AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

ISSN 1327-8231

ECONOMICS, ECOLOGY AND THE ENVIRONMENT

Working Paper No. 77

Wildlife Damage, Insurance/Compensation for Farmers and Conservation: Sri Lankan Elephants as a Case

by

Ranjith Bandara and Clem Tisdell

May 2003

THE UNIVERSITY OF QUEENSLAND

ISSN 1327-8231

WORKING PAPERS ON
ECONOMICS, ECOLOGY AND THE ENVIRONMENT

Working Paper No. 77

Wildlife Damage, Insurance/Compensation for Farmers and Conservation: Sri Lankan Elephants as a Case

by

Ranjith Bandara[*] and Clem Tisdell[§]

May 2003

© All rights reserved

* Senior Lecturer in Economics on leave from the Department of Economics, University of Colombo, Sri Lanaka. Email: s200516@student.uq.edu.au

§ School of Economics, The University of Queensland, Brisbane QLD 4072, Australia.
E-mail: c.tisdell@economics.uq.edu.au

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.

For more information: write to Professor Clem Tisdell, School of Economics, University of Queensland, Brisbane 4072, Australia.

WILDLIFE DAMAGE, INSURANCE/COMPENSATION FOR FARMERS AND CONSERVATION: SRI LANKAN ELEPHANTS AS A CASE

Abstract

The interference with agriculture has been recognised as the main cause for the current conflict between farmers and wild elephants in Sri Lanka, as elsewhere in the Asian elephant range. Thus compensating farmers for the damages caused by elephants is essential, if this endangered species is to survive in the long run. This paper explores the practicality of establishing an improved publicly funded insurance/compensation scheme to recompense farmers for the elephant damages. It does so by analysing results from two contingent valuation surveys undertaken in Sri Lanka. We find that possible public support of farmers plus urban dwellers significantly exceeds the financial requirement of the insurance scheme proposed in this study for perpetuity. The article also shows that it is often inappropriate from an economic viewpoint to analyse crop insurance as if it only involves the insurance of a private good because important positive externalities can arise from 'crop' damages by wildlife, e.g. elephants. The use of agricultural land by some species is essential for their long-term survival and this is often positively valued by the community as a whole.

Keywords: Public support, agricultural insurance/compensation, Asian elephant, human-elephant conflict, wildlife conservation.

WILDLIFE DAMAGE, INSURANCE/COMPENSATION FOR FARMERS AND CONSERVATION: SRI LANKAN ELEPHANTS AS A CASE

1. INTRODUCTION

Many species of wildlife damage farm crops, livestock and property. Sometimes this is because either agriculture or human settlements have encroached on the natural habitat of the wildlife concerned and deprived them of their natural foods and shelter (see Hill, 1997; Tisdell and Xiang, 1998; Hoare, 1999; Nyhus *et al.* 2000; Tisdell, 2002). For instance, between 65 and 85% of forest cover in the lowlands of Sumatra have been converted into agricultural fields over the last three decades (Santiapillai and Ramono, 1993). During the last century about 80% of Nepal's elephant habitat has been used to establish human settlements (Daniel, 1996). Similarly, more than 80% of the existing elephant habitat in Sri Lanka at present has some form of human disturbance (Karyawasam *et al.* 2002). This situation has forced the affected wildlife species to intrude into human use areas where crops act as a dietary substitute. Moreover, this in turn provides the necessary stimulation for some wild animals to 'decide' to consume agricultural produce because its high nutritional content, relative to the energy needed to obtain it, is higher than for wild food sources (see Eltringham, 1982, Sukumar, 1989). For instance, young bulls need to make maximum weight gains to increase their chances of mating as a female elephant generally chooses the largest male as a sexual partner. Hence, young bull elephants are avid consumers of crops and are therefore very likely to be injured or killed by angry farmers.

Several recent studies highlight this antipathy of the local farmers to the crop raiding elephants (see Ramakrishnan *et al.* 1997; Tisdell and Xiang, 1998; Nyhus *et al.* 2000). More recently, Bandara and Tisdell (2002a) found that farmers in Sri Lanka injure, harass and sometimes kill elephants mainly in an attempt to protect their crops. At present, on average about 100 elephants die every year in Sri Lanka because of their interference with agriculture (Weerakoon, 1999). This threatens the conservation of elephants in the wild in Sri Lanka. Ecologically, elephants are the dominant herbivores that exert the most profound impact on their habitat and ecosystem dynamics (Santiapillai, 1998). Thus in managing elephants in the wild, at least two closely related issues emerge: the first is the impact of the increasing number of elephants in their habitats within the existing protected area network; the second relates to

the continued expansion of human settlements into, and the economic development of, elephant ranges outside protected areas. Both have resulted in the escalation of conflict between humans and elephants.

However, in addressing these issues, it may not be possible to adopt any extreme position such as the removal (relocation) of the entire population of either elephants or humans from these areas. The Asian elephant is an endangered species (IUCN, 1996), and any relocation attempt may cause an unexpected ecological threat to its biophysical process. In addition, relocated elephants tend to return to their original territories and in the long-term Asian elephants in Sri Lanka will not survive if they are confined completely on protected areas (Bandara and Tisdell, 2000c). Moreover, getting rid of human settlements from the elephant range could be an extremely expensive undertaking and may not be an economically viable option for a country like Sri Lanka. Thus conserving elephants and mitigating human-elephant conflict (HEC) need to be addressed by promoting some co-existence between these two groups. This requires an appropriate mechanism to be in place to encourage farmers to allow elephants some access to their farming lands, for instance access to move across farmland from one isolated habitat to another. Furthermore, the long-term survival of the elephant in Sri Lanka, as elsewhere in the Asian elephant range, now depends on their sustainable, continuing use of agricultural land, particularly in the non-protected areas.

Bandara and Tisdell (2003) believe that farmers may be made more tolerant of elephants on agricultural land if they are insured or compensated for farm damages caused by these animals. The same is true for other forms of wildlife. While there are schemes in Asia to provide recompense to farmers suffering damage from Asian elephants, these schemes are relatively ineffective (Tisdell and Xiang, 1998). More recently, from an empirical study Bandara and Tisdell (2002a) have analysed this situation further in detail in the context of Sri Lanka. In this analysis these authors assessed the government sponsored farmer insurance/compensation scheme which currently is managed by the Department of Wildlife Conservation of Sri Lanka in collaboration with the Sri Lanka Insurance Cooperation. This is the only scheme available at present in Sri Lanka for farmers to cope with the economic damage caused by elephants. In this scheme, the highest payment is paid for the loss of life of the head of the household which is Rs. 50,000. If an adult who is not the chief householder is killed, the maximum amount paid is Rs. 35,000. For injury or damage to the crop and property, the compensation is less.

Nevertheless, in the above analysis, these authors found that between 1997 and 2001, the actual amount paid as compensation to farmers for the actual economic damage caused by elephants is less than eight percent of the total damage incurred by farmers. Furthermore, this analysis, also found a number of specific weaknesses about this scheme. These are: (a) there is a long delay before any compensation is paid, (b) compensation payment is very low for the property damage suffered, (c) compensation for loss life is unbalanced, as the death of a young person who is not the head of the household but who has potential future earning capacity, is not taken into account, (d) there is a lengthy documentation and assessment process, (e) no compensation paid for perennial and semi-perennial crop damage, and (f) there is no provision in the scheme to compensate the death of a female, including a female head of household.

Thus in this paper, we discuss an insurance/compensation scheme to recompense farmers for damages caused by wildlife and consider the feasibility of a more effective scheme in Sri Lanka as a step towards ensuring the survival of the Asian elephant in the wild. It does so by analysing results from two contingent valuation surveys undertaken in Sri Lanka; one of urban dwellers another of farmers. The urban survey involved a sample of 300 residents chosen from three selected housing schemes in Colombo, the capital of Sri Lanka. The other survey was of a sample of 300 farmers chosen from six selected villages in the northwestern province in Sri Lanka.

The main purpose of these two samples is to help identify the precise contribution for the proposed scheme by two specific social segments who have completely different perceptions about elephants and their conservation in the wild. Generally the non-farming community, such as urban dwellers in this sample, regard the elephant as a valued resource either for its use or non-use economic value (see Bandara and Tisdell, 2000d) and are likely to contribute funds for the proposed scheme primarily with the aim in mind of conserving this species in the wild. In contrast, many farmers in the area where wild elephants interfere with agriculture consider this species as a pest (see Tisdell and Xiang, 1998, Nyhus, *et al.* 2000). However, in theory, these farmers may be willing to pay for a scheme because it would provide them with compensation for damages caused by elephants. Moreover, there may be other farmers who, apart from appreciating the insurance aspect of this scheme, place a positive value on the

survival of wild elephants and may contribute more funds to the scheme than farmers in the first-mentioned category.

However, the farmers' contribution alone may not be able to provide all the necessary funds that are required in establishing the scheme proposed in this study for at least two main reasons: (a) the scheme is expected to provide reasonable insurance/compensation cover for all the farming families in the areas affected by human-elephant conflict in Sri Lanka, (b) the cost of insurance cover should include price of the policy (premium) and the cost of collecting possible public contributions. Therefore, in this study we use the urban dwellers' contribution as a supplementary source of funds for financing the proposed insurance/compensation scheme. This allows the proposed scheme to be more economically viable.

The paper first outlines the economics of a scheme to compensate farmers for damages caused by wild animals. This is followed by an empirical analysis of the practicality of establishing a publicly funded insurance/compensation scheme to recompense farmers for the damage caused by elephants.

2. SCHEME TO COMPENSATE FARMERS FOR DAMAGES CAUSED BY WILD ANIMALS

Given growing pressures for the preservation of biodiversity (Tisdell, 1999) and the fact that the availability of protected areas is insufficient to ensure the conservation of many wild animal species (because some require large ranges for their survival, for example, the home range for the Asian elephant is between 47.5 km^2 to 183.6 km^2), there is need for such animals to use private farmland and similar land with relative safety to ensure their survival and thereby, sustain biodiversity. However, in normal circumstances, this requires landholders to be compensated for damages caused by wildlife (Rollins and Briggs, 1996; Bandara and Tisdell, 2003). It may also be that in certain circumstances landholders should be encouraged to retain or re-establish some habitats favourable to the survival of particular species, including tree corridors, but this is not the main focus here. Rather the focus here is on schemes to insure/compensate farmers for damages caused by wild animals such as the Asian elephant.

The motivation for and nature of such insurance/compensation schemes can vary considerably (see Mosley and Krishnamurthy, 1995; Cooper and Keim, 1996; Wang *et al.* 1998). In some

cases, they are merely incidental as schemes to compensate for loss of income and property and have no wildlife conservation aim. In other cases, wildlife conservation may be an important ulterior motive (see Tisdell, 2002). In terms of the funding of such schemes by farmers, they may be: (a) self-funded contributory schemes, in which case they are insurance schemes and exist in many forms with different institutional designs (see Mishra, 1996), (b) partly contributory, and (c) non-contributory by farmers, in which case they are usually funded by the government and ultimately by tax payers. It is also possible for farmers' contributions to be compulsory, or voluntary and in the latter case only those who contribute are insured.

Payment for damages can also take several forms depending on the nature of the risk management program undertaken (see Carriker *et al.*1991). In some programs compensation is paid based on yield or income loss at the individual farm level. Other programs use average yield of a specific geographical area in which the compensation is paid if a particular farmer's yield falls below this level. In each of these schemes, full compensation may be paid or partial compensation (co-insurance) may be the rule. In relation to co-insurance several different rules may apply. For example, compensation may be paid only if the amount of damages reaches some threshold amount and/ or only a fraction of the cost of damages incurred may be paid for.

Many have recognised that compensating farmers for the crop damages or insuring their crop production from natural hazard as an important policy instrument in tackling the problem of agricultural risk (see Carriker *et al.* 199; Rollins and Briggs, 1996). In the past the public sector had a dominant involvement in undertaking most of the farmer compensation/insurance schemes both in developed and developing countries (see Hazell, 1992). This was considered necessary to remedy market failures, and to promote economic development and help reduce poverty (Mishra, 1996). With the emergence of strong advocacy for private sector involvement in the economy to increasingly replace that of the public sector, there has been rising participation of the private sector involvement in crop insurance. Furthermore, the importance of co-insurance is being stressed (Haq, 1993; Cooper and Keim, 1996). In addition, the desirability of stakeholder involvement (the 'user pays' principle) in sharing the cost of nature conservation is being accentuated (Zivin, *et al.* 2000), and the importance of farmer participation in crop damage insurance/compensation schemes is increasingly emphasized (Makki and Somwaru, 2001).

In relation to private insurance, two major concerns about inefficient operations have been raised. These are problems of moral hazard and difficulties arising from asymmetry of information. Moral hazard arises when the insured takes less care with insured property or assets and exposes the insurer to greater risk as a result (see Quiggin *et al.,* 1994*)*. Usually the greater the proportion of loss covered by the insured in the event of damages the less likely is the insured to increase the risk to the insurer. Secondly, asymmetry of information and the cost of the insurer assessing a loss fully often leads to inflated insurance claims by the insured. These are both problems in relation to insurance of private goods. They can result in market failure and they could also easily do that in an insurance scheme funded by farmers to compensate for wildlife damages. Nevertheless, the use of crop insurance/compensation as a management tool, particularly in the developing countries, is expected to eliminate the reluctance of low-income farmers to invest in new technology and compensate somewhat, for the chronic reluctance of financial institutions to lend to them (Mosley and Krishnamurthy, 1995).

In the literature on agricultural insurance, agricultural crops and production are treated as private goods. But they may be 'inputs' into the conservation of wildlife and wildlife is a mixed economic good rather than a private good. While farmers may look at wildlife as a pest (but not necessarily completely so) others, especially urban dwellers, may regard wildlife as an asset (Tisdell, 2002). The latter are the principal beneficiaries from conservation of wildlife. It is, therefore, not unreasonable that they should pay or contribute to the conservation of wildlife they value. In such cases, publicly funded compensation schemes seem appropriate. Also increased 'moral hazard' is not a problem up to a point because compensation should encourage farmers to allow wild animals to make greater use of their farm resources without harassment. This supports the aim of conserving the species involved. Given the public or spill over effects involved, it can be inappropriate to analyse farm crops purely as private goods as far as crop insurance is concerned. This has not previously been emphasised in the relevant literature.

Yet, asymmetry of information remains a problem. Farmers may over claim for compensation putting pressure on available funds. Also the transaction costs involved in such a scheme may be significant. If we consider a co-insurance scheme in which farmers are compensated for a proportion of damage caused by a species of wild animal, then a positive relationship may exist

between the proportion of damages recovered by farmers and the population of this wildlife species.

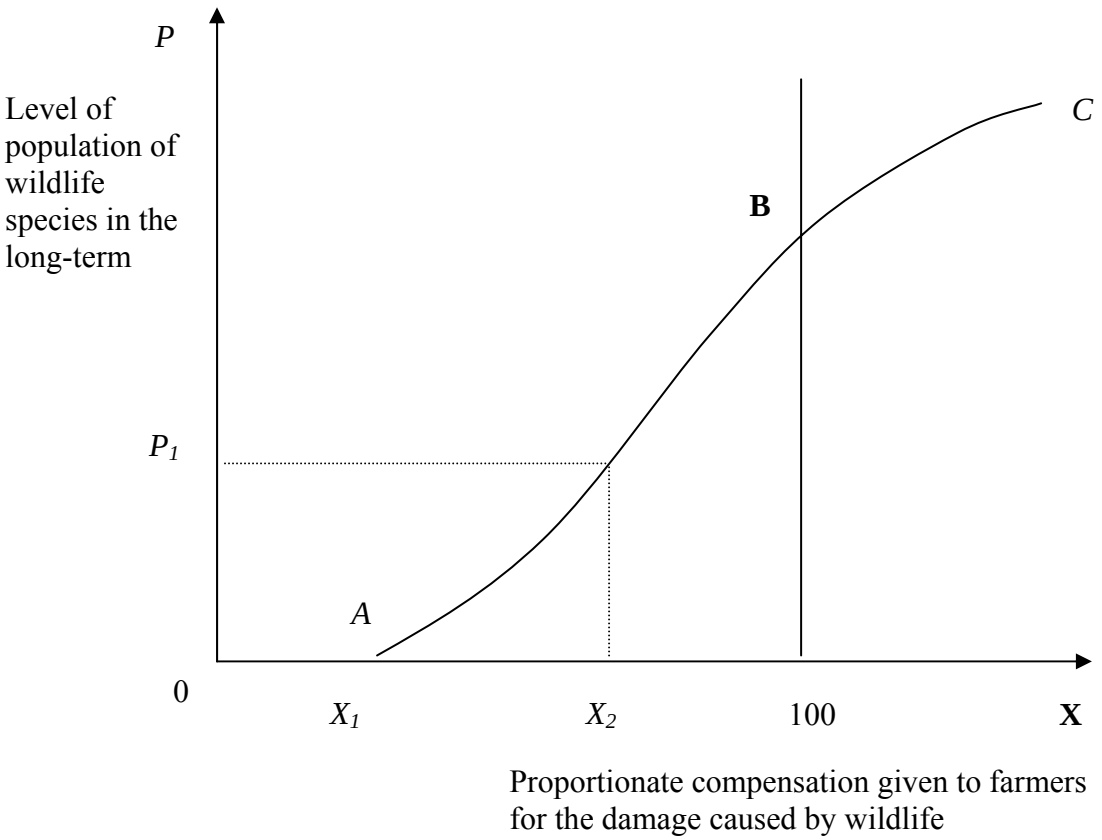

Figure 1: Possible relationship between the population of a wildlife species utilising agricultural land and proportionate compensation given to farmers for the damage caused by the species

One possibility may be as shown in Figure 1 by OABC. This relationship indicates that the proportionate compensation for damages has to be greater than some threshold value, X_1, before it has any effect on the long-term survival of the wildlife species (for example, in this case of elephants) and that the long run population level of the species then rises as the degree of compensation given to farmers increases. In many Asian countries, proportionate compensation to farmers for damages caused by elephants (and other wildlife) is so low that it is ineffective in encouraging their conservation (Tisdell and Xiang, 1998). In other words, the

degree of compensation is below the threshold of *A*. For example, Bandara and Tisdell (2002a) found that the amount of compensation paid for the economic losses incurred by farmers in Sri Lanka under the existing state sponsored insurance scheme is less than eight percent of the actual damage caused by elephants. This situation is quite common in many other countries in the Asian elephant range (see Kemf and Santiapillai 2000). Thus if the existing policies of compensating farmers for the damage caused by wildlife are not altered, many species concerned will become extinct in the long run.

If there is sufficient collective demand for survival of a species, then the proportionate compensation paid to farmers needs to be adjusted to achieve this objective. For example, if a population of P_1 of the species is desired for the long-term, proportionate compensation to farmers of X_2, needs to be given to farmers. This would gradually increase the tolerance of farmers and private landowners particularly in the unprotected areas to allow elephants some access to their farming lands, for instance access to move across from one isolated habitat to another.

We have estimated by surveys and the contingent valuation method that the value urban Sri Lankans place on the Sri Lanka's current elephant population exceeds the economic losses caused to farmers by elephants (see Bandara and Tisdell 2002b). Thus the economic collective benefits of retaining current elephant population in Sri Lanka exceed the costs involved in their use of agricultural land. However, the amount of compensation paid to farmers in Sri Lanka is inadequate to achieve the long-term survival of its elephant population.

The above does not, however, show that the current loss of Sri Lanka's population of elephant is optimal from a Kaldor-Hicks or social point of view. To determine the optimal long-term population of a wild species, such as the elephant, that must utilize agricultural land to survive, collective costs and benefits of different levels of population of elephants must be considered, taking into account the policy instrument(s) used to manipulate the population.

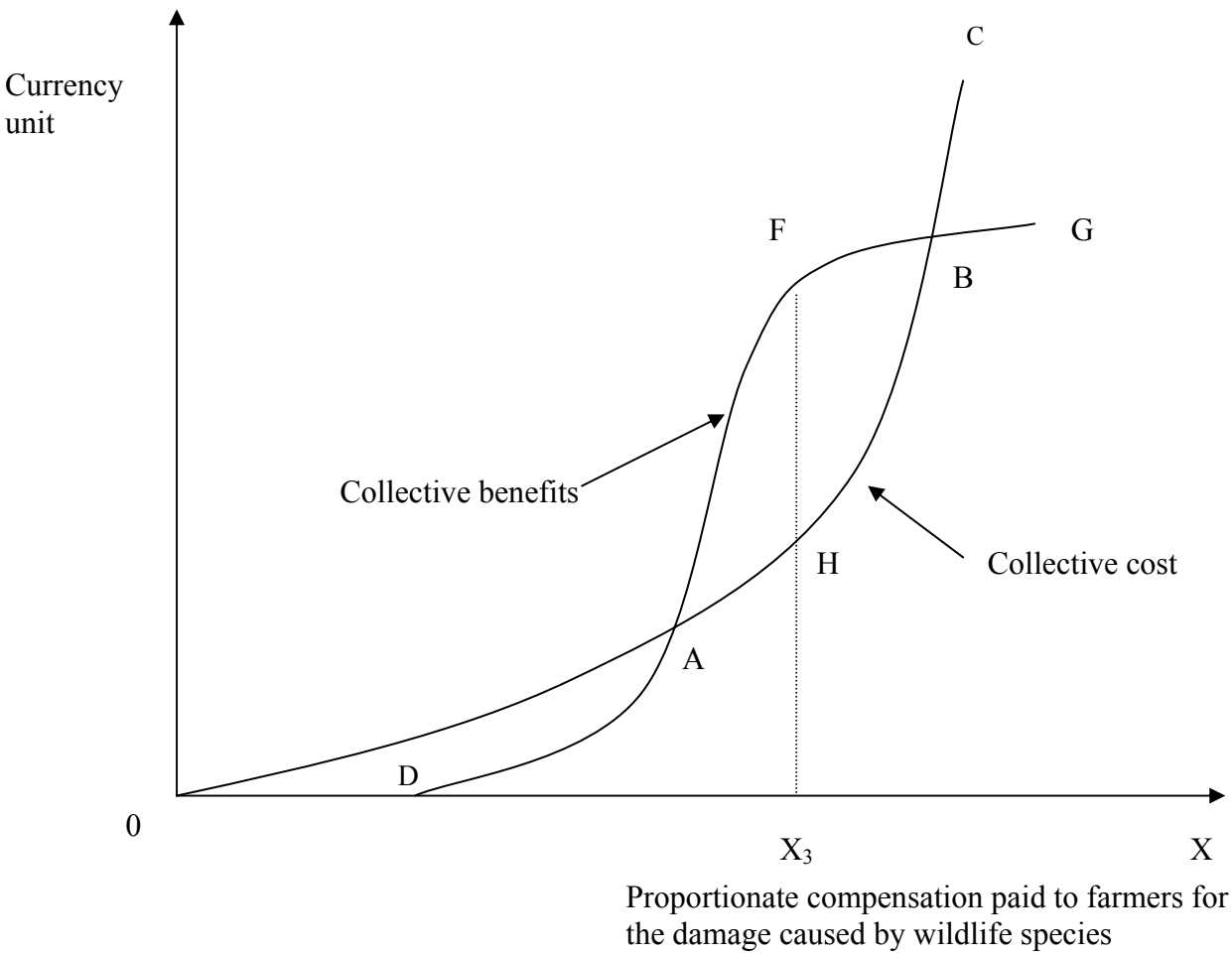

Figure 2: Kaldor-Hicks' optimal degree of compensation given to farmers taking into account collective cost and benefits of conserving a wildlife population

In Figure 2, for example, it is assumed that the proportionate compensation paid to farmers for damage caused by wildlife is the only policy instrument subject to variation. The curve *OABC* represents the total (collective) economic costs associated with variation of the values of this instrument. The relationship *ODFG* represents the total (collective) economic benefits from variation in the value of this instrument taking into account its impact on the long-term population of the wild species. Because a small degree of compensation is believed to be ineffective in ensuring survival of the wild species considered, no total economic benefit is obtained until compensation levels exceed *D*. This corresponds to the threshold X_1 in Figure 1.

The socially optimal policy in the case shown in Figure 2 is to ensure that the proportionate compensation paid to farmers is X_3 because this maximises net social benefits from the Kaldor-

Hicks viewpoint. At this level of compensation the marginal social benefits of greater wildlife population just equals the marginal social costs involved in instituting this policy.

While it may not be so difficult to measure collective economic value in the above case, measuring collective economic cost accurately is much more challenging. This is because economic cost is not the amount of compensation paid to farmers. This is merely an income transfer. Economic costs include the transaction costs involved in operating the compensation scheme as well as any extra losses in the value of agricultural production (for human use) that can be attributed to the scheme. For example, there may be extra consumption of agricultural crops by wild animals as a result of a compensation scheme. The net loss in the economic value of this produce (due to its consumption or damage by wildlife) constitutes an economic cost of the scheme. More, research is needed to identify and measure such costs fully and accurately.

3. THE PRACTICALITY OF AN IMPROVED SCHEME TO COMPENSATE FARMERS FOR ELEPHANT DAMAGE IN SRI LANKA

Around 47% of the irrigated agricultural schemes occur in and around the elephant range in Sri Lanka (Karyawasam *et al.* 2002). Farming in these areas has increasingly become a risky activity. Despite the usual uncertainly about weather and other natural hazards, the agricultural output in these areas now depends very much on the frequency and intensity of the elephant interference with cultivated crops. The estimates of De Silva (1998), Jayawardene (1998), Weerakooon (1999) disclose that wild elephants are responsible for between Rs. 6,000 and Rs. 30,000 worth of crop and property damage per annum on average per farming family. This amounts to Rs. 560.71 million per cropping season or Rs. 1121.42 million per annum on average in total for the entire elephant range in Sri Lanka (see Bandara and Tisdell, 2002b). 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 too many farms subject to considerable elephant damage.

Nevertheless, Kulathunga (1999) claims the ineffective handling of the HEC related issues by the wildlife authority have deepened the farmers' antagonism towards crop raiding elephants in Sri Lanka. This may be true because in Sri Lanka, a comprehensive national policy for elephant conservation and mitigation of human-elephant conflict has yet to be developed (Desai, 1998). Thus it is essential that Sri Lanka design new policies and programmes for

elephant conservation and mitigation of farmer-elephant conflict. Indeed, any such policy must adequately address compensating farmers for the economic losses of the crop and property damage caused by crop raiding elephants. As mentioned elsewhere, the existing scheme provides an inadequate compensation (see Bandara and Tisdell, 2002a), and thus it is unreasonable to ask farmers to tolerate elephants near or on their farms. On the other hand most farmers in the HEC affected areas are small-scale and have low incomes (De Silva, 1998) and they require consistent and quick recovery plans for their economic losses caused by elephants. Unless they are promptly and adequately compensated for the damage, it is impossible to prevent farmers' hostility towards crop raiding elephants. Hence, we investigated the practicality of establishing an improved publicly funded insurance/compensation scheme to recompense farmers for the elephant damage in order to improve their tolerance for the presence of this wildlife species on their faming land.

4. DATA

The data presented in this analysis were collected as part of two contingent valuation surveys conducted in Sri Lanka. One of these surveys involved a sample of 300 local farmers selected from six HEC affected villages in *Galgamuwa* divisional secretariat in the northwestern province in Sri Lanka. These villages were chosen based on the level of severity of the HEC as estimated by Desai (1998). The urban survey involved a sample of 300 randomly selected residents in three major housing schemes (*Jayanthipur*a, *Jayawadanagam*, and *Anderson Flats*) in Colombo, the capital of Sri Lanka. 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 so as to provide a stratified sample.

Both these surveys were conducted through face-to-face interviews in *Sinhales*, a language spoken by the majority of the people in Sri Lanka. Nine graduate students from the Faculty of Graduate Studies of the University of Colombo acted as interviewers. Hadker (1997) describes the value of this method in the context of India and the situation in Sri Lanka is comparable: mail surveys have a low response rate and suffer from self-selection biases; and telephone surveys are ruled out because the facility is not available to every signal household chosen for the samples. Further, in face-to-face surveys trained interviewers interact with respondents, clarifying their doubts to minimise non-response rates, and judging their sincerity. Consequently, the quality of the data generated improves.

5. THE NATURE OF PRINCIPAL SURVEY QUESTIONS ASKED

Prior to the principal survey questions being presented, the respondents in both samples were informed that the scheme proposed in this study is aimed at improving the current level of farmer compensation for the elephant damages. Then they were briefed that this scheme is expected to provide two different insurance covers to the farming families in the areas affected by HEC: one to deal with the crop and property damage caused by the elephant, and the other to recover the economic losses caused by the death (or permanent disability) of the economically active members in the farming families due to elephant attacks. In this conversation the respondents were informed that, based on a number of recent crop damage estimates (see Jayawardene, 1998; De Silva, 1998; Kulathunga, 1999; and Bandara and Tisdell 2002b), the expectation is that every single farming family in both the severely and less affected areas would be offered Rs. 30,000 and Rs. 20,000 worth of insurance coverage on average per annum respectively. Moreover, they were also told that the other scheme proposed in this study aimed to offer Rs. 150,000 worth of life insurance coverage for a person 25 years old in each farming family (preferably for the head of the household) for a period of 15 years.

Following the introduction of the proposed insurance schemes, the respondents in both samples were informed about the possible benefits that they would be able to obtain after the successful implementation of this programme. For instance, urban respondents were told that there would be greater possibilities to view more elephants in a single herd in the wild or greater opportunities to see elephants in the wild during a short number of visits to a given national park. On the other hand, farmers in the farmer sample were notified that they would be able to experience a more secure socio-economic status at the household level when these insurance schemes were implemented. Finally, the respondents in both urban and farmer samples were told that finance was required for the proposed programme and that the support of the general public would be needed to establish 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 scheme. A number of recent contingent studies, for example, Champ *et al.* (1997), Chilton 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 contingent valuation 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 eliciting the WTP contribution for the proposed scheme, the respondents in the urban sample were asked: *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, to the proposed scheme to compensate farmers for conserving the elephant in Sri Lanka.* Farmers in the rural sample were asked: *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, to finance a scheme to improve the current level of compensation for the damage caused by elephants.* The dichotomous choice format with a set of optional follow-up questions was used as a WTP elicitation technique (see FAO, 2000). These follow-up questions were always conditional on the respondent's response to the bid value offered in the previous question i.e. if the response to the initial question was'no', the amount offered would be lowered for the next follow-up questions. If the respondent's response was 'no', this process was continued by reducing the bid value offered on each occasion, until the lowest bid value in the bid list was reached. Whittington (1998) discusses the significance of this method in the context of developing countries. Moreover, more recently, Memon and Matsuoka (2002) empirically tested the validity of the contingent valuation method in general, in the developing country context, from a case study of rural Pakistan.

6. RESPONDENTS' PARTICIPATION IN THE PROPOSED INSURANCE/COMPENSATION SCHEME

Mishra (1996) describes the significance of an assessment of stakeholder participation in designing a insurance/compensation scheme for local farmers in the context of India. Makki and Somwaru (2001) argue that such an assessment provides opportunity for policy makers to gather the participants' perception, particularly farmers' opinion on premium rates, limits on

the sum insured, level of risk sharing, eligibility of participation and their contribution. This information is vital in designing necessary actions in order to avoid problems such as adverse selection and moral hazard which often emerge with the crop insurance schemes (Wang *et al.* 1998). For example, if the information gathered shows that the majority of farmers are interested in having an insurance cover to recover their economic losses (in our case caused by wild elephants), it can be made compulsory to have an insurance cover for the entire farming community in question. This could certainly resolve the issue of adverse selection (see Just *et al.* 1999).

In the present study, we assess respondents' participation in the proposed insurance/compensation scheme in this study by their responses to payment principle questions. In this assessment 'yes' to any of the WTP elicitation questions by the respondents was considered as positive participation in the scheme. The respondents who either refused (or said 'no") to pay the bids values offered with the WTP elicitation questions or agreed to pay some value less than the lowest bid value offered in these questions were treated as protest participants. Positive participation in the scheme was recorded as '1', and '0' otherwise.

A summary of the distribution of respondents' responses for the WTP elicitation questions is presented in Table 1 both at aggregate and sub-sample levels. Although, some variations existed in the respondents' responses to these questions, the majority of respondents interviewed in both sub-samples were ostensibly WTP for the scheme proposed in this study. About 85% of the respondents at the aggregate sample level were WTP for the scheme proposed in the survey, of which 52% represents the respondents in the urban sample.

Table 1

The distribution of respondents' responses for WTP elicitation questions at the sub sample level

Sample	**Total 'yes' to offered bids**	**Protest bids and bids of insignificant[a]**	**Total**
Rural sample	244 (81.3)[b]	56 (18.7)	300 (100)
Urban sample	266 (88.6)	34 (11.3)	300 (100)
Aggregate sample	510 (85)	90 (15)	600 (100)

Notes: a. Protest bids and bids of insignificant amounts include respondents who either refused to pay the bid values offered in the WTP elicitation questions or agreed to pay some value less than the lowest bid value offered in these questions (i.e. rural survey < Rs. 10 and urban survey < Rs. 25), **b.** Values are in percentage of total number of respondents in each sample.

The respondents' participation for the proposed insurance/compensation scheme in this study was assessed in relation to a number of selected socio-economic, demographic and attitudinal variables. In this assessment, first we estimate the correlation coefficients for each of these variables in order to understand their individual influence on the respondents' decision to participate in this scheme. Second, to recognize which of these variables are significant in predicting the respondents' decision, we performed hypothesis testing for the slope (b_1) in each of these models estimated at 0.05 level of significance. The least-squares method was used as the main statistical technique (see Levine *et al*. 2002) in these analyses. Table 2 presents the summary of the findings of these analyses.

Table 2:

Factors influencing respondents' participation in the proposed insurance/ compensation scheme proposed in this study[a]

Variable	Urban Sample (n = 300)			Rural sample (n =300)		
	b_0	r	t for b_1	b_0	r	t for b_1
ATAM	3.02 (2.87)[b]	0.69	3.97	2.21 (1.71)	0.61	1.18
BIDV	-1.29 (0.97)	0.77	2.32	-3.19 (1.74)	0.73	-2.90
CONSE[c]	2.04 (1.65)	0.71	4.04	----	-----	---
DAMA[d]	---	---	----	3.32 (2.63)	0.93	3.46
GREEN[c]	1.32 (1. 84)	0.89	4.01	------	----	---
NUEL	4.65 (2.17)	0.91	5.21	1. 67 (0.81)	0.69	0.98
INCO	2.97 (1.33)	0.79	2.21	2.38 (1.74)	0.82	2.75
YOSA	3.22 (2.74)	0.81	2.627	2.67 (1.78)	0.62	1.34

Note: ***ATAM*** = attitude towards alternative HEC management approach, ***BIDA*** = *R*upee value from the WTP elicitation questions, ***CONSE*** = awareness about the current elephant conservation issues), ***DAMA*** = respondent's experience with elephant crop depredation), ***GREEN*** = pro-conservation perception), ***NUEL*** = non-use value of elephants, ***INCO*** = family income, ***YOSA*** = years of schooling.

a. Respondents' decision to participate in the scheme used as the dependent variable in each model, $\alpha = 0.05$ used as the level of significance in hypothesis testing for b_1 in each models.

b. The estimated values of the slope (b_1) of each model are in the bracket.

c. Used only with the urban sample.

d. Used only with the rural sample.

The analysis undertaken for the urban sub-sample reveals, the respondents partaking in this scheme were highly influenced (with the average value of r = + 0.81) by the attitudinal variables such as pro-conservation attitudes, knowledge of the elephant related issues, and non use-value of the elephant. As expected, the non use-value of the elephant had the highest value of correlation coefficient (i.e. + 0.91) among these variables. This is quite understandable because, under normal circumstance, non-farming community such as urban dwellers and nature lovers are usually in favour of conserving wildlife and natural areas (see Tisdell 1979, 1982 and 2002). In this case, the elephant has much more appreciation among such groups of

people since it is a prominent enlightening symbol which has been closely associated with the people in Sri Lanka. Therefore, it is not surprising to have such a higher value of correlation coefficient between the non-use value of elephants and positive participation of urban dwellers.

In contrast, it was found that rural farmers' participation has a greater dependency (with the average value of correlation coefficient, r = + 0.79) on the economic variables such as total farming income, bid value offered from the WTP elicitation questions and whether they experienced any economic damage caused by elephants during the last five cropping seasons. In this analysis we noticed that the latter variable had the highest value of correlation coefficient (r = + 0.93). This implies that farmers who experience the elephant damage are more willing to contribute funds to the scheme proposed. Possibly this is because of an insurance motive. In addition, however, we also observed a positive correlation coefficient (r = + 0.69) for the variable of non-use value of elephants. This indicates that farmers who place some positive value on continued existence of the elephant, despite its damaging behaviour, are likely to contribute more funds to this scheme than farmers who consider the elephant purely as an agricultural pest.

7. Estimating public support for the proposed insurance/compensation scheme

We used the approach proposed by Hanemann (1984) to estimate the mean WTP and found that respondents in the farmer sample are WTP Rs. 61.19 per month on average, amounting to an annual value of Rs 734.28. As the payment would be made over five years, the total present discounted value of these annual amounts at the 5% real rate of discount equals Rs. 3445.52. On the other hand, we found that the respondents in the urban sample are WTP Rs. 110.17 per month on average. This amounts to an annual value of Rs 1322.04 and Rs. 6,009.75 for the period of five years at a 5% real rate of discount. Table 3 presents a detailed analysis of the distribution of mean annual willingness to pay (MAWTP) estimates at sub-sample levels.

Table 3:

The distribution of mean annual willingness to pay (MAWTP) estimates at the sub- sample levels

	Sample	MAWTP (in Rupees)
Urban:	High income earners	1816.80 (1816.67 – 1861.54)[a]
	Middle income earners	1224.00 (1224.19 –1242.54)
	Low income earners	925.20 (912.04 – 935.72)
Rural:	Severely affected villages	763.08 (622.08 – 823.56)
	Less affected villages	705.48 (565.68 – 738.36)

Note: a. 95% confidence intervals for respective MAWTP estimates are in the Brackets

The estimation of total public support available for the proposed insurance/compensation scheme was undertaken by using the mean WTP estimates cited above. The simple transferring point estimate approach was used in this process. A detailed account of the application of this method and its significance in contingent valuation studies are given in Hadker *et al.* (1997), and Loomis *et al.* (2000), Boyle and Bergsrom (1992) and Brouwer and Spaninks (1999). Furthermore, in extrapolating total WTP benefits from the study area to the unstudied 'policy area' (i.e. population of interest), mindful of the sensitivity of sample effects, the authors referred to three recent studies on the socio economic impacts of the HEC (see Munaweera and Kuruwita, 1998; Tennakoon, 2001; and Kulathunga, 1999) and a recent report of the population census (see Department of Census and Statistics of Sri Lanka, 2001). The findings of these studies reveal that socio economic condition and household characteristics were exceptionally close to the samples of the present study. Therefore, the impact that could have occurs from the differences in household characteristics on the estimation of final aggregate WTP estimates in this study would be minimal.

In our extrapolation of rural sample mean WTP value to the entire HEC affected farming families in Sri Lanka (in both severely and less affected areas), using a total of 327,840 farming families with a family size of about 4.19, we get a WTP of Rs. 20.06 million per month or Rs 240.72 million per annum. For a period of five years, this would give us Rs.

1194.62 million and would generate an estimated return on the capitalised sum of Rs. 59.70 million per annum at the 5% real rate of interest, if the entire farmer contribution were invested in the capital market.

On the other hand, extrapolating the urban sample mean WTP value for the entire urban population in Sri Lanka, using a population size of about 6.67 million 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 or Rs 8818.01 million per annum. This would be Rs. 40248.61 million for the five years. This would generate an estimated return on the capitalised sum of Rs. 2012.43 million per annum at the 5% real rate of interest.

By amalgamating estimated returns on the capitalised sum of both urban and farmer contributions, we could estimate the total finance available for the proposed publicly supported insurance/compensation scheme for perpetuity, which gives us Rs. 2072.13 million per annum.

8. In search of possible private sector involvement in risk sharing

The economic viability of any insurance/compensation scheme depends on the cost of the scheme in question and the prevalence of an appropriate risk-sharing mechanism (Mishra, 1996). In the past, when the public sector insurance organizations were dominant in the insurance market, they had an ability to offer low cost insurance because they were operated with government financial support. Thus they had the ability to transfer the financial risk which was involved with their insurance schemes directly to the general public, ultimately the taxpayers. However, with the continuous financial losses and gradual withdrawal of public funding, the state owned insurance agencies are now not in a position to offer low cost insurance cover, particularly for the subsistence agriculture sector. (See Hazell, 1992; Wang *et al.* 1998). The situation in Sri Lanka is not exceptional, for instance, two major crop insurance schemes offered by the National Insurance Cooperation of Sri Lanka to the subsistence farmers in Sri Lanka had been abandoned since the mid 1990s (Insurance Industry in Sri Lanka, 2002).

However, with the expansion of private sector involvement in the insurance industry in Sri Lanka, the area covered and type of insurance schemes available in the insurance market have also increased significantly in the recent past (Business in Sri Lanka, 2003). In many cases, it

is evident that these companies are interested in covering the specific risk involved in many principal sectors in the economy, such as subsistence agriculture (Central Bank of Sri Lanka, 1999). For example, during the last ten years or so, about fourteen new large private sector insurance agencies have started their operation in Sri Lanka, of which seven companies are offer various insurance schemes to the subsistence agriculture sector (Saarcnet, 2003). Insurance Industry in Sri Lanka (2002) reports that this had reduced the market share of public sector insurance agencies in agricultural insurance market over the last years by about 60%.

To select an appropriate insurance agency to administer the proposed insurance/compensation scheme proposed in this study, one of the authors of this article undertook a series of informal interviews with the officials of six selected leading insurance companies in Sri Lanka, including one state owned insurance organisation. In the interviews, these officials were asked to express their willingness to administer the scheme proposed in this study and also to submit their quotations i.e. annual premium and their terms and conditions. The officials of the state owned Sir Lanka Insurance Cooperation indicated that at present they are not in a position to undertake such a responsibility since the organisation is about to be privatised. However, we received quite encouraging feedback from the private sector insurance officials. In principle, each of these officials expressed their willingness to administer the scheme proposed, if we could put in place an appropriate mechanism to undertake the responsibility of collecting funds from the general public.

9. ESTIMATING THE COST OF THE INSURANCE/COMPENSATION SCHEME PROPOSED

The quotations received from the five private sector insurance companies (i.e. *Janashakthi* Insurance, CTC Eagles Insurance, *Ceylinco* Insurance, Union Assurance, Aitken Spence Insurance and Commercial Insurance) were used to estimate part of the total cost (i.e. cost of the premium) involved in the proposed scheme. The quotations which we received from these companies were quite similar, except for some terms and conditions. We found that, to provide Rs 30,000 worth of crop insurance policy for a farmer in the severely affected areas would require Rs.1816.22 as the annual premium. For a crop insurance policy worth Rs. 20,000 for a farmer in the less affected areas the quoted annual premium was Rs. 1210.67. To provide a life insurance policy Rs. 150,000 for a farmer 25 years old for a period of 15 years would require an annual premium of Rs. 903. 43.

Therefore to provide crop insurance cover for all the farming families in the severely affected areas would require Rs 66.01 million per annum. For all farming families in the less affected areas in the country the amount required is Rs. 352.24 million per annum. In addition, to provide life insurance cover to the head of the household in each farming family both in severely and less affected areas would require Rs. 295.54 million per annum. Therefore, the entire insurance/ compensation scheme proposed in this study would require a premium worth of Rs. 713.79 million per annum.

However, in estimating the total cost of the proposed scheme, this amount should be incorporated with the other associated costs, in particular, the cost involved in collecting and administrating the public WTP contribution. This may require establishing an appropriate mechanism at least at the divisional secretariat level. One possible and effective option would be the establishment of an association with the *Samurdi* movement which has about 54, 600 project offices at the *Grama Niladahri* (the government representative at the local level) and about 2,700 project managers at the divisional secretariat level. This is a government coordinated social safety net program which currently functions under the Ministry of Agriculture (United Nation, 2001). Thus, undoubtedly it could be possible to establish an alliance with the *Samurdi* movement in collecting public WTP contribution both at *Grama Niladahri* and divisional secretariat level. However, because of lack of empirical data we are not in a position to estimate the exact costs that would involved in collecting the public WTP contribution and other associated costs.

Nevertheless, by undertaking an inclusive empirical analysis of the Comprehensive Crop Insurance Scheme in India, Mishra (1996) found that to administer a community based crop insurance/compensation scheme would take at least one percent of the total expected community contribution. In this analysis, he also mentioned that this could be further reduced if there is a possibility of integrating such an exercise into a prevailing institutional setup at the community level, such as would be the case for the *Samurdi* movement in Sri Lanka. This approach also provides an opportunity for the community to participate in the proposed scheme in a familiar environment. Thus we decided to estimate the associated cost for collection of public WTP contributions based on Mishra (1996) where we found that it would require Rs. 90.58 million per annum and Rs.452.9 for five years. This in turn would reduce our previous estimate of the capitalised sum of WTP contribution (i.e. Rs. 2072.13 million) by Rs. 30.41 million per annum. When this amount is subtracted, it gives us Rs. 2041.72

million per annum for perpetuity to finance the proposed supported insurance/compensation scheme.

10. PUBLIC WTP CONTRIBUTION EXCEEDS THE FINANCIAL COST OF PROPOSED INSURANCE/ COMPENSATION SCHEME

When we compare the our estimate of public WTP contribution (the capitalised sum of Rs. 2041.72 million per annum) with the cost of the proposed insurance/compensation scheme (Rs. 804.37 million per annum), it shows that the community WTP contribution significantly exceeds the amount required to finance the scheme proposed in this study. Thus the balance could be used, if necessary, to adjust the initial amount of insurance/compensation proposed in the study. Indeed, such a promising adjustment would certainly further increase farmers' tolerance to the presence of wild elephants on their farming lands while providing access for them to move across from one isolated habitat to another. Undoubtedly this would reduce the current rate of elephant mortality which primarily occurs due to interference with agriculture and other human interests. This in turn ensures the continued existence of the wild elephant population in Sri Lanka, at least at their current population level.

Nevertheless, it is worth mentioning that when the economic damage caused by the elephant is covered, the interest in protecting their crop and properties by farmers is likely to be much reduced at the individual farm level. This would tend to increase the economic damage caused by the elephant collectively and it could be much higher than the present estimates of elephant damage. Therefore the initial amount proposed in the insurance/compensation scheme may not be adequate to provide a satisfactory protection for economic losses incurred by farmers or to keep their tolerance for the presence of elephant on the farming fields intact.

Furthermore, there could be at least two other technical issues to be address in implementing the proposed scheme in this study. First, it is hard to provide crop insurance/compensation in a cheap way, since contracts are generally numerous with many small business and damages have to be assessed by insurers on an individual basis. Therefore, scale economies are limited. Second, 'moral hazard' is present because if some compensation is paid farmers will reduce their vigilance in guarding crops against elephants. In this case, however, moral hazard has a social advantage to some extent. If some mechanism is established for farmers to recover the damage caused by the elephant, they would allow elephant some greater access to farming areas and this certainly would reduce the current rate of elephant deaths arising from their

interference with agriculture and other human interest. The socially optimal level of 'moral hazard' has, therefore, to be determined.

11. CONCLUDING REMARKS

This study investigated the practicality of establishing a publicly supported insurance/compensation scheme to compensate farmers for damages caused by elephants and to raise their tolerance for the presence of this wildlife species on their faming land. The data used in this analysis were collected as part of two contingent valuation surveys conducted in Sri Lanka.

The majority of the respondents in these samples were WTP to contribute to the scheme proposed in this study. Hence, farmers in the HEC affected areas could be motivated to increase their tolerance for the elephants' presence on the farming fields by establishing a scheme such as this. This will help ensure the survival of elephants in the wild in Sri Lanka.

The finding of our statistical analysis reveals that the respondents' motivation for their WTP contribution differed between samples. Rural respondents' WTP contribution was correlated primarily with economic factors, particularly their experience with elephant damage and farming income. Possibly this is because of an insurance motive. In contrast, the urban respondents' WTP contribution was largely connected with attitudinal variables such as pro-conservation attitudes, knowledge of the elephant related issues, and non use-value of the elephant.

The empirical analysis undertaken in investigating the practicality of establishing the proposed scheme reveals that estimated possible public support could generate funds in excess of the financial requirements of such an insurance/compensation scheme. However, we have insufficient data to determine to what extent this scheme would be economically effective in the long run in resolving the HEC related issues in Sri Lanka. Nonetheless, given that survival of the elephant in the wild in Sri Lanka is dependent on farmers' tolerance to them, and their tolerance in turn is dependent on their being compensated for the damage caused by elephants, the overall findings of this study are encouraging from a policy point of view. Furthermore, this article raised and illustrated the point that there can be important positive spillovers from 'crop damage' by wildlife, e.g. elephants, and this means that in many cases, damage to crops should not be analysed as though it only involves the loss of a private good.

Reference

Ahsan, S.M., Ali, A.A. G. and Kurian, N.J., (1982). Towards a theory of agricultural insurance. American Journal of Agricultural Economics, 64:520-29.

Bandara, R., Tisdell. C., (2002a). Asian elephants as agricultural pests: economics of control and compensation in Sri Lanka. Natural Resource Journal (in Press).

Bandara, R., Tisdell. C. (2002b). Willingness to pay for the conservation of Asian elephants: contingent valuation study, *Economics, Ecology and the Environment,* Working Paper No. 67, School of Economics, The University of Queensland, Qld 4072, Australia.

Bandara, R., Tisdell. C. (2002c). Conserving Asian elephants: economic issues illustrated by Sri Lankan concerns, pp. 193-211. In: C.A. Tisdell. *The Economics of Conserving of Wildlife and Natural Areas*. Edward Elgar, Cheltenham, UK.

Bandara, R., Tisdell. C. (2002d). Comparison of rural and urban attitudes to the conservation of Asian elephants in Sri Lanka: Biological Conservation (in Press).

Bandara, R., Tisdell.C., (2003). Willingness of Sri Lankan farmers to pay for a scheme to conserve elephants: an empirical analysis, *Economics, Ecology and the Environment*, Working Paper No 73, School of Economics, The University of Queensland, Qld 4072, Australia.

Berrens, R.P., Smith, H.J., Bohara, A. K. and Silva, C.L., 2002. Further investigation of voluntary contribution contingent valuation: fair share, time of contribution, and respondent uncertainty. Journal of Environmental Economics and Management, 44:144-168.

Bohara , M., Mckee, M., Berrens, H., Smith, H.J., Silva, C., Brookshire, D.,1998. Effects of cost and group size information on willingness to pay responses: open ended vs dichotomous choice. Journal of Environmental Economics and Management, 35:142-163.

Boyle, K.J. and Bergstrom, J.C., (1992). Benefits transfer studies: myths, pragmatism, and idealism. Water Resource Research, 28:675-683.

Brouwer, R. and Spaninks, F.A. (1999). The validity of environmental benefits transfer: further empirical testing. Environmental Economics and Management, 14:95-117. Business in Sri Lanka (2003). Sri Lanka e-business page-find business, production and) services (http://www.mysrilanka.com/travel/lanka/business/

Carriker, G.L., Williams, J.R., Barnaby, G.A. and Black, J.R., (1991). Yield and income risk reduction under alternative crop insurance and disaster assistance designs. Western Journal of Agricultural Economics, 16:238-250.

Champ, R., Bishop.R., Brown,T. and McCollum, D., 1997. Using donation mechanism to value non-use benefits from public goods. Journal of Environmental Economics and Management, 33:151-163.

Chilton, S. and Hutchinson, W. 1999. Some further implications of incorporating warm glow of giving into welfare measures: a comment on the use of donation mechanisms by Champ *et al*. Journal of Environmental Economics and Management, 37:202-209.

Cooper, J.C. and Keim, R.W. (1996). Incentive payments to encourage farmer adoption of water quality protection practices. American Journal of Agricultural Economics, 78:54 - 64.

Daniel, J.C., (1996). Conservation of Asian elephant, *Gajah,* 17:1-9.

Desai, A. A., (1998). *Conservation of Elephants and Human-Elephant Conflict*,Technical Report (unpublished report), Department of Wildlife Conservation, Colombo, Sri Lanka. Department of Census and Statistics of Sri Lanka, (2002). Census of population and housing- 2001. Department of Census and Statistics, Colombo, Sri Lanka.

De Silva, M., (1998). Status and conservation of the elephant and the alleviation of man-elephant conflict in Sri Lanka. *Gajah*, 19: 1-24.

Eltringham, S.K., (1982). Elephants. Blandford Press, Link House, West Street, Poole, Dorset, U.K.

FAO, 2000. Application of the contingent valuation method in developing countries: a survey. Information Division, Food and Agricultural Organization of the United Nation, Viale delle Terme di Caracalla, Rome, Italy.

Fraser, R., (1992). An analysis of willingness to pay for crop insurance. Australian Journal of Agricultural Economics, 36:83-95.

Hadker, N, Sharma, S, David, A and Muraleedharan, T. R., (1997). Willingness to pay for Borivli National Park: evidence from a contingent valuation. Ecological Economics, 21: 105 -122.

Hanemann, M., (1984). Welfare evaluations in contingent valuation experiments with discrete responses. American Journal of Agricultural Economics, 66: 332-41.

Haq, M.U., (1993). The myth of the friendly markets, pp. 23-31. In J.R. Anderson and C. Haan (eds), Public and Private Roles in Agricultural Development: Proceedings of the Twelfth Agricultural Sector Symposium, World Bank, Washington, DC.

Hazell, P.B.R., (1992). The appropriate role of agricultural insurance in developing countries. Journal of International Development, 4:567-96.

Hill, G.M., (1997). Crop raiding by wild vertebrates: the farmer's perspective in an agricultural community in western Uganda. International Journal of Pest Management 43,77-84.

Hoare, R.E., (1999). Determinants of human-elephant conflict in a land-use mosaic. Journal of Applied Ecology 36, 689-700.

Insurance Industry in Sri Lanka (2002), Insurance companies in Sri Lanka: an overview (http://www.srilankainsurance.com/about_us_mid.html)

IUCN, (1996). Red list of threatened animals, IUCN Gland, Switzerland.

Johannesson, M., Liljas, B. and Johannesson, O.P., 1998. An experimental compression of dichotomous choice contingent valuation question and real purchase decisions. Applied Economics, 30: 643-647.

Jayawardene, J., 1998. Elephant and Mahaweli: A 15-year study, Sri Lanka Nature, 2: 45-51.

Just, R.E., Calvin, L., and Quiggin, J., (1999). Adverse selection in crop insurance: actuarial and asymmetric information incentives. American Journal of Agriculture Economics, 81:834 -849.

Karyawasam, D., Dissanayake, S.R.B. and Santiapillai, C. (2002). The status of the Asian elephant (*Elephas maximus*) in Sri Lanka. A paper presented at the IUCN/SSC Asian Elephant Specialist Group Meeting, Phnom Penh, Cambodia, 26-30 May 2002.

Kemf, E., Santiapillai, C., (2000). Asian elephants in the wild: 2000 WWF Species Status Report. WWF-International, Gland, Switzerland.

Kulathunga, P. D. R., (1999). Sociological study on human-elephant conflict in Southern Sri Lanka (Unpublished Report). Open University of Sri Lanka, Colombo, Sri Lanka.

Levine, D.M., Stephan, D., Krehbiel, T.C., and Berenson, M.L., (2002). Statistics for managers using Microsoft Excel, Pearson Education, Inc., Upper Saddle River, New Jersey, UAS.

Loomis, J. B., Kent, P, Strange, L., Fausch, K. and Covich, A.,(2000). Measuring the total economic value of restoring ecosystem service in an impaired river basin: result from a contingent valuation survey. Ecological Economics. 33:103 – 117.

Makki, S.S. and Somwaru, A., (2001). Farmers' participation in crop insurance markets: creating the right insurances, American Journal of Agricultural Economics, 83:662-667.

Memon, M.A. and Matsuoka, S.M., (2002). Validity of contingent valuation estimates from developing countries: scope sensitivity analysis. Environmental Economics and Policy Studies, 5: 39 - 63.

Mishra, R.K., (1996). Agricultural risk, insurance and income: a study of the impact and design of India's comprehensive crop insurance scheme. Ashgate Publishing Limited, Gower House, Hants GU113HR, England.

Mosley, P. and Krishnamurthy, R., (1995). Can crop insurance work? The case of India. The Journal of Development Studies, 31:428-450.

Munaweera, D.P. and Kuruwita, V.Y., (1998). Rapid assessment of human elephant conflicts at Handapanagala area and recommendation for minimizing them, (Unpublished Report), Forestry Unit, The University of Sri Jayawardenapura, Colombo, Sri Lanka.

Nyhus, P.J., Tilson, R., Sumianto, P., (2000). Crop raiding elephants and conservation implication at Way Kambas National Park, Sumatra, Indonesia. Oryx 34, 262-274.

Quiggin, J., Karagiannis, G., Stanton, J. (1994). Crop insurance and crop production: an empirical study of moral hazard and adverse selection pp. 253-272. In: D.L. Hueth and W.H. Furtan (eds). *Economics of Crop Insurance: Theory and Evidence*. Kluwer Academic Publishers, Boston, USA.

Ramakrishnan, B., Sivaganesan, N., Srivatava,R., (1997). Human interference and its impact on elephant corridors in Sounth India. Gajah 18, 1-21.

Rollins, K. and Briggs, H., (1996). Moral hazard, externalities, and compensation for crop damage from wildlife. Journal of Environmental Economics and Management, 31:368-386.

Saarcnet (2003). Agricultural polices in Sri Lanka, Agricultural Research and Training Institute, (http://www.saarcnet.org/newsaarcnet/govtpolicies/srilanka.htm)

Santiapillai, C. and Ramono, W.S. (1993). Why do elephants raid crops in Sumatra? Gajah 11, 55-57.

Santiapillai, C., (1998). Human-elephant conflict management in Sri Lanka. Sri Lanka Nature .2: 5-7.

Sukumar, R., (1989), The Asian elephant: ecology and management. Cambridge University Press, Cambridge, UK.

Tennekoon**,** U.B., (2001). Human-elephant conflict in the boundaries of the Sri Lankan National Parks, (Unpublished Report), EAP1-Project, Ministry of Forestry and Environmental Conservation, Colombo, Sri Lanka.

Tisdell, C.A., (1979). Wildlife: a national asset or a pest to be managed? In Department of Science and the Environment, Environmental Economics, pp.79-87. A.G.P.S., Canberra.

Tisdell, C.A., (1982). Wild pigs: environmental pest or economic resource? Pergamon Press, Sydney, Oxford.

Tisdell, C.A., Xiang, Z., (1998). Protected areas, agricultural pests and economic damage: conflicts with elephants and pests in Yunnan. The Environmentalist 18, 109-118.

Tisdell, C.A., (1999). Biodiversity, conservation and sustainable development: principles and practices with Asian examples, New Horizons in Environmental Economics Series, Edward Elgar Publishing, Cheltenham, UK.

Tisdell, C.A., (2002). The economics of conserving wildlife and natural areas. Edward Elgar, Cheltenham, UK.

United Nation (2001), Sri Lanka, United Nations development assistance framework (2002-2006). Office of the United Nations, Colombo, Sri Lanka (http://www.undp.lk/Support/undaf6.pdf)

Urban Development Authority of Sri Lanka. (2001). Land use planning in Sri Lanka. Volume 1, Urban Development Authority, Sethsiripaya, Colombo, Sri Lanka.

Wang, H.H., Hanson, S.D., Myers, R. J., and Black, J.B., (1998). The effects of crop yield insurance designs on farmer participation and welfare. American Journal of Agriculture, 80:806-820.

Weerakoon, D. K., (1999). Ecology and ranging behaviour of wild elephants and human-elephant conflict in Sri Lanka (unpublished report). Department of Zoology, University of Colombo, Sri Lanka.

Whittington, D., (1998). Administering contingent valuation surveys in developing countries. World Development, 26:21-30.

Whittington, D., 2002. Improving the Performance of Contingent Valuation in Developing Countries. Environmental and Resource Economics, 22: 223-237.

Zivin, J.,Hueth, B.M., Zilberman, D., (2000). Managing a multiple-use resources: the case of feral pig management in California rangeland. Journal of Environmental Economics and Management, 39: 189-204.

PREVIOUS WORKING PAPERS IN THE SERIES

ECONOMICS, ECOLOGY AND THE ENVIRONMENT

1. Governance, Property Rights and Sustainable Resource Use: Analysis with Indian Ocean Rim Examples by Clem Tisdell and Kartik Roy, November 1996.

2. Protection of the Environment in Transitional Economies: Strategies and Practices by Clem Tisdell, November 1996.

3. Good Governance in Sustainable Development: The Impact of Institutions by K.C.Roy and C.A.Tisdell, November 1996.

4. Sustainability Issues and Socio-Economic Change in the Jingpo Communities of China: Governance, Culture and Land Rights by Ren Zhuge and Clem Tisdell, November 1996.

5. Sustainable Development and Environmental Conservation: Major Regional Issues with Asian Illustrations by Clem Tisdell, November 1996.

6. Integrated Regional Environmental Studies: The Role of Environmental Economics by Clem Tisdell, December 1996.

7. Poverty and Its Alleviation in Yunnan Province China: Sources, Policies and Solutions by Ren Zhuge and Clem Tisdell, December 1996.

8. Deforestation and Capital Accumulation: Lessons from the Upper Kerinci Region, Indonesia by Dradjad H. Wibowo, Clement a. Tisdell and R. Neil Byron, January 1997.

9. Sectoral Change, Urbanisation and South Asia's Environment in Global Context by Clem Tisdell, April 1997.

10. China's Environmental Problems with Particular Attention to its Energy Supply and Air Quality by Clem Tisdell, April 1997.

11. Weak and Strong Conditions for Sustainable Development: Clarification of concepts and their Policy Application by Clem Tisdell, April 1997.

12. Economic Policy Instruments and Environmental Sustainability: A Second Look at Marketable or Tradeable Pollution or Environmental-Use Permits by Clem Tisdell, April 1997.

13. Agricultural Sustainability in Marginal Areas: Principles, Policies and Examples form Asia by Clem Tisdell, April 1997.

14. Impact on the Poor of Changing Rural Environments and Technologies: Evidence from India and Bangladesh by Clem Tisdell, May 1997.

15. Tourism Economics and its Application to Regional Development by Clem Tisdell, May 1997.

16. Brunei's Quest for Sustainable Development: Diversification and Other Strategies by Clem Tisdell, August 1997.

17. A Review of Reports on Optimal Australian Dugong Populations and Proposed Action/Conservation Plans: An Economic Perspective by Clem Tisdell, October 1997.

18. Compensation for the taking of Resources Interests: Practices in Relations to the Wet Tropics and Fraser Island, General Principles and their Relevance to the Extension of Dugong Protected Areas by Clem Tisdell, October 1997.

19. Deforestation Mechanisms: A Survey by D.H. Wibowo and R.N. Byron, November 1997.

20. Ecotourism: Aspects of its Sustainability and Compatibility by Clem Tisdell, November 1997.

21. A Report Prepared for the Queensland Commercial Fisherman's Organisation by Gavin Ramsay, Clem Tisdell and Steve Harrison (Dept of Economics); David Pullar and Samantha Sun (Dept of Geographical Sciences and Planning) in conjunction with Ian Tibbetts (The School of Marine Science), January 1998.

22. Co-Evolutions in Asia, Markets and Globalization by Clem Tisdell, January 1998.

23. Asia's Livestock Industries: Changes and Environmental Consequences by Clem Tisdell, January 1998.

24. Socio-Economics of Pearl Culture: Industry Changes and Comparisons Focussing on Australia and French Polynesia by Clem Tisdell and Bernard Poirine, August 1998.

25. Asia's (Especially China's) Livestock Industries: Changes and Environmental Consequences by Clem Tisdell, August 1998.

26. Ecotourism: Aspects of its Sustainability and Compatibility with Conservation, Social and Other Objectives, September 1998.

27. Wider Dimensions of Tourism Economics: A Review of Impact Analyses, International Aspects, Development Issues, Sustainability and Environmental Aspects of Tourism, October 1998.

28. Basic Economics of Tourism: An Overview, November 1998.

29. Protecting the Environment in Transitional Situations, November 1998.

30. Australian Environmental Issues: An Overview by Clem Tisdell, December 1998.

31. Trends and Developments in India's Livestock Industries by Clem Tisdell and Jyothi Gali, February 1999.

32. Sea Turtles as a Non-Consumptive Tourism Resource in Australia by Clevo Wilson and Clem Tisdell, August 1999.

33. Transitional Economics and Economics Globalization: Social and Environmental Consequences by Clem Tisdell, August 1999.

34. Co-evolution, Agricultural Practices and Sustainability: Some Major Social and Ecological Issues by Clem Tisdell, August, 1999.

35. Technology Transfer from Publicly Funded Research for improved Water Management: Analysis and Australian Examples by Clem Tisdell, August 1999.

36. Safety and Socio-Economic Issues Raised by Modern Biotechnology by Dayuan Xue and Clem Tisdell, August 1999.

37. Valuing Ecological Functions of Biodiversity in Changbaishan Mountain Biosphere Reserve in Northeast China by Dayuan Xue and Clem Tisdell, March 2000.

38. Neglected Features of the Safe Minimum Standard: Socio-economics and Institutional Dimension by Irmi Seidl and Clem Tisdell, March 2000.

39. Free Trade, Globalisation, the Environment and Sustainability: Major Issues and the Position of WTO by Clem Tisdell, March 2000.

40. Globalisation and the WTO: Attitudes Expressed by Pressure Groups and by Less Developed Countries by Clem Tisdell, May 2000.

41. Sustainability: The Economic Bottom Line by Clem Tisdell, May 2000.

42. Trade and Environment: Evidence from China's Manufacturing Sector by Joseph C. H. Chai, June 2000.

43. Trends and Development in India's Livestock Industry by Clem Tisdell and Jyothi Gali, August 2000.

44. Tourism and Conservation of Sea Turtles by Clem Tisdell and Clevo Wilson, August 2000.

45. Developing Ecotourism for the Survival of Sea Turtles by Clem Tisdell and Clevo Wilson, August 2000.

46. Globalisation, WTO and Sustainable Development by Clem Tisdell, August 2000.

47. Environmental Impact of China's Accession to WTO in the Manufacturing Sector by Joseph Chai, August 2000.

48. Effects of Cartagena Biosafety Protocol on Trade in GMOs, WTO Implications, and Consequences for China (English version) by Dayuan Xue and Clem Tisdell, August 2000.

49. Effects of Cartagena Biosafety Protocol on Trade in GMOs, WTO Implications, and Consequences for China (Chinese version) by Dayuan Xue and Clem Tisdell, August 2000.

50. The Winnipeg Principles, WTO and Sustainable Development: Proposed Policies for Reconciling Trade and the Environment by Clem Tisdell, September 2000.

51. Resources Management within Nature Reserves in China by Dayuan Xue, October 2000.

52. Economics, Educational and Conservation Benefits of Sea Turtle Based Ecotourism: A Study Focused on Mon Repos by Clem Tisdell and Clevo Wilson, October 2000.

53. Why Farmers Continue to use Pesticides despite Environmental, Health and Sustainability Costs by Clevo Wilson and Clem Tisdell, November 2000.

54. Wildlife-based Tourism and Increased Tourist Support for Nature Conservation Financially and Otherwise: Evidence from Sea Turtle Ecotourism at Mon Repos by Clem Tisdell and Clevo Wilson, November 2000.

55. A Study of the Impact of Ecotourism on Environmental Education and Conservation: The Case of Turtle Watching at an Australian Site by Clem Tisdell and Clevo Wilson, December 2000.

56. Environmental Regulations of Land-use and Public Compensation: Principles with Swiss and Australian Examples by Irmi Seidl, Clem Tisdell and Steve Harrison.

57. Analysis of Property Values, Local Government Finances and Reservation of Land for National Parks and Similar Purposes by Clem Tisdell and Leonie Pearson, March 2001.

58. Alternative Specifications and Extensions of the Economic Threshold Concept and the Control of Livestock Pests by Rex Davis and Clem Tisdell, May 2001.

59. Conserving Asian Elephants: Economic Issues Illustrated by Sri Lankan Concerns by Ranjith Bandara and Clem Tisdell, June 2001.

60. World Heritage Listing of Australian Natural Sites: Tourism Stimulus and its Economic Value by Clem Tisdell and Clevo Wilson, September 2001.

61. Aquaculture, Environmental Spillovers and Sustainable Development: Links and Policy Choices by Clem Tisdell, October 2001.

62. Competition, Evolution and Optimisation: Comparisons of Models in Economics and Ecology by Clem Tisdell, October 2001.

63. Aquaculture Economics and Marketing: An Overview by Clem Tisdell, October 2001.

64. Conservation and Economic Benefits of Wildlife-Based Marine tourism: Sea Turtles and Whales as Case Studies by Clevo Wilson and Clem Tisdell, February 2002.

65. Asian Elephants as Agricultural Pests: Damages, Economics of Control and Compensation in Sri Lanka by Ranjith Bandara and Clem Tisdell, February 2002.

66. Rural and Urban Attitudes to the Conservation of Asian Elephants in Sri Lanka: Empirical Evidence by Ranjith Bandara and Clem Tisdell, May 2002.

67. Willingness to Pay for Conservation of the Asian Elephant in Sri Lanka: A Contingent Valuation Study by Ranjith Bandara and Clem Tisdell, May 2002.

68. Bioeconomic Analysis of Aquaculture's Impact on Wild Stocks and Biodiversity by Clem Tisdell, May 2002.

69. Will Bangladesh's Economic Growth Solve its Environmental Problems? by Clem Tisdell, May 2002.

70. Socioeconomic Causes of loss of Genetic Diversity: Analysis and Assessment by Clem Tisdell, June 2002.

71. Empirical Evidence Showing The Relationships Between Three Approaches For Pollution Control by Clevo Wilson, August 2002.

72. Energy-Use, the Environment and Development: Observations with Reference to China and India by Clem Tisdell and Kartik Roy, September 2002.

73. Willingness of Sri Lankan Farmers to Pay for a Scheme to Conserve Elephants: An Empirical Analysis by Ranjith Bandara and Clem Tisdell, January 2003.

74. The Public's Knowledge of and Support for Conservation of Australia's Tree-kangaroos by Clem Tisdell and Clevo Wilson, February 2003.

75. Ecotourism/Wildlife-based Tourism as Contributor to Nature Conservation with Reference to Vanni, Sri Lanka by Clem Tisdell, March 2003.

76. Visitor Profiles and Environmental Attributes, especially of Birds, Attracting Visitors to Lamington National Park: Tourist Attitudes and Economic Issues by Clem Tisdell and Clevo Wilson, March 2003.

77. Wildlife Damage, Insurance/Compensation for Farmers and Conservation: Sri Lankan Elephants as a Case by Ranjith Bandara and Clem Tisdell, May 2003.