-369,374-377	81	-	Through Out The Year	8-10	-
Forest	1,2,3,8-10, 57,59,44,46,48-51, 57,59,187,344,392	19	214	All the plots are more or less affected			Dec. To May	80-90	
Market Garden And Fruit Trees	72-84,200-210, 345-350	30	1.8					8-10	-

Source: Prepared by author based on plot to plot survey, 2015-17

CONCLUSION

At the end of the above discussion it may be concluded that in the study area the household economy of the residents is depend on the natural, cultural and financial assets. Sometimes, the natural assets are largely controlled by the seasonality, unavailability, unevenness and unreliability character so, the household income of the natural assets based residents is going up and down throughout the year. Whereas the cultural assets are entirely controlled by humans' demand and desire that is controlled by the thinking of human beings. As the humans' thinking are not constant so, the cultural assets are temporally changed within these area. At the same time the household income has also be changed of the cultural assets based households. In the study area when the elephants destroyed the crops and wandering in the forest then the income of the residents has been reduced in one hand, on the other the people are involved instantaneously in worker, labour, *rajmistri* or any other money making process to continue the earning household income system as well as the livelihood system. As most of the people have wanted to participate within these activities at the same time so, the residents have faced either the crisis of working opportunities or proper wages. They are compelled to go at minimum wages. The area has been developed in depending upon primary activities so, the financial assets are not very strong. It is true that some of the residents are involved in cattle business but their capital comes from either agriculture or NTFPs. In a nut shell it can be said that the hampering of agriculture and NTFPs means the hamper of all sources of household income in the study area. As the area is affected by the HEC so, the network system of earning household income is directly or indirectly interrupted.

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