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DEPARTMENT OF ECONOMICS

ESTIMATING THE VALUE FOR CONSERVATION OF WONCHI CRATER LAKE (APPLICATION OF CONTINGENT VALUATION METHOD)

A THESIS SUBMITTED TO THE DEPARTMENT OF ECONOMICS IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE (RESOURCE AND ENVIRONMENTAL ECONOMICS)

By:

NEGASSA FUFA LEBETA

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This is to certify that the thesis paper Prepared by Negassa Fufa entitled: Estimating the Value for Conservation of Wonchi Crater Lake (Application of Contingent Valuation Method) and submitted in partial fulfillment of the requirements for the Degree of Master of Science (Natural Resource and Environmental Economics) compromise with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

The reason why the Natural Resources or Environmental Goods and Services are polluting and destroying is due to the nature of the resources, they have the property of Public Goods which have no market value. Despite of their importance, society over utilize them for only the current benefits without thinking the future life span of these resources. The problems related to Natural Resources and Environmental Goods is now a day the main topic of discussion in every Conference and Panel discussions. The main objective of this study is, therefore, estimating the value of these resources as if they are conserved. Among all, this study focused on Conservation of Wenchi Crater Lake, which is very affecting lake by society. It is, the society's Willingness to pay (WTP) as if this lake is conserved. Contingent Valuation Method (CVM) was applied based on its advantages over other methods of valuation. To identify the individuals' WTP for conservation of the lake, Closed-ended question format was used. Follow-up question which is open was used to see whether there is starting bid bias or not, but excluded from analysis.

As of the descriptive statistics and Econometric results, from total of usable sample size 193, 190 (98%) were perceived the problem and are willing to pay. The result also shows as there is no serious starting bias so that individuals expressed their, nearly, true WTP which was proved by asking the follow-up question about their maximum WTP amount. From Econometric results, Probit and logit models, explanatory variables such as income, education, Origin, family size, and occupation of the respondents are positively affect the probability of saying 'yes' for proposed bids and are statistically significant variables at different level. Another variables, Age and Initial bids are also significant at 1% but negative impact on the probability of saying yes.

Therefore, taking the importance of the lake for society and for government in to consideration, and the society's WTP, the policy makers, and even government need to focus on identified factors in designing strategies for the conservation of the lake.

Key words: Willingness-to-pay, Contingent Valuation Method, Conservation of Wenchi Crater Lake.

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List of Abbreviations

BT --------- Benefit Transfer

CEM -------- Choice Experiment Method

CVM -------- Contingent Valuation Method

Fig. ---------- Figure

GDP ----------Gross Domestic Product

HPM ------ Hedonic Pricing Method

Km ---------- Kilo Meter

KMT -------- Kalpan-Meier-Turnbull

LR ---------- Likelihood Ratio

NOAA ----- National Oceanic and Atmospheric Administration of the USA

RP---------- Revealed Preference

SP ---------- Stated Preference

TCM ------ Travel Cost Method

TEV ---------- Total Economic Value

UN ----------United Nations

WTA ------Willingness to Accept

WTP ---------Willingness to Pay

CHAPTER ONE

1. INTRODUCTION

1.1. Background

Human beings are naturally created with the need to satisfy their own interest and to maximize their happiness through different ways. Even though the happiness of individuals differ across individuals and constrained by different factors like income, background and generally socio-economic characteristics, objective of all is to satisfy happiness or pleasure. This is maximized through consumption of goods and services in exchange, production of goods and services, recreation of mind by visiting man-made and natural recreation sites and even from work and leisure time. Freeman (1993, 443) supported this arguments saying "Many natural resource systems such as lakes, rivers and streams, forests and estuaries are used extensively by people for various kinds of recreational sites or activities." This objective of individual, as Varian (1992) has stated, is known as satisfaction maximization or Utility maximization.

Things those maximize satisfaction for human beings can be characterized by its value, that means, some of them have market value and others have no market value. Freeman (1993) clearly indicated that most of environmental goods and services have no market value and it is difficult to measure or indicate them by market price and it is impossible to allocate them through market mechanism. According to Hanley and White (1997), one and the major reason why they have no market prices are due to their characteristics of public goods. They are non-rival and non-excludable. Non-rival is when certain goods and services, once they are provided, consumption of one person never reduce the availability of the product for others. Non-excludability of goods and services is when there is no formally defined property right to exclude or prevent one or group of society from consumption of that good.

All people maximize their satisfaction without restriction and they are open, according to Freeman (1993), with zero price or nominal entrance fee. Recreation from visiting different recreational sites like parks, lakes, forests and even geographical site of lands, Girma (2006), recently is increasing more than before and as a result, recreational sites are given more consideration than any time before. Girma also argued that as these sites are home for

both consumable and non-consumable habitats, protecting for these are important for human beings. From various kinds of natural resource systems, this study will give more emphasis to recreation from lake.

Girma (2006) argued that in our country Ethiopia, most Lakes are naturally created and only limited numbers are man-made lakes. These naturally created lakes are located at rift valley level or low land part of the country. For example, Lake Awassa, Lake Tana, Lake Dambal, and others are naturally created lakes in Ethiopia. The basins of these lakes and their surroundings are home for flora and fauna.

Among lakes in Ethiopia, Wenchi Crater Lake is located in high land area, which means, high land of Oromia region, which is at central part of Ethiopia.

This lake is exactly 150km from Addis Ababa, and as a result it is near to Addis Ababa. The elevation of Wenchi is 3500m above sea level with temperate climate condition. According to information from culture and tourism office of Woliso (2012), just like other lakes of Ethiopia, this lake is home for habitats like birds and fish, even though it was not conserved well.

Things those make Wenchi Crater Lake different from other lakes of Ethiopia is its creation. As oral information from elders, at the very beginning, there is no even source of water around this area and it was just land without water. But mean while, the form of Volcano eruption has occurred around and this volcano has created a very attractive and beautiful lake which was called Wenchi lake by society of the area. This name is based on the image of the lake. It seems “Wechiti” one type of home furniture for the local society with ‘U’ shape. No one reached on the exact date and year in which Lake Wenchi has created at all but there are evidences showing this oral information is true. For example, the existence of Orthodox Church which is known as “Chirkos church” at the centre of the lake which is surrounded by water and the shape of the lake itself puts evidence for this oral information. The erupted volcano has destroyed all landscapes of the area and but not the church. This Orthodox Church has been the main part of the lake which attracts tourists. Its Blue-colored water is very attractive to visit. This lake, 1,600 square meters in total area, is ecologically, recreationally, and aesthetically important as well as a popular place for

tourists (Malairajan, Lakew, and Mitiku, 2008). Therefore, this paper will estimate the value for the conservation of Wenchi Crater Lake using or applying Contingent Valuation Method.

1.2.Statement of the problem

Most of environmental resource systems are home or habitats for flora and fauna those attracts tourists to visit the area (Girma, 2006) and to be conserved or to be protected from different activities which affect them negatively. They have the characteristics of public goods which is non-excludable and non-rival or available for all. Freeman (1993) argued most of environmental goods and services have no market value and it is difficult to measure or indicate them by market price and it is impossible to allocate them through market mechanism. This means even though human beings maximize their utility from recreation sites, we cannot measure this satisfaction by price directly. Among different environmental resource systems Lake is the one which is used for recreation, according to Freeman (1993, 443).

Wenchi Crater Lake in Ethiopia, which was created naturally from volcanic eruption around 1000 years ago (orally transmitted information but no evidence for this year) was located in Oromia region, South-west showa zone, at specific place of Wenchi area. Wenchi Lake is about 35km far from Woliso, the capital of zone and 30km from Ambo. It is possible to say that this lake is near Addis Ababa, the capital of Ethiopia with only 150km distance.

According to Malairajan, Lakew, and Mitiku, (2008), Wenchi Crater Lake is home for different species of Fish, endemic birds and animals as it was surrounded by forest. The lake has 'U' shaped landscape. It is very beautiful and odd lake in Ethiopia, as a result (Culture and tourism office, 2011, Woliso). According to information from this office, this lake is eco-tourism area and even the forest and landscape of the area is major part of recreation site or tourist attracting area. This lake has also great role in keeping the balance of the environment and protect the weather condition of the area according to Woliso culture and tourism offices' information.

Despite of these, society around the lake used agricultural activities by destroying the forest. They use traditional system of irrigation from some sources of water those are nutrient for the lake. Additionally, the society cuts trees for different purposes like charcoal and timber production. This activity puts the lake in danger by creating soil erosion which create delta around the water part of the lake. Cultivation in the lake may be external cost or benefit for residents in the lake. It is external cost as it reduces the size and volume of the lake and may eventually destroy it. On other hand, it is benefit for them as they use for cultivation of vegetables on delta created on the lake. Even though they may benefit from this activity, consequence or the result at the end puts the lake in danger or in short, it will dry in a very soon. In order to make the life of Wenchi Crater Lake longer, there is a need of conserving the forest and the general environment. Annex three indicates the existence of soil erosion and deforestation in the lake.

Protecting and conserving the lake is use full for specially three purposes: First, it increases the income for community and revenue for government as it is recreational site attracting tourists, and it maximizes satisfaction for tourists. Second, it balances the environmental weather condition because of the surrounding area is covered by forest. Third, endemic animals and birds living in and around the lake will be saved.

As we have no market value for such like public goods, to value the lake, it is made through valuation technique of environmental resources and then developing market scenario from Willingness to Pay (WTP) responses of respondents for conservation of the lake as it is explained by Freeman (1993). Valuation methods of environmental goods and services are direct/stated which includes Contingent Valuation (CV) and Choice experiment (CE), and indirect/revealed method which includes Travel cost (TC) and Hedonic pricing methods, as discussed by Perman et al (1999).

From these different methods of valuation, according to Perman et al (1999), Contingent Valuation Method (CVM) is more appropriate as it uses overall economic values, both use value and non-use value of the resources. Then estimating average WTP and developing market scenario for resource under question is the issue of this study.

There is no research done on the valuation aspect of Wenchi Crater Lake but only the nature of the water by Malairajan, Lakew, and Mitiku in 2008. Therefore, there is research gap and this paper is the first to estimate the valuation side of the lake.

Based on this research issue, this study answers the following research questions.

1.3.Research Questions

Main questions to be investigated will be as follows:

1. Are Wenchi residents and tourists willing to contribute to the conservation of Wenchi Crater Lake?
2. If they are, what is the maximum amount that they are willing to pay? If not, what are factors determining their willingness to pay?
3. Mean willingness to pay be calculated as the lake is conserved?
4. How the results from CVM contribute for policy makers?

To handle the above problems and research questions, the following general and specific objectives are accomplished.

1.4.Objectives of the study

General objective of this study is to estimate the overall economic value of Wenchi Crater Lake from WTP data or survey.

Specific objectives of the study are:

- To estimate mean WTP from, and generally the benefits of conserving the lake,
- Identifying determinants of individuals WTP for conservation of the lake,
- To show the importance and the general image of the lake to general society and the world.
- Finally the paper will try to provide policy makers for further improvements of the lake and its surroundings by concluding remarks.

1.5.Significance of the study

This study focuses on the estimation of value for conserved Wenchi Crater Lake. The WTP by individuals will be measured by using Contingent Valuation Method (CVM) questions.

If the lake is conserved, no one deny that there is increase in satisfaction for visitors and even increase in income or revenue for the society those are cooperated. This increases the revenue for government and hence GDP of the country. If the lake is conserved, different endemic birds and animals will be saved.

As no study has been conducted in this area yet, this study fills the gap and hopefully this study initiates other researchers to deal with Lake Wenchi-the most beautiful area, by providing the data. This data may also use as empirical reference. And finally, the paper will try to provide policy makers with much needed information for further improvements of the lake and its surroundings by drawing concluding remarks.

1.6. Scope of the study

The scope of the study is limited to Lake Resource from different environmental recourses like forests, rivers, streams and others. Among a number of lakes in Ethiopia, the paper gives emphasis to Wenchi Crater Lake based on the real or existing situation of the lake. Shortage of time and budget is the reason for limiting the site only to this lake.

For the specification purpose, the method of valuation is only CVM. This method is preferable and flexible than other methods of environmental goods and services valuation. It deals with WTP rather than WTA for conserving the lake based on NOAA agreements.

As there may be heterogeneity problem of respondents in including both users and non-users of the lake, the sample size is limited to only 200 individuals selected from cooperative workers on the lake, visitors and non-users.

1.7.Limitation of the study

As the study incorporates both users and non-users, the difficulty of getting total population is major limitation of the study. Additionally problem of protestors and shortage of finance limited the result.

CHAPTER TWO

2. REVIEW OF LITRATURE

2.1. Theoretical Background

2.1.1 The Economic Approach to Environmental Valuation

Efforts to value the environmental effects of economic activities lie at the heart of planning for sustainable development. In the past some environmental goods and services have been assigned zero or low values. This was due to difficulties involved in assigning economic values to such commodities or to the attitude that they are 'free goods'. As of Kolstad (2000), it is important to integrate environmental values into economic decision making processes because failure to do so can have adverse implications not only for current generations but also future generations.

According to this person, Ecosystem health in many parts of the world has deteriorated, in large part because of the loss of habitat from an ever-expanding world population. Virgin forests are being cleared for the purpose of selling the standing timber as well as providing farm land. Wetlands are drained to obtain more land for agriculture and housing. The number of endangered species of plants and animals grows annually. The world has yet to fully come to grips with how to appreciate and protect important ecosystems.

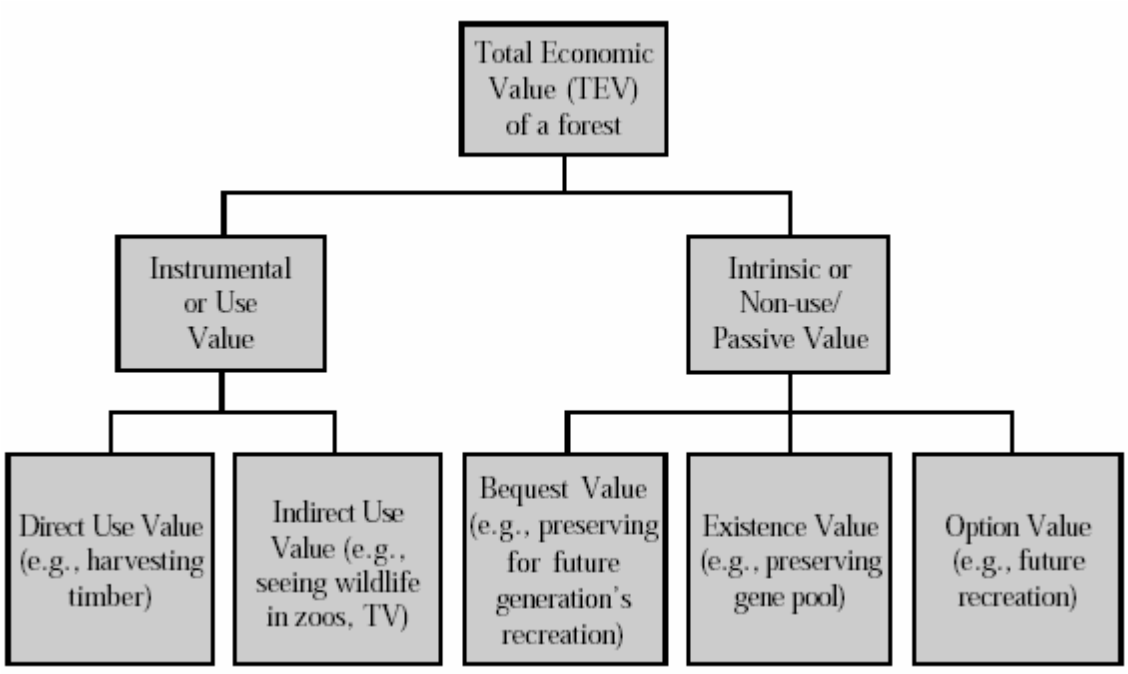
The economic concept of value is based on an anthropocentric, utilitarian approach to define value based on individuals' preferences. As such, it does not encompass all possible sources of value. However, it is much broader than the narrow concept of commercial or financial value, and includes all values, tangible and intangible value, that contribute to human satisfaction or welfare. This broad definition is reflected in the "total economic value" framework that underlies economic valuation and is described below.

2.1.2. The Total Economic Value Framework:

The *Total economic value* (TEV) framework is based on the presumption that individuals can hold multiple values for ecosystems. It provides a basis for taxonomy of these various values or benefits. Although any taxonomy of such values is somewhat arbitrary and may differ from one use to another, the TEV framework is necessary to ensure that all components of value are given recognition in empirical analyses and that "double counting" of values does not occur when multiple valuation methods are employed as Bishop et al., (1987) discussed. It is important to state that the TEV framework does not imply that the "total value" of an ecosystem should be estimated for each policy of concern. Even a marginal change in ecosystem services can give rise to changes in multiple values that can be held by the same individual, and the TEV framework simply implies that all values that an individual holds for a change should be counted.

Total Economic value=Use value + non-use value

Diagram 1: Economic value of resources



Source: Perman et al, 1999

In the simplest form, TEV distinguishes between *use* values and *nonuse* values. The former refer to those values associated with current or future (potential) use of an environmental resource by an individual, while nonuse values arise from the continued existence of the resource and are unrelated to use. Typically, use values involve some human "interaction" with the resource whereas nonuse values do not. The distinction between use and nonuse values is similar but not identical to the distinction between instrumental and intrinsic value. Clearly, use values are instrumental and utilitarian, but the concept of existence value is not identical to the notion of intrinsic value, because the latter is deontological and includes non anthropocentric values while the former does not. Within the TEV framework an individual can hold both use and nonuse values for the services of an ecosystem.

2.1.2.1. Use Values

Use values are generally grouped according to whether they are *direct* or *indirect*. The former refers to both *consumptive* and *non consumptive* uses that involve some form of direct physical interaction with the resources and services of the system. Consumptive uses involve extracting a component of the ecosystem for an anthropocentric purpose such as harvesting fish and wild resources. In contrast, non consumptive direct uses involve services provided directly by ecosystems without extraction, such as use of water for transportation and recreational activities such as swimming. Although non consumptive uses do not involve extraction and hence reduction in the quantity of the resource available, they can diminish the quality of ecosystems through pollution and other external effects. It is also increasingly recognized that the livelihoods of populations in areas near aquatic ecosystems may be affected by certain key *regulatory ecological functions* (e.g., storm or flood protection, water purification, habitat functions) (Freeman, 1993). The values derived from these services are considered indirect, since they are derived from the support and protection of activities that have directly measurable values (e.g., property and land values, drinking supplies, commercial fishing).

2.1.2.2. Non-use Values

Non–use values (sometimes called passive use value or intrinsic value) as the name suggests, are inherent in the good. That is, the satisfaction we derive from the good is not related to its consumption, *per se*. Non-use or passive use values consist of existence value, bequest value and option value.

Many natural environments are thought to have substantial existence values; individuals do not make use of these environments but nevertheless wish to see them preserved "in their own right" as discussed by Bishop and Welsh (1992) and Freeman (1993). Nonuse values refer to all values people hold that are not associated with the use of an ecosystem good or service. Use values typically arise from a good or service provided by ecosystems that people find desirable. Nonuse values need not arise from a service provided by an ecosystem; rather, people may benefit from the knowledge that an ecosystem simply exists unfettered by human activity. Existence value arises from the benefit an individual derives from knowing that a resource exists or will continue to exist, regardless of the fact that he or she has never seen or used the resource, or intends to see or use it in the future. A good example of the significance of non-use value is the international outcry over the whaling issue. There are many people who have never seen a whale or plan to see one, but are nevertheless willing to pay significant sums of money to ensure that whales are not hunted to extinction. Other motivations for nonuse values are bequest option and cultural or heritage values. Bequest value, as the name suggests, is derived from the benefits that individuals obtain from knowing that a resource will be available for future generations. The third type of non-use value, option value, is a little more complex. Option value may be defined as the amount of money an individual is willing to pay, at the current time, to ensure the future availability of the resource. To the extent that option value is the expected value of future use of the resource, it may also be classified as a use value. This is because of uncertainty of the future, if they get the chance of using the resource it is use value for them, unless it is non-use value.

The empirical literature generally does not attempt to measure values for individual aspects of nonuse values, but focuses on the estimation of nonuse values irrespective of the underlying motivations people have for holding this value component. The economic

valuation of the impacts of the *Exxon Valdez* oil spill on the aquatic and related ecosystems of Prince William Sound, Alaska, highlights the importance of nonuse values in natural resource damage assessments and project appraisals. The *Exxon Valdez* study revealed that many Americans who ***have not*** visited Alaska and never intend to do so nevertheless place high values on maintaining the pristine and unique but fragile coastal and aquatic ecosystems of Alaska (Carson et al., 1992).

2.1.3. Environmental Valuation Techniques

Society must choose the quantity of environmental goods it wishes to conserve or produce vis-à-vis other goods and services; and within this set of goods it must also select the desired quantity and quality of different environmental resources. Choices logically imply some form of valuation. A number of techniques are available to value environmental goods in economic terms. These include market valuation and non-market valuation.

2.1.3.1. Non-market valuation methods

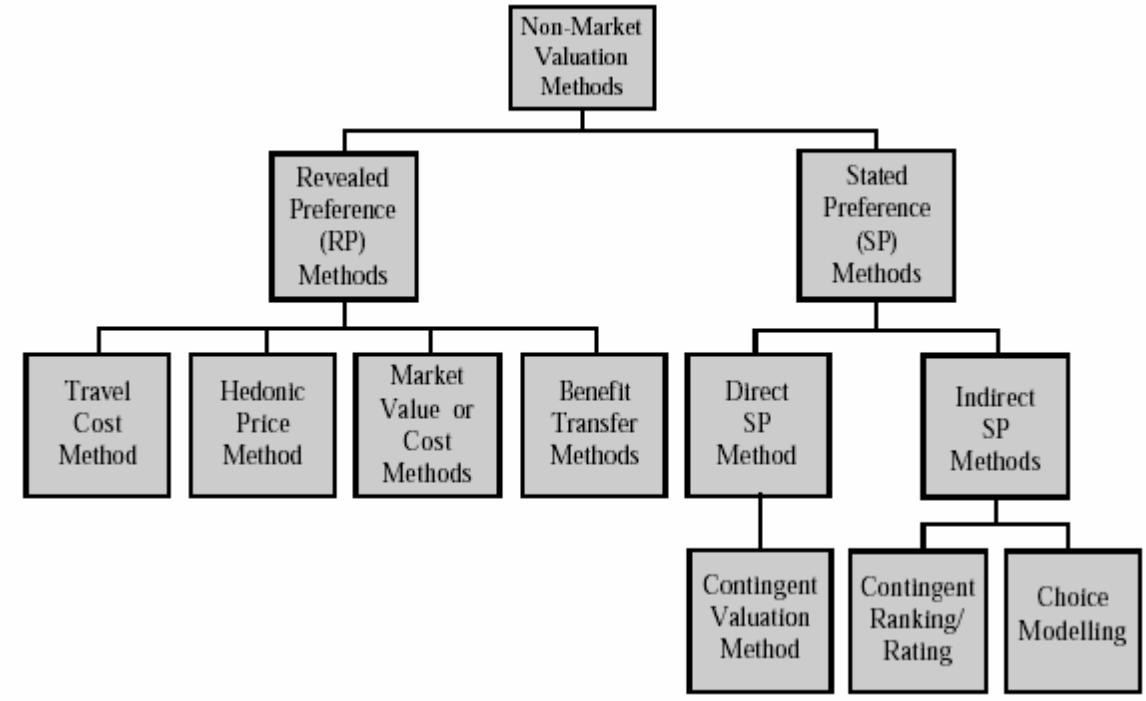
The methods of valuation of non-marketed goods have become crucial when determining the costs and benefits of public projects. Non- market valuation exercises have been conducted in many different areas, ranging from health and environmental applications to transport and public infrastructure projects. In the case of a good that is not traded in a market, an economic value of that good obviously cannot be directly obtained from the market. Markets fail to exist for some goods either because these goods simply do not exist yet, or because they are public goods, for which exclusion is not possible. Nevertheless, if one wants to compare different programs by using cost benefit analysis, the change in the quality or quantity of the non-market goods should be expressed in monetary terms. Another crucial application of valuation techniques is the determination of damages associated with a certain event. Under the Comprehensive

Environmental Response, Compensation and Liability Act of 1980 in the US, and after the events that followed the Exxon Valdez oil spill in 1989, the methods of valuation have become a central part of litigation for environmental and health related damages in the United States and in several other countries(Alpizar et.al.2001).

Over the years, the research on valuation of non-market goods has developed into two branches:

Revealed preference (RP) (or indirect) approaches, and Stated (or expressed) preference (SP) approaches (see the following diagram). The revealed preference (i.e., indirect) approach infers value indirectly by observing individuals' behavior in actual or simulated markets. For example, the value of wilderness area may be inferred by expenditures that recreationists incur to travel to the area. The value of, say, noise pollution may be inferred by analyzing the value of residential property near an airport. On the other hand, stated preference methods attempt to elicit environmental values directly from respondents by asking them about their preferences for a given environmental good or service. At the present time, only SP methods can be used to estimate total economic value (i.e., use and non-use values), whereas RP methods are only restricted to estimating use values.

Diagram 2.Classifications of Non-Market Valuation Methods



Source: Garrod and Willis, (1999)

2.1.3.1.1. Revealed Preference Methods

Revealed Preference methods include the Travel Cost Method (TCM), Hedonic Pricing Method (HPM), Cost (or Expenditure) Methods, and Benefit Transfer (BT) Methods. The two most-well known Revealed preference methods are the travel cost method and the hedonic pricing method According to Braden and Kolstad (1991). The indirect (inferential) approach (or revealed preference method) involves inferring about the unobservable demand for and hence value of the environmental goods and services based on the observable demands for the related marketable goods and services. That is, according to Freeman, (1993) and Jonsie, (2005), using information on market transactions for related private goods and services; economists try to infer the demand for environmental goods and services.

(a) The Travel Cost Method

The TCM assumes that the costs that an individual incurs in visiting a recreational site are a measure of his or her valuation of specified site. The approach involves asking visitors questions about where they have traveled from and the costs they have incurred.

The information is then related to the number of visits per annum, to generate a demand curve for the recreational site under question. Since we expect people living near the site to make more visits per annum compared to those living far away, the demand curve will be downward sloping. That is, travel cost will be inversely related to number of visits. The information requested in a travel cost survey includes the following: travel costs (petrol, food, and other travel-related expenses), income, alternative sites and personal motivations. Entrance fees to recreation sites are often non-existent or nominal. The demand curve drawn from the relationship between travel costs (a proxy for the price of recreation) and number of visits can be used to estimate the total recreation value of the given site (Freeman, A.M., 1979; Mahmud M. Yesuf, 1998)).

Limitations of the TCM

The main assumption of the TCM is that the value of a recreational site can be peroxide by the costs that the recreationist incurs in undertaking the recreational experience. The

strength of the approach is that it is based on real rather than hypothetical data and as such can provide true values. However, the assumption that the recreational value of a place is directly related to travel costs incurred in getting there could be an oversimplification of reality. For example, people who live near the site may incur zero or minimal travel costs but may nevertheless have high values for the site. In addition to this, TCM is passive and not include the non-use value in estimation. Multiple destinations, time and other factors which are assumed neutral, visiting more than one site are other limitation of TCM.

b) Hedonic Pricing Method (HP)

Hedonic pricing (HP) derives from characteristics theory of value and it has been mostly applied to analyze the underlying demands for and supplies of characteristics of housing such as age, size and number of rooms and neighborhood characteristics like air quality, crimes rate and availability of public goods (e.g. roads) (Palmquist, 1984). In recent years, as of Kolstad (2000), the HPM is applied to the wider areas such as agricultural land, land rents, effects of climatic conditions on agriculture, urban land, etc.

However, there are a number of problems that beset the HPM, according to Palmquist, (1984). Firstly, if consumers are not well informed about attributes of the good being valued, HP estimates are of little relevant. Secondly, it imposes strong assumptions concerning separability of consumers' utility functions. Thirdly, it suffers from econometric pitfalls such as identification problems, endogenueity problems, non-linearity and functional form.

2.1.3.1.2 Stated Preference Methods or Direct Methods

Stated preference method assesses the value of non-market goods by using individuals' stated behavior in a hypothetical setting. The method includes a number of different approaches such as conjoint analysis, contingent valuation method (CVM) and choice experiments. Stated Preference Methods can be either direct or indirect. The direct form of SP method is referred to as the contingent valuation method (CVM). Indirect SP methods include a variety of approaches including contingent ranking and choice experiment - sometimes called choice modeling. The most popular method used to value environmental goods and services is CVM.

(a) Contingent Valuation Method (CVM)

The idea of CVM was first suggested by Ciriacy Wantrup (1947), and the first study ever done was in 1961 by Davis (1963). Since then particularly in 1970s researchers in natural and environmental economics have made increasing uses of the CVM in order to value non-marketable natural resources. In the mid 1990s a bibliography lists 1,600 studies and papers using the CVM from over 40 countries on several topics including sanitation, health, environment, transportation and education (Hanemann, 1994 and Portney, 1994). However, according to Portney, (1994), studies using the CVM formed a sort of academic industry and only in the late 1980s that contingent valuation studies began to receive the kind of scrutiny normally devoted to the evidence in high-stakes legal proceedings.

The CVM directly infers values by using surveys to ask people their maximum willingness to pay (WTP) to avoid and/or minimum willingness to accept compensation (WTA) for changes in quality of Environmental goods and services. The term 'contingent' in CVM suggests that it is contingent on simulating a hypothetical market for the good in question. Since then, CVM surveys have become one of the most commonly used methods for valuation of non- market goods.

A CV survey has a number of well-defined components. First, the interviewer describes the environmental good or service, including the change in the resource to be valued. The second element is a mechanism for eliciting the respondent's WTP or WTA. There are various formats for eliciting WTP such as open-ended, biding games, payment card and single bounded and double bounded referendum formats. The dichotomous choice (or referendum) format is considered to be the state-of-the-art in CVM methodology. A National Oceanic and Atmospheric Administration (NOAA) panel of economic experts, chaired by Kenneth Arrow and Robert Solow, recommended the referendum format over the open-ended format as indicated by Arrow et al. (1993). In all the formats, a payment method such as increased income taxes increased utility bills or voluntary donations are used.

The CVM survey also asks questions about respondents' socioeconomic characteristics, as well as other information about their environmental attitudes and other factors that might affect their WTP. The final part of the CVM study is the statistical analysis. The WTP responses are usually regressed against the socioeconomic and attitudinal characteristics and the estimated equation is used to provide aggregate estimates of mean or median consumer's surplus.

Major steps involved in using CVM

1. Designing and administering a CV survey that elicits individual's value for a good or services. According to Michel and Carson (1989), under this step all parts of questionnaire must be included.
2. Analyzing WTP response-this involves the calculation of frequency distribution, cross tabulation of WTP responses with socio-economic characteristics and other variables including the estimation of bid function.
3. Estimating aggregate benefits or total WTP which can be calculated by multiplying the population by the mean WTP.
4. Evaluating the CVM exercises (validation test)-undertaking validity test to determine whether the CVM results are acceptable or not.

We have two approaches in analyzing the survey from CVM: Non-parametric and Parametric approaches.

a) **Non-parametric approach**: if one uses this approach, there is no need of assumption for distribution of variables and random errors. Having the initial bids, it is simply using these bids and P_j, the proportion of respondents WTP_j.

   We can use either of Kalpan-Meier-Turnbull (KMT) estimator or/and linear interpolation. As it gives more weight for participated respondents in the sample, this study will apply KMT.

   $$\mathbf{E\ (WTP)} = \sum_{k=1}^{n} \mathbf{WTPk}\ (\mathbf{Pk} - \mathbf{Pk} + \mathbf{1})$$

b) **Parametric approach:** using this approach requires the calculation of cumulative, Probability or Survivor density functions. Additionally, it is a must to assume the distribution of parameters, variables and random errors.

Limitations of the CVM

The method is quite versatile and can be applied to any environmental impact. As indicated earlier, it is the only method which can, so far, be used to estimate non-use values. The approach is fairly simple and relatively straightforward to apply. However, the CVM has many acknowledged problems. These include:

i) Hypothetical bias that relates with order of question bias,

ii) Strategic bias, when respondents' response for WTP is over or below their actual WTP, embedding effects,

iii) Information bias-when the information from interviewer is biased towards his/her common idea or purposes, and

iv) Survey techniques bias- starting bids bias refers to survey instruments in which respondents are asked to check of their answers from a predefined range of possibilities. The problem here is that how the survey questionnaire is designed may affect the resulting answers.

2.1.3.2. Market Valuation Mechanisms

Even though it is not important for the study, it is better to say something about market mechanism of valuation for certain goods and services. Based on nature of the market for the product, the value of the product can be calculated based on demand and supply of the product. Due to market failure, according to Perman et al (1999), we cannot value most of environmental resources by using market mechanism.

2.2. Empirical Literature

In recent years, especially since 1940, the Contingent Valuation method has found expensive application in valuation of environmental resources benefits. Until 1987 the application of this method was limited in less developed countries due to illiteracy and lack of capital, but currently it was improved the possibility of using the CVM in developing countries (Whittington et al., 1990 and 1998). The above theoretical explanations of the method have been employed in many studies of valuing the environment in both developed and developing countries. Some of CVM studies done in developing countries in general and in Ethiopia in particular are reviewed as follows.

The original work using CVM on outdoor recreation is a study conducted by Davis (1963) on the Maine woods. The survey result was used to derive aggregate demand curve and hence consumer surplus. The aggregate demand curve measures the number of respondents on the horizontal axis and maximum bid per respondents on the vertical axis. Using aggregate demand curve, Knetasch and Davis estimate annual benefit of $71,461 for access to an area near moose head Lake Maine.

Abala (1987) conducted a study on WTP for recreational services provided by Nairobi National Park using TCM. An interesting result of the study was that human congestion in the park has a significant negative impact on the users' WTP for the park service. In the study it was also indicated that people at higher level of education than those with higher incomes tend to pay more for park services. As the study used TCM, it is not accurate as of using the CVM. This means the study has not incorporated the 'non-users' in analyzing the result which may reduce the accuracy of the result and then the total value of the park.

Nam and Son (2004) used CVM and Choice modeling to access household demand for improved water services in Ho Chi Minch city, Vietnam employing Logarithmic Random Utility model for CVM and Multinomial Logit for choice modeling to analyze surveys responses. According to this finding, household size, number of children and income are significant. This study used choice modeling which is mostly full of biased which leads the result to unreliable. Additionally, the study is not in aspect of recreation sites.

Nallathiga and Paravatsu (2003) conducted CV survey to determine the economic value of water quality improvement for river Yamuna in India employing a CVM based on double bounded format question. The sample size was 125 households selected randomly from representative clusters. To analysis used multiple regression models and the result showed the average WTP was found to be Rs73.86 per capita per year with maximum WTP Rs77.86 which is significant.

Choe et al (1994) conducted a CVM survey based on open ended and dichotomous choice format to determine the economic value of water quality improvement for rivers and sea

near Davao City, Philippines. About 777 households were randomly selected from a relevant population. A closer investigation showed that also people are aware of the poor quality status, they do not place a high priority on it because of the existence of other environmental problem that are more urgent in the areas such as deforestation and poor management of solid wastes. The policy message is to wait until incomes and willingness to pay are higher before engaging on large investments. This paper was used two formats, that means, open ended and dichotomous choice to determine the economic value of water quality improvement which is time consuming and costly. This leads to inaccuracy of the result.

Vo Thanh Danh (2007) conducted study on Economic Value of ground water protection in the Mekong Delta using CVM survey. The mean willingness to pay estimated by the probit model was 141,730 VND (US$8.86)/household/year. Respondent's gender and groundwater-related health risk consideration were factors sensitively affecting the WTP values. Household income had a positive effect on the probability of demand for groundwater protection.

Goffe (1995) developed a contingent valuation for two goods: improved water salubrious and preservation of the ecosystem against eutrophication. The WTP values were explained using Tobit models. Whatever the good, the WTP was seen to rise with revenue. People accepted the exercise of contingent valuation and were willing to give important amounts.

The Ethiopian experience reveals that limited CVM studies have been conducted to investigate factors affecting households' WTP, especially for Lakes and other recreational sites but for improved water supply in rural and urban areas. There are also studies on improved lake quality.

Yibeltal (2011) conducted the value of improved water supply services in Motta town, east Gojjam, and Application of CVM using open ended and closed ended elicitation for the sample of 220. The finding from this study is individuals' WTP depends on the socio-economic characteristics of the respondents. He has used Probit and Tobit models to analyze the survey result.

Tsegaye (2005) used CVM by applying double-bounded format to elicit the WTP of fishermen to the improvement of Lake Chamo. His analysis showed that there is a positive and significant correlation between WTP and income, educational level of respondents and dummy variable Chamo. However the response is negatively and significantly correlated with age, and sex of respondents.

Terefe (2000) adopted the CVM and Travel Cost (TC) methods to estimate benefits from establishment of park around Tis Abay waterfalls. He analyzed the responses by multiple linear regression, Tobit and Probit models and the results revealed that, for the visitors' benefits, CV produced higher estimates than TC which excludes non-use value. Finally he argued that using these two methods give more information on users demand for public good.

Girma (2006) has conducted valuing the benefits of improved quality of Lake Awassa. He has applied the choice modeling or experiment method of valuation. He analyzed the data using Multinomial Logit model and derives important issues concerning the preferences of fishermen of Lake Awassa. Results confirm that fishermen of Awassa Lake have high levels of environmental concern and are willing to pay for the improvement of the lake environment in terms of the attributes selected in the Choice experiment. This study is not free from drawbacks of CE method.

Gossaye (2007) used the CVM to examine the determinants of households' WTP for improved water services in Bishoftu town. The elicitation method used in this study was single-bounded closed ended followed by open ended questions. The analysis method was Probit and the OLS methods. The coefficients of age, household size, volume of water used, reliability of existing water services, the starting bid, and household average monthly income had the expected signs and were statistically significant. Other variables like education dummy, quality dummy, gender dummy, and satisfaction dummy had also expected signs but were not statistically significant.

Moges (1999) has conducted the Economic Valuation of Environmental Goods as outdoor Recreation using the CV approach as the case study of Lake Tana. According to the result of this study, there is positive relation between respondents WTP and income, higher level of education, age, type of respondent (local resident or domestic external visitor), Orthodox religion, availability of other recreational sites, and attitude towards the lake while family size and age squared exert negative impact on WTP.

Deffar (1998) conducted a study using CVM to determine the Economic value of Abiyata-Shalla Lakes National parks. It deals with cost benefit analysis of conserving the lake as a park and/or producing soda ash around the river. According to his findings, WTP of respondent is a function of visitors' income, length of visit in day, years of acquaintance with the park and visit cost/ease of access. All explanatory variables were significant at 10% permissible error. From this we can understand that policy implication of the study is even if the production of soda ash is important in providing inputs for domestic industries and for earning foreign currencies, conserving natural resource is much more important for sustainable economic development.

Generally, even if it was limited with socioeconomic characteristics of society, the above and a number of empirical studies are undertaken using CVM successfully in developing countries in valuing the recreation sites and water related studies.

CHAPTER THREE

3. METHODOLOGY

3.1.Data source and type

The data source for this study is based on primary data which was collected from randomly selected individuals from two cooperatives- Horses owners and boats owners working on Lake Wenchi. Additionally, respondents were selected from visitors and from non-users to include the non-use value. Total sample size is, therefore, 200. The samples from these groups were selected purposively. The secondary data was also collected from Culture and tourism office to supplement the primary data.

The survey was administered using a face-to-face (in-person) interview in March 20 to May 15, 2013. Interviewers are supervised by the researcher. Before the main survey interviewers were trained carefully for two days on how they approach the problem to the respondents, explain the whole scenario and the attributes and their levels to be used in the survey. Pilot survey was conducted before the main questionnaires on fifty (50) individuals in March 01-15, 2013 which helped to revise the order and structure of the questionnaire, to determine the initial bids and to avoid the starting bids bias, and generally to alleviate the problem of different biases such as strategic bias and hypothetical bias which are the serious problem of CVM.

3.2.Sample design and procedures

There is no standard approach to the design of a CV survey but it should be done following the recommendations of NOAA panel as indicated in Portney (1994). For designing the sample the following are given consideration:

i) Interview - face-to-face or personal contact which is costly.

ii) It is the case of stated not revealed valuation method in using CVM. This means it is the matter of asking the true behavior rather than revealed one.

iii) It is the matter of generalizing for all based on the results from the sampled respondents. Based on these the above sample size is expected to be appropriate.

The development and the design of the questionnaire

The questionnaire consists of three parts; one with questions about socioeconomic status and habits of using the lake and its surroundings, and some attitudinal questions. This section of the questionnaire was devoted to questions seeking socio-economic data (age, sex, education status, occupation, income and so on) and information regarding attitudes (especially general sentiments regarding the environment). Second, it includes the overall explanation of the resource and the study which enables to get nearly the true WTP responses. Third, includes the WTP data questionnaire about WTP which is the main part of questionnaire. The questionnaire has the choice of status quo which shows the refusal to participate in conservation of the lake.

3.3.Model Specification

3.3.1. Theoretical Model

Contingent Valuation Method uses WTP of both users and non-users of specified resource that is the value that they attach to the conservation of resource and estimates benefits and costs from conservation of resources. WTP is a function of different determinants such as age of respondent, sex, income level of respondent, level of education, and settlement, home of respondent, category of respondent, Individuals purpose to use resource, and some other factors including initial bids.

Using this theoretical model we can develop the function for WTP or bid curve for individual i under empirical model.

3.3.2. Empirical Models

From the above theoretical model, Mathematical or Economic model/function can be written as:

WTP(i) = f(INC(i), EDUC(i), AGE(i), GENDER(i), U(i), FMSZ(i), OCCUP(i), SETTL(i), ORIG(i), CATEG(i), e(i)),

Where INC = income of respondent, EDUC = education of respondent, AGE = age of respondent, GENDER = sex of respondent, U = individual use of the environmental asset,

SETTL= settlement of respondent-whether they live in the lake or not, CATEG=is the category of respondent-visitor, cooperative worker, or nonuser, e = random disturbance or error term which is assumed to be normal**.**

In our contingent valuation survey the valuation question is phrased as a dichotomous choice, which is a closed-ended way of asking the willingness to pay. In the dichotomous choice method, according to Hanemann (1984), random utility theory is assumed. A random utility maximization model arises when it is assumed that although the individual's preferences are deterministic to him/her, they contain some components that cannot be observed by the researcher and they are treated as random variables. Let the indirect utility function the respondent have is given as;

$$\boldsymbol{V = (Q_i, y, X) + \varepsilon_j \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. 1}$$

Where, Q_j is the level of environmental good, y is income of respondent, and X is a vector of socioeconomic characteristics, is only partly observable by the researcher and ε_j random elements that influence utility.

Suppose certain program that improves environmental good from j=0 to j=1 is introduced. With the introduction of the program, suppose each individual is asked if they would pay an amount **A** for the environmental improvement (conserving Wenchi Crater Lake in our case). It is assumed that individual will accept a suggested amount, A, to maximize his or her utility under the following condition and reject it otherwise (Hanemann, 1984). The probability that they will accept this offer (that is, say ‘yes’) is;

$$\boldsymbol{Prob[yes] = Prob[(v(Q_1, y - A, X) + \varepsilon_1) \geq v(Q_0, y, X) + \varepsilon_0] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(2)}$$

Here, ε_1 and ε_0 are independently distributed random variables with zero means. Therefore, the probability that a household will decide to pay for the proposed program is the probability that the conditional indirect utility function for proposed intervention is greater than the conditional indirect utility function for the status quo. Our dependent variable is dichotomous, and equals 1if the i^{th} household is willing to pay to support proposed program and 0 otherwise.

The latent variable specification form is:

$WTP_i^*=\beta' X_i+\varepsilon$ …….(3)

Where WTP_i^* is the dependent variable, X_i is a vector of independent variables, β', is a Vector of parameters to be estimated, and ε is the error term.

In practice, WTP_i^* is unobservable. What we can observe is a dummy variable WTP_i defined by

WTP_i = 1, if $WTP_i^*>0$ or if $[(v_1 (Q_1, y- A, S) + \varepsilon_1) \geq v_0 (Q_0, y; S) + \varepsilon 0)$ and
0 otherwise

The probability that a household is willing to pay to assure establishment of the program is:

$Prob(WTP=1/x) = Prob(WTP^* > 0)$

Let $v_1(.) - v_0(.) = (\beta Xi)$ and $\varepsilon 1 - \varepsilon 0 = \eta i$

$$Prob(WTPi = 1/x) = \text{Prob}(\text{WTP} * > 0) = Prob[(\beta Xi) + \eta i > 0]$$

$$Prob(yes) = Prob[\eta i > -(\beta Xi)]$$

Due to symmetry we have

$$Prob(yes) = Prob[\eta i < (\beta Xi)]$$

$$\boldsymbol{Prob(yes) = F(.\,\beta Xi)} - - - - - - - - - - - - \quad (4)$$

Where, F is the cumulative distribution function (cdf). This provides an underlying structural model for estimating the probability and it can be estimated by either using a probit or logit model, depending on the assumption on the distribution of the error term (ε) and computational convenience (Green, 2003).

In the above derivation, we have seen the general computation of probability of yes/no responses. Now let us see the detail of models to value the Mean WTP using Probit and Logit models those are most commonly applicable in valuing the environmental resources in the following section.

a) The probit model

The main objectives of estimating econometric (or parametric) models in WTP survey are to calculate mean WTP and to allow inclusion of respondents' socio-economic factors into WTP functions. Such incorporation of individuals' socio-economic variables into the CV models helps the researcher to gain information on validity and reliability of the CV results

and increases confidences in applications of results obtained from the CV empirical analysis (Haab and McConnell, 2002).

Hanemann (1984) developed the basic model to analyze dichotomous responses based on the random utility theory. The central theme of this theory is that although individual knows his/her utility certainly, it has some components which are unobservable from the view of the researcher. As a result, the researcher can only make probability statement about respondent's "yes" or "no" responses to the proposed scenario.

Suppose the indirect utility function

$$U_{ij}=u_i(y_j, x_j, e_{ij})\text{---------- (5)}$$

Where Yj= j^{th} respondent income

i =1 denotes the final state and i=0 the status quo (or the initial state)

Xi=vector of household characteristics and attributes of a given choice

e_{ij}=random components of the given indirect utility

Now, if a payment (also called initial bid, β_i*) is introduced due to changes in a measurable attributes like quality or quantity of environmental goods, the consumer accepts the proposed bid only if

$$u_{1j}(y_j-\beta_i^*, x_j, e_{1j}) > u_{0j}(y_j, x_j, e_{0j})\text{---------- (6)}$$

Thus, the probability that the respondent says "yes" is the probability that s/he thinks that s/he is better off in the proposed program. For individual i, the probability is

$$\mathbf{Pr(yes) = [}u_{1j}(y_j-\beta_i^*, x_j, e_{1j}) > u_{0j}(y_j, x_j, e_{0j})\mathbf{]\text{---------- (7)}}$$

This probability statement provides an intuitive basis to analyze binary responses.

The probit model can be defined as:

$$T_i = \beta' X_i + \varepsilon_i \text{ ---------- (8)}$$

T_i = unobservable households' actual WTP which is talent variable.

What we observe is basically a dummy variable **WTPi**, which is defined as:

WTP_i = 1 if **$T_i \geq \beta_i^*$**

WTP_i = 0 if **$T_i < \beta_i^*$**

This means If there is a continuum of individuals who associate different values to the project, the probability that an individual's WTP does not exceed an amount βi^* is given by:

Pr (WTP≥β_i^*) = 1- F_{wtp} (β_i^*) → Probability of saying yes for proposed bid.

Pr (WTP<βi^*) = F_{wtp} (βi^*), probability of saying 'NO' for proposed bid. Where F_{wtp} (βi^*) is a right continuous, non-decreasing Cumulative density function with βi^* and βi^* is the level of bids.

The resulting log-likelihood function for the responses to a CV survey using the SB format is:

$$\ln L(\theta) = \sum\{d^y_i \ln G(\beta_i^*:\theta)+d^N_i \ln[1-G(\beta_i^*:\theta)]\} \text{ ---------- (9)}$$

Where: d^y_i = 1 if the *i*th response is Yes and 0 otherwise, while d^N_i =1 if the ith response is No and 0 otherwise.

b) Logit Model

In this study, the logit model (assuming error term has standard logistic distribution) was used to point out the mean willingness to pay value associated with maximum aggregate willingness to pay and to identify socio-economic factors that affect the WTP of individuals. By choosing the logistic cdf in equation (4) for the logit model, the probability that the ith individual is willing to pay for conserving Wenchi Crater Lake is;

Pr (WTP=1/X) =F(β X_i) = $P_i = \frac{e^{z_i}}{1+e^{z_i}}$ ... ...(10)

Z_i is a linear function of n explanatory variables (X), and expressed as:

$Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_k X_{ni}$

If P_i is the probability that the i^{th} individual is willing to pay for proposed program, then probability of not willing to pay is;

$1 - p_i = \frac{1}{1+e^{z_i}}$………………………………………………………… (11)

From the above (11), the ratio of the probability that a household is willing to pay for proposed program to the probability that a household is not or, shortly, *odds ratio* can be

$$\frac{P_i}{1-P_i} = \frac{e^{z_i}/1+e^{z_i}}{1/1+e^{z_i}} = e^{z_i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (12)$$

Taking natural log of this, log of the odds ratio,

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = ln e^{z_i} = z_i$$

From log of *odds ratio*

$Z_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots\ldots + \beta_k X_{ni} + \varepsilon$ -- (13)

Where Zi is dependent variable, in our case WTP for conservation of Wenchi Crater Lake, α is intercept or constant of the model, β_1, β_2, β_k are coefficients of explanatory variables or independent variables, and X_1, X_2, … X_{ni} are explanatory or independent variables determining the dependent variable and finally ε is error term which is logistically normally distributed with zero mean.

3.4.How to compute Mean WTP and Total WTP

The main objective of this study was valuing Wenchi Crater Lake as it was conserved or improved in quality. To do this, the first step is computing Mean WTP for proposed samples and then generalizing this result to total population.

Mean WTP = $-\alpha/\beta_i^*$

Where β_i^* is coefficient of initial bid or WTP_i and α is constant or intercept or

Mean WTP = $\ln(1+e^{\alpha})/\beta_i^*$ based on assumption on distribution.

3.5.Variables Definition and their expected signs

1. Dependent Variable

Willingness- to- Pay (WTP): The dependent variable in the model is the individuals' WTP, which will be expressed as 0 and 1, dummy or artificial value. Whenever a respondent answers "yes" to a threshold value, the value will be 1, and 0 otherwise.

2. Independent/explanatory variables

a) ***Education level of respondent (EDUC):*** is the level of education of individual respondents. This variable is continuous variable. It was given 0 for non grade individuals. The sign of this variable is expected to be positive which means individuals with formal education will pay more as they have more information.

b) ***Income of respondents (INC):*** this variable is pre-tax income of respondent per year. It is obvious that individuals underestimate their income level. Taking this in to account, the data was carefully collected from individuals. Income is continuous variable and was expected to have positive effect on dependent variable, WTP which shows individuals with higher income pay more for conservation of the lake.

c) ***Gender (GEND):*** Is dummy variable which shows whether the respondent is male or female. It takes the value 1 if male respondent and 0 otherwise. It is impossible to expect the sign of this variable before the analysis of the data.

d) ***Age:*** age variable is continuous variable which may be thought as either positive or negative effect on dependent variable based on the nature of resource under question. Respondents with older ages are expected to pay less for protection of natural resources as they have no awareness of the environment compared to new generations even though they understand the use of those resources through experience. On the other hand, individuals with lower age are expected to pay more based on the fact that current generation is more educated and understood the importance of the resources through education and real case. These two expectations are identified based on the data collected and analyzed. Therefore, individuals with lower age pay more for conservation of the lake. As climate change and recreation are the main topics of discussion at politicians, Economists and any other field of study, under this study, the

sign of age of respondent is to be negative, as age of individual increases the willingness to pay will decrease.

e) ***Family size of respondent (FMSZ):*** this variable is categorical dummy variable which was categorized based on the number of family the respondent has. It has 0 values if family size is less than 3, 1 if 3-5 and 2 if above 5. At the level of expectation, individual who live with more number of family will pay less based on the fact that income distribution of this individual is low.

f) ***Occupation of respondent (OCCUP):*** this variable is the job in which the respondent involved as income generation. Under this study, it is dummy variable categorized based on formal (Government work) and non-formal (Non-government) job. Formal job includes government work and any other private sectors employing individuals as permanent worker and non-government work includes self-employed and farmers. This variable also attached the value 1 if government works and 0 otherwise. It is theoretically believed that individuals with government work aware about natural resources than that of non-government works. So they are going to pay more for the conservation of the lake.

g) ***Category of respondent (CATEG):*** this variable is dummy variable whether the respondent is visitor, Cooperative worker, or Non-user. It is 0 if visitor, 1 if cooperative worker, and 2 if non-user. WTP is positively related with visitor individuals and indeterminate for the other two.

h) ***Settlement of respondent (SETTL):*** this is whether the respondent is living within the lake or resident in the lake or not which means the variable is dummy variable. Societies living in the lake are using the lake for different purposes for example, for irrigation purpose. So relative to non-resident, they are unhappy with conservation of the lake as outdoor recreation. It is assigned 1 if respondent is not resident and 0 otherwise.

i) ***Origin of respondent (ORIG):*** is domestic respondent and/or abroad. This also has the value 1 if domestic and 0 otherwise. It is expected that individuals those come from abroad are willing to pay more not of other reason but only due to the difference in level of income.

j) ***Value attached to the lake by respondents (USERE):*** this variable is once again categorical dummy variable which shows whether the respondents value or use the resource, i.e, Wenchi Crater Lake for the purpose of recreation, source of income, for future generation, or simply for existence value. We can say nothing about the sign or effect of this variable before the data was analyzed. But, not sure, individuals those use the lake for recreation and for future generation have high willingness to pay.

k) ***Initial bid (WTP_i):*** it is obvious that under the pilot-survey, the starting or initial bids were determined which is done by grouping the respondent's response from survey data in to four and calculating the average for these groups. These are, 15, 40, 65 and 90. As the level of initial bid increases, the probability of saying "yes" for that bid will be decreases. So the expected relation between the WTP and WTP_i is inversely related.

CHAPTER FOUR

4. EMPIRICAL RESULTS AND DISCUSSION

This chapter presents the results of the study. Here it begins by discussing and describing the information regarding socio-economic, demographic and resources characteristics. This information is important to explain respondent's WTP for conservation of the Wenchi Crater Lake. In this sub section descriptive analysis of these factors and their implication on conservation program will be discussed. Following that it presents the mean willingness to pay estimates and the factors that affect respondents' willingness to pay, and then about the treatment of protest answers. In addition it deals with the motivations for being willing to pay and not being willing to pay for improvement of quality of Wenchi Crater Lake. The validity of the results is also examined. The choice question is analyzed by using the logit and probit models. The need of using two models is simply to see the detail reliability of data collected.

4.1.Protest answers

This section discusses the treatment of protest answers. As of Bateman et al. (2002, 177-178), Protesting refers to the situation where respondents do not report their true value for the good in question. Not only this but also some respondents may not agree with the program. Individuals either provide a zero value or an unrealistically high value for the good instead of their true willingness to pay. Usually some people report lower and some higher values than they truly hold by thinking the benefits they may get from the program. If they expect the benefit is high, they will introduce higher value and inverse if they expect lower. So the total effect to the value estimate is unrealistic and biased (Boyle 2003, 145).

Bateman et al (2002, 178) take the view that the only option is to exclude protest responses as it is impossible to know the respondent's true value for the good. However, according to Meyerhoff & Liebe (2003), the exclusion of protest answers is unjustified and protest answers should be included in the analysis as there are no established rules for treating protest responses. If we include the protest answer in the case of lowering the WTP, it reduces the amount of Mean WTP which intern reduce the total WTP and total economic

value of the resource under question. The inverse is true if it is the case of higher WTP. Despite of the absence of established rules, there are usual procedures for the treatment of protest answers.

Here it is better to follow the common practice in contingent valuation and identify protesters based on the respondents' answers to the questionnaire and exclude them from the data set before the analysis.

A variety of techniques have been used to identify protest answers, but there are no established procedures for excluding misleading responses. A common technique for identifying protest zeros is through a follow-up question that probes respondents' motivations for answering the choice question. These answers can be used to distinguish between those who truly place a value of zero on the good, and those who respond zero for some other reason.

The survey under this thesis included a follow-up question to find out why respondents were willing or unwilling to-pay the amount of money in the choice question. The respondents were given a set of pre-determined reasons and they could also specify their own reason. We identified the protesters on the basis of the follow-up question. Those who are said we are earning income from irrigation and timber use were identified as protesters. There were total of 4 respondents who chose only that reason and they were excluded from the data set. In addition, three respondents did not answer the willingness to pay question and irrelevant data, so they were also excluded before data analysis. The number of usable responses in the willingness to pay analysis, therefore, was reduced from 200 to 193.

4.2.Descriptive Statistics

Table 1. Descriptive statistics

Variable	Description	mean	Stdv	Min	Max
	Individual characteristics				
AGE	Age of respondent in years	35.20725	9.240341	20	60
EDUC	Individual's level of education	6.290155	2.774746	0	12+5
GEND	Gender of respondent,1 = if male 0 otherwise	.5181347	.5009706	0	1
WTPi	The initial bids	45.69948	27.00121	15	90
WTP	Willingness to pay	.5647668	.4970769	0	1
	Household characteristics				
INC	Annual income(in thousands) of household in birr	9.435233	5.676358	2	30
SETTL	Settlement of respondent 1=if settled in the lake 0 otherwise	.8082902	.3946698	0	1
ORIG	Origin of respondent 1=if domestic 0= if abroad	.7823834	.4136984	0	1
OCCUP	1 = if government worker 0 otherwise	.357513	.4805141	0	1
CATEG	Category of respondent: 0 if visitor, 1 if cooperative worker, 2 if non-user	-.400231 .625451	.759662 .603798	0 0	1 2
FMSZ	Family size of respondent 0=less than 3, 1=if 3-5 and 2=if above 5	1.356465 2.483581	.5678015 .8199691	0 0	1 2
	Resource character				
USERE	Use of resource by respondent 0=if recreation 1=if source of income 2=if for future generation 3=if existence purpose	 -.5987109 .707303 -.1362575	 .8552118 .726284 .6839365	 0 0 0	 1 2 3

Source: survey data, 2013

From Table 1 above, one can understand that Variable definition and their expected sign which was discussed under chapter three is discussed on this single table in clear form. From this table, we have mean value, standard deviation and minimum and maximum value for each variable. These all values have interpretation. For example, age of respondents is 35.2 years in average and the deviation round the mean is by around 9.2 years. Similarly, for dummy or discrete variable, Gender for instance, has 0.52 mean values and 0.5 value of standard deviation. This means, there is no much deviation from the mean and the same interpretation is applicable for other variables based on the value corresponding to them.

For Categorical dummy variables, we have one category as a bench mark and depending on the value of bench mark we compare the results of other categories and hence the effects of all categories. Econometric software "STATA" can simply identify the category to be bench mark. This bench mark category is mostly the category which is preferred by most respondents from the group of categories.

Categorical dummy variables are CATEG, FMSZ and USERE. If we see the results of these categorical dummy variables from the above Table 1,

i) For Category of respondent (CATEG), Visitors have more weight and so visitor is bench mark. This means visitors are willing to pay for conservation of the lake than others. So the results can be interpreted as: Comparing with visitors, Cooperative workers are not willing to pay.
ii) For Family size (FMSZ), respondents with less than 3 family sizes are willing to pay and so used as bench mark.
iii) Similarly, for USERE, respondents those are using the lake for the purpose of recreation pays more and this category is bench mark.

Table 2: Willingness to pay tabulation

Willingness to pay	Frequency	Percent	Cum.
No	84	43.52	43.52
Yes	109	56.48	100
Total	193	100	

Source: survey data, 2013

As we can simply understand from the table 2, almost more than half, that means, 56% will agree and are willing to pay for conservation of the lake at proposed initial bids. Around 44% of respondents were agreed to pay for conservation of the lake but not to pay for proposed bids. This ratio of yes/no or this percentage is by excluding the protest answers and irrelevant data.

Table 3: Distribution of closed - ended responses

Bid (wtp_i)	Number of respondents	Share of yes responses
15	61	52
40	61	39
65	37	13
90	34	5
Total	193	109

Source: survey data, 2013

On Table 3 above, the share of yes responses decreases as the amount of bid increases. This means, if we put it in percentage term for 15, 40, 65, and 90, it is 85%, 64%, 35% and 15% respectively. This result indicates our expected hypothetical on sign or effect of initial bids on individual's willingness to pay was correct. There is inverse relationship between the dependent WTP and explanatory variable wtp_i.

4.3.Importance of Conserving the lake

There are some importance of the lake those initiate individuals to give the value for the lake. Not only lakes but also all other natural resources are attached different value by different people such as intrinsic value, recreation, jobs provision which is source of income, existence value, and reserving for future generation. From these, recreation and

source of income are use-value and the remaining one; intrinsic value, existence value and use of future generation are non-use-value.

The respondents were asked to indicate the value they attach to the lake and why they value the lake. A summary of these responses are indicated in the following table.

Table 4: Summary of reasons for conservation of Wenchi Crater Lake by respondents

Reasons	Persons	Percentage	Share of yes for WTP
Recreation	82	42%	54%
Future generation	42	22%	28%
Source of income	42	22%	7%
Existence	27	14%	11%
Total	193	100	100

Source: summary of survey data, 2013

The most important reasons were for recreation and future generation purposes which are 'bequest' value. This may be due to the fact that Wenchi Crater Lake is used for dual purposes; these are for recreational purposes and historical place with its cultural importance so that respondents want to transfer heritages from generation to generation.

From total respondents, 54% are using the lake for recreation purposes and willing to pay the proposed bids. Only 7% are willing to pay for proposed bids may be due to income generating from traditional system of irrigation and timber production by cutting the trees. They thought as if the lake is conserved, they are to be protected to use these trees and they have no other means of income generating jobs. In the same way, if the lake is conserved, no cultivation by destroying the forests. Most of respondents using the lake as source of income gave the above justification and even they have no enough income to contribute.

4.4.Econometric Results and Discussions

Econometric analysis helps in providing more insight about determinants that affect responses of households to CV survey questions. These determinants are mainly socio-economic variables, initial bids and resource characteristics. In modeling determinants of individuals' WTP for conserving Wenchi Crater Lake we employ a step-wise deletion of variables based on different criteria (like coefficient of determination) to identify explanatory variables that better explain the dependent variable (the binary response to the initial bid).

4.4.1. **The Probit Model Estimation Results**

Estimation results of the probit model are reported based on theoretical model that has already been developed in the 3rd chapter. Such statistical relationship is used to examine whether WTP responses of surveyed households are systematically related to socio-economic and other relevant variables or not. The probit model estimation results are presented on determinants of individuals' WTP for conserving Wenchi Crater Lake to improve the quality of the lake. The summary results of probit model estimates are reported in table 5 below.

Table 5: Probit estimates of determinants of WTP for conserving Wenchi Crater Lake

Probit regression				Number of obs =	193
				LR chi2(15) =	190.28
				Prob > chi2 =	0
Log likelihood = -37.013135				Pseudo R2 =	0.7199
WTP	**Coef.**	**Std. Err.**	**z**	**[95% Conf.**	**Interval]**
INC	.3513464	0.078	4.53***	.1993502	0.5033426
EDUC	1.260021	0.692	1.82**	-.0971156	2.617158
GEND	.0390898	0.359	0.11	-.6636349	0.7418144
CATEG					
1	-.051938	0.763	-0.07	-1.548026	1.44415
2	.2163593	0.640	0.34	-1.037306	1.470024
SETTL	.2086731	0.672	0.31	-1.108409	1.525755
ORIG	1.797969	0.670	2.68***	0.4842338	3.111703
FMSZ					
1	1.356465	0.568	2.39**	0.2435941	2.469335
2	2.483581	0.820	3.03***	0.8764714	4.090691
OCCUP	.9098884	0.479	1.9*	-.0284335	1.84821
AGE	-.1901013	0.041	-4.68***	-.2697375	-0.110465
WTPi	-.0203307	0.007	-2.79***	-.0346227	-0.0060388
USERE					
1	-.5987109	0.855	-0.7	-2.274895	1.077473
2	.707303	0.726	0.97	-.7161874	2.130793
3	-.1362575	0.684	-0.2	-1.476748	1.204233
_cons	.983032	1.682	0.58	-2.313349	4.279413

***=significant at 1%, **=significant at 5%, *=significant at 10% level

As depicted in table 5 the measure of overall significance of the model, namely, likelihood ratio (LR), which assumes the chi-square ($\chi 2$) distribution, is 190.28 for the probit model with 15 degree of freedom (df) to estimate WTP for conserving Wenchi Crater Lake. From chi-square ($\chi 2$) table, the critical value of chi-square statistic at 99.5% and 15 degrees of freedom is 4.6. This implies that the joint null hypothesis of coefficients of all explanatory variables included in the models are zero is rejected. Thus, the overall significance of the model is good (i.e. the model better fits the data).

4.4.2. Logit model estimates

The results of logit model are almost the same with that of probit model in testing significances of variables except some justification on coefficient terms. The following table illustrates the econometric results of WTP from logit regression.

Table 6: Logit estimates of determinants of WTP for conserving Wenchi Crater Lake

Logistic regression			Number of obs =	193
			LR chi2(15) =	190.80
			Prob > chi2 =	0.0000
Log likelihood = -36.752345			Pseudo R2 =	0.7219
WTP	**Coef.**	**Std. Err.**	**z**	**[95% Conf. Interval]**
INC	.6348077	.1580532	4.02***	.3250291 .9445862
EDUC	2.945904	1.651805	1.78*	-.2915749 6.183383
GEND	.227341	.6539026	0.35	-1.054284 1.508966
CATEG				
1	-.1775686	1.35622	-0.13	-2.835711 2.480574
2	.2563382	1.217706	0.21	-2.130323 2.642999
SETTL	.3449976	1.196424	0.29	-1.99995 2.689945
ORIG	3.024748	1.261415	2.40**	.5524195 5.497076
FMSZ				
1	2.27261	.997506	2.28**	.3175338 4.227685
2	4.601093	1.59386	2.89***	1.477184 7.725002
OCCUP	1.589609	.8799851	1.81*	-.1351297 3.314349
AGE	-.3458454	.0800932	-4.32***	-.5028252 -.1888655
WTPi	-.0377294	.0138453	-2.73***	-.0648658 -.0105931
USERE				
1	-.9705929	1.54144	-0.63	-3.991759 2.050573
2	1.307113	1.384466	0.94	-1.406391 4.020616
3	-.1754649	1.229354	-0.14	-2.584955 2.234025
_cons	1.485316	3.309153	0.45	-5.000505 7.971137

****, **, and * are significant at 1%, 5% and 10% respectively*

Effects of the explanatory variables

The logit and probit models allow us to examine whether the explanatory variables are significant in determining the willingness to pay responses and whether they affect the responses as the economic theory, intuition and empirical expectations. It is important for the validity of the results that the effects of the variables confirm to theoretical and empirical expectations.

The logit and probit coefficients do not have simple interpretations. However, the signs of the coefficients or parameters provide information about the effects of the variables to the probability that the dependent variable is one, in our case to the probability that the answer in the choice question is *yes*. If the coefficient is positive, an increase in the variable increases the probability of a *yes* answer in the choice question and if it is negative, an increase in the variable decreases the probability of a *yes response* (Stock & Watson 2003, 303.).

From Tables 6 and 5, variables those are statistically significant are INC, EDUC, ORIG, OCCUP, FMSZ, AGE, and WTP_i, at different level. INC, ORIG, AGE, WTP_i, and FMSZ at above 5 family sizes are highly statistically significant at 1% level of freedom. Other variables, EDUC and OCCUP, are significant at 10%. FMSZ, if number of family is 3-5, is the only significant variable at 5%level of freedom.

All variables except FMSZ have the same sign as expected in the definition and importance of variables under chapter three. AGE, and WTP_i are affecting the dependent variable (WTP) negatively and they are significant at 1% level of freedom. This shows, for AGE, as the age of respondent increases, the level of their interest to conserve is decreasing. This is due to the fact that old-age individuals use outdoor recreation below that of young-age individuals and this can happen partly because older people may shorten their planning time horizon as they expect they would benefit less from conserved lake. For WTPi, as the amount of initial bid increases, proportion of saying yes for proposed bid is decreasing. This improves the fact that as the price of goods and services increases, the demand for purchasing that product will decrease.

Economic theory predicts a positive association between willingness to pay and respondent's income (Bateman et al. 2002, 320). The coefficient on **INC** is statistically significant and positive as can be expected. It indicates that the higher the income of the respondent, the more likely s/he is to answer *yes* to the offered sum in the choice question. Regarding educational level, coefficient on **EDUC** is positive as theoretically expected due to the fact that individuals are more concerned about the environment as they become educated. Higher his/her awareness about environmental goods and services depends on education level perhaps results in high amount of information about environmental tasks. So it is significant at 10%.

In the case of OCCUP, it was expected individuals with formal job say government work are willing to pay more than those who have informal, say non-government work. Just as it was expected, government workers are willing to pay more. This is due to, may be, the fact individuals with formal work need recreation. So the variable OCCUP has positive effect on WTP and highly statistically significant at 1%.

The variable origin, ORIG is whether the respondent is domestic or abroad. It has also positive impact on WTP of respondents and highly significant at 1%. Other variables such as SETTL and GEND, have positive impact but they are statistically insignificant variables.

In the case of CATEG variable, if the respondent is Cooperative worker, it has negative impact and it has positive effect otherwise just as expected but insignificant. USERE variable has negative impact if respondent is using the resource either as source of income or simply for existence value. But it has positive relation if for recreation and future generation purposes. However, this variable is statistically insignificant.

The main point here in using both probit and logit models is generating the same result which has the same interpretation. The reason why to use both model is only to see the effectiveness and reliability of the data. The only point is numeric difference and the level of significant at which ORIG variable is statistically significant. This is under probit model; it is at 1% while under logit model it is significant at 5%.

Under the following section, we will see the effect and interpretation of marginal change or small change of explanatory variable and its effect on dependent variable, WTP.

Marginal Effect of selected Variables

The following table shows the result of logit model estimates and its result is the same as that of probit model. So if we analyze one of the models, I think it is enough.

Table 7: Marginal effect of explanatory variables on individuals' WTP

Marginal effects after logit

y = Pr(wtp) (predict)

= .7264098

variable |	dy/dx	Std. Err.	Z	P>|z|	[95% C.I.]	X
INC |	.1209089	.02378	5.08	0.000	.074291 .167527	9.43523
EDUC|	.5909919	.2032	2.91	0.004	.192725 .989259	2.474746
GEND*|	-.0263133	.10835	-0.24	0.808	-.23868 .186053	.518135
SETTL*|	.2466091	.1749	1.41	0.159	-.096179 .589398	.80829
ORIG*|	.5015623	.20652	2.43	0.015	.096783 .906342	.782383
OCCUP*|	.1815048	.11854	1.53	0.126	-.050836 .413845	.357513
AGE |	-.0267079	.00831	-3.21	0.001	-.042991 -.010424	35.2073
WTPi |	-.0072301	.00257	-2.82	0.005	-.012262 -.002198	45.6995

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Variables such as INC, EDUC, GEND, SETTL, ORIG, and OCCUP are positively related to WTP of individuals for conservation of Wenchi Crater Lake in marginal aspect.

The interpretation of the marginal effects of the probit and logit model indicates the change in the probability (or likelihood occurrence) of an event due to a unit change in the continuous explanatory variables and the change of dummy variables from 0 to 1 for discrete variables.

An increase in income by one unit increases the probability of saying yes for proposed bid increases by 12%. For education, as one individual's level of education increases by one, the probability of saying yes increases by 59%. The same explanation holds true for other variables with positive marginal effects.

AGE, WTPi and GEND have negative marginal effects. This means, one unit change in these variables decreases the probability of accepting the initial bids. For example, as age of individual increase by one year, the probability of saying yes for proposed bid decreases by 2.6%. In the same way, if the level of initial bid, WTPi increases there is reduction in probability of accepting this bid.

4.5.Tests of Heteroscedasticity

Table 8: Heteroscedastic logit estimates of determinants of WTP

Logistic regression					Number of obs =	193
					Wald chi2(15) =	51.88
					Prob > chi2 =	0.0000
Log pseudolikelihood = -36.752345					Pseudo R2 =	0.7219
WTP	**Coef.**	**Std. Err.**	**Z**	**P>z**	**[95% Conf.**	**Interval]**
INC	.6348077	.1860467	3.41	0.001***	.2701629	99954
EDUC	2.945904	2.821848	1.04	0.297	-2.584817	1.00522
GEND	.227341	.6004563	0.38	0.705	-1.054284	1.508966
CATEG						
1	-.1775686	1.232083	-0.14	0.885	-2.835711	2.480574
2	.2563382	1.497015	0.17	0.864	-2.130323	2.642999
SETTL	.3449976	1.197658	0.29	0.773	-1.99995	2.689945
ORIG	3.024748	1.187521	2.55	0.011**	.5524195	5.497076
FMSZ						
1	2.27261	.763364	2.98	0.003***	.3175338	4.227685
2	4.601093	1.782197	2.58	0.010**	1.477184	7.725002
OCCUP	1.589609	.8901267	1.79	0.074*	-.1351297	3.314349
AGE	-.3458454	.0918188	-3.77	0.000***	-.5028252	-.1888655
WTPi	-.0377294	.0139898	-2.70	0.007***	-.0648658	-.0105931
USERE						
1	-.9705929	1.435537	-0.68	0.499	-3.991759	2.050573
2	1.307113	1.458712	0.90	0.370	-1.406391	4.020616
3	-.1754649	1.08627	-0.16	0.872	-2.584955	2.234025
_cons	1.485316	3.540206	0.42	0.675	-5.000505	7.971137

****, **, and * are significant at 1%, 5% and 10% respectively*

The Table 8 depicts the Wald-test for Heteroscedasticity by using the chi-square distribution. At 15 degree of freedom, the result was well estimated if we compare the result of chi-square from chi-square statistics. This means, at critical value and at 99.5%, the value from table is 4.6 which indicate significant. All variables except EDUC have the

same or similar results as before conducting Heteroscedasticity test. This has interpretation that the data fits the model.

4.6.Estimated mean WTP

As it was explained under the objective of the study, this study estimates the mean WTP and then total WTP for conservation of the lake. Based on this value we can simply calculate total economic value of the lake.

Mean WTP = $-\alpha/\beta_i$* or

Mean WTP = $\ln(1+e^{\alpha})/\beta_i$* based on assumption of distribution of error term. **α** is constant or intercept of the model and **β_i*** is the coefficient of initial bids

From logit model, we have **α = 1.4** and coefficient of initial bid **β_i* = -0.03**

Based on this values,

Mean WTP = -[1.4/-0.03] = 46

Similarly, from Probit model, **α=0.9 and β_i*=-0.02**

Mean WTP=--[0.9/-0.02]=45.6 which is approximately 46.

To calculate the total WTP, there is a need of total population incorporated in the scope area. Multiplying the total population by mean WTP is total WTP for the resource conservation. Under this study, however, we cannot get total population as tourists and non-users are included in the sample size purposively.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Most of Environmental goods and services are, we can say, have no market value as they have the characteristics of public goods. Once it was provided, excluding other or having property right on it is impossible. This is the reason why most of environmental goods or resources including rivers, lakes, forests and others are polluting and destroying by human activities. Despite of these, they are using for different purposes. For example, to protect the balance of weather condition, to protect soil erosion and degradation, for recreation purpose, home for different endemic birds and animals, and so on. Once we loss these natural resources, we most probably loss the above mentioned things and it is difficult to attain them again.

This study therefore attempted to analyze the WTP of individuals to avoid activities those are destroying natural resources focusing on the lake. It is focused on conservation of Wenchi Crater Lake as this lake is mostly affecting by human activities living in and around the lake. In the study, mainly primary data was used and some or only limited information were collected from culture and tourism office of South-west Showa zone.

The Contingent Valuation Method (CVM) was used based on face-to-face or in-person interview with 200 randomly selected individuals but only 193 were analyzed due to protest and invalid responses. This sample included users and non-users to know the total economic value of the lake. Closed-ended format question was used to get the true WTP. To avoid the existence of biasness, the maximum amount that they are willing to pay was asked by using follow-up question. This also helps to make respondents free from interviewer bias. Furthermore, the sampled individuals were also asked about their socio-economic characteristics including age, sex, income, occupation, education level, family size, origin (whether domestic or foreigner), settlement (whether settled in the lake or not), demographic information, problems with existing services in the lake and some general questions.

The survey results obtained from this CV survey was analyzed by using Econometric software STATA version 12.0 using both descriptive and econometric analysis. Even though there is no much difference in the two models, both Probit and Logit models were used to analyze the determinants of individuals' WTP and to calculate mean WTP of the sampled individuals for conservation of Wenchi Crater Lake.

To test the fitness of the model, we have implemented the Likelihood Ratio (LR) test which uses the chi-square statistics. Based on the result of this test the data collected fits the model and the result was accurate. Additionally, Wald-test chi-square was used to test the Heteroscedasticity of the variables.

From the total usable 193 respondents 190 (98%) were confirmed as there is problem of conservation and other services in the lake. These problems include cutting the tree for different purposes especially for timber production and destroying forest for cultivation purpose, lack of infrastructure including hotels and road. Even, the volume of the water decreases by 2-3km within five years recently. Only 2% were answered as there is no problem with the existing situation of the lake.

From the total of usable sample, 109 (56%) were agreed to pay the initial bid amount for conservation of the lake. This indicates that there are motivations to pay for individuals. At mean level, 46, 100 (52%) of respondents agreed to accept payments for conserving the lake. This also shows individuals are willing to pay for conservation of Lake Wenchi.

In the case of the ratio of yes to no, from the total respondents 56% were accepted to pay and 44% refused to pay for proposed bids. This shows relatively near to each other, which means only the 12% difference indicating that there is no much serious starting bias in the model. Another important issue from descriptive analysis is that societies around 54% are using the lake for recreational services and are paying more. The second purpose of using and valuing the lake is reserving the resource for future generation which is 28% and the individuals those are using the lake as a source of income and existence value are relatively not willing to pay for the conservation of the lake as we compare them with individuals using the lake for recreation purposes and reserve for the future generations. The reason is, for example in the case of individuals using the lake as a source of income, as they are

using the Agricultural activities and production of timber for a long period of time, they think they never get alternative source of income if they are protected to use the pervious activities and they believe that if the conservation of the lake takes place, they are to be protected automatically from their activities. Beside of this they themselves perceived the existence of problem as they are destroying the forest.

The probit and logit model shows that there are several factors affecting individuals' willingness to pay (WTP) for conservation of Wenchi Crater Lake. Further, the models estimate mean WTP from closed-ended format of question. All explanatory variables are with the expected sign and effect on dependent variable, WTP, except Family size which was expected as negative relation, that is, as the number of family increases, the individuals' WTP will decrease. But the result demonstrate the inverse of this, i.e., increase in family size increases the significance of the variable. Justification of this result was given by respondents as individual with more number of children thinks and reserves the resources for future generation.

Explanatory variables those are positively affect the individuals' probability of saying 'yes' for initial bid offered to them are income (INC), Education (EDUC), Occupation (OCCUP) dummy (1=if government work, 0 otherwise), settlement (SETTL) dummy (1= if respondent live outside of the lake boundary), origin (ORIG) of respondent dummy (1=if domestic), family size (FMSZ) categorical dummy (0=if less than 3, 1=if 3-5, 2=if greater than 5), gender (GEND) dummy (1=if male 0 otherwise), category of respondent (CATEG) if visitors and non-users - categorical dummies (0=if visitor, 1=if cooperative worker, 2=if non-user) and reason for using the lake (USERE) if for recreation and reserving for future generation-categorical dummies (0=if recreation, 1=if source of income, 2=if future reserve, 3=if existence). All other variables are affecting the probability of individuals' to pay for proposed bid negatively.

If we see the result of logit model, AGE, WTPi, INC, FMSZ at greater than 5, are statistically significant at 1%. ORIG and FMSZ at 3-5 are significant variables at 5% and EDUC and OCCUP are statistically significant at 10%. The mean WTP was estimated at birr 46 per year.

5.2. Recommendations

As the result of this study depicted, we can say that almost all individuals included in sample size perceived the existing problem of Wenchi Crater Lake with 98% and only 2% are preferred status quo. Even though they perceive the existence of the problem, they have different factors determining them not to participate in conserving the lake. These factors are identified under this study.

Given the future increase in population size and increase in scarcity of Natural Resources, the economic value of the lake may be higher in the future than that of the present year. Individual respondents also understand it and they are mostly willing to pay. Based on this fact, the following should be takes place:

- The study concerns with valuing Wonchi Crater Lake by identifying the determinants of WTP of individuals as it is difficult to conserve the lake without participation of the society. For instance, teaching for individuals those are using the lake as source of income by destroying the trees about consequences of their activities. And if possible, creating another job which is income generating activities for them is policy implication of the study.
- Government must develop infrastructures like road and others and if not possible inviting investors to work on the lake as privatization is more profitable in developing infrastructures.
- Protecting the lake is may be not for only eco-tourism purposes it is also historical place having heritages which must be reserved for future. Therefore, reserving and protecting this area or lake for future generation means transferring heritages for future generation and increasing the recreational services of the lake on the same way-it is multi-dimensional activity.
- If it is possible it is better to develop modern irrigation system to reduce the problem with traditional irrigation system.

Generally, creating awareness in society, whether they are users or non-users, about the importance of the lake and the impacts of their activities, even though it is for current income generation, must be the role and home work for policy makers.

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Annex 1 Correlation Matrix of explanatory variables

	wtp	Incom	educ	gender	categ	home	orig	fmsz	occup	age2	wtpi	user
wtp	1.000											
income	0.579	1.000										
educ	0.713	0.6162	1.000									
gender	0.176	0.187	0.149	1.000								
categ	0.001	-0.097	-0.059	-0.072	1.000							
home	0.445	0.344	0.396	-0.084	-0.130	1.000						
orig	-0.295	-0.721	-0.452	-0.144	0.224	-0.205	1.000					
fmsz	-0.360	-0.246	-0.366	-0.049	0.165	-0.219	0.268	1.000				
occup	0.554	0.532	0.683	0.305	-0.172	0.359	-0.418	-0.320	1.000			
age2	-0.463	-0.320	-0.423	-0.028	0.204	-0.167	0.338	0.736	-0.343	1.000		
wtpi	-0.623	-0.299	-0.454	-0.083	0.018	-0.308	0.157	0.255	-0.359	0.288	1.000	
user	-0.175	-0.221	-0.234	-0.214	0.724	0.020	0.240	0.151	-0.277	0.262	0.104	1.000

ANNEX-2

CONTINGENT VALUATION SURVEY-QUESTIONNAIRE ON CONSARVATION OF WONCHI CRATER LAKE

Interviewer name: _____

Place of interview: _____

Date of interview: _____

Length of interview: _____ (minutes)

INTRODUCTION TO THE RESPONDENTS AND HYPHOTETICAL SENARIO

How are you? I am _____. I am assisting an ongoing research by Negassa Fufa for the partial fulfillment of his Msc in economics at Addis Ababa University. The questionnaire is designed to obtain information on the current situation of Wonchi Crater Lake and to value the lake as if it was conserved, from WTP survey. Wonchi is considered as one of the most beautiful place and eco-tourism area in Ethiopia attracting tourists and thus, generate income for both residents and government. No doubt that if this lake is conserved and improved, the income and recreational satisfaction from the lake will increase. Additionally, the environment and the forests around the lake protect or keep the balance of the environment and weather condition. However, to conserve and protect this lake, your contribution, both financial and ideal, is crucial. As a result, this questionnaire needs your perception and opinion, and it is an input for officials and policy makers in their attempt to conserve Wonchi Crater Lake. Furthermore, your response will help us to understand the value that households give for the lake and their interest in contributing for conservation. The response of each respondent is confidential. There is no right and no wrong answer. Please give your response as truthfully as possible and honestly!

THANK YOU IN ADVANCE!

SECTION ONE

General questions (this part of questionnaire has 15 questions and answer as per you asked)

1. Category of respondent
   a) Visitor
   b) Cooperative workers
   c) Non-user
2. Settlement of respondent
   a) Resident
   b) Not resident
3. Origin of respondent
   a) Domestic
   b) Abroad
4. Gender
   a) Male
   b) Female
5. Age of respondent: _____ years old.
6. What is the level of your education? _____ Grades.
7. What is your Family size?
   a) Less than 3
   b) 3-5
   c) 6+
8. What is your occupation?
   a) Self-employed, including farmer
   b) Government worker
9. Have you ever visited Wenchi Crater Lake? If 'no' go to question 17.
   a) Yes
   b) No
10. If your answer is 'yes' for question '9', how often you visit Wonchi Crater Lake?
    a) Very frequently
    b) Frequently
    c) Some times
    d) Rarely

11. What activities are taking place in and around the lake?
    a) Fishing
    b) Swimming
    c) Cultivation by irrigation
    d) Flowering
    e) Others (specify if any more)
12. Do you believe the existing situation of the lake is enough to attract tourists and it was well conserved?
    a) Yes
    b) No
13. If your answer to question '12' is 'No' what are problems of the lake and what do you think is the solution?

    _____
    _____
    _____
    _____.
14. What do you think to be happening on the lake if the current situation and activities are carrying on without conserving the lake?

    _____
    _____
    _____.
15. Who do you think is the responsible body for improvement of the lake and to protect or keep it from danger?
    a) Government
    b) The resident society
    c) Tourists
    d) All society including users and non-users
    e) All of the above are responsible
16. What is reason why you give the value for the lake?
    a) Recreation purpose
    b) Source of income
    c) Reserving for future generation
    d) Simply for existence of the lake
17. If your answer for question '9' is 'No', what is the reason of not to visit the lake?
    a) I have no time
    b) The road, including other services in the lake is not satisfactory
    c) Lack of interest
    d) Other reasons (specify)

SECTION TWO: Willingness to pay question

This section contains your interest and opinion to contribute in conserving Wonchi Crater Lake. You have the right of not to pay, that means, status quo if you are satisfied with the current status of the lake. The question is Dichotomous form with open-ended question. Choose what you are willing to pay and base on your own opinion please! The payment may be made by adding the specified amount on the tax.

18. Are you happy if Wonchi Crater Lake is conserved?
    a) Yes
    b) No
19. If your answer for question '18' is 'yes', would you like to take part or contribute in conserving the lake?
    a) Yes
    b) No
20. If your answer is 'yes' for question '19', are you willing to pay Birr '**xx**' in conserving the lake? ('XX' is the amount of initial bids proposed for respondents randomly form four initial bids: 15,
    a) Yes
    b) No
    c) No answer
21. What is the maximum amount that you are willing to pay for conservation of this lake? _____ Birr per annum.
22. What is/are the reason that makes you not to contribute in conserving the lake if your answer for question '19' is ''No''?
    _____
    _____ .

SECTION THREE

Educational background of the respondents and their income level

23. Pre-tax Income of respondent per year in Ethiopian Birr. Birr _____ per year.
24. Do you have any other comments to contribute on this Public Good?

    _____
    _____
    _____
    _____
    _____.

ANNEX 3 - Figures showing delta creation and soil erosion in and around the lake, due to deforestation.

Fig. 1: Figure showing Irrigation activities in the lake creating delta.

Fig. 2: Image of Wonchi Crater Lake with soil erosion

DECLARATION

I, the undersigned, declare that this thesis is my original work and has never been presented for a Masters Degree program in any other University and that all resources used for this thesis have been duly acknowledged.

Examiners' comments have been incorporated.

Declared by:

Name: _____

Signature: _____

Date: _____

Confirmed by Advisor:

Name: _____

Signature: _____

Date: _____