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WILLINGNESS TO PAY FOR WETLAND CONSERVATION IN SRI LANKA: A CONTINGENT VALUATION STUDY

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Abstract

A range of products are derived from wetlands and their freshwater habitats. Yet, wetland-ecosystems are often neglected or undervalued. The social and economic benefits of wetlands are numerous. Anthropogenic development activities, especially, unplanned urbanization, put wetlands at risk. Wetlands around the globe are reclaimed, modified, and overexploited for development purposes. Increase in population and high levels of resource consumption lead to land conversion. Upstream developments alter the quality and flow of water that feeds wetlands. Decision makers often have poor understanding of the environmental, cultural and economic value of wetlands as these are often perceived as having little or no value compared to uses yielding more visible and immediate economic benefits. In these circumstances, understanding the significance of wetlands in terms of their economic values is crucial in conserving and protecting such habitats. In addition, benefits of wetlands need to be reaped appositely.

The objective of this study is to estimate the Willingness to Pay (WTP) for conservation of Mudun Ela and Kalu Oya watersheds, located in the Western Province Sri Lanka using the Contingent Valuation Method (CVM). Respondents were randomly selected for data collection through face-to-face interviews. For estimating the entrance fee to use for conservation was derived using the Tobit model. The marginal effects on probabilities in the Tobit model suggest that householders of postgraduate degree holders, who use wetland for education, research and agricultural purposes play a significant role in residents' WTP for the protection of these wetlands. Therefore, householders with higher levels of education showed a positive effect on WTP to protect wetlands in Sri Lanka. On the other hand, households which use wetland for agricultural purposes showed negative effects on the WTP on practices of wetland protection.

Key Words: Wetlands, Economic Valuation, Contingent Valuation Method, Tobit Model, Willingness to Pay.

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1. Introduction

Wetlands play a number of important functions and are considered as the kidney of the earth. Functionalities include storage of rainwater, particularly during heavy monsoon seasons; act as flood retention areas, source of food in the form of freshwater fish and other aquatic vegetation, provider of opportunities for recreation, fuel wood and function as cattle grazing sites. Furthermore, wetlands recharge groundwater, maintain good water quality in rivers, reduce impacts from storm damage and flooding, carbon sequestration, controlling pests, stabilizing climatic conditions and most importantly support biodiversity.

An immense variety of species of microbes, plants, insects, amphibians, reptiles, birds, fish and mammals make up a wetland ecosystem. **Compared to rainforests and coral reefs wetlands are considered as one of the most productive ecosystems in the world.** Climate, landscape, geology and the movement and abundance of water support in determining the fauna and flora that inhabit each wetland. The complex, dynamic relationships among the organisms inhabiting the wetland environment are called food webs (Kwak and Zedler, 1997).

Wetlands provide greater volumes of food that attract many animal species and these animals utilize wetlands for part of or all of their lifecycle. Wetlands can be considered as "biological supermarkets" (Ji, 2008). Dead plant leaves and stems break down in the water to form small particles of organic material called "detritus" (Silk and 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. The importance and usefulness of wetlands are immeasurable--it has immense worth which encompasses direct and indirect social, economic and ecological benefits.

2. Problem and Objectives

Irrespective of the numerous socio-cultural, economic and cultural benefits generated by Wetlands for the well-being of the people these ecosystems are reclaimed, modified, and overexploited for development purposes. The increase in population and high levels of resource consumption lead to conversion of land in and around wetland for other purposes. Continuous upstream developments alter the quality and flow of water that feeds wetlands. Decision makers often have poor understanding of the environmental, cultural and economic value of wetlands as these are often perceived as having little or no value compared with uses that yield more visible and immediate economic benefits. In these circumstances, understanding the significance of wetlands in terms of value of these economic systems is crucial in conserving and protecting such habitats. In

addition, benefits of wetlands need to be reaped appositely. The objective of this study is to estimate the value generated by these ecosystems by undertaking a Willingness to Pay (WTP) study.

3. Literature Review

The valuation of ecosystem services is vital as it provides an assessment of the large number of public goods as well as private goods that it provides. Many studies thus far conducted have concentrated on valuation of wetland ecosystem services in the World and in Sri Lanka.

Researches carried out by Brouwer *et al.* (1999), Stanley (2001), and Woodward and Wui (2001) focus on a meta-analysis to value wetlands using a series of empirical studies to estimate the values and co-efficient values of variables of ecosystem services. The empirical results of these studies confirmed that the coefficient on water quality improvement has a high value. Similarly, benefit transfer valuation technique has been adopted for valuation of benefits for different populations living around wetlands from diverse countries.

The development in non-market valuation techniques have led to many studies to estimate the non-market values of wetland services. Studies conducted by Wattage and Mardle (2005) examined the stakeholder preferences either to conserve or develop the wetlands by estimating the corresponding total economic value (TEV). The results of these studies showed that stakeholders who were dependent on wetlands for their livelihoods preferred conservation to development. In another study by Wattage and Mardle (2008), the WTP for protecting *Muthurajawela* wetlands in Sri Lanka was estimated as Rs.287 per month.

Krupnick (1993) concludes 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 in a study where he discusses about a benefit transfer being more appropriate. Similarly, a case study of nitrogen abatement using wetlands (Gren, 1995) adopts this approach, making use of estimates of the value individuals place on reduced nitrate concentrations in drinking water, which is independent of how the nitrate is removed. In the case of recreation such as the use value of an important wetland, there is greater difficulty in using benefit transfer, since values tend to be highly reliant on the site and sample population's characteristics. Moreover, studies may also differ in focus, as in analyzing changes in quantity as opposed to quality, problems with the use of benefits transfer transpire where visual attributes are at stake.

Evidence presented by Hollis *et al.* (1993) shows that a reduction in flood plain inundation leads to a lower rate of groundwater recharge. Since 1983, when

the extent of flooding dropped appreciably, groundwater recharge fell by an estimated aggregate amount of 5000 $10^9 m^3$. However, the sum total of these additional benefits may actually exceed the estimated returns to flood plain agriculture, fishing and fuelwood. Although the most important environmental function of the Hadejia-Nguru wetlands in Nigeria is its role in recharging the groundwater aquifer of the Chad Formation, continual loss of groundwater storage and recharge have a significant impact on the numerous small villages throughout the region that depend on well water from the aquifer for domestic use and agricultural activities. Therefore, valuation of these impacts is challenging but can be accomplished through direct or indirect measures of villagers' WTP for water.

Wetlands provide ecological processes that enable the extraction of goods and services in the form of natural resources such as water, fish and other edible animals, wood, and energy. These provide the natural surroundings for recreational activities (Brouwer *et al.*, 1999; Woodward and Wui, 2001). Moreover, the range of services provided by wetlands is partly related to direct geophysical processes, such as the provision of flood and storm buffering capacity and sediment retention, and even extends to wider climatologic, biological, and socio-cultural functions, including impacts on local and global climate change and stabilization, preservation of biodiversity, and the provision of natural environmental amenities.

According to Cummings and Harrison (1995), the non-use values of wetlands reflect the economic value that can be attached to the mere existence of a wetland and are unrelated to any direct, indirect or future use. These components of the TEV 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 mentioned, some goods and services derived from wetlands can be traded directly in well-functioning markets and therefore have readily observable values. However, due to market failures resulting from undefined property rights or the (quasi) public good characteristics of some wetland functions, many valuable wetland services may not be traded directly or even indirectly through markets. Wetland functions that may not even be indirectly traded through markets include bequest and existence values. In cases where the values of important wetland functions are not observable in well-functioning markets, a number of non-market valuation methods can be applied to estimate economic values. A diverse range of valuation methods have been applied to value wetland functions, including the contingent valuation method (CVM), hedonic pricing, travel cost method, production function approach, net factor income approach, total revenue estimation, opportunity cost, and replacement cost. The applicability of each of these methods is largely dependent

upon the wetland function being valued and the type of value associated with it (Freeman, 1993).

Gelo and Koch (2015) state that CVM is a typical name as preference valuation method that investigate and inquire WTP of the participant on loss of the quality of environment and resource under the condition of a 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 were applied for the analysis of influencing factors of the WTP. Owing to the limitations of dichotomous dependent variable, tobit model is widely used to estimate the WTP for any conservation (Xu, 2012).

4. Data and Methodology

The majority of the beneficiaries of the wetlands are households, thus households were selected for the survey. Primary data was collected through the stratified sampling method and the respondents were randomly selected for data collection through face-to-face interview in 200 households. Mudun Ela and Kalu Oya watersheds in the Western Province in Sri Lanka were selected as the sample location. Study analyzed the results of the pilot survey and a questionnaire for final data collection was developed. Data collection was effected from households living in varying distances to these wetlands, which was indeed an optimal sample to run econometric models. While the variable of interest to the WTP is a continuous, many households did not choose to pay to protect the wetlands. Therefore, estimation with OLS could be biased unless the structure of the data was accounted for. The research utilized a number of standard environmental valuation techniques to estimate each component of the TEV which included asking open ended questions, CVM employing payment cards and WTP.

Parametric model was employed in analysing the WTP responses, where the WTP value chosen by each householder was estimated as a function of the respondents' socio-economic characteristics. A generalized Tobit model was used via maximum likelihood procedures. This model is also sometimes referred to as an Interval Regression Model as the WTP response is interpreted in the model not as an exact statement of WTP but 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 results section presents the parametric regression results of the generalized Tobit model.

The price ranges used in the payment card in the household questionnaire was based on the responses to the pilot study which utilized the open-ended elicitation format. Any potential bias accruing from the bid amounts used on the payment card was minimized through this process.

As per Hynes and Hanley (2009) 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:

$$\ln L = -\frac{1}{2}\sum_{i\in C} w_i \left\{ \left(\frac{WTP_i - x\beta}{\sigma} \right) + \log 2\pi\sigma^2 \right\} + \sum_{i\in L} w_i \log \Phi \left\{ \left(\frac{WTP_{Li} - x\beta}{\sigma} \right) \right\}$$

$$+ \sum_{i\in R} w_i \log \left\{ 1 - \Phi \left(\frac{WTP_{Ri} - x\beta}{\sigma} \right) \right\} + \sum_{i\in I} w_i \log \left\{ \Phi \left(\frac{WTP_{2i} - x\beta}{\sigma} \right) - \Phi \left(\frac{WTP_{1i} - x\beta}{\sigma} \right) \right.$$

where Φ is the standard cumulative normal and w_i is the weight of the *i*th individual. The factors associated with respondents' responses for the WTP elicitation question was identified through the above Tobit model and STATA 12 software was used in all computations.

5. Results and Discussion

It was found that a timber value was not placed on the wetland by a majority of the inhabitants, where three (3) families harvested some timber, which valued on average Rs.15,000/= annually. Likewise only seven (7) families said that they collect firewood from the neighboring wetlands. Due to pollution and contamination many families did not use water that was available, only three (3)

families utilized water for washing, nonetheless, if the water is cleaned more families would be benefited and the same is valid for bathing--only two (2) families mentioned that they use the water available in the wetlands for bathing. It is evident that the water is not suitable for drinking purposes, however, two (2) families use the water for drinking. Having dug wells adjacent to the wetland is also an option for drinking water. Nevertheless, majority of the respondents, i.e. thirty five (35) families out of the sample said they use wetland water for agricultural purposes, including home gardens. It is important to highlight the uses of the water is limited because of contamination and none are use wetlands for swimming simply because of soiled water. Households also do not use these wetlands for other recreational activities such as boating, however, during dry seasons wetlands are used for sports, while ten (10) families utilize wetlands for walking.

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.

Given the nature of the study, Tobit model is the most appropriate model to be used to estimate the probability of WTP to protect the wetlands. Accordingly, the study takes into account both WTP some amount and secondly the exact amount they are willing to pay. The decision on which variable/s to include was ultimately based on exploratory analysis. Empirical studies underline socio-demographic, socio-economic variables as possible explanatory variables expected to have an effect on WTP to protect the wetlands in the context of Sri Lanka, see Table 1 above.

All independent variables which are expected to have some effect on WTP to protect the wetlands in the context of Sri Lanka is depicted in Table 2.

Table 2: Summary Statistics of the variables

Variable	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 wetlands 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.

As given in Table 2, 38 per cent of the households are willing to pay at least some amount of money indicating that 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 per cent of the respondents represented age between 18 to 35 years where as 42 per cent represented from over 35 years. An analysis of the level of education shows that 75 per cent of the respondents of the households were between O/L and A/L and over 3 per cent completed their postgraduate level education. There are more females (54 per cent) in the sample compared to males (46 per cent). Disaggregation of the level of income shows that 43 per cent of the households reported between Rs. 20,000 and Rs.40,000 and approximately 40 per cent of the households reported less than Rs. 40,000 and over Rs 20,000 as their monthly family income, while 7 per cent reported over Rs. 80,000 as their income.

Looking at the ethnic and religious balance, on average over 90 per cent reported as Sinhala and approximately 35 per cent reported as Christian. In general, the family members, particularly children, use the wetlands for bird watching, and studying plants and animals , whereas most of the respondents strongly agreed that wetlands give a cooling effect during the harsh dry seasons. Majority of the respondents strongly believed that these wetlands are not only to be used for agricultural purposes.

The dependent variables in the Tobit model were continuous variable. Almost all the variable coefficients have the correct expected signs. The goodness-of-fit of the models is evaluated using an overall goodness-of-fit statistic and the model with the highest goodness-of-fit value was selected for the analysis.

5.1 Estimation Results

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 shows some of the independent socio-economic variables are significant at 5% level. In the analysis, a single respondent's opinions, attitudes and values were considered that of a respective household. It was evident that the older persons are willing to pay significant amounts to protect and conserve the wetlands. As given in Table 3, the effects of some of the independent variables were insignificant and this was expected. Most of respondent indicated zero payment which caused a censor problem, however, the Tobit model gave better estimate for this study rectifying the issues arisen due to non-representative sampling.

The education level of respondents is significant in both the models. Those who have received education up to G.C.E Ordinary Level (O/L) or Advanced Level (A/L) are willing to pay for protecting wetlands compared with those who received an education below the G.C.E O/L. As expected, the respondents with

bachelor's degrees and postgraduate qualifications, are willing to pay even more than G.C.E O/L and A/L qualified respondents, whilst all the others were equal. Residents with postgraduate degrees on average has a 14 per cent higher WTP than the O/L and A/L educated group. It clearly implies that educated persons have a clear understanding the importance and significance of wetlands.

Table 3: Tobit model estimation results

Variable	Tobit Model		
	Estimate	Marginal effect (in percentage)	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 wetlands 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	

Note: *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

The results of both models show that females would like to pay more for protecting wetlands compared to their male counterparts. Surprisingly, the income of the households does not show any significance in WTP for conservation. The high income level, i.e. greater than Rs. 80,000, is significant only in Tobit model. However, these results are reliable to a certain level as the higher the income higher the affordability to pay a higher amount for protection and conservation of wetlands. Regarding the ethnicity, it does not show any significance in WTP in both models. People of Sinhala ethnic group are willing to pay higher than other ethnic groups. Considering the impact of religion on WTP, it was evident that Buddhist people are willing to pay more but it is not significant.

One of the most significant variables is family member(s) utilizing the wetland for any research and educational purposes. These households are willing to pay more at 1 per cent level of significance and these families are willing to pay 7 per cent higher than the other. During the initial stages of the survey, it was found that school going children are given assignments which requires studying about the wetlands, which includes, observing both fauna and flora of the wetlands. Therefore, this aspect could be underlined in promoting programs in protecting and conserving wetlands.

As mentioned elsewhere, the respondents strongly believe that wetlands cool the environment during the dry seasons and this could be used in promoting wetland protection and conservation programs. Households that use water from wetlands for agriculture are willing to pay for protection of wetlands is not as significant as the former, probably because they consider water as a public good and consider the protection of waters and any cost involved to do so, as a role of the Government and not the people.

6. Conclusion

Identifying the level of association between Willingness to Pay to protect the wetlands and other socio-demographic, socio-economic variables was the main objective of the study. It was apparent that only a limited number of attempts have been made to study the Willingness to Pay to protect the wetlands in Sri Lanka econometrically Although econometric models have been used to study many aspects to protect the wetlands, this study offers a socio-economic benchmark to enhance the examination of the Willingness to Pay to conserve and protect the wetlands in Sri Lanka.

The marginal effects on probabilities in the Tobit model suggest that postgraduate degree holders, who are using wetlands for education, research and agricultural purposes play a significant role in residents' WTP to protect the

wetlands. Residents with postgraduate degrees on average are willing to pay 14 per cent higher than the O/L and A/L educated persons. In addition, families who use wetlands for education and research purposes are willing to pay 7 per cent higher than the others. Therefore, households with persons having obtained higher education qualifications, or persons pursuing higher education programmes, were found to have a positive effect on the WTP for conservation and protection of wetlands. This might be due to the fact that educated persons perceive wetlands as an asset and are willing to pay more than those less educated households. Moreover, households who use wetlands for agricultural purposes have positive effects on the WTP for protection of wetlands. This clearly highlights the importance of development of human capital for implementation of wetland protection practices.

In conclusion, the findings of this study have demonstrated that highly educated persons and high income earners, are willing to pay more to protect and conserve wetlands. The study has also demonstrated that families or member(s) of families who use wetlands for any educational or research purpose value them more, and are keener to conserve wetlands.

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