Would Wetland Biodiversity Conservation Improve Social Welfare? A Case Study in Vietnam's Mekong River Delta

Thang Nam Do and Jeff Bennett

Abstract— *Wetlands in the Vietnam's Mekong River Delta (MRD) have experienced losses and degradation. Plans have been drafted by government agencies to use public funding to conserve the wetlands. However, one challenge to policymakers is whether the wetland conservation proposed would improve social welfare. To provide an answer, this study conducts a cost-benefit analysis of a proposed biodiversity conservation program for Tram Chim National Park in the MRD. The cost to local farmers of changing wetland management in the form of reduced income from rice production is estimated using a production function approach. The benefit of wetland conservation is estimated using a choice modelling approach.*

It was found that the proposed conservation program of Tram Chim would generate a net social benefit in the order of USD 0.15 and 0.96 million, indicating that wetland conservation in the MRD would improve social welfare. This supports the proposed plan of using public funding for conserving the wetlands.

Keywords— **Cost-benefit analysis, Mekong, wetland biodiversity values.**

1. INTRODUCTION

Wetlands in Vietnam's Mekong River Delta (MRD) have great biodiversity. They support a large number of herons, egrets, storks and ibises and some rare species such as sarus Cranes, black necked storks, lesser adjutants and greater adjutants [1]. In particular, mature semi-natural Melaleuca forest and seasonally inundated grasslands in MRD have a large number of birds and support high numbers of globally threatened bird species [2]. Fourteen of 194 bird species recorded in the Delta are globally threatened [3].

However, the wetlands have experienced serious loss and degradation. The area of mangrove forest has decreased by about 80 per cent over the last 50 years [4]. The increase in shrimp farming is the leading cause of this loss. Other causes include the conversion of wetlands to agriculture and construction land, war destruction and excessive fuel wood collection. In addition, the *ad hoc* development of dykes in the MRD has altered hydrologic conditions and hence wetland health [5].

To address the wetland loss and degradation, plans have been drafted by government agencies to use public funding to improve the protection of the wetlands. However, at present, there is a lack of information on the impact of alternative management strategies on values of wetlands in the MRD [5]. In particular, there is limited information on the impact on local farmers' livelihoods as well as benefits of improved wetland biodiversity. Due to this information gap, it is unclear to policymakers whether the change in current wetland management practices would generate a net social benefit.

This study helps to fill this information gap by conducting a cost-benefit analysis (CBA) of a proposed wetland conservation program for Tram Chim National Park in the MRD. CBA of wetland alternative management strategies is aimed at calculating the net impact of a project on the economic welfare of society by measuring all the costs and benefits of the project relative to some base case or status quo [6]. In CBA, environmental impacts are evaluated and measured in monetary units. This process not only has a sound theoretical framework but also provides wetland managers with unambiguously quantitative data on which to make informed decisions [7].

The case study reported here was carried out in the Tram Chim National Park and its adjacent areas in the Plain of Reeds in the Mekong River Delta (Figure 1). Established as a national park in 1994, Tram Chim is a 9,000 ha wetland located in the Tam Nong District of Dong Thap Province. Tram Chim is a habitat for 127 plant species. It supports a large number of rare birds. Most notably, Tram Chim provides a habitat for the Sarus Cranes, the endangered bird species listed in the World Conservation Union (IUCN) Red Book [8]. Due to its biodiversity value, Tram Chim was the first wetland national park declared in Vietnam and has been nominated by the Vietnamese government to be a Ramsar wetland site [3].

Tram Chim is enclosed by a 53-km dyke built in 1985 to retain water in the national park during the dry season. This helped restore the wetland ecological systems damaged during the Vietnam war [10]. Evidence of ecological restoration came with the return of the Sarus crane. However, in 1996, to prevent fire, the local authorities raised the height of the dyke so that the water

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level is now constantly higher than the ecological optimal level of 0.5m [8].

Fig. 1. Location of Tram Chim National Park.

Source: Adapted from [9]

The current park dyke system has affected Tram Chim's ecological system [11]. While the long inundation supports some deepwater aquatic species, overall, it has negative impacts on the ecological system. Native plants have been replaced by invasive mimosa pigra while eleocharis or 'nang' grasses, the favourite food of the Sarus crane, have been destroyed. The latter has led to reduced numbers of this endangered bird species visiting the park. The dyke has also hindered fish migration and hence reduced the number of fish species living in the wetlands.

To improve wetland biodiversity, the Park Management Board has proposed to change the current park dyke system and wetland management practices [12]. The changes involve lowering the dyke, controlling the invasive species, increasing hydrological and biological monitoring and enforcing against illegal encroachments. The main impact on local farmers is reduced rice profit due to prolonged flood duration in adjacent farms [5]. In the present study, this cost was calculated using a production function approach. The benefit of wetland conservation was estimated using a choice modelling approach.

This paper comprises five sections. Following this introduction, Section 2 details the estimation of cost associated with the proposed program in the form of reduced rice profit of local farmers. Section 3 reports the process of valuing benefits derived from improved wetland biodiversity. Section 4 discusses the results of the cost-benefit analysis of the proposed program. The paper ends with the conclusion that the wetland conservation program would generate a net social benefit.

2. ESTIMATING THE COST OF REDUCED RICE PROFIT

Rice production function approach

The production function (PF) approach is used to estimate market values forgone as a result of government intervention to improve environmental qualities [13]. The complexity of the PF approach can range from simply examining the PF for single use systems to examining input and output market effects associated with multiple use systems [14]. In general, there are three types of models used in the PF approach: a traditional model, an optimal model and an econometric model [15].

The main algebraic forms of PF estimations are translog, which include quadratic polynomial and square-root quadratic polynomial, and Cobb-Douglas [16]. When there are three or more independent variables, it is generally best to use the Cobb-Douglas function [16]. This is particularly true for rice production in the MRD [17]-[18].

In this study, a static PF approach was used to estimate changes in rice producer surplus as a result of lowering the dyke surrounding Tram Chim. Current market prices for rice were used under the assumption that any changes in rice output in the Plain of Reeds would be insufficiently large to affect the market prices of inputs and rice. That is, it was assumed that resource use and prices, and thus consumer surplus remained constant. By using this approach, the effects of changes in flood duration resulting from the changes in wetland management on rice profits were estimated.

A literature search on the relationship between rice production and water management regimes was conducted to make sure that all relevant variables would be included in the farm survey questionnaire and to examine the suitability of using existing rice production models for this research. It was found that there has been considerable research on this topic. However, none of the existing models of rice production included a flood duration variable that could be used in this study [5].

Among the rice production function models available in the literature, the model reported in [17] was deemed to be the most relevant to this research because it had been recently developed based on Vietnam's Mekong Delta data. For this research, this model was extended to include a flood duration variable. The model takes the basic form:

$$Y = f(L, K, I, F, E) \quad (1)$$

where

Y is the output of rice of a household in the studied year of 2005 (tones/ha)

L is labour input (human working hours/ha)

K is capital input (machine working hours/ha)

I is a vector of material inputs such as seeds (kg/ha), fertilizers (kg/ha) and pesticides (100ml/ha)

F is flood duration in rice farms (days)

E is the vector of other factors such as household characteristics, farming conditions and environmental factors.

A Cobb-Douglas functional form [17]-[18] was applied as follows:

$$\ln (Y) = \alpha0 + \alpha1\ln(A) + \alpha2\ln(L) + \alpha3\ln(K) + \alpha4\ln (I) + \beta0F + \beta1E1 + \beta2E2 + \beta3E3 + \beta4E4 + \beta5E5 + \beta6E6 + \beta7E7 \quad (2)$$

where

Y, A, L, K, I, F are the same as in the above equation and

$\alpha1$ is the model constant

$\alpha2$ is the coefficient of labour,

$\alpha3$ is the coefficient of capital

$\alpha4$ is the coefficient of material inputs

$\beta0$ is the coefficient of dykes

E1 is farming experience (years)

$\beta1$ is the coefficient of farming experience

E2 is training on rice production (yes =1, no=0)

$\beta2$ is the coefficient of training on rice production

E3 is the soil conditions (fertile soil=1, other soil=0)

$\beta3$ is the coefficient of soil conditions

E4 is the farm fragmentation, represented by the number of farm plots

$\beta4$ is the coefficient of farm fragmentation

E5 is irrigation conditions, represented by the distance to water sources (m)

$\beta5$ is the coefficient of irrigation conditions

E6 is disasters during studied year of 2005 (yes=1, no=0)

$\beta6$ is the coefficient of disasters

E7 is the relative location of farms (upstream of the Mekong River=1, downstream of Mekong River=0)

$\beta7$ is the coefficient of the relative location of farms

Based on these models, the effect of flood duration on rice output was estimated.

Farm survey

A draft PF farm survey questionnaire was developed based on previous studies on rice production in the MRD [17]-[18]. A pre-test was conducted in 27 households in three villages in Dong Thap Province.

The two main objectives of selecting the sites studied were representativeness and heterogeneity. Representativeness means that the studied sites need to represent rice production and flood duration in the MRD. Heterogeneity means that the studied sites need to have sufficient variation in rice production input and output conditions under different flood duration to produce a meaningful production function estimate.

To achieve these objectives, a mixture of probability sampling techniques was adopted. The use of this mixture of sampling techniques aimed to maximise the advantages and minimise the disadvantages of each of the sampling techniques. It involved three stages. First, four districts were selected from the list of 29 districts in the Plain of Reeds, using a simple random sampling technique. Second, each selected district was stratified into two strata: high dyke and low dyke. Third, 34 households in each stratum were selected using a systematic sampling technique. Using this technique, enumerators approached every 50th households in the stratum. Households were the sample units with a member of the household who was over 18 years old being the unit of inquiry.

Using this sampling strategy, the following four districts were selected: Tam Nong and Thap Muoi in Dong Thap Province, Thu Thua in Long An Province and Cai Be in Tien Giang Province. The survey was conducted in June and July 2006. A total of 241 usable questionnaires were collected. The farm survey was conducted across 272 households. Socio-demographic characteristics of the sample were checked against those of the population of the Plain of Reeds. It was found that there were no significant differences between the sample and the population. Therefore, the sample could be considered to be representative of the population.

Results

The correlation matrix method was used to check for multicollinearity problems. No correlation of more than 70 per cent between the independent variables was found. That is, there was no multicollinearity in the independent variables. Definitions and descriptive statistics of the variables are presented in Appendixes 1 and 2 respectively.

The Cobb-Douglas functional form was estimated[1]. Heteroscedasticity was detected using the Breusch-Pagan method and corrected using feasible generalised least squares [19]. The model has an acceptable explanatory power with the adjusted R^2 being 0.42. The significant variables have a priori expected signs.

It was found that an increase by one day of flooding reduces rice productivity by 0.06 per cent, significant at the five per cent level (Table 1). The model also shows that the increase by one working hour per hectare per year increases rice productivity by six per cent. An additional one year of rice farming experience increases rice productivity by 0.3 per cent. Using the method for interpreting coefficients of the dummy variables in semilogarithmic equations [20], it was found that fertile soil increases rice productivity by 12.7 per cent. Similarly, rice productivity in upstream areas is 17.4

[1] Both Cobb-Douglas and translog functional forms were estimated. Following the method proposed in [17], the null hypothesis of a Cobb-Douglas functional form of the production function was tested against the translog functions. The resulting test statistics was $\chi^2_{20} = 29.3$ compared to a critical value of 31.4. This suggests that the Cobb-Douglas is preferred to the translog form.

higher than in downstream areas. Disasters reduce rice productivity by 5.1 per cent.

Based on findings reported in Table 1, the following equation was used to calculate impacts of changes in flood duration due to lowering park dykes on rice productivity.

$$\text{Ln (rice)} = 1.37 + 0.06*\ln(\text{labour}) - 0.0006*\text{flood} + 0.12*\text{soil} - 0.05*\text{disaster} + 0.003*\text{experience} + 0.16*\text{location} \quad (3)$$

It was predicted that the lowering of Tram Chim park dykes would prolong flood duration in adjacent areas by 16.2 days [5]. Using equation 3, it was estimated that the lowering of the park dyke would decrease the rice productivity on average by 0.06 tonne per ha per annum. With the average rice profit forgone being VND 1.24 million per tonne [5], it was estimated that the lowering of the Tram Chim park dykes would reduce rice profit on average by VND 0.07 million per ha per annum.

Table 1. Impacts of Flood Duration on Rice Productivity

Variable	**Coefficient (Standard error)**
Constant	1.37*** (0.24)
Labour	0.06*** (0.01)
Capital	0.003 (0.014)
Fertilizer	0.03 (0.02)
Seed	0.04 (0.03)
Pesticide	0.028 (0.018)
Herbicide	0.019 (0.02)
Flood	-0.0006** (0.0003)
Soil	0.12*** (0.02)
Plot	-0.009 (0.008)
Disaster	-0.05*** (0.01)
Irrigation	-0.0008 (0.0007)
Experience	0.003*** (0.0008)
Training	-0.04 (0.03)
Location	0.16*** (0.04)
Statistic summary	
R-square	0.45
Adjusted R-square	0.42
Std error of regression	0.18
Included observations	227

Note: *** denotes statistical significance at 1% level, ** denotes statistical significance at 5% level and * denotes significance at 10% level.

3. ESTIMATING BENEFITS OF IMPROVED WETLAND BIODIVERSITY

Choice Modelling

Choice Modeling (CM) is a stated preference technique used to estimate non-market values. CM involves asking survey respondents to choose their most preferred resource use option from a number of alternatives [21]. In CM, samples of choice sets or choice scenarios are drawn from all combinations of possible choice sets and presented to respondents. The objective of CM is to quantify a person's willingness to bear a financial cost to achieve some potential environmental improvement or to avoid some environmental harm. Using CM, not only the value of changes in individual attributes but also the value of aggregate changes in environmental quality are estimated [22].

CM is based on the Lancastrian consumer theory that utility or value is derived from attributes of a particular good or situation [13]. Under this theory, preferences are not based on single attributes but are based jointly on several attributes. In addition, CM is based on the theory of information processing in decision making [23]. This theory indicates how individuals trade-off different levels of attributes and form preferences over different alternatives. CM is also consistent with random utility theory [23]. In RUT, utility is a latent construct that exists in the mind of the consumer but cannot be observed directly. By using CM, some of this unobservable consumer utility can be explained, while some proportion remains unexplained.

To estimate the choice probabilities using Conditional Logit (CL), it is assumed that the random components are independently and identically distributed (IID). When the data do not support IID, CL estimates might be biased. This triggers the use of other models that allow heterogeneity across respondents, for example, random parameter logit (RPL). Discussions of the CL and RPL are detailed in [24].

Research Design and Survey Implementation

Detailed discussions of the questionnaire development and survey implementation are reported in [9]. Briefly, the questionnaire has the following five sections. First, it introduced Tram Chim National Park and its biodiversity loss due to poor wetland management. Second, it described the proposed plan for wetland improvement and the outcomes of different management options. Third, it explained that to implement the plan, the government would need to raise funds to cover the costs of lowering the dyke, remove invasive species, improve hydrological and biological monitoring and pay compensation to local farmers who would suffer from subsequent changes in flood levels. Fourth, it asked respondents to select their preferred options presented in the choice sets. Each option presented several wetland and social attributes associated with a cost in the form of a one-off increase in electricity bill. Example of a choice set is in Appendix 3. Last, it collected information about the demographic characteristics of the respondents.

Personal interviews were conducted in three sub-samples of respondents: Cao Lanh, Ho Chi Minh City and Ha Noi. These sub-samples represented three zones: inside the MRD, on the edge of the MRD, and outside the MRD respectively. The number of useable questionnaires collected was 917. The samples were found to have bias toward younger and better-educated males [9].

Results

LIMDEP was used to run CL and RPL models of the choice data. The RPL was preferred to CL for two reasons [9]. First, the RPL showed heterogeneity in respondents' preference. Second, it had a better model fit, with a higher pseudo-R square and significantly lower log-likelihood estimates, as opposed to the CL model. Therefore, the RPL (Appendix 4) was used for further analysis. Details of the model and its variables are reported in [9].

The willingness to pay (WTP) or compensating surplus for a specific management change scenario was calculated for each sub-sample. The status quo and the change scenario in three years' time predicted by wetland managers were:

- Status quo scenario: 50% healthy vegetation, 150 Sarus Cranes, 40 fish species and no farmers affected.
- Change scenario: 55% healthy vegetation, 250 Sarus Cranes, 40 fish species and 400 households to be affected.

The WTP were estimated using the following formula:

$$WTP = - (1/\beta monetary)*(V1 - V2)$$

where

V1 is the value of the indirect utility associated with the status quo,

V2 is the indirect utility associated with the specific levels of the attributes describing the changed resource allocation, and

βmonetary is the coefficient of the variable cost [21].

The indirect utility of the average respondent was calculated using the coefficients and the sample means of the significant variables. As shown in Table 2, the average WTPs for the proposed program in Ha Noi and Ho Chi Minh City were VND 93,910 (USD 5.9), VND 78,178 (USD 4.9) respectively. On the other hand, respondents in Cao Lanh were not willing to pay for the program[2]. This is because for respondents in Cao Lanh, the marginal values for the wetland attributes were not large enough to compensate for the marginal values of reducing the number of local farmers who would be negatively affected [5].

Hence, it can be surmised that the inverse distance decay function arose because although the local people in Cao Lanh desire the benefits of wetland improvement, they also know that they will be most affected by the costs of such a program. The costs include not only increased electricity bills but also potential increased prices of rice and other agricultural products due to farmers' losses after the change in current wetland management practices. Because Cao Lanh is closer to the affected areas than Ho Chi Minh and Hanoi, the respondents in Cao Lanh would bear these costs more directly. The inclusion of these costs in respondents' minds when making their choice would have reduced the WTP of local respondents.

Table 2. Willingness to Pay for Wetland Conservation

	Cao Lanh	Ho Chi Minh	Ha Noi
Distance from Tram Chim	40 km	250 km	2,000 km
Compensating surplus (VND)	-13,304 (7,254 to -34,691)	78,178 (42,836 to 131,997)	93,910 (47,541 to 152,469)
Compensating surplus (USD)	-0.8 (0.5~-2.1)	4.9 (2.7 to 8.3)	5.9 (3 to 9.5)

Note: Confidence intervals at 95%, calculated using Krinsky and Robb (1986) bootstrapping procedure, are given in brackets.
'_' denotes the WTPs that are not significantly different from zero at the 95% level.

4. DISCUSSIONS

Based on findings in Sections 2 and 3, a cost-benefit analysis for the proposed wetland conservation program was conducted. As discussed in Section 2, the rice profit would reduce by VND 0.07 million per ha per annum under the proposed program. With 30,000 ha that would be affected, the total loss in rice profit would be VND 2,100 million or about USD 131,250 per year, assuming that input choices and costs do not change. Other costs would include biological and hydrological monitoring expenses and engineering costs for dyke reconstruction. The total estimated cost for a five-year program would be about USD 1.9 million [12]. Using the discount rates of 5 and 15 per cent, the higher bound and lower bound present costs were estimated at USD 1.65 and USD 1.27 million respectively.

The benefits of the program were calculated based on the assumption that the benefits would be enjoyed by 0.3 million households living on the edge of the MRD and 0.3 million households living outside the MRD. The aggregation was conducted using two approaches. In the first approach, it was assumed that 30 per cent of non-respondents had the same WTP of the respondents, following the method proposed by [25]. In the second approach, non-respondents were assumed to have zero WTP, following [26]. The two approaches provided higher and lower bounds of aggregate willingness to pay values. The higher and lower bound WTPs for the populations were about USD 2.23 million and USD 1.8 million respectively. These WTP estimates are the

[2] The confidence intervals at 95% of WTP of Cao Lanh respondents included zero, indicating that the WTP of the two sub-samples were not significantly different from zero.

present values of benefits of the wetland conservation, because being asked to state values for wetland improvement in three years, the respondents had already discounted the values when selecting choices.

The lower bound net social benefit was calculated using the lower bound WTP and higher bound cost. Similarly, the higher bound net benefit was estimated by subtracting the lower bound cost from the higher bound WTP. The net social benefit of the program, therefore, ranged from USD 0.15 million to USD 0.96 million. This suggests that the proposed wetland conservation program would improve social welfare. It should be noted that the results of the CBA for the same proposed program varying the assumptions about the predicted outcomes, the number of beneficiaries and discount rates also showed positive net social benefits [9]. This suggests a robust finding about a potential net social benefit generated from wetland conservation.

5. CONCLUSION

This study investigates the changes in social welfare resulting from changes in current wetland management practices by conducting a case study of cost-benefit analysis of the proposed plan for wetland conservation of Tram Chim National Park in the MRD. To this end, two main aspects were assessed. First, the costs that the change in the wetland management would impose on local farmers due to lost rice production; and secondly, the benefits that would result from the wetland biodiversity improvements. The impact of changes in the wetland management on rice profits was assessed using a production function model. Estimates of the benefits of improved wetland biodiversity were carried out using a choice modelling technique.

It was found that the benefits of the plan under review would outweigh its costs. The biodiversity benefits of the changes outweigh the costs of reduced rice production. More specifically, the estimated net social benefit of the program ranged from USD 0.15 million to USD 0.96 million. This indicates that society as a whole would benefit from the proposed changes. However, individual farmers will suffer a loss of income. These individual farmers should be compensated. Information presented in this study can be used for determining the level of compensation paid to the local farmers.

The positive net social benefit of the proposed wetland improvement program indicates that wetland biodiversity conservation would improve social welfare. This supports the proposed plan of using public funding for conserving the wetlands. Indeed, the funding for implementing the wetland conservation program can be mobilised from urban populations on the edge of and outside the MRD, as they indicated their positive WTP for the program. This is in line with the Government of Vietnam's policy of socialising environmental protection, which involves mobilising funding for environmental protection from all sources including individuals.

The provision method of an increase in the electricity bill can be used, although further studies on alternative provision methods such as donations or taxes would provide more insights into this issue. The funding will be used for compensating the local farmers for their forgone incomes as calculated in this study. However, in the long run, the farmers may benefit from the wetland conservation conversion due to improved fish stock, reduced invasive mimosa pigra and eco-tourism [5]. These potential benefits can be used as incentives for farmers to accept the changes in the current wetland management practices but have not been evaluated in this study.

In conclusion, this study has showed that the proposed wetland biodiversity conservation strategy for Tram Chim would improve social welfare. Similar studies investigating environmental benefits and costs associated with changes in current environmental practice would be helpful in assisting policymaking so that better-informed decisions can be made to improve the wellbeing in the region.

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APPENDIXES

Appendix 1. Definitions of Variables in Rice Production Function

Variable	Definition
Rice	Rice yield per hectare per year
Capital	The operating duration of machines in all stages of rice production
Labour	The number of man-hours for rice production
Fertilizer	Amount of fertilizer used
Seed	Amount of seed used
Pesticide	Amount of pesticide used per year
Herbicide	Amount of herbicide used per year
Experience	The household's experience in rice cultivation
Training	Have attended training on rice production
Soil	Soil quality
Plot	Number of plots, representing farm fragmentation
Irrigation	Distance to irrigation sources
Disaster	Disasters that happened during the year, including pests, droughts and floods
Location	Location of the farms (used for capturing all other factors that might have impact on rice productivity)
Flood	Duration of floods per year

Appendix 2. Descriptive Statistics of Variables in Rice Production Function

Variable (unit)	Mean	Max	Min	S.D
Rice (tonnes/ha/year)	14.5	26.7	4.3	3.1
Land (ha)	2.3	12	0.5	2.1
Capital (hours/ha/year	58.7	330	6	56.4
Labour (hours/ha/year)	1,024	5,238	82.4	699.1
Fertilizer (kg/ha/year)	1126	4,680	107.1	539.4
Seed (kg/ha/year)	373.3	900	25.7	157.5
Pesticide (100ml/ha/year)	60.9	360	8	67.8
Herbicide (100ml/ha/year)	54.3	272	3	50
Experience (years)	25.4	66	5	13.2
Training (yes=1, no=0)	0.7	1	0	0.5
Soil (fertile soil=1, other soil=0)	0.75	1	0	0.4
Plot (number of plots)	2.2	20	1	1.8
Irrigation (m)	12.6	50	1	14.7
Disaster (yes=1, no=0)	0.37	1	0	0.5
Location (upstream=1, downstream=0)	0.57	1	0	0.49
Flood (days)	33.6	120	0	38.8

Appendix 3. An Example of a Choice Set

Scenario 1: Suppose options A, B and C are the ONLY ones available.			
The following factors will vary under different management options	**Option A (status quo - no change)**	**Option B**	**Option C**
Percentage of area having healthy vegetation	50%	60%	80%
Number of Sarus Cranes visiting the wetlands per year	150 birds	300 birds	450 birds
Number of fish species	40 species	50 species	70 species
Number of local households worse-off	0	900	900
One-off change in your current monthly electricity bill	No change	Increase by VND 10,000	Increase by VND 50,000

If there were a vote (in which if the majority votes for the option you choose, then that option will be selected), you would vote for:
TICK ONE BOX ONLY
Option A ☐
Option B ☐
Option C ☐

Appendix 4. Random Parameter Logit Model

	Ha Noi	Ho Chi Minh	Cao Lanh
Random parameter			
Vegetation (mean)	0.143E-01*** (0.453E-02)	0.137E-01*** (0.508E-02)	0.404E-01*** (0.116E-01)
Birds (mean)	0.200E-02*** (0.416E-03)	0.116E-02** (0.483E-03)	-0.109E-02 (0.130E-02)
Fish (mean)	0.289E-02 (0.624E-02)	0.301E-03 (0.720E-02)	0.160E-01 (0.133E-01)
Farmers (mean)	-0.162E-02*** (0.286E-03)	-0.111E-02*** (0.268E-03)	-0.377E-02*** (0.961E-03)
Non-random parameter			
Alternative Specific Constant (ASC)	0.12 (0.6)	0.862E-01 (0.580)	-0.896 (1.027)
Cost	-0.157E-04*** (0.281E-05)	-0.171E-04*** (0.245E-05)	-0.313*** (0.623)
ASC*age	0.400E-01*** (0.118E-01)	0.231E-01** (0.958E-02)	0.244E-01 (0.160E-01)
ASC*gender	-0.5** (0.238)	0.682*** (0.228)	0.948 (0.365)
ASC*education	3.112*** (0. 506)	0.324E-01 (0.275)	1.106* (0.594)
ASC*income	0.923E-04*** (0.441E-04)	-0.427E-04 (0.289E-04)	0.449E-03*** (0.157E-03)
ASC*knowledge	0.759** (0.251)	0.277 (0.231)	0.262 (0.505)
ASC*visit	1.072 (0.917)	0.127 (0.573)	-0.524 (0.441)
ASC*option	0.237 (0.252)	0.989*** (0.256)	0.072* (0.396)
ASC*bequest	-0.171 (0.269)	1.12*** (0.256)	1.989*** (0.652)
Cost*education	-0.275E-02 (0.286E-02)	-0.622E-02* (0.358E-02)	-0.501E-02 (0.689E-02)
ASC*cheaptalk	-0.913*** (0.275)	-0.109 (0.220)	n.a.
Standard deviation			
Vegetation	0.45E-01*** (0.131E-01)	0.150E-01 (0.166E-01)	0.381E-02 (0.185E-01)
Birds	0.213E-02* (0.191E-02)	0.105E-03 (0.360E-02)	0.724E-02*** (0.238E-02)
Fish	0.419E-01* (0.225E-01)	0.124E-01 (0.273E-01)	0.191E-01 (0.381E-01)
Farmers	0.361E-03 (0.533E-03)	0.354E-04 (0.506E-03)	0.139E-02 (0.115E-02)
Model statistics			
Log likelihood Pseudo-R2 Observations	-1216.700 0.22 1430	-648.145 0.21 765	-454.502 0.22 540

Note: Standard deviations are in parentheses. *** denotes statistical significance at 1% level, ** denotes statistical significance at 5% level and * denotes significance at 10% level.