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Economic valuation of biodiversity in South Asia: The case of Dachigam National Park in Jammu and Kashmir (India)

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Abstract

Biodiversity needs our attention because humans receive a wide range of direct and indirect benefits. Valuation of biodiversity is important to establish the importance of use and non-use values of biological resources and cost of ignoring them. Against this backdrop, the aim of this study is to capture the recreational value of the national park biodiversity while employing travel cost method. To this end, the value of the economic benefits generated by sustainable management of Dachigam National Park in Jammu and Kashmir (India) is estimated using data from 301 visitors from different parts of the country. Data are analysed using count data models, and results reveal that travel cost method is suitable for valuation of various use values generated by environmental resources such as national parks. Estimated results show that consumer surplus per visitor per visit in present study is equal to Rs. 12,470 (US $197), which translates into an annual monetary recreational value of about Rs. 247,614,828 (approximately US $3,930,395). Demand for tourism services is also found to be fairly insensitive to travel cost/price. Therefore, an increase in entry fee and redistribution of proceeds can improve the physical and financial management of the park.

KEYWORDS
Biodiversity, Consumer Surplus, Dachigam National Park, Economic Valuation, Travel Cost Method

1 | INTRODUCTION

Biological diversity or biodiversity, for short, is an umbrella term that embodies number, variety, and variability of living species in any specified assemblage (Pearce & Moran, 1994). Biodiversity benefits human societies in a number of ways by providing diverse ecological, economic, social, educational, scientific, and aesthetic services. However, in recent times, indiscriminate anthropogenic interventions in the natural ecosystems have resulted in loss of biodiversity (Chopra, 2004; Pearce & Moran, 1994). As stated by the International Union for Conservation of Nature (2017) data, around 866 animal species until now are extinct, 5,583 are critically endangered, 8,455 are endangered, 6,186 are near threatened, and 11,783 are vulnerable. Among plant species, 275 out of 20,755 are extinct, 2,347 are critically endangered, 3,510 are endangered, 5,376 are vulnerable, and 1,622 are near-threatened species. Current biodiversity losses are limiting future development options. Any cutbacks in the rate of loss of biodiversity will contribute substantially towards achieving sustainable development (World Commission on Environment and Development, 1987). Economics can play a significant part to guide the design of biodiversity policy through eliciting public preferences on different attributes of biodiversity. While assessing the economic value associated with the protection of biological resources, environmental valuation techniques like travel cost method (TCM), contingent valuation method, and choice experiment method can provide valuable evidence to support such policies. Interestingly, policy-makers are acknowledging the role of environmental valuation methodologies in policy formulation. For instance, the Convention of Biological Diversity's Conference of the Parties Decision IV/10 recognized that "economic valuation of biodiversity and biological resources is an essential tool for well-targeted and calibrated economic incentive measures." In the same way, it encourages governments and various organizations to "take into consideration economic, social, cultural and ethical valuation in the development of relevant incentive measure" (Christie et al., 2006). Central to upgrading level of understanding of the cost that biodiversity loss imposes on society or the gains from its preservation is measurement and valuation of biodiversity of different ecosystems. Therefore, policy-makers and people alike necessarily need to have knowledge of the opportunity cost in terms of lost values.

What follows from the above discussion is that biodiversity valuation must be worked out in terms of both market linkages and the existence of value outside the market that is considered relevant by a set of preidentified stakeholders. Accordingly, TCM is used to do this in the context of Dachigam National Park (DNP), an important protected area in northern India. Travel cost approach approximates the value expressed by one category of stakeholders, that is, tourists, reflecting a market-based situation of selecting a particular tourist place and spending both time and money.

The article is organized as follows: Section 2 introduces the study area. Section 3 delineates the methodology. Section 4 discusses the results, and finally, the main findings are summarized.

2 | DACHIGAM NATIONAL PARK: AN INTRODUCTION

The case study considered in this study is DNP, an important protected area in Jammu and Kashmir. DNP is situated 18 km north-east of Srinagar. It is divided into lower and upper Dachigam areas. The Harwan reservoir and New Theed village form its base, whereas the Mahadev Peak is the topmost among surrounding mountain range (see Figure 1). Not only does the Mansar Lake exist within it, but also the famous Dachigam River flows through it. It is one of the most important protected areas in Jammu and Kashmir. As DNP has the last viable population of hangul (*Cervus elaphus hanglu*) in world as well as the largest population of Asiatic black bear, it has become a famous tourist destination. The National Park gives shelter to a variety of floral and faunal elements, namely, Himalayan brown bear, Himalayan black bear, musk deer, leopard, hyena, birds (150 species), vascular plants (661 species), and so on.

Dachigam, being very close to Srinagar, summer capital of Jammu and Kashmir, receives a large number of tourists in summer because of its natural beauty. Every year, 10,000–15,000 tourists visit the park, which includes students, naturalists, scientists, and conservation activists. Therefore, the park yields a range of on-site and off-site benefits. Given that the park is managed for high levels of visitor use, the recreational and tourism value of Dachigam is

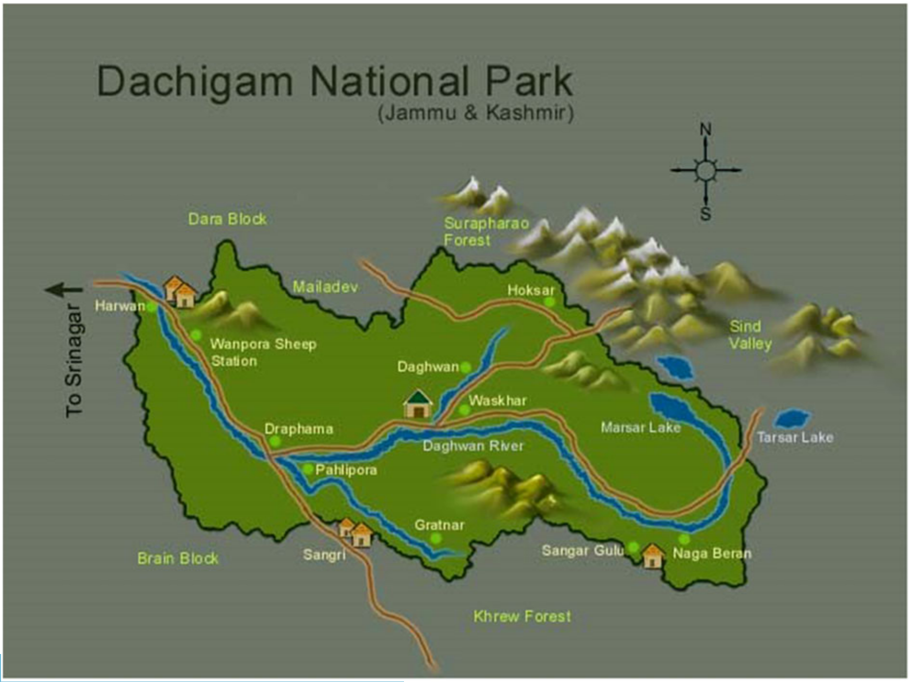

FIGURE 1 Location map of Dachigam National Park

likely to be significant. Other economic benefits are likely to include ecosystem services such as water purification, soil conservation, and landscape stability (Management Plan, 2011–2016). Despite extensive range of economic benefits provided by DNP, the park is threatened by various factors. The most important current threats identified are decline in the population of many species, extinction of species particularly the hangul, declining water quality, the clearing of remnant forest for cultivation, poaching, and the encroachment into riparian zones and water bodies (Department of Wildlife J&K, 2011).

3 | DATA AND ECONOMETRIC MODEL

3.1 | Travel cost method: Design and application

TCM, as an appropriate and widely used method for estimating recreational demand of natural resources, was first suggested by Harold Hotelling in 1947 (Haab & McConnell, 2002). It is assumed that individual's utility under TCM depends on number of visits to site, quality of site, and bundle of other goods (McConnell, 1992). As far as application of TCM is concerned, it can only capture the direct use of the environmental goods like wetlands and national park. Other components of total economic value like option value or non-use value cannot be quantified by this method.

In view of the main objectives of the present study, a sample of 301 tourists was selected at different spots of the park. A face-to-face interview method was used to elicit information from on-site visitors. A field survey was carried out in May–July 2015. As an individual TCM (ITCM)[1,2] has been used for estimating recreational benefits accruing to DNP in the present study, a questionnaire was designed in that direction to get the required data. It was divided into three parts, with some follow-up and multiple-choice-type questions to extract the most required information. Part 1 covered the demographic and socio-economic profile of the visitor. Part 2 included key questions related to the origin of visitor, mode of journey (by car, train, plane, bus, auto, cycle, foot, etc.), travel time, on-site time spent, and other expenditures related to trips. Part 3 contained questions related to the visitor's various on-site activities, related expenditures, and time requirements. These included activities, like birdwatching, trekking, watching endemic and endangered species, sightseeing, and spending time in a beautiful place with family or friends; and their expenditures and time spent. The last part was related to understanding respondents' perceptions and attitudes about existing state of environmental quality of the site, and their suggestions and preferences for further improvements of facilities, which may attract more tourists.

[1]As DNP possesses unique recreational facilities in relative sense and visitors gave prime importance to visit it and get benefited with its enchanting environment, thus, it does not possess any alternative (substitute) site nearby. Against this backdrop, the present study excluded treatment of substitute site variable from travel cost model.

[2]Keeping in mind objectives of the present study, we collected data through travel cost questionnaire from on-site visitors and not from off-site visitors (people whose visitation is zero or had never visited the site). Exclusion of off-site visitors in analysis introduces a bias called truncation bias (visitation truncated at one). This gives steeper demand function and ultimately generates faulty consumer surplus (see Creel & Loomis, 1990).

3.2 | Econometric specification

In the present study, a single-site ITCM has been applied to estimate the recreational value of the DNP. Following Garrod and Willis (1999), we estimated the following trip generation function:

$$NV_{ij} = f\left(RTTC_{ij}, RDHS_{ij}, S_i, Y_i\right), \tag{1}$$

where $i = 1, 2, 3, \ldots, n$. NV_{ij} is the number of visits made by individual i to site j in the last 1 year. $RTTC_{ij}$ is the round total travel cost including time cost incurred by individual i to site j.

$RDHS_{ij}$ is the round distance from home of individual i to site j. S_i is the vector of socio-demographic characteristics of respondent i. Y_i is the monthly income of the individual i.

Based on variables used in the models in this study, the proposed demand function is as follows:

$$NV = \exp\left(\alpha + \beta_1 RTTC + \beta_2 RDHS + \beta_3 Age + \beta_4 Flyz + \beta_5 Edu + \beta_6 MI + \varepsilon\right). \tag{2}$$

After taking natural logarithms, we have

$$\mathrm{Ln}(NV) = \alpha + \beta_1 RTTC + \beta_2 RDHS + \beta_3 Age + \beta_4 Flyz + \beta_5 Edu + \beta_6 MI + \varepsilon. \tag{3}$$

Once trip generation function is estimated, a demand function can be derived, which is used to estimate consumer surplus (CS)/welfare of the society. The following method given by Garrod and Willis (1999) and Creel and Loomis (1990) calculates CS (in absolute terms):

$$CS = -\frac{1}{\beta_1}. \tag{4}$$

The total CS (TCS) generated by site j to the users during a particular period is estimated by

TCS = Average CS × Total number of visitors to site j in the last 1 year.

Annual CS can be calculated as multiplying consumer's CS per visit with total number of visits during a particular time period (say 1 year). This is estimated as

CS_{annual} = CS per visit × Annual visits

$$CS_{\text{annual}} = \left(\frac{1}{-\beta_1}\right) \cdot Annual\ visits. \tag{5}$$

4 | RESULTS AND DISCUSSION

4.1 | Descriptive statistics

The summary of descriptive statistics of key variables (dependent and independent) collected from on-site visitors of the DNP are shown in Table A1. Keeping in view the objectives of the present study, descriptive statistics of these variables provide significant information regarding recreational behaviour, socio-economic and demographic features, and travel costs of sampled visitors to DNP. The average number of trips undertaken to the park (including the present one) was 2.25 as shown in Table A1.

Various key independent variables and other specific characteristics, which affect the number of trips of the visitors to the site, are discussed below.

4.1.1 | Round total travel cost (*RTTC*)

The average *RTTC* (included with time cost) for the respondents was calculated as Rs. 7,775 per visit per visitor to the site as shown in Table A1. *RTTC* (with time cost) included the two-way travel cost and time cost from home to the site.[3] It also included the on-site food expenses, costs for on-site recreational activities, and other accommodation charges (if any).

4.1.2 | Age of the visitors (*Age*)

Average age of sampled visitor was around 35 years with a minimum of 18 years, a maximum of 71 years, and a standard deviation of around 10 years, as shown in Table A1. The average age of the visitors indicates that the younger people (in the age group 18–69) were more enthusiastic to visit the recreational site.

4.1.3 | Sex of the respondents (*Sex*)

In present study, *Sex* is a dummy variable that attains value of 1 if visitor is male and 0 if female. It is depicted in Table A1 that male visitors dominated with a mean value of 0.79. Almost 79.40% of the visitors were males, whereas only 20.60% were females.

4.1.4 | Family size of the visitors (*Flyz*)

The average family size of sampled visitors worked out to be 4.92 persons, with a minimum of two and maximum of 15 family members.

4.1.5 | Marital status (*Mst*)

Marital status is taken as dummy variable, which implied that if visitor was married, its value is 1 and 0 if unmarried. The majority of visitors were found to be married, with a range of around three quarter (74%) of total visitors in the present study. This variable was not used in estimation, as it had not shown any significant effect. The average value of marital status was 0.73.

4.1.6 | Monthly income of the respondent (*MI*)

In India, there is vast diversity in earning income among the people from different types of jobs. In present study, 21.6%, 27.24%, and 19.27% visitors belonged to the income groups Rs. 10,001–20,000, Rs. 20,001–30,000, and Rs. 30,001–40,000, respectively. The average monthly income of a recreationist was found to be Rs. 32,951.83 (see Table A1), which almost falls in the middle-income group, implying that members of the middle-income group enjoy and spend more time at recreational sites than do those from lower income groups.

[3]Travel cost included the reported two-way travel costs from home to the site by different means of transport, whereas time cost included the two-way travel time cost and average on-site time cost on the basis of one-third reported wage rate of the respondents.

4.1.7 | Educational level of the respondents (*Edu*)

Visitors to the recreational sites are generally expected to be from better educational backgrounds. The TCM survey reported that most of the visitors were well educated; that is, 43.85% of the visitors have undergraduate and graduate levels of education, 41.52% of the visitors had PG and above (PhD, etc.), and about 13.29% of the visitors have up to secondary-school level of education.

4.1.8 | Round travel distance (*RTD*)

Most of sampled visitors to the park were from different states of the country other than the state where the park is situated. The survey for TCM revealed that people who came from a long distance had frequency of visits less than that of people who came from nearby areas/states. Descriptive statistics in Table A1 show that the reported average round distance of visitors was about 1,867.47 km with a reported maximum round distance of 8,000 km and minimum of 2 km to the site.

4.1.9 | Round travel time and on-site time

In the present study, visitor's average round travel time taken from the origin to the DNP was found to be around 17.45 hr, with a reported round maximum of 110 hr and minimum of 1 hr, as shown in Table A1. The table also shows that the maximum time spent on site by a visitor was around 5 hr, whereas the minimum time spent by a visitor was 1 hr. The average time spent on site by a visitor was 3.01 hr (see Table A1), which is included in the calculation of total time cost. The total time cost was included in RTTC in the estimation of TCM, as it creates multicollinearity effect if time cost is included as a separate variable in the estimation function (Englin & Shonkwiler, 1995; Heberling & Templeton, 2009).

4.2 | Empirical estimates from econometric models

Frequency of trips/visits undertaken by recreational visitors in a given period of time is a dependent variable in TCM. When parameters are estimated from on-site sampling data, then, according to Martınez-Espineira and Amoako-Tuffour (2008), the following caveats should be applied. (a) First, at least one trip to a recreational site should have been undertaken by each respondent; that is, the data are truncated at zero,[4] because only on-site visitors became a sampling unit and not the off-site visitors. (b) Endogenous stratification, that is, on-site sampling, often leads to choice-based sampling or size bias, because there are more chances to sample in a recreational site frequent visitors rather than occasional visitors. (c) Frequently overdispersed data, that is, variance, are greater than mean because few visitors make many trips and most visitors make only a few. (d) A dependent variable can only take values that are nonnegative integers, because it is a count calculated on the basis of number of visitor's visits. Literature suggests that simple ordinary least squares regression model is inappropriate to estimate the

[4]Non-visitors demand and their monetary value to recreational site are not captured in this study.

TCM with these problems. In this case, it is suggested that TCM should be estimated using a count data probability distribution (Cameron & Trivedi, 1986; Creel & Loomis, 1990; Hellerstein & Mendelsohn, 1993). Shaw (1988) first applied count data model to recreation demand. Count data models[5] are a series of econometric models used for the estimation on the basis of different types of problem and datasets (Cameron & Trivedi, 1998). In order to account for aforementioned limitations/problems, Poisson and truncated Poisson econometric models were used to estimate the results in the present study. Results obtained by Poisson model were estimated by using pseudo-maximum likelihood estimation (PMLE) approach using STATA Version 12.0. Recreational demand function was estimated with number of visits taken to the study site regressed on travel cost variable along with other socio-economic variables.

In the present study, travel cost acts as a proxy for the price of access, which includes expenses on travel, time cost (travel and on-site time cost), and other expenses on food and accommodation. With respect to estimated coefficients in both models, the price or coefficient of travel cost estimate (RTTC) was consistent with demand theory in that the quantity of visitors per thousand population was inversely related to travel cost or price. The estimated coefficient associated with travel cost variable (RTTC) was significantly different from zero at 1% level of significance in both models. Similarly, the estimated coefficient of income variable showed significance at 1% significance level in both the models. In addition, estimated income coefficient indicated a positive relationship between income and the quantity of visitors per thousand population. The coefficient of *Edu* variable is positive in both the models and significantly different from zero at the 1% level.

The marginal effects of the explanatory variables on the number of trips taken to DNP are also presented in Table A3, last column. The number of tourist visits to DNP increases by 0.41 with an increase of Rs. 1,000 in annual income of the visitors. One more year of education is associated with 0.6574 additional trips to DNP. Estimated marginal effect at mean for the variable age as −0.0036 indicates that keeping influences of all other independent factors constant (at their mean values), a 1-year increase in average age of respondents reduces the number of visits to DNP by 0.004. Similarly, a marginal effect at mean value of 0.6574 for *Edu* indicates that with a 1-year increase in respondent's education, the number of trips taken by respondent to DNP would increase by 0.66 (see Cameron & Trivedi, 1990). Estimation of elasticity coefficient provides information with regard to the visitor responsiveness to small changes in travel cost or price, which can be useful to site administrators (Poor & Smith, 2004). Price elasticity coefficients evaluated at variable means are presented in Table A6. The price elasticity coefficients for both the models are −0.1210 and −0.2771,[6] indicating a 1% increase in travel costs or price results in a corresponding less than 1% decline in the number of visits to DNP per 1,000 population. The elasticity coefficients indicate that if park authorities raise the price (say entry fee), they may experience an increase in associated revenues (Chopra, 2004).

[5]The outcome of the interest is a nonnegative integer, or a count. These models reflect the genetic interest in modelling discrete aspect of individual economic behaviour. These are useful in studying the occurrence rate per unit of time conditional on some covariates. These models are used for different datasets such as cross-sectional, time series, or longitudinal.

[6]Low price elasticities can be attributed to the following: (a) expenditure on the good is a small part of total income and (b) service in question provides a specialized type of recreational experience.

4.3 | Truncated Poisson regression model

In order to check the presence of overdispersion/underdispersion (i.e., mean ≠ variance)[7] or violation of equidispersion assumption (i.e., mean–variance equality [$\mathrm{var}(Y|X) = E(Y|X)$]), we conducted formal statistical tests for Poisson model, which reported that there is no overdispersion or underdispersion in our results. This has also been confirmed by the results obtained through using alternative method, that is, negative binomial method, which showed that the value of α is approximately equal to zero (i.e., 4.31E−08 and chibar^2 = 0.0E+0 with p-value 0.500). When $\alpha \rightarrow 0$ as in the present study, gamma distribution loses its significance and the negative binomial distribution reduces to a Poisson distribution (Cameron & Trivedi, 1986, 1990, 1998). Thus, following from this situation, no overdispersion has been found. However, number of visits (dependent variable) was truncated at one, which means at least one visit has been undertaken by the visitor, which creates truncation bias in the estimates. To tackle this problem in the present study, a truncated Poisson regression model (TPRM) was used, and results are reported in Table A3. Even though untruncated Poisson PMLE reported significant results, the main problem with this model is that it overestimates CS. Therefore, the truncated model was employed to overcome this problem. All estimated variables are in line with economic theory (see Table A3).

However, TPRM was quite fit for these data than are untruncated models as shown by the model statistics. The R^2 (pseudo-R^2) was 0.15, which is an improvement than that of untruncated Poisson models.

4.4 | Benefit/welfare estimates for DNP

Poisson MLE and truncated Poisson model were used to estimate the recreational demand function for number of visits to the site. After estimating the demand function, the results were used to estimate welfare measures/CS of visitor's visits to the DNP. Only the visitors to DNP were used for the calculation of welfare measures in the present study. The estimated coefficients of the travel cost covariates (for Poisson PMLE and truncated Poisson model) were used to calculate the consumer/welfare surpluses (see Table A4). As the average recreationists/visitors visit per year in our study was 2.25, the average annual CS per visitor is calculated by multiplying the average annual visits by CS per visitor per visit (see Table A4). This implies DNP visitors received a substantial amount of monetary benefit from the recreational use of the DNP ecosystem. It indicates that the park has a great unseen economic value and it is a valuable asset to the society. The total social welfare value of the recreational activities of the DNP is estimated by multiplying the total annual population of visitors to the park by average annual CS per visitor (see Table A4). It is observed from the estimation that due to the truncation effect, the total CSs obtained from the Poisson PMLE model showed upward biasness than did TPRM. This could be

[7]A statistical test of overdispersion (in which the conditional variance exceeds the conditional mean) is highly reasonable after running a Poisson regression. Overdispersion test statistics can be used to know whether for null hypotheses (H_0) $\alpha = 0$ or greater than zero for alternative hypotheses (H_1). It can be computed by estimating the Poisson model, constructing fitted values $\widehat{\lambda} = \exp(x_i\beta i)$, and running the auxiliary simple ordinary least squares regression without intercept term. That is, regress generated dependent variable $(Y_i - \lambda i)^2 - Y_i/\lambda$ on $\widehat{\lambda}$, without intercept term, and performing a t test of whether the coefficient of $\widehat{\lambda}$ is zero. Similarly, in case of underdispersion $\alpha < 0$ (in which the conditional variance is less than the conditional mean; see Cameron & Trivedi, 1986, 1990, 1998; and Greene, 2006, 2009, for details).

indicative of the fact that TPRM performs better than the Poisson MLE model, as it overcomes the problem of truncation bias.

4.5 | Recreational value of the DNP

The total recreational value equals the CS plus total cost of the visit. The total annual monetary recreational value of the DNP was estimated to be about Rs. 247,614,828 (approximately US $3,930,395) for given number of visitors (12,754),[8] which is shown in Table A5. This is the total annual value that the park yields for the economy. This estimated value of the park is the sum of the CS (benefit) of visitors and the total expenditure of the visitor to the site in the form of transportation charges, hotels and other accommodation charges, expenditure on food, and other expenses on site like expenses on sightseeing, watching endemic and endangered species, and trekking.

5 | CONCLUSION

DNP has an excellent potential and represents one of the most wonderful natural areas due to its naturally endowed diverse and rich resources. The main attractions of the area include its rich biodiversity, various numbers of endemic species, and paramount bio-physical features such as steep cliff, escarpments, landscape, and cool climate. The other definitive characteristics are unchanged traditional life of the local people, trekking, mountain hiking, and ecological studies. Now, the park has undergone deterioration of the population of endemic wild animals, encroachment and human settlement, loss of biodiversity, and grazing and has experienced the impacts of road construction. Thus, understanding the recreational value of natural resources of the park is fundamental to effective conservation programs. That is, when natural resources are damaged by human activities, their recreational value is greatly reduced along with their potential contribution to conservation programs. Therefore, it is important to estimate how much value people attach to this park to demonstrate how the respective authorities can extract additional revenue to improve the qualities and expand the types and varieties of their services. In doing so, the present study attempted to estimate the direct use value of the DNP, which will provide a feedback for policy-makers concerning decisions of improving quality of the recreational site. For analysis of recreational values of the DNP, ITCM and count data model (i.e., Poisson regression model with PMLE) were employed. With the use of the estimated coefficient of *RTTC* (β_{RTTC}) of Poisson PMLE, CS per visitor per visit was calculated at Rs. 12,470 (US$197).[9] This was used to determine total welfare of the site, which implied that DNP visitors received a substantial amount of benefit from its recreational use. It is observed from the results that various socio-economic characteristics (like age, education, and income) and factors (like travel cost, travel distance, and opportunity cost of time) determine visitor's recreational demand for the site. The study showed a significantly inverse relationship between number of visits of a visitor (dependent variable) and key independent variables, that is, travel cost and travel distance to the site. Empirical analysis of socio-economic variables and estimates of CS in this study can help in the formulation of policies with respect to its management. These may include creating separate tourist zone, eco-friendly restaurants, and more attractions

[8]As per the unofficial records 12, 754 visited the park in 2015.

[9]On the basis of exchange rates in June 2015.

featuring migratory and local birds. Estimated results reincarnate its significance as a precious natural asset providing varied functions and services to people. Hence, its preservation, overall development, and sustainable management should be important policy objectives and a national priority.

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APPENDIX A

TABLE A1 Descriptive statistics of variables

Variable	*N*	Mean	*SD*
No. of visits	301	2.252	1.375
Age	301	35.522	10.595
Sex (male = 1, female = 0)	301	0.794	0.405
Family size (*Flyz*)	301	4.917	2.320
Marital status (*Mst*)	301	0.734	0.442
Monthly income	301	32,951.83	20,466.6
Round travel distance (km)	301	1,867.468	1,912.362
Round total travel cost (with time cost) *RTTC* (in Rs. 000's)	301	7.775	7.388
Round total travel cost (without time cost) *RTTC* (in Rs. 000's)	301	6.944	7.036
Educational level (*Edu*; ranges from Category 0 to 7)	301	4.937	1.435
Time on site (hr)	301	2.73	1.133
Round travel time (hr)	301	17.45	23.500
Income	301	32.951	20.467

Source: Field survey carried out in 2015.

TABLE A2 Results from Poisson regression

Variable	Coefficient	*SE*	*Z*	*p* > *z*
Age	−0.00353	0.019597	−0.18	0.857
Age^2	5.73E−05	0.000231	0.25	0.804
Gen	0.214397*	0.080905	2.65	0.008
Flyz	0.000571	0.010869	0.05	0.958
MI	0.007168*	0.001452	4.94	0.000
RTD	−0.00015*	2.28E−05	−6.76	0.000
RTTC	−0.01556*	0.006003	−2.59	0.010
Edu	0.061689*	0.021523	2.87	0.004
Constant	0.473344	0.399159	1.19	0.236
Model statistics summary				
Log pseudolikelihood		−453.249		
Wald χ^2 (Clawson & Knetsch, 1966)		281.84		
Prob > χ^2		0.000		
Pseudo-R^2		0.1002		
N		301		

Source: Field survey carried out in 2015. *N*: no. of observations.

*The coefficient is statistically significant at the 1% level or less.

TABLE A3 Truncated Poisson regression dependent variable = No. of visits last 1 year (NV)

Variable	Coefficient	*SE*	*Z*	*p* > *z*	Marginal effect *dy*/*dx*
RTTC	−0.08019*	0.012113	−6.62	0.000	−0.6235
Age	−0.0001	0.00469	−0.02	0.982	−0.0036
Sex	0.389306**	0.154713	2.52	0.012	0.3091
Flyz	0.006286	0.017439	0.36	0.718	0.0309
MI	1.25E−05*	2.03E−06	6.17	0.000	0.4119
Edu	0.133168*	0.036568	3.64	0.000	0.6574
Constant	−0.34496	0.345165	−1.00	0.318	
Log pseudolikelihood			−398.579		
LR χ^2			137.03		
Prob > χ^2			0.000		
Pseudo-R^2			0.1525		
N			301		

Source: Field survey carried out in 2015. LR: likelihood ratio.

*Statistically significant at the 1% level.

**Statistically significant at the 5% level.

TABLE A4 Welfare measures for Dachigam National Park

Coefficient/CS	Poisson PMLE	Truncated Poisson model
β_{RTTC}	−0.01556	−0.08019
CS/visit per visitor (95% CI)	Rs. 64267.35 (US$1020.12)[a]	Rs. 12,470.38 (US$197.94)[a] Rs. 9,621.86 ($152.73)–Rs. 17,717.93 ($281.24)
Average CS per year[b]	Rs. 1,44,601.54 (US$2295.26)[a]	Rs. 28,058 (US$445.37)[a] Rs. 21,649.185 ($343.64)–Rs. 39,865.34 ($632.79)

Source: Field survey carried out in 2015. β_{RTTC}: coefficient of round total travel cost; PMLE: pseudo-maximum likelihood estimation; CS: consumer surplus.

[a]US$1 = Rs. 63 on the basis of exchange rates in June 2015. [b]Based on the sample mean of the visits (i.e., 2.25). Based on the sample (total number of visitors,i.e., 301).

TABLE A5 Total recreational value per year of the Dachigam National Park on the basis of visitors data from the Office of Warden

Consumer surplus		Total expenditure		Total recreational value
Per visitor (*A*)	Per year visitors (*B*) = (*A* × 12,754)	Per visitor (*C*)	Per year visitor (*D*) = (*C* × 12,754)	Per year visitor (*B* + *D*)
Rs. 12,470[a] (US$197)[b]	Rs.159,042,380 (US$81,455)[b]	Rs. 7,775[c] (US$123)[b]	Rs. 99,162,350[c] (US$15,74,006)[b]	Rs. 247,614,828 (US$3,930,395)[b]

Source: Field survey carried out in 2015.

[a]Calculated on the basis of truncated Poisson regression model. [b]US$1 = Rs. 63 on the basis of exchange rates in June 2015.

[c]Without inclusion of time cost.

TABLE A6 Price elasticity coefficient estimates

Functional form	TC price elasticity
Poisson (untruncated)	−0.1210
Poisson (truncated)	−0.2362

Note. Elasticities evaluated at variable means. TC: travel cost.