ISSN 1327-8231

ECONOMICS, ECOLOGY AND THE ENVIRONMENT

Working Paper No. 67

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THE UNIVERSITY OF QUEENSLAND

ISSN 1327-8231

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WORKING PAPERS IN THE SERIES, *Economics, Ecology and the Environment* are published by the School of Economics, University of Queensland, 4072, Australia, as follow up to the Australian Centre for International Agricultural Research Project 40 of which Professor Clem Tisdell was the Project Leader. Views expressed in these working papers are those of their authors and not necessarily of any of the organisations associated with the Project. They should not be reproduced in whole or in part without the written permission of the Project Leader. It is planned to publish contributions to this series over the next few years.

Research for ACIAR project 40, *Economic impact and rural adjustments to nature conservation (biodiversity) programmes: A case study of Xishuangbanna Dai Autonomous Prefecture, Yunnan, China* was sponsored by the Australian Centre for International Agricultural Research (ACIAR), GPO Box 1571, Canberra, ACT, 2601, Australia.

The research for ACIAR project 40 has led in part, to the research being carried out in this current series.

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Working Paper 67 [Economics, Ecology and the Environment]

Willingness to Pay for Conservation of the Asian Elephant in Sri Lanka: A Contingent Valuation Study

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Abstract

Results from a CVM survey of willingness to pay for the conservation of the Asian elephant of a sample of urban residents in three selected housing schemes in Colombo, the capital of Sri Lanka, are reported. Face– to–face surveys were conducted using an interview schedule. A non-linear logit regression model was constructed to analyse the respondents' responses for the payment principle questions and to identify the factors that influence their responses. We investigate whether urban residents' WTP for the conservation of elephants is sufficient to compensate farmers for the damage caused by elephants, and consequently to raise farmers' tolerance of the presence of elephants on the farming fields. We find that beneficiaries (the urban residents) could compensate losers (the farmers in the HEC affected areas) and be better off than in the absence of elephants in Sri Lanka. This suggests that there is a strong economic case for the conservation of the wild elephant population in Sri Lanka. However, we have insufficient data to determine Sri Lanka's optimal elephant population in the Kaldor-Hicks sense.

KEYWORDS: Asian elephant, *Elephas maximus*, Elephant conservation, Willingness to pay, Contingent valuation, Sri Lanka.

Willingness to Pay for Conservation of the Asian Elephant in Sri Lanka: A Contingent Valuation Study

1. Introduction

In the past, most management of endangered species, such as Asian elephant (*Elephas maximus*), has been largely based on qualitative ecological criteria. These criteria have mainly been used for estimating the extent of the decline in the population of endangered species and understanding underlying causes behind these declines in order to formulate of conservation action plans. However, in the last two decades, several authors have emphasised the usefulness of economic valuation as a management tool in conservation and management of endangered species (Boyle and Bishop, 1987; Gregory *et al*.1989; Stevens**,** *et al.* 1991; Whitehead, 1992; Loomis and Larson, 1994; Loomis and White, 1996; Hadker, 1997; Loomis and Ekstrand, 1998; Tisdell and Xiang, 1998; and White *et al.* 2001). While some economic evaluation of elephants has been done, economists have mostly concentrated on economic issues involved in the conservation of the African elephant (*Loxodonta africana)* and have given much less attention to the Asian elephant.

In many respects the survival of the Asian elephant is more precarious than that of the African elephant (Bandara and Tisdell, 2002a). IUCN (1996) declared this species of wildlife to be one of the most seriously endangered species of large mammals in the world. At present, it occurs only in thirteen countries in Asia, including Sri Lanka. The elephant population in Sri Lanka, for example, underwent a marked reduction starting from the mid-nineteenth century (De Silva and Attapattu, 1997, De Silva, 1998, Weerakoon, 1999). The fragmentation and loss of natural habitat are considered to be

the major factors that have contributed to this decline. This is largely a result of the *ad hoc* development projects that have been carried out during the last fifty years (Weerakoon, 1999). This has been exacerbated by the lack of co-ordination between different government departments and wildlife authorities and poor integration of economic aspects and lack of attention to public preferences for elephant conservation.

One economic concept sometimes used to guide decisions by conservation managers is the total economic valuation (TEV) of species and ecological components. It provides a framework for the assessment of economic aspects of conservation of endangered species and other valuable environmental amenities (Barnes, 1996). In the *TEV* framework, the total economic value of any give environmental amenity can be categorised into two major components: its use value and non-use value. For instance, the use value of elephants can be found from their direct use such as the monetary value to be gained from ivory, hides, sale of calves and recreation. The non-use value of elephants such as option, existence and aesthetic values cannot be traded in the markets.

Environmental valuation attempts to quantify non-market values, which can then be combined with market values to give a total economic value (Bateman and Langford, 1997). There are several techniques available for the estimation of the non-market value of environmental attributes or amenities. These include the travel cost method, simulated market method and contingent valuation method (Carson *et al*. 1996). However, the contingent valuation method (CVM) may be the only appropriate method for estimating fully the anthropocentric benefits of potential future conservation programs (Ready *et al*. 1996, Loomis and Ekstrand, 1998**,** White *et al*. 2001). In CVM,

the non-use values are generally measured based on the willingness to pay for an improved environment, or using the willingness to accept compensation for a damaged or diminished environment. An appealing aspect of the contingent valuation method is that it allows us to estimate total value rather than components of that total value (Pate and Loomis, 1997). Carson *et al.* (1994) provide a bibliography of 1,600 CVM studies and related publications.

In any typical CVM study, a survey respondent is asked to imagine that he or she is faced with a decision regarding the level of provision of a non-market good such as conservation of elephants in their natural habitat. In that hypothetical situation, the respondent has an opportunity to increase the level of provision of the goods, but must pay some amount of money do so. This in turn generates the information about respondents' compensating variation for the increase in the level of provision of the non-market goods in question (Ready, *et al*. 1996). However, the CVM and its derived values are not without criticisms. Pate and Loomis (1997) examine some of these criticism in a case study of wetland and salmon in California. CVM derived values, such as WTP for given environmental amenity, reflect many assumptions of neo-classical economics, including an anthropocentric view of natural resources. Moreover, CVM values are contingent upon the levels of information the respondent brings to the survey and the amount of information provided by the survey. Certainly WTP may fail to measure all ecological values, since humans may not fully understand the functions of resources such as habitat impacts of elephants favourable to conservation of other wildlife. In addition, not everyone in society accept the moral and ethical values inherent in TEV. Researchers are, however, continually attempting to broaden the societal values reflected in CVM studies.

The purpose of this study is to present the results from a CVM survey of a sample of urban residents in Colombo, the capital of Sri Lanka, and to elicit their willingness to pay for the conservation of the Asian elephant. A dichotomous choice form of contingent valuation is applied to quantify the economic aspects of individual preferences associated with the conservation of the elephant in Sri Lanka. An analysis is undertaken to investigate the underlying factors that determine the willingness of urban respondents to pay for the conservation of the elephant. Furthermore, we investigate whether urban residents' WTP for the conservation of elephants is sufficient to compensate farmers for the damage caused by elephants and to raise farmers' tolerance of the present elephants on the farming fields. Specific issues and limitations of the empirical approach are discussed, some of which have been previously raised by Bowker and Stoll, (1988), Hadker, *et al*. (1997) and Loomis and Ekstrand (1998). This study pays special attention to starting point bias, embedding effects and part-whole biases. This improves the quality of CV results. The survey procedures are outlined first and this is followed by analysis of the results using logit regression analysis. Losses associated with damages imposed on farmers by elephants are then estimated and compared with compensation that might be paid by urban residents to farmers.

2. Procedures - Nature of Questions Asked

The process of devising a convincing CV scenario involves several elements (Jordan and Elnagheeb, 1994). The first step is to devise a hypothetical market for the environmental good in question with respondents being requested to make decisions as consumers in the framework of a hypothetical market (White, *et al.* 2001). The

market prices for the conservation of endangered wildlife species or any other environmental amenities rarely exist. Therefore, in a typical CVM study, individuals are presented with the hypothetical market scenario for a given public good and are then asked about their willingness to pay (or willingness to accept compensation) for its use or protection (or both) (Ready, *et al.* 1996).

In this study, a hypothetical market was established to assess urban residents' WTP for the conservation of the Asian elephant in Sri Lanka. This hypothetical market is based on several assumptions. First, the existing protected area network in the country is unable to provide sufficient protection and natural habitats for the elephants. Secondly, the establishment of human settlements and large-scale agriculture projects within or close to the areas inhabited by elephants has led to a conflict of interest between humans and elephants. Thirdly, this problem adversely affects both people and elephants. Fourthly, a management agency believes that the conservation of elephants can be achieved through integrated policies involving both public and private landholders in the elephant's range and other interest groups such as city-dwellers.

The respondents were presented with a hypothetical conservation and management programme for the Asian elephant in Sri Lanka along with an information brochure. This contained a set of updated information about the present status of the elephant population, and the issues that need to be addressed in elephant conservation in the country. The respondents were informed that the elephant population in Sri Lanka has been in decline since the mid-nineteenth century. This has accelerated over the last fifty years mainly due to the expansion of human settlements and agricultural

development schemes into elephant habitats, particularly in the dry zone area of the country. As a result, IUCN (1996) has declared the Asian elephant in Sri Lanka to be an endangered species. Although the protected area network of Sri Lanka provides basic shelter for the elephant population, it covers only one third of the elephant range in the country. Habitat loss, fragmentation and degradation continue to be a problem within the elephant's range. Sri Lanka has a very high population density of 259 people per square kilometre. With a growth rate of 1.2 %, human population this will continue to increase and there is likely to be a corresponding increase in the demand for new land. Moreover, taking into account the small size of the country, its already large commitment to conservation, the economic aspirations of its growing human population, and its socio-economic conditions, it may be impossible in the future to increase the size of its protected areas to any substantial degree. Whether elephants will be able to survive in such restricted areas in the long term is uncertain. Therefore, it is necessary to consider alternative policy options for elephant conservation in Sri Lanka both inside and outside protected areas.

After survey respondents were presented with the information about current status and issues in elephant conservation in Sri Lanka, they were asked about their awareness of this information: *Is this information new to you?* The answers 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 was followed by another question where respondents are asked to present their opinion about the extinction of elephant population in the country: *If this present decreasing trend in elephant populations in Sri Lanka continues, future generations will be deprived of the chance to enjoy or even to see elephants in their natural state. How concerned are you about this scenario?* The

answers recorded, ‘very concerned’ (coded as 1), ‘a little concerned’ (coded as 2), ‘not concerned at all’ (coded as 3).

Respondents were then introduced to an alternative policy designed for conservation of elephants in the country. The respondents are asked to assume that an autonomous body, reputed for its efficient and honest work, would introduce a sound conservation programme so that the current downward trend in elephant population could be halted. The respondents were also informed that this organisation would initially implement the following measures for the conservation of the elephant in the country: a) Provision of extra protection around existing national parks and protected areas, b) translocation of excess and troublesome elephants, c) domestication of the elephants for local and foreign zoos, tourist establishments, temples, study centers, or for use as work animals, d) establishment of animal orphanages and recreation centers to promote eco-tourism. After offering this alternative programme for elephant conservation, the respondents were asked to present their concerns about it: *If the current downward trend in elephant population could be halted with the implementation of these policy options; how concerned are you about this situation?* The answers recorded, ‘very concerned’ (coded as 1), ‘a little concerned’ (coded as 2), ‘not concerned at all’ (coded as 3). If the respondents expressed a positive response for the proposed alternative conservation programme, this indirectly confirms that they would be interested in knowing how this programme would be financed.

The respondents were presented with the issue of financing the proposed programme and the necessity of the support of the general public to establish a ‘trust fund’ to undertake a proposed conservation programme. Moreover, the respondents were also

informed of possible benefits that they would be able to realise after the successful implementation of this programme for the conservation of elephant. The benefits that the respondents would like to have could be different from one another depending on individual preferences. Therefore, respondents were presented a list of generalised benefits that they would receive as a return for their contribution towards the establishment of a proposed trust fund to undertake a proposed conservation programme. The benefits presented to the respondents included: a) greater possibilities to view more elephants in a single herd in the wild, b) greater opportunities to see elephants in the wild during a short number of visits to a given national park, c) opportunities to domesticate more elephants for the purpose of religious festivals and the local tourism industry, d) increase in agricultural crop production due to the mitigation of HEC in the main agricultural regions in the dry zone of the country.

Following the description of the establishment of a conservation trust fund and the possible benefits of the implementation of elephant conservation programmes, the respondents were presented with the 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 implement the above mentioned programs to conserve the elephants in the country*". This was presented as a double-bounded dichotomous choice question. Each respondent was presented with a sequence of two bids and asked for a 'yes' or 'no' vote on whether the respondent's WTP equals or exceeds each bid. The second bid is conditioned on the respondent's response to the first bid, lower if the first response is 'no' and higher if it is 'yes'. The Rupee amount

variable (policy price), Rs X, is the minimum contribution necessary to establish and maintain the conservation programme. The contingent market must include payment and policy implementation rules (Mitchell and Carson, 1989). The payment rule is a voluntary contribution mechanism. The implicit policy decision rule is that, if a sufficient amount of voluntary contributions are received, the management programme will be implemented. The dichotomous-choice form of contingent valuation provides incentives for truth telling by contingent market respondents (Hoehn and Randall, 1987). Follow-up questions contained categories of reasons for the response to the contingent market and the respondent's preferred method of payment. These questions help to identify protest responses as well as motives for preservation.

3. Procedures Continued - The Survey, Sample, Data Collection and Method of Analysis.

Sample

The surveyed population was chosen from urban residents in Colombo, the capital of Sri Lanka. The population density, level of urbanisation, living standards and life style of residents were taken into account for the selection of a sample of urban residents. A sample of 300 residents was chosen from three main housing schemes in Colombo, *Jayanthipur*a, *Jayawadanagam*, and *Anderson Flats*. The Housing Development Authority of Sri Lanka classifies these schemes as upper middle class, middle class and lower middle class housing schemes respectively. This classification is based on the value of the property and other urban facilities in the area where these housing schemes are located i.e. public schooling, shopping centers and recreational sits. A hundred residents from each of these housing schemes were chosen as the sample. A stratified

sampling procedure was adopted in selecting this sample. A summary of socio-economic characteristics of the sample is presented in Table 1.

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

Variable	Mean	Std. Devi
Household size	3.130	1.141
Gender (male=1)	1.390	0.49
Age	44.021	10.860
Years of schooling	12.540	3.120
Personal income	12986.67	8692.046
Number of income earners	2.581	1.700
Total monthly family income	25166.671	18889.015

The Interview schedule (IS)

The interview schedule developed for this study consists of five different sections. The first section of the IS contained the personal profile of the respondent. This section was designed to gain information about the respondent's social, economic and demographic characteristics, and to establish a conversational rapport with the respondent. The second section of the IS contained questions to assess the attitudes of the respondents on 'development' and 'environment'. The questions in this section aimed to identify three categories: a) extremely 'green' people, b) people in the 'pro-development' lobby, c) people between these two extremes. The preferences of these categories of people were measured on a five-point-scale ranging from 'strongly agree'; 'agree', 'neutral', and 'disagree 'to' strongly disagree.

In section three of the IS, respondents are presented with an information brochure. This contains the present status of elephant conservation and the problems that are encountered in conserving elephant in the existing protected area network. Respondents were asked how 'new' the information in the brochure was to them. They

were also asked to describe what they think is 'valuable' about conservation of elephants in their natural state. This question was intended to check the attitude of the respondent on the use and non-use values of elephants. The hypothesis was that those who perceived greater non-use value of the elephant would be willing to pay more for it, under *ceteris paribus.* Section four of the IS contained the most important questions in the survey, where respondents were presented with dichotomous choice elicitation to assess their WTP for the conservation of elephant. Respondents were offered a set of bid values at four different stages conditioned to their response for the first WTP elicitation question. In this section, respondents were presented one open-ended question where they were given the opportunity to express their preferred vehicle for payment. Section five of the IS contained a set of questions for the interviewer. In these questions, interviewers were asked about the level of understanding and sincerity of the respondents. If interviewers were not confident about the respondent's comprehension and sincerity, the interviewees' responses were not included in analysis.

The administration of the survey

A face-to-face survey was conducted to gather the information through an interview schedule. Hadker (1997) describes the value of this method compared to the questionnaire mail and telephonic surveys in the developing country context. Mail surveys have been found to have a low response rate (the percentage of questionnaires returned, duly completed) and also suffers from self-selection biases. In a country like Sri Lanka, telephonic surveys would bias the sample towards upper-middle and higher income bracket people. Further, face-to-face surveys have the advantage that trained interviewers can actually interact with respondents, and can clarify their doubts to minimise non-response rates. They also have the added advantage that trained

interviewers may judge the sincerity of respondents. Consequently, the quality of the data generated can be expected to improve. Nine graduate students from the Faculty of Graduate Studies of the University of Colombo were used as interviewers to administer the IS.

Dealing with biases

Given the presence of numerous biases associated with CVs, it was necessary to either control them through the IS itself, or in the subsequent analytical stage. However, in most cases, the biases can be econometrically corrected if they have been captured by a proxy variable. In the present study, the BIDVA variable is highly significant and implies that estimated WTP may be affected by the in an iteration process depending on the bid value respondents were offered. This shows that there is the possibility of respondents suffering from anchoring effects also known as starting point bias. In this study, respondents were presented with six separate opportunities to express their WTP through double bounded dichotomous choice questions and asked for a 'yes' or 'no' vote on whether the respondent's WTP equalled or exceeded a given bid, in this case it was Rs. 500.00. The second bid (Rs. 250.00) is conditioned on the respondent's response to the first bid; lower if the first response is 'no' and higher if it is 'yes'. If the respondent's are willing to pay more than Rs. 500.00, they are asked to present the maximum amount that they are WTP for the conservation of elephant. In addition to this procedure, in order to remove the effect of starting point bias, in this study we estimate WTP setting BIDVA equal to zero. This reduced WTP to about Rs. 8.33.

Method of analysis

In the present study, a non-linear logit regression model was constructed for the respondents' response to the WTP elicitation questions. Jaibi and Raa (1998) provide a list of economic applications of this model. Pate and Loomis (1997) describe this model as the most commonly used non-linear model in CV studies. Sellar *et al.* (1986) note the merits of logit model: first, its estimation is relatively simple; second, it usually provides a good approximation to the probit model. When logit is selected as the proper tool for analysing quantal choices, the next question is to specify the appropriate functional form for the explanatory factors. Economic theory can then be of some help by providing us with a theory of choice. Using this theory one can relate the probabilities of particular choices to a set of behavioural rules reflecting the decision-maker's preferences. McFadden (1974) discusses the dichotomous choice theory corresponding to the logit specification. The mathematics of double-bounded dichotomous choice responses are a straightforward extension of the signal-bounded models (Kanninen and Khawaja, 1995). Usually, the preference function (logistic equation) that is maximised by the decision-maker is conveniently assumed to be linear in the parameters, although it may be either linear or non-linear in the explanatory variables.

In the logit analysis with dichotomous choice structure, the dependent variable can be formulated from the respondents' responses for the payment principle questions. In this process, the 'yes' responses are coded as one and 'no' responses as zero, so that the probability of a respondent saying 'yes' to the bid value offered can be found: P_i *= Probability (yes) = probability (*$WTP_i \geq$ *Initial Bid value),* the probability of obtaining a 'no' response is (1- P_i), where $0 < P_I < 1$. Thus the dependent variable can

be transformed by eliminating the upper and lower boundary problem by estimating $P_i /(1 - P_I)$. This ratio will be positive since $0< P_I< 1$. However, when P_I approaches one, $P_i /(1 - P_I)$ goes towards infinity which results in the lower boundary problem. This problem can be eliminated by estimating the natural logarithm, log $[P_i /(1 - P_I)]$ the result of which can be any real number from negative to positive infinity (Hanemann, 1984).

In this study, a number of socio-economic, demographic and attitudinal variables were included as independent variables for the preliminary logit analysis. The variables included are presented in Table 3 in section 4. The choice of these variables need based on several previous CVM studies (see Whitehead, 1992; Miller and Lindsay, 1993; Bateman and Langgord, 1997; Witzer and Urfei, 2001). Several goodness of fit measures are used to assess how well the estimated model explains the observed data or how well the values of the response variable fit in comparison to the actual values. These measures include: McFadden pseudo R^2, the Pearson chi-square test and the classification procedure.

4. Analysis of Results – Contingent valuations and logit analysis

The questions in the interview schedule elicited a variety of details regarding respondents' age, income, position in the family, recreational interests, attitudes towards the current issues in elephant conservation, and attitudes towards alternative management options. These questions were asked both to answer specific queries (for example what proportion of respondents were direct users or whether their cultural and religious affiliation to elephant has a significant impact on WTP etc.), and to provide validation data, both generally and with specific reference to WTP responses. A further

issue addressed was the extent to which respondents could be said to be representative of a wider population.

Table 2: Distribution of 'yes' response to the payment principle questions

Bid value (in Rs)	'Yes' response	% of total
500.00	28	9.33
250.00	16	5.33
100.00	106	35.33
50.00	60	21.33
25.00	56	18.67
Total 'yes' responses	266	88.67
Protest responses	34	11.33
Total	300	100.00

The responses received for the payment principle questions are presented in Table 2. Of the 300 respondents, 266 (88.7%) answered positively to the payment principle questions and 34 (11.3%) respondents protested all the bid values offered by the payment principle questions. However, about one third (32.35%) of the protest respondents were prepared to contribute less than Rs 25.00 which is the lowest bid value offered by the payment principle questions. The free-estimated probability to the 'yes' response increased from 0.093 to 0.62 as the bid value offered decreased from Rs. 500.00 to Rs. 25.00.

The probability of the response received for the principal WTP elicitation questions were used as a dependent variable. The independent variables which was used in the preliminary logit analysis, are presented in Table 3. The basic statistics of these variables are presented in Table 4.

Table 3: Variables included in the preliminary logit analysis

Variable	Definition
AGERE	Age of the respondent in years
ATHEC	Respondent's concern towards alternative elephant conservation and HEC mitigation approaches: 1= Very concerned, 2= A little concerned 3= Not concerned at all
BIDVA	Rupee value from the WTP question
CONSE	Respondent's awareness about the current issues in the conservation of elephants and mitigation of HEC. 1=Not aware, 2 = Aware 3 = Very aware
FUPRE	Respondent's concern about future generation needs; 1= Very concerned, 2= A little concerned 3=Not concerned at all
GENDE	Gender, 1 if male; 0 if female
GREEN	Respondent's opinion on pro-conservation perception; 5 = strongly supportive 4 = supportive 3 =Neutral 2 = Not supportive 1 = Strongly not supportive
MEMBE	1 if the respondent is a member of an environmental society; 0 otherwise
NONUV	Respondent's opinion on the non use-value of the elephant; 1 = Not valued, 2 = some valued, 3 = Highly valued
PERIN	Personal monthly income in Rupees
PRODE	Respondent's attitudes towards pro-development activities; 5 = strongly supportive 4 = supportive 3 =Neutral
OCCUP	Occupation; 1= Professionals, 2 = Business/self-employed, 3 = Public servant, 4 = Private sector employee, 5 = Pensioner, 6= Elementary occupation, 6 = Unemployed
RPOSF	I if the respondent's position is head of the household; 0 otherwise
TOFIN	Total family income in Rupees.
USRER	1 if the respondent had visited national park(s) to see the elephants or wildlife in general; 0 otherwise
YRSCH	Years of schooling

Table 4: Statistics of important variables

Variable	Mean	Std. dev	Max	Min
AGERE	44.02	10.82	57	20
ATHEC	1.41	0.57	3	1
BIDVA	185	196.53	500.00	25.00
CONSE	2.37	0.68	3	1
FUPRE	1.33	0.55	3	1
GENDE	0.69	0.49	1	0
GREEN	3.42	1.12	5	1
MEMB	0.19	0.49	1	0
NONUV	2.69	0.57	3	1
PERIN	12986.67	8692.05	42500.00	5000.00
PRODE	3.97	0.81	5	1
RPOSF	0.52	0.50	1	0
TOFIN	25166.67	18889.01	87500.00	5000.00
USRER	0.39	0.49	1	0
YRSCH	12.59	3.21	20	0

The preliminary multivariate logit regression analysis was undertaken by using the Statistical Package for Social Sciences (SPSS) Version 10.0 to identify the factors which were associated with respondents' responses for the principal WTP elicitation question at the $p < 0.05$ significance level. This analysis reveals that some of the independent variables used were either not significant or were highly correlated with other variables at the $r > 0.8$ level. For instance, variables such as *MEMB, USRER* and *UVEL* were not significant. Hence, it was decided to exclude these variables from the final logit regression analysis. On the other hand, as the variable *TOFIN* correlated with *PERIN* (r = 0.89), it was decided to use only *PERIN*. As *YRSCH* correlated with *OCCUP* (r = 0.87), it was decided to exclude *OCCU*P. As *RPOSF* correlated with *GENDE* (r = 0.91), it was decided to include only RPOSF. Finally as *CONSE* correlated with the *ATHEC* (r = 0.90), it was decided to include only *CONSE*.

The final logit regression analysis was made using the forward stepwise selection of variables which significantly improved the resulting model's goodness of fit measured by the log-likelihood ratio. The *F* statistic was used as a second measure to estimate the overall statistical performance of the estimated logit equation. The coefficient of multiple determination (R^2) was employed as an additional test to examine to what extent the variation in the explanatory variables used in the model were capable of explaining the variation of the dependent variable. These measures indicate that the model had satisfactory explanatory power and fitted the data reasonably well. The results suggest that the overall ability of the model to yield a correct prediction on urban residents' WTP for the conservation of elephant was significant at the 0.05 level of significance.

Table 5: The final logit regression results for WTP

Variable	Coefficient	Standardized Error	*t* - value	*P*- value
CONSTANT	-5.021	1.944	-2.098	< 0.013
AGERE	-0.872	0.377	-3.392	< 0.021
BIDVA	-1.029	0.258	-4.198	< 0.002
CONSE	1.045	0.075	4.685	< 0.001
GREEN	3.322	0.095	7.583	< 0.000
NONUV	1.284	0.541	2.904	< 0.003
PERIN	4.785	1.346	9.213	< 0.000
PRODE	-0.043	0.916	0.904	< 0.717
RPOSF	1.224	0.867	1.253	< 0.002
YRSCH	2.990	0.985	5.207	< 0.001

Summary statistics:
Dependent variable = the probability of saying 'yes' to the principle WTP questions, Number of observations =300; log- likelihood is 73.8654,
F statistic: 31.1846; $\alpha = 0.05$; df = 9; $R^2 = 0.0.6050$; Adjusted R^2 0.5861.

A summary of the final logit regression results is presented in Table 5. Most of the estimated coefficients had a positive influence on the probability of saying 'yes' to the principle WTP questions by the respondents in the sample. The positive sign for the *CONSE* variable supports the hypothesis that the probability of the respondent saying 'yes' to the WTP question increases as the awareness of the present status of HEC and the issues involved in the conservation of elephants in Sri Lanka increases. Loomis and Ekstrand (1998) observe a similar situation in relation to Mexican spotted owl. In their study, they argued that the main source of respondents' uncertainties regarding their responses for the WTP questions link with their poor awareness about the conservation issues in question. Moreover, the authors also suggested the provision of necessary information to the respondents along with the survey instruments (questioner or interview schedule) as an alternative approach to reduce such uncertainties.

As might be expected, the coefficient for the *NONUV* was positive and significant in the model. This suggests that the respondent who values the non-use values of elephant (such as altruistic bequest and existence values) has a higher probability of answering 'yes' to the WTP question. This is understandable because the elephant has been closely associated with the people in Sri Lanka and their history, religion, culture, folklore, mythology and ceremony over the generations. Still certain social and religious groups consider this species of wildlife as a prominent cultural symbol. Boyle and Bishop (1987) noticed a similar situation in relation to non-use value of endangered species in a CV study carried out in Wisconsin. In this study, they also noted the weakness of the existing narrow valuation framework of wildlife resources. The authors further argued that this is because much of the empirical work on the valuation of wildlife resources has focused on consumptive uses with little or sometimes no attention being given for the non-consumptive use value. Thus a such narrowly defined valuation framework would overlook the monetary values that members of the society might place on the preservation of endangered species. In addition, the non-use values of the most endangered species of wildlife like the elephant are relatively obscure in the usual market places.

The coefficient for the attitudinal variables such as *GREEN* was positive and significant. The result suggests that a respondent with pro-conservation attitudes would contribute more towards the conservation of the elephant. Loomis and Larson (1994) observe a similar situation in a CV survey of grey whale. In this study, they tested whether the respondents' pro- conservation attitude would influence for their responses for the WTP elicitation questions. In this analysis two scenarios were tested (50% and

100% increases in whale population) and they conclude that total economic value for large change in wildlife resources was consistent with consumer theory.

Variable *PRODE* was used in the model to assess the response of anti-conservation attitudes on the probability of saying 'yes' to the WTP question. The *PRODE* was not significant. This is understandable because the majority of the respondents in the sample disagreed with development programs that cause environmental problems. In our preliminary discussion when we put the proposition "*Sri Lanka should not encourage development programs such as tobacco cultivation in central highlands that cause serious environmental damage*" 88.6% respondents agreed, implying that they were rather 'green', and inclined strongly towards environmental protection. Hadker *et al.* (1997) observes similar attitudes in a CV study in India. In this study it was found that about 72% of respondents strongly disagreed with development programs that hurt the environment.

BIDVA 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 interview to the respondent as a WTP elicitation question, the less willing these respondents were to pay for elephant conservation. In this study, respondents were presented with six WTP amounts in a double bounded dichotomous choice format. Each respondent was asked for a 'yes' or 'no' vote on whether the respondent's WTP equals or exceeds each bid. The second bid is conditioned on the respondent's response to the first bid, lower if the first response is 'no' and higher if it is 'yes'. Preliminary finding of this study revealed that respondents' response for bid values was closely correlated with the income variables. The incidence of 'yes' for the highest bid value by the

respondents who belonged to higher income brackets was greater than for those who belong to lower income brackets. Miller and Lindsay (1993) notice a similar relationship in a CV survey which was conducted to analysis WTP for a state gypsy moth control program in New Hampshire. Loomis and White (1996) also observe a similar result in an analysis of economic benefits of rare and endangered species.

Among the socio-economic characteristics, age, personal income, years of schooling, and respondent's position in the family were identified by the model to assess the impacts of the respondent's response to the probability of their willingness to pay for the conservation of the elephant. Results suggested that these variables were significant at the $\alpha = 0.05$ level in the analysis.

The positive sign of the coefficient of the *YRSCH* indicates that the probability of saying 'yes' for the WTP question increased with an increase in the number of years of schooling. This is understandable because more years of schooling would arguably increase the knowledge a person has about social, political, economic and environmental happenings. Moreover, the education would help a person comprehend news about environmental effects of economic development. Our preliminary analysis carried out in relation to level of education reveals that about 99.3 % of the respondents in the sample are literate, and 90% of the respondents had at least 10 years of formal schooling. Moreover, about 17 % of the sample had obtained a Bachelor's Degree or higher, and 31 % had completed their education at the diploma level. Several CV studies observe a similar relationship between level of education and respondent's response towards the WTP elicitation questions. For example, Whitehead (1992) noticed that the level of education often positively correlates with the WTP amount in

an *ex ante* willingness to pay analysis. Hadker *et al.* (1997) found in a case study of India that every one year increase in years of schooling increase the WTP by 5%. Pate and Loomis (1997) describe the rationale behind this relationship in a case study of wetland and salmon in California. Loomis *et al.* (2000) used level of education as one of the key independent variables in measuring the total economic value of restoring ecosystem services.

The variable *AGERE* was significant with negative coefficient. This implies that the younger respondents were more willing to say 'yes' to the WTP question than their older counterparts in the sample. In most cases, age was closely and negatively associated with the level of education. Expansion of the free education system since 1947 and the incorporation of environmental education into the school curriculum in the early 1980s have had a positive impact on the younger people's awareness or specific knowledge about contemporary conservation issues. Heinen (1993) observes a similar situation in a study of people's attitudes towards the wildlife in the *Kosi Tappu* Wildlife Reserve in Nepal. In this study, he reveals that the positive attitudes towards the preservation of nature could be measured by the individual willingness to pay amounts which correlate highly with the respondents' age, years of schooling and the gender. He also notices an interesting relationship between age and the years of schooling. Younger respondents are found often to have more years of schooling than the older ones in the sample. This is quite similar to the situation found in Sri Lanka.

The variable *RPOSF* was significant with a positive contribution. However, this result may be linked to the traditional Sri Lankan family culture and values. In this setting, families are represented by the head of the household. In most cases, the head of the

household is the father (or the mother in the absence of the father) or the oldest child (in the absence of both the father and mother). As a result, in this study over representation of more heads of households in the age group of 30 years and above become unavoidable. This cultural situation restricted the opportunities to interview the other members in certain households. In most cases such opportunities were found only where the head of the household was absent at the time of the interview and he or she permitted another family member (in most cases the most educated person in the family) to represent him or her in the interview.

The *PERIN* 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 *PERIN* implies that the respondents whose personal income was greater were more willing to pay for the conservation of the elephant than the respondents whose personal income was lower. A number of other CV studies have obtained a similar result. Boyle and Bishop (1987) estimate the effects of the income on the determination of WTP amount for the conservation of endangered species. Carson *et al.* (1996) found that the sum individuals are less willing to pay for the preservation of quasi-public goods tends to rise with their income. Loomis and Larson (1994) estimate an individual's WTP for increase in the quantity of an environmental public good in relation to a number of socio-economic factors including household income. Findings of Hadker *et al.* (1997) suggest that the higher income earners in the metropolitan area of Bombay have a stronger interest in environmental conservation than the lower income earners.

Reasons why respondents refuse to or are willing to pay for the conservation of elephants, payment vehicles and so on

Of the 300 respondents, bids of 34 respondents were identified as protest bids. To elicit their maximum willingness to pay an amount for the conservation of elephant, these respondents were presented with an alternative question: *If all the suggested amounts in the above are too high, what is your maximum willingness to pay to conserve the elephants in the country.* It was often not clear how much some were willing to pay. Many were not willing to pay at all. About 60% expressed their unwillingness to pay because of personal financial difficulties, saying that their present income is insufficient even to support their families. Little over 20% of these respondents think that the conservation of elephant and other wildlife is the responsibility either of the government or international organizations interested in conservation of natural resources in LDC. The rest of the respondents expressed various other reasons to justify their decisions. However, these 34 protest responses were removed from the sample so that genuine WTP could be analyzed. Therefore, a total of 266 WTP amounts were used to carry out the analysis.

The preliminary WTP estimates reveal that the respondents in this study in general are willing to pay Rs. 110.17 per month on average for elephant conservation. This amounts to an annual value of Rs 1322.04. As the payment will be made over a period of five years, the total present discounted value of these annual amounts at the 5% real rate of discount equals Rs. 6,009.75. However, the detailed WTP estimates accomplished at sub-sample levels suggest that the respondents' responses for the principal WPT questions are closely associated with their socio-economic background. Table 6 presents detailed WTP estimates at sub sample levels. Boyle and Bishop (1987) observe a similar situation in a case study of endangered species in Wisconsin.

They noticed that the respondents from different socio-economic backgrounds differ also in value assessment about wildlife and nature conservation. More recently, in a CVM study in India, Hadker *et al.* (1997) found WTP to be a function of the respondent's personal characteristics and income level.

Table 6: The distribution mean annual willingness to pay (MAWTP) estimates for the conservation of elephant at sub sample level (n =266)[a]

Sub-sample	MAWTP amounts	MAWTPA as a % of mean annual personal income	MAWTPA as a % of mean annual total family income
Jayanthipura	**1816.80** (*Sd*.208.4, *Med*.1200)[b]	**1.069** (*Sd*.0.099, *Med*. 0.92)	**0.526** (*Sd*.0.04, *Med*. 0.48)
Jayawadagama	**1224.00** (*Sd*.145.7, *Med*. 600)	**0.805** (*Sd*.0.048, *Med*. 0.65)	**0.397** (*Sd*.0.038, *Med*. 0.32)
Anderson Flats	**925.20** (*Sd*.112.7, *Med*. 600)	**0.635** (*Sd*.0.39, *Med*. 0.48)	**0.365** (*Sd*.0.49, *Med*. 0.29)
Aggregate value	**1322.00** (*Sd*.94.85, *Med*. 900)	**0.933** (*Sd*.0.22, *Med*. 0.33)	**0.481** (*Sd*.0.23, *Med*. 0.37)

Note: a: The protest responses were excluded form calculation of MAWTP estimates.

b: Respective standard deviations and median values are presented in the

The respondents who expressed their willingness to pay for the conservation of elephant in this study were asked the following question: *Can you kindly disclose why you are willing to have your household income reduced* (indicating the highest amount that respondents WTP) *for the conservation of elephants in the country?* This question was designed to check for embedding effects where respondents were paying for an environmental conservation in general, rather than elephant conservation in particular so that the final valuation could be adjusted appropriately. About 50% of the respondents said that it is their responsibility to contribute as much as they could to the conservation of elephant because the elephant is part of their history, culture and religion. Little over 20% of the sample mentioned the importance of preserving

elephant because of its contribution to biological diversity and its ecological value. About 8% of the respondents said that they were willing to pay because the government alone cannot solve the issues involved in the conservation of elephant. Little over 2% of the sample wanted to pay to foster better management practices for environmental conservation in general. About 18% mentioned various other reasons to for their decisions.

Finally, the respondents who agreed to pay for the conservation of elephant in the sample were also asked a question about their preferred method of payment: *Please indicate one of the following methods most convenient for you to make your contribution for the elephant conservation in Sri Lanka.* Several payment methods were identified in the pilot survey of this study. These payment methods were presented along with the information brochure to obtain respondents' responses for this question. The result of this analysis suggests that the majority of the respondents preferred to use conventional methods; about one-third preferred to make a direct cash payment to the relevant organization which undertook the proposed elephant conservation programs; a similar number preferred to pay their contribution along with their either monthly electricity or telephone bills; and the remaining responses of the rest of the 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 7.

Table 7: The distribution of preferred methods of payment

Method of Payment	Frequency	% of total
Along with my child's school fee every month	20	7.51
Along with insurance premium every 3 month	14	5.26
Along with TV license fee	13	4.88
Along with monthly telephone bill	41	15.41
Along with monthly electricity bill	58	21.80
A direct cash payment to the relevant organisation	93	34.96
Along with monthly grocery bill	9	3.38
Standing order for direct deduction from my salary	11	4.13
Other	7	2.63
Total	266	100

The aggregation of WTP benefits

In extrapolating from the sample to the Colombo metropolitan area, the sample characteristics and limitations must be borne in mind. If a sample bias exists, the projection too will be biased. The authors, mindful of the sensitivity of sample effects, referred to a study done by the Department of Census and Statistics of Sri Lanka on economic and demographic aspects of the population in the Colombo metropolitan area (Department of Census and Statistics, 1998). It was found that Colombo household characteristics were very close to the sample of the present study. However, it must be noted that the mean WTP values used to extrapolate from the sample to the population refer to the ones after the removal of protest bids.

Extrapolating to the Colombo metropolitan area, using a population size of about 1.51 million (this figure was drawn by deducting 11.3% from the total population of 1.7 people in the Colombo metropolitan area to represent the protest responses based on the findings of the case study presented in this paper) with a family size of about 3.7, we get a WTP for Colombo of Rs. 166.35 million per month for the conservation of elephant. This amounts to an annual value of Rs 1996.22 million. As the payment will

be made over a period of five years, the total net present discounted value of these annual amounts, at the 5% real rate of discount, equals Rs. 9,075.02 million.

Similar extrapolation could be carried out for the major urban areas such as Jaffana, Galle, Kandy to estimate the total WTP amount for elephant conservation by urban population in Sri Lanka. The Central Bank of Sri Lanka (2000) reveals that socio-economic conditions and household characteristics of the urban populations in these urban areas do not differ significantly from one another. Extrapolating to these major urban areas in Sri Lanka, using a population size of about 3.98 million (this figure was drawn by deducting 11.3% from the total population of 4.484 people in these urban areas to represent the protest responses based on the findings of the case study presented in this paper) with a family size of about 3.8, we get a WTP for urban population in the above cited major urban areas of Rs. 438.48 million per month for the conservation of elephant. This amounts to an annual value of Rs 5,261.17 million. As the payment will be made over a period of five years, the total present discounted value of these annual amounts, at a 5% real rate of discount, equals Rs. 24,554.20 million.

The Department of Census and Statistics (1998) reveals that the percentage of the urban population in Sri Lanka increased from 11% in 1871 to 21.5 % in 1981. At present it is about 38.7% of the total population of 19.353 million (Central Bank of Sri Lanka, 2000). From a population projection study Abeykoon (2001) found that about 45% of the population in Sri Lanka would reside in the urban areas by 2015. According to the Urban Development Authority, (2001), during the last two decades, the geographical distribution of the urban population in Sri Lanka has extended beyond the traditional urban centers while creating a number of new urban centers around the

country. Such centers arose adjacent to the major urban areas such as Colombo, Kandy and Gall due to increase in population pressure and the rapid expansion of the commercial activities. Furthermore, a set of eight provincial administrative capitals/urban centers were established with the introduction of the 13th Amendment to the present Sri Lankan Constitution for the devolution of power at the provincial level in 1987.

Doubtless socio-economic conditions and household characteristics of these recently established urban areas may differ from one another and from the major urban centers cited above in relation to the degree of the urbanisation and urban facilities available to the mass. However, there is no systematic discussion backed up by empirical research to determine to what extent such differences may exist. Therefore, in this analysis it is assumed that, even if there are some difference in socio-economic conditions and household characteristics among the urban residents in different urban centers in Sri Lanka in general, the possible impact on the respondents' responses for the payment principle questions will be insignificant. As De Silva (1998) reveals the elephant has been closely associated with the people in Sri Lanka and their history, religion, culture, folklore, mythology and ceremony over the generations. More recently, Bandara and Tisdell (2002c) examine to what extent the significance of the wild elephant in Sri Lanka influenced urban and rural attitudes towards the conservation of this species of wildlife. In this analysis, they found that 90.3% of the urban and 76 % of rural respondents in the sample were in favour of the conservation of elephant at least at the current level primarily due its non-consumptive use values cited above.

Extrapolating to the entire urban population in Sri Lanka, using a population size of about 6.67 million (this figure was drawn by deducting 11.3% from the total population of 7.49 million people in urban areas to represent the protest responses based on the findings of the case study presented in this paper) with a family size of about 3.82, we get a WTP for the entire urban population in Sri Lanka of Rs. 734.83 million per month for the conservation of elephant. This amounts to an annual value of Rs 8818.01 million. As the payments are only specified over a period of five years, the total present discounted value of these annual amounts, at a 5% real rate of discount, equals Rs. 40248.61 million. We know that urban residents are WTP Rs 8818.01 million per year for five years but we do not know their WTP beyond that. Damages caused by elephants will, however, continue in perpetuity given current populations of elephants. One possible way to compensate farmers would, in principle, be to invest the urban dwellers' contribution over five years in the capital market to give an estimated return on the capitalised sum of Rs. 2012.43 million per annum at the 5% real rate of interest. This could arguably be considered an indirect indication of the willingness of urban dwellers to pay in principle in perpetuity to conserve wild elephants.

It is also worth mentioning that although in this study we asked respondents' contribution for the conservation of elephants for only five years, some (maybe most) respondents certainly would probably be willing to pay beyond this period. Thus the total WTP amount available for the proposed trust fund would be much higher than the present estimated amount of Rs. 40248.61 million. On the other hand, this amount could be increased by at least another 100%, if we extended our extrapolation to the population of residents in the rural areas where elephants do not occur or interfere with farming practices. To make such an extrapolation process more realistic, we could have

introduced bid values for this group a little lower than those of urban dwellers. This might be needed because rural dwellers have lower incomes than urban dwellers.

5. To What Extent would Urban Dwellers be willing to Compensate Farmers for Damages caused by Wild Elephants?

As discussed elsewhere in this paper, in most cases, non-farming communities such as urban dwellers, nature lovers and conservationists appreciate the elephant as a valuable resource particularly its non-consumptive use value. By contrast, available evidence reveals that most local farmers in the vicinity of the elephant ranges consider this species of wildlife to be an agricultural pest that interferes with their farming practices. Several recent studies report that the Asian elephants are responsible for much of the crop and property damage throughout their range (see Tisdell and Xiang, 1998; Weerakoon, 1999; Ramakrishnan, *et al.* 1997; and Nyhus *et al.* 2000). As a result of the elephant's interference with agriculture, the size of the elephant population in many parts of the Asian elephant range has declined substantially. For instance, the elephant population in Sri Lanka has fallen from 12,000 elephants in the mid-nineteenth century to about 3500 now. De Silva (1998) reports that between 100-120 elephants are lost in the wild in Sri Lanka every year on average primarily because of attempts by farmers to protect their crops. Desai (1998) believes that the likelihood of this trend continuing in Sri Lanka is almost certain given the current increase in fragmentation and the loss of the natural habitat of elephants. Thouless (1994) and De Silva (1998) argue that policies for the construction of wild elephants are inadequate and further reduction in Sri Lanka's elephant population can be expected.

Bandara and Tisdell (2002a) proposed the application of integrated economic policies for the conservation of elephants and to alleviate HEC. In this analysis, they argue that this requires the development of public policies and appropriate strategies based on stakeholder perceptions to encourage private landowners and farmers in the unprotected areas to tolerate the presence of elephants on their private land. Compensating farmers for the damage caused by elephant could be an important policy option to encourage them to allow elephants some access to their crops for food and survival and reduce the likelihood of the killing of the animals. Thus we undertake an analysis to investigate whether the urban residents' WTP for conservation of elephants is sufficient to compensate farmers for the crop and property damage caused by elephants and to raise farmers' tolerance of the presence elephants. If urban dwellers could compensate farmers for their losses from elephants given the current elephant population, and better off than in the absence of wild elephants, the current population would be Kaldor-Hicks superior to the absence of wild elephants.

Crop depredation by wild elephants is a common problem across the entire elephant range in Sri Lanka. Several recent case studies provide some estimate for the crop and property damage caused by elephants in certain elephant ranges in the country (see Bandara and Tisdell (2002b); Jayawardene (1998); Kulathunga (1999); De Silva (1998); Weerakoon (1999); Desai (1998); Desai (1995); and Santiapillai, (1998). However, so far no systematic attempt has been made to estimate the total crop and property damage caused by the elephant at the macro level. Thus, we used the three selected studies cited above to extrapolate total value of the elephant damage for the entire elephant range in the country. These studies were selected based two criteria: inter and intra variation of the different parts of elephant rages in Sri Lanka. The first

criterion was used to examine to what extent the dynamic factors such as ranging behaviour of the elephant, their feeding habits, and fodder availability which influence the inter variation of the damages caused by elephants were taken into account in the sampling procedures of each of these studies. The second criterion was used ensure to what extent these studies represent the variation that could exist in different parts of the elephant rage in the country. Desai (1995) classifies the entire elephant range in Sri Lanka into three broader categories based on the severity of the HEC: Northwestern, Mahaweli and Southern. The Northwestern elephant range represents the highest elephant crop-raiding region; the Mahaweli and Southern represents medium and low crop-raiding ranges respectively.

For extrapolating the crop and property damage cased by elephants we chose Bandara and Tisdell (2002b). This study was conducted in 2001 on a sample of 300 farmers chosen form six villages in the *Galgamuwa* divisional secretariat division of the Northwestern province. In this study, the authors found that elephants were responsible for about Rs 12,049 worth of crop and property damage on average per farmer/per cropping season in the study area. In extrapolating from the sample to the entire Northwestern elephant range, using about 16,800[1] farming families who suffered the elephant damage, we get a total crop and property damage cased by elephant for the entire elephant range of Rs. 202.42 million per cropping season. This amounts to an annual value of Rs 404.84 million.

For extrapolating the elephant damage for the Mahaweli elephant range we used Jayawardene (1998). This study was conducted in a sample of 200 paddy farmers in System G of the Accelerated *Mahaweli* Development Programme. In this study, it is

[1] These figures are drawn from the information given during personal discussion between one of the authors of this paper and the regional wildlife authorities in the respective elephant ranges.

estimated that on average about Rs. 11,810 worth of crop damage is caused by elephant per cropping season per farming family. In extrapolating from the sample to the whole *Mahaweli* elephant range, using about 15700[1] farming families who suffered the elephant damage, we get a total economic loss for the region of Rs. 185.42 million per cropping season. This amounts to an annual value of Rs 370.83 million.

For extrapolating the elephant damage for the Southern elephant range we used De Silva (1998). This study was conducted in 1997 on a sample of 200 farmers in the Southern elephant range. This study found that elephants are responsible for about Rs. 11,760 worth of crop damage per cropping season on average per farming family in the sample. In extrapolating from the sample to the whole Southern elephant range, using about 14,700[1] farming families who suffered the elephant damage, we get a total economic loss for the region of Rs. 172.87 million per cropping season. This amounts to an annual value of Rs 345.74 million.

The total economic value of the crop and property damage caused by elephants for the entire elephant range in Sri Lanka can be obtained by amalgamating the estimates cited above. This amounts to Rs. 560.71 million per cropping season or Rs. 1121.42 million per annum. Before we use this figure to reach any conclusion, it must be noted that the crop and property damage calculated in this analysis is a fraction of the total economic cost associated with elephants. Total economic cost includes this and other associated costs such as the cost of control measures undertaken by farmers to scare away the crop raiding elephants, income foregone by farmers in having to replace some crops with others that are less attractive to elephants, and the management cost borne by government departments to undertake various programs for the conservation of

elephants and the mitigation of HEC. The Ministry of Environmental Management (1998) reveals that the Department of Wildlife Conservation in Sri Lanka, the principle agency which is responsible for elephant conservation and mitigation of HEC at present spent around 6% (Rs. 16.4 million) of its annual budgetary allocation on average only to undertake on-site elephant management activities such as construction and maintenance of electric fences, rehabilitation of elephant dives, and translocation of problem elephants. However, no estimates of farmers' real on crop protection as of income forgone are available.

Nevertheless, when we compare our economic estimates of the crop and property damage caused by elephants and other associated costs with the estimated return on the capitalised sum of Rs. 2012.43 million per annum, it shows that urban residents' financial support for the conservation of elephant significantly exceeds the economic losses caused by the elephant. This means that our estimated return of Rs. 2012.43 million per annum on the capitalised sum in perpetuity is more than sufficient to compensate farmers for their estimated crop losses of Rs. 1,121.41 per annum.

When compensation is paid, control by farmers is likely to be much reduced. Furthermore, a lot of their control costs are ineffective in aggregate, either because elephants have become resistant to control measures or because, in many cases, control measures merely result in elephants moving from one farmed area to another (cf. Rollins and Briggs, 1996, p.369). Consequently, in the latter case, a type of prisoners' dilemma problem exists. If compensation leads to much reduced control of elephants by farmers, they should achieve a net economic benefit because their control costs will be greatly reduced (or in the extreme case, eliminated) and the aggregate damage

experienced by them from elephants will increase little or not at all. There could, however, be a small increase in damage in aggregate, if, for example, elephant populations increase slightly due to less harassment of elephants. Nevertheless, it is clear, that if compensation were paid to farmers, a sum of less than Rs 1,124.42 million per year would compensate them if allowance were made for the reduced control effort of farmers.

6. Concluding Remarks

This study was conducted to survey a sample of urban residents in the Colombo metropolitan area to elicit their willingness to pay for the conservation of the Asian elephant in Sri Lanka. A non-linear logit regression model was constructed for the respondents' response on the question of willingness to pay in order to investigate the underlying factors that determine the willingness to pay. An analysis is also undertaken to explore whether urban residents' WTP for the conservation of elephant is sufficient to compensate farmers for the damage caused by elephants and to raise their tolerance for the presence of elephants on the farming fields. Of the 300 respondents surveyed in this study, 266 (88.7%) answered positively to the payment principle questions. Most respondents were very articulate in both positive and negative answers to the question about WTP, as well as in giving their views and perceptions about the true nature of the issues of elephant conservation, alternative use of elephants, and the historical, cultural and religious significance of this species of wildlife.

The finding of this analysis indicates that there is a strong economic case for ensuring the survival of wild elephants in Sri Lanka. There is strong evidence that the current population of wild elephants in Sir Lanka is Kaldor-Hicks preferable to their absence.

However, we are not in a position to determine the extent to which the current population of wild elephants in Sri Lanka can be altered to bring about a Kaldor-Hicks improvement.

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