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MEASURING ENVIRONMENTAL BENEFIT OF A RECREATION SITE: AN ECONOMIC ESTIMATE OF SODERE RECREATION AREA

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MAHMUD MOHAMMED

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Measuring Environmental Benefit of a Recreation Site: An Economic Estimate of Sodere Recration Area

By

Mahmud Mohammed

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Measuring Environmental Benefit of a Recreation Site:
An Economic Estimate of Sodere Recreation Area

By
Mahmud Mohammed Yesuf
Faculty of Business and Economics

Approval by Board of Examiners:

Dr. Andre Croppenstedt
Advisor

André Croppenstedt
Signature

Dr. Dejene Aredo
Examiner

Signature

Dr. Alemayehu Seyoum
Examiner

Signature

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DEDICATION

This thesis is dedicated to my mother and my father.

ABSTRACT

In this study, an attempt was made to attach quantitative estimates to the on-site recreational benefit of Sodere Recreation Area so as to demonstrate how the respective authorities can extract revenue out of the excess benefits to improve qualities and expand the types and varieties of their services. Furthermore, welfare effects of two of the major drawbacks of recreational qualities on the site were estimated. In doing so, the study applied two standard procedures in Environmental Economics, i.e. Travel Cost and Contingent Valuation Methods, using primary data collected from a survey of 232 visitors at Sodere Recreation Area.

The Travel Cost Method used the amount of money and time people spend getting to the site to derive the demand function for the site, which in turn was used to calculate recreational benefits associated with the site. On the other hand, the Contingent Valuation Method used hypothetical elicitation techniques to evaluate people's Willingness-to-Pay (WTP) in exchange for access to an improved recreational qualities, which in turn was used to estimate the welfare effects of the existing problems on the site.

Like other similar studies, travel costs, visitor's income, mode of transport, and experience on other substitute sites were identified as major determinants of visits to the site. On the other hand, visitor's income, visitor's attitude towards the problems, and visitor's position and responsibility in the household were found to be important determinants of the WTP responses.

Using Maximum Likelihood estimators of truncated models, the annual on-site recreational benefit of the site was estimated to be Birr 9,824,094.80 (US $1,403,442.10) per year, in

which the site authorities collect only 9 percent of this sum, i.e. an average of Birr 856,680 (US $122,382) per year, from gate fees. This shows that much can be done to generate revenue for the support of quality improvement and expansion projects at the site. On the other hand, using the same models, the welfare effects of congestion and malaria problems were valued as Birr 1.37 (US $0.20) and Birr 4.39(US $0.63) per visit respectively, showing the relative depth and seriousness of malaria problems on the site.

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CHAPTER ONE

INTRODUCTION

1.1. General Background

Many conventional commodities that are considered as private goods are generally treated in the market. Quantities and Prices are determined through the interaction of supply and demand. The value of such commodities are therefore determined in the market according to buyers willingness to pay, and sellers willingness to supply or assert payments. So no problem exists in valuing private goods. But the problem arises on the valuation of environmental goods and other public goods. For most of them, there are no markets or markets are imperfect if they exist at all. Most environmental goods tend to be impure public goods and hence their values can not be easily determined in conventional market situations, for public goods and externalities can't be easily treated in the market. Hence a way must be found to put monetary values on environmental benefits or costs. Thus valuation of environmental resources refers to putting money values to environmental damage or improvement. It enables economists to identify or approximate the optimum especially where the market fails to allocate resources optimally.

People's preference is the basis for valuing environmental resources. People express their preference through their Willingness-to-Pay (WTP) when confronted with choices of goods and services. An aggregation of WTP reflects what is socially desirable. For some of impure public goods such as recreation sites which are accessed with some institutionally determined gate fees, market prices can be taken as a starting point to estimate people's WTP. In other words, total expenditure on a good can be taken as the first approximation of benefit proceeds. However, the concept of consumer surplus indicates that some people's WTP is higher than the market price. Thus the totality of actual expenditure and consumer surplus forms Gross Willingness to Pay or Total Social Benefits of the resource under consideration. This in fact is the area under the demand curve.

Now the problem is how to elicit people's WTP so as to estimate these demand curves? There are various valuation techniques used to estimate the value consumers place on environmental and other public goods. These include Travel Cost Methods (TCM), and Contingent Valuation Methods (CVM), and Hedonic Pricing Methods (HPM). Two of these valuation techniques, i.e. Travel Cost and Contingent Valuation Methods are used in this study. HPM uses market prices of a given marketable commodity to estimate an environmental value that is embodied in the observed price of the commodity. For example, it is used to estimate the value of clean air on the price of a house. Therefore, HPM is excluded in this study because it is not an appropriate method for measuring site value of a recreational site.

1.2 Statement of the Problem

Many people equate recreation with "fun". They do not consider it as a subject for serious study. That is why research in outdoor recreation in many countries has been almost non-existent. Nevertheless outdoor recreation should be thought of as human activity that adds to utility and requires and competes for limited natural and financial resources for its provision. These resources include land, water, beaches, buildings, parks, forests, personnel, and other natural, human and financial resources. Stemming from increasing population, income , and mobility, the demand for outdoor recreation has been increasing in many developing countries (Clawson et. al., 1966). If more of the above resources are devoted to recreation or diverted or reallocated to different recreational uses, something must necessarily be given up from alternative uses. Therefore, quantitative estimates of both the costs and benefits should be properly conducted so as to allocate the existing scarce resources properly and efficiently. In this respect, the problem in outdoor recreations is that, we can not rely on market values to estimate total benefits, for these commodities are club or public goods and are not produced and distributed in accordance with the market mechanism. Hence, we need to impute values that reflect the true social costs and benefits of activities using some indirect methods. Failure to incorporate the true social costs and benefits may underestimate net conservation benefits and overestimate net development benefits which in turn might impose an irreversible damage to the natural recreational resources in favor of other developmental activities.

In line with this broad and general problem, this research will investigate outdoor recreation demand functions and overall recreation benefits, taking *Sodere* Recreation Area as a case study. *Sodere* is famous as a natural recreation center for many people in *Addis Ababa, Nazreth, Assela*, and the surrounding regions. It is known for its natural hot water baths and swimming pools. Despite these sources of natural attractions, the center has been unable to improve the qualities of recreation experience and expand the types and variety of its outdoor recreation services for a long period of time. Instead, the site is deteriorating mainly because of weekend congestion and serious malaria epidemics at the site. It has also been affected by flooding from the nearby Awash river. If these problems continue to reduce recreational qualities of the site, visitors might be forced to spend their recreation time on other substitute sites and the site be used for some other alternative development activities, which in turn may result in irreversible damage to the different environmental resources on the site. It is therefore an important first step to estimate how much people attach value to the site so as to demonstrate how the site managers can extract revenue out of the excess benefit so as to improve the qualities of the recreation experience and expand the types and variety of the services.

1.3 The Study Site

Sodere is a resort area found 120 kms away from Addis Ababa at a little village which has grown near one of the dams of the Awash river. *Sodere* takes advantage of the volcanic mineral springs, which bubble to the surface to fill its two swimming pools with warm water, and of the nearby Awash river with its forest made up of giant shade trees.

Although swimming, bathing and relaxing are the objectives of most people's trip to *Sodere*, walks in the surrounding country side afford views of velvet monkeys and baboons, as well as crocodile, hippos, and birds. Apart from these natural resources, *Sodere* provides different accommodation and restaurant and snack services.

According to internal sources of the site, *Sodere* was reserved as a public recreation center in 1958 with a small common bath, a little swimming pool, under the supervision of the Ministry of Finance. Before 1958, it was a privately owned dense forest in which a variety of wildlife had been residing. Until 1958, only a couple of leprosy patients had been using the spring water of *Sodere* as a means of medication. Later in 1965, the center had been expanded, with one more Olympic size swimming pool constructed, under the supervision of *Filwoha Administration.* At the early years of the Center, entrance was free. However since 1962, different gate fees have been imposed, ranging from 0.50 cents in 1962 to Birr 5.00 in 1997. Currently, visitation to the site ranges from less than 100 people during weekdays to more than 1000 people during weekends and holidays.

Table 1.1

Daily visitations to Sodere(first week in March 1998)

Monday	Tuesday	Wednesday	Thursday*	Friday	Saturday	Sunday	Total
148	173	80	998	418	959	868	3644

Source:- Weekly Sales Report of *Sodere* (Unpublished)
Note:- * A Public Holiday

Similarly, peak visitations are observed during the summer season (June-August), and low visitations during the major malaria and flooding seasons of September and October. This condition can be demonstrated with visitations records in the table below.

Table 1.2

Monthly visitations to Sodere (March 1997-February 1998)

Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Total
17572	14069	18439	16431	20564	16565	3938	8667	11373	14840	12833	16045	171336

Source:- Annual Sales Report at *Sodere* (Unpublished)

According to the same source, the center collects, on the average, Birr 50,000 to Birr 100,000 (US $ 7,143 to US $ 14,286) from gate fees each month to finance its expenses and salaries for the 192 full time and par time employees.

1.4 Significance of the Study

Evaluation of recreation benefits has made significant headway in the past few years. A lot of research work has been done in many developed countries since the first attempt has been made by Clawson and Knetsch in 1961. But very little attempt has been made in developing countries, despite the important role that parks, beaches and other recreation areas are playing in their tourism industries. So far no attempt has been made in Ethiopia to impute economic values for any of the parks, and other recreation centers. Therefore, this is the first academic attempt to estimate total economic benefits of a recreation site. This research work will contribute to the existing limited economic literature for Ethiopia in this area of environmental economics. It will demonstrate how the economic benefits relating to public or club commodities can be quantified using two relatively new techniques in a way that may facilitate better planning and management. The result may be used as an input for comprehensive and rigorous policy oriented research work in the area.

1.5 Objectives

The ultimate objective of this study is to estimate total recreational benefit of recreation site using Travel Cost and Contingent Valuation estimation Methods. The valuation is intended to provide quantitative results for recreation authorities and managers for better planning and management of reserved forests, parks, beaches and other recreation sites. The specific objectives include:

- To identify factors that determine visitations to outdoor recreation and estimate a recreation demand function.
- To estimate total on-site recreational benefits of the site.
- To estimate the welfare effect of congestion and the malaria problem in the *Sodere* recreation area.

1.6 The Scope and Limitation of the Study

Due to limited time and financial constraints, this study has restricted itself to measuring site value only for the *Sodere* Recreation Area as a case study. Also samples are drawn only from users. Furthermore, the study measures only current recreational values of the site out of the total economic benefits of the environmental resource under consideration (see fig.1.1 for the detail). However, it is believed that the techniques employed in this study could be easily adopted for any further comprehensive policy oriented research work to measure total economic benefits of other recreational sites or other environmental resources from samples drawn both from users and non-users.

1.7 Organization of the Study

The remaining part of this paper is organized as follows. Chapter two provides a review of the literature, consisting of both the theoretical issues on valuation techniques and recent applications in the field. Chapter three discusses data and methodological issues, including the data source, the field procedures, model specifications, expected signs, and functional forms. In chapter four the main findings of the study are presented and discussed. Finally, and in chapter five conclusions and policy implications are drawn based on the results obtained from the study.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews both theoretical and empirical issues in the area of estimating environmental benefit in general and recreation demand analysis in particular. The first part of the review focuses on theoretical issues such as demonstrating the different components of values of an environmental resource, the different valuation techniques and their underlying theoretical framework. The second part reviews recent empirical applications of the techniques both in the developed and developing countries.

2.1 Components of Value for Environmental Resources

Many Environmental resources including water and forest based recreation sites have both use and non-use values to human beings.

Total Value = Use Value + Non-use Value

Economists and Ecologists classify overall use values into four categories such as Direct Use Value , Indirect Use Value, Option Value, and Quasi-Option values. (See fig. 2.1 for graphical presentation).

Direct Use Values are fairly straight forward in concept, for they are current utilities obtained from the given resource in the form of food and innumerable materials. Sustainable provision of timber, fish, medicine, plant genetics, human habitat etc. are some of the direct use values obtained from water and forest based recreation sites. Indirect use values correspond to the ecologist's concept of ecological functions and current recreational benefits. These include nutrient cycling, watershed protection, air pollution reduction, outdoor recreation etc.

Option values relate to the amount that resulted from demand and supply uncertainties and risk aversion behavior of individual consumer. Future personal recreation can be mentioned as an example in this case. Quasi-option value is the value of information about the future benefits that would be precluded by development decision now. It captures the willingness to pay (WTP) of people to preserve an environmental resource if they lack information about future use of a resource that would be precluded if the development decision is made today. Thus Quasi-option value arises due to irreversibility of development decisions. Quasi-option value can not be added to option value as they measure different concepts.

Non-use values can also be categorized as bequest values that captures inter-generational equities such as future generation recreation needs and existence values which reveal many people's WTP for the existence of an environmental asset through wildlife and other environmental charities. This component of non-use value is even more pronounced where the environmental resource under consideration is unique.

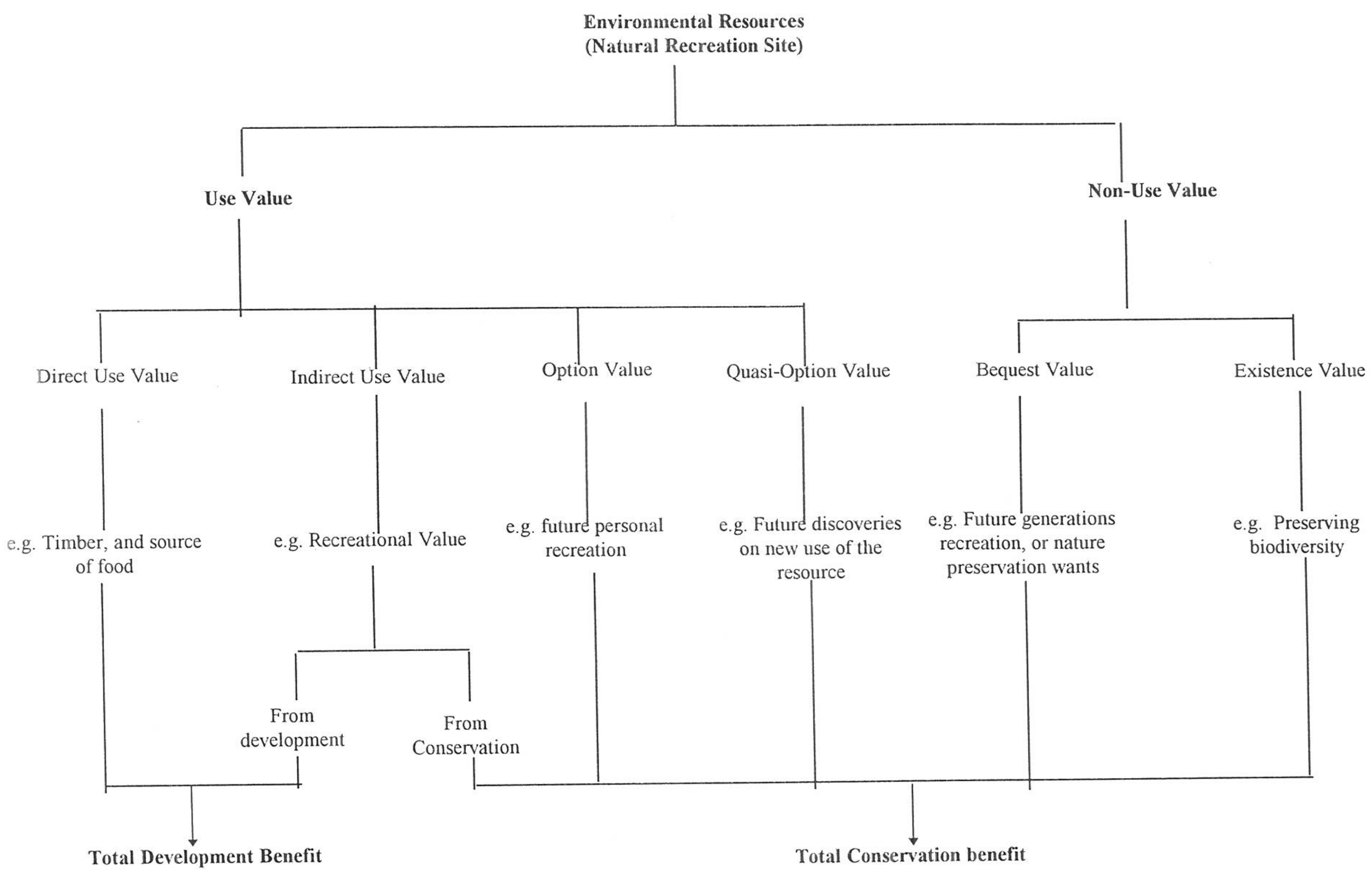

Fig. 2.1 Total Economic Values of an environmental resource (Adopted from Bateman et. al., 1993).

It is important, therefore, that a proper measurement of total economic benefits of an environmental resource should take into account all these components of value. Any effort that omits one or more of these components will underestimate conservation benefits of the resource under consideration.

Due to time and financial constraints, this study measures only one component of total economic benefits (i.e. current recreational benefits) of the recreational site under consideration.

2.2 Theoretical Framework for Valuing Environmental Amenities

This section attempts to provide a common theoretical basis for the two basic approaches used in this study to value environmental benefits for out door recreation. The presentations are due to Brookshire et. al.(1982) , Johansson (1987) and Bateman et.al. (1993), with some modification to recreational sites.

Consider a household utility function which is composed of an environmental good (say recreational activity), and composite commodity which is not associated with recreation. Note that all the variables are specified as vectors.

$$U= U (X , R_j , Z_{ij} , Q_j) \qquad (2.1)$$

Where

X = Consumption of Composite good, not associated with outdoor recreation

R_j = Recreational Visits to site j

Z_{ij}= Total distance traveled by individual i to site j, this is equal to $R_j.D_{ij}$, where D_{ij} is the round trip distance from individual i's home to site j. This is assumed to be fixed for a given visitor.

Q_j = Quality index of the recreation

Where $\partial U/\partial R_j = U^i_R \geq 0$, $\partial U/\partial Q_j = U^i_Q \geq 0$, and $\partial U/\partial X = U_x \geq 0$. So utility is increasing in R_j, Q_j and X . On the other hand $\partial U/\partial Z_{ij} \gtreqless 0$, so that utility obtained from travel is indeterminate a priori.

Now the household is facing a utility maximization problem subject to a budget constraints given by,

$$Y - \sum PR_j . R_j - \sum PTC.Z_{ij} - X = 0 \quad \text{.................................} \quad (2.2)$$

$$T - \sum ST_i . R_j - \sum t_{ij}.Z_{ij} = 0 \quad \text{.................................} \quad (2.3)$$

Where

Y= disposable income of visitor (household)

PR_j= entrance fee at site j

PTC= Money Expenditure on travel (petrol, etc.) per km or mile.

T = total recreation time (fixed)

ST_j = length of per visit on-site time at site j

t_{ij} = travel time per km or mile for individual i o site j

X= Money expenditure on composite good and the price of composite good is assumed to be unity (for simplicity purpose).

Total travel distance to site j is also assumed to be fixed for a given individual. Furthermore, recreational quality of site j is assumed to be unchanged during individual i's visit to site j.

Forming the Lagrangean function and substituting Z_{ij} with $D_{ij}.R_j$, we obtain

$$L = U(X, R_j, Z_{ij}, Q_j) + \lambda \, (Y - X - \sum PR_j.R_j - \sum PTC . D_{ij}.R_j) + \eta \, (T - \sum ST_i.R_j - \sum t_{ij}.D_{ij}.R_j) \quad (2.4)$$

$$\partial L / \partial X = U_x - \lambda \quad \text{...} \quad (2.5)$$

$$\partial L/\partial R_j = U_R - \lambda \sum PR_j - \lambda \sum PTC . D_{ij} - \eta \sum ST_i - \eta \sum t_{ij}.D_{ij} \quad (2.6)$$

$$\partial L/\partial \lambda = Y - X - \sum PR_j.R_j - \sum PTC . D_{ij}.R_j \quad \ldots\ldots\ldots\ldots \quad (2.7)$$

$$\partial L/\partial \eta = T - \sum ST_i.R_j - \sum t_{ij}.D_{ij}.R_j) \quad \ldots\ldots\ldots\ldots \quad (2.8)$$

Dividing (2.6) by (2.5) , we obtain

$$U_R/U_x = \sum PR_j - \sum PTC . D_{ij} + \eta \sum ST_i + \eta \sum t_{ij}.D_{ij} \quad \ldots\ldots\ldots \quad (2.9)$$

and also from (2.6),

$$\partial U/\partial R_j = \lambda PR_j + \lambda \sum PTC . D_{ij} + \eta \; ST_i + \eta \; t_{ij}.D_{ij} \quad \ldots\ldots \quad (2.10)$$

- $\partial U/\partial R_j$ ↓ marginal utility of a visit to site j
- λPR_j ↓ opportunity cost of entrance fee
- $\lambda \sum PTC . D_{ij}$ ↓ opportunity cost of money travel cost (petrol etc.)
- $\eta \; ST_i$ ↓ opportunity cost of time spent on site
- $\eta \; t_{ij}.D_{ij}$ ↓ opportunity cost of time spent on travel

Equation (2.9) and (2.10) are common results observed in studies of recreation demand analysis. They state that in equilibrium, a rational consumer considered under this framework will equate the marginal rate of substitution between recreational activities and consumption of composite goods with the total travel costs associated with a trip. Also the individual equates the marginal utility of visits with their total costs in his effort of maximizing utility. Solving the equations from (2.5) to (2.8) yields ordinary (Marshallian) demand functions as a function of prices, PR_j and PTC, income Y, Recreational visits (R), and distance traveled (Z_{ij}).

The total area under this demand curve is the total recreational benefit associated with a given trip. This is the theoretical basis for the travel cost estimation technique considered in this study, where data is collected about people's visitations and associated costs to estimate the demand curve for a visit to *Sodere*.

Similarly, to determine the marginal willingness to pay for environmental quality (which is a basis for the Contingent Valuation technique), we minimize the expenditure function subject to a given utility level as,

$$\textbf{Min. } Y - \sum PR_j.\ R_j - \sum PTC.\ D_j\ .\ R_j - X \qquad \textbf{(2.11)}$$

Subject to

$$U(X, R_j, Z_{ij}, Q_j) \geq \bar{U} \qquad \textbf{(2.12)}$$

Setting the Lagrangean Function, and solving for the first order necessary conditions, we obtain a Hicksian demand function which is a function of all the prices, the quality index and the given utility level.

To determine the marginal willingness to pay for recreation quality improvement activity (say reducing Congestion or Malaria problems in the case of *Sodere*) we set the utility function in equation (2.1) equal to constant and totally differentiate the resulting expression. By then taking total differential of equation (2.2), and setting all the price changes to zero, and by using equation (2.9) , we obtain

$$U^i_Q/U^i_X = -dY/dQ_j \qquad \textbf{(2.13)}$$

Equation (2.13) shows the change in income necessary to offset a change in environmental quality improvement activity.

Therefore, in empirical studies, if the objective is to determine the marginal willingness to pay for environmental quality (U_{Qj}/U_x), one obvious approach is to simply postulate in the survey questionnaire that Q_j increases (decreases) by a small amount dQ_j, where market prices are hypothetically held constant, and request information on the contingent willingness of individuals to give up income (or accept compensation) for an increase (decrease) in quality. This is called Compensating (Equivalent) Variation for improved (reduced) recreational quality. Therefore Compensating and Equivalent Variation measures are the two important micro economic concepts behind the contingent valuation technique.

2.3 Valuation Methods of Environmental Resources

2.3.1 The Travel Cost Method

The travel cost approach was originally proposed by Hoteling in a letter to the U.S Department of the Interior's National Park Service. It was later redefined and applied by Clawson and Knetsch (1966). It has been applied primarily to outdoor recreation in the United States and Canada. Today, it stands as a widely accepted and applied method of evaluating outdoor recreation benefits of natural resources such as water and forests.

The travel cost procedure exploits the fact that users travel from various places to spend their time at the site, which involves costs in traveling to and from the site. This cost in terms of the time and money individuals expend getting to and from the site, can be used to derive a demand function for the site. Once demand has been derived, it is possible to estimate the benefits associated with the site.

Most of the literature in recreation demand analysis focus on the use of Individual versus Zonal Travel Cost Methods, on the calculation of visit costs, on the selection of explanatory variables and on the selection of models and specifications of the dependent variable. These issues are briefly reviewed below.

2.3.1.1 Zonal versus Individual Travel Cost Methods

Based on their definition of the dependent variable V (visits), the literature can be divided into two basic variants of this model: Zonal Travel Cost Method(ZTCM) and Individual Travel Cost Method (ITCM).

The ITCM simply defines the dependent variable as the number of site visits made by each visitor over a specific period, say one year. The ZTCM, on the other hand, portions the entire area from which visitors originate into a set of visitor zones and then defines the dependent variable as the visitor rate i.e. the number of visits made from a particular zone in a period divided by the population of that zone.

A simple typical trip TCM model, based on individual observations can be defined as follows:

$$\mathbf{V=f(C,X)}$$

Where,

V= Visits to a site

C= Visit costs

X= Other socio-economic variables which are hypothesized to explain V.

Similarly, the typical trip model redefined in ZTCM is given by ,

$$V_{hj}/N_h = f(C_h, X_h)$$

Where, V_{hj}= Visits from zone h to site j

N_h= population of zone h

C_h= visit costs from zone h

X_h= socioeconomic explanatory variables in zone h,

The basic benefit estimation procedure in ZTCM can be briefly outlined as follows:

- ⇒ Data on the number of visits made by households in a period (say annually) and their origin will be collected through on site surveys
- ⇒ The area encompassing all the visitors origin will be subdivided into zones of increasing travel cost.
- ⇒ The number of household visits per zone will be calculated by allocating sampled household visits to their relevant zone of origin
- ⇒ the household average visit rate in each zone will be calculated by dividing the number of household visits in each zone by the Zonal population
- ⇒ The Zonal average cost of a visit (both travel cost and opportunity cost of travel and on site time) will be calculated with reference to the distance from the trip origin to the site.
- ⇒ A demand curve will then be fitted relating the Zonal average price of a trip (travel cost) and other relevant explanatory variables to the Zonal average number of visits per household. This curve will estimate demand for the "Whole Recreation

Experience" (WRE) which is composed of both on-site and off-site experience. Integrating under this curve between the initial travel cost and that travel cost at which visits in all zones fall to zero will estimate total benefits for the WRE. Hence the estimation of the on-site recreation benefit requires a scaling factor derived from visitors value judgment on how much of their total utility from the recreation was due to on-site experience.

On the other hand, in an ITCM, data will be collected on a sample of visitors on their visits, travel costs incurred and their socio-economic characteristics. A demand curve is then fitted relating travel costs and other relevant explanatory variables to their number of visitations adjusted to a per capita basis. This demand curve will estimate demand for Whole Recreation Experience. Hence the estimation of the on site experience follows the same procedure outlined in ZTCM except individual visitations and costs are considered instead of Zonal averages. (see Caulkins et. al., 1986 and Smith, 1988).

Many authors have pointed out a number of methodological problems associated with the ZTCM. These are problems associated with the methods by which zones are defined, the use of an average value of visitations as a dependent variable, problems associated with aggregation, omission of individual specific explanatory variables, upward bias in the R^2 statistic arising from aggregating individual responses into Zonal average figures. All these problems will produce biased estimates in ZTCM. On the other hand, ITCM has the advantage of allowing specification of a number of individual specific explanatory variables and hence has a stronger behavioral foundation than ZTCM.

2.3.1.2 Calculating Visit Costs

Total visit costs can be decomposed into travel costs and time costs, the latter being subdivided into travel time and on-site time costs . The major problem in calculating visit costs arise in empirical estimation of the opportunity costs of travel and on-site time. Travel time values, particularly, are difficult to analyze in that we have no definite a priori notion about whether travel time utility is positive or negative to the visitor. Visitors can be grouped either as ***pure visitors*** who are strongly site oriented (with negative travel time utility), ***transit visitors*** who make multiple purpose trip (with undefined travel time utility), and ***meanderers*** who gain utility primarily from the journey itself and hence have incurred less opportunity cost in their travel time.

Different practical approaches have been followed. Bojo, for example, doesn't include a travel time cost (he simply gives such time an opportunity cost of zero) on the grounds that 80% of survey respondents expressed a positive utility for travel time to the site under consideration (see Bojo, 1985). Another approach to this problem is to apply a utility weighting to a standard travel time cost , the weighting being derived by direct questioning of the respondents. By asking respondents to rate their enjoyment of the travel time alone. An inverse index can be set up such that a respondent who hates traveling (pure visitors) is given an index value of 1 while a respondent who prefers traveling to visiting (meanderer) is given an index value of 0, with continuous gradations between these extremes (Cesario, 1976). The resultant index can be used to weight any per hour travel time costs. Others took the full wage rate as travel time cost , for they argued that there is no clear cut method for estimating opportunity cost of time (Ward, 1983, and McConnell, et.al 1981). They used the same full wage rate for on site time.

In any case, failure to account for both travel and on-site time costs can lead to potential bias in benefit estimation. The fact that the marginal utility of a visit will be influenced by both travel and on-site was easily demonstrated using the utility maximization problem illustrated in section 2.2.

Equation (2.10) demonstrates the potential importance of on-site and travel time as determinants of visits. This study supports the idea of Ward and McConnell that there is no clear cut method for estimating opportunity cost of time and hence the full hourly wage rate is used to calculate total time costs.

2.3.2 Contingent Valuation Method (CVM)

Although Ciriacy-Wantrup in1947 had suggested the use of the direct interview method to measure the values associated with natural resources, it was Davis who first used the Contingent Valuation Method to estimate benefits from outdoor recreation.

The basic idea behind the Contingent Valuation Method is that a survey is administered to elicit information about preferences for a good or services by asking individuals question about how much they value a good or service. This information can then be used to estimate a demand function and economic benefits associated with the provision of goods and services under consideration. Contingent Valuation should not be confused with market research or opinion polls. Contingent Valuation typically focuses on individuals' preferences for non-market goods and services. Market surveys and opinion polls focus almost exclusively on marketed goods and services. The technique is termed as contingent because the situation the respondent is asked to value is hypothetical (if this happened what would you be willing to pay?)

The basic benefit estimation techniques in CVM can be outlined as follows:

⇒ A CV questionnaire will be designed and administered to elicit information from individuals on how much they are willing to pay to have access to a new or improved environmental resources or other public goods. In its first section, the questionnaire (communicated through the interviewer) should present sufficient information and detailed information about the goods to be valued. If the good or service to be valued is not well understood by the respondent, CVM responses are likely to be unreliable. Furthermore, the questionnaire should explicitly indicate the structure under which the good is to be provided, and the vehicle under which the payment is to be made.

⇒ The information obtained from a CV survey will be analyzed using various descriptive statistics so as to determine whether respondents' answers are consistent with theory and common sense and to establish statistical relationships or models that will be estimated for WTP responses against selected explanatory variables. Successful estimates using variables which theory identifies as predictive of people's WTP serves as partial evidence for reliability and validity.

⇒ The frequency distribution of WTP bids and the estimated demand function will be used to estimate total WTP and welfare changes after having access to new or improved environmental resources.

⇒ Results obtained from the sample will be aggregated to the whole population so as to get total benefit of the resource for a given period of time.

The major problem usually encountered in the Contingent Valuation is the degree of reliability that can be attached to the information the respondent provides the interviewer, for the responses are subject to many biases such as strategic bias, hypothetical bias, information bias, and instrument bias.

Strategic bias arises when respondents don't reveal their "true" value of the good or service in the hope of a "free ride", expecting others would pay for the provision. Hypothetical bias occurs when the respondent is being confronted by a contrived, rather than actual set of choices. Information bias arises when the facts given to the respondents fail to represent the real scenario. Finally, instrument bias arises when the respondent is hostile to the means by which payment would be collected.

Most of these biases arise from the hypothetical nature of the survey. But these biases are less serious when CVM is applied to outdoor recreation, for the respondents are actual consumers of the good (not potential users), and the interviews are conducted on the site where the respondents are actually engaged in the activity (see Cummings et. al., 1986 and Mitchell and Carson, 1989).

Another problem related to CVM is the decision whether Compensating Variation or Equivalent Variation is the appropriate measure of Consumer Surplus. In recreation benefit estimation, Compensating Variation refers to the maximum amount of money that an individual is willing to pay to secure an improved provision of recreational activity (Type 1 in fig. 2.2). If the supply or quality of the recreation activity under consideration is reduced, then the Compensating Variation measure gives the minimum compensation that must be given to the individual while leaving him as well of as before the reduction in the quality of recreation experience (Type 4 in fig. 2.2). The latter scenario is not usually observed in recreation activities. In order to obtain an aggregate measure, the Compensating variations for all affected individuals are added together. In the case of an equivalent variation measure, each individual remains at his final, as opposed to his initial level of satisfaction. This measure represents the sum of the minimum (maximum) sum of money that must be given (taken from) each individual to make him as well off as he would have been following an increase (decrease) in the provision of the resource under consideration (Type 2 & 3 in fig. 2.2 respectively).

Related to Compensating and Equivalent variations are WTP and WTA as means of eliciting consumers' preferences (see fig.2.2). WTP is defined as the maximum amount that consumers would be willing to pay to have a proposed project completed if the project that has a favorable impact on the group of consumers (Type 1 in fig. 2.2) or the maximum amount that potentially harmed consumers would be willing to pay to see the proposed project abandoned (Type 3 in fig. 2.2). On the other hand, WTA equals the minimum amount of compensation that would have to be paid to consumers to make them as well off as they would be if the project were completed (Type 4 in fig. 2.2) or abandoned (Type 2 in fig. 2.2). In other words, WTA is the amount of money that would be required to place the consumer on the higher indifference curve that would have been reached if the project were completed during welfare losses or abandoned during welfare gains.

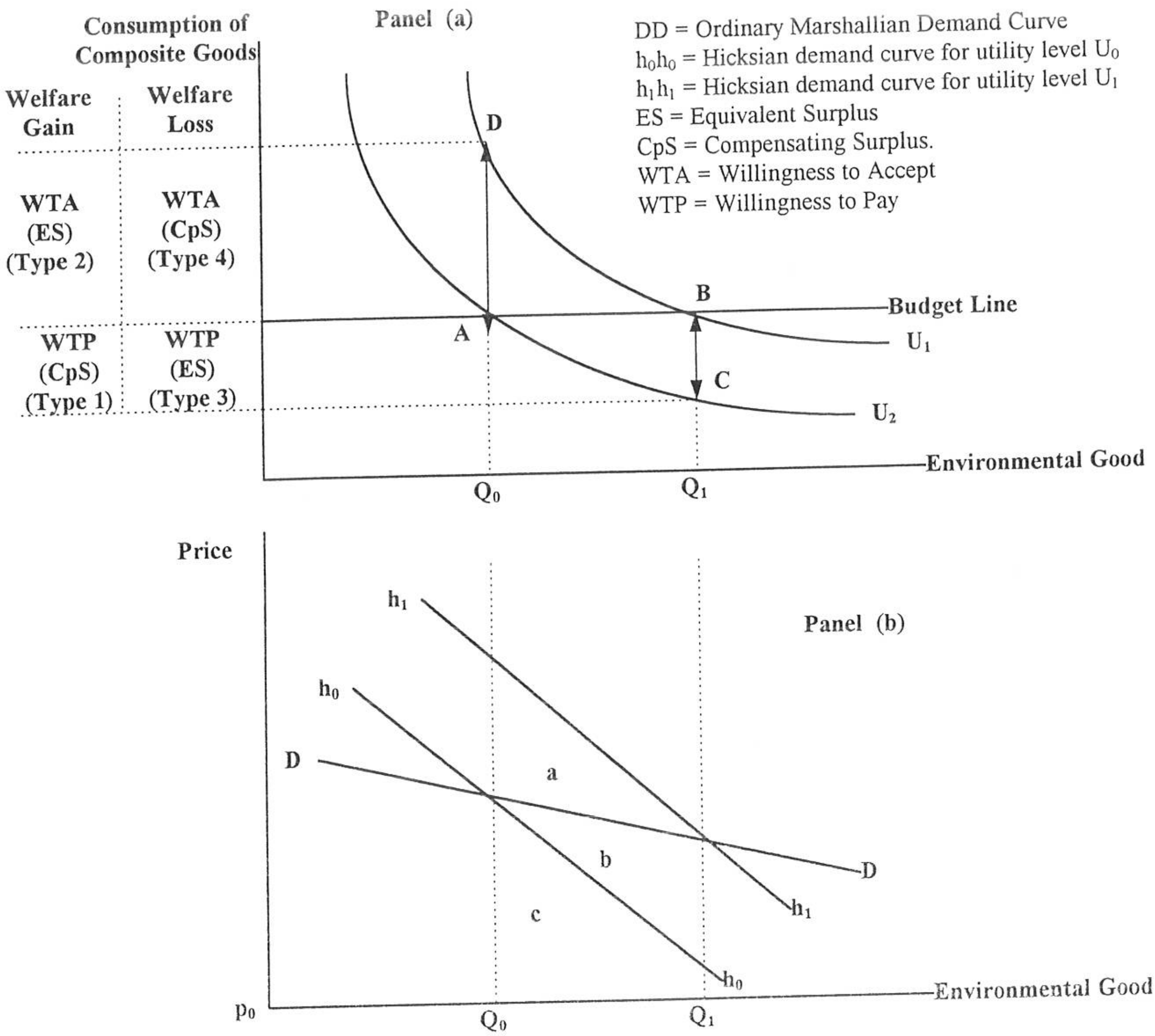

Fig. 2.2. Choice of Benefit Measures for Different Scenarios of Welfare Gain and Loss (Adopted from Bateman et. al., 1993)

Because of income effects, WTP and WTA will not be equal (Note that type 2 & 4 are greater than Type 1 & 3 in fig. 2.2). That is, if consumers actually paid their full WTP, their incomes would be reduced which could cause a downward shift in all of their demand curves. The Marshallian demand curve (the line DD in panel (b) of fig. 2.2) doesn't reflect this fact. That is why it is called uncompensated money measure of utility, and hence its triangle of consumer surplus (area b + c in fig. 2.2) is larger than the true WTP (area c in fig. 2.2). Likewise, if consumers actually receive their full WTA, their incomes would increase, shifting their demand curves outward (from h_0h_0 to h_1h_1 in fig. 2.2). In this case, the consumer surplus under the Marshallian demand curve will be less than the true WTA (area a + b + c in fig. 2.2). In both Scenarios, WTP will be less than WTA for normal goods in general.

Given that the two measures will generally differ, which is appropriate? Mitchell and Carson (1993) argued that so long as (1) the Marshallian triangle is small relative to the total income of the affected consumers and (2) the income elasticity of demand is reasonable, WTP, WTA and the Marshallian triangle will be approximately equal. However, if the good or service occupies a large part of the consumers' budget and the income elasticity of demand is significantly greater than zero, there will be a large difference between WTP and WTA, since WTP is bounded by income while WTA is not. Others argued that the choice between WTP and WTA is determined by the type of the public good in question, and the prevailing property rights. In a recreation benefit estimation , the amount of money that you would be willing to pay to avoid losing access to a recreation site is smaller than the amount you would have to be paid to willingly forgo use of the site, and the difference may be larger if recreation use makes a relatively large contribution to your total economic well being. This is because income and basic needs constrain your WTP but not your WTA.

In this study, because the property right is in the hands of the site authorities, WTP is chosen as the appropriate method of eliciting people's willingness to pay for a hypothetical change in an increased recreational quality on the site under consideration. Furthermore, since the expenditure share of outdoor recreation in the visitor's budget and the income elasticity of demand for outdoor recreation are relatively smaller, the results are not expected to be much affected by the choice of WTP and WTA as elicitation methods.

2.4 Recent Applications

This section reviews recent applications of these techniques both in the developed and developing countries.

In his doctoral dissertation, Davis had made the first comparison of results obtained from the Travel Cost and Contingent Valuation techniques in his effort to measure the value of outdoor recreation for Maine Woods forests, USA in 1963. 185 respondents were used as his cluster samples which represents hunters, fishermen, and summer campers. The interviews included both objective questions and visitors opinion. In the travel cost method, a linear demand curve was estimated, giving a price-quantity relationship based on total travel costs and number of visits. Similarly, a Willingness to Pay per visit was regressed against income of the household, years of experience by the household in visiting the area, and the length of stay in the area to estimate a linear demand curve for the Contingent Valuation Method. The results show that while the negative intercept of the estimated equations, necessitated by its linear form causes some difficulties of interpretation, he found a positive and significant relationship between WTP and number of visits on the one hand, and years of experience, length of stay and income on the other hand. The household income not only reflects an ability to pay, but also a positive income elasticity of demand for outdoor recreation. Finally, Davis had calculated total recreation benefits of the site for the two demand equations and found comparable results in the two estimation techniques, indicating at least the fact that the estimates of both methods are on the right track. It should be noted that the results obtained from TCM and CVM are not always expected to be equal, at least, due to the income effects. Recall that the former approach gives an uncompensated measure while the latter gives a compensated measure.

Also, Bojo (1985) used both Travel Cost and Contingent Valuation Methods to estimate environmental value of the Vala Valley as part of the cost-benefit analysis initiated by the Swedish Environmental Protection Agency to resolve a conflict between the Swedish Forest Service and the Swedish Nature Conservation Movement on reforestation versus conservation scenarios. Using data obtained from a sample of 282 households visiting the valley, the following function was estimated for the TCM.

$$H_i = F(P_i, Y_i, S_i, D_i)$$

Where, H_i, P_i, Y_i, S_i, D_i are number of visits, round trip travel costs, disposable household income, index of substitute sites, and dummy for mode of transport respectively. Similarly, Bojo used an open ended bidding game approach to elicit WTP and to estimate the demand curve for the CVM. From the sample of visitors collected, a couple of respondents who had come by bus or aeroplane was excluded, for the majority of the respondents were coming to the valley by car or train. Furthermore, sportsmen and businessmen whose trips were not paid by themselves were excluded. Multiple site visitors were also excluded due to the problem of reallocating the travel costs between different sites. In calculating visit costs, repair and maintenance costs were not included since the respondents were expected to have difficulties in estimating the magnitude of such costs. In addition he used the after tax wage rate to calculate the opportunity cost of time spent at the site. But he did not include the opportunity cost for travel time, for 80% of the respondents found the trip to the valley to be a positive experience. Bojo used four functional forms (such as linear, quadratic, semi-logarithmic, and logarithmic) to estimate a demand function for TCM. But he found the most significant and reliable results with expected signs for the linear function where, an increase in travel costs reduces visitations, the supply of similar sites affecting visitations, and disposable household income with no significant effect on visitations. Similar results were obtained for CVM.

Finally, Bojo used these two demand functions to calculate aggregate recreation benefit of the valley and found comparable estimates of consumer surplus and concluded that converting the examined area to forestry use will cause irreversible damage to the environment with a yearly loss of at least 1 million Swedish Kroner.

Similarly, in a World Bank study, Mushasinghe (1993) used Travel Cost and Contingent Valuation methods to assess the costs and benefits across different socio- economic groups emanating from the creation of Mantadia National Park in Madagascar. The opportunity costs of park creation incurred by local residents included forgone benefits previously derived from the forest such as firewood, pasture, animals, fish and land for shifting agriculture. Conversely, international tourists benefit from the recreation of the park through visiting the park. The CVM was used to estimate the opportunity costs to local users of forests as a result of park establishment. A sample of 351 local communities were asked whether they are willing to accept the bid amount measured in units of rice as compensation for loss of access to forest lands. On the other hand, a Travel Cost study was administered to a sample of 87 tourists visiting a nearby park to estimate recreational benefits to the international tourists if the park was established. A demand function was estimated for the CVM by regressing discrete choices (accept / not accept bids) against a number of explanatory variables such as family size, hectares of land available for cultivation, number of years the household lived near the forest, rice yield per household (as a proxy for income), years of education of household head, a dummy for the identity of the interviewer, and the frequency of fuel wood collection. Only the first three variables were found significant. On the other hand, the travel cost data were analyzed using a regression model with number of visits regressed against a number of explanatory variables such as quality of natural recreation facilities, cultural interaction possibilities, travel costs (proxy for price), dummy for visitors' nationality, income and education. All except income and education were found significant. Both approaches used the Maximum Likelihood technique to estimate a truncated model and to calculate total costs and benefits associated with the establishment of the park.

Also Brown and Henry (1989) used both CVM and TCM to indicate how the monetary value of viewing and photographing elephants on the safari would be affected if poaching continues to reduce the elephant population in Kenya. The travel cost and visitation data obtained from a sample of 53 tourists was used to construct a linear demand curve for the TCM. Using this demand curve, the consumer surplus for the safari was estimated. The part of this value attributable to elephants is determined by responses to survey questions which identify how tourists distribute the satisfaction they receive from a safari over a variety of activities and types of wildlife, including elephants. While estimating travel time costs as part of total travel cost, Brown and Henry used the product of hourly wage rate, round trip travel time and a 30 percent weighting to reflect the view that the value of time, net of taxes, while going on vacation is less than the gross wage rate. Similarly, information from a survey that asks the same people on safari hypothetical questions about how much they are willing to pay or accept in exchange for the maintenance of or increase (decrease) in the elephant population was used to estimate a linear demand curve and the respective consumer surplus for the CVM.

Most recently, Nyangena (1997) used CVM to examine the environmental preferences and benefits of Lake Bogoria National Reserve to the surrounding local communities in Kenya. The study used both WTP and WTA compensation to measure the benefits and opportunity costs associated with the presence and expansion of the Park. For a sample of 509 household, the questionnaire provides a detailed description of the circumstances under which the reserve was created and made available, and asks for the respondents bio-data (age, income, their use of the park, substitute sites, family size etc.), and an open ended question eliciting the respondents' preference and their maximum WTP for visiting the park and their minimum WTA compensation per hectares of land allocated for the expansion of the reserve. WTP responses were analyzed with a TOBIT model using a semi-log specification, taking WTP responses as the dependent variable and the respondents' attitudes towards the park, education, age, income and substitute sites and family size as independent variables. The results show that income, education, age, and family size have a positive and significant influence on WTP, whereas attitude and availability of substitute sites have a negative influence on WTP. Based on this demand equation consumer surplus was calculated for the sample and aggregated for the total population..

CHPTER THREE

DATA AND METHODOLOGY

The study basically employed two standard procedures in recreation economics (Travel Cost and Contingent Valuation) to estimate site value for the *Sodere* Recreation Area. For this purpose a questionnaire was designed and administered to a sample of visitors at *Sodere* Recreation Area. The information obtained from this questionnaire was then used to estimate the respective demand functions for each method which in turn were used to calculate total recreational benefits of the site.

In this chapter, different sampling and methodological issues including data sources, sample designs, field procedures, model specifications and expected signs are discussed.

3.1 Data Sources

The data for this study was obtained from primary sources. It was collected from a sample of visitors at *Sodere* Recreation Area by means of a questionnaire. The data sets included all the information necessary to represent all the variables in the demand equations as discussed in section 3.4

3.2 The Sample Design

Given time and financial constraints and bearing in mind the need to minimize exposure to small sample bias, this study is limited to 232 sample visitors coming from major zones of visitors principally, from *Addis Ababa, Assela, Awash Melkasa, Debre Zeit, Dera, Eteya, Hurutha, Modjo, Nazreth, Robe, Sodere* and *Wonji*.

To generate the samples, a cluster sampling technique was adopted so as to systematically sample different visitors engaged in different recreational activities. This sampling technique has passed through the following three stages.

(a) Using data obtained from annual sales reports of the site authorities, average number of visitors (grouped by sex) was calculated both for the weekdays and weekends. Then, the total sample was allocated to weekday and weekend visitors according to their proportion.

(b) The total area of the site was divided into four clusters i.e. Main Swimming Pool, Little Swimming Pool, Common Bath and Abader Bath. Average number of visitors was calculated, and the total sample was distributed for each cluster, using data obtained from the site authorities.

(c) Finally, random selection was adopted to interview individual visitors at each cluster group.

Using this sampling procedure, 202 weekend visitors (118 male & 84 female), and 30 weekday visitors (16 male & 14 female) were interviewed. In terms of clusters, 60, 38, 55, 79 samples were drawn from Abder Bath, Common Bath, Little Swimming Pool and Main Swimming Pool respectively. The rationale for this type of sampling is to equally represent different visitors coming to consume different characteristics of the recreation site.

3.3 The Field Procedure

The design and implementation of this survey has passed through four different stages.

(a) Major recreational activities of the site were identified and samples were designed as explained in section 3.2.

(b) The training of enumerators was conducted on Feb. 1, 1998.

(c) A pilot survey was done for 15 visitors at the site whose response was not included in the final study. The pilot survey was carried out to give the enumerators exercise in administering the questionnaire, and to test the applicability and structure of the questionnaire. The pilot survey showed that visitors are less willing (unhappy) to give details on some of their household characteristics, especially, their ethnicity, income and name. Hence these elements were brought to the end of the questionnaire in the final organization of the questions. Furthermore, the pilot survey indicated that most of the visitors were not accustomed to the bidding game techniques to express their willingness to pay for a hypothetically proposed quality improvement actions on the site. Hence, in the final questionnaire, an open ended format were adopted for the willingness to pay questions.

(d) Final administration of the questionnaire was conducted from Feb.15, 1998 to Mar. 13, 1998. Three enumerators and one supervisor including myself conducted the survey.

3.4 Model Specification and Expected Signs

3.4.1 The Truncated Model

This study is conducted based on survey data collected from visitors at *Sodere* Recreation Area. Non-visitors are not sampled and hence are excluded from the study. Therefore, the application of Ordinary Least Square (OLS) to this type of data sets leads to biased estimates of the parameters, and hence incorrect measures of consumer surplus will be reported. Thus in selecting a model, we need to take into consideration the fact that the dependent variable is truncated at a certain point (in our case at visits greater than or equal to one). Maximum Likelihood estimates is best suited to this type of data set.

The truncated model for the recreation demand function was adopted from the general presentations on Greene (pp. 682-690) and Madalla (pp. 149-196). The density function, the conditional mean and variance of the truncated variable are presented below.

Consider the trip generating function of an individual travel cost method as

$$\mathbf{V_{ij} = \beta' X_i + \varepsilon_i} \qquad \text{.......} \qquad \mathbf{(3.1)}$$

and assume that $\mathbf{V_{ij}/X_i \sim N(\mu, \sigma^2)}$; $\mu = \boldsymbol{\beta' X_i}$

Where V_{ij} is individual i's visit to site j, Xi as vector of explanatory variables, β as a parameter vector to be estimated, and ε_i as an error term.

With truncated sampling, we observe V_{ij} only if $V_{ij} \geq 1$. This implies that $\beta' X_i + \varepsilon_i \geq 1$ or $\varepsilon_i \geq 1 - \beta' X_i$. Clearly $E(\varepsilon_i/\varepsilon_i \geq 1 - \beta' X_i)$ is not equal to zero. In fact it will be a function of X_i. Thus the residual is correlated with the explanatory variable X_i, and we get inconsistent estimates of the parameters, β, if we use OLS method.

Given that V_{ij} is truncated from below at $V_{ij} \geq 1$, the density function of the truncated variable (V_{ij}) with probability density function of $f(V_{ij})$, and mean $\mu = \beta' X_i$, and standard deviation σ is given by,

$$\mathbf{f(V_{ij}/V_{ij} \geq 1)} = \frac{f(V_{ij})}{prob(V_{ij}) \geq 1}$$

$$= \frac{(1/\sigma)\phi((V_{ij} - \beta' X_i)/\sigma)}{1 - \Phi(\alpha_i)} \qquad \text{.......} \qquad \mathbf{(3.2)}$$

Where

ϕ (.) = standard normal pdf.

Φ(.) = standard normal cdf.

$\alpha_i = (1 - \beta' X_i) / \sigma$

Then it follows that

$$\mathbf{E}\ (V_{ij}/V_{ij} \geq 1) = \beta' X_i + \sigma \frac{\phi((1-\beta' X_i)/\sigma)}{1-\Phi((1-\beta' X_i)\sigma)} \quad \text{.............................} \quad \mathbf{(3.3)}$$

and

$$\mathbf{Var}\ (V_{ij}/V_{ij} \geq 1) = \sigma^2 (1-\delta(\alpha_i)) \quad \text{...} \quad \mathbf{(3.4)}$$

The conditional mean is therefore a non-linear function of X and β, and so is the variance. Therefore, ML estimation is preferred to OLS for this type of data set. In ML estimation technique, we find the estimator β that maximizes the log-likelihood function which is simply the sum of logs of the density function in equation (3.2). But note that in a truncated model, the marginal effect which is the partial derivative of equation (3.3) is not equal to β, rather it is equal to β **$(1-\delta(\alpha_i))$**. It is this value that is of great importance in the calculation of recreation benefit under section 4.3.

In this study, an econometric package called LIMDEP, V. 7.0 was used to derive the parameters and the marginal effects of the ML estimator.

3.4.2 Specification of the dependent variable.

Many empirical researchers indicate substantial efficiency gains in estimating outdoor recreation demand function using individual observations instead of traditional zone averages (see for example, Brown et.al., 1985 and Willis et.al., 1991). However, using individual observations can lead to incorrect consumer surplus estimates unless they are on a per capita basis. Essentially, the problem with fitting a travel cost based recreation demand function to unadjusted individual observations is that such a procedure doesn't properly account for cases in which a lower percentage of the more distant population zones participate in recreational activity. In such cases biased estimates of the travel cost coefficient results. This leads to incorrect consumer surplus estimates. Thus, if the underlying demand function is to be estimated validly from individual observations, then each observation needs to be adjusted on a per capita basis.

To make this adjustment in the study, each observation was expanded by the inverse of the sampling rate and then divided by the appropriate share of their origin's population.

3.4.3. Functional forms

In empirical estimation of recreation demand models, analysts used a variety of functional forms such as linear, quadratic, semi-log and log-linear. No one of these functional forms is theoretically superior to the others. In this study, all of these functional forms were employed. But tests explained below were conducted to select a better specification to estimate recreational benefit and consumer surplus.

In fact, among other methods, appropriate functional form may be selected by comparing adjusted R^2. However, adjusted R^2 is not comparable when the dependent variables are specified differently. One approach that might be considered for this problem is to examine the unexplained variations for each specification as measured by their Residual Sum of Squares

(RSS), and choose the equation with the smallest unexplained variation (Griffiths et. al., 1993). In this study a combination of an F-test and a test suggested by Box and Cox were employed to select a specification with the smallest RSS. The Procedures are described below.

In the first step, we used an F-test of linear restriction to choose from linear and quadratic forms. The linear specification is simply a restricted version of quadratic form, where additional variables in the quadratic version were restricted to be equal to zero. In this case, the relevant F-statistic used for testing the null hypothesis that the additional variables in the unrestricted model (i.e. quadratic) were equal to zero is given by

$$F = \frac{(RRSS - URSS) / J}{URSS / N - K} \sim F_{J,\ N-k}$$

where,

RRSS = RSS for the restricted model (linear)

URSS = RSS for the unrestricted model (quadratic)

J = Number of restrictions

K= Number of regressors

N = Number of observations

If the null hypothesis is accepted at a given significant level, then we prefer linear model as better specification, otherwise quadratic model will be preferred.

In the second step we compared the RSS of the model selected in the first step to that of Semi-log and Log-linear models. But this comparison required transformation of the RSS in the Linear/Quadratic model to the one that was unit free and hence comparable to that of Semi-log and Log-linear. To do such transformation we used a procedure suggested by Box and Cox. Under this procedure, the linear model was regressed again, taking visits (divided by its geometric mean[1]) as dependent variable. The RSS obtained from this transformed model was used for comparison after testing the null hypothesis that the two models (i.e. Linear/Quadratic and Semi-log/Log-linear) are empirically equivalent. The Statistic used to test the null hypothesis is given by

$$\ell = \frac{N}{2}\left|\ln\left[\frac{RSS_{\lg m}}{RSS_{ll}}\right]\right| \sim \chi^2(1)$$

where, $\mathbf{RSS}_{lgm}$ = RSS of the transformed linear/quadratic model

$\mathbf{RSS}_{ll}$ = RSS of the log-linear/semi-log model

If the null hypothesis is rejected and the RSS_{lgm} is smaller than RSS_{ll}, then the linear/quadratic model is preferred, otherwise the Log-linear/semi-log specification will be selected.

3.4.4. Specific Equations

This study employed the travel cost and contingent valuation methods to estimate recreation benefit and consumer surpluses. The specific equations estimated by each method are presented as follows.

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[1] The geometric mean of the dependent variable, visits (V_g) is calculated as $\bar{V}_g = (V_1 \times V_2 \times \ldots \times V_n)^{1/N}$ which is equivalent to $\exp\left\{1/N\sum_{N=1}^{n}\ln Vn\right\}$, where N is the number of observations.

3.4.4.1 Travel Cost Methods

In a Travel Cost Method, a demand function is estimated using the number of visits to a site as the dependent variable and the travel cost associated with the trip and household characteristics as independent variable. In this study the specific econometrics models used to describe the relationship between individual visits per year and the travel cost and other explanatory variables of the ITCM (in log-linear form) is given by,

$$\mathbf{Ln(Visits)_i} = \alpha_0 + \alpha_1 \mathbf{ln(TC)_i} + \alpha_2 \mathbf{ln(AGE)_i} + \alpha_3 \mathbf{ln(EDNYRS)_i} + \alpha_4 \mathbf{ln(FMSZ)_i}$$

$$+ \alpha_5 \mathbf{ln(VINC)_i} + \alpha_6 \mathbf{ln(KNOW)_i} + \alpha_7 \mathbf{(DGEN)_i} + \alpha_8 \mathbf{(DMARSTA)_i}$$

$$+ \alpha_9\mathbf{(DOWNC)_i} + \alpha_{10} \mathbf{(DGRP)_i} + \alpha_{11}\mathbf{(DWGSS)_i} + \varepsilon_i \quad \mathbf{(3.5)}$$

Where,

Visits = The total number of per capita visits individual i takes to *Sodere* during the past 12 months. The total number of individual visits was expanded by the inverse of the sampling rate and then divided by the appropriate share of main zone's population of the visitor to get its per capita equivalent.

TC = Total travel cost associated with a round trip to and from *Sodere*. This includes fuel cost or transport cost, and travel and on-site time costs. Time costs are calculated at net of tax wage rates. Generally a negative relationship between TC and number of Visits is expected, for TC is considered as a proxy for price in recreation demand analysis.

AGE = This is measured as the age in years. Generally, a negative relationship between AGE and number of Visits is expected, for older people are relatively less interested to travel longer distances for recreation than the younger ones.

EDNYRS = This represents visitor's educational level in years of education. It is included to test whether visitors educational level determines their visitations to the given site. Education is important to understand the effect of recreation on human welfare.. Therefore, a positive relationship is expected between EDNYRS and Visits.

FMSZ = This is family size measured as the total number of people in the visitor's household. A negative relationship is expected between FMSZ and number of visits, for a visitor with large number of family size spends a relatively more proportion of its income on the consumption of composite goods than recreational activities.

VINC = This is disposable monthly income of visitor i . Income reflects the ability to pay for repeated trips to a site. Therefore, a significant positive relationship is expected between VINC and number of Visits to *Sodere*.

KNOW = This represents the number of years that visitors have known the site. It reflects the accumulated knowledge of visitor i about the site. It measures both the quantity and quality dimensions of visits, probably suggesting that longer acquaintance with the site reflects a greater degree of preference for the area. Therefore, a significant positive relationship is expected.

DGEN = This variable represents the sex of visitor i. It is included in the study as a dummy variable, where 1 for male and 0 for female, to test whether gender of visitors is an important determinant of number of visits to the site. This relationship is indeterminate a priori.

DMARSTA = This represents the marital status of the visitor. This variable is included in the study as dummy, where 1 for married and 0 for single, to test whether MARSTA is important determinant of the number of visit to the site. No a priori relationship is determined between MARSTA and number of Visits to the site.

DOWNC = This variable represents the mode of transport used during visits to *Sodere*. It is included as dummy, where 1 for own car and 0 otherwise, to test the hypothesis that using own car is important determinant of visits to the site. A positive relationship is expected, for visitors usually find own cars to be convenient for recreational trips to the site.

DGRP = This variable represents whether recreational trips are made in groups or alone. It is included as dummy variable, where 1 for group trips and 0 for otherwise, to test the hypothesis that group trips are important determinant of number of visits to the site. In this study, 90 percent of the visitors in the sample are found to be group visitors.

DWGSS = This variable represents the presence of *wondogenet* substitute site in determining recreation demands for *Sodere*. Substitute sites affect the demand for a given site in three different ways, such as through their visit price, their entrance fee and environmental quality on the substitute sites. In practice such variables are rarely included in estimated forms, for it is costly to gather information on these variables in the substitute sites. However complete omission of substitute site variables in the Travel Cost method can lead to an overestimation and underestimation of consumer surplus depending upon the spatial relationship between substitute sites and visitors' residence. In this study, visitors were asked whether they have experienced substitute sites. This variable is included as dummy, where 1 for *Wondogenet* as substitute site and 0 otherwise. Only *Wondogenet* is included as dummy for substitute site, for it is highly similar to *Sodere* in its recreational activities and also 87 percent of the respondents have indicated *Wondogenet* as the only close substitute site they have experienced . Furthermore, the gate fee in *wondogenet* is reported to be lower than that of *Sodere*. Therefore, a negative relationship is expected between DWGSS and number of visits to *Sodere*.

3.4.4.2 Contingent Valuation Method

As stated in the literature review section, the essence of the CVM of measuring welfare changes resulting from improved recreational experience is that through a properly constructed interview approach, one can elicit from recreationists information concerning the maximum price they would pay in the form of gate fees so as to have access to an improved recreational experience.

As indicated in the statement of the problem section, weekend congestions and seasonal malaria epidemics were identified as two of the major drawbacks to the recreational experience at *Sodere*. Congestion occurs when the number of users of a recreation facility is "too large". If the stock of visitors is reasonably small, it may have no or even a positive influence on utility because of the opportunities for social interactions. If the number of visitors is large, an increase in the stock of visitors may cause congestion and so decrease the marginal utility of a visit.

To estimate the welfare effect of each of these problems, CVM was adopted to elicit people's WTP in the form of gate fees if the problems are removed with proposed hypothetical actions. Visitors were asked how much they would be willing to pay if the problem of congestion would be removed by constructing one more swimming pool and one more *Abader* Bath. Similarly, visitors were also asked how much they would be willing to pay if the problem of malaria would be controlled by spraying DDT or some other insecticide on the site at appropriate intervals.

Like the TCM, the Truncated Maximum Likelihood estimation technique was adopted to estimate the econometric models used to describe the WTP responses of the CVM. Two models, each at different functional forms, were estimated to describe the relationship between WTP responses and several explanatory variables. The models, specified in double-log forms, are presented in equations 3.6 and 3.7 below.

$$\begin{aligned} Ln(MWTPCNG)_i = {} & \alpha_0 + \alpha_1 \ln(AGE)_i + \alpha_2 \ln(EDNYRS)_i + \alpha_3 \ln(FMSZ)_i \\ & + \alpha_4 \ln(VINC)_i + \alpha_5 \ln(KNOW)_i + \alpha_6 (DATTCNG)_i + \alpha_7 (DGEN)_i \\ & + \alpha_8 (DHEAD)_i + \alpha_9 (DWGSS)_i + \alpha_{10} (DOWNC)_i + \varepsilon_i \end{aligned} \tag{3.6}$$

and

$$\begin{aligned} Ln(MWTPMAL)_i = {} & \alpha_0 + \alpha_1 \ln(AGE)_i + \alpha_2 \ln(EDNYRS)_i + \alpha_3 \ln(FMSZ)_i \\ & + \alpha_4 \ln(VINC)_i + \alpha_5 \ln(KNOW)_i + \alpha_6 (DATTMAL)_i + \alpha_7 (DGEN)_i \\ & + \alpha_8 (DHEAD)_i + \alpha_9 (DWGSS)_i + \alpha_{10} (DOWNC)_i + \varepsilon_i \end{aligned} \tag{3.7}$$

Where,

MWTPCNG = is the maximum amount that visitor i is willing to pay in the form of gate fee if the problem of congestion on the site is reduced by constructing one more swimming pool and one more *Abader* Bath.

MWTPMAL = is the maximum amount that visitor i is willing to pay in the form of gate fee if the problem of malaria on the site is controlled by spraying DDT or some other insecticide on the site at appropriate intervals.

AGE = This is measured as the age in years. A positive and significant relationship is expected between AGE and MWTPCNG, for older people relatively hate congestions once they come to the site than the younger visitors. Similar relationship is also expected between AGE and MWTPMAL, for older people understand and react quickly to the potential effect of malaria than the younger ones.

EDNYRS = This represents visitor's educational level in years of education. Education is important to understand the effect of congestion and malaria epidemics on human utility and health. Therefore, a positive and significant relationship is expected between EDNYRS and MWTPCNG & MWTPMAL.

FMSZ =This is family size measured as the total number of people in the visitor's household. A negative relationship between FMSZ and MWTPCNG & MWTPMAL is expected, for a visitor with large number of family size spends a relatively more proportion of its income on the consumption of composite goods hence becomes less willing to pay for quality improvement activities on the site even if he/she perceived that the problems are critical.

VINC = This represents disposable monthly income of visitors. Since income reflects the ability to pay, a positive relationship is expected in both equations.

KNOW = This indicates the number of years that visitors have known the site. The relationship is indeterminate a priori, for longer knowledge may either reflect preference for the site despite the problems of congestion and malaria and hence are less willing to pay to the proposed quality improvement activities or may reflect closer understanding of the problems and hence high willingness to pay for the proposed actions.

DATTCNG/DATTMAL = These variables indicate visitor's attitude towards congestion and malaria as problems that reduce recreational quality at the site. They are included as dummies in the respective equations, where 1 for they are serious problems and 0 for they are not serious problems in recreational experience. Generally, a positive relationship is expected in both equations.

DGEN =This variable represents the sex of the visitor. It is included as dummy, where 1 for male and 0 for female, to test whether the gender of the visitor is important in determining the WTP responses both for congestion and malaria problems. The sign of the relationship is indeterminate a priori.

DHEAD =This variable indicates whether the visitor is head of the household. It is included as dummy, where 1 for head, and 0 otherwise. It is added in the study to test whether being head of the household influences the WTP responses in both equations. Head of households have got so many responsibilities in terms of expenditures on composite goods, and hence are less willing to pay for recreational activities. Therefore, the relationship is expected to be negative.

DWGSS = This variable represents the presence of *wondogenet* substitute site in determining WTP responses for the proposed quality improvement activities at *Sodere*. It is included as dummy, where 1 for *Wondogenet* as substitute site and 0 otherwise. Only *Wondogenet* is included as dummy for substitute site, for it is highly similar to *Sodere* in its recreational activities and also 87 percent of the respondents indicated *Wondogenet* as the only substitute site they had experienced. The relationship is indeterminate a priori, for people may prefer the substitute sites either due to other better recreational qualities and hence are not willing to pay for the proposed actions, or people prefer the substitute sites just because of the prevailing problems of congestion and malaria at *Sodere* and hence are willing to pay for any recreational quality improvement activities that reduce these problems.

DOWNC = This variable represents the mode of transport used during visits to *Sodere*. It is included as dummy, where 1 for own car and 0 otherwise. A positive relationship is expected in both equations at least for two reasons. First possessing own car is an indication of the ability to pay like income. Second, own car travellers are expected to be frequent visitors to the site and hence are relatively more exposed for any disutilities or health problems arising from congestion and malaria epidemics than others. Hence they are more willing to pay for the proposed quality improvement actions than the less frequent visitors.

CHAPTER FOUR

RESULTS AND DISCUSSION

Empirical findings discussed in this chapter consist of both descriptive statistics and regression results. Also aggregate benefit are calculated based on results obtained from the regressions.

4.1 Descriptive Statistics

The questionnaire was organized in three sections so as to collect data on household characteristic, visitations, and willingness to pay responses. Frequency distributions and cross tabulations were formulated to analyze the responses obtained from the questionnaire.

4.1.1 Household Characteristic

This study is conducted based on the survey data collected from a sample of 232 (98 female and 134 male) visitors coming from 12 different zones of origin. 80 percent of the sample visitors came from three principal cities around *Sodere*, i.e. *Addis Ababa, Assela* and *Nazreth*. 62 percent of the sample visitors were identified as head of the household and 54 percent of the respondents were married. The mean family size of the respondents was also calculated to be 6. Also the mean age of the respondents was 33 years old. Further more, a good proportion (58 percent) of the visitors had just secondary education, equivalent to 12 years of education. The mean years of education was 11 years. As far as income is concerned, 82 percent of the respondents did earn their own income, of whom, 44 percent of the respondents ran their own business, and 22 percent were public sector employees. The mean income of visitors was Birr 1315 (US $ 188) per month.

4.1.2 Responses on Visitations

Total number of annual visits and travel costs per trip were the two important variables used to construct the demand curve for outdoor recreation on the site. The average number of annual visits, and travel costs per round trip were reported to be 9 and Birr 99 respectively. The minimum round trip travel cost was reported as Birr 2 and Maximum Birr 155. Travel costs consists of both mileage and time costs.

Apart from visits and travel costs, data were collected on several characteristics of the visits including mode of transport, Whole Recreation Experience and Substitute sites.

More than 90 percent of the visitors were travelling in a group, either with their friends, families or work colleagues. Only 10 percent were traveling alone, and DGRP is used as one of the regressors in equation (3.5) of the recreation demand function to capture the group effect. Questions regarding the years of acquaintance of visitors with the site revealed that 41 percent of the visitors had known the site for the last ten or more years, with average knowledge of the site being 11 years. Furthermore, question asking respondent's experience on substitute sites revealed that 64 percent had visited one or more substitute sites, of which *Wondogenet* was identified as the closest substitute for 87 percent of the respondents. Responses on the mode of transport used for visitations revealed that 50 and 33 percents of the visitors were using public transport and own cars respectively to travel to and from *Sodere*. Furthermore, visitors were asked whether or not they have enjoyed the car travel on their trip, and 71 percent had expressed a dislike to car travels. There were also questions that requested respondents to allocate their total enjoyment (Whole Recreation Experience) into travel and on-site experience, and they had given 31 and 69 percent (average) for the two categories respectively. This was a good indication that most of the respondents considered in this study were pure visitors (not meanderers). Of the total enjoyment envisaged on the on-site experience, 66 percent were allotted to Swimming and Bathing.

Respondents were also asked to express their views on the problems of the site. Especially they were asked to what extent did weekend congestion and seasonal malaria epidemics reduce the recreational qualities of the site. The responses are summarized in table 4.1. below.

Table 4.1

Degree of Congestion and Malaria Problems in Reducing Recreation Qualities

	Congestion		*Malaria*	
Degree	*Frequency*	*Percent*	*Frequency*	*Percent*
A Serious Problem	89	38.3%	201	86.6%
A Problem	26	11.2%	6	2.6%
A Simple Problem	112	48.3%	25	10.8%
Not a Problem at All	5	2.2%	0	0.0%
Total	232	100.0%	232	100.0%

Source:- Computed from the survey data

These responses are good evidences to undertake the study that measures the welfare effects of these problems on the visitors.

4.1.3 WTP Responses

As indicated in the study design, two WTP questions were designed to elicit people's preferences to improved recreational qualities by reducing (controlling) weekend congestions and seasonal malaria epidemics. For this purpose, an open ended formats were adopted, with gate fees as the elicitation vehicle.

The mean WTP stated by the sample visitors was Birr 9.33 (US $ 1.35) for congestion and Birr 11.90 (US $ 1.70) for malaria. The frequency distribution of the WTP responses are presented in the table 4.2 below.

Table 4.2

Frequency Distribution of WTP for Congestion and Malaria

	Congestion			*Malaria*		
WTP (in birr)	*Frequency*	*Percent*	*Cumulative Percent*	*Frequency*	*Percent*	*Cumulative Percent*
0-5	110	47.4%	47.4%	73	31.5%	31.5%
5-10	55	23.7%	71.1%	58	25.0%	56.5%
10-15	42	18.1%	89.2%	51	22.0%	78.5%
15-20	15	6.5%	95.7%	30	12.9%	91.4%
20-25	3	1.3%	97.0%	6	2.6%	94.0%
25-30	3	1.3%	98.3%	10	4.3%	98.3%
30-35	2	0.9%	99.1%	1	0.4%	98.7%
35-40	0	0.0%	99.1%	1	0.4%	99.2%
40-45	0	0.0%	99.1%	0	0.0%	99.2%
45-50	2	0.9%	100.0%	2	0.9%	100.0%
	232	100.0 %		232	100.0%	

Source:- Computed from the survey data

As indicated in the table, 47.4 and 31.5 percents of the respondents were not willing to pay for congestion and malaria respectively beyond the current gate fee which is Birr 5.00. Respondents were asked to indicate their reason for refusing to pay over and above the current gate fee. The reasons are summarized in table 4.3 below.

Table 4.3

Reasons for Refusing to Pay Gate Fee Over and Above the Current Gate Fee

	Congestion		*Malaria*	
Reason	***Frequency***	***Percent***	***Frequency***	***Percent***
Lack of Income	38	34.2%	24	34.3%
The Current Fee Should Retain	68	61.3%	23	32.9%
Site Authorities/Gov't Should Pay	5	4.5%	23	32.9%
Dislike the Payment Vehicle	0	0.0%	0	0.0%
Total refusal	111	100.0%	70	100.0%

Source:- Computed from the survey data

4.2 The Regression Results

This section presents regression results obtained from the estimation of the models specified earlier in section 3.4.4. Three equations (each at four different functional forms) were estimated using the ML estimator of the truncated model.

4.2.1 The Travel Cost Method Results

To establish a recreation demand function, equation 3.5 in section 3.5.4 was estimated in Linear, Semi-log (dependent), Log-linear, and Quadratic functional forms. In all the specifications, per capita annual visits was used as dependent variable, and a number of explanatory variable including travel costs and income were used as independent variables.

Four functional forms were employed, for no one of them is found to be theoretically superior to others. But a test described under section 3.4.3 was conducted and Log-linear specification was found to be a better specification to our data set. The results of the test, and regression results of the other specifications are attached in appendix B. Note that the signs of the regressors are consistent in all the specifications.

The regression results of the Log-linear model are presented in table 4.4 below. The OLS results are also displayed for comparison.

Table 4.4

Travel Cost Method Results: ML estimations for a Truncated model

(Ln (Visits) as dependent variable)

Variables	OLS Coefficients (1)	ML Coefficients (2)	Marginal Effects (%) (3)	Mean Values (4)
ln (TC)	-0.5168* (-4.424)	-0.5552* (-4.577)	-0.5394* (-4.577)	4.138
ln (AGE)	-0.0631 (-0.180)	-0.0783 (-0.218)	-0.0760 (-0.218)	3.474
ln (EDNYRS)	-0.1076 (-0.558)	-0.1137 (-0.581)	-0.1104 (-0.581)	2.459
ln (FMSZ)	-0.1041 (-1.049)	-0.1105 (-1.103)	-0.1074 (-1.103)	1.609
ln (VINC)	0.1420* (3.186)	0.1556* (3.301)	0.1511* (3.301)	6.152
ln (KNOW)	0.3301* (3.482)	0.3635* (3.644)	0.3531* (3.644)	2.299
DGEN	-0.2342*** (-1.718)	-0.2527*** (-1.829)	-0.2454*** (-1.829)	0.6207
DMARSTA	0.0061 (0.040)	0.0051 (0.033)	0.0050 (0.033)	0.4655
DOWNC	0.5438* (2.749)	0.5855* (2.888)	0.5688* (2.888)	0.4943
DGRP	0.0034*** (1.688)	0.0035*** (1.742)	0.0034*** (1.742)	0.5168
DWGSS	-0.0035** (-2.026)	-0.0037** (-2.074)	-0.0036** (-2.074)	0.6053
CONSTANT	1.2408* (2.590)	1.2945* (2.575)	1.2002* (2.575)	

ML Diagnostic results
Unrestricted Log-Likelihood = -192.5358
Restricted (β= 0) Log-Likelihood = -222.0534
Number of Observations = 232

Values in brackets are t-values
*** Significant at 1 percent level**
**** Significant at 5 percent level**
***** Significant at 10 percent level**

The overall significance of the model was tested using the log likelihood results on table 4.4. The log likelihood ratio calculated as -2(Restricted Log-L - Unrestricted Log-L) equals

59.035. The critical values of the chi-square distribution for 12 degrees of freedom is found to be 21.026 ($\chi^2_{(12)} = 21.026$). Therefore the null hypothesis that all the explanatory variables are irrelevant in the determination of the variation in the dependent variable can be rejected at 5% level of significance. This implies that the estimated model exhibits an overall significance. One can also observe that the results of OLS estimations (column1) and ML estimations (column 2) are almost identical. This shows that the problem of bias on OLS estimators caused by variable truncation is minimal in this study. Using the logarithmic form has also the benefit of reducing heteroscedasticity.

All the estimated coefficients have the expected signs in all the specifications, and they are in conformity with the theories suggested in recreation economics. That is travel costs (TC), visitor's income (VINC), acquaintance with the site (KNOW), experience of substitute sites (DWGSS), the mode of transport used for the trips (DOWNC) are important determinants of a recreation demand at *Sodere*. Further more, gender of visitors (DGEN) and group visitations (DGRP) are found to be important and significant determinants of visits to *Sodere*, showing that people prefer to make their trip in groups; and females are more likely to make repeated visits to *Sodere* than males. On the other hand, age, education, family size, and marital status of visitors are not significant determinants of the visits to *Sodere*.

Of all significant variables, travel costs, substitute sites and gender exert a negative impact on the demand for visits; where as income, knowledge about the site, mode of transport and group visitations have a positive significant influence on the same demand function. In a separate regression household income was substituted for visitors income, but it turned out to be insignificant.

The results on column 3 of table 4.4 are interpreted as elasticities of the demand for visits. For example, the TC variable is negatively significant at the 1% level indicating that, *ceteris paribus*, when travel cost increases by one percent, visitations to *Sodere* will decrease by 0.54 percent. Similarly, the VINC variable is positively significant at least at the 10% level, indicating that when a person's income increases by one percent, *ceteris paribus*, visits to *Sodere* will increase by 0.15 percent.

In conclusion, it is evident from the econometric results for the travel cost method that there are various factors which affect individuals visitations to the given site. These variables include travel costs, income, mode of transport, and substitute sites. These variables are identified in the literature as major explanatory variables to visitations in the travel cost method. Therefore, the results obtained in this study are consistent with other similar studies.

4.2.2 The Contingent Valuation Method Results

Equations (3.6) and (3.7) of section 3.4.4 were also estimated with an ML estimation technique of a truncated model to establish demand functions for measuring consumer surpluses (welfare effects) of the existing congestion and malaria problems of the site in the Contingent Valuation Methods.

Four functional forms were employed for the reasons explained earlier. But a test described under section 3.4.3 was conducted and Log-linear specification was found to be a better specification to our data set. Also, tests for strategic biases were conducted and the validity of the WTP responses checked. The results of the tests, and regression results of the other specifications are attached in appendix B. Note that the signs of the regressors are consistent in all the specifications. Also the fact that the OLS and ML estimates on table 4.5 and 4.6 are almost identical imply that the estimate bias that could have been caused by the OLS estimates are very small.

4.2.2.1 CVM to measure welfare effects of congestion

The natural log of the maximum amount that visitors were willing to pay in the form of gate fee if the problem of congestion on the site was reduced by constructing one more swimming pool and one more *Abader* Bath was used as dependent variable; income and other several variables were used as independent variables. The results of the Log-Linear specification are summarized in table 4.5. The OLS results are also displayed for comparison.

The Log-Likelihood ratio test with Log-L ratios calculated as 216.767 and $\chi^2_{(10)}$=18.307 showed the overall significance of the model. Also the fact that the variables are specified in logarithmic format minimizes the possibility of heteroscdasticty.

All the estimated coefficients have the expected signs in all of the four specifications. All the variables except family size and knowledge about the site showed a positive relationship as hypothesized in section 3.4.4.

The variables VINC, FMSZ, DHEAD, DOWNC, and DATTCNG are consistently significant in all the specifications, where as the variables AGE, EDNYRS, KNOW, DGEN, DWGSS are entirely insignificant in all the specifications.

Like the travel cost method, the results on column 3 of table 4.5 are interpreted as elasticities. For example, the FMSZ variable is negatively significant at least at 10% level, indicating that when the number of family members of visitors increase by one percent, *ceteris paribus*, the visitor's willingness to pay for the proposed program of the site will decrease by 0.0865. Similarly, the VINC variable is positively significant at least at 10% level indicating that, *ceteris paribus*, when visitor income increases by one percent, the visitor's willingness to pay for the proposed program of the site will increase by 0.0594 percent.

It is evident from the econometric results for the contingent valuation method that there are various factors which affect individuals visitations to the given site. Like other similar studies, visitor's income, visitor's attitude to the problem, and visitor's responsibilities and positions in the household significantly influences the WTP responses in this study.

Table 4.5

CVM results used to measure welfare effects of congestion

ML estimations for a truncated model

(ln (MWTPCNG) as dependent variable)

Variable	**OLS Coefficients (1)**	**ML Coefficients (2)**	**Marginal Effects (%) (3)**	**Mean Values (4)**
ln (AGE)	0.1679 (1.221)	0.1679 (1.259)	0.1661 (1.259)	3.474
ln (EDNYRS)	0.0450 (0.559)	0.0450 (0.576)	0.0445 (0.576)	2.459
ln (FMSZ)	-0.0874** (-2.063)	-0.0874** (-2.128)	-0.0865** (-2.128)	1.609
ln (VINC)	0.0600*** (1.777)	0.0600*** (1.833)	0.0594*** (1.833)	6.152
ln (KNOW)	-0.0265 (-0.843)	-0.0265 (-0.869)	-0.0262 (-0.869)	2.299
DGEN	0.0193 (0.343)	0.0193 (0.354)	0.0191 (0.354)	0.6207
DHEAD	-0.1700* (-2.544)	-0.1700* (-2.624)	-0.1682* (-2.624)	0.3224
DOWNC	0.1110*** (1.772)	0.1110*** (1.828)	0.1098*** (1.828)	0.4943
DWGSS	0.0004 (0.511)	0.0004 (0.527)	0.0004 (0.527)	0.6053
DATTCNG	0.9409* (17.953)	0.9409* (18.518)	0.9310* (18.518)	0.5628
CONSTANT	1.1083** (1.966)	1.1083** (1.996)	1.1083** (1.996)	

<u>Diagnostic Results for ML</u>

Unrestricted Log-Likelihood = -55.7381

Restricted (β= 0) Log-Likelihood = -164.1215

Number of Observations = 232

Values in brackets are t-values

*** Significant at 1 percent level**

**** Significant at 5 percent level**

***** Significant at 10 percent level**

4.2.2.2 CVM to measure welfare effects of malaria

The natural log of the maximum amount that visitors were willing to pay in the form of gate fee if the problem of malaria on the site is controlled by spraying DDT or some other insecticide the site at appropriate intervals was used as dependent variable where as income and other several variables are used as independent variables. The results of the Log-Linear specification are summarized in table 4.6. As usual, the OLS results are also displayed for comparison.

Like for the previous equation, the log-likelihood test was conducted for the results on table 4.6 and the overall significance of the model was proved. Furthermore, the signs and significance of all the explanatory variables except KNOW are the same as the results on table 4.5, showing that the same variables explains the willingness to pay for the proposed programs of reducing malaria and congestion at *Sodere*. Acquaintance with the site (KNOW) has positive relationship to WTP for malaria but negative for congestion. This in fact is in conformity with the hypothesis under section 3.4.4 that the effect of knowledge about the site on WTP is ambiguous in that longer knowledge may either reflect preference for the site despite the problems and hence are less willing to pay to the proposed programs or may reflect closer understanding of the problems and hence a higher willingness to pay for the proposed actions.

Table 4.6

CVM results used to measure welfare effects of Malaria

ML estimations for a truncated model

(ln (MWTPMAL) as dependent variable)

Variable	**OLS Coefficients (1)**	**ML Coefficients (2)**	**Marginal Effects (%) (3)**	**Mean Values (4)**
ln (AGE)	0.1521 (1.025)	0.1521 (1.057)	0.1513 (1.057)	3.474
ln (EDNYRS)	0.0554 (0.660)	0.0555 (0.681)	0.0552 (0.681)	2.459
ln (FMSZ)	-0.0827*** (-1.837)	-0.0828*** (-1.895)	-0.0824*** (-1.895)	1.609
ln (VINC)	0.0750** (2.125)	0.0751** (2.192)	0.0747** (2.192)	6.152
ln (KNOW)	0.0346 (1.051)	0.0346 (1.084)	0.0344 (1.084)	2.299
DGEN	0.0044 (0.077)	0.0045 (0.079)	0.0045 (0.079)	0.6207
DHEAD	0.1476** (2.103)	0.1477** (2.169)	0.1470** (2.169)	0.3224
DOWNC	0.1179*** (1.759)	0.1180*** (1.814)	0.1093*** (1.814)	0.4943
DWGSS	0.0012*** (1.684)	0.0012*** (1.737)	0.0012*** (1.737)	0.6053
DATTMAL	1.0571* (16.640)	1.057* (17.163)	1.052* (17.163)	0.5628
CONSTANT	1.3149*** (1.851)	1.3150*** (1.868)	1.3134*** (1.868)	

Diagnostic Results for ML

Unrestricted Log-Likelihood	=	-64.6286
Restricted (β= 0) Log-Likelihood	=	-166.4954
Number of Observations	=	232

Values in brackets are t-values
*** Significant at 1 percent level**
**** Significant at 5 percent level**
***** Significant at 10 percent level**

Like the previous estimates, the results in column 3 of table 4.6 are interpreted as elasticities. For example, the FMSZ variable is negatively significant at least at the 10% level, indicating that when the number of family members of visitors increase by one percent, *ceteris paribus*, the visitor's willingness to pay for the proposed program of the site will decrease by 0.0824. Similarly, the VINC variable is positively significant at least at 10% level indicating that, *ceteris paribus*, when visitor income increases by one percent, the visitor's willingness to pay for the proposed program of the site will increase by 0.0747 percent.

It is evident from the econometric results for the contingent valuation method that there are various factors which affect individuals visitations to the given site. Like other similar studies, visitor's income, visitor's attitude to the problem, and visitor's responsibilities and positions in the household significantly influences the WTP responses in this study.

Finally, a comparison of estimates on table 4.5 and 4.6 shows that WTP is highly responsive to changes in many of the variables for malaria than congestion problem. Therefore a greater consumer surplus (welfare effect) is expected due to the problem caused by malaria than congestion. The estimates of the consumer surpluses based on these demand functions are presented in the next section.

4.3 Benefit Estimation

Now that the demand functions are estimated, total recreational benefit of the site, and consumer surplus for the reduction of congestion and malaria problems can be estimated.

4.3.1 Recreational Benefits

To calculate recreational benefit, a simple demand function of the form $V_{ij} = \alpha_0 + \alpha_1 TC_i$ can be estimated by using the coefficients and mean values of significant variables reported in table

4.4 , where V_{ij} represents individual i's per capita annual visit to site j, and TC for travel costs per trip. In order to calculate the constant term (α_0), assume all other variables are at their mean values. α_1 is simply the coefficient on the TC variable in table. Using the coefficients and mean values of variables on table 4.4, the demand function is now estimated as:

$$\mathbf{Ln\ V_{ij} = 3.07 - 0.5394\ ln\ TC_i} \quad \text{.......................................} \quad \mathbf{(4.1)}$$

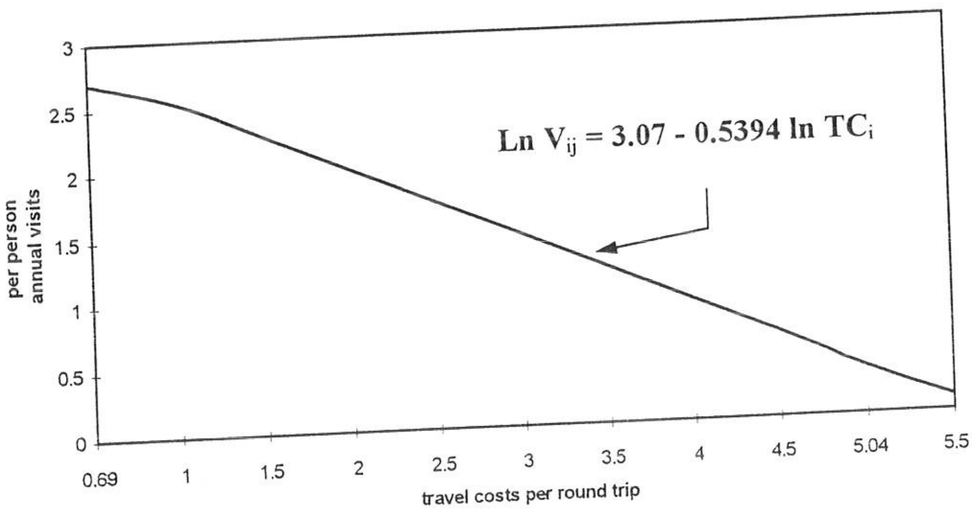

fig. 4.1. Recreation demand curve for Sodere

Integrating equation (4.1) between the natural log of minimum and maximum travel costs reported on the sample will estimate per person annual recreational benefit for the Whole Recreational Experience. This is given by

$$\int_{\ln 2}^{\ln 155} (3.07 - 0.5394 \ln TC) d \ln TC = \textbf{Birr 759.07 (US \$ 108.44)}$$

This estimate is simply the area under the demand curve in fig between 0.69 and 5.04 travel costs.

Obviously, not all of this recreational benefit can be attributed to the on-site experience. Hence we need to find a technique to evaluate how much of this benefit can justifiably be said to have been purely related to the on-site experience. The usual method is asking visitors to allocate percentage points to the on-site and off-site experience to evaluate how much of the utility of the Whole Recreational Experience is due to the on-site experience (See for example Willis and Garrod, 1991). In this a study similar procedure was followed, i.e. visitors were asked to allocate their total enjoyment into travel and on-site experience (see question 9 of section B in the questionnaire). The mean value for the on-site experience was calculated to be 68.5%, and hence per person annual recreational benefit for the on-site experience was estimated as Birr 520 (US $74.30). Considering an annual visits of 171,336 reported on table 1.2, and mean value for per person annual visits of 9.069 in the sample, the annual estimates for per person recreational benefit can be translated into expected total on-site recreational benefit of Birr 9,824,094.80 (US $1,403,442.10) per annum.

4.3.2 Welfare Effects of Congestion and Malaria

Using the coefficients and mean values of significant variables on tables 4.5 and 4.6, per visit willingness to pay for congestion and malaria problems were calculated as Birr 6.37 (US $0.91) and Birr 9.39 (US $1.34) respectively. To reach at the net welfare effects of these two problems, the current gate fees of Birr 5 should be subtracted from the willingness to pay estimates above. As a result, the net welfare effects of congestion and malaria problems was estimated as Birr 1.37 (US $0.20) and Birr 4.39(US $0.63). Multiplying these estimates by the actual number of annual visits reported on table 1.2 (i.e. 171,336) will result in expected aggregate annual effects of Birr 234,730 (US $33,532) and Birr 752,165 (US $107,452) for the two problems respectively.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

The quality of many of the recreation sites and national parks and reserves of Ethiopia are deteriorating mainly because of lack of sustainable income from internal sources to support improvement and expansion projects. It is therefore an important first step to estimate how much people attach value to these sites so as to demonstrate how the respective authorities can extract revenue out of the excess benefit to improve qualities and expand the types and varieties of their services.

This study sought to provide a quantitative estimate for current recreational use values of Sodere Natural Recreational Site. Furthermore, it tried to estimate welfare effects of the existing problems of the site that were proposed to have negative impacts on the recreational qualities. In doing so, the study applied two standard procedures in environmental economics, i.e. Travel Cost and Contingent Valuation Methods, using primary data collected from a survey of 232 visitors at *Sodere* Recreation Area.

The Travel Cost Method depends on information about the amount of money and time people spend getting to the site to infer a value for that site. This cost, which is the amount of time and money individuals expend getting to and from the site was used to derive a demand function for the site. Once demand was derived, it was used to estimate the benefit associated with the site.

The Contingent Valuation Method, on the other hand, was employed to measure welfare effects of the existing problems of the site (i.e. congestion and malaria) that were proposed to have negative impacts on the recreational qualities. In the CVM, sample visitors were asked hypothetical questions designed to elicit how much money they were willing to pay in exchange for access to improved recreation qualities. Specifically, they were asked how much money they would be willing to pay if the problem of congestion would be removed by constructing one more swimming pool and one more *Abader* Bath, and with similar approach, visitors were also asked how much they would be willing to pay if the problem of malaria would be controlled by spraying DDT or some other insecticide on the site at appropriate intervals. The information obtained through these techniques were used to construct a Hicksian demand function that associates WTP to a number of economic and household characteristics, which in turn were used to calculate predicted mean WTP per visit. The fact that respondents on the site are familiar to the proposed hypothetical good under consideration will minimize the problems that could have been encountered on our estimates due to hypothetical biases. Also the results of strategic bias tests that proved the absence of strategic behavior in their WTP responses have augmented the validity of the CVM results.

Four functional forms were employed to estimate the demand functions in both methods. However, a combination of an F-test and a χ^2-test suggested by Box and Cox were employed to select a better specification for the estimation of recreational benefit and welfare effects. According to the results of these tests, the Log-Linear specification was selected in both the Methods.

Because the sample was collected only from current users of the site, the demand functions of both the methods were estimated using Maximum Likelihood estimates of truncated models.

The regression results obtained from both the methods were, to a large extent, comparable to other similar empirical findings. In the Travel Cost method, travel costs, visitor's income (not household income), mode of transport and availability of substitute sites were found to have significant impact on visitations to the site. On the other hand in the Contingent Valuation Method analysis of WTP responses, visitor's income, visitor's attitude towards the problems, and visitor's responsibilities and positions in the household were found to have significant influences on their WTP responses.

Using the regression results obtained from both the methods, the study tried to estimate on-site recreational benefit of the site, and welfare effects of congestion and malaria problems of the site. According to these estimates, annual per person on-site recreational benefit of the site amounted to Birr 520 (US $ 74.30). This amount was translated in to an expected aggregate annual benefit of Birr 9,824,094.80 (US $1,403,442.10). Similarly, per visit welfare effects of congestion and malaria problems were valued as Birr 1.37 (US $0.20) and Birr 4.39(US $0.63), which are aggregated to Birr 234,730 (US $33,532) and Birr 752,165 (US $107,452) as expected annual effects respectively.

Based on these results of the study, the following policy implications can be drawn.

1. The total amount of Birr 856,680 (US $122,382) per year that site authorities are collecting through gate fees from an average of 171,336 visitors per year does not reflect the true social recreational benefit of the site. This study estimated the true social recreational benefit of the site as Birr 9,824,094.80 (US $1,403,442.10) per year. Gate fees capture only 9 percent of the true recreational benefit of the site. If we are thinking of the benefits of the site in tems of the revenue collected through gate fees, we are not likely to put strong efforts for conservation.

Therefore, failure to properly incorporate the true social benefit in any future decisions of the site may underestimate conservation efforts and benefit. This in turn may result in an irreversible damage to the natural resources of the site.

2. The high benefits that people are getting from the site and low payments they are making to the site authorities is a good indication of the fact that much can be done to raise additional money for quality improvements by forcing visitors to pay more. Increasing gate fee seems a good policy instrument. But it is against the principle of equity and hence may crowd out the already small proportion of low income groups from visiting the site. Therefore, other policy instruments that would possibly and implicitly affect higher income groups should be implemented so as to maintain equity. Among others, these policy instruments include additional tariffs imposed on alcohol drinks, foodstuffs, entrance or parking fees for cars, etc.

3. In this study, malaria was proved to be one of the major drawbacks of recreational qualities at the site. 86 percent of the sample visitors identified malaria as serious problem to the site, unlike the 36 percent responses for congestion. Also, Higher WTP responses to malaria than congestion showed the relative depth of the problem. Therefore, site authorities should immediately alleviate this problem so as to maintain the existing recreational demand to the site. For this purpose, site authorities can exploit part of the consumer surplus illustrated in the Contingent Valuation Studies, using instruments pointed out above. Failure to address this problem may force visitors to spend their time on other close substitute sites such as *Wondogenet*. This may lead eventual close down and damage to the recreation site.

4. Looking at the large personal benefit that visitors derive from recreation, and potential demand for quality recreational sites, it would seem sensible to locate similar sites in the

vicinity of Addis Ababa. To this end, the government should issue licenses to private investors to develop such site, or encourage and support local communities to develop and operate their sites for recreation. In doing so, the government could generate an excellent opportunity of income and employment to local communities and private investors.

5. This study did not try to estimate total economic benefit of the site. It sought to measure only one component of value i.e. on-site recreational benefit. Other components of value such as direct use value, option and quasi-option values, and bequest and existence values were not estimated. Therefore, understanding of total economic values requires attaching monetary figures to all of these components. Site authorities or the Environment Protection Agency should commission a study to address these issues.

6. Finally, in many cases, decision makers quite simply have no idea as to the economic values of environmental resources such as a recreational site. They base their decision on their value judgment. Therefore, they should start to make their decisions based on estimates obtained through an indirect estimation techniques such as Travel Cost, Contingent Valuation and Hedonic Pricing Methods. Using some technique is preferable than complete ignorance.

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Appendix A

Questionnaire

Interviewer Code ______________________ Date______________

Interview Started _________________ Interview ended________

Supervisor_____________________

Interviewee Number_______________

Hello, I am a student from the Addis Ababa University. I am talking to a selected sample of visitors at *Sodere* Recreation Area to estimate how much the recreationists benefited from the site. Your views could be used to help policy makers to make informed decisions about the site. Most of the questions have to do with actual historical information based on your experience. Some questions may involve issues that require your attitudes and opinion, in which there are no "right" or "wrong" answers. All responses will be treated in strict confidentiality. Your name will never be associated with your answers.

SECTION A
Respondents' Personal Data

The questions here are important and once again be assured that the information is strictly confidential.

1. Name_________________________________

2. Place of residence _____________(Since_______E.c)

   How many Kms is that from *Sodere*?__________Kms.

3. Gender: 1= Male 2= Female

4. Marital Status:

   1= Single 2= Married 3= Divorced/Separated

   4= Other (e.g. Cohabitation without marriage) Please specify___________

5. How old are you?_______(Years)

6. Years of formal Education: ___________ (Years).

7. Occupation:

   1= Public Sector Employee 2= Private Sector Employee

SECTION B

Views on the Site and Visitations

The following questions are meant to gauge respondents' attitude towards the site, and to collect historical data regarding their visitations.

1. When did you arrive at the site this time?_____________(DD/MM/YY)
2. How long will you stay on the site?___________days.(from arrival to departure)
3. With whom did you come to the site? (Specify as friends, wife, families, others).

Relation	*No. of Adults*	*No. of Children*
Family		
Friends		
Work Colleagues		
Others		

4. How long have you known about *Sodere* Recreation Area?___________years.
5. Have you visited other similar sites before?

    1= No   2= Yes

6. If Yes, Specify name and gate fees

Name	*Gate Fee*

7. Do you prefer this recreation area to other recreation sites

    1= Yes

    2= No

    3= Indifferent

8. Do you enjoy the journey to and from the site?

    1= No   2= Yes

9. What percent of your total recreation experience can be attributed to each of the following. (Please make sure your responses add to 100%).

1= Journey to and from the site_______________

2= Recreation on the site___________________

10. Thinking just about *Sodere* as recreation site, and the pleasure and enjoyment it has given or is giving you, what percent of your enjoyment on the site would you attribute to each of the following. (Please make sure your responses add to 100%).

1. Swimming___________
2. Abader bath__________
3. Common bath_________
4. Watching birds and monkeys__________
5. Relaxing, Photographing,____________
6. Chewing Chat under acacia tree shades_____________
7. Others (Please Specify___________________

11. How many times have you visited *Sodere* during the last 12 months?_____times

March 1997 - June 1997 :_____________times.

July 1997 - October 1997 :____________times.

November 1997 - February 1998:________times.

12. Which days do you frequently come to this site?

1= Working days 2= Weekends 3= Public Holidays

13. Which mode of transport do you use to and from *Sodere*

1= Own vehicle

2= Public transport

3= National Tour Organization or other travel agents' vehicle

4= Others (Specify_________)

14. Specify the cost incurred for transport in question 13 above. (Money expenditure on fuel or tariff per round trip)

15. How many Kms do you usually travel to and from *Sodere*?_____Kms.

16. How many hours do you usually travel to and from *Sodere*?____Hrs.

17. How many hours do you usually stay on the site? ______ Hrs.

SECTION C
Questions on Willingness-to-Pay

1. To what extent do you perceive that congestion during weekends or public holidays is a problem and have a negative effect on the recreation qualities of the site.

    1= A Serious Problem

    2= A Problem

    3= A Simple Problem

    4= Not a problem at all

2. Suppose that the site authorities want to decrease weekend congestion by increasing the services i.e. Building one more pool and one more Abader Bath., what is the maximum gate fees that you are willing to pay to support this effort of decreasing congestion?__________ (Birr)

3. If your response to question 2 above is zero, why do you give zero responses?

_____________________________________.

4. If one more pool and one more Abader Bath were built and the gate fees and accommodation fees remained unchanged, would you increase the duration of your stays at *Sodere*?

    1. Yes   2. No

5. To what extent do you perceive that malaria on the site is a problem and has a negative effect on the recreation qualities of the site.

    1= A Serious Problem

    2= A Problem

    3= A Simple Problem

    4= Not a problem at all

6. Suppose that the site authorities started to control malaria on the site by spraying DDT or some other insecticide on the site at appropriate intervals, What is the maximum gate fees that you are willing to pay to support this effort of controlling malaria epidemic on the site?____ ____________ (Birr)

7. If your response to question 6 above is zero, why do you give zero responses?

_____________________________________.

8. If the authorities started to control malaria in this fashion while leaving the gate fees and accommodation fees unaltered, would you increase the duration of your stays at *Sodere*?

    1. Yes   2. No

Thanks for your time and assistance!

Appendix B

1. Regression Results for Linear, Semi-log, and Quadratic Specifications.

Table B.1. ML Coefficients for the Travel Cost Method (Visits as dependent Variable)

	ML Coefficients (N= 232)		
Variables	QUADRATIC	LINEAR	SEMI-LOG
TC	-0.2503* (-3.279)	-0.2783* (-4.283)	-0.0090* (-4.758)
AGE	-0.5990 (-0.673)	-0.4644*** (-1.860)	-0.0098 (-1.074)
EDNYRS	-1.0535 (-0.659)	-0.3588 (-0.817)	-0.0076 (-0.454)
FMSZ	-4.4727 (-1.611)	-0.6335 (-1.075)	-0.0198 (-0.942)
VINC	0.0070 (1.030)	0.0119* (4.187)	0.0004* (4.670)
KNOW	2.9923* (3.646)	1.3571* (4.575)	0.0323* (3.598)
DGEN	-3.9634 (-1.202)	-1.6846 (-0.494)	-0.1884 (-1.395)
DMARSTA	0.5472 (0.142)	0.3300 (0.086)	0.0366 (0.243)
DOWNC	12.681* (2.698)	15.064* (2.968)	0.5179* (2.638)
DGRP	0.0785*** (1.717)	0.1213** (2.454)	0.0044** (2.180)
DWGSS	-0.0600 (-1.447)	-0.0885*** (-1.871)	-0.0032*** (-1.841)
$(TC)^2$	-0.00003 (-0.280)	N/A	N/A
$(AGE)^2$	0.00002 (0.002)	N/A	N/A
$(EDNYRS)^2$	-0.0714 (-1.064)	N/A	N/A
$(FMSZ)^2$	0.3455** (2.154)	N/A	N/A
$(VINC)^2$	0000.0 (0.243)	N/A	N/A
$(KNOW)^2$	-0.0515** (-2.419)	N/A	N/A
(AGE)* (VINC)	0.0002 (1.408)	N/A	N/A
(EDNYRS)*(FMSZ)	-0.0095 (-0.080)	N/A	N/A
(FMSZ)*(VINC)	-0.0005 (-1.348)	N/A	N/A
CONSTANT	11.315 (0.524)	10.956 (1.016)	2.5475* (6.327)
Unrestricted Log-L	-693.2923	-701.4814	-211.8978
Restricted Log-L	-830.5073	-830.5073	-238.5521

Note:- N/A stands for Not Applicable
*, **, *** indicates that the variables are significant at 1%, 5% and 10% level respectively.

Table B.2. ML Coefficients for the CVM Method (MWTPCNG / MWTPMAL as dependent variable)

	CONGESTION			MALARIA		
Variables	**QUADRATIC**	**LINEAR**	**SEMI-LOG**	**QUADRATIC**	**LINEAR**	**SEMI-LOG**
AGE	0.0277 (0.096)	0.1462*** (1.839)	0.0073** (2.285)	0.1200 (0.416)	0.0940 (1.148)	0.0054 (1.568)
EDNYRS	0.2046 (0.345)	0.0687 (0.443)	0.0044 (0.739)	0.3761 (0.701)	0.2823*** (1.865)	0.0140** (2.214)
FMSZ	-1.1295 (-1.225)	-0.4361** (-2.096)	-0.0180** (-2.272)	-1.9088** (-2.135)	-0.2719 (-1.306)	-0.0082 (-0.961)
VINC	0.0031** (1.921)	0.0005** (1.921)	0.0003* (2.587)	0.0034** (2.094)	0.0004 (1.325)	0.0002 (1.588)
KNOW	-0.0568 (-0.261)	-0.0078 (-0.098)	-0.0006 (-0.207)	0.3984*** (1.765)	0.1244 (1.491)	0.0055*** (1.661)
DGEN	0.2684 (0.224)	0.5474 (0.463)	-0.0163 (-0.353)	0.5878 (0.512)	1.1844 (1.009)	0.0044 (0.090)
DHEAD	-3.4182** (-2.100)	-3.3104** (-2.262)	-0.1751* (-3.041)	2.8895*** (1.844)	2.2826 (1.550)	0.1125*** (1.811)
DOWNC	3.8853* (2.994)	3.8786* (3.000)	0.1421* (2.785)	3.1195** (2.468)	3.5153* (2.716)	0.1221** (2.185)
DWGSS	0.0216 (1.516)	0.0204 (1.415)	0.0004 (0.614)	0.0271** (1.964)	0.0247*** (1.717)	0.0011*** (1.755)
DATT(CNG OR MAL)	13.107* (8.593)	13.170* (8.458)	0.8971* (20.339)	15.244* (8.728)	15.753* (8.432)	0.9920* (19.271)
$(AGE)^2$	0.0025 (0.733)	N/A	N/A	-0.0003 (-0.087)	N/A	N/A
$(EDNYRS)^2$	-0.0003 (-0.010)	N/A	N/A	0.0299 (1.284)	N/A	N/A
$(FMSZ)^2$	0.0926*** (1.751)	N/A	N/A	0.1390* (2.711)	N/A	N/A
$(VINC)^2$	0.0000 (0.679)	N/A	N/A	0.0000 (0.679)	N/A	N/A
$(KNOW)^2$	-0.0014 (-0.202)	N/A	N/A	-0.0087 (-1.246)	N/A	N/A
(AGE)* (VINC)	-0.00004 (-1.068)	N/A	N/A	-0.00004 (-0.902)	N/A	N/A
(EDNYRS)*(FMSZ)	-0.0242 (-0.556)	N/A	N/A	0.0084 (0.205)	N/A	N/A
(FMSZ)*(VINC)	-0.0001 (-1.092)	N/	N/A	-0.0002 (-1.568)	N/A	N/A
CONSTANT	-6.0666 (-0.765)	-8.4747** (-2.076)	1.2087* (8.573)	-7.5608 (-1.004)	-12.051* (-2.832)	1.0892* (6.997)
Unrestricted Log-L	-660.1482	- 663.6616	-65.5545	-698.093	-706.9138	-83.3804
Restricted Log-L	-776.5712	- 776.5712	- 205.3772	-805.1606	-805.1606	-211.0371
N	232	232	232	232	232	232

Note:- N/A stands for Not Applicable

* , **, *** indicate that the variables are significant at 1%, 5% and 10% level respectively.

2. Tests for selection of functional forms.

A combination of both an F-test and Box-Cox procedures were applied to select a better specification for benefit estimation both in the Travel Cost and Contingent Valuation Methods. The steps involved in the applications of the tests were described earlier in section 3.5.3. The results of these tests are presented below.

Let **RSS_L** = Residual Sum of Square for the Linear Model.

RSS_{LL} = Residual Sum of Square for the Log-Linear Model

RSS_{SL} = Residual Sum of Square for the Semi-Log Model

RSS_Q = Residual Sum of Square for the Quadratic Model

RSS_{LGM} =Residual Sum of Square of the Linear Model after transformation.

STEP 1:- Collect RSS both in the four basic specifications and the transformed models. The resulting RSS are summarized in the table B.3. below.

Table B.3. Summary of RSS for the basic and transformed models

RESIDUALS	TRAVEL COST METHOD	CONTINGENT VALUATION METHOD	
		CONGESTION	MALARIA
RSS_L	11996.3	5948.2	8029.82
RSS_{LL}	95.41	19.70	21.71
RSS_{SL}	194.58	23.90	27.87
RSS_Q	11449.4	5784.62	7600.72
RSS_{LGM}	182.39	92.10	72.45

Step 2:- Conduct an F-test to select between Linear and Quadratic formats, with the null hypothesis that additional variables in the quadratic format are zero and hence Linear format is a better specification. The F-values are calculated with the following F-statistics.

$$F = \frac{(RRSS - URSS) / J}{URSS / N - K} \sim F_{J,\ N-k}$$

where,

RRSS = RSS for the restricted model (linear)

URSS = RSS for the unrestricted model (quadratic)

J = Number of restrictions

K= Number of regressors

N = Number of observations

The resulting F-values and the corresponding Critical Values are summarized in the table B.4. below.

Table B.4. Selection of Models between Linear and Quadratic Forms

Methods	**Calculated F-values**	**Critical F-values (at 5% level)**	**Decision**
Travel cost Method	1.167	1.94	Select Linear
CVM (Congestion)	0.76	1.94	Select Linear
CVM (Malaria)	2.0	1.94	Select Linear

Step 3:- Conduct the test suggested by Box and Cox to test the null hypothesis that the remaining models (i.e. Linear and Semi-log and Log-linear) are empirically equivalent. The Statistic used to test the null hypothesis is given by

$$\ell = \frac{N}{2} \left| \ln \left[\frac{RSS_{\lg m}}{RSS_{ll}} \right] \right| \sim \chi^2(1)$$

where, $\mathbf{RSS_{lgm}}$ = RSS of the transformed linear model

$\mathbf{RSS_{ll}}$ = RSS of the log-linear/semi-log model

The result of this test indicated that all the models are not empirically equivalent.

Step 4:- Compare the RSS of the transformed linear model with that of the log-linear and semi-log models and select the Model with the smallest RSS. With this final comparison the Log-Linear Model was selected in both the Travel Cost and Contingent Valuation Methods.

3. Tests for strategic biases.

A simple two-tailed t-test was conducted to check whether WTP responses derived from the Contingent Valuation studies were influenced by respondent's strategic behavior. For this purpose the survey data was collected in two market scenarios, where the two formats were distributed equally among the questionnaire. The first scenario was designed to capture any strategic elements involved during valuation of quality improvements. The second scenario, on the other hand, was designed to discourage respondents from incorporating any strategic element in their responses.

This test, therefore, evaluates whether there is a significant difference between the mean WTP in these two scenarios, with the null hypothesis that there is no significant difference between the two mean values and hence the two samples are drawn from the same population.

The statistic used to evaluate the null hypothesis is given by:

$$\mathbf{t} = \frac{\left(\bar{X}_1 - \bar{X}_2\right)}{\left(S_P\sqrt{\frac{1}{N_1} + \frac{1}{N_2}}\right)} \sim \mathbf{t}_{N1+N2-2}$$

Where $\bar{X}$ stands for mean WTP values, and N for number of observations, and subscripts 1 and 2 to identify values for the two market scenario respectively. S_p stands for standard deviation of the full sample.

The results of the tests for CVM studies for congestion and malaria are presented in the B.5. table below.

Table B.5. Test results for strategic biases

Description	***Congestion***		***Malaria***	
	Scenario 1	*Scenario 2*	*Scenario 1*	*Scenario 2*
No. of Observations	119	113	119	113
Mean WTP (in Birr)	9.26	9.42	11.79	12.02
Standard Deviation	7.57	6.14	7.39	8.19
Mean of the Full Sample (in Birr)	9.33		11.90	
Standard Deviation of Full Sample	6.89		7.80	
Calculated t-values	0.18		0.23	

The calculated t-values in both congestion and malaria cases are smaller that the critical t-values for 230 degrees of freedom at 5% significance level. Therefore, the null hypothesis that the two samples were drawn from the same population can not be rejected, implying that significant strategic behavior is not observed in the respondents' WTP responses.

DECLARATION

This thesis is my original work. It has not been presented in any other universities and that all the sources of materials used in the thesis have been fully acknowledge.

Mahmud Mohammed

May 22, 1998

This thesis has been submitted for examination with my approval as university advisor.

Dr. Andre Croppenstedt

May 22, 1998

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May 22, 1998

ADDIS ABABA UNIVERSITY
FACULTY OF BUSINESS AND ECONOMICS
DEPARTMENT OF ECONOMICS

Ref. N°: FBE/ED/355/90

Date: 18 June 1998

To: School of Graduate Studies

From: Mulat Demeke, A/Chairman
Department of Economics

Subject: MSc Economics Theses

Following the defence, the examiners submitted their comments and suggestions for improvement. The department verified that the students have duly incorporated the corrections. It was after this verification that the theses were presented to the DGC and FGC for final approval. Attached please find the FGC Minutes.

The list of the prospective graduates include:

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Thank you.