146

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THE VALUE OF WATER QUALITY IMPROVEMENT ON LAKE HORA-ARSEDI

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146

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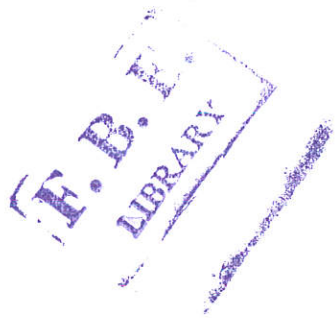

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THE VALUE OF WATER QUALITY IMPROVEMENT ON LAKE HORA-ARSEDI

BY:

HAYMANOT LEGESSE BEKELE

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirement for the Degree of Master of science in Economics (Natural Resource and Environmental Economics)

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"The Value of Water Quality Improvement on Lake HoraArsedi."

By

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ABSTRACT

Surface water quality affects the wellbeing of local community and thus an improvement to Lake Hora-Arsedi would benefit Beshoftu residents. An Improvement proposed in this study is improving the quality of water in the lake one step from how Beshoftu residents perceived the existing water quality. In this study, an attempt was made to elicit the willingness to pay (WTP) of Beshoftu residents to this improvement using contingent valuation method. A total of 250 households from Beshoftu town residents were selected randomly. The study used the single bounded dichotomous choice technique followed by an open-ended question for eliciting the willingness to pay of household for the lake clean-up. Probit and Tobit models were applied to identify factors affecting WTP.

The mean willingness to pay estimate, birr 11.42, from closed ended format aggregated for the total population and total willingness to pay of the residents was found to be 119, 893 birr per month and 1,438,716 per annum. While the mean willingness to pay estimate from open-ended mean willingness to pay estimate, 5.02 birr , this total willingness to pay was found to be 254,152 birr per month and 3,049,825birr per annum. The study revealed that the distance of the respondent's homestead from the lake, perception of the existing lake water quality, awareness of environmental problems, income of the respondent, sex of the respondent and family size are factors significantly affect the willingness to pay of a household for lake clean-up.

The policy implication of the study is *the government or any concerned body could have active participation of local community* by *enhancing environmental consciousness of residents and creating awareness on the benefits associated with improved lake water quality through meetings and seminars. Moreover, the concerned body should consider the case of major sources of lake pollution and take measures without wasting time to improve the lake water quality.*

Key words: **Contingent valuation, Water quality improvement, Willingness-to-pay**

TABLE OF CONTENT

LIST OF TABLES

1. INTRODUCTION

1.1 BACKGROUND

Surface water bodies perform numerous interrelated functions, and provide a wide range of important goods and services to the society. Moreover, these water bodies enhance the economic livelihood of local communities by supporting commercial fishing, supporting agriculture, and serving the recreational sector. The continuance or growth of these types of economic activities is directly related to the extent and health of these surface waters. However, surface waters are probably the most abused of environmental resources. This might be because they have special characteristics due to their nature and dynamics that make them to be vulnerable to pollution.

Surface water quality is usually affected by natural phenomena, human activities, and other causes. Overtime the loading of contaminants has resulted in the degradation of water quality and loss of biodiversity due to various causes including eutrophication. Accelerated eutrophication of surface water because of human activity is a concern throughout the world. However, surface water pollution is more sever in the developing countries (Zinabu, 1994). Pollution of water bodies negatively affects welfare of the society.

An essential element of an environmental economics analysis is to compare the benefits of a proposed action to the costs. Such analysis is seriously flawed without monetary values for the environmental goods affected by a proposed action (Carson, 2000). Therefore, it is important to understand and attempt to estimate the value of environmental goods and services and considered in cost benefit analysis of a project involving some environmental goods. Otherwise, the benefits

of such goods and services would be underestimated in turn it result too little protection for environmental resources. However, the question is how to estimate the value of environmental goods. As environmental goods are not traded in the market and hence cannot be valued by looking at market prices. To resolve this problem, economists have developed several techniques for placing monetary values on non-market goods and services. There are various Non-Market Valuation techniques used to estimate the value of environmental resources(Mitchell and Carson, 1989).

This paper tried to apply one of these methods, the Contingent Valuation Methods (CVM), in the elicitation of the willingness to pay of Beshoftu residents for water quality improvement of Lake Hora-Arsedi.

1.2 THE STUDY SITE

Lake Hora-Arsedi is one of crater lakes in Beshoftu town at 1850-2000m altitude. The town is located in the central part of Ethiopia and only 47 kilometers southeast of Addis Ababa; it is endowed with other beautiful crater lakes namely, Beshoftu, Babo gaya, Hadhoo and Kuriftu together with the other two shallow lakes of Chelekleke and Chefe. Lake Hora-Arsedi is located only 2 km drive from the center of Beshoftu town. The lake has a maximum depth is 38 meters and 1.06 sq. km area (Mesfine, 1999). This Lake is large and round with tree-covered hills rising above the lake water. Lake Hora-Arsedi and its surrounding are endowed with natural qualities. The diverse flora and fauna of the lake offer recreational services. The floras along the lakeshores include baboons, grasses and species of different vegetables; while the faunas include around 20 various species of birds and variety types of fishes in the Lake Hora-Arsedi.

The lake has two sites, the recreational and the irrecha (thanks giving ceremony) sites. The lake also has an interesting history associated with the Oromo people. Thus, the irrecha site (the other lakeside) is important place for the worship and visited by the Oromo people once a year. The irrecha festival is said to have started 1400 years ago at Lake Hora-Arsedi (John Graham, 2005). Those people who believe that the lake is miraculous drink from it on this day and will be healed. In addition, these people also believe that their cattle would be healthy and fecund when they drink water from the lake. In addition to this, the other sides of the lake freely accessed for watering livestock, washing clothes and bathing.

Lake Hora-Arsedi like any other lakes serves as home to aquatic life such as fish and birds as well as keeping the balance of climate. The major uses of the lake that has got attention so far are recreation and irrecha festival.

1.3 PROBLEM STATEMENT

Lakes are one of humanity's most important resources and they provide water for consumption, fishing, irrigation, power generation, transportation, recreation, disposal of wastes, and for a variety of other purposes. As in other developing countries, the water quality of Ethiopian lakes and rivers has been deteriorating through time. The main causes of surface water pollutions in the Ethiopian context are industrial activities, sewage and agricultural activities (Zinabu, 1994). In Ethiopia, 85% of the population lives in the rural areas and 35% of the people that live in the city and towns have no access to sewer systems. From this fact, it is obvious that surface waters are contaminated with human wastes, i.e., urine and facees. The rest of the people that live in towns use septic tanker or release the sewage into the streams through tube (EPA, 2003). These burdens

lead to the pollution of surface and ground water bodies. This sewage also creates toxic affect or promotes eutrophication on the water bodies and upset aquatic biota and ecosystems.

Lake Hora-Arsedi has tourist attractions potential however, it has not played significant role as expected in the tourism industry of the country. The lake has a very few number of visitors and most of them are local residents. Currently, there is damage to Lake Hora-Arsedi and its catchments. The lake receives untreated industrial effluents (from the tannery just beyond the rim of the crater), sewage effluent directly and indirectly from Bishoftu town. In addition, cereal cultivation has entirely replaced the natural vegetation of the surrounding landscape that increases surface runoff. The dumping site, which is used by the City Administration, is found near to the lake; hence, this may increase the probability of lake pollution. The finding of the study made in 1999 by a steering and technical committee which established by the Ada-liban woreda administration revealed that the lake is highly polluted and contaminated so much. Therefore, the water is confirmed non-potable and strictly recommended not to be used to swimming (Mesfine, 1999). Moreover, the surface area of the lake became increase overtime for unknown reasons; however, one of the suspected causes of this problem is soil erosion into the lake because of deforestation.

However, the risks of lake water pollution get little attention so far. If this situation continues, these wastes promote eutrophication on the lake then affect its aquatic life and impose ecological damage. This calls for water quality improvement plan in lake Hora-Arsedi. To implement the improvment program participation of local community is required. The main interest of the study is to elicit WTP of Beshoftu town residents for the improvement of water quality in the lake.

1.4 OBJECTIVES OF THE STUDY

The general objective of the study is to analyze how much Beshoftu town residents' are willing to pay for improved water quality of Lake Hora-Arsedi by conducting a contingent valuation survey. The valuation is intended to provide helpful information for decision-makers to introduce a cost-sharing scheme in the lake clean-up program.

Specifically, the study set out to:

- Estimate the willingness-to-pay of households for a one-step water quality level improvement in Lake Hora-Arsedi
- To find out determinant of WTP for water quality improvement of the Lake
- To aggregate the monetary value.

1.5 SIGNIFICIANCE OF THE STUDY

Existing water related valuation exercises in developing countries have concentrated in water supply and sanitation area thus studies of surface water quality are scarce. This study attempts to estimate how much Beshoftu residents are willing to pay for water quality improvement of Lake Hora-Arsedi, on which almost no prior study is conducted. The study used single-bounded dichotomous choice elicitation technique with a follow-up open-ended format is applied and a comparison of the result made. Also, it tries to examine the presence of inconsistency in response to the valuation question and the reason. The result may provide helpful information for policy makers to introduce a cost-sharing scheme in the improvement program.

1.6 METHODOLOGY

This study employed contingent valuation method to estimate the willingness to pay of Beshoftu residents for water quality improvement of Lake Hora-Arsedi. The relevant population for the survey was defined as the residents in Beshoftu town where the Lake Hora-Arsedi is situated. Beshoftu town consists of nine Kebeles. A total of 250 households randomly selected from these kebeles. Although, it is advisable to consider more sample size to increase the quality of the CV data (Mitchell and Carson, 1989), given the time and financial constraints it was difficult to increase the sample size. To generate the necessary information residents were directly asked (face-to-face interview) about their willingness to pay for the lake water quality improvement through a survey based on well-designed questionnaire. The questionnaire has three sections: attitudes on the water quality of the lake, the question on the willingness to pay, and socio-economic and demographic section. The main survey is preceded by a pilot survey carried out for focus group to obtain bid amount and other relevant information. Other information on current recreational activities of the lake and privatization of the recreational site were obtained by interviewing officials of Beshoftu City Administration and Oromia Investment Office.

In this study, the single bounded dichotomous choice elicitation techniques of CVM together with the open-ended format are applied and a comparison of the results is made. In the single bounded dichotomous choice approach the respondent is asked a question requiring a 'yes' or 'no' answers whether he/she is willing to pay a given amount (bid). Moreover, in the open–ended payment question the respondent is asked his/her maximum willingness to pay amount for this program.

The data obtained from CV study is analyzed using both descriptive statistics (mean, median and standard deviation) and econometrics models. In the study, econometrics models, namely Probit and Tobit models are estimated. The Probit model is used to identify factors that determine household's willingness to pay. That is, The Probit model is used to discuss the relationship between responses to closed ended questions on willingness to pay of respondents and factors expected to influence it. The Tobit is used to estimates and the mean willingness to pay of respondents for the proposed lake clean-up program.

1.7 LIMITATION

The scope of the study is limited to generate information from Beshoftu town residents concerning the willingness to pay for water quality improvement in lake Hora-Arsedi. Since the study used a hypothetical market to value water quality improvement in the lake, there might be differences between actual and hypothetical improvement. In addition to that, respondents may not tell their true WTP. Thus, care should be taken in interpretation and using of the results. Furthermore, due to time and resources constraints, the sample size is only 250.

2. LITERATURE REVIEW

This chapter reviews the theoretical and empirical issue in the area of environmental goods, particularly water quality. First, the review focuses on theoretical issue such as economic valuation of environmental resource, the valuation technique and its underlying theoretical framework and then reviews empirical application of the technique.

2.1 ECONOMIC VALUATION OF ENVIRONMENTAL RESOURCES

2.1.1 VALUING ENVIRONMENTAL GOODS

Environmental resources are quite valuable since they provide a variety of service, which often fail to be valued in conventional markets. These services range from basic life support to the filtration of pollution. A society values environmental resources; however, the value of environmental goods and services is not reflected in market prices. This is because environmental commodities are typically public goods like air, water and forests. Humans tend to consume more of priceless environmental commodities than what is optimal, both from human and environmental points of view. Overuse of natural resources and environmental degradation to some degree can be explained by lack of market prices (Perman et al., 1999).

A main interest of environmental economists is to put such lacking prices on environmental goods (Hoevenagle et al., 1993). Thus, they developed several methods of non-market valuations techniques that have been employed in recent years to estimate economic value of environmental goods and services. These methods can be used to evaluate the impacts of environmental policy and management decisions.

Valuation of an environmental good captures the economic value of the good. It is largely based on the assumption that individuals are willing to pay for environmental gains and, conversely, they are willing to accept compensation for some environmental losses. Hence, individuals demonstrate preferences, which in turn place values on environmental resources for their services. If individual believes he/she is better off after a change in environmental quality and the, then that individual would be willing to pay to secure this improvement, and the amount of money reflects his/her economic valuation of improved environmental quality (Freeman, 1993; Hanely et al., 1997). On the other hand, if the change makes the individual worse off, he/she might be accepting compensation to let this deterioration.

The aim of economic valuation is to bring out the relative preference attached to a good or service in monetary terms. Economic valuation of non-marketed goods is used as an input in decision-making and, in particular, for aiding the assessment of policy choices concerning various management options for environmental resources. Failure to include the value of such goods in benefit-cost calculations will implicitly assign them a value of zero. Therefore, information on the price or value of non-marketed goods could provide policy makers with helpful information to balance the benefits and costs of alternative policies.

The economic concept of value encompasses any net change in the welfare of society and is therefore not restricted to benefits derived solely from the direct use of a resource. Hence, Total Economic Value (TEV) is a useful concept to measure the economic value of an environmental good (Mitchell and Carson, 1989). The total economic value can broadly be divided into two: use value (UV) and non-use value (NUV). Use value arises from direct or indirect physical use. It can be further divided into consumptive uses derived from resource consumption and non-

consumptive uses accrue from the service provided by public goods. Non-consumptive use also divided into two: direct use and indirect use. Non-use value may be obtained without actually using them and it includes Option value, Bequest value and Existence values (ibid). Option value refers maintaining the option to utilize the resource in the future and bequest value refers to protecting resources for future generations. Existence value refers the value individual have for resources apart from any situ use of a resources.

Existence value is sometimes described as non-use or passive-use value to suggest that the benefit obtained does not depend on direct or indirect interaction with the resource. Existence value is identified for the first time by Krutilla (1967); he tried to show people derived non-use benefit from non-marketed goods and have positive willingness to pay (Freeman, 1993). There are different views concerning the inclusion of passive use (non-use) value in cost- benefit analysis of policies. However, many economists have argued that capturing these non-use values are important and should be taken into account (ibid). Several methods of valuation have been proposed in order to estimate economic value of environmental resources.

environmental goods are not traded thus their value cannot be determined in the market. This is the challenge to policy makers in cost-benefit analysis of projects, which involve with environmental benefits and costs. To solve these problems economist developed various non-market valuation methods.

2.1.2 METHODS OF VALUING ENVIRONMENTAL GOODS

Economist proposed and applied different non-market valuation technique to estimate the total economic value of environmental goods. Environmental valuation methods classified based on

two criteria (Mitchell and Carson, 1989). The first criteria deals with whether the valuation method is based on observed economic behavior, from which individual preferences can be inferred, or whether the valuation method is based on responses to survey questions that reveal stated preferences by individuals. The second criterion is whether the method yields monetary value directly or they must be inferred through some indirect methods. Using these criteria the methods of valuation techniques are categories into four groups: direct observed and indirect observed methods plus direct hypothetical and indirect hypothetical methods (ibid). In the case of direct observed methods the source of data is what one observes while Indirect observed methods are based on actual behavior. Both indirect hypothetical methods and direct hypothetical methods involve asking people question directly to place value on environmental service. However, direct hypothetical method is different from indirect hypothetical method in that in the first case values are directly obtained from the response of the respondents while in the second case values are inferred the yes or no response of the respondents.

The two broad approaches of theoretically consistent methods of valuing environmental goods are revealed preference techniques and stated preference techniques. Revealed preference techniques use information from related markets to impute a value for non-marketed goods (Navrud, 2000). The revealed preference approach includes surrogate market and conventional market approaches. However, the most commonly used techniques are the hedonic price method and the travel cost method. Stated preference techniques that can be used to estimate non-market values are based on the stated preferences of individuals. This approach includes Contingent Valuation Method (CVM), Contingent Ranking (CR) and Conjoint Analysis (CA). The most widely used stated preference technique for estimating non-market values is the Contingent Valuation Method (CVM).

Stated preference methods such as CVM rely on surveys. Stated preference methods have the following advantages over revealed preference approaches (Carson, 2000):

- They are the only method that can be used to estimate non-use values.
- They can be prospective and used where no related market data are available for estimating use values.
- They are good to measure people's preference for government policies or programs to changes in the quality of environmental goods

Due to unavailability of market related data in other valuation methods CVM, which is appropriate for this study is employed.

2.2 CONTINGENT VALUATION METHOD

The CVM first came into use in the early 1960s by Rober K. Davis (1963) used questionnaire to estimate outdoor recreation in benefit of the Maine backwoods area. Since then the method has been used by economists to measure the benefits of variety of environmental goods (Mitchell and Carson, 1989). It is important to estimate the value people place on some environmental goods where no market information about their preference of an item is available. Contingent valuation is a method of estimating the value that a person places on a good. CVM utilizes surveys to determine how much individuals are willing to pay for environmental quality improvement. In contingent valuation survey by means of an appropriately designed questionnaire, a hypothetical market is described where the good in question can be traded (Carson, 2000). CVM assesses the economic value of environmental goods, by asking respondents questions that reveal their willingness-to-pay to improve or reduce the deterioration in the quality of an environmental good. Alternatively, respondents are asked for the amount of compensation they would be willing

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to accept to give up specific environmental services. CVM is widely used in estimating social benefits resulting from improvements in the quality of environmental goods, such as water quality improvements, which are of direct use to the consumer (Brox et al., 2003).

Contingent valuation method, CVM, is different from other methods in that it generates both use and non-use values as well as it has easy of flexibility. Therefore, it is a widely acceptable method for estimating total economic values. CVM can be applied to a wide variety of issues (King and Mazzotta, 2005). That is, contingent valuation studies can be applied to a situation where there is not enough data to utilize revealed preferences. Other method such as Travel Cost Method and Hedonic Pricing requires detail data about the good in question, which is difficult to obtain. In addition, these methods do not capture non-use value that are important when we deal with environmental resources hence underestimate the Total Economic Value (Carson, 2000). Therefore, Contingent Valuation Method (CVM) is the only technique theoretically capable of estimating the benefits produced by water quality improvements, including non-use values.

There are several stages in a CVM analysis (Hanley et al., 1997). The first stage is a construction of a hypothetical market. This stage is the most fundamental part of the contingent valuation survey. During the construction of a hypothetical market a scenario that corresponds as closely as possible to a real-world situation should be established and described to the respondents. Thus, in our case, residents of the town presented with issues about a change in the provision of environmental goods, what this change consists of and its benefits. Moreover, respondent had told about a concerned body that is responsible for the improvement of environmental quality. Although it is hypothetical for the persons being interviewed, effort was made to assure every respondent clearly understood the present situation and the change that they are being asked to

value. Then described to the respondent the implementation of the program will take place if households are willing to share the cost. Moreover, the method of payment or the bid vehicle (community charge) explained to the respondent. The payment vehicle chosen from the pilot survey attempted to fulfilled conditions with respect to incentive compatibility, realism, and subjective justice among respondents. Then a provision rule, a mechanism by which the good is to be provided explained to the respondent.

To elicit respondent WTP for changes in an environmental asset a questionnaire designed (Mitchel and Carson, 1989). A CVM questioner consists of the following sections (Whitehead, 2000). These are introductory, attitudinal, valuation and socio-economic characteristics sections. Each component in the questionnaire fulfills an important role taken together, they introduce the respondent to the context and relevant background in progressively more detail, and also gather information about the respondent and their understanding of the scenario which are needed to report the results or to establish the validity of the response.

- An introductory section is essential to state the purpose of the CV questionnaire to ensure that respondents understand the contexts and are able to participate in an informed manner. The context is as realistic as possible in order to encourage realistic and truthful responses (but not to bias the answers). The interviewers explained who they are (for example conducting a survey on behalf of what organization), and should assure the respondents that their answers will be confidential.
- Attitudinal section seeks the respondent's attitudes to general issues concerning the good then to the good in question.

- Valuation section is essential to elicit the Willingness to pay of the respondent for the good to be valued.
- Socio-economic characteristics section is the final section of this questionnaire asks for the socio economic characteristics of the respondent. This information is used to test weather the willingness to pay answers conform the theoretical expectation.

The most widely used elicitation formats in the CV survey are open-ended, binding game, payment card, and single bounded or double bounded dichotomous choice (Hanley et al., 1997). In all approaches, respondents reminded of substitute goods as well as the need to trade off money for benefits. Respondents also reminded of their budget constraints and hence the consequent need to make compensating adjustments in other types of expenditure to accommodate the additional financial transaction implied by the survey.

The two main arguments that are proposed as to the advantage of the use of dichotomous choice format over open-ended question format in eliciting WTP are the simplicity for respondents and reduced incentives for strategic responses (Bateman et al. 1992). In the case of public goods, such as water quality improvement closed-ended questions have been shown to be incentive-compatible (Hoehn and Randall, 1987). Closed-ended approaches, which ask the respondent whether they would pay a stated amount for the good in question, provide intervals in which the respondent's WTP lies. This approach requires only a yes-no answer. It has the advantage of being much more similar to the choices that individuals are asked to make in real markets when faced by market prices. However, the problem here is this approach requires much larger sample sizes to increase efficiency, as the information collected from any one respondent is limited. In

addition, the WTP is not directly obtained from this format and it is more difficult to analyze the yes/no responses empirically.

The closed-ended format presented in the form of single bounded or double bounded dichotomous choice. Using the single bounded format respondent asked his/her willingness to pay for a stated amount only; and the double bounded format similar to single bounded but with additional follow-up payment question. The study used both closed-ended and open-ended format, that is, single bounded format with a follow-up open-ended format.

The second stage of CVM is obtaining bids. Hence, to obtain initial bids select a limited sample of the underlying population and interview these sample respondents. CVM survey will be administered in Mail questionnaire (with follow-ups), Telephone interview or In-person (face-to-face) interview. Mail and telephone surveys kept fairly short, or response rates are likely to drop dramatically. Telephone surveys may be less expensive, but it is often difficult to ask contingent valuation questions over the telephone, because of the amount of background information required. In-person interview reduces misunderstanding, because it is often easier to explain the required background information to respondents in person, increasing engagement and, makes spontaneous questions possible (may be important). In-person interviews are generally the most expensive type of survey because the cost of hiring professionals, traveling and time is high. Moreover, it is often blamed for the existence of interviewer bias.

The third stage is estimating average willingness to pay. The calculation of average WTP is a straightforward task with open-ended and bidding-game formats (Hanley et al., 1997). However,

it requires more data and the estimation of probability functions is difficult in the case of closed ended format.

The fourth stage is estimating bid curves. A bid curve traces out the impact of people's characteristics on their willingness to pay for environmental goods or services. The analytical approach taken will depend on the elicitation format used in the survey. If an open-ended question format used to collect the WTP data, simple ordinary least squares (OLS) regression may be applicable. If the WTP data collected using a dichotomous choice question format then a limited dependent variable econometric model (e.g. the Probit model) is appropriate.

The last stage is aggregating the data. To aggregate the data the sample mean is converted to population mean through different ways. One way of doing this is multiplying the number of households in the population by the sample mean.

2.2.1 THEORETICAL REVIEW OF CVM

Carson (2000) explains the theoretical foundation of using hypothetical market for welfare measurement, and how to incorporate WTP (willingness to pay) and WTA (willingness to accept) by the idea of "constructed markets". Moreover, Randall (1987) discussed this theoretical framework more clearly. Introducing some non-market good in the utility function then we assume individuals maximizes their utility from market goods and environmental goods, subject to budget constraint:

$U=U(Q_0,Z)$ s.t $Y=PZ$ 2.1

Where, U() is utility function, Z is composite of all goods, Q_0 is environmental good, P is a vector of prices of Z and M is the budget constraint. The indirect utility function can be written as

$V = V(P_0, Q_0, M)$ 2.2

Assume environmental quality change from Q_0 toQ_1 so that individual utility change from U^0 (utility of status quo) to U^1 (utility with the proposed program), where U^1 exceeds U^0. If the individual would be willing to give up his/her income for an increase in quality, this is called compensation variation for improved lake water quality The compensating variation associated with this environmental quality improvement is the amount of money (y) that satisfies:

$V = V(P, Q_0, M) = V(P, Q_1, M-y)$ 2.3

Where, Q_1 = is improved environmental quality.

The amount of money 'y' that sacrificed for water quality improvement in the lake could be considered as his/her willingness to pay. Therefore, in the study Contingent Valuation Methods (CVM) attempts to determine the amount of compensation paid (WTP) to secure an improved provision of water quality in the lake. Since the utility function that individual wants to maximize are not observable or the random part of individual preferences do not know by the researchers, estimation method using this approach usually make the researcher contrive situation in which experimental subjects. That is researcher may not know the individual's WTP certainly then he can only make probability statements about individual responses.

2.2.2 LIMITATION OF CVM

There are two main problem areas associated with CVM (Hanley and Spash, 1993)

1. Biased estimates of values

A number of biases are identified in CVM studies. Some of these are discussed below:

Hypothetical bias: it may arise because the respondent may not understand the description of the scenario. Then, their responses may not on actual bases like other market where goods are value based on their prices. In order to get reliable response or to minimize this bias the description of the scenario should be clear and understand by the respondent.

Strategic bias: occurs when respondents deliberately understate or overstate their WTP. Respondents may understate their WTP if they believe that the actual fees they will pay for provision of the environmental good will be influenced by their response. On the other hand, they overstate their true WTP in the hope that this may increase the likelihood of a policy being accepted (Mitchell and Carson, 1989). Therefore, to minimize such bias all outliers should be removed and the proposed environmental change described to the respondent, that is, what this change consists of and its effect.

Payment vehicle bias: occurs when individuals may have preferences/dislike for particular vehicles, which has strong influence on willingness to pay bid. To reduce this bias the payment vehicle is chose based on their choice during pilot survey.

Starting point bias: occurs when an initial starting point can significantly influence the mean WTP. The starting point may lead the respondents to make a decision without thinking about their true WTP (Mitchell and Carson, 1989).

Informational biases: occur when information provided in the survey instrument is not perceived by the respondent as intended by the researcher. Therefore, Valuation may depend on how the information about the good and its provision and financing is provided, who makes the

interview, what other information the respondents have about a particular good or incident. To minimize this problem the interviewers should be trained and use a well-designed questionnaire in the survey.

2. Choice of welfare measure

The choice of using willingness to accept (WTA) or willingness to pay (WTP) is another problem area in CVM. Empirical work showed that WTA formats gave a proportionately high number of protest bids and that in most cases; stated WTP was significantly lower than stated willingness to accept (WTA). The frequently mentioned reasons why WTA is greater than WTP are (Hanemann and Kanninen, 1998):

- Actual WTA is greater than actual WTP because of "loss aversion". Individuals value a given reduction in entitlements more highly than an equivalent increase in entitlement.
- Income and substitution effects. Income constrains WTP whereas WTA are unconstrained
- Risk aversion. Consumers who are given any one chance to value the good (rather than repeated valuation) will on average overstate WTA and understate WTP. This might be because consumers are unsure how much they value the good and to avoid bidding an amount greater than its true value.

The decision to use willingness to pay (WTP) or willingness to accept (WTA), among other things, depends on individuals' perception as to who has the property right over the resource in question (ibid). In this study, because the property right is in the hands of the city administration, WTP is chosen as the appropriate method of eliciting people's willingness to pay for a hypothetical improved water quality in the lake.

2.2.3 VALIDITY OF CVM

There are no general guidelines for constructing reliable CV studies, although Mitchel and Carson provide some checkpoints for evaluating CV survey. Field application should be, therefore, always be combined with methodological tests. The construction and framing of a CV survey should therefore be carefully examined before the results from it are used for policy purpose.

In order to test whether contingent valuation provides accurate estimates of value, researchers use validation tests. One validation test is to compare contingent valuation estimates of WTP with estimates produced by indirect methods, to see whether they converge on the same results (Carson, 2000). However, results from comparisons of contingent valuation, hedonic and travel-time measures are mixed, and in any case, the validity of the comparison depends on the exact parameters of the investigation.

Another form of validation is to concentrate on the internal consistency of the method (Loomis, 1989). This involves trying to ask whether the questionnaire describes the commodity to be valued in a meaningful way and avoid bias that distorts the estimation of correct value for the good in question. It can also involve inferring the underlying meanings and determinants of people's responses through statistical or sociological analyses.

2.3 EMPIRICAL EVIDENCE

Churai Tapvong and Jittapatr Kruavan (1999) undertook a case study on water quality improvements of Chao Phraya River in Thailand. They used CVM based on double bounded

format to elicit willingness to pay of residents. The data were collected from a sample of 1100 household interviews in 20 districts in Bangkok. A two-stage stratified random sampling procedure was used to select households from the Bankok metropolitan area population where central wastewater treatment facilities existed. Of 1100 household interviews, 1,020 provided sufficiently complete responses to permit empirical analysis. The use of logistic regression to study the WTP for the wastewater treatment service indicates that the factors governing the respondents' behavior whether to pay for the service are education, knowledge and importance of the project, living near a river or canal, and referendum fees. On the quantitative side, the mean values of the fee for the treatment of water quality from existing to boatable and from boatable to swimmable are found to be 100.81 and 115.03 baht/month respectively. The use of OLS models also concludes that the amount of fees the respondents are willing to pay depend a great deal on referendum fee, income, education, quality of existing water and being near a river or canal.

Brett Day and Susana Mourato (1998) conducted CVM based on double-bounded format to determine the value to the Beijing population of maintaining river water quality in one or all the rivers in the region, China. From the total 2,694,000 households in the Beijing area 999 respondents were selected randomly using a selection process where the element of the sample picked from sample strata based on regions. The survey administered both on-site and off-site at river locations. The analysis of willingness to pay, which was done using a combined spike model and willingness to pay model, showed that the Average WTP per household per year for the prevention of water quality deterioration was found to be 123 Yuan (US$15) for the Chaobai and 101 Yuan (US$12) for the Nan Sha He. As expected, these two values are not statistically different from one another although the two rivers are perceived to be very different. The implication is that transferability of values between rivers may be possible even though the rivers

may be different. Average WTP per household per year to maintain the quality of all Beijing Rivers was estimated to be 186 Yuan (US$22). This value is significantly higher than the value of individual rivers like the Chaobai or the Nan Sha He. The average annual household WTP to maintain water quality in all the rivers around Beijing is found to be significantly higher than for any individual river, showing that respondents are sensitive to the scale of the proposed water quality improvements. Aggregating over the target population yields an estimate of 500 million Yuan (US$60 million) per annum for the preservation of all rivers in the area. Non-use motivations appear to be the most important determinants of river preservation for the Chinese

Yapping (2003) applied CV and Travel Cost Method to estimate the value of improved water quality for recreation in East Lake, Wouhan, of China. The survey concentrated on the users group because this group was believed to be the representative of the general population. In total 600 of the 501 questionnaires returned, 408 could be used for TCM and CVM analyses. The necessary information for estimation of WTP had been elicited using open-ended questions. The results of multivariate regression analysis show that improving the water quality to swimmable quality and drinkable level could increase the unit value of the lake by CNY 18.09/m2 and CNY 32.13/m2 respectively. In order to cross-check these findings researchers use contingent valuation method and ask the WTP for different levels of clean-up. They found that CV values are higher than those from travel cost are. Income and education are individually significant at 99% level of confidence and hence important determinants of WTP of respondents. However, distance and perception were found to be statistically insignificant. To increase the reliability of the income data, which is rarely genuine, this study adjust the real income of the respondents for the possible difference in the residential house.

Gren, et al. (1997) reported benefit estimates using CVM in Poland and Sweden. The CVM study used mail survey to obtain information on how much residents were willing to pay in extra environmental tax for a large-scale international action plan to reduce eutrophication in the Baltic Sea. For Sweden, the mean annual WTP was estimated to be about 5,800 SKr per person. Based on the lower estimate, the total national WTP for Sweden (based on total adult population) was calculated to be about 20 billion SKr. For Poland, the WTP per person was estimated to be between 300 SKr and 600 SKr. The national WTP, using the low estimate again, was found to be approximately 7.8 billion SKr. It is not surprising that the estimates for Poland were significantly lower than for Sweden. It is known that WTP estimates are significantly affected by income levels and are expected to be much lower for developing and transition economies than for developed countries.

Nallathiga and Paravastu (2003) conducted contingent valuation survey to determine the economic value of water quality improvement for river Yamuna in India. The study employed a CVM based on double bounded format. About 125 household were randomly selected from representative clusters spread across upstream, middle stream and downstream contiguous areas of the river. Hence, the survey method used a combination of random and representative sampling to obtain a more realistic estimate. The survey carried out for a sample of 112 households. The result of multiple linear regression analysis showed that the average WTP for current river water quality maintenance was found to be Rs.73.86 per capita per year, while maximum WTP of it was found to be Rs. 77.86.The results indicate that the willingness to pay for the river water quality improvements is small but significant. Moreover, the survey results add that the people, being aware of a variety of water goods and services provided by river water,

are inclined to conserve the water quality by paying a premium for it. Income and perception are important determinants of WTP.

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. Times Beach water quality has deteriorated due to nearby discharge of the Davao River, such as silt, household waste and industrial waste. The city's Health Department issued warnings about the health risks of swimming at the beach. Furthermore, the deterioration of the beach water quality discouraged other recreational activities, such as picnics. About 777 household randomly selected from relevant population. The cost of the Cleanup Plan estimated that ranges from $5 to $15 for each household per month. The result show that from CVM the estimated average willingness-to-pay values of the users of Times Beach for water quality improvement ranges from $1.2 to $2.04 per month. There were also people who were interviewed but were non-users of the beach. The mean WTP of these people for an improvement of the water body's quality ranges from $0.04 to $1.4 per month. On the other hand, the estimated monthly WTP from TCM ranges from $1.44 to $2.04 per user. Here, it can be noticed that the estimates from both valuation approaches are close to each other. A closer investigation showed that although people are aware of the poor water quality status, they do not place a high priority on it. This is because there are other environmental problems that are more urgent in the area such as deforestation and poor management of solid waste. The policy message of the study is to wait until incomes and WTP are higher before engaging on large investments (e.g., waste treatment infrastructures).

In Ethiopia, only a few studies have been conducted on improved water quality in the lake by applying CVM. Moges (1999) used CVM to estimate the willingness to pay for the Tana recreation site. He came up with a conclusion that income, family size and level of education are significant factors influencing the WTP of a household for the recreation site.

Tsegaye (2005) used CVM by applying double bounded format to elicit the willingness to pay (WTP) of fishermen to the improvement of Lake Chamo. The mean willingness to pay is birr 4.63 per month. His analysis showed that there is a positive and significant correlation between willingness to pay and income of household, educational level of the respondent and the dummy variable Chamo. However, the response is negatively and significantly correlated with the age, perception of the respondent about the existing quality of the lake and sex of the respondent male.

On the other hand, Fisseha (1997) and Duffel (1998) also applied the CVM studies for measuring the willingness to pay for improved water quality in Meki town and Ada'a-Liben districts respectively. In both studies income and time (distance) spent to fetch water were reported to be the significant factors determining the willingness to pay of the household, while education and wealth were insignificant. In Fisseha`s study occupation and in Dunffa`s study family size and sex of the household were insignificant.

3. METHODOLOGY

3.1 DATA SOURCE

The main data type used in this study is primary data. Data sources were mainly the CV survey used for this purpose and relevant documents from Beshoftu Municipality. The Primary data were collected with a questionnaire. The CV survey was conducted with a face-to-face interview method.

3.2 SURVEY DESIGN AND ADMINISTRATION

Portney (1994) claims that there is no standard approach to the design a CV survey, but does assert that virtually all CV surveys consist of several well-defined elements. A CV survey questionnaire[1] was designed and developed to generate the necessary information in eliciting the WTP of respondents. The questionnaire has four sections: introductory, attitudinal, valuations and socio-economic characteristics section.

The pilot survey was implemented to collect information on uses of the lake, attitudes towards Lake clean-up program and how much respondents were willing to pay. Pre-testing was conducted through focused group to develop the questionnaire. The Focus group consisted of municipality officials, Beshoftu tourism Bero officials, knowledgeable residents about Lake Hora-Arsedi, and eighteen randomly selected households. These participants expressed their rankings of the current state of the lake, described existing limitations for lake use, and portrayed possible changes in the lake and their tributaries from water quality improvements.

[1] The questioner is given in appendix

The pre-test provided information to make some possible modification in the design of final survey questionnaire. Thus, the questionnaire modified by including questions on monthly expenditure that taken as a proxy for income. Based on pre-test the order of the questionnaire was restructured making questions on household characteristics (especially questions on income) to appear in the last part of the questionnaire. Moreover, adjustments and corrections were made for a clear understanding of the questionnaire between interviewers and respondents.

The payment vehicle was chosen based on the pre-test result. Similarly, the bids (starting price) were obtained from the pre-test through open-ended questions, which asked the respondents their maximum willingness to pay for water quality improvement of the lake. In the pre-test, six households from kebele 06, 04 and 09 who live near to lake Hora-Arsedi are willing to pay (8,8,10,12,14 and 8 birr per month) since they were more conscious to the problem of lake Hora-Arsedi pollution relative to others. Hence, 10 birr is used as one starting value. Other Six households from kebeles 05, 02, and 03 who live at fair distance are willing to pay (3, 5,5,3,9 and 5 birr per month); hence, 5 birr is used as the second starting value. Six households from kebele 01 ,07& 08, who live far away from the lake are willing to contribute from 2 birr to 4 birr per month (1,2,3,3,5 &4 birr) as they have less information on the current lake water quality. Hence, the average 3 birr is used as the third starting value. The three starting prices (3, 5 and 10 birr per month) were equally and randomly distributed in the 9 kebeles interviewed. Households interviewed in the pre-test were not included in the main survey. Furthermore, the pre-test result showed that closed-ended with an open-ended follow up format is easier to express their willingness to pay for a hypothetically proposed water quality improvement of the lake. If the maximum willingness to pay in open-ended question is less than the already agreed amount in the

closed-ended format (single-bounded dichotomous choice), we ask the reason why. This will help to compare the results obtained from the different elicitation methods.

A considerable effort was made to make the survey as representative as possible. A stratified random sampling technique was used in the sample household selection. The town is currently divided into 9 kebeles and the sample households are selected from these kebeles. A proportional size of households[2] from each kebele is interviewed to have a representative sample of households in the town. Households from each kebele were selected by randomly picking the starting house (with the help of random table) from the household number lists obtained from the respective kebele offices. In the town about 22,255 households[3] were estimated for the year 2006. In this study, the survey was based on a random sample of 250 households. Though it is advisable to consider more sample size to increase the quality of the CV data (Mitchell and Carson, 1989), it was difficult to increase the sample size because of time and budget constraints. Hence, the sample has covered 1.1% of the total households in the town.

In the context of contingent valuation, several types of biases arise in the questionnaire survey. A considerable effort was made to minimize some of these biases while conducting the survey. The 'free rider' problem was minimized by asking explanation for zero WTP. Constant budget bias is minimized by reminding the respondent about his budget constraint. To check the existence of starting point bias, the starting bid is used in the model as an explanatory variable. To minimize payment vehicle bias the fee collected through community contribution from all residents per

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[2] Proportional household number from each kebele = $\frac{\text{the number of households in each kebele's}}{\text{the total number of households in the city}} * \text{sample size}$

[3] since the actual number of households for the year 2006 is not available, $22{,}255 = \frac{\text{Population projection for 2006}}{\text{Mean family size of 5.72}}$

(source:from CSA. Beshoftu Branch, from own survey)

month is specified to the respondent. Moreover, the questionnaire was translated into Amharic language accompanied the English version to minimize interviewer bias. However, this does not mean the study is free from all biases but attempted to minimize their effect in this study.

The main survey conducted from November 15, 2006 to December 10, 2006. Three enumerators with two supervisors including the researcher participated in the survey. Of the total enumerators, one was diploma holder and three were students who had been attending degree program in colleges. Three days long training was given to the enumerators on the aim of the survey and related issues to the survey. The pre-test was also helping the enumerators to exercise the survey administration.

3.3 MODEL SPECIFICATION

The data obtained from this CV study is analyzed in two ways:

- Using descriptive statistics
- Using econometric model

As described in the first section we used the Probit and the Tobit models in this study. The Probit model was estimated for single bounded dichotomous choice; and the Tobit model was estimated for open-ended format. The Probit model is used to identify factors affecting the probability of having a positive willingness to pay for lake water quality improvement. The Tobit model is used to estimate the mean willingness to pay from the follow-up open-ended question.

3.3.1 THE PROBIT MODEL

In this study, the Probit model is used to identify factors that affect the probability of WTP. In this study, individuals are given initial bid that has 'no' or 'yes' responses. Therefore, it is a single-bounded dichotomous choice model to be framed under the random utility method. The basic model for analyzing dichotomous contingent valuation response is random utility model, which was constructed by Hanemann (1984). The random utility model starts with utility function where by indirect utility of an individual contains deterministic and stochastic components. The indirect utility function for respondent j can be written as (Haab and McConnell, 2002):-

$$u_{ij} = u_i (Q_i, y_j, z_j, \varepsilon_{ij}) \qquad 3.1$$

Where u_i = utility function of an individual

$i = 1$ for the final state (that prevails when the CV program is implemented) and

$i = 0$ for status quo

Q_i = the state of the lake

y_j = income of the individual,

z_j = household characteristics

ε_{ij} = a random component

Based on this model, respondent j answers 'yes' or 'no' to a required payment of t_j for the proposed lake clean-up program. Economic theory tells us that the individual would pay t_j if the utility with the proposed program is exceed utility of the status quo:

$$U_{1j} (Q_i, y_j - t_j, z_j, \varepsilon_{1j}) > U_{0j} (Q_i, y_j, z_j, \varepsilon_{0j}) \qquad 3.2$$

A problem that the researcher may encounters here is the random part of the preferences is not observed; therefore, the researcher can only make probability statement about 'yes' and 'no' responses for the given bid. In other words, the true willingness to pay of the respondent is unobservable but only a discrete indicator variable, I_j. That is, the discrete variable, I_j, equals 1 if the individual accepts the offer and 0 otherwise, and the researcher can only make probability statements about individual willingness to pay. The probability of 'yes' response is the probability that the respondent thinks that he is better off with the program than without it, even with the required payment, so that $U_{1j} > U_{0j}$. Thus for individual j, the probability is

$$pr(yes_j) = pr(I_j = 1) = pr[U_{1j}(Q_1, y_j - t_j, z_j, \varepsilon_{ij}) > U_{0j}(Q_0, y_j, z_j, \varepsilon_{0j})] \quad 3.3$$

Although this probability statement provides an intuitive basis for analyzing responses, it is too general to estimate. Hence, decision over the functional form of utility and distribution of random (stochastic) term should be made. By specifying the utility function as additively separable in deterministic and stochastic preferences:

$$U_{ij}(Q_j, y_j, z_j, \varepsilon_{ij}) = U_i(Q_i, y_j, z_j) + \varepsilon_{ij} \quad 3.4$$

The deterministic part of preference function is linear in income and covariates and can be expressed as:

$$U_i(Q_i, y_j, z_j) = \alpha_j z_{ij} + \beta_i y_j \quad 3.5$$

note here that α_j stands for a vector of parameters and z_i stands for different variables excluding income, related to individual 'i' that affect his utility:

$$\alpha_j z_{ij} = \sum\alpha \alpha_{jk} z_{ik}$$

if the offer t_j is accepted and the program is implemented the deterministic utility would be

$$U_1(y_j - t_j) = \alpha_1 z_i + \beta_1(y_j - t_j) \quad 3.6$$

In the same way, the initial (status quo) would be:

$$U_0(y_j) = \alpha_0 z_i + \beta_0 y_j \qquad 3.7$$

The change in deterministic utility is given by the difference between equations (3.6) and (3.7):

$$U_1(.) - U_0(.) = (\alpha_1 z_i - \alpha_0 z_i) + \beta_1(y_j - t_j) - \beta_0 y_j$$

$$\Delta U = (\alpha_1 - \alpha_0) z_i + \beta_1(y_j - t_j) - \beta_0 y_j$$

By assuming, the marginal utility of income is constant between the initial and final state (i.e, $\beta_1 = \beta_0 = \beta$), the change in utility (ΔU) is given by

$$\Delta U = \alpha z_j - \beta t_j \qquad 3.8$$

Where, $\alpha = \alpha_1 - \alpha_0$

With the additive specification of equation (3.4) the probability statement for respondent j becomes:

$$Pr(yes_j) = pr[U_1(Q_1, y_j - t_j, z_j) + \varepsilon_{1j} > U_0(Q_0, y_j, z_j) + \varepsilon_{0j}] \qquad 3.9$$

This probability statement is still too general for estimation but it leads to all utility-based parametric models.

$$Pr(yes_j) = pr[U_1(.) - U_0(.) + \varepsilon_{1j} - \varepsilon_{0j} > 0]$$

$$= pr[\Delta U + \eta_j > 0] \qquad 3.10$$

Where, $\eta_j = \varepsilon_{1j} - \varepsilon_{0j}$

To reduce computational efforts, multiply both sides of inequality in equation (3.10) by -1:

$$Pr(yes_j) = pr[-\Delta U - \eta_j < 0]$$

$$= 1 - pr(-(\alpha z_j - \beta t_j) > \eta_j)$$

$$= pr(\eta_j < \alpha z_j - \beta t_j) \qquad 3.11$$

Suppose that the distribution for η_j is normal and symmetric That is, $\eta_j \sim N(0,\sigma^2)$. To use typical software package, it is necessary to convert $\eta_j \sim N(0,\sigma^2)$ to standard normal (N(0,1)) variable dividing the inequality in (equation. 3.11) by σ then:

$$\Pr(yes_j) = pr(\eta_j < \alpha z_j - \beta t_j) = pr(\theta < \alpha/\sigma z_j - \beta/\sigma t_j) \text{ where } \theta = \eta_j/\sigma \text{ then } \theta \sim N(0, 1) \quad 3.12$$

$$= \Phi(\alpha/\sigma z_j - \beta/\sigma t_j) \quad 3.13$$

where, Φ = is commutative standard normal

Using the maximum likelihood method, we can estimate the parameters of equation (3.13) that maximize the joint probability of responses to the CV survey. The likelihood function for the response to a CV survey using the single-bounded format is:

$$L_j = [\Phi(\alpha/\sigma z_j - \beta/\sigma t_j)]^{Ij} [1 - \Phi(\alpha/\sigma z_j - \beta/\sigma t_j)]^{1-Ij} \quad 3.14$$

Where I_j = is a dummy variable which equals 1 if respondent j answers 'yes' and 0 if respondent j answers 'no'.

L_j = is known as the likelihood function

Then the logarithm of the likelihood function becomes

$\ln L_j = \Sigma\{ I_j \ln[\Phi(\alpha/\sigma z_j - \beta/\sigma t_j)] + 1 - I_j \ln[1 - \Phi(\alpha/\sigma z_j - \beta/\sigma t_j]\}$ maximizing this equation with respect to parameters to obtain parameters of Probit model.

Let the Probit model takes the following form (Cameron and Quiggin, 1994):

$$Y_j = \beta_0 + \beta X_j + \varepsilon_j \quad 3.15$$

$I_j = 1$ if $Y_j \geq t_j$

$I_j = 0$ if $Y_j < t_j$

Where Y_j = j^{th} respondent's true unobserved point valuation for the environmental resource in question.

β = a vector of coefficient for X

X_j = observable attributes of the respondent. That is a vector of explanatory variables.

ε_j = unobservable random component distributed $N(0, \sigma)$

I_j = discrete response of respondent j for the WTP question (1=yes, 0= no)

t_j = the offered threshold, assigned arbitrarily to the j^{th} respondent

The Probit model is also used to calculate mean willingness to pay which equals:

Mean WTP= - (Intercept / Bidcoeff) 3.16

3.3.2 THE TOBIT MODEL

In total 250 individuals received a questionnaire; since invalid responses and protest zeros were eliminated from the data set, 227 (90.8%) are available for analysis. This study used the Tobit model to identify factors that affect the level of the willingness to pay (WTP) of households for the proposed lake water quality improvement. A Tobit model is an extension of the Probit model and was developed by Tobin (1958). A Tobit model is a censored regression model when the researcher knows only the values of independent variables while observations on the dependent variable for some individuals are not observable. The formulation of Tobit model is (Gujarati, 2003):

$$\hat{y}_i = \beta_0 + \beta x_i + \varepsilon_i \quad 3.17$$

$$yi = \hat{y}_i \text{ if } \hat{y}_i > 0 \quad 3.18$$

$$yi = 0 \text{ if } \hat{y}_i \leq 0 \quad 3.19$$

Where y_i = the observed contingent valuation bid by individual i that is, the maximum willingness to pay of individual i.

$\hat{y}_i$ = the latent measure, this variable is not observed when it is less than or equal to zero but observed if it is greater than zero.

x_i = the independent variables,

β = a vector of parameters, and

ε_i = the error term distributed as independent normal with mean 0 and variance σ_2.

3.3.3 DESCRIPTION OF EXPLANATORY VARIABLES

Monthly Income of the Household (INCOME)

Residents of Beshoftu town get most of their income from activities like trade, wage, remittance and others. In addition to the income of the head, monthly earnings of the household also include income of all other members of the household from different sources (birr). Considering these sources, income of a family is expected to affect the WTP positively.

Bid amount (BID)

This refers to the starting prices (amount of payment) that offer and paid by the respondent. The starting price was included in the analysis to see weather it had a relation with the WTP of a household or not. It is expected inversely related to the willingness to pay, that is, as the bid amount increases the willingness to pay of the respondent will decline.

Age of the Respondents (AGE)

The WTP for water quality improvement was expected to decrease with age as it was expected that as people get older, their experience with the benefits and services of the lake water quality decreases. It is expected that the younger generation could be more concerned about the environmental quality issues relative to older people.

Sex of the Respondents (SEX)

This variable is included in the study as dummy variable, where 1 for male and 0 for female to test whether sex of the respondent is an important determinant of the willingness to pay for the lake water quality improvement. a priori relationship was not determined between sex and the WTP.

Family Size (FAMSZ)

This represents the total number of people in the respondent household. As the family size increases, household willingness to pay for the Lake clean-up would be increased. This variable is expected positively related to the willingness to pay amount for water quality improvement in the lake, which implies altruistic attitude towards future generation.

Martial status of Respondent (MARITIAL)

Martial status is a dummy variable taking 1 if the respondent is married; 0 otherwise. No prior expectation made on the influence of this variable on the WTP amount. That is the effect of marriage on the probability of willingness to pay amount is unpredictable.

Educational level of the Respondent

This refers to household's educational level in years of schooling. Education is important to understand the benefit of water quality improvement. It is expected that when people are more educated, their consideration and valuation of environmental quality improvement benefits will increase. That is, as the years of education increase the willingness to pay of the respondent also increases. PRIMARY is a dummy variable taking 1 if the respondent's education level is primary education; 0 otherwise. SECONDRY is a dummy variable taking 1 if the respondent's education level is junior education; 0 otherwise.

F.B.E. LIBRARY

House ownership (HOUSE)

This variable refers to being owner of the house in which the respondent lives. Homeowners are expected to be more concerned about environmental quality and the lake. This might be because improvement of the lake would indirectly increase the value of their house.

Distance from the Lake (DISTANCE)

This refers to the distance between the respondent's homestead and the proposed lake clean-up. Respondents who live near to the lake expected to be more aware about water quality degradation in the lake. Thus, as the distance of the lake from the household homestead decreases, the WTP of the respondent for Lake clean-up will be higher.

Environmental Awareness (ENVPB)

This refers to awareness of general environmental problem in the town. It is a dummy variable taking 1 if the respondent acknowledged environmental problem in the town; 0 otherwise. It is expected that being aware of environmental problem in the town would increase the WTP for Lake clean-up.

Lake Use of the Respondent (USE)

People could use the lake for different purposes. This is a dummy variable taking 1 if the respondent use the lake for recreation; 0 otherwise. It is expected that being user of the lake would increase the WTP for water quality improvement in the lake. That is users of the lake are more beneficiaries from water quality improvement of the lake.

Rank of Lake Water Quality (RLWQ)

This refers to the perception of the respondent who ranking water quality level of the lake. VGOODQW is a dummy variable taking 1 if the respondent perceive the existing lake water quality

as very good; 0 otherwise. GOODQW is a dummy variable taking 1 if the respondent perceive lake water quality as good; 0 otherwise.

Concern for Aquatic Life (CONCERN)

This refers to the concern of the respondent about aquatic life in the lake. This is a dummy variable taking 1 if the respondent is concerned; 0 otherwise. Those concerned about aquatic life are expected to be more willing than those who have no concern at all.

Substitute Lake (SUBLA)

This refers to the possibility of other lake that provide same recreational services to the respondent. If substitution possibilities are high then people can easily switch their recreation activities to another lake. That is we would not expect the decline in water quality in one lake to elicit a large WTP response. High substitution possibility inversely related to the willingness to pay of the respondent for water quality improvement of the lake. This variable is dummy taking 1 if the respondent substitute other lake for recreation; 0 otherwise.

4. EMPIRICAL RESULTS AND DISCUSSION

This section deals with the analysis of data obtained from the survey and it analyzes the attitude of Beshoftu residents towards the problems pertaining to the Lake Hora-Arsedi and their willingness to pay for Lake clean-up. Both descriptive and econometric (using LIMDEP econometric software) analyses are used in analyzing the information obtained from the survey. The willingness to pay amount is also aggregated for the total population and results are interpreted.

4.1 DESCRIPTIVE ANALYSIS

4.1.1 CHARACTERISTICS OF HOUSEHOLD

This study is conducted based on the survey data collected from a sample 227 Beshoftu town residents. Respondents' age was range from 21 to 90 years with an average of 49 years. Majority of respondents (90.1%) of the respondents were household heads. Of these, 74.4% were male headed while the rest 25.6% were female headed. This increase the reliability of the response provided that the town household head knows and manages most of the household income and resources. Family size in the sample ranges from 1 to 16. The average family size for the sample respondent was 5.7.About 48.4% of households had family size of 1-6 members while 51.6% had more than six members. Approximately 60.8% of respondents were married and the remaining 39.2% were single, divorced or widowed. Educational level of respondents ranged from illiterate to 12, with a mean value of 6.3. The majority of respondents were primary and junior secondary school attendants. About 4.9 % of the respondents were categorized under illiterate group, 50.2% were primary school attendants (from grade 1 upto 6 including those who were attending informal education and who can read and write) categorized under primary level of education.

Around 40.8% were junior and senior secondary school complete (from grade 7 to 12) categorized under secondary level of education.

The survey finding shows that 78.8% of household heads were employed and the remaining 21.2% were unemployed and retired. Of those employed 40.1% were government employees, 17.6% were private organization and non- governmental organization employee, 42.3% were employee in own business. The average income of sample of respondents was 441.65.birr per month, with the minimum of 85 and the maximum of 1200 birr per month. The income figures have been adjusted to include income from all sources as reported by respondents. Moreover, expenditure on major items asked and used as a proxy to monthly income for those who were not interested to disclosed their monthly income. The survey result also shows that from the interviewed household 56.4 % have their own houses, 43.6% rented from kebele and individuals. According to the survey, the respondents live in the city for an average of 50 years. The survey revealed that the interviewed households live near to the lake for an average of distance 2.8km with a minimum of 1.5km and a maximum of 6km.

Table4.1: summary of descriptive statistics selected socio-economic variables

variables	Min	Max	Mean
AGE	21	90	49.82
SEX	0	1	0.74
FMSZ	1	16	5.72
MARSTAT	0	1	0.60
EDUCATION	0	12	6.27
- ILLITERATE	0	1	0.04
-PRIMERY	0	1	0.50.
-SECONDERY	0	1	0.40
INCOME	85	1200	441.63
HOUSE	0	1	0.56
DISTANCE	1.5	6	2.82

Source: *Computed from the survey data*

4.1.2 HOUSEHOLD'S ATTITUDE ABOUT ENVIRONMENTAL QUALITY

Given the focus of the survey, a large number of attitudinal questions were posed specifically with respect to Hora-Arsedi lake water quality, where respondent were asked to express their opinion. These were mainly aimed at understanding how Beshoftu residents view their lake and uncovering the most important consequences of lake water pollution.

The opening attitudinal question asked respondents about the relative importance of a particular environmental problem of the town that would like immediately addressed. Out of a list that included a range of six different environmental problems, 82% of respondent gave the response while the rest 18% failed to understand about environmental problem at all. Of these 82% of respondents who were aware about environmental problems, poor waste management is reported as the most important environmental problem by about 34.1% of respondents considered. Lake water pollution is reported as the third environmental problem by about 19.8% of respondents in Table 4.2.

Table 4.2: Major environmental problems identified by the respondents

1	Waste management	34.1%
2	Deforestation	22.0%
3	Lake water pollution	19.8%
4	Air pollution	10.7%
5	Species extinction	7.6%
6	Drinking water quality	5.8 %

Source: Computed from the survey data

About 51.1% of respondents aware about environmental quality (in terms of deforestation, trash and other waste materials) problem around the lake area while 34.6% of respondents thought that there is no environmental quality problem in this area. The rest 16.5% did not concern about environmental quality problem of the lake area. Approximately 76.7% of sample respondents were visited and had used Lake Hora-Arsedi. While 23.3% of respondents were never visit the

lake. Respondents who had used the lake were asked what sort of activities they engaged in while visiting the lake and the results are presented in Table 4.3. The most popular activities are recreational, activity (irreacha festival) and subsistence related (washing clothes and bathing) mentioned by 56.8%, 14.2% and 5.7% of respondents, respectively. Recreational users of the lake were asked further question in which recreational activities they were engaged. The major recreational activities were off-stream uses like 'relaxing and enjoying the scenery' and 'watching birds' mentioned by 50.4% and 25.5% of respondents respectively. Although, very few respondents considered species extinction to be an important issue in the opening attitudinal questions, 'watching birds' mentioned as the second major recreational activity. On the other hand, in stream activities like swimming, fishing, boating were also mentioned by 16.2%, 4.8% and 2.2% respondents, respectively.

Table 4.3: Activities of the Lake

Lake Activity	percentage
Cultural	14.2
Recreational	56.8
Relaxing and enjoying scenery	50.4
Swimming for pleasure	16.2
Fishing for pleasure	4.8
Boating	2.2
Bird watching	25.5
Never use	23.3
Washing or cleaning yourself or your clothes	5.7

Source: Computed from the survey data

* *Note: people may do more than one activity*

Many of these activities are done simultaneously. Therefore, the fact that many people mention 'relaxing and enjoying the scenery' as an activity does not necessarily meant that 'relaxing 'is the main reason why they visit the lake. However, when inquired about the one most important reason for taking a trip to the lake, the same pattern of result emerges 'relaxing and enjoying the scenery' is the most important activity for 35.3% of the people, followed by 'bird watching' for 18.4 %. This also indicates off-stream activities seem to be predominant in Lake Hora–Arsedi. This might be because people thought the water quality of the lake is unsafe for in stream activities like swimming.

Perceptions about the current lake water quality and source of pollution may affect people, evaluation and willingness to pay for Lake clean-up program. Thus, Respondents were asked about their perception of the lake water quality. It is found that 62.1% of sample respondents consider that the lake is polluted and unsafe for humans either to swim in or to drink; and then ranking it as 'moderate'. However, a significant minority thinks differently. That is, 19.3% of respondents consider the lake generally clean and safe for humans to swim in and ranking it as 'good'. Presumably, these are people who actually swim in the lake Hora-Arsedi. About (7.4%) clean and safe for human to drink and ranking it as 'very good'. The rest 11.2% of respondents failed to provide any level of ranking. This indicates that there was a general awareness of pollution in the lake Hora-Arsedi. These results closely match with the finding of a steering and technical committee from Adda-liban wareda, indicating the accurateness of people's perceptions. Many people perceived the lake as being already polluted and may be willing to improve

water quality level. These results could have implications for respondents' willingness to pay for water quality improvement of the lake. The perception of the respondents on existing water quality of the lake summarized in Table 4.4.

Table 4.4: Perception of the respondents on existing water quality

Water quality	Number of respondents (% of total)
moderate	62.1
good	19.3
Very good	7.4
Do not know	11.2

Source: Computed from the survey data

Regarding environmental problems around the lake area, majority (63%) of respondents stated that currently there are few plants and trees surroundings in the lake area because of deforestation. They suggested that afforestation near the lake area is required to improve scenic nature of the lake as well as to safeguard the lake from surface runoff.

As indicated in Table 4.5, the survey result show that 65.6% of sample respondents shared the opinion that the main source of lake pollution is agricultural (like run off like animal wastes from the pastures and field around the lake and run off fertilizers and pesticides from agricultural land around the lake). Small-scale industry (like leather tannery) which is found near to the lake is

considered to be as the second pollution sources by 20.7% of sample respondents. Nearly all respondents (94%) were unaware about the effluent of untreated domestic sewerage from the town into the lake: hence, they cannot consider it as sources of the lake Pollution. This might be because untreated sewerage discharges are not visible.

Table 4.5: Perceived sources of pollution

Pollution sources	Number of respondent (%)
Wastewater from small-scale industry (leather tannery)	20.7
Agricultural source(runoff organic materials from cultivated land and animal waste from pasture field)	65.6
Sewage from villages and towns (Institutions, Hospitals, training center that near to the lake and town residents)	0.4
Dumping of trash from villages and towns	-
Do not know	13.3

Source: Computed from the survey data

About 87.2% of sample respondents were concerned about birds, fish and other aquatic life to survive in this lake. Majority of the respondents (76.1 %) suggested if current situation continue the lake will be severely polluted; and this will result elimination of aquatic life as well as health risks (waterborne disease) in the near future. As the survey result indicates, the attitudes towards the proposed program to improve lake water quality were highly favorable with 67.4% of respondents; and suggested that the project is important and would receive

strong public support. The rest 32.6 % of respondents suspect the implementation of the proposed program.

4.1.3 HOUSEHOLD'S WTP WATER QUALITY IMPROVEMENT

From 250 households interviewed, data for 227 households (90.8%) are analyzed and of these 39(17.2%) are non-protest zero responses (true zeros). The remaining data of the 23 (9.2%) are rejected because of incomplete responses 5 (2.2%) and invalid 18(7.2%) responses. Out of these 18 invalid responses, 11(4.4%) households believe that the lake clean-up program is not their responsibility. The rest 7(3.1%) of respondents protested the lake improvement program because they believe the existing lake water quality is excellent and do not need improvement.

As mentioned in the methodology part, to elicit people's preference to lake water quality improvement single-bounded dichotomous choices with open-ended formats were adopted. The mean WTP stated by the respondents was 5.02 birr per month (with 4.03301 standard error), as the minimum and the maximum of WTP amounts were 0 and 20 birr per month respectively. Estimated mean gross household income was 441 birr per month. As shown in Table 4.7 majority of respondents, 148 (65.2%) gave the WTP amount of 5 birr and less per month where as 79(34.7%) respondents gave values between 6 and 20, inclusive.

Table 4.6: Maximum WTP values stated by sample respondents

Maximum WTP (Birr)	No. of respondents	% of respondents
0-2	48	21.1
3-5	100	44.1
6-8	32	14.1
9-11	32	14.1
12-14	6	2.6
15-17	6	2.6
18-20	3	1.3

Source: Computed from the survey data

Respondents were asked the reason behind their willingness to pay for the hypothetical lake water quality improvement program. The survey result showed that approximately 12.9% of respondents mentioned their motivation to participate in the program to have clean environment when they visit the lake. About 63.9% of the surveyed population stated that their motivation was clean lake attract new business to the town and that can boost the local economy and indirectly benefit a number of people (indirect use motivation). That is, new business in a particular area can boost the local economy and benefit a number of people. It is found that 66.9% of the sample respondents wanted to improve the level of water quality in the lake for the benefit of future generations (bequest motive). About 30.5% of respondent supporting lake improvement for the sake of the ecosystem, that is, the lake provides the habitat for animals and plants (existence

value motivation). About 51.3% have option motive that is, they support the improvement even though they may not use the lake now.

It is interesting to assess to what extent the different motivations reflected in these attitudinal responses overlap at the level of individual respondent. Table 4.6 reports the correlation coefficients between each pair of attitudinal variables and reveals a number of interesting points. There are positive correlations between people motivated by non-use values (existence, bequest and option values). For example, the correlation between those motivated by bequest and option values is 0.39; indeed, 43.3%of the sample either consistently mentioned or not mentioned both of these variables. The correlations are positive between non-use and indirect use values. For example, the correlation between people motivated by bequest value and indirect use values is 0.37. There is a negative correlation between those motivated mainly by direct concerns and those primarily driven by non-use concerns. For example, the correlation between the 'BEQUEST' and 'DIRECT' variable is -0.18.

Generally, no single motivation stands out as the most important factor driving respondents' attitudes regardless of respondent type. There are positive correlations between a numbers of motivations indicating that many considerations play a role in individual attitudes. These results imply non-use values and indirect use values seem to play important role in respondents' willingness to pay for the Lake clean-up program.

Table 4.7: Correlation between different motivation concerns[4] for supporting the Lake clean-up

	DIRECT	INDIRECT	BEQUEST	EXISTANCE	OPTION
DIRECT	1.00000				
INDIRECT	-.18464	1.00000			
BEQUEST	-.1818	.36950	1.00000		
EXISTANCE	-.0485	.28323	.18713	1.00000	
OPTION	-.03852	.02425	.39078	.12388	1.00000

Source: Computed from the survey data

4.2 THE ECONOMETRIC ANALYSIS

In this section. we describe how the collected data from the contingent valuation surveys was analyzed and present some of this analysis. The econometric analysis of contingent valuation surveys seeks to build a model that explains why respondents answer WTP as they do. The model uses responses from the survey to judge exactly how different factors such as income or use of the lake influence households WTP for water quality in the lake. A Correlation analysis was done for examining any close association between independent variables, which might lead to multicollinearity. According to the rule of thumb, the correlation matrix result greater than or equal to 0.8 indicating that the presence of serious multicollinearity problem among independent

[4] These different motivation concerns are represented from the response for question number 27 on the survey questionnaire. 'DIRECT' for Q. 27a, 'INDIRECT' for Q. 27b, 'OPTION' for' Q.27c, 'BEQUEST' 27d, 'EXISTENCE' Q.27e

variables (Gujarati, 1995). A pair wise correlation coefficient analysis reflects low correlation matrix result, which is 0.6 (the highest correlation value) between income and education indicate that the model was perhaps free from multicollinearity problem. Hetroscedasicity-consistent Tobit and Probit models from Limdep program are used to minimize hetroscedasicity problem, which is expected from survey data.

4.3 REGRESSION RESULT AND DISCUSSION

4.3.1 PROBIT MODEL RESULT AND DISCUSSION

The Probit model result presented in Table 4.8.

Monthely Income of the Household (INCOME)

As expected, income of the respondent is a significant explanatory variable of the WTP for the water quality improvement in the lake. The survey result shows that this variable is positively significant at 1% level indicating that, other things being constant, when the respondent's income increase by one percent, respondent's willingness to pay for improvement of the lake will increases by 0.047 percent.

Bid amount (BID)

This variable is negatively related to the respondent's willingness to pay amount. The inverse relation implies that as the amount of bid increases the probability of a 'yes' response declines; which makes sense. However, the influence of bid amount is insignificant to influence the probability of 'yes' response.

Age of the Respondents (AGE)

Although this variable is insignificant to determine the probability of willingness to pay, it has a negative sign as expected, as the age of the respondent increases, the probability of saying yes would decline. The younger generations are expected to be more concerned about the environment and are more willing to pay for the provision of improved lake water quality than older ones.

Sex of the Respondent (SEX)

Although no a prior expectation was made abut the relationship between this variable and WTP, the survey results show that this variable has a positive sign and significant at 5% level. Thus, the probability of saying 'yes' will increase by 9.01 percent if the respondent is male. The male respondents are more willing to pay for the lake improvement than female respondents. This might be because male respondents are more interested to participate in recreational activities relative to female.

Family Size of the Respondent (FMSZ)

Unexpectedly, the impact of family size on the willingness to pay response is negative. This might be because of the proportion of household income that spends on the consumption of other goods would be more than environmental improvement program as a family size is large. The variable is significant at 10% level, indicating that, when the number of family members in the household increase by one percent, other things being constant, the respondent's willingness to pay for the proposed program of the lake will decrease by 1.4 percent.

Martial status of the Respondent (MARITAL)

A priori expectation about the direction of martial effect is not made. However, the survey results show that this variable has a negative sign and insignificant to influence the yes response. That is, it has negatively related to the probability of getting positive willingness to pay. This might be because married people are likely to have large family and would have more other things to worry about than environmental issues.

Educational level of the Respondent

Educational level of the respondent affects the probability of willingness to pay for the cleaning-up program. That is more educated people are more willing to pay for the improvement effort. To avoid a dummy variable trap the illiterate group is taken as a control group, from the three categories of educational level. Both two educational dummies have positively related to the probability of willingness to pay but insignificant.

House Ownership (HOUSE)

This variable is positively related to 'yes' response even though it is statistically insignificant in influencing the willingness to pay. That is, if the respondent is the owner of the house he/she has a better attitude for water quality improvement of the lake relative to renters. This might be because of the owners of the house would expect future benefit from rising of house prices in a good environment.

Distance from the Lake (DISTANCE)

As expected, increase in distance of the proposed lake improvement site from the household homestead has a negative impact and significant at 10%. That is, as the distance of household

homestead increases by one unit, the respondent's willingness to pay for the proposed improvement of the lake will decrease by 2.3 units.

Environmental Awareness (ENVPB)

This variable has positive coefficient, which implies that it is directly related to the willingness to pay of the respondent and it is significant at 10% level. That is, as the respondents more aware about environmental problems of the town they were more willing to participate in the lake water quality improvement. This might be because majority of the respondents who were aware about environmental problems are more concerned about environmental problems around the lake area. This is consistent with the fact that lake water pollution is stated as a third environmental problem next to poor waste management and deforestation.

Lake Use of the Respondent (USE)

This variable has positive coefficient as expected. This implies that users of the lake have positive attitude for the lake improvement program. However, it is not significant to determine the probability of saying 'yes' answer for a given bid amount.

Ranking of Lake Water Quality (RLWQ)

The probability of getting positive willingness to pay is expected to decline as the perception of the respondent about the existing water quality moves towards better quality level. To avoid a dummy variable trap the moderate quality is taken as a control group from three categories of quality level. Both quality dummies show negative effect on the probability of 'yes' response. The GOODQW dummy is significant at 10% level.

Concern for Aquatic Life (CONCERN)

This variable, as expected, has a positive coefficient but insignificant to influence the probability of 'yes' response. The positive sign indicates that those respondents who were concerned about the ability of fish and other aquatic life to survive in the lake are more willing to get involved in the lake clean-up project.

Substitute Lake (SUBLA)

The possibility of existing substitute lake has insignificant impact on the probability of 'yes' response. Here, the negative coefficient implies that it is inversely related to the willingness to pay of the respondent. As expected, the existence of other lakes for recreation will change the attitude of the respondent for the lake improvement. However, the survey result indicates that it has insignificant impact on the probability of willingness to pay of the respondent for water quality improvement of the lake. The reason for this might be either low mobility of visitors or the respondents give more value to the lake Hora-Arsedi relative to other lakes.

Generally, variables including, house ownership, lake use, concern have positive coefficient as expected but they are insignificant to determine the willingness to pay amount for water quality improvements. The same is true for the variables age, martial status, substitute lake and bid have negative signs as expected but are insignificant to influence an individual's WTP for water quality improvements in the lake. This implies these variables are not such an important explanatory variables in WTP of Beshoftu residents though they have the expected sign.

Although, the objective of the Probit model in this study is to determine factors that are affecting the probability of willingness to pay of respondent for the proposed program, the mean

willingness to pay is also estimated to make comparison between the closed ended and open-ended format. Hence:

$$\text{Mean WTP} = -\frac{\text{Intercept}}{\text{Bidcoeff}} = -[0.76764746/(-0.06722415)] = 11.42$$

The mean willingness to pay obtained from closed ended format is 11.42 birr.

Generally, the significance of the model was tested using the log likelihood results in Table4.7. The log likelihood ratio calculated as -2(restricted log –L – unrestricted Log-L) equals 54.3. The critical value of the chi-square distribution for 16 degrees of freedom is found to be 26.29 for Probit model. Therefore, the null hypothesis is that the parameters of all explanatory variables including the constant are equal to zero that is irrelevant in the determination of the variation in the dependent variable can be rejected at 5% level of significance.

Table 4.8 Maximum likelihood estimates for Probit model

Variable	Coefficient	Marginal effect	Standard error	z	P-value
Constant	0.76764746	0.07241074	0.10831752	.669	0.5038
INCOME	0.00496975	0.00846879***	0.00316580	2.675	0.0087
BID	-0.06722415	-0.00634113	0.00612511	-1.035	0.3005
AGE	-0.00284603	-0.00026846	0.00108756	-.247	0.8050
SEX	0.95543508	0.09012439**	0.04224155	2.134	0.0329
FMSZ	-0.14637055	-0.01380686*	0.00756005	-1.826	0.0678
MARSTAT	-0.20061959	-0.01892407	0.02571304	-.736	0.4617
PRIMERY	0.01915029	0.00180641	0.02582969	.070	0.9442
SECONDRY	0.04727000	0.00445889	0.02797743	1.359	0.8734
HOUSE	0.02961493	0.00279352	0.02471257	.113	0.9100
DISTANCE	-0.4578505	-0.02467185*	0.01492550	-1.653	0.0975
ENVPB	0.14537809	-0.01293566*	0.00735432	1.758	0.0794
USELAKE	0.39658896	0.03740949	0.03043212	1.229	0.2190
VGOODQW	-0.09581209	-0.00903777	0.03873605	-.233	0.8155
GOODQW	-0.68709460	-0.06481234*	0.03865896	-1.676	0.0936
CONCERN	0.00110265	0.00010401	0.00008942	1.163	0.2448
SUBLA	-0.00342867	-0.00032342	0.00081058	-.399	0.6899
Unrestricted Log-Likelihood = -59.63770					
Restricted Log-Likelihood = -113.2550					
Number of Observations = 227					

*Source: computed from survey data, 2006 *** Significant at 1%*

*** Significant at 5%*

** Significant at 10%*

4.3.2 TOBIT MODEL: RESULT AND DISCUSSION

In this study, the main objective of Tobit model is used to determine factors that are affecting the amount of willingness to pay of respondent for the proposed lake clean-up program. The mean willingness to pay value is 5.02 birr per month (with 4.03301 standard error), as the minimum and the maximum of WTP amounts were 0 and 20 birr per month respectively.

Monthly Income of the Household (INCOME)

As expected, income of the respondent has a positive influence on the willingness to pay amount and highly significant at 1% level. Therefore, income is the major determinant and has high explanatory power in determining the willingness to pay for the lake clean-up program.

Sex of the Respondent (SEX)

The impact of Sex of the respondent, as expected, has a positive sign and statistically significant at 10% indicating that recreational activity is the major concern of male respondents relative to female respondents. Therefore, the willingness to pay amount increases for male respondents than female respondents in both existence and nonexistence of substitution possibility.

Distance from the Lake (DISTANCE)

This variable refers to the distance between the lake and household homestead. This variable, as expected has a negative relationship with the willingness to pay amount. That is, as the distance of the proposed cleaning up lake from the household homestead increases the willingness to pay amount for the project will decline. This variable is significant at 5%.

Environmental Awareness (ENVPB)

This variable it is directly related to the willingness to pay of the respondent and significant at 10% level. That is, those respondents who are more aware about environmental problems around the lake area are willing to participate in the lake clean-up program. This might be because those respondents are more concerned about environmental problem surrounding the lake area .

Ranking of Lake Water Quality (RLWQ)

This variable refers to the perception of the respondent about the existing water quality level. As the perception of lake water quality increases, the willingness to pay amount will decline and vice versa. That is the GOODQW dummy is negatively related to the willingness to pay amount for the proposed improvement and significant at 10%. Those respondents who ranked the existing level of water quality is good have less willingness to pay.

Table 4.9 Maximum Likelihood estimates for the Tobit model

Variable	Coefficient	Marginal effect	Standard error	z	p-value
CONSTANT	2.14570026	1.87005213	1.54051310	1.214	0.2248
INCOME	0.01054768	0.00919266***	0.00283973	3.237	0.0012
BID	-0.00479025	-0.00417487	0.08351019	-.050	0.9601
AGE	-0.01241115	-0.01081675	0.01528447	-.708	0.4791
SEX	0.88738571	0.77338739*	0.44817339	1.726	0.0844
FMSZ	-0.05376597	-0.04685891	0.07427999	-.631	0.5281
MARSTAT	-0.26188054	-0.22823796	0.38935975	-.586	0.5577
PRIMERY	0.58822136	0.51265530	0.39956938	1.283	0.1995
SECONDRY	0.25687858	0.22387858	0.41793809	.536	0.5922
HOUSE	0.49440546	0.43089149	0.37396123	1.152	0.2492
DISTANCE	-0.54349768	-0.47367706**	0.22436892	-2.111	0.0348
ENVPB	0.22361786	-0.79153848*	0.43844698	1.805	0.0660
USELAKE	0.77930687	-0.67919294	0.50343121	1.349	0.1773
VGOODQW	-0.95233739	0.82999504	0.62656148	-1.325	0.1853
GOODQW	-1.24942812	-1.08891990*	0.62678286	-1.737	0.0823
CONCERN	0.00820732	0.00715297**	0.00288110	2.483	0.0130
SUBLA	-0.00844041	-0.00735611	0.00695712	-1.057	0.1630

Source: computed from survey data, 2006 *** *Significant at 1%*

** *Significant at 5%*

* *Significant at 10%*

4.3.3 COMPARISON OF MEAN WTP VALUES UNDER CLOSED-ENDED AND OPEN-ENDED FORMAT

As it was discussed in the methodology part, after the dichotomous single bounded question, a follow up open-ended question was asked. About 18.5% of the respondents gave an amount less than the amount that they already agreed to pay in the dichotomous choice questions. The major reason for 95% of these respondents was that first they thought that the bids offered to them were an obligation imposed by the government (despite the explanation given about the aim of the survey) so that they decided to agree but when they felt that it was a voluntary contribution, they told their 'true' willingness to pay.

Therefore, the mean willingness to pay estimate for water quality improvement of the lake from closed ended (i.e. the single bounded) format, 11.42 birr, is greater than the mean WTP value estimated from the open-ended format, 5.02 birr.

4.4 ESTIMATING TOTAL WILLINGNESS TO PAY

The mean WTP figure can be aggregated for the total population. The population consists of 22,255 households in Beshoftu town in 2006. As mentioned previously, the number of households was obtained by dividing the projected population size of 126,856 with the mean family size of the town, 5.7 (CSA, Beshoftu Branch, 2006 and own survey, 2006) as the actual number of households for the year 2006 was not available. To make the aggregation, class boundaries for the maximum willingness to pay values are utilized. The aggregate benefits of the society are summarized in Table 4.10

Table 4.10: Aggregate WTP value from sample estimates for water quality improvement of the Lake (birr)

Class-boundary	Class-mark for WTP amount	Sample distribution		Total number of HHS	Total WTP
		No. of respondents	% of respondents		
0-2	1	48	21.1	4706	4706
3-5	4	100	44.1	9805	39220
6-8	7	32	14.1	3137	21959
9-11	10	32	14.1	3137	31370
12-14	13	6	2.6	588	7644
15-17	16	6	2.6	588	9408
18- 20	19	3	1.3	294	5586
Total		227		22255	119893

Source: computed from survey, 2006

In Table 4.10, the first column shows the interval for the willingness to pay amount. The second column shows the class marks (middle point of the payment) that is calculated from the given intervals in column one. The third Column shows the proportion of sample respondent and the fourth column is the percentage of these sample respondents. In column five, the total number of households in each interval that is calculated by multiplied total number of household in the town by sample proportion of households (column four) from the corresponding intervals. Lastly, the

sixth column shows the total willingness to pay, which is calculated by multiplying the class mark with the total number of households in column five.

Aggregate the mean WTP estimate from open-ended format for the total population; and total willingness to pay of the town residents for water quality improvement of the lake was found to be 119,893 birr per month and 1,438,716 birr per annum. The aggregate willingness to pay would become 254,152 birr per month and 3,049,825 birr per year if we use the single bounded WTP estimate for this program. This improvement program implemented based on community contribution. The cost of water quality improvement of the lake is unknown; hence, the study cannot suggest the clean-up program is cost recovery. If the cost of clean-up is equivalent to the amount of residents willingness to pay and it could be collectable then the program is cost recovery and could be implemented by the concerned body.

5. CONCLUSIONS AND RECOMMENDATIONS

Surface water quality generate both use and non-use benefits. Therefore, it affects the wellbeing of local communities by reducing environmental quality. Hence, local residents welfare enhance and benefit most if surface water quality was improve. The improvements, however, would cost many and the participation of local community and others in the improvement programs is required. The study attempted to elicit the willingness to pay of the town residents alone as the participation of others beyond the scope of this study.

The proposed improvement in this study is one-step up wards water quality improvement level of the lake. That is, the quality improvement is based on the perception of respondents about the existing quality of the lake and it is one-step improvement from how they ranked the quality. The program improves water quality by collecting wastewater from reachable lake area through sewer lines; and then treats using treatment plant. In addition, the program include afforestation to minimize surface runoff into the lake.

The Contingent Valuation Method was employed to elicit the willingness to pay of Beshoftu town residents. A single bounded dichotomous choice format with a follow up open-ended format was used and comparison of the results obtained from these elicitation formats is made. The mean willingness to pay value estimated from closed-ended format (11.42 birr) is higher than which estimated from open-ended format (5.02 birr). The main reason for this result is respondents considered that the bid offered to them was an obligation imposed by the government so that they decided to agree but when they felt it was a voluntary contribution, they told their 'true' WTP. The mean WTP estimates from open-ended and closed-ended format

aggregated for the total population; and total willingness to pay of the town residents was found to be 119,893 birr per month and 1,438,716 birr per annum and 254,152 birr per month and 3,049,825 birr per year, respectively.

In this study, it is found that the homestead distance of the respondent (being near the lake) affects the willingness to pay for water quality improvement of the lake. That is, respondents who live near the lake are more willingness to pay for the improvement program. In same way, the perception of the existing lake water quality has impact on the probability of willingness to pay. That is, as the respondent perceive the existing water quality level of the lake move up ward (good or very good), their willingness to pay for lake improvement will decline. On the other hand, as income of the respondent increases the probability of willingness to pay for improvement becomes higher. Moreover, sex of the respondent (male) is a determinant of the willingness to pay for water quality improvement in the lake. That is, male respondents are more willing to participate in the proposed lake clean-up relative to female.

The out come of the study indicates more than two-thirds of the respondents (75.2%) under the survey indicated their willingness to pay for the clean-up program. Therefore, if the money is collectable from residents of the town, the lake improvement program could undertake by the concerned party.

Policy implication

- Most of sample respondents are aware and willingness to participate in the lake clean-up program implies a need to enhance environmental consciousness of residents and awareness creation on the benefits associated with improved lake water quality through meetings and

seminars. Therefore, the City Administration or any concerned body could have active participation of the local community in the lake clean-up program.

- The survey indicates that Surface runoff from agricultural land, which surrounds the lake area, and pasture field was major source of lake pollution. Moreover, there are few numbers of plants and trees found in the lake area because of deforestation. Therefore, as respondents mentioned to reduce surface runoff as well as to improve scenic nature of the lake afforestation around the lake area should be emphasized.

- The survey implies the leather tannery, which released wastewater, is considered as the second source of lake pollution. Hence, in order to mitigate pollution impact of wastewater, the tannery should build its own on-site pollution control facilities and treat its wastewater before releasing into the lake. Otherwise, the concerned body should consider the case of the tannery and if possible, it should be moved away.

- The waste-dumping site, which is currently used by the City Administration, is found near to the lake and this may increases the probability of lake pollution. Hence, the dumping site should be moved away from the lake area to alleviate the risk of lake pollution, as well as freely accessed side of the lake need to be protected from illegal activities.

- The lake has a potential for tourist attraction and it would have played a significant role in tourism sector of the country. Therefore, concerned body should improve recreation

experience quality and increase types of the lake recreational services in order to attract both local and foreign visitors.

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ANNEX

CONTINGENT VALUATION SUERVEY- QUESTIONNAIRE

Interviewer name---------- Date of interview----------

Time of Interview: started---------- ended----------

Supervisor---------- interviewee Number ----------

How are you, I am ----------. We are conducting a study concerning the water quality of Lake Hor-Arsedi. Hence, your opinion and perception will help us to understand the attitude of Beshoftu residents towards lake water quality improvement program and their involvement. personal information of the respondent will be kept confidential and will not be associated with any responses in this survey. We only want to know your opinion so there is no right or wrong answers. Thank you very much for your cooperation.

SECTION A

Household attitude on environmental quality

1. In your opinion, which problem is the most urgent environmental problem in Beshoftu that you would like to be immediately addressed (or solved)?

   a. drinking water pollution.....

   b. Air pollution .....

   c. species extinction.....

   d. lake water pollution.....

   e. solid waste management.....

   f. destruction of forest.....

   g. Others (please specify).....

   h. Don't know.....

2. In the past few years, what happened to the environmental quality around your area ?

   a. Improved

   b. Stayed the same

   c. Gotten worse

   d. Don't know

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   g. Others (please specify).....

   h. Don't know.....

2. In the past few years, what happened to the environmental quality around your area ?

   a. Improved

   b. Stayed the same

   c. Gotten worse

   d. Don't know

3. Are you familiar with Hora Lake? *(If respondent's answer is No, go to question no.5)*

   a. yes b. No

4. Have you ever used Lake Hora for one of these lake activities?

   a. subsistence (drinking water and washing cloth etc)

   b.Recreation (swimming, Bird watching, walking and boating)

   c. irrecha festival (Ritual worship)

   d. Commercial Fishing

   e. others (please specify).....

5. If your answer to Q.3 is 'No' please explain your reason.....

6. In which of the following outdoor activities, if any, do you frequently participate at Lake Hora-Arsedi?

   a. recreational fishing in the lake

   b. Swimming

   d. bird watching

   e. relaxing and enjoying the scenery

   f. boating

   g. other (please specify).....

7. Which of the following is the most important reason for taking a trip to the lake?

   a. Swimming

   b. Bird watching

   c. Fishing

   d. Boating

   e. relaxing and enjoying the scenery

8. Have you ever used other lake in Ethiopia?

   a. Yes

   b. No *(go to Q.9)*

9. When compared to Lake Hora, which one is better in terms of water quality?

.....

10. How do you rate the quality of water in Lake Hora-Arsedi?

    a. very good (clean and safe for human drink)

    b. good (clean and safe to swim in)

    c. moderate (have garbage and sewage in it)

    d. poor (badly smell)

    e. Don't know.

11. Do you think that there are a large number and variety of trees and plants near Lake Hora-Arsedi?

    a. Yes b. No c. do not know

12. Do you think that there are environmental problems associated with Lake Hora-Arsedi?

    a. Yes b. No c. do not know

13. Which one of the following do you believe the major source of Lake Hora pollution?

    a. Agriculture sources: including runoff of crop fertilizers and pesticides, runoff of animal wastes from field and pastures

    b. Small-scale industry sources: including discharge from industrial process (like chemicals from Hora tannery)

    c. Sewage from villages and towns (Institutions, Hospitals, training center that near to the lake and town residents)

    d. Dumping of trash from villages and towns

    f. Others (please specify)

    g. Do not know

14. Do you know where your household's wastewater is being discharged to

    a. Drains into Lake Hora and Beshoftu

    b. Seeps into the ground near the house

    c.do not know

    d. Others (please specify).....

15. How concerned are you about the ability of wild life to survive in the Lake Hora ?

    a. concerned

    b. Not concerned at all

    c. do not know

16. For which of the following outdoor activities Lake Hora-Arsedi water quality is the most important to you?

    a. Swimming

    b. Bird watching

    c. Fishing

    d. Boating

    e. relaxing and enjoying the scenery

17. What problems do you think will arise in association with water pollution in Hora Lake?

    a. Health problem

    b. unable to swim

    c. Decline fish stock

    d. sever pollution

    e. emitting odor

    f. others (specify).....

    g. Do not know

18. What should be done to solve this lake water pollution problem?.....

    .....

19. Is it required to invest on the clean up project on Lake Hora-Arsedi?

    a. yes b. No

    explain your reason? .....

    .....

20. In your opinion, which is the best way to improve water quality of Lake Hora-Arsedi?

    a. Encourage Beshoftu residents to be aware of and participate in water quality improvement project

b. Improving the adminsretion of the lake (protect animals into the lake for drinking or washing)

c. Punishing polluters

d. Do not know

e. Others (please specify).....

SECTION B

QUESTIONS ON HOSEHOLD'S WILLINGNESS-TO-PAY FOR IMPROVED WATER QUALITY IN THE LAKE HORA

Hora-Arsedi Lake is one of crater lakes in Bishoftu town. The lake provide different services and some of these are serves as recreational center, a place for irreacha festival and home for different aquatic life. Currently, the Lake receives untreated sewage affluent from the town, small-scale industrial wastewater (from leather tannery) and surface runoff. Moreover, the waste dumping site which is used by City Adminministration is near to the lake; and this will increase the probability of the lake pollution. According to a steering and technical committee from Adda-liban wareda the lake water is non-potable and unsafe to swim. The ever-rising trend of these pollutants may prohibit the lake from providing its services.

Consider the municipality proposed a program to improve the quality of water in the lake one-step from how you perceive the existing quality of water in the lake. To clean-up the lake collect wastewater from reachable lake area through sewer lines then treat it using treatment plant. In addition, the program includes afforestation to minimize surface runoff into the lake. However, this program is costly to implement for the municipality. Hence, residents are requested to share the cost of the project. The proposed programs go ahead if the community agrees to share the cost and sufficient fund were generated. The payment for this program will be collected through community contribution per month for five consecutive years. The improvement program would be controlled and managed by the Municipality as well as the community itself.

21. Are you willing to participate in this improvement program?

a. Yes (*go to question 22*) b. No

22. Considering your budget constraint, when you contribute for the project you will face shortage in your budget, would you be willing to pay for the improvement?

a. Yes b. No

23. If you are asked to contribute birr 3 / 5 /10 per month for five consecutive years, would your household be willing to contribute the money ? The money will be collected by a committee established from the community.

a. Yes b. No

24. What would be the maximum amount your household would be willing to pay per month for five consecutive years?.....birr.

25. (If *yes in Q.23 and if the respondent maximum willingness to pay is greater than in Q.24, then ask*)

You said that you are willing to pay .....birr (in Q.23) but when I ask you your maximum willingness to pay you said .....birr (in Q.24) which is less than the amount you already agreed to pay previously why?.....

26. If you are not willing to pay for this program, which statement best reflects your reason?

a. The water quality is all right, not necessary to improve

b. No money to pay because of my low income

c. Not my responsibility

d. I don't think community charge is the best way to pay for it

e. Others (please specify): .....

27. If you are willing to pay for this program, for whom the improvement in water quality?

a. Yourself (a nice environment when you visit)

b. To enhance tourism

c. to visit the lake in the future

d. for the benefit of future generations (should not be deprived of clean water)

e. for the sake of ecosystem

f. Others (please specify):.....

28. After cleaning up Lake Hora-Arsedi, what other improvements, if any, would you like to see along the lake?

    a. Public access for fishing and recreation

    b. Regular trash clean-ups

    c. Fish stocking

    d. Different bird species

    e. None

    f. Other. please specify.....

29. Do you think after the cleaning up program you will visit the lake?

    a. Yes

    b. No

30. Other comment.....

SECTION C

HOUSEHOLD CHARACTERSTICS

To remind you this last set of questions is for background purpose only

The questions here are important and the information is strictly confidential.

31. Gender: a. male b. female

32. Marital status: a. Single b. married c. divorced/separated d. widowed

33. How old are you? ---------- (years)

34. Education:

    a. unable to read and writing

    b. able to read and write

    c. from 1 -6

    d. from 7 – 12

    e. above 12

35. Occupation:

a. government Employee

b. private sector employe c. Own business

e. Unemployed f. please specify others .....

36. How much is your gross income per month?.....

37. How much is monthly income of household from other members (in birr):.....

38. Ownership of the house

a. Owned house b. Rented from kebele c. rented from private d. other.....

39. For how many years have you lived in this town? ..... years.

40. Indicate the distance from your house to the lake Hora

a. About ..... k.meters

b.about .....meters

c. about .....hours

41. How many are you in your household? ..... (No. of people)

No. of adults..... 15 year old and above No. of children..... (below 15 years old)

42. Main expenditure of the household per month (in birr)

a. food :.....

b. Housing;.....

c. Health:.....

d. Energy consumption (fire wood, electricity, kerosene, etc):.....

e. Phone:.....

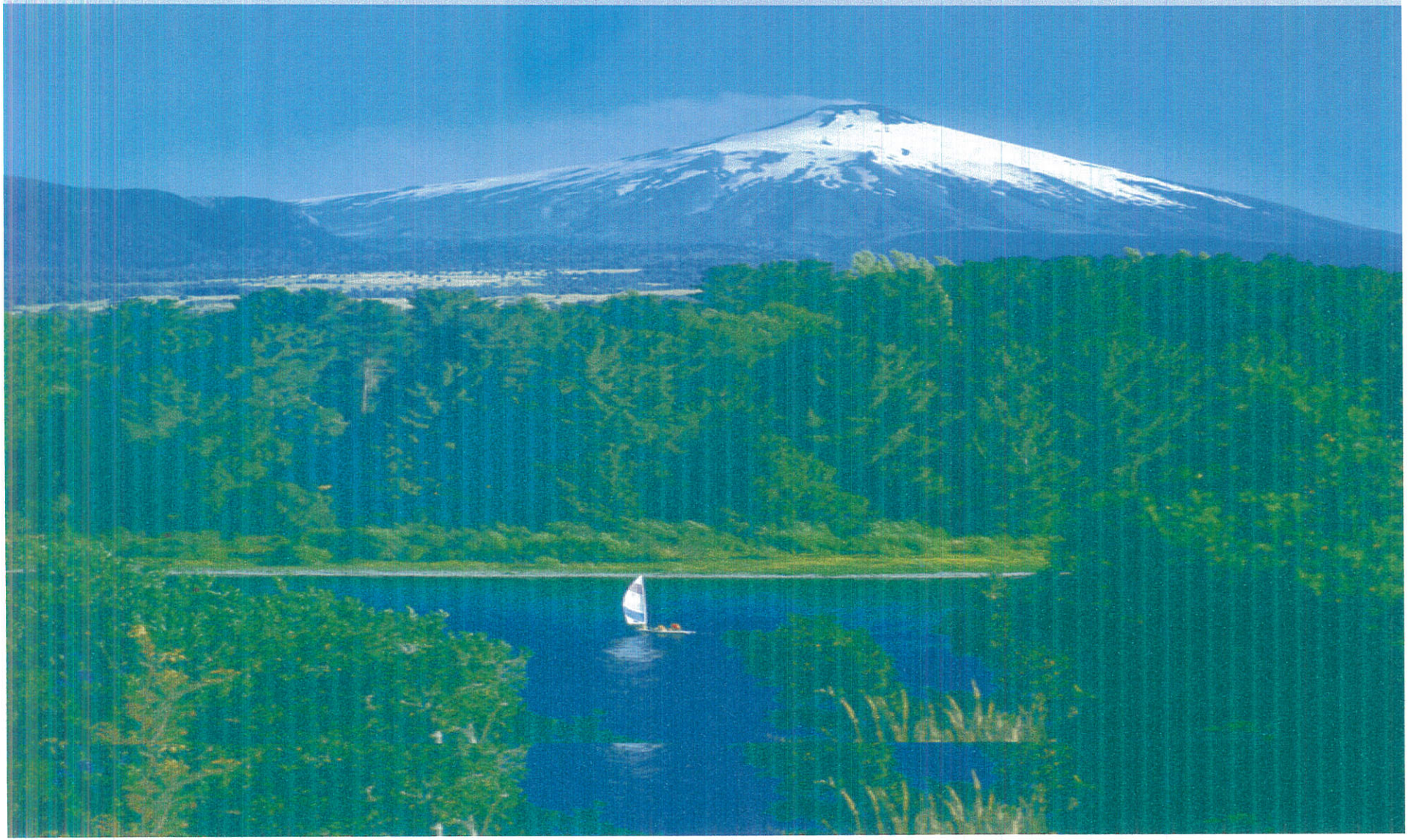
f. Education:.....

g. community contribution ('Eder')..... other expenses:.....

TANK YOU

Lake Hora-Arsedi

Lake Hora-Arsedi After Improvement



DECLARATION

I, the undersigned, declare that this thesis is my original work, has never presented for degree in any other university and that all source of material used for this thesis have been dully acknowledged.

Declared by:

Candidate

Signature.....

Date: March,28,2007

confirmed by:

Dr. Wassie Berhanu

Advisor

Signature.....

Date: March,28,2007

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