Asian Journal of Agricultural Extension, Economics & Sociology

Volume 41, Issue 9, Page 11-23, 2023; Article no.AJAEES.100989
ISSN: 2320-7027

Farmer's Perception and Willingness to Pay for Mitigating Man-Animal Conflicts in Coimbatore Forest Circle

P. Unniravisankar [a++*], C. Sekhar [b#], Keerthana Das [c++], A. Vidhyavathi [b†], M. Vijayabhama [d‡] and K. Baranidharan [d‡]

[a] National Dairy Research Institute, Karnal, India.
[b] Department of Agricultural Economics, TNAU, Coimbatore – 3, India.
[c] Kerala Agricultural University, Trissur, India.
[d] Forest College and Research Institute, Mettupalayam – 641 301, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2023/v41i92009

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/100989

Original Research Article

Received: 01/04/2023
Accepted: 02/06/2023
Published: 17/06/2023

ABSTRACT

The study assessed the farmers and other stakeholder's perception on man-animal conflict at Coimbatore forest circle. Around 37 per cent of the respondents outlined that the farm floor is less than one kilometre distance from the reserve forest. Whereas, 33 per cent of the farm floor was within the distance of one to two kilometres revealed that around 70 per cent of the farm floor is very closer to the forest floor and hence the visit of elephants and other animals to the farm field is quite often taking place. While examining the reason for man-animal conflicts, the same were

[++]Research Scholar;
[#]Professor;
[†]Associate Professor;
[‡]Assistant Professor;
**Corresponding author: E-mail: u4unniravi@gmail.com;*

ranked based on the mean score obtained by using the Likert scaling technique with five point continuum. Among the major reasons, the habitat fragmentation found to be number one stood with the opinion of “strongly agree” according to eighty per cent of the respondents. This was followed by shortage of food resources in the forest perimeter and the periodic human invasion into the forests for their various needs like small timber, fuel wood and bush meat related activities found to be the major reasons for unexpected conflicts between the wild animals and the human being. The same was supported by their respective mean scores of “agree” mode of scale developed for this purpose. The most affected crop is banana which is the one most preferred to the elephants which stood in the first rank and the second rank goes to the coconut, the banana and the coconut were the preferred crop to the elephants. in the absence of the two expressed in the rank one and two, the arecanut and sugarcane could attract the elephants around 32 per cent of the respondents were ready to pay some higher amount which ranges between rs 200 to 500. However, around 17 per cent of the respondents were not interested in paying any contribution towards such initiatives. Among the many protective measures practiced by the farmers, the fire crackers and the powerful torches illuminated on the animal face could alleviate the animals immediately and hence these two protective measures were common among the farmers. Besides, researchers has also used probit regression analysis to analyse the influence of different factors on the dependent variable, willingness to pay. Awareness of the respondents towards mitigation measures, effectiveness of existing mitigating measures, and proximity of farm land to reserved forest, percentage of farm income to household income, farm size and economic loss incurred due crop and property damages by the animals. among the seven variables, awareness of the respondents towards mitigation measures, effectiveness of existing mitigating measures, proximity of farm land to reserved forest, farm size and economic loss incurred due crop and property damage were the six factors found to be statistically significant indicated that these factors cause significant changes in the willingness to pay among the stakeholders.

Keywords: Man-animal conflicts; willingness to pay; mitigating measures; probit analysis, Human Elephant Conflict (HEC).

1. INTRODUCTION

The Human wildlife conflict is on the increasing across the world due to many factors such as growth in the human population and increased consumption of natural resources from forest viz. fruits, fibre, fodder, floss, fuel and flesh (6Fs) as cheaper in cost and hence the common public are trying to take as much as possible from the forest in the absence of protection of forest nearer to the human habitation. Another factor is establishment of animal loving crops in the forest fringes like Banana, Sugarcane etc. Habitat loss and fragmentation to the elephants and the unauthorized erection of buildings of religious nature and schools in the elephant corridors were forced the elephants to cross migrate to the human habitations [1,2]. Managing Human – wildlife conflict is a greatest challenge of conservation agencies in India. Across the world, it is generally accepted that conflict erode public support and builds animosity against wildlife conservation [3]. Similar chronic conflict has profound impact on wildlife and their habitat. It will degrade the wildlife at species, population, and individual through process of extinction. The HEC is happening not only due to poaching but also the activity of crop raiding and crop damage in the farm lands because of absence of required fodder crops in the forest territory and the water for its requirement. Another factor is establishment of animal loving crops in the forest fringes like Banana, Sugarcane etc. Habitat loss and fragmentation to the elephants and the unauthorized erection of buildings of religious nature and schools in the elephant corridors were forced the elephants to cross migrate to the human habitations. Crop damage is a major problem in the farm lands adjacent to wildlife corridors. Bell [4] reported that the crop damage is prevalent mostly in the boundary of the forest and it does not move into the distant locations for its food. Similar results were observed in the study conducted by Hawkes [5]. The elephant herds are known to migrate across 350 – 500 square kilometres annually but increasingly fragmented landscapes are driving the giant animals more frequently into human dominated areas giving rise to more man-animal conflicts [6]. The Mitigating measures are being taken up by the Forest Department. But these measures are not much contributing for the mitigation of such conflicts [7,8]. In this circumstances participation of public in the animal mitigating

measures by the way of Willingness to Pay for the measures may serve the purpose and hence efforts has been taken to assess the farmers perception and willingness to pay becomes important.

2. MATERIALS AND METHODOLOGY

The current investigation was carried out in the Coimbatore Forest Circle which consists of Three Divisions. They are

- Anamalai Wildlife Division
- Coimbatore Forest Division
- Nilgiris North Forest Division

The Coimbatore Forest Circle is credential for its flora, fauna and other natural resources comprising timber, non-timber and medicinal resources. These divisions have significant number of tribal population, wild animal population and commands higher multifarious development activities including wildlife conservation and management of wildlife. The Coimbatore District has 1.58 lakh ha of forest, which constitutes 21.20 per cent of the total geographical area of the district. It is almost equal to the percentage of forest area in the state of Tamil Nadu (22 Per Cent).The district ranks eighth among the districts of Tamil Nadu in the state of forest area. The Coimbatore Forest Circle (CFC) is purposively selected for the present study so that the results of the study would act as a model for conservation strategies and sustainable development of forests in other divisions of the state. The details of selected samples for the purpose of study were presented in List 1.

As outlined in List 1 the researcher has chosen 140 samples in the study area which comprises of farmers, tribes, forest officials, Non-Governmental Organizations, scientists working in the wild life institutions, veterinarian and the biologists. Among these, the farmers and tribes were respectively accounted for 43 per cent to the total samples selected for the study as they were the affected personnel and hence priority in sampling was given. Others were interviewed for their opinion related to Man-animal conflicts.

2.1 Methods of Collection of Data

The study uses both primary and secondary data to meet the requirements of the objectives. Primary data required for the study was collected from the sample farms and tribes through personal interview method with the help of a comprehensive well structured, pre-tested interview schedules, bearing questions in relation to the objectives enshrined in the study.

The secondary data required for the study like location of the study area, demography, rainfall pattern, land use pattern, irrigation sources, cropping pattern practiced in the forest fringes, type of attacks by the wild animals and the compensation received by the respondents etc. from the department of forests, department of agriculture and from the department of economics and statistics located in the Coimbatore district headquarters. The data collected using the fact sheet of the corridors from experts, Forest Department personnel and tribes were analysed and the meaningful conclusions were drawn.

2.2 Tools of Analysis

2.2.1 Contingent Valuation Method (CVM)

CVM is the best approach to get the Willingness to Pay (WTP) / Willingness to Accept (WTA) for the total economic value of an environmental improvement. Basically, people are asked how much they would be willing to pay or accept for the damages caused by the wild animals in the

List 1. Details of samples selected from coimbatore forest circle

Sl. No	Details of Sampling Units	Number of Samples	Percentage to Total
01	Farmers	60	43
02	Tribes	60	43
03	Forest Officials	06	04
04	Non-Governmental Organizations Relevant to Wildlife Conservation and Management	03	02
05	Scientists involved in Wildlife Management	05	04
06	Veterinary Physician	03	02
07	Wildlife Biologist	03	02
Total Number of Sampling Units		140	100.00

farm front located in the forest fringes. If people understand fully on the environmental impact due to the animals and answer truthfully on WTP/WTA related questions in a better way, this approach is ideal because the analysis would get an individual's strength for the preference for the proposed change in the environment. The values expressed by the people in CVM interviews are contingent upon such factors, how it will be provided. The value of the environmental damage in such a situation can be measured either by

- The individual's maximum willingness to pay to avoid the environmental damages or
- The individual's minimum willingness to accept as compensation to consent the environmental damage

The combined approaches of dichotomous choice, bidding game format and open ended question format were used to obtain the WTA from the respondents. The Probit model was used to evaluate the factors which influence the stakeholders' willingness to pay for the deterrent measures and damages caused by them due to wild animal conflict.

In order to explain the behaviour of the dichotomous dependent variable we have to use a suitably chosen cumulative distribution function. The Logit model uses the cumulative logistic function. The estimating model that emerges from the normal cumulative distribution function is known as the Probit Model. Let us assume that in the measure of willingness to pay, the decision of the respondent willingness to pay or not, depends on observed utility index, I_i, that is determined by the explanatory variables in such a way that the larger the value of index I_i, greater the probability of the respondents to pay for the deterrent measures.

In general the index I_i, can be expressed as

$$I_i = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots + \beta_7 X_7 \ldots\ldots \quad (1)$$

For each respondent there is critical or threshold level of the index (I_i*) such that If I_i, exceed I_i*, the respondents will adopt the deterrent measures against the elephant depredation otherwise not.

In Probit analysis, the unobservable utility index is known as normal equivalent deviate (NED). Since NED or I_i* will be negative whenever P_i< 0.5, in practice the equation A is added to NED and the result so obtained is called the Probit.

That is,

$$\text{Probit} = \text{NED} + (A) = I_i + (A)$$

In order to estimate

$$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7 \text{ in equation} \quad (2)$$

$$I_i = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \text{Ui} \ldots\ldots\ldots \quad (3)$$

$$\text{WTP} = f(\alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \text{Ui}). \quad (4)$$

Where,

WTP = Willingness of the stakeholders to pay for the deterrent measures which if the Government implements in the fringes or in the border of the crop land and reserved forest areas; Here, the value 1 is given if they are willing to pay and '0' otherwise.

X_1 = Awareness of the respondents on the details of Elephant Protection Measures; If the protection is poor, Value 1 is given. If it is medium, value 2 is given and if the protection is good, the value 3 is given.

X_2 = Effectiveness of Existing Deterrent Measures (Value 1 is given if it is ineffective; value 2 is given if it is Less Effective and Value 3 is given if it is found more effective)

X_3 = Proximity of the Farm lands to the Reserved Forest Area in km

X_4 = Relative Percentage of Farm income to the Household income

X_5 = Size of the Farm Land in Ha

X_6 = Human Suffering including Injury and Death due to the Wild animals attack (If human suffering is there, value 1 is given; '0' otherwise.

X_7 = Economic Loss includes both value of the crop loss and property (Rs in lakhs)

Where, the coefficients of $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ are to be estimated.

2.2.2 Garett's ranking technique

Garett's Ranking Technique was adopted to analyse the prioritization given by the farmers and other stakeholders to the different types of crops affected by the elephant depredation. In this technique, the rank order was given in a sample ordinal scale.

In this technique, the farmers were asked to rank the different types of crops attacked by the elephants and the crops which were most affected by the elephant depredation have been

arranged in ascending order according to the rank found.

The technique was also used to rank the suitable elephant depredation mitigation measures in the study area. This was obtained by asking the respondents to rank the different types of mitigation measures which is best suited for them to implement. The order of merit given by the respondents was converted into score by using the following formula,

$$\text{Per cent position} = 100 (R_{ij} - 0.5) / N_j$$

Where,

R_{ij} = Rank given for i^{th} Factor by j^{th} Individual
N_j = Number of Factors ranked by j^{th} individual

The per cent position of each rank thus obtained was converted into scores by referring to the table. For each factor, the scores of individual respondents are added together and divided by the total number of respondents from whom the scores are added. The mean score was thus estimated and these mean scores for all the factors were arranged in a descending order and factor with the highest mean score was given first rank. The most important factors were thus identified and ranked.

3. RESULTS AND DISCUSSION

3.1 Awareness Level on Human-Animal Mitigation Measures

Even after knowing that the elephants are attracted much towards the crops like Banana, Sugarcane and Coconut, the farmers were establishing these crops in their farm lands as these crops are capable of providing higher income per annum. In this regard, they continuously raise the commercial crops in their farm lands and practice certain elephant mitigation measures. In certain pockets, the farmers were not much exposed to the mitigation measures and hence an effort has been taken to assess the level of awareness on the elephant mitigation measures which are practiced and its usefulness. These details are analysed and the results are presented in Table 1.

It is to infer from Table 1 that the respondents were well aware of the human-animal mitigation measures to an extent of very good and good level which is accounted for 44 per cent and 28 per cent respectively to the total. These two level put together accounted for 74 per cent revealed that the farmers were aware of the mitigation measures and practiced in their fields also. Whereas, few of the farmers were not much aware about the wild animal mitigation measures whom are accounted for around 12 per cent to the total. The human-animal mitigation measures were known partially to around 16 per cent of the respondents. From that one could infer that around 28 per cent of the farmers living away from the villages and hence they were not having much awareness about the mitigation measures. Another thing that they would not have faced such situations in their holding to think about the animal mitigation measures.

3.2 Frequency of Visit of Animals to the Farm Front

When one could talk about awareness level, the frequency of visit of animals to the farm environment also to be assessed. In this respect, the opinion of the farm households on the frequency of visit of animals were analysed and the results are presented in Table 2.

Table 2 inferred that elephant migration takes place during summer months in search of water and food. By that time, the elephants invade the crops. Approximately, the elephants numbering around one hundred per annum is migrating and damaging the crops and the frequency of damage is arrived at weekly. The elephant migration and its damage is visible because of its time of movement and hence the farmers could mitigate to certain extent. Whereas, the damages

Table 1. Awareness level on human – animal mitigation measures

Sl. No	Awareness	Number of respondents	Percentage to Total
01	Poor	14	12
02	Medium	19	16
03	Good	34	28
04	Very Good	53	44
	Total	**120**	**100.00**

Table 2. Opinion of inhabitants on the frequency of visit of animals to the farm

Sl. No	Name of the Animal	Frequency of Visit	Season of Visit	Approx. No of Animals Visited Per Annum
01	Elephants	Weekly	Summer	100
02	Wild Boar	Daily	Winter	250
03	Bison	Daily	Summer	50
04	Monkeys	Daily	Summer and Monsoon	200
05	Peacock	Daily	Summer and Winter	75

caused to the crops by Wild Boar is the biggest issue to the farmers as they are moving in herds during the winter months which are approximately arrived at 250 in numbers. They used to damage the root zone of Banana and other crops which are rhizome in nature. The visit of Wild Boar is almost on daily basis which are uncontrollable.

Bison, though its number is limited per visit, the extent of damage is high and almost on par with the elephants and feed on the crops heavily. Visit of Bison is also on daily basis to the farmer field during summer and winter months. Monkeys were the other wild animals which are also causing damages to the Banana and other fruit and nut crops during the months of summer and winter and causes more damage to the fruiting of Banana. Peacock is feeding on the grain crops and damages the vegetable fields on daily basis. All these invades forcing the farmer to the level of confusion to decide on which crop that all these animals and birds cannot damage and the farmer could take at least some benefits is in question.

Protective measures also specific to one animal cannot be decided. Peacock and Monkey attacks mostly on aerial attacks. Wild Boar can be controlled by erecting barbed wire fence but the same cannot controlled the entry of Bison and the Elephant. For them, the solar operated electric fence or battery operated electric fence will bring protection to some extent. Battery operated electric fence can be easily manoeuvred by the elephants by pressing the post in the bottom so that all the post which is bearing the electric line become dysfunctional and then it walk through the field for grazing.

3.3 Visiting Hours of Elephants to the Farm Front

If one could observe the crops grown in the farm field from the hill side slopes, a lush green colour with vigorous crop growth is visible during summer while the forest slopes filled with grasses which are dried and not appealing to the animals motivated them to migrate to the farm floor in search of good food and water and hence it migrates from the forest floor to the farm floor. In this context, it is important to assess the visiting hours of wild animals from the households in the form of their opinion which are analysed and the results are furnished in Table 3.

Table 3 revealed the details of opinion on the visit of animals to the farm floor for feeding of crops. Around 70 per cent of the respondents have expressed that the animals are visiting in the early morning hours for feeding the crops. It was supported by the mean score of 3.85 and ranked in third rank. The visit of elephants to the farm floor is mainly during the evening hours according to 85 per cent of the respondents which has generated a mean score of 4.38 revealed that the statements are agreeable. Whereas, the mid night visit of animals was expressed by 88 per cent of the respondents which has generated a mean score of 4.57 revealed that the statements are strongly agreeable to the respondents and stood at first rank. From that one could infer that the visit of animals to the farm floor is mostly during the mid-night and very early hours in the morning which was a good sleeping time to the farmers. The animals used to wait nearby forest floor for undisturbed hours and then they visit to take their requirements.

If the farmers were awakening and using the crackers for threatening the animals, the young animals were troubled much because of the unwanted sound and run here and there which causes heavy damages. In this connection, development of fumes with safety measures along the periphery of the forest floor may alleviate the animals from not entering the farm floor and the crops could be safely protected.

Table 3. Opinion on visiting hours of elephants leading to conflicts

Sl. No	Timings	SA	A	N	DA	SDA	M.S	Rank
01	Early Morning	11	75	04	05	25	03.85	III
02	Day Time	03	05	12	25	75	01.60	IV
03	Evening Hours	80	22	05	10	03	04.38	II
04	Mid Night Visit	95	10	08	03	04	04.57	I

(SA- Strongly Agree, A- Agree, N- Neutral, D- Disagree, SDA- Strongly Disagree; MS- Mean Score)

3.4 Proximity of the Farm Floor to the Reserved Forest Floor

The damages caused to the field crops, assets of the farmer and the livestock animals becomes much pain to the farmers in the forest fringe villages. In this connection, the researcher has shown interest in collecting the distance of forest floor from the farm was enquired with the farmers and the details are analysed and the results are presented in Table 4.

Around 37 per cent of the respondents outlined that the farm floor is less than one kilometre distance (Table 4). Whereas, 33 per cent of the farm floor was within the distance of one to two kilometres revealed that around 70 per cent of the farm floor is very closer to the forest floor and hence the visit of elephants and other animals to the farm field is quite often taking place and hence the farmer has the responsibility of protecting their own farm field from the attack of wild animals without giving any harm to the wild animals stipulated under the law. Violation of the same will lead to serious punishment to the farmers. Such actions should not be initiated to reduce the killing of animals by injecting poison and electrocution of animals.

3.5 Major Reasons for Man-Animal Conflicts

The opinion of the respondents with regard to identification of major reasons for the man-animal conflicts in the study area were invited and the opinion expressed by them were subjected to scaling techniques and the results were exhibited in the form of mean scores and the results are presented in Table 5.

Table 5 revealed the details of major reasons for the existence of man-animal conflicts. These were ranked based on the mean score obtained by using the Likert scaling technique with five point continuum. Among the major reasons, the habitat fragmentation found to be number one stood with 4.7 as its mean score indicated that the factor has scored the opinion of “Strongly Agree” according to 80 per cent of the respondents. This was followed by Shortage of food resources in the forest perimeter and the Periodic human invasion into the forests for their various needs like small timber, fuel wood and bush meat related activities found to be the major reasons for unexpected conflicts between the wild animals and the human being. The same was supported by mean scores of 4.13 and 4.04 indicating that the “Agree” mode of scale developed for this purpose.

Another reasons like Degradation of Forests and Climate Change and Insufficient Water in the Habitat of the Elephants were the motivating factors in search of good environment and water in the farm lands were responsible for conflicts which are also supported by the mean scores of 3.96 and 3.72 indicating that the respondents were agreeing to that. In this circumstances, the forest department has to provide water and fodder requirements in the corridor vicinity to check the animals from diversion to farm fields in search of food and water.

Table 4. Proximity of the affected area to the reserved forest area

Sl. No.	Proximity to Reserve Forest in kms	No of Households	Percentage to Total
01	Less Than One	44	36.67
02	1 - 2	40	33.33
03	2-3	25	20.83
04	3-5	11	09.17
	Total	**120**	**100.00**

Table 5. Stakeholders opinion on major reasons for the human - animal conflicts

Sl. No	Factors Influencing Conflicts	Opinion of Respondents					Mean Score	Rank
		SA	A	N	DA	SDA		
01	Establishment of Elephant Loving Crops on Farm Lands without Protective Fences	39	43	16	8	14	3.70	VI
02	Improper Maintenance of Fence by the Farmers	18	60	11	25	03	3.46	VII
03	Shortage of Food Resources in the Forest Perimeter	38	56	23	05	03	4.13	II
04	Degradation of Forest and Climate Change	08	102	07	02	01	3.96	IV
05	Insufficient Water in the Habitat of the Elephants	17	72	14	15	02	3.72	V
06	Encroachment of Corridors by Manmade Institutions	28	38	23	26	05	3.48	VIII
07	Unable to Sense the Animal Movement by the Farmers	25	37	26	26	06	3.40	IX
08	Forest Fire Causing all the Wildlife to Move to Safe Zones	24	35	27	28	06	3.35	X
09	Habitat Fragmentation	96	19	02	02	01	4.72	I
10	Periodic Human Invasion into Forests for Various Needs	36	59	21	02	02	4.04	III

(SA- Strongly Agree, A- Agree, N- Neutral, D- Disagree, SDA- Strongly Disagree)

3.6 Perception of Stakeholders on the Co-Existence

Amidst all these conflicts and issues, some of the respondents are ready to stay in the farm lands which are located in the forest fringe villages and they are expressing their willingness to stay along with the visit of the wild animals. Few of them are interested in staying to see the animals and their visit and want to mitigate them when they are damaging too much in the farm lands by exercising some force which are threaten in nature and not harming of animals. Such coexistence details are analysed and the results are presented in Table 6.

Table 6. Perception of stakeholders on co-existence with the visit of wild animals

Sl. No	Measures	Opinion of Respondents					Mean Score	Rank
		SA	A	N	DA	SDA		
01	Rehabilitation of Elephant Corridors	39	43	16	08	14	03.70	V
02	Strengthening Wildlife Protection Squad	18	63	10	25	04	03.55	VII
03	Erection of Wild Life Monitoring Sensors	03	34	31	31	21	02.72	X
04	Provision of Preferred Food in its Domain	03	103	09	03	02	03.85	III
05	Provision of Water for the Animals inside the Forests	36	55	29	04	02	04.14	II
06	Establishment of Bio Wall using Honey Bee Alarm	23	42	13	32	10	03.30	IX
07	Separate Area for Wildlife by making Suitable Fencing	13	76	14	14	03	03.68	VI
08	Establishment of Elephant Conservatory Units	24	35	27	28	06	03.35	VIII
09	Providing Training to the Farmers in Forest Villages	15	75	15	12	3	3.72	IV
10	Compensation for the Damages	97	10	03	04	06	04.57	I

(SA- Strongly Agree, A- Agree, N- Neutral, D- Disagree, SDA- Strongly Disagree)

Table 6 inferred that among the various factors responsible for aversion of conflicts and coexistence with the farm lands, the farmers felt that even if the damages are caused by the animals, the compensation package should be paid timely which has generated a mean score of 4.57 as its mean score and the rating in the range of "Strongly Agree" according to 81 per cent of the respondents. Provision of water for the animals inside the forests and Provision of preferred food for the elephants in its domain are the other two factors have generated the mean score of 4.14 and 3.85 and respectively ranked second and third level indicating that these two are the variables in the "Agree" category according to 46 per cent and 86 per cent of the respondents respectively.

Providing training to the farmers in Forest fringe villages and Rehabilitation of elephant corridors are the other two factors which are also in its ranking more considerable has generated the mean scores of 3.72 and 3.70 respectively having the ranks of fourth and fifth. The fourth factor found to be the best choice for the forest department to provide training to the farmers on how to behave while the elephants or other animals accidentally or incidentally entered the farm lands. Such details are given to the farmers, then the conflicts could be bring to halt in the wilder and farm land environment.

3.7 Prioritizing the Most Affected Crops in the Sample Farms

Garrett's Ranking Technique is one of the measure can be practiced to rank the opinion of the farmers on crop damages by the elephants. In this respect, the analysis could find out the most affected crop by the wild animal damages through the mean score obtained from the analysis of the opinion of the farmers. These details are analysed and the results are presented in Table 7.

Table 7 inferred that the most affected crop is Banana which is the one most preferred to the elephants with a mean score of 75.67 and stood in the first rank and the second rank goes to the Coconut with the mean score of 74.13 indicated that the Banana and the Coconut were the preferred crop to the elephants. The third rank goes to the Arecanut crop. In the absence of the two expressed in the rank one and two, the Arecanut and Sugarcane could attract the elephants and gained the mean scores of 59.73 and 59.54respectively. The difference between the mean scores of Arecanut and Sugarcane is only marginal and these two are the crops most palatable one to the elephants and hence the farmers who are raising the crops in the forest fringe areas should specifically take protective measures to protect the crop from the wild animals.

3.8 Willingness to Pay for the Measures to Mitigate the Conflicts

Amidst several protective measures, few are successful and some are facing failure due to the non-participation or support from the common public living in the forest fringe villages. The participation of villagers or the farmers or the tourists be made available to lead any programs into a successful one by means of some contribution. In this respect, their willingness to pay for the development initiatives or measures taken to mitigate the conflicts between man and the animals are the need of the hour and hence the discussion on the following lines will fulfil the Willingness to pay objective. They are

- Details of Mitigation Measures Practiced to Control Man-Animal Conflicts
- Willingness to Pay for Different Protective Measures
- Probit Regression Analysis
- Averting Expenditure Approach

Table 7. Results of Garrett's ranking technique on affected crops

Sl. No	Crops Affected	Mean Score (N=120)	Rank
01	Arecanut	59.73	III
02	Banana	75.67	I
03	Cereals	35.53	VII
04	Coconut	74.13	II
05	Mango	47.58	V
06	Papaya	33.23	VIII
07	Pulses	30.16	IX
08	Sugarcane	59.54	IV
09	Vegetables	35.73	VI

3.8.1 Details of mitigation measures practiced to control man-animal conflicts

Even after taking some of the protective measures by the farmers, the protective measures were become fatal before the elephants. If the elephant planned to feed the crops, it violates the protective measures initiated unless the big elephant trench would have been established. In this respect, it is important to learn about the measures which are effective or ineffective and hence these details are analysed and the results are presented in Table 8.

Table 8 inferred that among the many protective measures practiced by the farmers, the fire crackers and the powerful torches illuminated on the animal face could alleviate the animals immediately and hence these two protective measures were common among the farmers which are respectively accounted for 97 per cent and 92 per cent to the total respondents. Battery operated electric fence found to be the next best alternative to the farmers in the farm boundary to protect the crops from the animals. Continued high voltage electrification in the boundary is an offence and hence the pulse per second based shocks could be the vital one and fed to the wires to control the wild animals. Besides these, some of the respondents have opined that the protective measures like solar fence, camera surveillance and the trenches were found to be cost wise expensive and are not contribute to the protection of the crops and hence these were not practiced by most of the farmers considering ineffective measures. Amidst various protection measures, the wild animals have violated the same measures and damaged the crops leading to human injury and human deaths. In this respect, the details of number of compensation applied to the forest department and the number of compensation which are pending for payment and their details are analysed and the results are presented in Table 9.

Table 9 inferred the details of compensation applied to the Forest Department for getting the compensation but only around 62 per cent of the respondents were able to get the compensation from the Forest Department and the remaining 38 per cent of the claims were pending with the department for want of sufficient funds from the head and in some establishments, unnecessary delay could be visualized according to the respondents. From the opinion of the Forest Department officials, the insufficient funds and non-availability of appropriate evidence related issues are forcing the officials to keep pending. On receipt of necessary documents, the claims will be settled at the earliest according to the officials. Since this claim involves the documentary evidences from Department of Agriculture, Department of Horticulture and Plantation Crops and hence the delay is possible to certain extent as it involves the visit of different officials to the spot for verification and assessment of damages.

Table 8. Adoption and opinion of different protective measures (Multiple responses)

Sl. No	Type of Measures	Opinion of Respondents			Number of Respondents Practiced	Number Of Respondents Not Adopted
		Effective	Less Effective	Ineffective		
01	Electric Fences	85	17	18	85 (71)	35
02	Solar Fences	25	65	30	15 (13)	105
03	Fire Crackers	105	10	05	116 (97)	04
04	Torches	102	12	06	110 (92)	10
05	Trenches	45	34	41	23 (20)	97
06	Camera Surveillance	75	35	10	18 (15.00)	102

(Figures in Parentheses indicate Percentage to Total)

Table 9. Details of compensation applied and obtained from the forest department

Sl. No	Types of Damages	Number of Households	Compensation Applied	Compensation Obtained
01	Crop Damages	105	24	11
02	Property Damages	40	32	21
03	Humans Death and Injury	11	11	9
04	Livestock Damages	52	35	22
	Total		102 (100.00)	63 (61.76)

(Figures in parentheses indicate percentage to total)

3.8.2 Willingness to pay for different protective measures

The respondents' willingness to pay for the development measures or the protective measures to control the man-animal conflicts is important and hence these details are analysed and the results are presented in Table 10.

Table 10 inferred that most of the respondents whom are accounted for 27 per cent are willing to pay from Rs one hundred to Rs Two hundred followed by 25 per cent of the respondents were interested in paying Rs 50 to 100. Around 32 per cent of the respondents were ready to pay some higher amount which ranges between Rs 200 to 500. However, around 17 per cent of the respondents were not interested in paying any contribution towards such initiatives. Hence, the respondents should be created some awareness on the benefits of forest protection measures which are needed for preserving the wild animals so as to maintain biodiversity and ecotourism.

3.8.3 Probit regression analysis for contingent valuation method

The willingness to pay is the dependent variable which is influenced by some of the explanatory variables. The variables included in the analysis were Awareness of the respondents towards mitigation measures, Effectiveness of existing Mitigation measures, proximity of farm land to the reserved forest, percentage of farm income to the household income, Farm size available with the farmers, Human sufferings like death and injuries because of the attack of elephants and the economic loss incurred by the farmer due to the crop and property damages. In order to assess the willingness to pay for mitigating measures among the stakeholders and to ascertain the factor responsible for determining the WTP (Willingness to Pay). The Contingent Valuation Method (CVM) is applied and used STATA 13 to solve the Probit analysis and the results are presented in Table 11.

The estimated R^2value of 0.55 indicated that 55 percent variation in the dependent variable is explained by independent variables included in the analysis: Awareness of the respondents towards mitigation measures, Effectiveness of Existing Mitigating Measures, Proximity of farm land to reserved forest, Percentage of farm income to household income, Farm sizeand Economic loss incurred due crop and property damages by the animals. Among the seven variables, Awareness of the respondents towards

Table 10. Stakeholders Willingness to Pay (WTP) for protective measures

Sl. No	WTP in Rs	Number of Stakeholders	Percentage to Total
1	050-100	30	25.00
2	100-200	32	26.67
3	200-300	18	15.00
4	300-400	13	10.83
5	400-500	07	05.83
6	NIL	20	16.67
	Total	120	100

Table 11. Results of probit regression analysis for the contingent valuation method

Sl. No	Variables	Coefficient	Standard Error	p- Value
01	Intercept	5.1319	1.2806	0.0080
02	Awareness of the Respondents towards Mitigation Measures	1.1581*	0.5308	0.0290
03	Effectiveness of Existing Mitigating Measures	1.3315*	0.7246	0.0660
04	Proximity of Farm Land to Reserved Forest	-0.445**	0.4306	0.0301
05	Percentage of Farm Income to Household Income	0.0137	.0095	0.4153
06	Farm Size	0.5882*	0.1067	0.0582
07	Human Sufferings leading to Death and Injuries	0.5789**	0.8615	0.0350
08	Economic Loss incurred due to Crop and Property Damages by the Animals	0.1435**	0.1863	0.044
	R^2Value	00.55		

*(** Indicates significance at five per cent level; * Indicates significance at ten per cent level)*

mitigation measures, Effectiveness of Existing Mitigating Measures, Proximity of farm land to reserved forest, Farm size and Economic loss incurred due crop and property damage were the six factors found to be statistically significant indicated that these factors cause significant changes in the willingness to pay among the stakeholders. Among these, Proximity of farm land to reserved forest is inversely related to WTP. According to probit results, when the significant variables like Awareness of the respondents towards mitigation measures, Effectiveness of existing Mitigation measures, Farm size available, human sufferings like death and injuries and the economic loss incurred due to the crop and property damages by the animals increases, the farmers are more likely to pay for the protective measures. On the other side, when the Proximity of Farm Land to Reserved Forest increases, the farmers are unlikely to pay for the protective measures. This denotes that, as the farms were more far away from the reserved forests, the farmers were less likely to pay for the protection.

3.9 Marginal Effect Analysis

That is one per cent increase in distance of farm land from reserved forest would decrease the WTP by 0.54 per cent and this variable is significant at 5 per cent level. Another variables like Human sufferings leading to Death and Injuries, Economic loss incurred due to crop and property damages caused by the elephants which are also significant at five per cent level indicating that one per cent increase in the above variables will increase the Willingness to Pay by 0.64 per cent and 0.34 per cent respectively. The remaining variables like Awareness of the respondents towards mitigation measures, Effectiveness of Existing Mitigating Measures and Farm size are found to be significant at 10 per cent level revealed that One per cent increase in the coefficient of above mentioned variables would results in an increase in the Willingness to Pay by .85 per cent, .95 per cent and 0.45 per cent.

4. CONCLUSION

The present study on Man-Animal Conflicts is one of the burning issue among the socio political and environmental arena where the environment is damaged by the human for want of food, fuel, fodder and small timber requirements and at the same time the animal invades to the adjacent crop fields for want of food and water. This type of invasion is existing all time among the man and the animals particularly among the elephants and very rarely the predatory animals.

The respondents were well aware of the human-animal mitigation measures to an extent of very good and good level which are accounted for 44 per cent and 28 per cent respectively to the total. These two level put together accounted for 74 per cent revealed that the farmers were aware of the mitigation measures and practiced in their fields also. Whereas, few of the farmers were not much aware about the wild animal mitigation measures whom are accounted for around 12 per cent to the total.

Among the various factors responsible for aversion of conflicts and coexistence with the farm lands, the farmers felt that even if the damages are caused by the animals, the compensation package should be paid timely which has generated a mean score of 4.57 as its mean score and the rating is in the range of “Strongly Agree” according to 81 per cent of the respondents. Provision of water for the animals inside the forests and Provision of preferred food for the elephants in its domain are the other two factors have generated the mean score of 4.14 and 3.85 and respectively ranked second and third level.

Amidst several protective measures, few are successful and some are facing failure due to the non-participation from the common public living in the forest fringe villages. The participation is based on the Willingness to Pay in the developmental interventions. In this respect, willingness to pay for the mitigation aspects of man-animal conflicts are the need of the hour and hence the willingness to pay is discussed under different heads.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Madhusudan MD. Environmental Management. 2003;31(4):0466-0475.
2. Singh, Shiv Sahey, AathiraPerinchery. Elephant Corridors in India Threatened, says Study, The Hindu (Nov 11, 2017; Kochi); 2017.
3. Bell RHV. Conservation and wildlife management in Africa. 1984;387-416.

4. Jones Trevor, Andrew J Bamford, Daniella Ferrol-Schulte, ProchesHieronimo, Nicholas McWilliam, Francesco Rovero. Tropical Conservation Science. 2012;5(4): 463-474.
5. Boominathan D, Mohanraj N, Aziz T, Desai A. Management of the Asian elephant in the Nilgris and Eastern Ghats: human-elephant conflict in Somwarpet Subdivision (Madikeri Forest Division). WWF AREAS; 2008.
6. Carson Richard T, Robert C Mitchell, Michael Hanemann, Raymond J Kopp, Stanley Presser, Paul A Ruud. Contingent valuation and lost passive use: Damages from the Exxon Valdez oil spill. Environmental and Resource Economics. 2003;25(3):257-286.
7. Abugri SA, Amikuzuno J, Daadi EB. Looking out for a better mitigation strategy: smallholder farmers' willingness to pay for drought-index crop insurance premium in the Northern Region of Ghana. Agriculture & Food Security. 2017 Dec;6(1):1-9.
8. Onugo TN, Onyeneke RU. Farmers' Preference and Willingness to Pay for Climate-Smart Rice Varieties in Uzo-Uwani Local Government Area of Enugu State, Nigeria. Ekológia (Bratislava). 2022 Jul 1;41(3):262-71.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/100989