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Abstract

This paper explores the feasibility of adopting an integrated economic approach to raise farmers' tolerance of the presence of elephants on their farming lands. Responses to this approach were sought from a sample of farmers in the areas affected by human elephant conflict in the northwestern province of Sri Lanka. Results from a contingent valuation survey of their willingness to pay for a scheme to conserve elephants are also reported. Two separate logit regression analyses were undertaken to examine the factors that influence the farmers' responses for the payment principle question and their opinions on the integrated economic approach. Although found that the majority of the respondents expressed their willingness to pay for the proposed scheme and supported for the implementation of the integrated approach, we have insufficient data yet to determine if their support and financial contribution would be sufficient to set up this programme and also to predict its economic viability. Nevertheless, the overall finding of this study provides an improved economic assessment of the farmers' attitudes towards the wild elephant in Sri Lanka. At the same time the study shows that, contrary to commonly held assumptions, farmers in this developing country, do support wildlife conservation.

Keywords: Agricultural pest, agricultural insurance, Asian elephant, economic valuation, *Elephas maximus*, farmers' wildlife attitudes, human-elephant conflict, wildlife conservation

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1. Introduction

The Asian elephant (*Elephas maximus*) is regarded as an important cultural and religious icon in Sri Lanka. The relationship between people and elephants is deep and dates back at least 3,000 years (Jayawardene, 1994). But, despite this unique relationship, the long-term survival of wild elephants in Sri Lanka, although not entirely hopeless, appears bleak. On average, about 100 elephants die every year in Sri Lanka primarily because of their interference with agriculture and farming practices (Weerakoon, 1999). Kemf and Santiapillai (2000) confirm this and point out that in Sri Lanka, unlike Africa, ivory poaching is not a threat to the elephant given that tusks are found only in a small proportion (less than 7%) of the bulls. Therefore, the problem arises from the conjunction of farming and elephants.

The crop raiding behaviour of wild elephants is not yet fully understood (Stuewe and Venkataraman, 2002). However, Nyhus *et al.* (2000) believe that the frequency and severity of crop raiding by elephants are closely associated with the degree of destruction of their natural habitat. For example, in Sri Lanka, more than 80% of the elephant habitat has some form of human disturbance (Desai, 1995), and about 46% of the elephant population lives outside the officially gazetted protected areas (De Silva, 1998) leading to the serious conflict with farmers. Santiapillai (1998) believes that such conflict began with the establishment of large-scale plantations when Sri Lanka was a British colony. This situation has been further aggravated over the last five decades as successive governments have all supported agricultural development (Bandara and Tisdell (2000a). Consequently, many families were resettled in and around elephant ranges in the low country dry zone, most translocated from

areas without wild elephants. These farmers show a marked inability to successfully cultivate in areas frequented by these animals and to co-exist with them.

Johnsingh and Williams (1999) believe that, as long as agriculture is the prominent form of land use around the main elephant range in Asia, it will be impossible to prevent elephants from moving into the farming areas. In Sri Lanka around 47% of the irrigated agricultural schemes occur in and around areas frequented by elephants. These schemes produce about 60% of the nation's rice while providing livelihood for about 350,000 farming families. At the same time, protected areas in the vicinity of these schemes provide shelter for about 50% of Sri Lanka's elephant population (Karaywasam *et al.,* 2002). Thus it is impossible to adopt any extreme position such as the removal (relocation) of the entire population of either elephants or humans from these areas. Moreover, since there is no proper mechanism for farmers to recover the cost of damage caused by elephants Bandara and Tisdell (2002b), it is impossible to prevent farmers' hostility towards crop raiding elephants. Thus in reality, given the current capacity and degree of fragmentation of the elephant habitat, long-term survival of wild elephants in Sri Lanka depends on their continued use of both protected and non-protected areas.

Bandara and Tisdell (2002a) believe that establishing an appropriate mechanism to compensate for the damage caused by elephants could encourage farmers in the non-protected areas to tolerate these animals. In theory, farmers in these areas may be willing to contribute funds to such a scheme at least for two reasons. Even if they see no economic value in elephants and regard them purely as pests, farmers may be willing to contribute to the scheme because it will provide them with compensation for damages caused by elephants. Such farmers value only the insurance aspect of the scheme. However, there may be other

farmers who, apart from appreciating the insurance aspect of the scheme, place a positive value on the survival of wild elephants. Other things equal, they will be willing to contribute more funds to the scheme than farmers in the first-mentioned category. To what extent are Sri Lankan farmers motivated by these two aspects of the scheme? Our data collection and analysis are designed to help answer this question.

Therefore, the purpose of this study is to present the results from a contingent survey of a sample of farming families in the northern boundary of *Wilpattu* National Park of Sri Lanka, and to elicit their willingness to pay (WTP) for a scheme to conserve the Asian elephant. In this survey, the feasibility of adopting an integrated economic approach to raise respondents' tolerance of the presence of elephants on their farming lands was also explored. The paper first establishes the contingent valuation market to assess farmers' total economic valuation of a scheme for conserving elephants. The nature of the sample survey and materials and methods used in this study are then reported. Analyses undertaken to assess respondents' awareness of HEC related issues and their opinion about integrated economic policies are presented. The factors influencing respondents' responses for the principle WTP elicitation question are analysed using logit analysis. Results are reported separately for individual and aggregate WTP estimates and extrapolated for all the areas where HEC prevails in the country. The final section presents conclusions reached and the direction for further research.

2. Establishing a contingent valuation market to assess farmers' total value of a scheme to conserve the elephant

The empirical procedure of any typical contingent valuation study begins by establishing a hypothetical market to assess the provision of a non-market commodity (Wills and Powe, 1998; Witzer and Urfei, 2001; White *et al.* 2001). In that hypothetical situation, it is expected

that respondents act as consumers in an actual market situation where they have the opportunity to increase the level of provision of the goods, but must pay some amount of money do so (Ready *et al*. 1996). In the present study, we established a contingent market to assess farmers' WTP for a scheme to conserve elephants. The objective of this scheme is to compensate farmers for economic damages caused by elephants in areas affected by HEC. In this process, we adopted the procedures promoted by Hadker *et al.* (1997), Whittington (1998), and FAO (2000) in the developing country context. Interviews with the respondents involved four different steps.

In the first step, the respondents were informed that in 1996 the International Union of Nature Conservation had declared the Asian elephant in Sri Lanka to be one of the most seriously endangered species of large mammals in the world (see IUCN, 1996). Then, with reference to relevant statistics, such as elephant mortality, respondents were updated about the current status of HEC in Sri Lanka and its consequences. In this conversation, respondents were also told that existing protected areas would be inadequate in size to ensure the long-term survival of wild elephants if elephants are confined to these areas, that there is little or no prospect of a significant increase in the size of the areas, and thus, the survival of elephants in the long run depends on their continued use of both protected and non-protected areas. Respondents were then notified that this requires socially acceptable strategies to establish an appropriate level of co-existence between farmers and elephants.

In the second step, respondents were briefed on the basic elements of an integrated economic approach proposed by Banadra and Tisdell (2002a) to address the issues involved in conserving the elephant and mitigating HEC. Respondents were then told that, in this approach, it is expected that farmers and private landowners in the unprotected areas would

allow elephants some access to their farming lands, for instance access to move across from one isolated habitat to another. However, no restriction would be imposed on farmers in undertaking legally allowed methods to control habitual crop-raiding elephants. Then they were told about the idea of the setting up of an appropriate scheme for them to recover the damages caused by elephants.

In this conversation, respondents were informed that this proposed scheme is aimed at providing two different insurance covers: one is to cover the crop and property damage caused by the elephant and the other is for economic losses caused by the death (or permanent disability) of the head of the household due to elephant attacks. Then they were told that, based on a number of recent crop damage estimates (see Jayawardene, 1998; De Silva, 1998; Kulathunga, 1999; and Bandara and Tisdell 2002b), the expectation is that every single farming family both in the severely and less affected areas would be offered Rs. 30,000 and Rs. 20,000 worth of insurance coverage on average per annum respectively to recover the crop and property damages caused by elephants. Moreover, they were also informed that the other scheme proposed in this study aimed to offer Rs. 150,000 worth of life insurance coverage for a person 25 years old in each farming family (preferably for the head of the household) for a period of 15 years. Finely, the survey respondents were told that provision of these insurance covers is expected to raise farmers' tolerance for the presence of the elephant on their faming land.

In the third step, respondents were told that an autonomous body, reputed for its efficient and honest work, would undertake the proposed sachems in this study. This organisation believes that the current HEC related issues could be alleviated while re-establishing necessary co-existence between elephants and farmers as in the past. Respondents were then told that

finance was required for the proposed programme and that the support of the general public would be needed to establish a 'trust fund' to undertake it. In this process, we adopted non-obligatory, specific voluntary contribution mechanisms (VCM) to determine the survey respondents' likely contributions to the proposed trust fund. A number of recent contingent valuation studies, for example Champ *et al.* (1997) and Chilton and Hutchinson (1999) have used this mechanism to motivate respondents to tell the truth. Whittington, (2002) argued that respondents in developing countries could be motivated more towards truth telling through the VCM than the conventional bid vehicles such as income tax, entry charges, property tax and changes in utility bills. Bohara *et al.* (1998) indicate that the VCM often creates a believable scenario while reducing the hypothetical nature of contingent valuation procedures.

In the fourth step, respondents were presented with the following contingent market valuation question: *For the next five years, would you be willing to pay Rs X from the monthly income of your household, that is Rs X per year, starting from January 1st 2002, towards the establishment of the proposed trust fund to finance the abovementioned scheme".* The dichotomous choice format with a set of optional follow-up questions was used as a WTP elicitation technique. This format was initially proposed by Hanemann *et al.* (1991). FAO (2000) reports that this method has recently become a widely used elicitation format, particularly in developing countries; Whittington (1998) and Bateman and Wills (1999) discuss its significance in the context of developing countries; and Bateman *et al.* (2001) provide a useful review of the recent studies based on this format.

In this format, the principle WTP elicitation question is presented with the highest bid value in the bid vector, which in the present study was Rs. 250. The follow-up question is

conditional on the respondent's response to the bid value offered in the initial question: the amount offered is lower if the response is 'no'. This process is continued by reducing the bid value offered on each occasion, if the respondent's response is 'no', until the lowest bid value in the bid vector is reached. In the preset study, the bid vector contained five different bid values i.e. Rs. 250, 100, 50, 25 and 10. Finally, the respondents who refused all the bid values offered in the survey were asked to present the maximum amount that they would be WTP for conserving the elephant in Sri Lanka. Cooper (1994) suggests that this open-ended question offered at the end of the elicitation process improves the precision of the WTP estimate. Alberine *et al.* (1997) point out that this whole approach mimics consumers' behaviour in regular markets.

3. Samples, Data Collection and Method of Analysis

3.1 Samples

Two sub-samples of farmers were chosen from the *Galgamuwa* divisional secretariat in the northwestern province in Sri Lanka based on the level of severity of the HEC as estimated by Desai (1998). One of these sub-samples was chosen from three severely affected villages (*Karuwalagas wewa, Raswahera,* and *Meegalawa*) within the northern boundary of *Wilpatthuwa* national park. The other sub-sample was chosen from three less affected villages (*Galkiriyagama, Makulawa,* and *Vitharandeniya*) in the areas adjacent to the national park boundary. One hundred and fifty randomly selected farming families were chosen for each of these sub-samples. A summary of socio-economic characteristics of the sample is presented in Table 1.

Table 1: A summary of socio-economic characteristics of the samples

Variable	Subs-ample 1[a]		Sub-sample 2[b]		Aggregate sample	
	Mean	Stdv	Mean	Stdv	Mean	Stdv
Household size	3.98	1.98	4.69	1.07	4.67	1.27
Gender (male=1)	0.74	0.48	0.60	0.48	0.64	0.48
Age	39.13	12.82	42.13	9.92	41.13	10.89
Years of schooling	9.3	5.01	13.3	3.01	11.3	2.01
Size of the landholding[c]	1.69	0.61	1.02	0.61	1.29	0.61
Total farming income[d]	27552	7533	33552	5510	29552	6540
Agricultural dependency ratio[e]	97. 7%	-	93. 2%	-	94. 9%	-

Note: a) Villages within the boundary of national park; **b**) Villages in the area adjacent to boundary of the national park; **c**) In hectares; **d**) Per cropping season in Rupees; **e**) Total annual average farming income as a percentage of total annual average family income.

3.2. Survey instrument and nature of questions asked

An interview schedule (IS) in four separate sections was used as the main survey instrument. Section one captured the personal profile of the respondent, and was designed not only to gain information about the respondent's social, economic and demographic characteristics but also to establish conversational rapport. In section two, respondents were asked two questions: one in relation to their awareness about the current status of HEC related issues; and the other on their opinion towards IEA proposed in this study. Section three presented contingent market valuation questions to assess farmers' WTP for a scheme to conserve the elephant. In section four, respondents were asked two open-ended questions: one to express their motivation for the contribution and the other to indicate their preferred vehicle for payment.

3.3. Administration of the surveys.

A six-week field study was carried out from 14th June to 30th July 2001 with nine graduate students from the Faculty of Graduate Studies of the University of Colombo as interviewers. The face-to-face survey was conducted in *Sinhales*, a language spoken by the majority of the people in Sri Lanka. Each interview took, on average approximately one and a half hour to complete. Hadker (1997) describes the value of this method in the context of India and the situation in Sri Lanka is comparable: mail surveys have a low response rate and suffer from self-selection biases; and telephone surveys are ruled out because the facility is not available to most rural dwellers. Further, in face-to-face surveys trained interviewers interact with respondents, clarifying their doubts to minimise non-response rates, and judging their sincerity. Consequently, the quality of the data generated improves.

3.4. Method of analysis.

Two separate non-linear logit regression models were constructed in order to identify which socio-economic, demographic and attitudinal factors influenced the farmers' opinion of the integrated economic approach (IEA) proposed in this study and their responses to the WTP elicitation questions. Liao (1994) examines the advantages of use of a non-linear logit regression model for a contingent valuation survey with dichotomous format. One such advantage is the opportunity to use logit analysis, a non-linear method to regress a dichotomous dependent variable on one or more independent variables. As the probability of respondents' responses for the principle WTP elicitation question (or the question offered on the proposed IEA) is bounded by zero and one, it is not appropriate to estimate a linear probability function using OLS procedures. There is no guarantee that an OLS estimate will yield predicted probabilities in the 1-0 range. Moreover, in this case the dependent viable

being dichotomous, the OLS estimates are not efficient and classical tests of goodness of fit measures do not apply.

Equation 1 presents the conceptualised logit equation that predicts the respondents' response for principle WTP elicitation question (or the question offered on the proposed IEA) in this study:

$$Z = \beta_0 + \beta_1 x_i + \beta_2 x_2 + \ldots\ldots\ldots \beta_k x_k + u_i \qquad (1)$$

where Z = log (probability of yes) / (probability of no), β_0 ..... β_k are the estimated coefficients parameter, x_i are the independent variables that are consistent with demand theory, and u_i is the error term. The independent variables included in this study are presented in Table 2.

Table 2: Description of the variables used in the preliminary logit regression models

Variable	Hypothesized sign[a] and variable description
ATAM	(+) Attitude towards alternative HEC management approach: 1 = Strongly supportive, 2 = Supportive, 3 = Somewhat supportive, 4 = Not supportive.
AWAR	(+) Respondent's awareness about current elephant related issues: 1 = Not aware, 2= Aware, 3 = Very aware.
BIDV	(-) Rupee value from the WTP elicitation questions.
COED	(+) The amount spent on elephant damage control in Rupees per cropping season.
DAMA	(+) 1 if elephants caused damage during the last five cropping seasons; 1 if they experienced elephant damage; 0 otherwise.
GEND	(-) Gender: 1 if male; 0 otherwise.
NFPR	(-) Nature of the farming practice: 1 if Subsistence, 0 otherwise.
NUEL	(+) Non-consumptive use value of the elephant: 1= Not valued, 2 = Some valued, 3 = Highly valued.
OHEC	(+) Opinion on the severity of the HEC in the study area: 1=Very serious, 3 = Not so serious, 3 = Not serious at all.
PEDV	(-) Pro-development attitudes: 1 = Not supportive, 2 = Neutral, 3 = Supportive.
RAGE	(-) Respondent's age in years
RPHH	(-) Respondent's position in the family: 1 if head of the household; 0 .
TFIN	(+) Total farming income in Rupees per cropping season.
VCPC	(-) The average value of the damage caused by elephant per cropping season.
YOSA	(+) Years of schooling.

Note: a. Hypothesized signs of the variables are in brackets

Once the logistic equation is estimated, predicted probabilities can be determined by the following equation:

$$P = 1 / (1 + \exp^{-Z}) \qquad (2)$$

where *p* is the probability of a 'yes' response to the WTP questions (or to the IEA questions) and *Z* is the logit predication of a 'yes' or 'no' response. Then the interpolation of estimated regression coefficients were carried out on the basis of a one-unit change in the independent variable in question (holding all other independent variables constant) on the log of the probability of the "yes" or "no" choice.

4. The farmers' awareness about current HEC related issues: empirical evidence

The survey respondents were presented updated information in relation to the current status of HEC and conservation of elephants in Sri Lanka. Then they were asked: "*How 'new' is the information that we presented to you?"* Respondents' responses recorded, 'yes, very new' (coded as 1), 'only some of it is new' (coded as 2), and 'I knew all of this already' (coded as 3). This question was designed to test the claim that there is an immense information gap between urban and rural areas in less developing countries about the nature conservation issues that these countries are facing (see Abel and Blaikie, 1986; Bandon and Well, 1992; Shan, 1995; Skonhoft and Solstad, 1998). A summary of the respondents' responses is presented in Table 3.

Table 3: Farmers awareness about current HEC related issues

Response	Sub-sample1[a]	Sub-sample 2[b]	Aggregate sample
Yes, very new (recorded as 1)	21 (14.0)[c]	11(7.3)[c]	32 (10.7)[c]
Only some of it is new (recorded as 2)	99 (66.0)	88 (58.7)	187 (62.3)
I knew all of this already (recorded as3)	30 (20.0)	51 (34.0)	81 (27.0)
Mean	2.06 (0.58)[d]	2.27 (0.59)[d]	2.16 (0.59)[d]

Note: a: Villages within the boundary of national park (n =150); **b:** Villages in the areas adjacent to boundary of the national park (n =150); **c:** Percentage of total number of respondents in each sample; **d:** Standard deviation.

Although some variations existed between the two sub-samples, 89.3% of the respondents in the sample in general were aware of current elephant related issues in Sri Lanka. Of this 43% were fully aware of the situation. Our primary correlation analysis between respondents' awareness and the other socio-economic variables found that the degree of association between the awareness and the level of education (i.e. years of schooling) was positive with the value of coefficient of correlation (r) + 0.89. This is understandable because the majority of the respondents in the sample had 11.3 years of schooling on average (see Table 1 in section 3.1). This figure corresponds with estimates of the rural literacy in Sri Lanka which was estimated in a recently conducted population census (see Department of Census and Statistics, 2002). Research by Infield (1988) and Newmark *et al*. (1993) indicates that levels of education are positively correlated with local people's awareness of the nature conservation issues. Therefore, our results lead us to reject the claim that rural people in developing countries are less informed about current conservation issues compared to the urban dwellers, particularly in a situation where the rural literacy rate is high as in countries like Sri Lanka.

5. Integrated economic approach: an analysis of farmers' opinion

To assess their opinion of the IEA proposed in this study, respondents were asked: *if you were provided some mechanism to recover the damage caused by elephants, would you allow some access for the elephants to your farming fields*. Respondents' opinions were recorded on a four-point-scale ranging from 'strongly supportive' to 'not supportive'. A summary of the respondents' responses is presented in Table 4.

Table 4: Respondents' opinions towards integrated economic approach for conserving elephants and mitigating human-elephant conflict.

Nature of the respondents' response	Sub-sample1[a] (n =150)	Sub-sample 2[b] (n =150)	Aggregate sample (n = 300)
Strongly supportive (recorded as 1)	59[c] (39.3)[d]	49[c] (32.7)[d]	108[c] (36.0)[d]
Supportive (recorded as 2)	70 (46.7)	69 (46.0)	139 (46.3)
Neutral (recorded as 3)	14 (9.3)	23 (15.3)	37 (12.3)
Not supportive (recorded as 4)	7 (4.7)	9 (6.0)	16 (5.3)
Mean recorded value	1.79 (0.80)[e]	1.95 (0.85)[e]	1.87 (0.83)[e]

Note: a: Villages within the boundary of national park; **b:** Villages in the area adjacent to boundary of the national park; **c:** Number of respondents in each samples; **d:** Percentage of total number of respondents in each samples; **e:** Standard deviation.

As indicated in Table 4, the majority of the respondents in the sample have expressed some form of support for the proposed IEA. However, it seems that the support extended by the farmers in sub-sample 1 (within the park boundary) is relatively higher than the farmers in sub-sample 2 (areas adjacent to park boundary). This is understandable because the farmers within the park boundary experienced elephant damage to a greater degree than those in the adjoining areas. Doubtless they felt that allowing elephants some access to their farming fields would not make much difference to the situation that they are experiencing at present. Fiallo and Jacobson (1995) observe a similar pattern of support towards the alternative

approaches of nature conservation in a comparative study of residents within and outside the *Machalilla* National park in Ecuador as did Gillingham and Lee (1999) in relation to the *Selous* Game Reserve in Tanzania. Thus the findings of these studies and ours suggest that, contrary to the assumptions of many Western conservationist and development agencies, people in less developing countries, particularly local farmers, are not necessarily antagonistic to new approaches to wildlife conservation and not reluctant to extend their support for such programs.

We estimated three separate logit regression models in order to identify the factors that influenced the farmers' opinions on the proposed IEA. One was estimated for the aggregate sample and the others for the sub-samples. A revised version of the respondents' responses to the IEA was used as the dependent variable in these models. The revision has been carried out based on the assumption that a neutral response could indicate a potentially non-supportive response (after Newmark *et al*. 1993 and Gillingham and Lee, 1999), and strongly supportive and supportive opinions would indicate, by definition, the backing for the proposed IEA. *AWAR, COED, DAMA, GEND, NFPR, NUEL, OHEC, RAGE, RPHH, VCPC,* and *YOSA* were used as explanatory variables in the preliminary analysis of these models (see Table 2 in section 3.4 for the description of these variables). This analysis reveals that some of the independent variables cited above were either statistically not significant, or were highly correlated with other variables at the $r > 0.8$ level. Hence, it was decided to exclude these variables from the final analysis.

Table 5: The factors influencing farmers' opinions to the integrated economic approach proposed in this study

	Logit regression models for					
	Sub-sample 1		Sub-sample 2		Aggregate sample	
Variable	Coefficient	*t*-value	Coefficient	*t*-value	Coefficient	*t*-value
Constant	-2.831	-2.997	-3.761	-2.871	-3.651	-2.182
AWAR	3.971	4.132	3.103	2.573	2.910	3.131
COED	2.416	2.104	1.324	0.941	3.684	2.904
DAMA	1.761	2.672	1.021	3.984	1.652	2.381
NFPR	3.119	2.061	2.941	3.182	2.591	3.412
NUEL	1.974	0.812	3.913	2.193	2.872	1.942
VCPC	4.915	3.421	4.603	3.152	3.175	2.641
YOSA	1.690	2.627	2.940	3.783	3.910	2.715

Note:

1. Summary Statistics:

Sub-sample 1(villages within the boundary of national parka): n=150
Log likelihood ratio = 37.64, F statistic = 19.167 R^2 = 0.632, Adjusted R^2 = 0.598;
Sub-sample 2 (villages in the areas adjacent to the boundary of national park): n=150
Log likelihood ratio = 41.61, F statistic = 16.632, R^2 = 0.592, Adjusted R^2 = 0.564;
Aggregate sample: n=300, Log likelihood ratio = 39.34, F statistic = 24.82, R^2 = 0.612, Adjusted R^2 = 0.597.

2. Dependent variable: the probability of saying 'yes' to the IEA proposed in the study, level of significance 0.05 df = 6.

The results of the estimated regression models are presented in Table 5. The goodness of fit measures used in this analysis found that the overall explanatory power of the estimated models was reasonable at 0.05 significant levels. The variables *AWAR, COED, DAMA, NEPR, NUEL, VCPC and YOSA* were significant with positive coefficients (at 0.05 significant levels) in predicting respondents' opinions at the aggregate sample level.

However, *NUEL,* non-consumptive use value of elephants, was not significant in sub-sample 1. This is untreatable because the degree of crop damage experienced by the farmers in this sample is much greater than that by the farmers in areas adjacent to the boundary of the park. Therefore it is not surprising that these farmers did not recognise the non-use value of the elephant as a significant reasons to support the IEA proposed in this study. Instead, they may

consider the wild elephant as an agricultural pest or a significant threat which interferes with their social wellbeing. On the other hand, *COED,* the amount spent on elephant damage control, was not significant in the model estimated for sub-sample 2. This situation is quite clear because the farmers in sub-sample 2 spend a significantly smaller amount out of their farming income to protect the elephant damage compared to the farmers in sub-sample 1. Our preliminary estimate of the farmers' damage control cost in the sample revealed that the latter group spends about five times more than the former. This is about Rs. 1434 or 5% of their total farming income per cropping season.

6.Contingent valuation of farmers' willingness to pay for a scheme to conserve the elephant: preliminary findings

Of the 300 respondents in the entire sample, 244 (81.3%) answered positively to the WTP elicitation questions and 56 (18.7%) protested all the bid values offered by these questions. Of the 150 respondents in sub-sample 1, (within the park boundary), bids of 35 (23.3%) respondents were identified as protest bids. On the other hand, of the 150 respondents of sub-sample 2, (adjacent to the park boundary), bids of 21 (14%) respondents were identified as protest bids. The respondents' responses to payment principle questions and free-estimated probability to the 'yes' response are presented in Table 6.

Table 6: Frequencies and probability estimates for the yes response to the payment principle questions.

Bid value	Sample - Responses		Aggregate responses	Free estimated probability[c]
	Sub-sample 1[a]	Sub-sample 2[b]		
250.00	5 (4.3)[d]	15 (11.6)[d]	20 (8.2)[d]	0.06
100.00	10 (8.7)	20 (15.5)	30 (12.3)	0.10
50.00	20 (17.4)	21 (14.0)	40 (16.4)	0.13
25.00	26 (22.6)	23 (16.3)	46 (19.0)	0.15
10.00	54 (46.9)	50 (38.8)	108 (44.3)	0.36
Total 'yes' responses	115 (76.7)	129 (86.0)	244 (81.3)	0.81
Total protest responses	35 (23.3)	21 (14.0)	56 (18.7)	0.18

Note: a: Villages within the boundary of national park (n =150); **b:** Villages in the area adjacent to boundary of the national park (n =150); **c:** $P_i /(1 - P_I)$, where P_i = Probability of yes to the payment principle questions; **d:** Percentage of total number of yes responses in each samples.

Preliminary estimates reveal that the mean WTP value for sub-sample 1 was Rs. 63.59 per month and Rs 58.79 per month for sub-sample 2. This at the aggregate level was Rs. 61.19 per month, amounting to an annual value of Rs 734.28. As the payment would be made over five years, the total present discounted value of these annual amounts at the 5% real rate of discount equals Rs. 3445.52. A summary of our WTP estimates is presented in Table 7. The WTP estimates presented in this study were accomplished by an approach suggested by Hanemann (1984), and are also in accord with those of similar WTP estimation studies such as Miller and Lindsay (1993), Hadker (1997), Witzer and Urfei (2001).

Table7: WTP estimates for each of the three models

Benefit measures	Sub sample 1[a]	Sub sample 2[b]	Aggregate sample
Mean WTP	63.59	58.79	61.19
Median WTP	25	10	25
Standard deviation	75.77	52.21	66.52
Confidence intervals for mean WTP[c]	51.84 - 68.63	47.14 - 61-53	54.37 - 67.72

Note: a: Villages within the boundary of national park (n = 150); **b:** Villages areas adjacent to the boundary of national park (n =150); **c:** Estimated for 95**%** level of confidence.

Farmers who responded positively for the WTP questions were asked: *Can you kindly disclose why you are willing to have your farming income reduced* (indicating the highest amount that respondents are WTP) *to undertake the propose program in this study?* This question was designed for two reasons: a) to assess the farmers' genuine motivation behind their financial support for conserving the elephant and mitigating HEC in the country, and b) to check for embedding effects whereby respondents pay for the management of elephant related issues in general, rather than undertaking a specific action in particular so that the final valuation could be adjusted appropriately. Several reasons were identified in the pilot survey of this study. These reasons were presented along with the information brochure in order to obtain farmers' responses for this question. Respondents were then asked to rank these reasons in descending order. Table 8 presents a summary of the farmers' ranking of their motivation to support a scheme to conserve elephants.

Table 8: Farmers' ranking of their reasons to support for a scheme to conserve elephants (n = 244).

Motivation	Rank	Frequency
a. We need to secure our social well-being and household economy.	1	234 (95.9) [a]
b. We would like to bring to an end the killing of elephants.	2	233 (95.5)
c. So far the wildlife and agricultural authority have failed to solve this problem.	3	224 (91.8)
d. Non-consumptive use value of the elephant.	4	219 (89.7)
e. The government along cannot solve this problem.	5	208 (85.2)
f. We too have a moral responsibility to solve this problem	6	198 (81.1)

Note: a: Number of respondents who have ranked a given reason as a percentage of the total number of respondents who expressed their willingness to pay for a scheme to conserve elephants

The respondents who responded positively to the WTP elicitation questions were also asked a question about their preferred method of payment. Whittington *et al.* (1993) use a similar approach. Hoehn and Randall (1987) point out the analysis of payment rules provide incentives for truth telling by contingent market respondents, and Hadker *et al.* (1997) that it also helps to identify the survey respondents' motives for their contribution. In the present study, several payment methods were identified in the pilot survey and these were presented to the participants for their responses. The result of this analysis suggests that the majority of the respondents preferred to use conventional methods: about 50% preferred to make a direct cash payment to the nearest Cooperative Bank at the end of every cropping season; about 25% preferred to pay their contribution along with their monthly farmer's insurance premium every three months; and the remaining respondents were distributed unevenly among the other methods of payment suggested in this study. The distribution of methods of payment preferred by respondents is presented in Table 9.

Table 9: The distribution of preferred methods of payment

Preferred method	Frequency	% of total
a. Child's school facility fee in every month	32	13.1
b. Farmers' insurance premium in every three months	59	24.2
c. Revenue charges of the local government authority	6	2.5
d. Annual member fee of village development society	8	3.3
e. Direct payment to the nearest Co-operative Bank	124	50.8
f. Allowing direct deduction form my *Samurdi* benefits[a]	15	6.2
Total	244	100

Note: a. *Samurdi* is a state sponsored poverty alleviation program currently functioning under the Ministry of Samurdi and Agriculture.

7. Factors influencing farmers' responses for the principle WTP elicitation question: logit analysis

The preliminary logit regression analysis was undertaken by using the Statistical Package for Social Sciences (SPSS) Version 10.0 to identify the factors associated with respondents' responses for the WTP elicitation question. The results of this analysis reveal that some of the explanatory variables used in this study were either not significant or were highly correlated with other variables at the coefficient of correlation (r) > 0.8 level. Thus it was decided to remove some of these variables ─ *AWAR, COED, GEND, NFPR, OHEC, PEDV, RPHH* and *VCPC* ─ from the final logit regression analyses (see Table 2 in section 3.4 for the description of these variables).

A summary of the final logit models developed both at aggregate and sub-sample levels are presented in Table 10. The common characteristic of these models is the greater dependency on the economic variables such as *TFIN, BIDV* and *DAMA* in predicting respondents' responses to WTP elicitation questions. The goodness-of-fit measures which are used in

evaluating the statistical significance of these models indicate that their overall ability to yield a correct prediction of the farmers' responses to principle WTP elicitation questions was significant at the 0.05 level of significance and fitted the data reasonably well. Moreover, most of the explanatory variables used in each of these models were statistically significant in common with their hypothesized signs.

Table 10: The factors influencing respondents' responses for the payment principle questions : The final logit regression results[2]

	Logit regression models for					
	Sub-sample 1[a]		Sub-sample 2[b]		Aggregate sample[c]	
Variable	Coefficient	*t*-statistics	Coefficient	*t*-statistics	Coefficient	*t*-statistics
Constant	-4.149	-2.181	-3.831	-2.997	-3.021	-2.198
ATAM	3.103	5.810*	3.791	4.132	2.910	4.731
BIDV	-1.021	-3.198	-1.786	-2.972	-1.902	-2.198
DAMA	1.941	3.182	1.619	2.416	1.591	3.142
NUEL	1.184	1.941	0.916	0.983	1.684	2.014
RAGE	-0.591	-0.193	-0.974	-1.392	-0.872	-0.942
TFIN	3.785	6.352*	4.985	5.213*	4.785	6.213*
YOSA	1.690	3.713	1.690	3.207	2.901	5.207

Note: 1. Summary statistics:
a. **Sub-sample 1** (villages within the boundary of national park (n = 150): Log likelihood ratio = 38.864, F statistic = 17.978, R^2 = 0.592, Adjusted R^2 = 0.578;
b. **Sub-sample 2** (villages in the areas adjacent to the boundary of national park (n = 150): Log likelihood ratio = 39.641, F statistic = 19.632, R^2 = 0.544, Adjusted R^2 = 0.528;
c. **Aggregate sample** (n = 300): Log likelihood ratio = 43.154, F statistic = 21.162, R^2 = 0.631, Adjusted R^2 = 0.617.
2. Dependent variable = the probability of saying 'yes' to the principle WTP questions;
*Level of significance 0.01; df = 6.

As indicated in Table 10, most of the estimated coefficients hypothesized did indeed influence the probability of saying 'yes' to the principle WTP elicitation questions by the respondents in the sample. In the aggregate model, except for *RAGE***,** the other explanatory

variables used were significant either at the 0.01 or 0.05 level of significance. This variable was also not significant for the models developed for the sub-samples.

Both at aggregate and sub-sample levels, the variable *BIDV* had a negative influence on the probability of the respondent saying 'yes' to the WTP question. This means that the larger the bid value presented in the survey to the respondent as a WTP elicitation question, the less willing these respondents were to pay for undertaking the proposed programmes in this study (see Table 6 for details). Miller and Lindsay (1993) observe a similar situation in their contingent valuation survey conducted to analyse WTP for a state gypsy moth control program in New Hampshire.

The Variable *ATAM* was used to assess farmers' attitudes towards the IEA proposed in this study on the probability of saying 'yes' to WTP elicitation questions. As expected, *ATAM* was significant with a positive sign in each of the three models developed in this study. The positive sign of this variable supports the hypothesis that the probability of saying 'yes' to the payment principle questions increases as the farmers' enthusiasm towards this alternative approach increases. Our preliminary analysis reveals that about 83% of the respondents in the sample have expressed some form of a support for the IEA proposed in the study. Thus it is obvious that *ATAM* is significant in predicting respondents' responses for the WTP elicitation questions.

NUEL was used to investigate whether the historical, cultural, and religious significance of elephants for Sri Lankan society have any influence on the farmers' WTP for the scheme proposed in this study. Testing this hypothesis is important because a number of recent studies have claimed that the farmers' attitudes towards the elephant in many parts of the

Asian elephant range have been deteriorating over the years mainly due to its interference with agriculture (see Ramakrishnan, *et al.,* 1997; Tisdell and Xiang, 1998; and Nyhus *et al.* 2000). However, in our preliminary analysis we found that, despite its damaging behaviour, still some farmers in the HEC affected areas appreciate the non-consumptive use values of the elephant. This was further confirmed by the findings of our logit analysis.

NUEL was significant in the models developed for sub-sample 2, and the aggregate sample. However, this variable was not significant in the sub-sample1. This is understandable because the degree of the elephant interference in agriculture and the economic damage caused by it in the villages within the park boundary may not allow farmers to appreciate any non-consumptive use value of elephants. These farmers may consider the elephant as a mere agricultural pest. However, the positive sign of the coefficient of the *NUEL* found in each of these three models suggests that the farmer who appreciates the non-consumptive use value of the elephant has a higher probability of answering 'yes' to the WTP question. This situation is quite consistent with the findings of Hill (1998).

The *TFIN* was significant and had a positive influence on the probability of an individual saying 'yes' to the WTP question. The positive sign of the coefficient *TFIN* implies that the respondents' willingness to pay for a scheme to conserve the elephant increases with the increase in total farming income. A number of recent contingent valuation studies have observed a similar pattern for changes in agricultural policies, farming technologies, and pest management programmes. For instance, Pietola and Lansink (2001) found this when analysing factors determining the farmers' response to the promotion of organic farming in Finland. Lohr and Salomonsson (2000) also notice a somewhat similar situation in a comparative analysis of farmer responses to proposed agricultural subsidies to promote

organic farming in Sweden. Findings of Hadker *et al*. (1997) suggest that the higher income earners have a stronger interest than the lower income earners in environmental conservation.

The *YOSA* was significant in each of three models developed. The positive sign of the coefficient of the *YOSA* indicates that the probability of saying 'yes' for the WTP question increased with the number of years of schooling. Several CV studies observe a similar relationship between years of schooling and respondent's response towards the WTP elicitation questions: Whitehead (1992) noted that this positive correlation in an *ex ante* willingness to pay analysis; Hadker *et al.* (1997) found in a case study in India that every one-year increase in years of schooling increases the WTP by 5%; and Pate and Loomis (1997) describe the rationale behind this relationship in a case study of wetland and salmon in California.

It was assumed that, from a pure insurance perspective, the farmers who continuously sufferer economic damages caused by the elephant would put no positive value on its continued existence. However, they would consider contributing to the scheme proposed in this study in order to ease their economic losses. *DAMA* was used to examine this hypothesis. This variable was based on the responses to question asking respondents to indicate whether they have suffered any economic due to elephants during the last five years. The responses recorded; 'yes, I have suffered continuously over the last five years' (coded as 3), 'I suffered only on a few occasions, (coded as 2), ' I did not suffer at all (coded as 1). *DAMA* was significant with the positive coefficient in each of the three models developed. This positive sign of the coefficients indicates that the probability of saying 'yes' for the WTP question increases with the extent and continuity of the economic damage incurred by farmers. In this situation, farmers are risk-averse and may regard the elephant as a pure agricultural pest.

Thus they seem to be prepared to pay for the proposed scheme in order to be compensated against the elephant damage. However, if they recognised that the elephant also has some non-consumptive use value, they are likely to pay more in order to contribute to the conservation of this species of wildlife.

8. Estimating farmers' contribution for the proposed scheme

Two different approaches are often used to aggregate mean WTP benefits (Miller and Lindsay, 1993). The first approach is to multiply the mean WTP by the number of individuals in the population (Stoll and Johanson 1998). Use of this approach, however, requires the assumption that there are no statistical differences between survey respondents and non-respondents. The second approach is to generalise the sample to only the percentage of individuals who responded to the survey. Non-respondents are assumed to have a zero mean WTP value (Loomis, 1987). However, Miller and Lindsay (1993) claimed that this assumption is unrealistic and therefore the use of this approach could be result in quite conservative values in aggregating WTP benefits. More recently Hadker *et al.* (1997) has also observed similar weaknesses in relation to this approach. Therefore in the present study, we used the first approach for aggregating WTP benefits from survey respondents to non-respondents. This decision justifies the findings of two recently conducted case studies on the socio economic impacts of the HEC in the northwestern province (see Munaweera and Kuruwita, 1998; Tennekoon, 2001) and of the population census of Sri Lanka in 2001 (see Department of Census and Statistics, 2002). The findings in these reports revealed that socio-economic condition and household characteristics of the samples of the present study were exceptionally close to the population of affected farming families in the northwestern province. Therefore, any impact that could have arisen from the differences in household

characteristics on the estimation of final aggregate WTP estimates in this study would be minimal.

In the present study, the aggregation of WTP benefits was carried out at three different levels: a. from the sub-sample of severely affected farming families (sub-sample 1) to other severely affected families in the northwestern province; b. from the sub-sample of less affected farming families (sub-sample 2) to the less affected families in the northwestern province; and c. from the aggregate sample to all the affected families in the northwestern province. In this process, we also noticed that, as the WTP estimates were essentially made on a per-household basis, it would be incorrect to aggregate the entire population of individuals in the farming families in this province. Instead aggregation of WTP was made across the number of households: multiplying the estimated mean WTP value of each sub-sample by the number of households yields the aggregated benefits.

In aggregation of mean WTP to the population of severely affected families in the northwestern province, using a total of 16,800 farming families with a family size of about 3.98, we get a WTP for the northwestern province of Rs. 1.07 million per month or Rs. 12.82 million annually. As the payment will be made over five years, the total net present discounted value of these annual amounts, at the 5% real rate of discount, equals Rs. 62.98 million. Similar aggregation can be carried out for the less affected farming families in this province where , with a total of 138, 642 farming families with a family size of 4.69, we get a WTP for the northwestern province of Rs. 8.15 million per month or Rs 94.93 million annually. The total net present discounted value of this annual aggregated WTP amount would be Rs. 482.64 million for five years. Finally, estimation of aggregated WTP benefits at the aggregate sample level could be obtained by amalgamating the estimates cited above.

This amounts to Rs. 9.22 million per month or Rs. 104.63 million per annum. For five years, it would be Rs. 548.76 million at a 5% real rate of discount.

The report of population census of Sri Lanka-2001 (see Department of Census and Statistics, 2002) indicates that there is no significant difference among the rural farming families in the northwestern and the other elephant ranges such as the *Mahaweli* and the southern in Sri Lanka. Thus, if necessary, we could use our estimated sample mean WTP value to extrapolate the total WTP contribution by all the farming families in areas affected by HEC in Sri Lanka. Indeed, several benefit transfer approaches are available transferring such WTP benefits from the 'study area' to the unstudied 'policy area'. However, a number of recent contingent valuation studies ─ for example, Hadker *et al.* (1997), and Loomis *et al.* (2000) ─ have used the simple transferring point estimate approach (STPE) to extrapolate WTP benefits. Boyle and Bergsrom (1992) examine the advantages of this method compared to the benefits function transfer approach (BFTA). Brouwer and Spaninks (1999) tested the statistical validity of the STPE approach and found it to be more robust than the other approaches.

When we extrapolate our estimated mean WTP value to the population of affected families in the entire elephant range in Sri Lanka, using a total of 327,840 farming family with a families size of 4.19, we get Rs. 20.06 million per month or Rs. 240.72 million per annum. As the payment will be made for five years, the total present discounted value of these annual amounts would be Rs. 1194.62 million. This would generate an estimated return on the capitalised sum of Rs. 59.70 million per annum at the 5% real rate of interest for perpetuity, if the farmers' contribution were invested in the capital market. Nevertheless, we have insufficient data to determine yet to what extent this amount would be sufficient to set up the

scheme proposed in this study and its economic viability in the long run. Indeed it is a separate issue which requires more theoretical empirical analysis. However it is quite clear that, if some mechanism is established for farmers to recover the damage caused by the elephant, they would allow the animals some access to the farming areas and this certainly would reduce the current rate of elephant deaths.

9. Concluding Remarks

This study was undertaken to assess the willingness of Sri Lankan farmers to pay for a scheme to conserve elephants. It does so by analysing the results from a contingent valuation survey of a sample of 300 farming families in the northern boundary of *Wilpattu* National Park in northwestern Sri Lanka. The preliminary findings of this study indicate that the majority of farmers in the areas affected by HEC are well aware of the current status of HEC related issues in the country. Moreover, the findings of the correlation analysis undertaken between respondents' awareness and the other socio-economic variables found that the level of education (i.e. years of schooling) was positive with the value of coefficient of correlation (r) + 0.89.

The analysis of farmers' opinion of the integrated economic approach reveals that about 82.3% of the respondents expressed support for it. This support positively correlates with variables such as *AWAR* (awareness about current elephant related issues), *DAMA* (whether the elephants have caused any economic damage during the last five cropping seasons), VCPC (average of value of crop and property damage caused by elephants), *YOSA* (years of schooling) and *NUEL* (non-use value of elephants) at 0.05 significant levels.

The estimate of respondents response for WTP election questions, it was revealed that about 81% of the respondents were WTP for the scheme proposed in this study. This amounts to Rs. 61.59 per month or Rs. 739.08 per annum on average. The aggregation of mean WTP to the entire affected faming household (both severely and less affected) in the Northwestern province, we found that this amounts to Rs. 104.63 million per annum and Rs. 548.76 million for a period of five years. In extrapolating WTP benefits to the farming families over the entire elephant range in Sri Lanka, we found that they are WTP Rs. 240.72 million per annum or Rs. 1194.62 million for a period of five years. This would generate an estimated return on the capitalised sum of Rs. 59.7 million per annum for perpetuity. Thus this could arguably be considered an indirect indication that these farmers in the HEC affected areas are ready to tolerate the presence of the elephants on the farming fields and would allow some access to ensure the survival of this species in the wild even though we have insufficient data to determine the degree of farmers' tolerance and the level of access they would provide.

The logit analysis on the factors influencing the respondents' responses to the principle WTP elicitation question reveals that the *YOSA (*years of schooling), *TFIN* (total farming income), *BIDV* (bid value), *DAMA* (whether the elephants have caused any economic damage during the last five cropping seasons), *ATAM* (Attitude towards alternative HEC management approach), and *NUEL* (non use-value of the elephant) were significant determinants of farmers' responses to this question.

As observed, the coefficient of *DAMA* is positive. This implies that farmers who experience the elephant damage are willing to contribute funds to the scheme proposed. Possibly this is because of an insurance motive. In addition, however, we also observed a positive coefficient for *NUEL*. This indicates that farmers who place some positive value on continued existence

of the elephant (its non-use value) despite its damaging behaviour and likely to contribute more funds to this scheme than farmers who consider the elephant purely as an agricultural pest. There were in fact a high proportion of farmers in our sample expressing a non-consumptive use-value for elephants.

In conclusion, the overall finding of this study provides a strong economic basis to believe that farmers in the elephant range in Sri Lanka could be motivated to conserve elephants and mitigate human-elephant conflict. Thus this rejects the assumptions of many Western conservationist and development agencies that people in less developed countries, particularly rural farmers, are antagonistic towards experimenting with new wildlife conservation approaches. To the contrary, this study reveals they are willing to extend their support for such programs.

10. References

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