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A Policy and Contingent Valuation Study

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† School of Economics, The University of Queensland, Brisbane QLD 4072, Australia
Email: s200516@student.uq.edu.au

* School of Economics, The University of Queensland, Brisbane QLD 4072, Australia
Email: c.tisdell@economics.uq.edu.au

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For more information write to Professor Clem Tisdell, School of Economics, University of Queensland, Brisbane 4072, Australia. Email
c.tisdell@economics.uq.edu.au

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A Policy and Contingent Valuation Study

Abstract

Reports results from a contingent valuation survey of willingness to pay for the conservation of the Asian elephant of a sample of urban residents living in three selected housing schemes in Colombo, the capital of Sri Lanka. Face–to–face surveys were conducted using an interview schedule. A non-linear logit regression model is used to analyse the respondents' responses for the payment principle questions and to identify the factors that influence their responses. We investigate whether urban residents' willingness to pay for the conservation of elephants is sufficient to compensate farmers for the damage caused by elephants. We find that the beneficiaries (the urban residents) could compensate losers (the farmers in the areas affected by human–elephant conflict) and be better off than in the absence of elephants in Sri Lanka. Therefore, there is a strong economic case for the conservation of the wild elephant population in Sri Lanka. However, we have insufficient data to determine the optimal level of this elephant population in the Kaldor-Hicks sense. Nevertheless, the current population of elephant in Sri Lanka is Kaldor-Hicks preferable to having none.

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

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1. Introduction

While most management of endangered species, such as the Asian elephant (*Elephas maximus*), still relies on qualitative ecological criteria, in the last two decades, several authors have emphasised the usefulness of economic valuation as a wildlife management tool (Gregory *et al.*1989; Stevens**,** *et al.* 1991; Whitehead, 1992; Loomis and White, 1996; Hadker *et al.* 1997; Tisdell and Xiang, 1998; and White *et al.* 2001). Although 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) has declared the Asian elephant to be one of the most seriously endangered species of large mammals. It is now found in only thirteen countries in Asia, including Sri Lanka. Even the elephant population in Sri Lanka has fallen sharply, starting from the mid-nineteenth century (De Silva, 1998). The major factors contributing to this decline are the fragmentation and loss of the natural habitat of elephants (Desai, 1998), largely a result of *ad hoc* economic development projects completed during the last fifty years (Weerakoon, 1999). Lack of co-ordination between different government departments and wildlife authorities, failure to consider fully economic aspects and evaluate public preferences for elephant conservation have contributed to this result.

Several techniques exist for measuring the economic value placed by members of the general public place on conserving wildlife such as the Asian elephant. These include the hedonic pricing approach (HPA), the travel cost method (TCM), and the contingent valuation method (CVM) (Carson *et al*. 1996). However, the HPA and TCM have been criticised by several authors for failing to measure adequately the non-use or intangible values of wildlife (Stevens *et al.* 1995). The CVM is however, able to measure such values (Kotchen, 2000) by using survey questions to elicit people's stated preferences for public goods, such as conservation of elephants (Ready *et al*. 1996; White *et al*. 2001). However, CVM also has limitations (Pate and Loomis, 1997). It can for example, involve errors in estimation of economic value due to strategic, design, part-whole and hypothetical biases (Garrod and Willis, 1999).

Nevertheless, CVM is a widely applied monetary evaluation method for valuing environmental and natural resource-related goods, such as the preservation of wildlife species and outdoor recreational amenities (cf. Jakobsson and Dragun, 1996; Welsh and Poe, 1998; Witzer and Urfei, 2001 Whitehead, 2002). Carson *et al.* (1994) have provided a bibliography of 1,600 CVM studies and related publications. In CVM, the measurement of non-use economic values of a given environmental amenity are generally based on the willingness to pay (WTP) for an improved situation, or the willingness to accept (WTA) compensation for a damaged or diminished situation. An appealing aspect of the contingent valuation method is that it estimates the total economic value of any environmental amenity in question (Pate and Loomis, 1997).

The purpose of this study is to present the results from a contingent valuation (CV) survey of a sample of urban residents in Colombo, the capital of Sri Lanka that elicits their WTP for the conservation of the Asian elephant. An analysis is undertaken to investigate the underlying factors that determine the willingness of urban respondents to pay for elephant conservation. Furthermore, we consider whether urban residents' WTP for the conservation of elephants is sufficient to compensate farmers for the damage caused by elephants. We ask whether it would be possible for urban residents to compensate farmers for their losses and thereby raise farmers' tolerance of the presence of elephants on their farming fields. Specific issues and limitations of this type of 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). First, survey procedures are outlined and followed by analysis of the results. 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 the Contingent Valuation Questions Asked

The process of devising a convincing CV scenario involves several steps (Jordan and Elnagheeb, 1994). The first step is to devise a hypothetical market for the environmental amenity in question with respondents being requested to make decisions as consumers in the framework of a hypothetical market (White, *et al.* 2001). In this study, a hypothetical market was established to assess the urban residents' WTP to conserve the elephant in Sri Lanka. Interviews with the respondents involved five different steps.

First, the respondents were presented with updated information about the present status of the elephant population in Sri Lanka, the policy and institutional issues that need to be addressed in conserving the elephant, and mitigating of the human elephant conflict (HEC). Respondents were then told why it is important to adopt new approaches to ensure the survival of the elephant in Sri Lanka in the long-term. They were informed that the existing protected area network in the country is unable to provide sufficient protection and natural habitats for the elephants to survive in the long-term (Bandara and Tisdell 2002a). Furthermore, there is no prospect of increasing the size of the total protected area in Sri Lanka. Thus, the long-term survival of the elephant in Sri Lanka seems to depend on their continued use of both protected and non-protected areas.

Secondly, in the survey respondents were presented with an alternative policy designed to address these issues. They were asked to assume that an autonomous body, reputed for its efficient and honest work, would introduce an appropriate programme so that the current downward trend in the elephant population could be halted while addressing other elephant related issues. Respondents were then briefed on the details of the policies and strategies that this organisation intended to implement to encourage farmers in the unprotected areas to tolerate the presence of elephants on their private land. An appropriate programme would be undertaken to compensate farmers for the damage caused by elephants in order to encourage them to allow elephants some access to their crops for food and reduce the likelihood of farmers' killing these animals. Simultaneously, suitable programs would also be undertaken for the provision of extra protection around existing national parks, translocation and domestication of troublesome elephants, the establishment of recreation centers and the promotion of the elephant based eco-tourism. Finally, the respondents were informed about the possible benefits that they would be able to obtain after the successful implementation of this programme.

Thirdly, respondents were 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 CV studies, for example, Champ *et al.* (1997), Chiton and Hutchinson (1999) have used this mechanism to motivate respondents to tell the truth. FAO (2000) concludes that the use of conventional bid vehicles such as variations in income tax, entry charges, property tax

and changes in utility bills, reduce the willingness of respondents' motivation to tell the truth in these countries. Bohara *et al.* (1998) indicate that the VCM often creates a believable scenario while reducing the hypothetical nature of CV procedures. However, the VCM and its derived values are not without criticisms. For example, Berrens *et al.* (2002) argue that their application in absence of a coercive provision rule could create both free-riding and warm-glow giving situations. Johannesson *el al.* (1998) indicate that the VCM may create incentives to overstate hypothetical donations if respondents do not believe payment will be required. Nevertheless, more recently, Whittington, (2002) argued that respondents in developing countries could be motivated more towards truth telling through the VCM than the conventional bid vehicles.

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 implement the above mentioned program to conserve the elephants in the country"*. 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, in the recent past, this method has 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 initial WTP elicitation question is presented with the highest bid value in the bid vector, which in the present study, was Rs. 500. 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 list is reached. In the preset study, the bid vector contained five different bid values i.e. Rs. 500, 250, 100, 50 and 25. 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. Moreover,

this approach has also been shown to be incentive-compatible: provided that respondents understand that provision of the good depends on the majority of votes, and the respondent's own vote in itself cannot influence such provision, truth-telling is in the respondent's best interest (FAO, 2000).

Although at first glance this approach may appear to be an 'iterative bidding approach' (cf. Randall *et al.* 1974; Boyle and Bishop. 1987; Whitehead, 2002), closer analysis shows that these two approaches differ. In the iterative bidding approach, the WTP elicitation starts by querying individuals using some initial randomly chosen dollar value, and then varying the value until the respondent accepts to pay an exact amount. This final dollar amount is interpreted as the respondents' WTP. However, FAO (2000, p.5) claims that this approach has been virtually abandoned because it results in starting point bias. Another significant disadvantage of this approach is that repeated questioning may annoy or tire respondents, causing them to say 'yes' or no' to a stated amount in the hope of terminating the interview (Welsh and Poe, 1998). In contrast, an upper bounded the dichotomous format with follow-up questions is used in the present study. It does not determine WTP directly for most respondents; instead it forms broad intervals around the most respondents' WTP amount (cf. FAO, 200, p15).

Finally, those who responded positively to the WTP election question were asked to disclose their preferred methods of payment. Whittington *et al.* (1993) use similar approach. Hoehn and Randall (1987) point out the analysis of payment rules provide incentives for truth telling by contingent market respondents, and it also helps to identify the survey respondents' motives for their contribution (Hadker *et al.* 1997). Moreover, Mitchell and Carson (1989) suggest that the incorporation of payment rules reduce the hypothetical nature of the CV studies. Thus, in the present study, an additional question is asked about preferred methods of payments by respondents.

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

3.1 Sample

The surveyed urban population was chosen from residents in Colombo. The population density, level of urbanisation, living standards and life style of residents were taken into account in selecting a sample of 300 residents from three main housing schemes in Colombo, *Jayanthipur*a, *Jayawadanagam*, and *Anderson Flats.* The Urban Development Authority of Sri

Lanka (2001) classifies these schemes into three broader categories of income earners i.e. high, mid and low. A hundred residents were chosen from each of these housing schemes as so as to provide stratified sample. The socio-economic characteristics of the sample are summarized in Table 1.

Table 1

A Summary of Socio-economic Characteristics of the Sample*

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

Note: a. 300 randomly selected urban residents in three selected housing schemes in Colombo metropolitan area in Sri Lanka were chosen as a sample.

3.2 Interview schedule

An interview schedule (IS) consisting of six separate sections was used as the main survey instrument. Section one contained 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. Section two assessed the attitudes of the respondents on 'development' and 'environment'. Section three contained questions designed to assess respondents' awareness about the elephant related issues in Sri Lanka and attitudes towards conserving elephants in their natural state. Section four presented contingent market valuation questions to assess the economic value of conserving the elephant. In section five, respondents who positively responded to WTP elicitation questions were asked their preferred method of payment and the motivation for their contribution. Section six of the IS comprised a set of questions for the interviewer.

3.3 The administration of the survey

Nine graduate students from the Faculty of Graduate Studies of the University of Colombo were used as interviewers to administer the IS. In administrating the IS, face– to–face surveys were conducted in *Sinhala*, a major language in Sri Lanka. FAO (2000) reveals that most CV studies in developing countries have relied on this direct approach. Hadker *et al.* (1997) describes the value of this method compared to the mailed questionnaire and telephone surveys in the developing country context. Mail surveys yield a low response rate and suffer from self-

selection biases. In a country like Sri Lanka, telephone surveys would bias the sample towards the upper-middle and higher income brackets. Further, face-to-face surveys have the advantage that trained interviewers can actually interact with respondents, and can clarify respondents' doubts thereby 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.

3.4 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 many cases, the biases can be econometrically removed if they have been captured by a proxy variable (Kanninen, 1995). In the present study, the variable BIDVA (Bid value, rupee value offered from the payment principle questions) is highly significant and implies that estimated mean WTP may be influenced in the elicitation process by the bid values offered in optional follow-up questions. This indicates the possibility of respondents suffering from anchoring effects, also known as starting point bias. However, in this study, respondents were given seven separate opportunities to decide their WTP amount. In addition to this procedure, in order to remove this effect further, in the subsequent logit analytical stage, we estimate mean WTP by removing insignificant bids (bid values of less than Rs.25) and 'protest' responses setting their BIDVA equal to zero.

3.5 Method of analysis

In the present study, a non-linear logit regression model was applied to the respondents' response to the principle WTP elicitation question following an approach similar to Hanemann (1984). 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 the 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 helpful in suggesting an appropriate form. Using this function one can relate the probabilities of particular choices to a set of behavioural rules reflecting the decision-maker's preferences (McFadden, 1974).

In the logit analysis with a 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 from each WTP elicitation question 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).

4. Analysis of Results – Contingent valuations and logit analysis

The responses received for the payment principle questions are presented in Table 2. Of the 300 respondents, 266 (88.7%) answered positively to the particular bid values listed and 34 (11.3%) respondents did not say 'yes' to any of all the bid values offered by the payment principle questions**.** The free-estimated marginal probability of a 'yes' response increased from 0.093 to 0.40 as the bid value offered decreased from Rs. 500.00 to Rs. 25.00.

Table 2

Distribution of 'yes' response to the payment principle questions

Bid value (in Rupees)	'Yes' response	% of total	Marginal probability of a 'yes' response
500.00	28	9.33	0.093
250.00	16	5.33	0.059
100.00	106	35.33	0.414
50.00	60	21.33	0.571
25.00	56	18.67	0.400
Total 'yes' to offered bids	266	88.67	0.886
Bid of < Rs. 25 ('protest' bids)[a]	34	11.33	0.113
Total	300	100.00	--

Note: **a.** Number of protest bids plus bid s of insignificant value (< Rs. 25) is 34 or 11.33% of the sample. Total number of respondents willingness to pay is 280 inclusive of bids of less than Rs. 25.

The probability (P_i) being WTP Rs 25 or more is used as a dependent variable in the logit analysis. This can be interpreted as the WTP other than an 'insignificant' amounts towards the

scheme to conserve elephants (A value of Rs. 25 is about 25 cents US). Therefore (1- P_i) in this logit analysis is the probability of giving an insignificant bid (< Rs. 25) or a 'protest bid'. The independent variables used in the preliminary logit analysis, are described in Table 3 and their basic statistics are given in Table 4.

Table 3

Variables included in the preliminary logit analysis

Variable	Definition
AGERE	Age of the respondent in years.
ATHEC	Concern towards alternative elephant conservation approaches; 1= Very concerned, 2= A little concerned 3= Not concerned at all
BIDVA	Rupee value from the WTP question.
CONSE	Awareness about the current elephant conservation issues; 1=Not aware, 2 = Aware 3 = Very aware.
FUPRE	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	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	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	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 included in the preliminary logit analysis

Variable	Mean	Stan.devi.	Maximum	Minimum
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

Preliminary multivariate 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 principal WTP elicitation question at the $p < 0.05$ significance level. This analysis reveals that some of the independent variables used are either not significant or are highly correlated with other variables at the $r > 0.8$ level. Hence, it was decided to exclude these variables from the final logit regression analysis.

The final logit regression analysis, done by using the forward stepwise selection of variables, significantly improved the resulting model's goodness of fit as 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 also employed 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 overall ability of the model to yield a correct prediction on urban residents' WTP for the conservation of the elephant was significant at the 0.05 level of significance.

Most of the estimated coefficients (See Table 5) had a positive influence on the probability of respondents saying 'yes' to the principle WTP questions, that is their probability of being WTP a 'significant' amount (Rs. 25 or more) to support the conservation scheme. The positive sign for the *CONSE* (the awareness about the current elephant conservation issues) variable supports the hypothesis that the probability of the respondent saying 'yes' to the WTP question increases with the respondents' awareness of the present status of HEC and the issues involved in the conservation of elephants in Sri Lanka. Loomis and Ekstrand (1998) observe a similar situation in relation to Mexican spotted owl. These authors argued that the main source of respondents' uncertainties regarding their responses for the WTP questions arises from their lack of awareness of the conservation issues in question. Moreover, they suggest 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.

Table 5

The factors influencing respondents' responses for the payment principle questions: the final logit regression results

Variable	Coefficient	Standardized error	*t*-statistics	*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.

As might be expected, the coefficient for the *NONUV* (the non use-value of the elephant) was positive and significant in the model. This suggests that a respondent who values the non-use values of elephants (such as altruistic, bequest and existence values) has a higher probability of answering 'yes' to the WTP question. Boyle and Bishop (1987) noticed a similar situation in relation to the 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 no attention being given to the non-consumptive use value.

The coefficient for the attitudinal variables such as *GREEN* (pro-conservation perception) was positive and significant. The result suggests that a respondent with pro-conservation attitude would contribute more towards the conservation of the elephant. Loomis and Larson (1994) observe a similar situation in a CV survey of grey whale. They tested whether the respondents' pro-conservation attitude would influence their responses for the WTP elicitation questions.

BIDVA (bid - value, rupee value from the WTP elicitation question) 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 to the respondent, the less willing the respondent was to pay for elephant conservation. After the initial elicitation question, five different bid values were offered on five different occasions conditioned by the respondent's response for the bid value offered in each elicitation occasion. Preliminary findings revealed that respondents' response for bid values offered on each occasion were positively correlated with the income variable. The incidence of 'yes' for the highest bid value by the respondents in higher income brackets was greater than for those in lower income brackets. This is not surprising; Miller and Lindsay (1993) notice a similar relationship in a CV survey conducted to analyse WTP for a state gypsy moth control program in New Hampshire; and Loomis and White (1996) observe a similar result in an analysis of economic benefits of rare and endangered species.

Our analysis reveals that about 99.3 % of the sampled respondents 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. The positive sign of the coefficient of the *YRSCH* (years of schooling) in Table 5 indicates that the probability of saying 'yes' for the WTP question increased with the number of years of schooling. This is understandable because more years of schooling would arguably increase a person's knowledge about social, political, economic and environmental happenings. Moreover, the education would help a person comprehend news about environmental effects of economic development. Loomis *et al.* (2000) used level of education as one of the key independent variables in their measurement of the total economic value of restoring ecosystem services. Several CV studies observe a positive relationship between level of education and respondents' responses to the WTP questions. For example, Whitehead (1992) found that the level of education positively correlates with the *ex ante* WTP for sea turtle protection. Hadker *et al.* (1997) found in an Indian conservation case study that every one year increase in schooling raises the WTP by 5%. Pate and Loomis (1997) describe the rationale behind this relationship in case studies of wetlands and salmon in California.

The variable *AGERE* (age of the respondent) is statistically significant and has a negative coefficient. This implies that the younger respondents were more willing to say 'yes' to the WTP question than their older counterparts. In most cases, age was closely and negatively associated with the level of education. Expansion of the Sri Lankan 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 found that positive attitudes towards the preservation of nature, as measured by the individual's willingness to pay, 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 his sample. This is quite similar to the Sri Lankan situation.

The variable *RPOSF* (respondent's position in the family) was significant with a positive contribution to support for conservation of elephants. However, this result may be linked to the traditional Sri Lankan family culture and values. In this context, 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 eldest child (in the absence of both the father and mother). As a result, in this study over representation of heads of households in the age group of 30 years and above was unavoidable. This cultural situation restricted opportunities to interview 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 or if 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* (personal monthly income) was significant and higher income had a positive influence on the probability of an individual saying 'yes' to the WTP question. 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. The results parallel those of Carson *et al.* (1996), Loomis and Larson (1994), and Hadker *et al*. (1997) for the demand for other environmental goods.

4.1 Reasons why respondents refuse to or are willing to pay for the conservation of elephants, aggregate WTP, preferred methods of payment, and so on

Of the 300 respondents, 34 did not accept any of the specific bid values offered. To elicit their maximum WTP amount, they were presented with an alternative question: *If all the suggested amounts in the above are too high, what is your maximum WTP?* Of these 34 respondents, 14 offered a positive amount of less than Rs. 25 and the remainder gave 'protest' bids or zero bids. Some were unwilling to pay (gave zero bids) because of personal financial difficulties, saying that their present income is insufficient even to support their families. Others protested saying 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 developing countries and they would not contribute. And there were few other reasons for not giving a positive bid.

While unwillingness to pay and willingness to pay only an insignificant amount (less than Rs. 25) are interpreted for the purposes of the logit analysis (see Table 5) as lack of WTP for the elephant conservation scheme, all bid values are taken into account here to estimate the aggregate WTP for the conservation scheme for elephants. Note however, in advance the values imputed for WTP will underestimate the aggregate WTP because values offered (see

Table 2) are upper bounded at Rs 500 and some of 266 respondents who were WTP Rs 25 or higher would have presumably been prepared to pay more than the bid value offered. For example, of 106 WTP Rs.100, some would have been WTP an amount higher than Rs. 100 but less than Rs. 250. However, this likely underestimate of aggregate WTP will not, as it transpires, offer the policy conclusion from this particular exercise.

The WTP estimates reveal that non- protest respondents on average are willing to pay Rs. 110.17 per month 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 a 5% real rate of discount equals Rs. 6,009.75. Detailed WTP estimates examined at sub-sample levels suggest that responses for the principal WPT questions are closely associated with the socio-economic background of respondents. Table 6 presents detailed WTP estimates at sub - sample levels. Boyle and Bishop (1987) observe a similar situation in a study of endangered species in Wisconsin. 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 (in Rupees)	MAWTP as a % of mean annual personal income	MAWTP as a % of mean annual total family income
Jayanthipura	**1816.80** (1806:1861[b]; 208.4[c];1200[d])	**1.069** (0.91:1.3[b]; 0.099[c]; 0.92[d])	**0.526** (0.39:0.68[b]; 0.04[c]; 0.48[d])
Jayawadagama	**1224.00** (1213:1242[b]; 145.7[c]; 600[d])	**0.805** (0.07:1.01[b]; 0.048[c]; 0.65[d])	**0.397** (0.271:4.31[b]; 0.038[c]; 0.32[d])
Anderson Flats	**925.20** (912:935[b]; 112.7[c]; 600[d])	**0.635** (0.48:075[b]; 0.39[c]; 0.48[d])	**0.365** (0.242:0.481[b]; 0.49[c]; 0.29[d])
Aggregate sample	**1322.00** (1311:1332[b]; 94.85[c]; 600[d])	**0.933** (0.87:1.56[b]; 0.22[c]; 0.33[d])	**0.481** (0.314:0.573[b]; 0.23[c]; 0.37[d])

Note: a: The protest responses were excluded form calculation of MAWTP estimates.
b: 95% confidence intervals for respective MAWTP estimates;
c. Respective standard deviations; d. Respective median value.

The analysis of the respondents' motivation to contribute to the conservation of the elephant in Sri Lanka reveals that about 50% of the respondents said that it is their responsibility to contribute as much as they can to the conservation of elephant because the elephant is part of their history, culture and religion. A little over 20% of the sample mentioned the importance of preserving the elephant because of its contribution to biological diversity and its ecological value. About 8% of the respondents said they were willing to pay because the government alone cannot solve the issues involved in the conservation of the elephant. Slightly over 2% of the sample wanted to pay to foster better management practices for environmental conservation in general.

The analysis of respondents' preferred method of payment indicates that the majority preferred to use the non conventional methods; about one-third preferred to make a direct cash payment to the relevant organization undertaking the proposed elephant conservation programs; a similar number preferred to pay their contribution along with either their monthly electricity or telephone bill; and the reminder of responses were distributed unevenly among the other methods of payment suggested as indicated 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**

4.2. The extrapolation of WTP benefits ─ Urban dwellers benefit from the presence of elephants

The simple transferring point estimate approach (STPE) was used to extrapolate WTP benefits. A number of recent contingent valuation studies ─ for example, Loomis and Ekstrand (1997), Hadker *et al.* (1997), and Loomis *et al.* (2000) ─ have used this approach to extrapolate

environmental benefits. Boyle and Bergsrom (1992) examine the advantages of this method compared to 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. Furthermore, Feather and Hellerstein (1997) found that the accuracy of the results obtained from BFTA depends heavily on the degree of similarity between the 'study area' and the unstudied 'policy area' (i.e. population of interest). Moreover, the use of the BFTA tends to create large biases when a major difference exists in the value of the non-market commodity to the different social segments in the same society. The debate about this approach continues and remains unresolved (Brouwer and Spaninks, 1999).

Nevertheless, mindful of the sensitivity of sample effects, we noted the results for the socio-economic attributes of the urban population in Sri Lanka from the census conducted by the Department of Census and Statistics of Sri Lanka (2002). It was found that the overall household characteristics of the urban dwellers in Sri Lanka were very close to those of the sample used in the present study. Therefore, extrapolation of final aggregate WTP urban estimates found in this study is likely to introduce little error. In the present study, the extrapolation of WTP benefits for the urban sample was carried out at three different levels: a) from the sample to the Colombo metropolitan area, b) from the Colombo metropolitan area to the major urban areas, and c) from major urban areas to the entire urban population in Sri Lanka. Although the mean WTP value of non-protest respondents is used to extrapolate from the sample to the population, we deduct 11.3% from the population to allow for protest bid. This means that the WTP of those with protest bids is treated as zero.

Extrapolating from the sample to the Colombo metropolitan area, using a population size of about 1.51 million (this figure was determined by deducting 11.3% from the total population of 1.7 people in the Colombo metropolitan area to allow for protest responses based on our Colombo sample) 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.

Extrapolating from the Colombo metropolitan area to other the major urban areas such as Jaffana, Galle, Kandy, using a population size of about 3.98 million (this figure was derived by

deducting 11.3% from the total population of 4.484 people in these urban areas to allow for protest responses) 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.

Extrapolating from major urban areas to the entire urban population in Sri Lanka, using a population size of about 6.67 million (this figure was obtained by deducting 11.3% from the total population of 7.49 million people in urban areas to allow for protest responses) with a family size of about 3.82, we get a WTP for the entire urban population of 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.

5. The Cost of Elephants; Mostly Damage to Farmers

As discussed earlier in this paper, non-farming communities, such as urban dwellers usually consider the elephant to be a valuable resource. They frequently favour legislation to protect it. However, many farmers regard the elephant as an agricultural pest responsible for much crop and property damage in Asia (Nyhus *et al.* 2000). Damage caused by elephants to agriculture have resulted in the size of the elephant population in many parts of Asia being substantially reduced (Kemf and Santiapillai 2000). For instance, the elephant population in Sri Lanka has fallen from 12,000 elephants in the mid-nineteenth century to about 3,500 at present (De Silva, 1998). Desai (1998) believes that this trend is almost certain to continue given the current increase in fragmentation and the loss of the natural habitat of elephants. Thus, the long-term

survival of this species seems to depend on its use of both protected and non-protected areas (Bandara and Tisdell, 2002a).

As mentioned above, compensating farmers for the damage caused by elephant could be an important policy option to encourage farmers to allow elephants some access to their crops for food and reduce their likelihood of farmers killing of elephants. Hence, in this section we determine the size of economic losses of farmers from damages caused by elephants. This will enable us to discover whether the urban residents' WTP for conservation of elephants is sufficient to compensate farmers for the crop and property damage caused by elephants. If urban dwellers could compensate farmers for their losses from elephants given the current elephant population, and be better off than in the absence of wild elephants, the current elephant population would be Kaldor-Hicks superior to the absence of wild elephants in Sri Lanka.

Crop depredation by wild elephants is a common problem across the entire elephant range in Sri Lanka. However, so far no systematic estimates of the total crop and property damage caused by Asian elephants in Sri Lanka are available at the macro level. Therefore, we used three selected studies ─ Bandara and Tisdell (2002b), Jayawardene (1998), and De Silva (1998) ─ to estimate the total economic damage caused by elephants in range in Sri Lanka. These studies were selected because they are for samples in each of the main regions where elephants cause agricultural damage, namely Northwestern, Mahaweli and Southern regions.

For extrapolating for the Northwestern region, we chose Bandara and Tisdell (2002b). 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. Extrapolating from this sample to the entire Northwestern elephant range, assuming that 16,800[1] farming families are subject on average to similar elephant damage, we find that the total crop and property damage caused by elephant in this region amounts to Rs. 202.42 million per cropping season. This amounts to an annual loss of Rs 404.84 million.

In extrapolating for the Mahaweli region, we used Jayawardene (1998). This study, found that on average about Rs. 11,810 worth of crop damage is caused by elephants per cropping season per farming family. In extrapolating from the sample to the whole *Mahaweli* region assuming that 15700[2] farming families suffer similar damage from elephants, we get a total economic

loss for the region of Rs. 185.42 million per cropping season. This amounts to an annual amount of Rs 370.83 million.

In extrapolating for the Southern region we used De Silva (1998). 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 this sample. In extrapolating from the sample to the whole Southern elephant range, supposing that 14,700[3] farming families suffer damage from elephants, we get a total economic loss for the region of Rs. 172.87 million per cropping season. This amounts to an annual loss 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 is obtained by amalgamating the above estimates, and amounts to Rs. 560.71 million per cropping season or Rs. 1121.42 million per annum. This estimate may, however, be on the high side because the samples on which it is based could have an upward bias by inclusion of higher than average relative frequency of farms subject to considerable elephant damage. The main point for this analysis is that the estimate is not an under estimate. However, before using this figure to reach any conclusion, it should be noted that the crop and property damage is only a portion of the total economic cost associated with elephants. Total economic cost includes this cost 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. Nevertheless, damage to crops and farming property appear to involve the major cost associated with wild elephants.

The opportunity cost of retaining the existing protected area network in Sri Lanka is not treated here as a relevant economic cost for deciding whether or not elephants as a species should be conserved in Sri Lanka. Because no reduction in the size of the protected system is likely for political reasons in Sri Lanka, no trade-off is politically possible. Furthermore, no significant expansion of this system seems likely because of the perceived opportunity costs involved. Therefore, the current protected area system is treated as fixed for the current exercise. The purpose of this exercise is as follows: given the existing extent of protected areas, and given that elephants must also use non-protected areas in order to survive as a species in Sri Lanka in the long-term (Bandara and Tisdell, 2002a), to decide whether aggregate benefit from

continuing survival of elephants in Sri Lanka exceeds the aggregate economic cost involved in their use of non-protected areas. If it does, this establishes an economic case for supporting the co-existence of elephants and humans in non-protected areas in Sri Lanka.

The Ministry of Forestry and Environmental Management (1998) states that the Department of Wildlife Conservation in Sri Lanka, the principle agency responsible for elephant conservation and mitigation of HEC, at present spend around 6% (Rs. 16.4 million) of its annual budgetary allocation on average to undertake on-site elephant management activities such as construction and maintenance of electric fences, rehabilitation of elephant drives, and translocation of problem elephants. This might be added to the cost to farmers in order to obtain total costs of the presence of with wild elephants but is a relatively minor cost compare to the aggregate costs of crop and agricultural damage caused by elephants. Its addition does not make a material difference to net benefit calculation.

6. Net Benefits from the Current Population of Wild Elephants in Sri Lanka is Positive.

When we compare our economic estimates of the crop and property damage caused by elephants and other probable 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. 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 and property losses of Rs. 1,121.41 per annum.

When compensation is paid, the control of elephants by farmers is likely to be much reduced. Furthermore, a lot of elephant control by farmers efforts and control costs are currently 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). Consequently, in the latter case, a type of prisoners' dilemma problem exists. If compensation leads to much reduced control of elephants by farmers, they might 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 may 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, if compensation were paid to farmers, a sum

of less than Rs 1,124.42 million per year would compensate them for tolerating elephants, especially if allowance is made for lowered expenditure on control of elephants by farmers.

7. 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. Of the 300 respondents surveyed in this study, 280 (93.3%) said that they were willing to pay for the scheme. Most respondents were very articulate in providing both positive and negative answers to the question about WTP, as well as in giving their views and perceptions about issues involved in elephant conservation, alternative use of elephants, and the historical, cultural and religious significance of this species.

Application of logit analysis reveals that the years of schooling, income, age, bid value, pro-conservation attitudes, knowledge of the elephant related issues, and non use-value of the elephant were significant determinants of respondents' responses to the WTP elicitation question.

It is estimated as a result of this analysis that urban residents' WTP for the conservation of the elephant in Sri Lanka is sufficient to compensate farmers for the damage caused by elephants. In fact, the annual return for the total extrapolated WTP of urban residents (Rs. 2012.43 million) for conserving the elephant in Sri Lanka is nearly twice the extent of crop and property damage caused to farmers by elephants (Rs. (Rs.1121.42 million) per annum. This indicates that the policy of compensating farmers for elephant damage so they will tolerate elephants on their farming fields might be viable. Furthermore, the results show that urban residents could compensate farmers for these damages and be better off than in the absence of elephants in the country.

In sum, this analysis indicates that there is a strong economic case for ensuring the survival of wild elephants in Sri Lanka. Moreover, there is strong evidence that the current population of wild elephants in Sri 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 should be altered to bring about a Kaldor-Hicks improvement that is to determine a

socially optimal level for the population of wild elephants. However, the Kaldor-Hicks optimal elephant population is not zero.

Endnotes:

1. Based on information provided to one of the authors of this paper by the regional wildlife authority in *Galgamuva*.

2. Based on information provided to one of the authors of this paper by the regional wildlife authority in *Anurathpura*.

3. Based on information provided to one of the authors of this paper by the regional wildlifeauthority in *Mathra*.

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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 (Aldrich & Nelson, 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.

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