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Research Article

Willingness to pay for conservation of wetland ecosystem: Case of Mudun Ela and Kalu Oya watersheds of Western Province, Sri Lanka

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Abstract

The wetland ecosystem provides a number of social and economic benefits for people. This importance is often neglected or undervalued and therefore wetlands are in a serious risk today. Specially, in relation to human activities and unwise utilization, wetlands around the globe are being modified, reclaimed and over-exploited due to high levels of resource consumption, land conversion and also upstream developments that alter the quality and flow of water that feeds into wetlands. Decision makers often have a little understanding of the environmental value of wetlands because wetlands are often perceived as having little or no value compared with uses that yield more visible and immediate economic benefits. In this circumstance, revelation and recognition of value of wetlands has been an essential issue which helps to protect such habitats and also it is useful to utilize the benefits of wetlands with a proper management. The present study was carried out with the aim of estimating the willingness to pay (WTP) for conservation of Mudun Ela and Kalu Oya watersheds, Western Province of Sri Lanka using Contingent Valuation Method (CVM). Respondents were randomly selected for data collection through face-to-face interview. The Tobit Model was used to estimate the entrance fee for conservation. The marginal effects on probabilities in the Tobit model suggests that Post-graduate Degree holders and households who are using wetland as education, research and agricultural purposes play significant roles in the residents' WTP for conservation of wetland. On the other hand, households who are using wetland for agricultural purposes have negative effects on willingness to pay for wetland conservation practices. Reasons behind is that many of the wetlands that have been managed in the past as paddy lands have been abandoned during the past few decades due to lack of water, low economic returns, water pollutions, lack of interest shown by younger generation for paddy cultivation, etc. Furthermore, use of wetlands for disposal of solid waste has also contributed to degradation of wetlands. Therefore, development of a strategic plan for management of wetlands within the two basins, Mudun Ela and Kalu Oya is a timely intervention that can help manage the remaining wetlands in an efficient manner.

Keywords: Contingent valuation method, Economic valuation, Tobit model, Wetlands, Willingness to pay

Introduction

Wetland is known as the kidney of the earth since it plays number of important functions such as storage of rainwater, particularly during heavy monsoon seasons and thereby functioning as flood retention areas, providing opportunities for recreation, provision of food in the form of freshwater fish and other aquatic vegetation, fuel wood and functioning as cattle grazing sites. Wetlands also help reduce the impacts from storm damage and flooding, maintain good water quality in rivers, recharge groundwater, store carbon, help stabilize climatic conditions and control pests. They are also important sites for biodiversity.

Wetlands are among the most productive ecosystems in the world, comparable to rain forests and coral reefs. An immense variety of species of microbes, plants, insects, amphibians, reptiles, birds, fish and mammals can be part of a wetland ecosystem. Climate, landscape shape (topology), geology and movement and abundance of water help to determine the plants and animals that inhabit each wetland. The complex, dynamic relationships among the organisms inhabiting the wetland environment are called food webs (Kwak & Zedler, 1997).

In addition to above importance, wetlands can be thought as "biological supermarkets" (Ji, 2008). They provide great volumes of food that attract many animal species. These animals use

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wetlands for part of or all of their life-cycle. Dead plant leaves and stems break down in the water to form small particles of organic material called "detritus" (Silk & Ciruna, 2004). This enriched material feeds many small aquatic insects, shellfish and small fish that are food for larger predatory fish, reptiles, amphibians, birds and mammals. Hence, importance and usefulness of wetlands are immeasurable; it indicates a huge worth in terms of social, economic and ecological aspects.

On this usefulness and worth of wetlands, the valuation of these ecosystem services makes sense as well as a justification to public sector officials to make decisions about wetland conservation. So far, many studies have focused on valuation of wetland ecosystem services in the World and in Sri Lanka.

Some researchers have carried out a meta-analysis to value wetlands (Brouwer et al., 1999; Stanley, 2001; Woodward & Wui, 2001) which uses a series of empirical studies to estimate the values and co-efficient of variables of ecosystem services. The results of these studies have confirmed that the coefficient on water quality improvement has a high value. The other valuation technique is benefit transfer which has adopted the same studies for a different country case for valuation of benefits for different population living around the resources.

As a result of developments in non-market valuation techniques, many studies have applied the technique to estimate the non-market values of wetlands. Wattage and Mardle (2005) examined the stakeholder preferences either to conserve or develop wetlands and estimate total economic value. The results showed that the stakeholders who are dependent on wetlands for their livelihoods preferred conservation to development. Furthermore, Wattage and Mardle (2008) have estimated WTP for protecting Muthurajawela wetlands in Sri Lanka, which is Sri Lankan Rupee (LKR) 287 (US$ 2) per month for only two years.

Krupnick (1993) discusses the situations where a benefits transfer may be appropriate and points out that the valuation of health impacts may be more amenable to benefits transfer than the valuation of other impacts, such as changes in recreation values. Furthermore, the sum total of these additional benefits may actually exceed the estimated returns to floodplain agriculture, fishing and fuel-wood. Evidence presented by Hollis et al. (1993) shows that a reduction in flood plain inundation leads to a lower rate of groundwater recharge. This study conducted in the Hadejia-Nguru wetlands in Nigeria.

Cummings and Harrison (1995) pointed out that the non-use values of wetlands are unrelated to any direct, indirect or future use; rather reflect the economic value that can be attached to the mere existence of a wetland. These components of the total economic value of wetlands often do not accrue to the owner of the wetland, and as a result, important wetland values are often overlooked in decision-making on wetland conversion. As it mentions, some goods and services derived from wetlands can be traded directly in well-functioning markets and therefore have readily observable values.

Contingent Valuation Method (CVM) is a typical name as preference valuation method (Gelo & Koch, 2015), which investigate and inquire Willingness to Pay (WTP) of the participant on loss of the quality of environment and resource under condition of the hypothetical marketplace. CVM create the WTP of inquirers to estimate the economic value of environmental quality losses. In general, this method does not need to establish explicit linkages between non-market commodity and the market price, but simply create a hypothetical market environment and get the value of the respondents of public goods (Tao et al., 2012). This technique is presently extensively used in the research of environmental valuation such as wetland. Among the literature, Tobit Model, Binary Logistic Model, Multivariate Logistic Model, and Log-lin Models are applied for the analysis of the influencing factors of the WTP. In line with the literature, due to the limitation of dichotomous dependent variable Tobit Model is widely used to estimate the WTP of any conservation (Xu, 2012).

Materials and Method

Study Area

Kalu Oya and Mudun Ela Basins are located within Gampaha District of Western Province of Sri Lanka. The Kalu Oya Basin is a relatively small catchment located between the Ja Ela Basin to the North and Kelani River Basin to the South, extending up to approximately 66.8 km² (Fig. 1). The stream originates in the north-eastern part of the basin about 15 km away from the sea.

Figure 1 Kalu Oya and Mudun Ela Basins (Source: SLLRDC, 2018)

The wetlands of the Kalu Oya and Mudun Ela Basins are highly diverse, ranging from man-made canals and tanks to complex mosaics of natural marshes and wetlands modified for direct human uses such as paddy lands. These provide a wide array of ecosystem services to the residents in the area. Among these, the most important and tangible service is the retention of floods.

Method

Based on number of beneficiaries from each of the wetlands, households were allocated for data collection. Primary data was collected using the stratified sampling method. Respondents were randomly selected for data collection through face-to-face interview in 200 households (10 households from each village). As the sample location, Mudun-Ela and Kalu-Oya watersheds in Western Province of Sri Lanka were selected. The present study analysed the results of pilot survey and finally developed questionnaire for final data collection. Data were collected from households living in varying distances to these wetlands, which is indeed an optimal sample to run econometric models. While the variable of interest, the willingness to pay is a continuous variable, many households did not choose to pay to protect the wetlands. Thus, estimation with Ordinary Least Squire (OLS) could be biased unless this structure of the data was accounted for. The present research employed a number of standard environmental valuation techniques to estimate each component of the total economic value. These valuation techniques included asking open ended questions for Contingent Valuation employing payment cards and WTP.

The WTP responses treated in a parametric model, where the WTP value chosen by each household was estimated as a function of the respondents' socio-economic characteristics. A generalized Tobit Model was employed via maximum likelihood procedures. This model is sometimes also referred to as an Interval Regression Model as the WTP response is interpreted in the model not as an exact statement of the willingness to pay, rather as an indication that the WTP lies somewhere between the chosen value and the next larger value above it on the payment card. The parametric regression results of the generalized Tobit Model are presented in the results section.

In the household questionnaire, the price range used in the payment card based on the responses to the pilot study which utilized the open-ended elicitation format. This minimizes potential bias accruing from the bid amounts used on the payment card.

Following Hynes and Hanley (2008) and Xu (2012), the WTP responses to the CVM question treated in a parametric model, where the WTP value chosen by each respondent was specified as: $WTP_i = \mu_i + \varepsilon_i$ where μ_i is the deterministic component and ε is the error term. It is assumed that $\varepsilon \sim N(0, \sigma^2 I)$. The chosen Generalized Tobit Interval Model employs a log-likelihood function adjusted to make provision for point, left-censored, right-censored (top WTP category with only a lower bound) and interval data. For individuals $i \in C$, we observe WTP_i, i.e. point data and for respondents $i \in L$, WTP_i are left censored. Individuals $i \in R$ are right censored; we know only that the unobserved WTP_i is greater than or equal to WTP_{Ri}. Finally, respondents $i \in I$ are intervals; we know only that the unobserved WTP_i is in the interval $[WTP_{1i}, WTP_{2i}]$. The log likelihood is given by:

$$\ln L = -\frac{1}{2}\sum_{i \in C} w_j \left\{ \left(\frac{WTP_i - x\beta}{\sigma} \right) + \text{Log} 2\pi\sigma^2 \right\}$$

$$+ \sum_{i \in L} w_i \text{Log}\, \Phi \left\{ \left(\frac{WTP_{Li} - x\beta}{\sigma} \right) \right\} + \sum_{i \in R} w_i \text{Log} \left\{ 1 - \Phi \left(\frac{WTP_{Ri} - x\beta}{\sigma} \right) \right\}$$

$$+ \sum_{i \in I} w_j \text{Log} \left\{ \Phi \left(\frac{WTP_{2i} - x\beta}{\sigma} \right) - \Phi \left(\frac{WTP_{1i} - x\beta}{\sigma} \right) \right.$$

Where,

Φ is the standard cumulative normal and w_i is the weight of the i^{th} individual. The above Tobit Model was used to identify the factors associated with respondents' responses for the WTP elicitation question. All computations were made by using STATA-12 software.

Results and Discussion

The present study has revealed that people have no timber values from this wetland. Only three families harvest some timber valued at average LKR 15000 annually (99 US$). In the same way, only seven families responded that they take firewood from the neighbouring wetlands. Only three families use water for washing because these wetlands are polluted and contaminated. But, if it is cleaned more families would be benefited. Same is valid for bathing. Therefore, only two families mentioned that they use these wetlands for bathing. It is not possible at all to drink this water, but two families responded that they use it for drinking. They have dug wells adjacent to the wetlands by that it is possible to use this water for drinking.

However, many people use wetland water for agriculture and watering plants in home gardens. Thirty-five families, out of sampled families, said they use this water for agriculture. No one uses wetlands for swimming simply because water is contaminated. They also don't use these wetlands for recreational boating as well. In dry season, people use wetland for sports. Fifteen families or their children use the wetland for sports in the dry season. In addition, 10 families are using these wetland areas in dry seasonfor walking.

This study has estimated the probability of willingness to pay to protect the wetlands using the Tobit Model. The study has taken into account just willingness to pay at least some money. In our empirical specification, the decision on which variables to include is ultimately based on exploratory analysis. Based on past

studies, possible explanatory variables expected to have an effect on willingness to pay to protect the wetlands in context of Sri Lanka include socio- demographic and socio-economic variables (Table 1).

The summary statistics for all independent variables expected to have some effects on willingness to pay to protect the wetlands in context of Sri Lanka (Table 2). It shows that 38% of the households are willing to pay at least some amount of money (Table 2). This indicates over one quarter of the sample would like to pay some money to protect the wetlands in the country. Looking at the socio-demographic characteristics of the households in Sri Lanka, on average, 18% of the respondents represented age between 18 and 35 years, whereas 42% represented age over 35 years. An analysis of the level of education shows that 75% of the household respondents were between Ordinary Level (O/L) and Advanced Level (A/L) and over three percent have completed their postgraduate level. There are more female adult dominant (54%) households in the sample compared to male adult dominant (46%) households. Dis-aggregation of the level of income shows that 43% of the households reported as their income is between LKR 20,000 (US$ 132) and LKR 40,000 (US$ 264) and approximately 40% of the households reported as less than LKR 40,000 (US$ 264) and over LKR 20,000 (US$ 132). Furthermore, 7% of the households reported as over LKR. 80,000 (US$ 528) income earn households.

Looking at the Sinhala and Christian variables of the sample, on average over 90% reported as Sinhala and approximately 35% were reported as Christian. In general, the average response to the family members (children) who use this wetland for bird watching and studying plants and animal is neutral, whereas most of the respondents strongly agreed that wetland is cooling environment in dry season. However, the majority of the respondents strongly responded that this wetland is using not only for the agriculture purposes.

In the Tobit Model, dependent variable was continuous variable. Almost all the variable coefficients have the correct expected signs. The goodness-of-fit of the models was evaluated using an overall goodness-of-fit statistics and the model with the highest goodness-of-fit value was selected for the analysis. The estimation results are presented in Table 3.

Taking the willingness to pay, at least some amount of money as the dependent variable, the results show some of the independent socio-economic variables are significant at 5% confident level. We considered the respondents represent the opinions, attitudes and values of entire household as a unit.

Table 1 Description of variables, their names and units used in models

Variable	Units
Whether willing to pay or not (dependent variable)	Yes 1, No 0
Age	
Age1N	Years 18-35
Age2N	Years 35-55
Age3N	>Year 55
Education	
Edu1N	Grade O/L
Edu2N	G.C.E(O/L)-A/L
Edu3N	Degree-postgraduate
Gender	Male 1, female 0
Household income	
Income1N	Rs.10000-20000
Income2N	Rs.20000-40000
Income3N	Rs.40000-80000
Income4N	>Rs.80000/=
Income4N	> Rs.80000
Ethnicity	Sinhala = 1, Otherwise = 0
Religion	Buddhist = 1, Christian = 0
Whether family uses wetland for education and research purposes	Likert-scale (1-5)
Whether they use water of wetland for agriculture	Yes=1, No=0
Income they get from paddy farming	Rs.

Table 2 Summary Statistics of the variables

Variabl	Analytical sample (N=200)[a]	
	Means if numerical (%)	Std. deviation
Willingness to pay[b]	38.50	
Age		
18-35[b]	18.50	
35-55[b]	42.50	
Education		
O/L –A/L[b]	75.00	
Degree-Postgraduate[b]	3.50	
Gender	46.00	
Household income		
Rs.20000/=-Rs.40000/=[b]	43.50	
Rs.40000/=-Rs.80,000/=[b]	40.00	
>Rs.80000/=[b]	7.50	
Sinhala[b]	94.50	
Religion (Christian)[b]	35.50	
Whether family uses wetland for education and research purposes	3.37	0.4797
Whether this wetland cooling the environment in dry seasons	4.57	1.5577
Whether the respondent uses water from wetland for agriculture	0.19	0.8769

Notes: [a] based on all households that reported every explanatory variable.
[b] Binary variable.

Only the older people would like to pay more significantly which has been showing only in the Tobit Model analysis to protect wetlands. As shown on Table 3, the effects of some of the independent variables were insignificant and most of them were expected. Since the sample selection model was not appropriate, and most of respondents indicated zero payment which causes a sensor problem, the Tobit Model gave better estimate for this study. The education level of respondents is significant in both models. Those who have received education G.C.E Ordinary Level or Advanced Level would like to pay for protecting wetlands compared to those who have education below G.C.E (Ordinary Level). As expected, the respondents with Bachelor Degree and Post-graduate qualification, are willing to pay even more significantly than G.C.E (Ordinary Level) and G.C.E (Advanced Level) level respondents. All else been equal, residents with having the Post--graduate level education showed on average WTP 14% higher than the O/L and A/L educated group. This means educated people is understanding the importance of wetland in every means. The results of both models show that female would like to pay more for protecting wetlands compared to males. Surprisingly, the income of the households does not show any significant relation with willingness to pay (WTP) for conservation. The high-income level (More than LKR 80,000 or US$ 528) is significant only in Tobit Model. However, these results are reliable to certain level as the high income could afford the high willingness to pay. Regarding the ethnicity, it does not show any significant relation with the willingness to pay in both models. Sinhala nationals would like to pay higher than other nationalities. Considering the impact of religion on the willingness to pay, Buddhist people would like to pay more, though not significant.

One of the very significant variables is using the wetland by any family member or members for any research and educational purposes. They would like to pay more at 1% level of significance. Thus, families who have used wetland for education and research purposes showed 7% higher WTP than others. This tells us a big story. We learned from residents of these areas during the initial stages of the study; the school children are given assignments by teachers to study some aspects of wetlands. It could be some observations of birds, insects, other animals or plants. Therefore, it is reasonable to recommend that this variable could be used in promoting protection of wetlands.

The respondents strictly believe that wetlands cool the environment in dry season again which could be used in promotion programs. The households who use water from wetlands for agriculture would not like to pay for protection of wetlands significantly. They might be thinking water as a public good and therefore the government should protect it for people.

Table 3 Tobit model estimation results

Variable	Tobit Model		
	Estimate	Marginal effect (in %)	Robust SE
Constant	-1762.22***		0.10
Age			
Age1NAge 18-35	98.66	0.06	0.07
Age 35-55	204.12	0.11	0.08
Education			
O/L –A/L	257.22	0.14	0.17
Degree-Postgraduate	662.75*	0.14	0.07
Gender	-146.85	-0.08	0.10
Household income			
Rs.20000/=-Rs.40000/=	-84.09	-0.05	0.10
Rs.40000/=-Rs.80,000/=	146.64	-0.05	0.20
>Rs.80000/=	447.83	0.26	0.12
Ethnicity Sinhala	300.69	0.15	0.07
Religion Christian	-39.62	-0.02	0.02
Whether family uses wetland for education and research purposes	122.10***	0.07	0.05
Whether this wetland cooling the environment in dry seasons	127.69	0.07	0.10
Whether the respondent uses water from wetland for agriculture	-295.15*	-0.07	0.00
Pseudo R^2		0.0278	
Log likelihood		-571.26	
Number of observations		200	

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