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Recreational Value of Wetland Ecosystem: Evidence from Harike, Punjab

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ABSTRACT

The valuation of wetland ecosystems plays a vital role in understanding their economic significance and the potential benefits they offer to the society. Wetlands are distinctive ecosystems that offer a wide range of ecological services, including habitat preservation, flood control, and water filtration. Evaluation of the value of wetlands may contribute in a major way to the decision-making processes regarding conservation and management strategies. By employing the Travel Cost Method (TCM), this study aims to determine the economic worth associated with recreational activities in Harike Wetland in Punjab, India which contribute towards a better understanding of its true worth and thus helps in facilitating the sustainable management practices of this important wetland ecosystem. The recreational value of wetland was evaluated empirically, and its affecting characteristics were identified using the Poisson regression model. The study results indicate that the anticipated total annual recreational value of the Harike Wetland amounts to about 10.04 crore rupees per annum.

Keywords: Wetlands, Economic valuation, Travel Cost Method, Poisson regression.

JEL: Q26, Q51, Q57, Z32

I

INTRODUCTION

The benefits that people receive from ecosystems, whether directly or through indirect ways, are referred to as ecosystem services (Yang *et al*., 2008). Wetland ecosystems are characterised by the presence of water, which distinguishes them from other terrestrial or aquatic landscapes. These unique environments provide a variety of ecological services, involving water filtration, groundwater recharge, flood regulation, climate regulation, and biodiversity conservation (Kadlec and Knight, 2001; Davidson, 2014). Alongside their ecological significance, wetlands also possess substantial economic value, often derived from recreational activities, tourism, and other ecosystem services (Krutilla, 1967; Barbier *et al*., 2011).

Wetlands, often referred to as the "kidneys of the landscape," are recognised as highly valuable ecosystems on earth. They serve as biological hotspots, supporting intricate food webs and a wide array of species. These versatile resources possess significant economic importance, making them multipurpose assets (Turner *et al.*, 2000). On a global scale, wetlands contribute to approximately 15 per cent of the ecological services and natural resources (Brouwer *et al.,* 1999). These resources in India encompass a vast estimated area of 58.2 million km^2 and offer substantial recreational, conservation, and scenic attributes (Prasher *et al.,* 2006).

Harike Wetland in Punjab a globally acknowledged site positioned between the latitudes of 31'060N and 31'120N and the longitudes of 74'550E and 75'050E. It

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spans three districts: Firozpur, Tarn Taran, and Kapurthala, covering a total area of 12 kilometers in length and 11 kilometers in width (Kaur *et al.*, 2017). It is an important habitat for a diverse array of plants, animals, and migratory birds, making it a popular destination for tourists, nature enthusiasts, and researchers alike (Choudhary *et al*., 2018). The Harike Wetland, despite its significant biodiversity and international recognition as a wetland, is currently experiencing degradation due to various factors. These include siltation leading to reduced water flow, excessive growth of weeds, the inflow of industrial effluent and domestic wastewater through the Sutlej and Beas rivers, encroachments by illegal settlements, uncontrolled grazing, and illegal hunting. These detrimental activities are causing severe disruptions to the ecological balance of the wetland (Gupta *et al.,* 2016). Recognising the ecological and economic significance of this wetland, it becomes crucial to assess its economic value accurately. Valuation studies can provide insights into the monetary worth of wetlands, thus facilitating informed decision-making and promoting sustainable management practices.

The Travel Cost Method (TCM) is one such valuation technique widely employed to determine the economic value of leisure time spent in natural environments (Rolfe *et al*., 2017). By examining the travel expenses incurred by visitors, their frequency of visits, and other relevant factors, TCM allows researchers to determine the economic value derived from the recreational use of the wetland ecosystem (Hanley *et al*., 2001). This method has been widely applied in the field of natural resource economics to assess the economic value of various natural resources and ecosystems (Loomis *et al*., 2000; Johnston *et al*., 2019).

This research paper aims to employ the TCM to assess the recreational value of recreational activities at Harike Wetland in Punjab, India. By analysing the travel costs, visitor characteristics, and other pertinent factors, this study seeks to comprehensively evaluate the recreational value associated with the wetland. The findings of this research will shed light on the economic significance of the wetland and provide valuable insights for policy makers, conservationists, and management authorities to make informed decisions regarding wetland preservation and sustainable resource utilisation.

II

DATA SOURCES AND METHODOLOGY

This section provides a concise overview of the study area, data collection methods, and the conceptual framework used in the study. The sub-heads within this section are dedicated to provide details on each of these aspects.

(i) Study Area

The present research was carried out within the boundaries of Harike wetland, which was deliberately chosen due to its status as one of Punjab's largest wetlands, spanning an impressive area of 41 square kilometers. Additionally, this wetland

boasts a diverse range of species, further enhancing its significance. The study area map has been depicted in Figure 1.

Fig. 1: Location maps of the study area

(ii) Data Collection and Research Design

This research study utilises a combination of primary and secondary data to assess the recreational value generated by the ecosystem. The primary data were collected directly from tourists, who are key stakeholders in understanding and evaluating the significance of the ecosystem's recreational value. To ensure a representative sample, a simple random survey was conducted among a group of 100 tourists. This sample size was determined to be sufficient in capturing the diverse perspectives and experiences of tourists visiting the wetland. Tourists were asked to provide information on their socio-demographic characteristics, travel expenses and costs associated with engaging in luxuries.

(iii) Analytical Framework

To estimate the ecosystem's worth for recreation, the Travel Cost Method (TCM) was employed. This method involves analysing the expenses incurred by tourists during their visits, which are considered a representation of the importance they place on the recreational benefits provided by the ecosystem. By examining the travel costs, including transportation expenses, accommodation fees, and other related expenditures, an estimation of the ecosystem's recreational value has been derived. TCM is a popular approach for valuing preferences based on observed behavior. It is extensively employed to estimate the demand for environmental recreation. This method considers the travel cost as an implied price for visiting a particular site and aims to investigate the impact of changes in travel cost on visit frequency. Estimating the demand function for leisure activities critically depends on leveraging this actual relationship between travel cost and number of visits. In the demand function, the travel cost method takes the number of visits into account as the quantity demanded, making it the dependent variable. Factors such as family income, monthly expenditure, gender, education, marital status, family type, religion and caste, also influence the number of visits to a recreational site, in addition to travel cost known as independent variables.

The Individual Travel Cost Method (ITCM) has been used to quantify the environmental amenities' recreational and other use values. By accounting for the data's natural variation rather than depending solely on zonal aggregate statistics, the ITCM has a clear advantage over the Zonal Travel Cost Method (ZTCM). According to the theory of demand, a commodity's quantity requested decreases as its price rises and vice versa (Garcia *et al.,* 2020). By taking into account how the aforesaid components affect the visiting rate, the assessment of the leisure demand function for ecotourism can be expressed as:

$$V_i = f(TTC_i + RG_i + CS_i + MS_i + GN_i + ED_i + FI_i + FE_i)$$

Where,

V_i = visiting frequency for the ith individual.

TTC_i= Total Travel cost (= Travel cost + Travel expenditure + Monetary value of time spent), RG_i= Religion of respondents (= 1 for sikh respondents, 0 otherwise), CS_i= Caste of respondents (= 1 for general respondents, 0 otherwise), MS_i = Marital status (= 1 for married respondents, 0 otherwise), GN_i = Gender of respondents (male = 1, 0 otherwise), ED_i= Education of respondents, FI_i= Family Income of respondents (Rs./month), FE_i= Family Expenditure of respondents (Rs./month).

Number of Visits (V): A dependent variable that is described as the number of trips a respondent made over the survey year, is taken into account in the initial specification. Number of visits (V) is a discrete count variable that takes finite non-negative values. It is usual practice to use count data distributions to simulate single-

site recreational demand functions. (Czajkowski and Giergiczny, 2019; Marothia, 2019).

Total Travel Cost (TTC): To determine the value that visitors place on the benefits obtained from a site, the travel cost approach uses the total amount spent by visitors throughout their visits to the wetland. These expenses cover a range of different costs, like hotel costs, food and drink costs, opportunity costs, round-trip travel costs etc. The travel cost is inversely related to the number of visits, meaning that as the cost of travel increases, the rate at which individuals visit wetlands tends to decrease.

Total Travel Cost (TTC) = Travel Cost (TC) + Monetary value of time spent + Travel expenditure + Miscellaneous charges.

Monthly working hours for fixed salaried group = 160 hrs

The hourly wage rate for fixed salaried group = $\frac{Family\ Income\ (Rs/month)}{160}$

The monetary value of time spent by a visitor = $\frac{Family\ Income\ (Rs/month)}{160}$ x Time spent per visit (in hours)

Religion (RG): The religion of visitors may also impact the number of visits to the wetland, particularly if there are religious sites located in close proximity. The variable representing religion (RG) is expected to have a positive correlation with the dependent variable.

Caste (CS): The caste of visitors can also influence the frequency of visits. As an explanatory variable, caste is expected to have a negative impact on the dependent variable.

Marital Status (MS): The marital status (MS) of visitors, represented as a dummy variable where 1 indicates a married visitor and 0 otherwise, is considered as an additional explanatory variable in this study. It is expected that the marital status of visitors has a negative association with their visits to the wetland.

Gender (GN): The sex of visitors is considered as an additional explanatory variable that may influence the demand for visits to the wetland. To assess the potential impact of visitor sex on the number of visits, a dummy variable (GN) is employed. In this variable, GN is assigned a value of 1 for males and 0 for females. It is anticipated that males tend to visit the wetland more frequently than females.

Education (EDU): Education plays a vital role in creating awareness among individuals regarding the presence and significance of environmental amenities, including recreational opportunities provided by green spaces such as wetlands. Therefore, in order to assess the influence of education on the demand for these amenities, the level of educational attainment (measured in years) of the visitors is considered as an additional explanatory variable. It is anticipated that education (EDU) has a positive effect on the number of visits to the wetland.

Family Income (Rs./month) of the visitor (FI): The income of consumers plays a significant role in influencing the demand for goods and services. It is reasonable to assume that there is a strong positive correlation between income and the economic status of a household, specifically in terms of per capita income. It is anticipated that the family income of visitors and the frequency of visits to the wetland exhibit a positive relationship, as suggested by studies conducted by (Chopra, 2004; Badola *et al*., 2010).

Family Expenditure (Rs./month) of the visitor (FE): It can be reasonably assumed that there is a strong negative correlation between household economic status and expenditure. It is expected that the family expenditure of visitors and the frequency of visits to the wetland are negatively related.

A normal linear regression approach might not be suitable because the dependent variable is a count variable so this study utilized the Poisson regression model to assess the sensitivity of the results by employing STATA 16 (Neher *et al*., 2013). After estimating the demand function, the consumer surplus can be used to approximate the welfare associated with visiting the site. Mathematically, it is possible to compute the consumer surplus by integrating the following demand function (Chopra, 2004, Bharali and Mazumder, 2012).

$V_i = b_o + b_1 TTC_i + b_2 \overline{RG_i} + {}_3\overline{CSi} + b_4\overline{MSi} + b_5\overline{GNi} + b_6\overline{EDUi} + b_7\overline{FIi} + b_8\overline{FEi}$

$V_i = bó + b_1 TTC_i$

$CS = \lim_{\epsilon \to 0} \int_{\epsilon}^{v} V = \int_{\epsilon}^{v} (bó + b_1 TTCi)$

Here, CS = Consumer surplus, $bó$= b_o+ sum product of mean value other explanatory variable and their respective coefficient

The annual recreational value of the site has been obtained by aggregating the consumer surplus of all visitors to the site for one year. i.e.,

Recreational value = Consumer surplus (CS) × annual number of visitors.

III

RESULTS AND DISCUSSION

(i) Socio-Economic Characteristics of Tourist

In this section, the findings related to the background characteristics of visitors are presented. Table 1 provides information on the demographic features of tourists and includes descriptive data. The findings indicate that among the sampled tourists, 70 per cent were male, while only 30 per cent were female. Additionally, it was observed that the majority of the visitors were married (73 per cent) and the average age was estimated to be 39 years. Furthermore, the analysis revealed that 78 per cent of the respondents were categorised as general, with 75 per cent of them identifying as Sikh religion.

TABLE 1. DETAILS OF SOCIO-ECONOMIC CHARACTERISTICS OF TOURISTS.

Variables (1)	Description of variables (2)	Mean (3)	SD (4)	Min (5)	Max (6)
GN	Gender of visitors (male=1, 0=female)	0.70	0.46	0.00	1.00
MS	Marital status (married=1, 0=otherwise)	0.73	0.45	0.00	1.00
RG	Religion (Sikh=1, 0=otherwise)	0.75	0.44	0.00	1.00
CS	Caste (general=1,0=otherwise)	0.78	0.42	0.00	1.00
FT	Family type (joint=1,0=nuclear)	0.13	0.34	1.00	2.00
AG	Age of visitor	39.14	13.09	15	67
EDU	Education level (in years)	12.50	4.60	0	17

The mean year of schooling of the respondents was 12 years. The age of the tourists ranged from 15 to 67 years. Moreover, only 13 per cent of the families belonged to a joint family and the majority of tourists (87 per cent) had a nuclear family. The occupation pattern of tourists has presented in Figure 2. The results revealed that the majority of the respondents were service holders (29 per cent), businessmen (24 per cent) and farmers (23 per cent). Only 8 per cent of students and 16 per cent of housewives were tourists at the Harike Wetland. The results were in alignment with the study conducted by Singh *et al*. (2022).

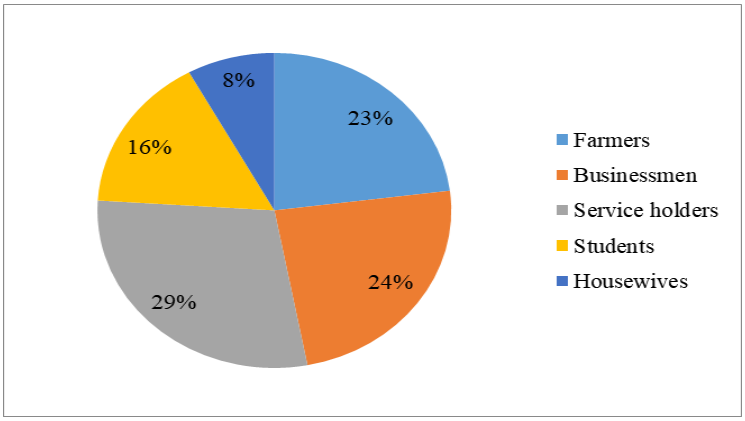

Figure 2. Occupational Pattern of the Tourists

(ii) Distribution of Income and Expenditure

To examine the variables under study, Table 2 presents the descriptive statistics regarding month income and expenditure of visitors in the study area. The average Family Income (FI) of the visitors was Rs. 61100/month, with a range spanning from Rs. 25000/month to Rs. 160000/month. Additionally, the mean family

TABLE 2. FAMILY INCOME AND EXPENDITURE OF VISITORS

(*Rs./month*)

Variables (1)	Description of variables (2)	Mean (3)	Standard Deviation (4)	Min (5)	Max (6)
FI	Family Income	61100	29546	25000	160000
FE	Family Expenditure	38000	13390	20000	80000

expenditure (FE) was determined to be Rs. 38000/month in the range of between Rs. 20000/month to Rs. 80000/month.

The Lorenz curves in Figure 3 illustrate the distribution of Family Income (FI) and Family Expenditure (FE) for the visitors. These curves are accompanied by the numerical summary provided by the Gini coefficients. The x-axis represents the percentage of the visitor population, while the y-axis represents the cumulative percentages of family income and family expenditure.

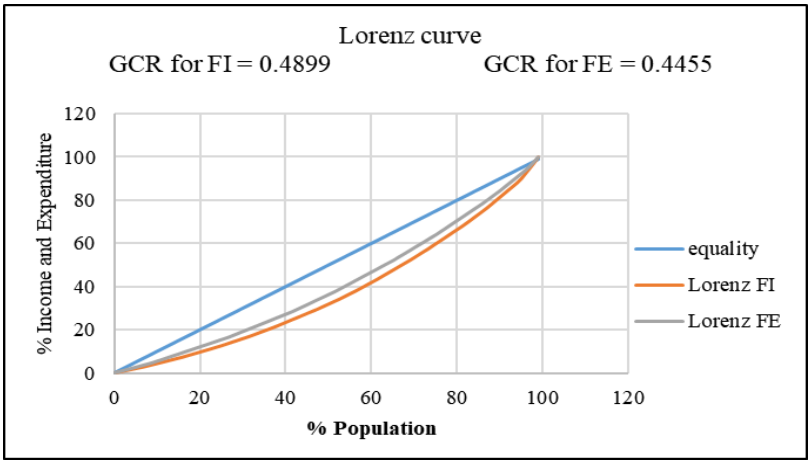

Figure 3. Lorenz Curve and Gini Concentration Ratio of Family Income and Family Expenditure

The diagonal line represents complete distributive equality, where each visitor would have an equal proportionate share of the total income and expenditure. The degree of inequality is indicated by the shape of the Lorenz curve. The farther the curve deviates from the diagonal line, the greater the income distribution inequality, and vice versa. The Gini concentration ratio (GCR), which is directly linked to the Lorenz curve, quantifies the extent of inequality. It represents the percentage share of the area between the Lorenz curve and the diagonal line. For the Family Income (FI) variable, the Gini coefficient was calculated to be 0.4899, while for the Family Expenditure (FE) variable, it was found to be 0.4455. These findings also correspond with the study conducted by Kronenberg and Fuchs (2022). It is concluded that the distribution of tourist family income is more unequal as compared to their expenditure. Also, the value of GCR is found to be less than 0.50 indicating that inequality in family income and expenditure among tourists was not severe.

(iii) Estimation of Total Travel Cost (TTC)

Table 3 provides information on the visitor rate and travel expenses. The table shows that the average number of visits per visitor was 4.13, with the lowest and

highest values falling between one and one hundred visits. This can be attributed to the fact that, within a sample of 100 tourists, two visitors were found to be residing in close proximity to the Harike wetland. These visitors exhibited a consistent pattern of behavior, with each of them making 100 visits to the wetland specifically for the purpose of engaging in recreational walking activities. However, half of the tourists visit the wetland only one time and 29 per cent of tourists visit twice a year as shown in Figure 4. On average, tourists spend about 2.31 hours in the wetlands, the time also varies between one to five hours among tourist. The range of total travel expenses per visit was ranged from Rs. 187 to Rs. 20,000, with an average of Rs. 4844.

TABLE 3. DESCRIPTIVE STATISITCS OF NUMBER OF VISITS AND TRAVEL COST

Variables (1)	Description of variables (2)	Mean (3)	Standard Deviation (4)	Min (5)	Max (6)
V	Visits (number)	4.13	13.96	1.00	100.00
TS	Time spent per visit (hours)	2.31	1.27	1.00	5.00
TC	Travel cost (Rs.)	2116	1908	0.00	8000
TTC	Total travel cost (Rs.)	4844	4227	187	20000

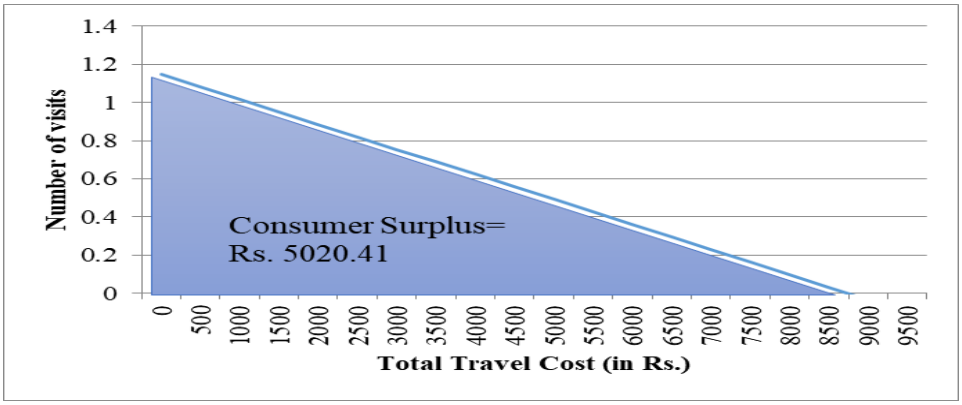

Figure 4. Estimation of Consumer Surplus Using Travel Cost Method

(iv) Poisson Regression Model

The number of visits to recreational site is influenced by numerous factors, including the socio-economic and demographic characteristics of the visitors and the associated travel costs. The estimated parameters of these determinants, along with their sign, magnitude, and level of significance, are presented in Table 4. The value of log-likelihood was found to be -283.37 and significant at a 5 per cent level indicating a better fit model. The pseudo R^2 was also reasonably well, i.e., 0.5954.

One of the significant determinants of frequency of visits is the Total Travel Cost (TTC), which encompasses all travel expenses, including monetary and time-related costs. As expected, the coefficient of TTC was found to be both significant and negative. This indicates that as the travel cost increases, the visits or recreational

demand for the wetland decreases. Specifically, the coefficient of the travel cost suggests that holding other factors constant, every 10 thousand rupees increase in the travel cost leads to a decrease in the visit to Harike Wetland by one (0.00013 X 10,000). This implies that individuals who reside closer to the site tend to make more frequent trips, while those living farther away make fewer trips due to the relatively lower travel costs they incur. These findings align with the well-established theory of consumer behavior, which states that demand for any good or service decreases as the associated costs increase (Desta and Bersisa, 2019).

TABLE 4. EFFECT OF TRAVEL COST AND OTHER EXPLANATORY VARIABLES ON NUMBER OF VISITS

Particulars	Coefficient	Standard error	t stat	p-value
(1)	(2)	(3)	(4)	(5)
Intercept	2.243	0.389	5.760	0.000
Total Travel Cost (Rs.)	0.0001318	0.000025	-5.270	0.000
Gender (Male=1, 0 otherwise_	-0.354	0.108	-3.270	0.001
Education level (years)	0.035	0.016	2.180	0.029
Marital status (married=1, 0=otherwise)	0.899	0.151	5.970	0.000
Religion (sikh=1, 0=otherwise)	0.632	0.184	3.430	0.001
Caste (general=1,0=otherwise)	-0.684	0.128	-5.350	0.000
Family monthly income (Rs.)	0.000057	0.000004	15.790	0.000
Family monthly expenditure (Rs.)	-0.000140	0.000010	-14.360	0.000
Number of observations	100	LR $chi^2(8)$	833.94	
Log-likelihood	-283.37*	Pseudo R^2	0.5954	

*p<0.05

The other explanatory variables with predicted indications of their coefficients were also discovered to be significant. While the predicted coefficients for family income, education level, married status, and religion all turned out to be significant and positive, those for gender, caste, and family expenditure were shown to be significant and negative.

(v) Estimation of Recreational Value Using Consumer Surplus Approach

To calculate the recreational value and consumer surplus that the wetland offers to its visitors, the estimated coefficient of travel cost is used in this study. Using the coefficients and means of important variables, the first stage entails evaluating the demand relationship for the recreational benefit. In particular, this is done by looking at the correlation between the number of visits and the corresponding travel expenses. The estimated Harike Wetland demand function is as following:

V =1.150383- 0.0001318 TTC

By employing an exponential demand function, the Consumer Surplus (CS), an indicator of net social benefit, for the average number of visits was estimated to be Rs. 5020.41 (see Figure 5). According to secondary data collected from the Forest Department of Punjab, the average annual number of tourists visiting the Harike wetland was approximately 20,000. Through the aggregation of the consumer surplus

for all visitors to the site over one year, the estimated annual recreational value of the site, was calculated to be Rs 10.04 crore.

Annual Recreational Value = 5020.41 x 20000 = Rs. 10,04,08,198 = Rs 10.04 crore

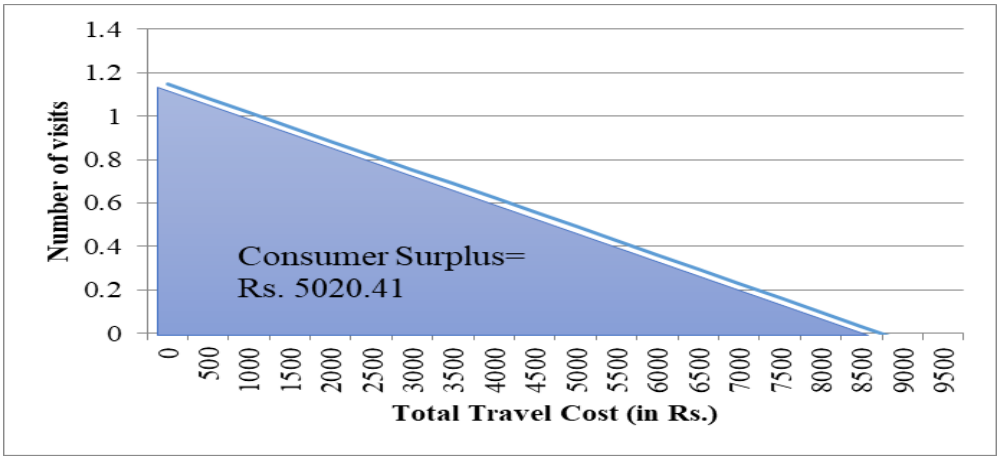

Figure 5. Estimation of Consumer Surplus Using Travel Cost Method

IV

SUMMARY AND CONCLUSIONS

In the absence of information on the economic values connected to environmental resources, such as the recreational value of a wetland the decision-makers, especially policy makers, have to rely on their personal value judgments while making decisions to manage these resources. This knowledge deficit can hinder efforts to sustain and expand recreational services offered by wetlands. Therefore, decision-makers must base their choices on estimates derived through valuation techniques, enabling a more informed and objective approach to decision-making.

The present study aimed to estimate the recreational value of the Harike wetland using individual travel cost method. Personal interviews were conducted with 100 randomly selected visitors of the wetland to gather the survey results. The results of this survey were then examined utilizing the econometric and descriptive analysis. The wetland's expected recreational demand, taking into account the various factors and their respective influences the number of visits has been estimated by employing count data models (Poisson regression model) because dependent variable (visits per year) comprised count integer values. The analysis of the demand function yielded a consumer surplus value of Rs. 5020.41 and an estimated total recreational value of Rs 10.04 crore per annum for the wetland. Based on these findings, the study suggests that increasing visitor fees and charges could generate additional funds for improving the management and logistical facilities provided to tourists, and thus, in turn, enhance the potential to attract more visitors to the wetland.

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