A Truncated Poisson Modeling of Visitors' Use-Values of Addis Ababa Lions Zoological Park, Ethiopia

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Abstract: Environmental resources provide economic benefits to man though these are sometimes difficult to value due to missing markets. This study estimated total economic use values of Addis Ababa Zoo Park using the Individual Travel Cost Method (ITCM). Data were collected from 158 visitors using structured questionnaires to estimate the value of viewing. Data were analyzed with descriptive statistics and truncated Poisson model. The results show that travel cost, monthly income and number of dependents significantly influenced demand for recreational site ($p<0.10$). Potential annual use value of the park was estimated at Birr11,767,287 per annum. The findings are critical in assisting policy makers to fashion out adequate investment profile for ensuring appropriate pricing of the wildlife.

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1. Introduction

Natural and environmental resources provide a complex set of values to individuals and benefits to the society. Protected areas, for example, offer scenic panoramas and radiant sunsets, exhilaration of white-water canoeing, the total serenity of wilderness trek, educational and spiritual values. There are different types of protected areas which are designed to give different services to the public. These include national parks, zoological gardens, cultural and historical parks, scenic or natural parks, amusement parks, children parks, sport parks, botanical gardens and nurseries. Both national parks and zoological parks are mainly used for protecting wildlife, but they serve different goals. In the national parks or sanctuaries, wildlife lives within a natural forest and there is no limitation on their movement from place to place whether in search for food or mates. On the other hand, since zoological parks are mostly found in towns, wildlife animals are forced to be incarcerated and dependent on humans for survival. Zoological parks are useful in protecting wildlife from dangers and increasing their number through breeding and close monitoring. Besides, zoological gardens create wildlife conservation awareness to the public and are very important for research and educational purposes (Carson, 2000; Bateman *et al.*, 2001; Tarfasa, 2007; Yalemzewd, 2007).

Zoological parks and botanical gardens have other advantages beside their primary activity of preserving and conserving wildlife. First, they serve as sources of income. For example, bird watching or birding in North America contributes more than $20 billion each year (Fish and Ervice, 1982). Second, they create job opportunities for the local community. Finally, establishment of zoos and botanical gardens motivate other investments such as gas stations, hotels and parking services in the neighborhood. Despite all these benefits, the conservation activities done by the recreational authorities and the society's contribution are limited. A majority of people in developing countries would like a better natural environment, less air pollution, more peace and serenity, cleaner beaches, more nature reserves and greener electricity production.

Unfortunately, those same people also need better roads and railways, more new homes to be built and low taxes to pay. Besides, many human activities are competing with the environment; for example, an increasing demand for agricultural land due to population growth puts pressure on wildlife, while an increase in number of industries results in water, noise and air pollution. Nevertheless, most people are not willing to compensate for the loss of environmental resources and even, if people are willing to pay for the benefit they derive from environmental services, getting the appropriate price for environmental resources is a bit difficult due to the absence of appropriate markets. It is the failure of the market system to allocate and price resources and environmental services correctly that creates the need for environmental valuation in order to guide policy makers (Byrne *et al.,*2003; Bowker and Leeworthy, 1998; Shaw, 1992).

Although Ethiopia is among the world leaders in terms of richness and endemism of mammalian species, the economic values of these

resources are still unknown. Because of absence of markets for these resources, their economic contributions to the development of the economy are undervalued. This has affected the sector negatively through limited conservation activities done by the responsible bodies. The wildlife population in Ethiopia has diminished over the last century, both in amount and distribution through hunting and land clearance for farming. Land degradation due to overgrazing is also intense and a vital contributing factor (Cameron, 1996; Cameron and Trivedi, 1998; Gizaw, 2007; Phillips, 1998; Shaw 1992; Mesfin 2010).

This study analyzed the economic values of wildlife resources inAddis Ababa Lions' Zoo Park. This study can be justified for some reasons. First, the zoological garden is a potential tourist destination because it is situated in Africa's administrative center. Therefore, it has potentials to generate high income and support for the tourism sector if appropriate valuation is employed. Second, this study seeks to contribute to a policy design for appropriately managing the Park through budgetary allocations by estimating the willingness to pay. This will also assist in adjusting the entrance fees in a manner that reflects economic and social costs/benefits.

The general objective of the study is to examine the total economic value of wildlife at Addis Ababa Lions Zoo Park and its contributions to national economic activity. The specific objectives are to determine the optimum entrance fee to the park and assess the socio-economic and demographic characteristics that influence people's willingness to pay for use value. In the remaining parts of the paper, methodology, results and discussions and conclusion were presented.

2. Materials and Methods

Sources of data

Data were collected from 150 visitors to assess consumers' economic surpluses for the direct use value The sample individuals were obtained from those visitors on the site during the survey. The respondents were randomly selected in the Park for interview after obtaining the consent of the authority of the zoo. The enumerators were in the Park in the morning till evening, and data collection took about 2 weeks including week-ends. Although interferences of the enumerators would have constituted some disturbance to the respondents, these were reduced by targeting the interviews with them while relaxing after going through the garden.

Individual Travel Cost Method

The travel cost method was used to estimate the recreational use value of the Park.In a model of single-site travel cost method (TCM), it is assumed that an individual's utility can be expressed as:

$U = U(X, L, y).1$ (1)

Where U is the individual's utility, X is the aggregate consumption, L is leisure and y is number of trips. The study further assume weak complementarity of trips with quality at the site, q. In other words, $\frac{\partial U}{\partial q} = 0$ when $y = 0$ (when a person does not visit the site, his or her utility is not affected by its quality), and y is increasing in q. The individual chooses X, L and y to maximize utility subject to the budget constraint:

$W \times [T - L - y(t_1 + t_2)] = X + P_y \times y$ .2

where Wis the wage rate, T is total time, t_1 is travel time to the site, t_2 is travel time to home, f is the access fee (if any) and P_y is the full price of travel. This model further assumes that travel time and time spent at the site are exogenous, that there is no utility or disutility from traveling to the site, and that each trip to the site is undertaken for no other purpose than visiting the site. It also assumes that individuals perceive and respond to changes in travel costs in the same way they would to changes in a fee for being admitted to the site. Finally, the model assumes that work hours are not flexible. This yields the demand function for trips:

$y^* = y^*(P_y)$ .3

Where $P_y = \frac{1}{4} \times hourlywage(t_1 + t_2) + travelcostisthefullpriceofatrip.$[1] .4

In this study, it is assumed that the demand function for trip is semi log because when compared with other functional forms like linear, quadratic and log-log forms it is highly efficient according to many studies. Englin (1995) compared linear, quadratic and semi log forms and got semi log is better in explaining the TCM demand function. Haab and McConnell (2003) deduce that semi log and log-log functional forms are preferred to other types of model specifications since they reduce heteroscadesticity and multicoolinrearity problems, and gives efficient and consistent estimates.

To estimate the demand equation, it is necessary to ask a sample of visitors to report the number of trips they took in a specified period, cost per trip, wage and other individual characteristics that might affect the demand for visits to the site. Once the demand function has been estimated, the consumer surplus provides an approximation of the

[1] $\frac{1}{4} \times hourly\ wage\ (t_1 + t_2)$ is the opportunity cost of travel time. The study takes ¼ of wage rate since many visitors visit the park during weekends and as a result the opportunity cost of time is small.

welfare associated with visiting the site. Formally, based on the demand function equation, the consumer surplus is equal to the area below the trip demand function and above the travel cost function. Estimation of the demand function and consumer surplus for the actual visitors is done using the count data model.

The non-negative and integer nature of trip demand suites the count data model to estimate recreational benefits. The application of count data model to assess recreation site demand by adopting on-site survey encounters the problems of asking the frequency of visits and truncated non-user samples. So, the study follow Shaw's (1988) on-site Poisson model to correct for these two evaluation problems. Moreover the study employed semi log functional form to estimate the recreational demand of the site. The total travel cost and other socio-economic variables are included in the model as independent variable. Total travel cost contains transportation costs of visitors, converting round-trip distance from home to destination site into ETB and opportunity cost of time. Without estimating travel time for a recreation site, the consumer surplus of benefits will be underestimated. The functional relationship is presented below:

$$Ln\,(y) = \beta_0 + \beta_1 T\ cost + \beta_2 Income + \beta_3 travel\ distance + \beta_4 SUP + \beta_5 \text{group} + \beta_6 \text{RSW} + \beta_7 \text{age} + \in_i \quad .5$$

Where, $Ln\,(y)$ = the expected number of trips (in logarithm) which is the dependent variable. *T cost* is the sum of travel cost and time cost of travel including a return in ETB, *Income* is monthly income of visitors in ETB, *travel distance* is the total travel distance in kilometers, including a return, *RSW* is the relationship with wildlife as dummy variable (1= relationship with wildlife, 0= no relationship with wildlife), *age* is visitors age, group is the travel characteristics as dummy variable (1=group, 0=single), *SUP* is the number of people that the respondent supports, β_0 is the constant term, $\in_i$ is the residual term which has a normal distribution with mean zero and variance δ^2

The primary aim of travel cost method is finding the use value of recreational demand benefits and computation of consumer surplus for each recreational trip. The appropriate recreational demand function is derived from the regression result between the expected number of trips and travel cost.

Estimation of the Demand for the Recreational Experience and Welfare Calculation

The study used the estimated coefficient of travel cost to calculate the welfare measures. Basically there are two steps to arrive at the final welfare of the visitor. The first step is estimating the demand relationship for the recreational benefit. This is done by relating the number of visit with the travel cost.

The linear semi log travel cost model hypothesis is:

$$\ln\,(y_i) = \beta_0 - \beta_1 Travel\ cost_i + \in_i \quad .6$$

Where y_i= individual i's annual visits to Addis zoo park, $Travel\ cost_i$ = Travel cost for individual i measured in ETB, β_1 is the constant term, β_0 is the coefficient of the travel cost

$\in_i$= residual and which has a normal distribution with mean zero and variance δ^2

3. Results and Discussions

Descriptive analysis visitors' characteristics and park attributes

Based on the survey data, demographic and travel characteristics of the visitors are presented in Table 1.

Table 1: Distribution of the visitors' demographic and travel characteristics

Variables		Frequency (n = 158)	Percent (100%)
Sex	Male	88	55.7
	Female	70	44.3
Marital status	Married	33	59.5
	Unmarried	125	40.5
Education level	Below Degree	83	52.6
	Degree and above	75	47.4
Preferred day of visit	Weekdays	21	13.3
	Weekends	125	79.1
	Public holiday	12	7.6

The results in table 1 show that 55.7% of the visitors were male and 44.3% were female. In the past, women were mostly engaged in domestic chores and hardly got the opportunity to attend school. The rise in the number of females in the recreational areas as visitors is an indicator of change in the society's attitude toward the gender division of different activities. Broadly speaking, couples spend most of their leisure time in recreational areas. This study also shows that 59.5% of the visitors are related or married, whereas single and divorced visitors together account 40.5%.Level of education among the sampled respondents is almost similarly distributed. About 47.4% of respondents have at least a first degree and above while 52.6% of the respondents have lower level of education.

Table 1 also reveals that 79.1% of the respondents preferred to visit Addis Zoo Park during weekends and 13.3% and 7.6% of the respondents preferred to visit during week days and holidays, respectively. This shows that many visitors prefer to visit the park during their leisure time to working time. This finding supports our previous conclusion in the methodology section on the opportunity cost of time as one fourth of the wage rate.

Since many visitors have preferred to visit the site during their leisure time the study takes the lower bound, which is one fourth of the wage rate, as an opportunity cost of time. Table 2 shows that almost three quarters of the respondents made small number of trips to Addis Zoo Park with 74.1% and high number of trips account only 5.1%.The table also shows that 55.7% of the visitors visit the site with their families and relatives and 44.3% were lonely visitors. Relatively high number of lonely visitors made a small number of trips as compared with visitors who were traveling in a group. For example 37.4% of the lonely visitors made small number of trips but group visitors made only 36.7%. On the contrary, 3.2% of the group visitors made many trips while lonely visitors made only 1.9% of the total respondent. This indicates that when people travel to recreational areas with a group then there will be a tendency to make more trips than lonely visits.

Table 2: Cross tabulation of visitors travel characteristics and number of trips

Number of trips (per year)	Visiting alone or in group		Total(%)
	Alone (%)	In group (%)	
Small number of trips (1-23)	37.4	36.7	74.1
Medium number of trips (24-49)	5.1	15.8	20.9
High number of trips (50-80)	1.9	3.2	5.1
Total (%)	44.3	55.7	100

Table 3: Cross tabulation of visitors level of satisfaction and number of trips

Number of trips (per year)	Satisfaction level			Total(%)
	Better than expected (%)	As expected (%)	Worse than expected (%)	
Small number of trips (1-23)	10.8	54.4	8.9	74.1
Medium number of trips (24-49)	1.9	18.4	0.6	20.9
High number of trips (50-80)	1.2	3.8	0.0	5.1
Total (%)	13.9	76.6	9.5	100

As depicted in table 3, many visitors were satisfied with the environment and the service delivery in the park. 90.55% of the visitors reported that they were satisfied with their stay in the park. 9.5% of the visitors responded that the park services were worse than their expectations and they only made small number of visits. More number of visits were made by those visitors that were satisfied with the park services. Table 4 identifies aspects of the park which attracted the visitors, and the respective number of trips made.

Table 4: Cross tabulation of attracting part of the park and number of trips

Number of trips (per year)		Attracting part of the park (AP)			Total (%)
		Existence of endemic wildlife (%)	Its green environment (%)	Its recreational service (%)	
Small number of trips (1-23)	Within AP	74.6	72.2	71.4	
	From Total	59.5	8.2	6.4	74.1
Medium number of trips (24-49)	Within AP	19.8	27.8	21.4	
	From Total	15.8	3.2	1.9	20.9
High number of trips (50-80)	Within AP	5.6	0	7.1	
	From Total	4.4	0	0.6	5.1
Total (%)		79.7	11.4	8.9	100

Addis Ababa lion Zoo Park is the only recreational zoo park in Ethiopia, the only wildlife reserving area in Addis Ababa and a home to some endemic animals. The lions in Addis Ababa zoo are the only traits in Ethiopia which attracts many national and foreign visitors. The existence of endemic wildlife attracts many visitors as shown in table 4 with 79.7%out of which 74.6% of the respondents made small number of visits. This indicates that even if they are attracted by the existence of endemic animals in the park, the small number of endemic animals found in the park is also the main reason for the respondents' disappointment.

Results of Truncated Poisson Regression

The econometric model presented in this section attempts to make some analysis and make inferences based on the information obtained from the sampled visitors. The robust regression result from truncated Poisson model is presented in table 5 below.

Table 5: A maximum likelihood estimation of the truncated Poisson regression

Explanatory variable	Expected coefficient Sign	Truncated Poisson coefficient	p-value	Marginal Effect	Mean Value
Distance Travel	-	-0.003 (0.006)	0.647	-0.006	10.332
Sup	-	-0.112 (0.049)	0.023**	-0.227	1.114
Age	-	0.007 (0.012)	0.528	0.015	27.563
Income	+	0.0001 (0.0001)	0.082*	0.0002	1632.089
Total travel cost (T cost)	-	-0.026 (0.006)	0.000***	-0.052	22.624
RSW	+	0.034 (0.152)	0.824	0.069	0.158
Group travel	+	0.064 (0.122)	0.602	0.129	0.563
Constant		1.044 (0.299)	0.000	-	-

*** 1 percent level of significance, ** 5 percent level of significance, * 10 percent level of significance (numbers in parenthesis are standard errors)

The truncated Poisson model is selected as an appropriate model that fits our data because of the absence of over dispersion problem. Over dispersion occurs when the variance is larger than the mean for the data. This may be due to few respondents making a large number of trips while most respondents making only a few. The mean of the visitation which is 2.533 is higher than the variance of the visitation 0.847, an indication of absence of the over dispersion problem. Furthermore test of over dispersion was made and the result shows that the dispersion coefficient alpha (ά) is $9.99e^{-24}$ and the p-value fails to reject the null hypothesis that says the value of alpha equal to zero or there is no over dispersion problem. Moreover, log-likelihood ratio test and the pseudo-R^2 value are used to test the significance of the model. The pseudo R^2 for truncated Poisson model is 10.87. The log-likelihood ratio (LR) test is formally more preferred to test the significance of the model. The calculated LR Chi Square (50.82) is statistically significant ($p<0.01$). Therefore, null hypothesis that all parameters are zero can be rejected.

The demand function of the independent variables includes travel cost, travel distance, income, SUP, RSW and age. It is expected that travel cost, travel distance, SUP and age are negatively correlated with the number of visits; and income, group and RSW positively correlated with the number of visits. The most important coefficients in this study for the purpose of gaining consumer surplus measures is the travel cost. The travel cost is the sum of all travel cost expenses including the travel time cost. The travel cost coefficients have registered the expected signs, negative sign, and is significant at 1 per cent significance level. The travel cost coefficients are consistent with the demand theory, which stipulates that when the price of travel increases then the number of visits will decrease.The negative sign is expected because as the costs of travel to the site increase, one is expected to take fewer trips per annum, ceteris paribus (given a fixed level of income). An increase in the travel cost by one birr will decrease the number of visits made to the site approximately by 5%. This means that people living closer to the site made many trips while those living far from the site made fewer trips.

Visitors' monthly income is also considered as one of the main variables that affects the number of visits positively. This seems reasonable, because when the income of an individual increases then the individual might be willing to substitute wage for leisure. On the other hand it is natural that people are willing to pay more for normal goods when their income increases. As described in table 4.9, the coefficient for income is significant at 10% significant level. As the income of the visitors' increases by one birr then the number of visits are expected to increase by 0.01%. However, the marginal effect of income on number of visits is very small which is due to the reason that the entrance fee to the park is very small, which is two birr. As shown in the appendix section, many visitors who made many trips are those who come from places near the site and therefore, they value their on-site expenses including entrance fee for their decision to visit or not. The onsite expenses are very small including the entrance fee which weakens income as the main determinant variable on the number of visits. As visitors income increases to higher level people also prefer clean and attractive environment during their time of visits. But as it illustrated in the appendix section almost 50% of high income group visitors are dissatisfied because of the environment and they made very small number of trips. For reasons outlined above, monthly income of visitors is an important variable but has a very small effect on the decision to make more or fewer trips.

Similarly, the variable SUP also registered the expected sign and significant level. The variable SUP is significant at 5% significant level. As the number of people an individual is supporting increases then the number of visits that he/ she makes will decrease and this is also consistent with the

theory of demand. When a visitor decides to support one more individuals at the margin then his willingness to visit the park will decrease by an approximate value of 22%. The first thing to note about this result is that, the magnitude is very large which could be because of two reasons. First when an individual supports his household members, he is devoting his income that might be used for visits and as a result the number of visit will decrease since the two goods are very competitive. Second, most importantly when an individual supports his household members, he is also scarifying his leisure time. This indicates that the variable SUP affects the number of visits from two directions.

The estimate of the RSW, distance travel and group coefficient produced the expected sign, but the estimated effect of the variable age did not. However, all these variables are not significantly different from zero.

The estimated demand function for Addis Ababa lions Zoo Park can be expressed as:

$$y = e^{1.04-0.52TC} \quad .7$$

The second step in the estimation of the welfare of an individual for a trip is finding the area under the estimated demand function which gives the recreational benefit flowing to each individual. The area of this demand function is estimated by integrating the inverse demand function between zero and the average number of visit. The result from this estimation gives the recreational value for average number of visits. Table 6 gives the result of the above estimation.

Table 6 Result of recreational value estimation and consumer surplus

Recreational value for average visit	Recreation value per trip	Average consumer surplus per trip
52.375 ETB	20.95 ETB	10 ETB

Source: Own computation

As shown in table 6, the recreational value for the average visit for truncated Poisson model is 52.375 ETB. Therefore the recreational value of the site per visit per person is estimated to be approximately 21 ETB. The annual report of Addis Zoo Park shows that the total number of visits to Addis Ababa lions Zoo Park in the last 12 months is 560,347 visits. Therefore, the annual on site recreational value can be calculated as 21 ETB x560,347 visit, which gives 11, 767,287 ETB

The last task in the measurement of welfare is finding consumer surplus. Consumer surplus is a widely accepted measure of net social benefit. It represents the difference between an individual's willingness to pay and actual expenditure for a good and service. With count data models, the procedure most often used is to calculate per trip consumer surplus (Creel and Loomis 1990). Per trip measure can be multiplied by the estimated number of trips in a year to obtain the aggregate consumer surplus of access to a given site or sites, in general or for a specific activity. The method establishes a relationship between the costs (the price) incurred by travelers to a site and the number of trips taken. This relationship is further exploited to derive Marshallian Consumer Surplus (CS) for access to the park for recreation experiences, by integrating the area under the demand recreation curve and above average travel cost 22 ETB. The result for average consumer surplus per visit as depicted in the table 6 is 10 ETB. Aggregate consumer surplus is obtained by multiplying the per trip consumer surplus of the visitors for the total number of 560,347 visits for the last 12 months, which is approximated to 5,603,470 ETB.

4. Conclusion and Policy Implications

This study analyzed the total economic value of Addis Ababa Zoo Park. This has been necessitated because of the economic importance of the development of tourism. Specifically, the tourism industry provides a number of economic returns in the form of foreign exchange earnings, employment generation, individual income and government revenues. In this regard, the potentials for using wildlife as an instrument for economic growth and development are quite enormous. However, these have not been fully explored both in Ethiopia and in other developing countries. Although some developments have been recently witnessed in the sector, wildlife is still largely considered from the limited aesthetic and touristic functions. In this respect, valuation can show, and quantify, the actual and potential contribution of wildlife to national economic growth, employment and income, to local livelihoods, to commercial profits and to industrial activities; and has shown how this information can be used to influence and mainstream development decisions and economic indicators.

This study attempted to measure the use value of wildlife through the employment of the travel cost method. The use value of wildlife estimated from data collected through the TCM, which helped to find the current recreational benefit of the park. The regression results showed that travel

cost, monthly income and SUP are important determinants for the recreational demand of the site.

The TCM is used extensively to value non-commercial outdoor recreational sites which have nominal access fees to inform decisions to invest in public recreation sites. Using travel cost method, the study attempted to quantify the benefits associated with the non-consumptive use of Addis Ababa Zoo Park. To increase number of visitors to the park while there is lack of awareness among visitors on the importance of wildlife, the results of the study could be useful to park management in setting appropriate conservation fee.

For TCM, an on-site truncated Poisson model of TCM is adopted to evaluate the use value of wildlife by calculating the consumer surplus. As estimated by the count data model, the study found the mean consumer surplus per trip to be 10 ETB. This demonstrates the magnitude of benefit provision by visitors and some proportion of revenue foregone at current pricing rates. This surplus represents only one category of total recreational value but it is sufficient to overturn approximate estimates of the opportunity cost. And the total recreational value of the park is approximately estimated to be 11, 767,287ETB per annum and the total recreational benefit or consumer surplus is estimated to be 5,603,470 ETB per annum.

The implication of the findings is important as a guideline to assist the park management or decision-makers in order to meet the sustainable use of wildlife through conservation activities. The result of this study may also be incorporated in the economic analysis for determining the viability of conserving wildlife of the park in the long run. However, future research is necessary to fully examine the robustness of the welfare values derived from the park to be used for management decision in the long run. Furthermore, the estimated benefits obtained from this study can be transferred to other similar parks for the purpose of policy or management decisions to affect the target resources.

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