Non-user Benefits Emanating from Enhanced Water Flow to the Yala Protected Area Complex

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Abstract

Water is a multiple use resource. Increasing scarcity and competition from various sectors is an important dimension to be considered in its management. Understanding the value of water to different water uses is, therefore, necessary to assist decision-making in water allocation among sectors. Although water used in agriculture can be valued using production function approaches, such direct valuation methods are not available for the environmental uses of water. This paper uses non-market valuation methods to estimate the economic value of a committed flow through a unique ecosystem, the Yala Protected Area Complex (YPC).

The Yala Protected Area Complex is an important wildlife refuge situated in south-eastern Sri Lanka. Its large land extent, undisturbed nature, and abundance and diversity of fauna contribute to its uniqueness. The fact that the YPC is also the most visited national park in Sri Lanka is partially a result of this uniqueness. However, maintenance of the park's ecosystem depends on the flow of the Menik Ganga. This flow is regulated by the Veheragala Reservoir Project, and there is now discussion of reducing flow into the park by about half of the current level. The proposed plan ensures dry season flow into the YPC and, therefore, has been deemed acceptable. However, there is a possibility that farmers will demand further water releases during the dry season which could in turn endanger the planned downstream water releases. So there is a potential trade-off between environmental and irrigation uses of water.

A willingness to pay (WTP) survey was conducted in ten districts in Sri Lanka during the fourth quarter of 2008 to estimate the WTP of the general population of the country towards maintaining this important environmental resource. In the hypothetical market presented, participants were told of the need for financial contributions from the general public to ensure the release of a minimum downstream flow commitment of 50 MCM. Participants were also informed of how this flow would enhance the ecosystem of the YPC. A single bound dichotomous choice contingent valuation approach was used as the elicitation format. Non-obligatory voluntary contributions were solicited towards a trust fund that could be used to ensure release of the required quantity of water downstream during dry months.

According to the results of a binary logistic regression, income, age, and religious attachments are important factors affecting the decision to contribute to environmental flow maintenance to the YPC. Sixty-five percent of respondents were willing to pay something to ensure the maintenance of an adequate environmental flow in the YPC. The estimated mean WTP for water releases to enhance the YPC is Sri Lankan Rupees (SLR) 435 per year. Over the requested payment horizon of 10 years, the present value of aggregate WTP from the Sri Lankan population to enhance the ecosystem of the YPC is SLR 12 billion. This quantity greatly surpasses the present value of net benefits from rice farming estimated at SLR 0.64 billion, which would be generated if the same quantity of water was used for irrigation for 10 years (assuming current prices and input intensities). Thus, there is a clear opportunity for national welfare gain by ensuring adequate flow in YPC.

Introduction

Water is a multi-purpose natural resource and is the foundation of life and civilizations. The natural availability of water in an area is governed by hydrological factors. Throughout history, humans have altered the natural patterns of spatial and temporal availability of water for their benefit. The idea of treating water as an economic good and subsequently using the concept of marginal value in water allocation decisions is on the frontline of developmental thinking today. Optimum inter-sector water allocation requires knowledge of the marginal values of water by different sectors and uses.

Valuation of water is a complex task. Different sectors require different valuation approaches and these measures should be aggregated at the end. Water valuation falls within the broader area of environmental valuation, which is built on the notion that markets do not exist for some goods and services. Although development agencies emphasize water as an economic good, (World Commission on Water for the Twenty-first Century, 2000; ICWE 1992), the applicability of this concept, especially in developing countries, has been questioned (Davis 2005; Theesfeld 2004). Furthermore, incorporating environmental values in water allocation decisions is now being emphasized by recognizing that substantial stream-flows are necessary for maintaining eco-systems (Whiting 2002).

As water allocation rules are increasingly using economic values as an allocation criterion, it is important to incorporate the values generated by all potential water uses within a total economic value framework. Non-inclusion of some potential values would lead to undervaluation of water with the potential danger of depriving some users through under allocations and irreversible policy decisions.

Wildlife and park reserves are an important component of land use in many countries. Although the general public has limited use of these reserves, the greater need for the establishment of these reserves is for habitat conservation and biodiversity. This research uses non-market valuation methods to estimate the value of water flow in a forest ecosystem in southeastern Sri Lanka, namely the Yala Protected Area Complex (YPC). Valuation of the resource was conducted through a willingness to pay (WTP) survey using a nationwide sample. This paper first describes the YPC and the proposed water allocation followed by a discussion of the theoretical basis of non-market valuation. This is followed by a description of the research procedures, the results, and a discussion of the results.

The Yala Protected Area Complex

The Yala Protected Area Complex (YPC) is an aggregation of protected areas extending northeast from the southeastern shoreline of Sri Lanka. It is located 280 km from Colombo (the capital) and lies in the Hambantota, Monaragala and Ampara administrative districts. The YPC is administered by the Department of Wildlife Conservation and has a total area of 144,934 ha. The complex and adjoining protected areas form the largest contiguous protected area in the country covering 171,000 ha. The YPC is rich in wildlife, including Asian elephants, leopards, sloth bears (the only bear species found in Sri Lanka), and the endangered marsh and estuarine crocodiles. Two-hundred and eighty species of plants are found in the area. The area is home to over 280 bird species and was once a popular birding area. The YPC provides large, contiguous areas of undisturbed habitat needed by large animals, such as the elephants and crocodiles found there. This makes the YPC an important undisturbed eco-system of national and global interest.

The YPC has been the most visited national park in Sri Lanka in recent years. Most visitors are domestic tourists whose primary destination is the nearby Kataragama Sacred City. Although Yala is heavily visited, it remains an important wildlife refuge because only 10 % of the total area is open to the public. This and limited access portals, in general, underlie the area's conservation value.

Twelve rivers with a cumulative watershed area of 3,087 km^2 flow through or border the YPC. However, about 80 % of the total water discharge is contributed by the Menik Ganga and Kumbukkan Oya rivers. The project of interest in this analysis is the Veheragala Diversion Project, implemented by the Sri Lanka Department of Irrigation. The project was designed to change the current flow regime of the Menik River through the construction of a 75 MCM (million cubic meters) storage reservoir. The total expected annual diversion to the Kirindi Oya basin is 75 MCM. The structure of the current flow of the Menik River is highly seasonal. The estimated water yield from the watershed above the dam site is 153 MCM, about 44 % of the river's annual runoff. Implementation of the project will result in a 50 % reduction of the downstream flow from the dam site.

According to the proposed water allocation plan of the Veheragala Project (Table 1) the seasonal nature of the flow will be altered. The committed downstream flow rate of 1.5 m^3s^{-1} is greater than the average flow rate during the dry season. About 47 % of the current water volume is available for use within the basin. Two major tributaries of the Menik Ganga, the Hangune Ara and the Darage Ara, join the river downstream of the reservoir site. These and other small tributaries collectively contribute to a total of 193 MCM of discharge downstream of the proposed dam site and are not affected by the project. Therefore, the resultant flow changes can be considered as beneficial to the YPC ecosystem because the regulated release of downstream water will ensure continued water flow in the river, thus eliminating the current dry periods. Large-scale water releases to flood wetlands near the estuary of the river are also planned.

Table 1. Annual water balance at Veheragala after the project.

	Component	Volume (MCM)
	Inflow	153.7
Commitments		
(A)	Downstream flow	47.3
(B)	Dead storage	6.5
	Total in Basin (A + B)	53.8
(C)	Diversion to Kirindi Oya	75.0
	Total (A + B + C)	128.8
(D)	Non committed available for In basin use	24.9
Total downstream flow	(A + B)	72..2

The objective of ecosystem enhancement will be realized only if the water is issued during the dry season. However, these releases are required during the peak water demand for agriculture. Since water is stored in the reservoir for release during forthcoming months, it is possible for groups, primarily farmers, to press for the release of water to their fields. If this occurs the situation will be worsened as no return flows will be available downstream of the Menik River. The volume of the expected downstream release of 50 MCM is equal to that needed to irrigate about 1,500 ha of rice during both cultivation seasons. This generates average annual net benefits of SLR 103,552 per ha, based on current input intensities and prices.

We do not expect a drastic change in the regulations of the protected area, and these areas will be administered for wildlife conservation purposes. Therefore, flow enhancement will ensure the existence of the YPC and benefit the wildlife habitat. Based on this scenario, the objective of the WTP survey was to estimate the WTP of the general population of Sri Lanka to maintain the YPC ecosystem through assured water releases to the YPC during the dry season. The non-market good here is the quality of the environment. We expect an improvement of environmental quality from the current (poor) state before the regulated flow, to the expected (good) state after the regulated new flow regime if water is allocated based on environmental concerns.

Theoretical Basis for Environmental Valuation

The concept of total economic value is used in valuing resources that generate multiple benefits. Values arise from both use and non-use values. As described by Freeman (2003), valuing non-market goods is based on the welfare measures for a utility-maximizing consumer.

Non-market valuation techniques are classified into two broad classes: revealed preference (RP) methods and stated preference (SP) methods. Revealed preference methods use the market behavior of an observable good or service related to the environmental amenities, while SP methods are based on hypothetical markets. Values associated with environmental quality may be expressed through market behavior. The Contingent Valuation (CV) Method is the most widely used of several SP methods and is extensively used in valuing recreational benefits and quality of water. The use of SP methods has its own niche as it can hypothetically create markets that are otherwise non-existent, including non-use values.

We used single bound dichotomous choice format in eliciting responses. Non-obligatory, specific voluntary contribution mechanisms (VCM) were considered an appropriate payment vehicle because charitable contributions of various sorts are widespread in Sri Lankan society, but tax collection is a relatively weak institution. In an evaluation of the Sinharaja Biosphere Reserve, Ekanayake and Abeygunawardena (1993) used payment to a conservation club for estimating total economic value. More recently, Bandara and Tisdell (2005) reported that VCM was the method of payment preferred by respondents for a hypothetical elephant conservation program in Sri Lanka. Elicited responses were used to calculate WTP, estimating a non-parametric survivor function (NSF). A binary logistic regression model was estimated in order to understand the determinants of willingness to contribute to the improvement of the YPC.

Survey Design and Implementation

A CV survey was conducted during the last quarter of 2008 in ten districts randomly selected from a list of 18 administrative districts in Sri Lanka. Of the 25 administrative districts in Sri Lanka, 7 districts from the northern and eastern provinces were not included in the sample selection due to the logistical difficulties of conducting socioeconomic surveys). According to the most recent National Census of Population and Housing conducted in 2001 (Department of Census and Statistics 2004), the cumulative population of the districts surveyed accounted for 86 % of Sri Lanka's total population. We used a multi-stage random sampling procedure to select respondents. In the first stage, the 10 survey districts were selected using the Probability Proportionate to Size (PPS) sampling method. The use of 10 districts was based on the expectation of generating more than 500 valid responses, the minimum to carry out a valid dichotomous choice CV survey. Two divisional secretary areas from each selected district were randomly selected during the second stage, while one village from each selected DS division was selected in the third stage. Respondent households were randomly selected at the final stage.

The 10 districts that were selected were a good representation of the regional variations within the country. The sample contained approximately 20 % urban and 80 % rural respondents, equal to the urban/rural population proportions in Sri Lanka. However, we did not differentiate between the WTP of urban and rural responses at this stage as the sub-samples in our study were not large enough to generate separate WTP values.

A one-page insert describing the significance of the YPC and the proposed changes to the water flow regime of the Menik Ganga River was included in the questionnaires. In order to reduce the potential influence on WTP from expected future uses, we emphasized that the area through which the river flows is not open to the public. The hypothetical scenario was constructed to show the improvements to the downstream ecosystem if water is released to the park as scheduled. The expected enhancement of the quality of the downstream eco-system was depicted using pictures showing differences in the state of the environment with and without water flow as described. Change in the flow pattern, including the quantity of water (expressed as the quantity of water needed to irrigate the expected extent of rice land) was mentioned. Monetary contributions from the general public were explained to be needed to protect downstream releases of water from possible additional demands from the agriculture sector.

Using single bounded dichotomous choice elicitation format, respondents were asked whether they would pay for a period of 10 years, an annual membership fee to the Yala Environment Protection Organization (YEPO) the amount of which was equal to the presented bid value. The YEPO was modeled as a not-for-profit organization with democratic member control. News of its activities and programs were expected to be disseminated to members through a newsletter. Bid values selected were, 100, 300, 500, 700, and 900 SLR. These values were within the range of actual payments made by Sri Lankans for memberships in social and professional organizations. Each bid value was randomly assigned to one-fifth of the sample households in each survey village. Responses were analyzed using the non-parametric survivor function approach. A follow-up question asking whether they are willing to pay for the same purpose, any other positive contribution was presented to respondents who answered "No" to the WTP question.

The standard procedure for drop-off and pick-up surveys was followed. Our survey is the first-ever documented socioeconomic survey of this type in Sri Lanka. The survey was completed by the principal decision-maker of the household, and completed questionnaires were collected after 2 weeks.

Standard demographic and socioeconomic information and information on possible determinants of the WTP decisions were also collected (Table 2). Distance from the main entrance of the YPC to the center of the respondents' villages was measured using 1:50,000 topographic maps.

Table 2. Independent variables in the Binary Logistic Regression.

Variable Name	Description	Measure
edulvl	Number of years of education	Years of education
hhhage	Age of the Household Head	Years
graduate	Higher education status of Household Head	1, if the household head had a college degree 0, otherwise
inccls01	Annual Household income class	1, if income is less than SLR 75,000 0, otherwise
inccls02	Annual Household income class	1, if income is between SLR 75,000 and 120,000 0, otherwise
inccls03	Annual Household income class	1, if income is between SLR 120,000 and 240,000 0, otherwise
inccls04	Annual Household income class	1, if income is between SLR 240,000 and 360,000 0, otherwise
inccls05	Annual Household income class	1, if income is over SLR 360,000 0, otherwise (Reference Category)
ofchloco	Office holder in local organizations	1, if office holder 0, otherwise
assets	Asset index	Index of household assets and housing quality
religious	A proxy variable to measure close association with religion	1, if the household contributes regular donations to religious institutions 0, otherwise
distypc	Road distance from main entrance of YPC to the village	km

(continued)

Table 2. Independent variables in the Binary Logistic Regression. (continued)

urban	Sector of residence	1, if respondent's residence is located in urban area 0, otherwise
heard	Level of awareness	1, if respondent had previous awareness of YPC 0, otherwise
vistypc	Visitor status	1, if respondent has visited YPC 0, otherwise

Results and Discussion

Calculation of WTP

Calculated values of the non-parametric survival function are presented in Table 3. The estimated mean WTP for enhancement of the YPC in the sample is SLR 435 per annum per household, with a 95 % confidence interval between SLR 401 and SLR 467. Estimated mean household WTP was aggregated for the whole population of survey districts using mid-year population

Table 3. Estimated point estimates of non-parametric survival function (n = 531).

Bid Value (SLR)	Number of respondents (Nj)	Number of response		Point estimate of non-parametric survival function
		Yes (nj)	No (Nj - nj)	
100.00	107	82	25	0.77
300.00	109	59	50	0.54
500.00	106	51	55	0.48
700.00	104	43	61	0.44
900.00	105	37	68	0.35
Total	531	272	259	

in Sri Lanka in 2008 (Central Bank of Sri Lanka 2009). The average household size reported by the Sri Lanka Household Income and Expenditure Survey 2006/07 is 4.1 persons. Thus, the total number of households in the survey districts is 4,422,927, and there are 503,171 households in the excluded districts from the northern and eastern provinces. We estimated an aggregate WTP of SLR 1,920.8 million per annum for the survey districts. As payments will occur for 10 years, the net present value of the WTP stream, using a 12 % discount rate, is SLR 10.8 billion.

We used WTP values from the survey districts to calculate WTP for the rest of Sri Lanka assuming that residents in excluded districts would have the same average WTP and that household size is as in the survey districts. The cumulative WTP to enhance the ecosystem of the YPC is estimated to be SLR 12 billion for the entire Sri Lankan population. The net present value of incremental net benefits, arising if the quantity of water committed to downstream use is diverted to the adjoining Kirindi Oya Basin and used to grow rice, would be SLR 0.64 billion at current input intensities and factor/output prices. This reveals that the estimated WTP

for the YPC from the general population of Sri Lanka is several times higher. This generates important policy implications as welfare gains from a larger population should be considered an important input when deciding water allocations at the Veheragala Reservoir Site.

Factors Affecting the Decision to Contribute for Conservation

Descriptive statistics for the explanatory variables used in the binary logistic regression are presented in Table 4. Sixty-five percent of respondents agreed to support the YEPO by a positive annual membership contribution. On average, respondents had 12 years of education and 19 % of them had a university degree. The age of household heads ranged from 20 to 88 years with an average of 46 years. Eighty-eight percent of household heads were males. Sixty-five percent of the surveyed households indicated that they contributed to a Buddhist temple. It was hypothesized that holding an office in a village organization would positively influence attitudes on environmental protection; in this case 26.2 % of the respondents were office holders in a non-political or social community level organization.

Table 4. Descriptives of explanatory variables in Binary Logistic Regression (n = 531).

Variable Name	Mean	SD
edulvl	12.56	(2.69)
hhhage	46.08	(11.5)
graduate	18.8%	
inccls01	14.1%	
inccls02	16.6%	
inccls03	36.0%	
inccls04	15.4%	
inccls05	17.9%	
religious	65.5%	
heard	97.9%	
vistypc	45.4%	
urban	20.2%	
ofchloco	26.2%	

Source: Survey data 2008

According to the results of the binary logistic regression (Table 5), older household heads were less likely to contribute to the YEPO. However, this estimate is statistically insignificant.

Table 5. Parameter estimates for Binary Logistic Regression.

Variable Name	Parameter Estimate	Significance	Significant at	Exp(β)
edulvl	-0.08758	0.123	ns	0.9161
hhhage	-0.01435	0.102	ns	0.9858
distyala	0.001746	0.241	ns	1.0017
inccls01	-0.3826	0.320	ns	0.6821
inccls02	0.200851	0.554	ns	1.2224
inccls03	0.661026	0.033	++	1.9368
inccls04	0.420969	0.233	ns	1.5234
urban	0.354011	0.174	ns	1.4248
religious	1.081865	0.000	+++	2.9502
graduate	1.43029	0.000	+++	4.1799
ofchloco	0.352732	0.136	ns	1.4229
vistypc	-0.24853	0.220	ns	0.7799
Constant	0.813202	0.421	ns	2.2551

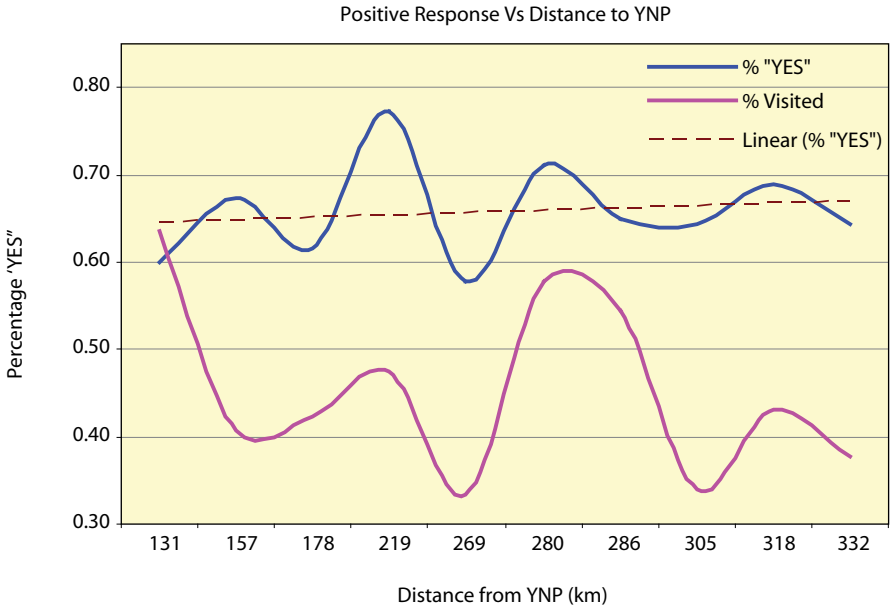
Notes: ++ Parameter estimates are significant at 5 % probability, +++ Parameter estimates are significant at 1 % probability

The decision to contribute to the YEPO was significantly associated with household income. Upper middle income households (those having annual household income between SLR 120,000 and 240,000) showed a significantly higher likelihood of contributing when compared with the reference category. Households with religious attachments and college graduates were also more likely to be willing to contribute towards the YEPO.

A total of 45.4 % of respondents had visited the YPC at least once during their lifetimes. Although previous visitors are expected to be positively associated with willingness to pay for quality enhancement of the resource, our data does not support such association. Previous studies show that appreciation for a national park decreases as the distance to the park increases. Willingness to contribute for enhancement of the YPC (positive contributions = 1; otherwise = 0) was regressed with travel distance as the independent variable. Contrary to the expectation of declining probability to contribute as the distance from an environmental asset increases, the estimated parameter for distance to the YPC in the regression model is positive but statistically non-significant at 10 % probability. The percentage of respondents with positive the WTP and the percentage of respondents who had visited the YPC are arranged by deciles, of distance between the YPC and respective residences in Figure 1.

Our data does not show significant differences in the decision to contribute between urban and rural households. A separate binary logistic regression was done to show the relationship between visitor status and distance to the YPC. We found that the visitor status declined with increasing distance and the estimated coefficient was statistically significant at a 1 % level of probability.

Figure 1. Changes in visitor status and percentage willing to contribute with road distance to YPC.



Based on these findings we can conclude that the decision to contribute does not change with the visitor status, location or the sector of residence of respondents. We conclude that the YPC is valued by the general population of Sri Lanka and this value is generated mainly through non-use values.

Conclusions

Yala National Park in Sri Lanka can be considered a unique environmental resource due to its undisturbed nature, large size, the composition of flora and fauna and the uninhabited stretch of coastline. This research demonstrates that the general population of Sri Lanka values the non-user benefits of the YPC irrespective of household sector, distance to the YPC and their previous experiences with the YPC. Monetary values elicited through CV reveals those improvements to the YPC ecosystem through an assured supply of water generates benefits that are about 20 times that of the net benefits generated by using the same amount of water for rice production.

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