WOLKITE UNIVERSITY

COLLEGE OF BUSSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

Household's willingness to pay for improved water supply service in The case of Harbu chulule town.

A senior essay submitted to the department of economics in partial fulfillment of the requirement for the degree of Bachelor of Art In Economics

Prepared by Alemu Idae

ID No: 055/09

Advisor: Lemma Sh (MSC)

June, 2019

Wolkite, Ethiopia

Declaration

Alemu Idae declared that this work title" Household's willingness to pay for improved water supply service in The case of Harbu chulule town." I have produced it independently except for the guidance and suggestion of the research adviser.

Declared by:

Name . Alemu Idae

Signature_____ Date_____ Confirmed by adviser:

Name_____

Signature_____ Date_____
Approval board of examiners:

Adviser name _____Signature_____

Examiner name_____ Signature

Acknowledgement

First and for most I wish to express my sincere thanks to the almighty GOD. Who has given my health, strength, tolerance and patience to reach at this level.

Next, my special thanks go to my advisor instructor Lemma Sha(msc)for his great advice, assistance, guidance, and comment in the course of this senior essay preparation.

I am also grateful to Harbu chulule TownWater Supply Service Office employees for their integrity and cooperation for giving me relevant data.

Finally, the last but not the least my deepest and heart full thanks go to my families, my friends and department of economics for their moral, material and financial assistance.

Abstract

This paper tried to examine and analyze the households' willingness to pay for improved water supply services in Town areas of Ethiopia, Harbu chulule Town as a case study. This study therefore, aims to estimate the amount that households would be willing to pay for improved water supply services and identify the potential factors affecting their Willingness to pay for improved water supply service in Harbu chulul Town Contingent valuation Method was used to examine the determinants of willingness to pay. A total 86 sample households were interviewed during the survey. The survey result showed that, if the water Town office provide improved water supply, more than 74.71% of households' were willing and able to pay for the service at a price more than a cost recovery tariff rate. ,, result showed that sex of the household, income of households, educational level of household, reliability of existing water supply service and bid price were significantly affecting WTP for improved water services in the Thus if the proposed water improvement scheme is implemented, in addition to satisfying the water needs of the households, the Town utility management can collect more revenue from the sale of improved water. The CV survey results also show that the mean WTP of households for the proposed improved water service is between 31.26 cents and 51.51 cents per jerry can depending on the method used. Therefore, policy makers need to take in to consideration these socio-economic and demographic factors and some other attributes of water in designing the improved water supply system of the Town.

Acronyms

CEM	Choice Experiment Method
CSA	Central Statistics Agency
CV	Contingent Valuation
CVM	Contingent Valuation Method
FAO	Food and Agriculture Organization (of the United Nations)
FDRE	Federal Democratic Republic of Ethiopia
HPM	Hedonic Pricing Method
LR	Likelihood Ratio
MWTP	Maximum Willingness to Pay
MoWRs	Ministry of Water Resources
NGO	nongovernment organization
OLS	Ordinary Least Squares
TCM	Travel Cost Method
TEV	Total Economic Value
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNICEF	United Nations Children's Fund
WHO	World Health Organization
WTA	Willingness to accept
WTP	Willingness to Pay

Table of content

Table of content

Page

Declaration i
Acknowledgement ii
Abstract iii
Acronyms iv
CHAPTER ONE 1
INTRODUCTION 1
1.1. Background of the study 1
1.2. Statement of the problem 2
1.3. Objective of the study 3
1.3.1. The General objective 3
1.3.2. The specific objective 3
1.3.3. Research question 3
1.4. Significance of the study 3
1.5. Scope of the study 4
1.6. Limitation of the study 4
1.7. Organization of the paper 5
CHAPTER TWO 6
LITRETURE REVIEW 6
2. 1. Theoretical literature review 6
2.1.2. Value of environmental resource 7
2.2. Empirical Literature Review 13
CHAPTER THREE 17
RESEARCH METHODOLOGY 17
3.1. Description of the Study Area 17
3.1.1. Location of the Study Area 17
3.1.2. Water Supply Situation of the Harbu chulule Town 17

3.1.3. Water tariff Structure of the Harbu chulule Town 18
3.2 Data type and source 18
3.3. Method of data collection 19
3.4. Sampling design and sample size 19
3.5. Method of Data Analysis 20
3.5.1. Model Specification 20
3.5.2. The Probit Model 20
3.5.3. Description of Explanatory Variables and Hypothesis 22
CHAPTER FOUR 23
RESULTS AND DISCUSION 23
4.1. Descriptive Analysis 23
4.1.1. Socioeconomic and Characteristics of Households 23
4.2. Existing water supply condition of the sampled households 25
4.2.1. Current source of water supply 26
Table 4.2: Current Sources of water supply for the Harbu chulule town. 26
4.2.3. Reliability of current water supply source 26
4.2.4. Level of satisfaction with the existing source. 27
4.3. Demand and Willingness to pay for improved water supply 27
4.3.1. Demand for improved water supply 28
4.2. Empirical Analysis 28
4.2.1. Determinants of household's willingness to pay responses 28
4.2.2. Results and discussions of the Probit Model 29
Goodness 30
The pseudo R-squared: 30
LRch2 (6): 31
Education of Respondent 31
Sex of respondent: 31
Age of respondents: 31
Family size: 31
Household income 31
Marital status 32
TEST FOR MULTICOLLINIARITY 32

TESTS OF HETROSKEDASTICITY 32
LRch2 (6) 32
CONCLUSIONS AND RECOMNDATION 33
5.1. Conclusions 33
5.2. Recommendation 34
BIBLIOGRAPHY/ REFERENCES 36
APPENDEX I: QUESTIONAIRE 38
CONTINGENT VALUATION SURVEY - HOUSEHOLD QUESTIONNAIRE 38

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Water is a source of life and natural resource that sustains life and our environments. It is one of the precious gifts to mane kind and most basic human needs. Water plays a great role in socio economic development of human beings and also for survivals and economic developments. Domestic water supply is one of the fundamental requirements for human life. Without water, life cannot be sustained beyond a few days and the lack of access to adequate water supplies leads to the spread of diseases. Women and children bear the greater health burden and drudgery in collection of water and lots of opportunities because of the time that water fetching consumes. Hence the provision of safe and adequate potable water in urban areas in both developed and developing countries is essentials for life.

Access to water services is the major component in the UNDP human poverty index for developing countries the problem is more heart in developing countries than others. Ethiopia has many constraints to make potable water easily accessible and it is only 38% of total population has access to reliable, safe and clean potable water supply in the urban areas of Ethiopia the service is better when compared with rural areas however there is the problem with the quantity, and quality, sustainability as coverage associated with rapid population growth and rapid urbanization in some cities like Mekelle city.

The main reason for the town water supply problem is absence of adequate finance. Most of water supply projects are by their nature requiring huge capitals.

In addition, most people's see water as public good that is supplied freely. It has an impact on the sustainability of the project. In most towns the revenues obtains from consumers not cover the cost of providing the service. Then it should be implemented cost recovery tariff rate. It is tariff rate at which the revenue gained from the service is fully covered all expense incurred on water supply. Whether the citizens are able and willing to pay for the service provided is important. This helps to understand the value of the consumer places on the improved water service and for identifying those groups who are not willing to pay and to establish a cost recovery tariff. (Fekadu,June 2011)

1.2. Statement of the problem

Water is crucial for human survival and economic development. The provision of adequate supply of potable water in urban areas of both developed and developing counters is essentials for life. For instance in developing countries the privation of safe and adequate potable water improver health by reducing incidence of water related illness such as diaries, cholera etc. This also helps to decrease mortality and morbidity rate and increase GDP by reducing time lost in sick and by making available more healthy time for individual to participate in labor market. Reducing demand for imported medicine and consumption of heath care goods, which intern reduce the continuous increase in health care goods which intern reduce the continuous increase in health care expenditure and there by easing balance of payment problem facing least developed countries like that of Ethiopia. Grossman (Health Economics)

The demand for such resource in town areas of developing countries has been increasing over time under such circumstance pining for efficient and equitable water delivery system in both short and long runs crucial to ensure adequate water supply.

However the problem here is the wide spread failure of water supply in the urban areas of Ethiopia which attributed to the cost inquired on water projects is too high. In most urban areas the revenue gained from water supply is unable to cover the cost incurred on Harbu Chulul town is one of the earliest town Ethiopia that the revenue gained from water is unable to cover the expense incurred on water service activities. This problem is further Aggravated by rapid population growth of town.

In order to satisfy the rapid growing population water demand as well as the required quantity for existing population new water project must be designed as well as the sustainability of existing water project must be maintained. The capital needed to supply water to the city is too high. This

makes the investment on water difficult. The finance require to fill this financial problem can be filled by NGO s government and the society itself but the most sustainable way is cost recovery by the consumer itself to do this water tariff of the town should be at cost of recovery rate. In order to implement cost recovery tariff in urban area research whether the households are able and willingness to pay is very important this helps to understand the fundamental value the consumer place on the improved water service. So that the price that reflect the ability and willing to pay of the household for improved water service, as strategy for cost recovery, can be established. This study therefore, aims to estimate the amount that household would be willing to pay for improved water supply services and identify the potential factors affecting their willingness to pay in Harbu Chulule town.

1.3. Objective of the study

1.3.1. The General objective

The main objective of this study is to estimate the Households willingness to pay for improver water service in Harbu chulule town.

1.3.2. The specific objective

The specific objective of the study includes:

- ✓ To examine the demand for improved water supply
- ✓ To estimate and identify the willingness to pay for water supply
- ✓ To identify and examine the determinant of willingness to pay for improved water supply

1.3.3. Research question

- ➢ How to examine the demand for improved water supply?
- ➢ How to estimate and identify the willingness to pay for improved water supply?
- ➢ What are the determinants of willingness to pay for improved water supply?

1.4. Significance of the study

The policy of providing free water to the society except in emergency is unfair situation. Since there is no enough service, provide free water. The rural and urban poor are the first to suffer. A better and much more equitable would be to collects water price from consumers and then improve and expand the water supply system. That is cost recovery is the main requirement for sustainable

development in water supply. However the price of water should be depend on the consumers' capacity and willingness to pay for such service.

Therefore this study designed to find out whether it is possible to cover the expenses incurred in supplying improved water service in urban areas. This implies the study provides required information on the ability and willingness of the people not only to pay for the service but also to sustain their supplies that include paying for maintenance and investment costs.

It will help as a reference material for others who are going to conduct their study on the willingness to pay for improved water service in urban areas. While there have been few studies on the subject in Ethiopian. As Griffin entail (1993) indicated any attempt comminutes and in other setting can lead to serious miss leading and erroneous conclusion even when natural condition between community and serious to be offered are quite similar. In relation to this there is a need to prove the relevance of contingent valuation method in Harbu Chulule town.

1.5. Scope of the study

The scope of the study is restricted to Harbu Chulule town particularly kebele 02 and kebele 05 due to limited time and financial constraints. Harbu Chulule town particularly kebele 02 and kebele 05 was selected because this areas has serious shortage of water. The study is restricted to analyze the determinant of willingness to pay and analyze the ability to pay of households only for domestic purpose in the town. The study is also limited to demand side information to water supply problem and on supply side it was including the cost of providing improved water supply only.

1.6. Limitation of the study

The study was limited by the following constraints

- Lack of experience in the field of the study
- Lack of enough reference material
- Language problem
- Financial problem

1.7. Organization of the paper

This paper has classified in to five chapters. The first chapter contains the introduction part, background, and statement of the problem, objectives, significance, scope and limitation of the study. The second chapter is Literature part and includes the theoretical and empirical literature. Third chapter is the methodology part and it contains the type of data collected and the method of data analysis technique used in the analysis. The forth chapter is the discussion part. In this part, the collected data was analyzed through appropriate data analysis techniques and the last chapter contains conclusion and recommendations.

CHAPTER TWO

LITRETURE REVIEW

2. 1. Theoretical literature review

2.1.1. Concepts of Willingness to pay

The issue that is most important for water project designers and planners is how to ensure the financial sustainability of a project. This can involve predicting and estimating what users will be willing and able to pay for proposed water schemes in the future. That is because most water projects in developing countries are financially unsustainable leading to water supply shortages in many places.

WTP is the maximum amount individual states they are willing to pay for particular goods or services based its characteristics (e.g. water supply: the difficulty of obtaining it, available sources, water quality and service level) (Douangchanhlopaying, 2004). It is the amount a person would be "willing to pay" to obtain a good or service. It is what the person is willing to sacrifice to get the good. It is the amount of money a person can give up, receive the good, and have their utility remain the same.

People are willing to pay very high prices for basic minimum water requirements to ensure the survival of household. Consumers are often willing to pay a higher price for water than the tariffs charged. How much higher depends on how much water is being used. WTP diminishes rapidly with non-essential levels of water use, therefore the relationship between WTP and water use can be shown by a downward sloping demand curve (sansoon, 2003). Another definition is one by Cardone and fonseca states that “Willingness to pay (WTP) is an expression of the demand for a service, and it is strong prerequisite for sustainable cost recovery because it is the materialization of the users’ satisfaction and of their desire to contribute its functioning” (Woldemeskel, March 2006). At this time most of water projects revenue is unable to cover the cost incurred on it. So this willingness to pay survey is an important tool whether to state consumers’ preference to pay at cost recovery rate.

2.1.2. Value of environmental resource

The term value has many meanings, which may be used in different sense. The theory of value in economics attempts to explain the worth of goods and services. Classical economists believed labor as true measure of value. For them value equals the amount of labor embodied in the commodity (Srivastava, 1996, p. 140).

The neoclassical economists did not agree with classical concepts of value. They defined value as marginal concept. Jevons, one of the founders of neo classical economics school defined value as marginal utility. Since then the theory of value developed along this line.

The neo classical economists used marginal utility gained by individuals from the last unit consumed to explain the market prices of the given commodity. The neoclassical economists mainly focused on explaining the behavior of prices and the allocation of goods and services in the market. They also replaced the classical notions of absolute scarcity with relative values as determined by the forces of supply and demand (Permian, et al 2003, p. 6).

Ideally all values would be expressed in monetary terms. Tradable goods since they have only use values their value can easily expressed in monetary terms. Environmental resource provides a complex set of values, such as life support service, amenity services, material resources for the production of goods and services, and used as sink of wastes generated by households and firms.

The value of environmental resource such as improved water resource consists both use and non-use values. Use values, which can be broken down into direct and indirect use values arise from the actual use of environmental resources. The non-use value (or passive use value) arises from independent use of resources. The non-use value (or passive use value) comprises three separable components- option values, bequest value, and existence value. Thus total economic value (TEV) of environmental resource can be cited as the sum of use and non-use values (Hessen, 2000, pp.300-301).

2.1.3. Non-market valuation techniques

In a market economy goods and services are allocated by the price mechanisms. Market price reflects people's willingness to pay for marketable goods and services. However, this approach is difficult for environmental resources, for market failures often occur in providing environmental

resource due to externalities. Many environmental resources are not traded in markets. The market rarely exists for environmental goods and services (Pearce, et al 2002, P.6). We therefore, require non-market valuation methods to value improvements and /or reduction in environmental goods and services including water resource.

"Although water is increasingly allocated by market mechanism its unit attributes makes it a classic example of the markets potential failure to achieve an economically efficient allocation. Externalities, public goods, decrease costs in supply, and high transaction costs among reasons why markets will not always best serve society in allocating water resources. Thus we use the non-market valuation techniques to provide measures of value and scarcity for economic policy making related to water" (Young, 2005, p.22). Economists have developed the broad categories of non-market valuation techniques for valuing the value of public environmental resources. These valuation techniques are called revealed preference and stated preference methods. Cross cutting methods, which combines market based and non-market valuation techniques such as benefit transfer and unit day methods also use for valuing public environmental goods, such as Water resources. The most widely recognized revealed preference and the stated preference valuation techniques are discussed below.

2.1.3.1. Revealed preference methods

The revealed preference methods infer the value of environmental goods by studying their actual or revealed behavior in closely related markets through the application of some model of relationships between marketable goods and environmental services. The great advantage of the revealed preference methods is that it dependence on the actual behavior (Bockstael et al 2005, P.538). However, the application of the revealed preference methods requires weak complementarities between environmental goods and private goods. The revealed preference methods have also some drawbacks. It is used to value only use values. The method is not appropriate for valuing non-use values of environmental goods. The other problems in applying these methods are that it is often difficult to find suitable and reliable links between market goods and environmental amenities. The sensitivity of the estimated results with respect to the assumptions of the models is also another drawback of the revealed preference methods. The revealed preference methods that are in use in relation with water resource valuation are hedonic pricing method, the travel cost method and defensive (averting) behavior (Young, 2005)

2.1.3.1.1. Hedonic pricing methods

The hedonic pricing method is one of the revealed preference non-market valuation techniques. It is derived from the characteristics theory of value and seeks to explain the value of commodities as a bundle of valuable characteristics. The method indirectly measure people's willingness to pay for change in water attribute when housing prices can be affected by the availability of improved water supply. The hedonic pricing method for it is based on actual market prices its application is straight forward and uncontroversial (Young, 2005, p.256). The main shortcoming of the method is that it requires real property markets and does not capture non-use values of environmental resource (Bockstael, et al PP.558-563).

2.1.3.1.2. Travel cost method

Travel cost method is originated with a letter sent to the U.S.A national park by Harold Hostelling. It is the oldest environmental valuation technique and is used to assess the value people place on recreational activities such as parks, lakes and other areas which host a good deal of recreational activities. The travel cost method estimates the demand function of recreational site and the site's consumer surplus. The site's consumer surplus found by this way, however, is only use value. It does not include non-use values. The method failed to estimate non-use values. The other drawback of the method is that its application is limited only for valuation of recreational sites (Seller, Christine, et al 1985)

2.1.3.1.3. Defensive (Averting) behavior

This method is the less frequently used valuation techniques. The method is used to infer value from household expenditure to avert environmental problems, such as water pollution. The method is used to measure peoples' willingness to pay for welfare gain from the improved environmental resource such as from clean water. The general premise of the method is that a rational person will adopt defensive or averting behavior as long as the value of the damage avoided is greater than aversive expenditure. The method is used for valuation of water quality improvements to protect against polluted drinking water (Young, 2005, p.133; Hussen, 2000, p.298).

2.1.3.2. Stated preference methods

The stated preference methods are the direct valuation methods used to solicit value measures by asking individuals hypothetical questions. In the stated preference techniques individuals are

directly asked to state their willingness to pay (WTP) and/ or willingness to accept (WTA) compensation for change in public environmental resources from hypothetical market scenario (Frey et al. 2004, p.1).

The stated preference methods used for valuing both use and non-use values of environmental resources. The original and the most commonly used stated preference method is the contingent valuation method (CVM). Other forms of stated preference methods include conjoint analysis, choice experiment, contingent ranking, and contingent rating (Bockstael et al 2005, pp.539-540). We discuss only the contingent valuation method for it is the most widely used stated preference methods.

2.1.3.2.1. Contingent valuation method (CVM)

The contingent valuation method is the earliest technique of the stated preference method of non-market valuation approaches. The CVM involves asking people directly what they would be willing to pay or willing to accept compensation for change in preferences. This method is called contingent valuation for it is contingent on the hypothetical market. The contingent valuation method is preferred to the revealed preference methods for it deals with both use and non-use values and survey responses to willingness to pay or willingness to accept hypothetical questions go directly to the monetary measures of utility change (Perman et al, 2003, P.420). S.V Ciriacy-Wanstap first proposed the contingent valuation survey method as a method of valuation for non-marketed environmental public good in 1947. However Robert K Davis, who did the first empirical research in 1961 in valuing outdoor recreations, Since then the method become one of the widely used valuation approach in water and sanitation services, urban air pollution, soil erosion, deforestation, biodiversity, water shed management and ecosystem valuation (Whittington, 2002, p.345). In designing good CVM study we must follow certain methodological procedures. They include:

1) Creating survey instruments. This can be seen as having three components:

A) Designing hypothetical scenario;

B) Deciding whether WTP or WTA questions have to be asked; and

C) Creating hypothetical scenario about the means of payment or compensation (Permian etal., 2003, p. 421)

2) The service of environmental good to be valued must be limited geographically and should be defined in terms of characteristics that can enter respondents' utility function.

3) Methods of asking questions - The elicitation methods can be open ended, iterative bidding approach, the payment card approach and dichotomous choice format. To improve the precision of the estimates in recent years researchers have introduced dichotomous choice format followed by the dichotomous choice format. Some researchers to get the advantage of both dichotomous choice format and the open ended format they use the dichotomous choice format followed by open ended format (FAO Corporate Document Repository, 2007, pp. 6-7; Shyue-CherngLiaw and Wan Jiun Chen2006).

4) Data collection technique - Survey responses can be gathered by face-to-face interview, telephone interview or mailed questionnaire. Face to face interview method is superior to telephone interview and mailed questionnaire, but the use of the face to face interview method is very expensive as compared to telephone and mail survey.

5) Analyzing survey responses - This includes estimating average WTP/WTA of the population, computing total WTP/WTA of the population, and assessing the survey result so as to judge the accuracy of the estimates.

Generally CVM has many advantages. According to Hoevenagel (1994), the CVM has the following strong advantages over the other methods, the applicability of this method is larger compared with other valuation methods in terms of completeness.

- It is able to measure a wide range of goods, including those not yet supplied in a manner consistent with economic theory.
- The method can measure non-use values.
- CVM has been judged to be superior due to its potential validity and ease with which the method can be implemented.

Contingent valuation (CV) elicitation formats

The most widely used elicitation formats in CV surveys are open-ended, bidding game, payment card and single (double) bounded dichotomous choice (Hanley et al., 1997).

I. Open-ended format – a CV question in which respondents are asked to provide the interviewer with a point estimate of his/her WTP; it has the advantage of relative computational easiness and counter starting point bias. But the method is associated with a large number of respondents' non-responses and protests zero bids. Mitchelland Carson (1989) further argue that the method is difficult since respondent's faced to pick a value out of the air without some form of assistance.

II. Closed-ended approaches (dichotomous choice question) - asked respondents whether they would pay a stated amount for the good in question by providing intervals in which the respondents WTP lies. This method is advantageous over open ended question format in eliciting WTP because of the simplicity of "yes "or "no "answers for the respondents and thus reduce incentives for strategic responses(Bateman et al., 1992). It has also advantage of being much more similar to the choice that individuals are asked to make in real markets when faced by market prices.

However it suffers from starting point bias, shortage of information, reducing efficiency and requirement of large sample to estimate benefits as maximum WTP is not directly obtained from this format. This study uses both closed ended (double bounded) and open- ended formats.

III. Bidding game – is a CV question format in which individuals are iteratively asked whether they would be willing to pay a certain amount, by raising (lowering) the amount depending on the respondents WTP for the previous offered amount. It has a better efficiency than closed-ended format because it has a potential to elicit the respondents maximum WTP (Cummings et al., 1986) and that the iterative process helps the respondents to fully consider the value of the good in question (Hoehn and Randall, 1987). But the method exhibits very strong starting bias and may be boringto the respondents and thus they may give answers only to avoid additional questions.

IV. Payment card - is a CV question format in which individuals are asked to choose a WTP point estimate (or an interval) from a list of values predetermined by the surveyors and shown to the respondent on the card. This method is better than open ended format as it could be simpler for the respondents and large proportion of responses could be obtained. However, the method requires the respondent to be literate that makes it of little use in developing countries where a considerable proportion of the population is illiterate.

In general all methods that we have discussed, either stated or revealed preference methods for non- market valuation, that are used for measuring the benefits of water related public goods have their own strength and shortcomings. As indicated above the revealed preferences methods are used to estimate people's WTP for environmental public goods from actual consumer behavior and hence failed to capture non-use values of environmental resources and thus are inadequate for assessing new policy initiatives (Young, 2005, p. 156). But the stated preference methods such as CVM is used to estimate both use and non-use values and also used to estimate values of proposed new policies (Young, 2005, p.152) , and this indicates that CVM can measure the total economic value of improved water projects. That is the reason why in 1979 the U.S.A. Water Resource Planning Council recommended the CVM as an acceptable method for estimating the benefits of water resource projects (Young, 2005, p.135). Therefore CVM is the appropriate method for valuing improved water supply of Harbu chulule town.

2.2. Empirical Literature Review

Most empirical studies on the WTP for improved water resources and supply indicate that income, household size, education, age, distance from existing water source, employment status and gender influence willingness to pay for improved water resources. For instance, Otsetswe (2001) found that the above parameters were the main determinant for WTP for private water connection in Kanye village in Botswana. In 2004, Pham Khanh Nam and Tran VO Hung Son did a study on Household Demand for Improved Water Services in Ho Chi Minh City, Vietnam. The study assessed the willingness of people in Ho Chi Minh City to pay for improvements in their water supply system. It also investigated what aspects of water supply, such as quality and water pressure are most important. Many households surveyed already had to do a lot and spend lot of money to cope with unreliable poor quality public water supply they currently use. Also, households without piped water are more willing to pay for improved services than those that already enjoy fixed supply. Non-piped households place more importance on water quality than water pressure. The studies reviewed above have all employed CVM to solicit WTP for improved water service.

In recent years CVM has been extensively applied to variety of water related issues in different frameworks. Some of the CVM studies done on improved water supply service are cited below.

Briscoe et al. (1990) employed CVM to assess households' willingness to pay for the improved water supply in three rural areas of Brazil: one relatively prosperous well watered southern state

of panama and two dry areas of north areas. In this study the bidding game was administered, and the Probit, Tobit and Multinomial Logit models were used to analyses the survey responses. The findings of the study indicate that the majority of surveyed households are prepared to pay much higher tariffs than existing tariffs. The willingness to pay for yard tap is positively affected by income, assets, education and formal sector occupation. The findings of the study also indicated that it is possible to provide free water to the poor at public taps without harming the financial viability of the scheme.

Whittington et al (1992) used CVM to estimate the WTP for public taps and private connections to the improved drinking water system in three Ibgo villages: Edem, Ekwegbe and Umunko- in the Nsukka district of Anambra state of Nigeria. All these three villages were predominantly agricultural communities and at the time of the study none of them had operational water supply system. In this study two different starting values (high and low) starting values were used and each household in the sample was assigned to one of these two groups. In this study the households' response was analyzed in three ways: interval estimate, ordering of the alternatives, and as choice to a single decision about the availability of water system. To analyze survey responses the ordinary least square (OLS) and Multivariate models were employed. The findings of the study indicates that the coefficients of attitudes, assets, education, housing type, storage capacity and the qualitative variable for the starting point had expected sign and statistically significant and determines households' willingness to pay for the improved services. Fujita et al. (2005) used CVM to assess the WTP for the improved water supply and sanitation service in Iquitos city, the Republic of Peru. In this study double bound CVM format was used and to analyze survey responses the survival analysis and Weibell models were employed. The data were analyzed by statistical package called CVM 2002. The research finding indicated that age of the respondent, household income and current water usage practices determine households' willingness to pay for the improved water supply service. The findings of the study in particular indicate that the younger the age of the respondent, the higher the monthly income, and the shorter the availability of time to fetch water from the existing source the higher the households'WTP for the improved water services.

In Ethiopia we found some studies done on improved water supply through CVM method. Fisseha Abera (1997) employed CVM to analyses the households WTP for improved water service supply

in Meki town. In this study multinomial ordered probit model was used to analyze the households' response. Similar to other studies in this study socio economic and demographic factors and water problems and households water consumption practices used as explanatory variables.

Assefa Chaka (1998) used the CVM to assess the WTP for improved water supply of Addis Ababa by taking four kebeles as a case study. In this study probit binomial models were estimated with LIMDEP 7.0. Chaka specified two models to analyze the households' responses. In the first model, the probability of the household who wish to connect to the improved water supply was taken as dependent variable while in the second model the respondents WTP for improved service falls within specified interval was taken as dependent variable. The findings of the study indicate that all coefficients of the explanatory variables had expected signs, though all are not significant. The coefficients of income, household size, sex of the respondent, level of education, and time required for fetching water, and households' attitude towards the responsibility for supplying improved water were found statistically significant. The coefficients of age of the respondent, house (taken as proxy for wealth) and employment in the formal sector though they had expected sign they were not significant and rejected. According to the finding of this research female respondents had more willingness to pay for the improved water service as compared to male respondents for wealth, women, children, domestic animals and sex of the respondent statistically insignificant and rejected.

Genanew Bekele in his study used the midpoint of WTP interval in the bidding game with in which respondents' WTP bid falls as dependent variable. Like others the explanatory variables used in the study were socio economic and demographic factors and the status of water exist at the time of the study. The findings of the study indicates that the coefficients of income, education, gender of the household head, location of the study area, staring point bid game and quality of the water exist during the survey time statistically significant and determines households' willingness to pay for the improved water services. The coefficients of family size and employment in the formal sector were not significant. The findings of the study show that the entire surveyed households preferred the provision of the improved water service. The surveyed households show their WTP about 15 times more than the existing tariff if they get improved water service.

A similar study was also made by Medhin (2006) using a CV survey on household demand for improved water services in Addis Ababa. This study used 250 sample households and the single

bounded format with open-ended follow up questions was elicitation methods used in this study. She used Probit and Tobit models to analyze the determinants of households' WTP for improved water services. In the Tobit model income, education and satisfaction facility were found to have a positive sign and significant, whereas perceived quality, age and water related diseases were negative and significant at the standard level of significance. Concerning the Probit model, income, education, marital status water related diseases and years of stay in the area positively affect the probability of accepting the initial bid. The findings further indicated that the mean WTP was found to be 20 cents per Jeri can (20 liters container) from single bounded probit model estimates and 15.79 cents Jeri can per from the open-ended format.

Yibeltal Bantie (2011) used the CVM to examine the determinants of households' WTP for improved water services inHacabar town. The elicitation method used in this study was double-bounded dichotomous choice followed by open-ended questions. Households' WTP forimproved water service was analyzed by estimating the Probit and the Tobit models. The explanatory variables quality of water being used dummy (1 if not safe to drink or poor), reliability of the existing water service dummy (not reliable=1), education dummies (both primary and tertiary education), income of the household, wealth of the respondents and their years of stay in the town were significant factors that affect positively households' probability of saying offered to households, age of the respondents and source of water being used by households have positive expected sign and have significant effect on the probability of saying to the proposed . The results from the Tobit model showed that the quality of water (1 if poor), reliability (1 if not reliable), education dummies (primary, secondary and tertiary educations), income and years of stay in the town positively and significantly affects the maximum amount household willing to pay. The variables responsible organ (1 if government), source of water (piped=1) and age have the expected positive sign with a statistically significant influence on the maximum willingness to pay of households.

In general these and other CVM empirical studies on water quality improvement and other non-marketable environmental goods and services in developing economies in general and Ethiopia in particular imply that the CVM can be successfully applied to low income countries.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Description of the Study Area

3.1.1. Location of the Study Area

Harbu Chulule Town is one of the slow growing Town of Ethiopia serving as Harbu chulule Town the total area of the town is 9,200km2. And it is located in the south west part of Ethiopia some128km far from Addis Ababa. The Town is the center of many regional and non-organization Geographically, it is located between altitudes of 200- 220m above sea level and has a weina degas agro-ecology zone (medium high land climatic condition). The Town is found in 39`28'' east & 13`28'' north with rainy and dry seasons as the two important seasons of theTownand its average annual rainfall is 700mm/year, this rainy season is characterized as unpredictable, unreliable and unevenly distributed throughout the year. And has an average mean temperature of 19'c. (WRDF, 2008). This study would be conducted in Harbu chulule Town. Harbu chulule Town is one of the Smallest Town.This Town incorporates five kebeles and the overall population of the Town is 6472(at household level 1974). In this Town there is water supply problem specially kebele 02 and kebele 05.

3.1.2. Water Supply Situation of the Harbu chulule Town

According to Harbu chulule Town water supply service office, the main source of water for the inhabitants is ground water and the Town has started to use piped water in 1949 E.C. In the same year, a pipe line connected to the Place and the Hospital has been introduced for the first time in the Town history .Harbu chulule Town water supply and sewerage service office (HTWSSSO) is the organization responsible for the production, treatment, transmission, distribution, and sales potable water supply to the potable users of Town.

The operational tariff for the Harbu chulule Town water supply service is block rising progressive tariff with the lowest band consumption (0-5m^3) tariff of Birr 4 per m^3 and the highest band consumption (>100 m^3) at Birr 15per m^3. The tariff rate is designed to cover the operation and maintenance costs of potable water production.

3.1.3. Water tariff Structure of the Harbu chulule Town

Survey about the current Government water tariff of the town water supply is based on a progressive water tariff calculation aiming to support the majority low income customer and high consumers to pay progressively higher as their consumption.

The Town water supply service office has revised its tariff structure starting from January; 2013. The price has increased in each consumption blocks. The new tariff structure of the town is summarized as follows.

Table3.1: Current tariff structure of the Harbu chulule Town

Consumption blocks (consumption m ^{3}/Month)	Tariff in birr/m^3 for household connection	Tariff in birr/$m^3$for business, public bodies and insurance
0.1-5m^3	4	6
5.1-10 m^3	5	8
10.1-20 m^3	8	10
20.1-50 m^3	10	12
50.1-100 m^3	12	15
>100 m^3	15	20

Source: Harbuchululewater supply service office, 2019

Note that the above pricing technique is called progressive pricing. But the price of water from public tabs is not based on progressive pricing, which are 4 birr/ m^3 constant over each block.

3.2 Data type and source

To undertake this research, the study was mainly uses primary and secondary data. Primary data would be collected from local peoples and the Town and from the concerned office.

The secondary data would be collected form recorder and previous works of water service provider and other related studies in the subject.

3.3. Method of data collection

For collecting the data suitable technique would be used depending upon the nature of the data. Primary data would be collected from household through questionnaires and key informant interview. The questionnaires that are used to elicit households' willingness to pay for improved water supply services can be divided to three basic parts namely:-

1) Households socio economic characteristics

2) Existing water supply situations of the town) Households willingness to pay for improved water supply questions

For secondary data related literature are going to be consulted and reviewed.

3.4. Sampling design and sample size

The study populations were the entire domestic water user household in Harbu chulule town. In order to represent the population with sufficient accuracy and inter the sample results to the population the target sample households was selected using a two-stage simple random sampling technique. In first stage two Kebeles were randomly selected out of five kebeles found in the town. In the second stage, the target households (from two kebeles) for this research are 2897 house hold mainly this kebeles. The researcher was used purposive sampling techniques to select respondents from each kebeles. Out of the total household (2897) in the study area, the researcher is going to take 86 respondents as a sample.

Several rules of thumb have been suggested for determining the minimum number of sample households requires conducting multiple regression analysis. The study used a method developed by green (1991) to select the total sample size from the household. Green (1991) suggested a rule of thumb that N>50+8m, where N is minimum number of households and M is explanatory variables used in the regression analysis. The explanatory variables in this study were six(6). So that the minimum sample sizes is N>50+8*6=98However, considering limited resources and time, a total 86 sample households were used for the study.

Table 3.2: kebeles and number of households randomly selected for questionnaire survey

No	Name of Kebele	Total household	The share of each kebele	Sample size from each kebele
1	Kebele-02	1911	66%	55
2	Kebele-05	986	34%	31
	Total	2897	100%	86

3.5. Method of Data Analysis

After the relevant data are gathered both descriptive and Econometric analysis methods would be used. The main reason to use descriptive analysis is most of the data collected through open-ended questionnaires and interviews which is difficult to quantify. Hence, it is appropriate and convincible to use the technique based on the fact and information collected.

3.5.1. Model Specification

To determine the socio-economic variables that influence WTP the study adopted a logit or probit econometric model as commonly and previously used in environmental studies by Ahtiainen (2007) and Mehrara et al (2009).

3.5.2. The Probit Model

The Probit model is among the most widely used members of the family of generalized linear models in the case of binary dependent variables. This model specifies an indirect utility function for each respondent assuming that the representative household gains utility from improvement in water services.

The basic model to analyze dichotomous responses based on the random utility theory was developed by Hahnemann in1984. The central theme of this theory is that although an individual knows his/her utility certainly, it has some components, which are unobservable from the view of the researcher. As a result, the researcher can only make probability statement about respondent's 'yes' or 'no' responses to the proposed scenario.

The indirect utility function for the jth respondent can be specified as follows: Uij=Ui (Yj, Xj, εij) Where Yj= jth respondent's income i=1 denotes the final state and i=0 the status quo (or the initial state) Xj= vector of household characteristics and attributes of a given choice εij= random component of the given indirect utility.

If a payment is introduced due to changes in measurable attributes like quality or quantity of environmental goods, the consumer accepts the proposed bid only if u1j (yj - βi*, xj, ε1j)>u0j (yj, xj, ε0j)

For the researcher, however, the random components of preferences cannot be known and she/he can only make probability statement of 'yes' or 'no' responses. Thus, the probability that the respondent says' yes' is the probability that she/he thinks that she/he is better off in the proposed program. For individual j, the probability is: P (yes) = P [u1j (yj - βi*, xj, ε1j)>u0j (yj, xj, ε0j)] this probability statement provides an intuitive basis to analyze binary responses.

This study has dependent variable which elicits "yes" or "no" responses to WTP question, so probit regression are suitable to estimate the model. The Probit model is employed to analyze Factors that determine households' willingness to pay for the improved water services for single bound dichotomous choice questions survey responses.

In the model, WTP is endogenously determined and is a function of the following independent variable: - initial proposed bid, s income level, gender, age, education, household size , marital status, daily used volume of water , and satisfaction .Thus,

P (WTP=1) = (β0+β1RESX + β2REIN + β3REFS + β4REMS + β5REED +β6RAGE+εi)

Where,

WTP: Willingness of Harbu chulule town residents to pay for improved water supply service

β0: Constant

Bi: Coefficients where i= 1 to 10

Ei: error term

3.5.3. Description of Explanatory Variables and Hypothesis

RESX: The sex of the respondent. It is assumed that women would express more preference for improved water services and would be more willing to pay than men for the reason that women are often around the house with a higher burden of fetching water for domestic uses. A dummy variable for sex will be specified as 1 for female and 0 for male with a positive expected sign.

REED: The education level of the respondent. It is expected that, households with higher educational level are more aware of the different benefits that could be gained from an improved water services thus a positive relationship is expected. A dummy variable 1 is specified for Formal education (primary, secondary and tertiary) and 0 otherwise

REIN: Monthly income of the household. This continuous variable is a sum of the head's income and the income of other members of the family. The available literature suggests that there is a positive relationship between income and improved water service. Theory also supports this intuition that income and quantity demanded are positively related in the case of normal goods. As a result a positive sign is expected on the variables of income

REMS: Respondents Marital Status. This is a dummy variable taking 1 if the respondent is married; 0 otherwise. This variable is expected to have a positive sign since married people are more careful of the health and other risk involved in poor water supply service due to family responsibility in the future than the single ones.

REFS: Respondents family size. The rationale given is that, as the number of members increases in a given household, households will be more aware of the risk involved with poor water supply provision. Thus desire for a better service by giving high willingness-to-pay. As a result negative sign is unexpected on the variables of family.

AGEHH: Respondents of the age the given that data are members increase in a given household, households would more increase as expected to the variable positive relationship age and improved households willingness to pay improved water supply service**.**

CHAPTER FOUR

RESULTS AND DISCUSION

This chapter deals with the empirical findings and discusses the results obtained. The data from the contingent valuation survey is analyzed in two ways. The first part used descriptive analysis with the help of summary statistics (**See Table 4.1**). Besides, an overview of the households' attitude towards the existing water supply in the city is discussed. In the second part, probit models are used to analyze the surveyed data econometrically. In the Probit model we have analyzed and discussed factors that affect households' probability of accepting the proposed to them and the mean WTP from the closed-ended questions has been also estimated.

4.1. Descriptive Analysis

4.1.1. Socioeconomic and Characteristics of Households

Using a contingent valuation survey, a total of 86 sample households were interviewed during the survey. From the total sample households, 62(72.09%) are female households, while the remaining 25(29.06%) are male households. This shows that female household in most of the case in Ethiopia context the household burden falls up on women. This means that the probability of the women to have work outside of the home is less as compare.

The result also showed that 38.97 year is the average age, with the minimum of 24 years and maximum of 75 years.

The education level of the respondents showed that, the minimum education level achieved by the respondents was not able to read and write (illiterate), while the maximum level is Master's Degree. From total respondents who gave answer to this question, 32 (37.20%) have within Secondary Education (9-12), 18 (20.93%) have within primary education (1-8 grades), 13 (15.11%) have diploma, 14(16.09%) have degree, 5(5.81%) can neither read nor write (illiterate) and the reaming 5 (5.81%) were above degree. In general the result showed that, majority of the respondents were within secondary education level.

The average family size of the total sample households were 3.46 with the maximum family size of the sampled household is 11, while the minimum of 1. The data about the occupation of the respondents shows that 41(47.67%) of them were self-employed, 25(29.06%) of them were government employee, 11 (12.79%) were unemployed. while the remaining 10 (11.62) of them were involved in private business. In general the result showed that, majority of the respondent engaged in self-employed. The possible reasons for this, sometime the people prefer to have own business as compared to others in terms of freedom and lacking others work even divert them to be self-employ.

The average monthly income of the sample households was Birr 3974.402, which is ranging from the maximum of Birr 65000 to the minimum of Birr 1500. Data about the income of households reveals that, there is income disparity/inequality between the households of the town.

Attempts were also made to know the wealth status of the sampled households. Based on this, from total sample households of 38 (44.18%) of them reveals that they live in their own house, 49 (56.97%) lives in privately rented house. In general the result showed that, majority of the respondents have no their own house (lives in privately rented house). This implies that most of the urban settler migrants and the cost of having house is not easy task.

Households were given different social services to rank them in accordance with their priority of need. Survey results showed that 43)50%) rank water service as their first need, 27 (31.39%) rank health service as their first need, 17 (19.76%) rank electric service as their first need. With regard to their second and third choice, most of the respondent chooses health and electric service respectively. From this we are clearly understood water supply is the priority need of sample households and the most important thing for them.

.

Variable	Description	Mean	Std.Dev	Min.	Max.
RESX	sex, dummy variable 1 If female,0 if male	0.6395349	0.4829515	0	1
REMS	Marital status, dummy variable 1if married, 0 if otherwise	0.5930233	0.4941518	0	1
REAG	Age of the respondents in years	36.59302	7.142875	21	45
REIN	Households' average monthly income in birr	3697.884	1242.952	1500	65000
REFS	Family size of the respondent in number	3.94186	1.758038	1	8
REED	Education level of the respondent, dummy variable 1 if	5.872093	5.792077	0	16
	formal education, 0 otherwise				
MWTP	Households maximum willingness to pay	0.5697674	0.4980125	0	1

Surveyed data 2019

Note that the mean estimates of dummy variables should be interpreted as percentage. For example, the mean of the respondents' Sex is 0.6395349 this means that 63.95349% of the respondents are female.

4.2. Existing water supply condition of the sampled households

Household's attitude towards current water supply situation of the town is presented in the following section by discussing main source of water, quantity and quality, Level of satisfaction with the existing source and reliability of current water supply source.

4.2.1. Current source of water supply

With respect to the sources of water supply households were using, most of sampled households were using piped water from the main source supplied to the town followed by public hand pump respectively as can be seen in the following table.

Table 4.2: Current Sources of water supply for the Harbu chulule town.

Source of water supply	No of respondents	Percentage	Cumulative
Private piped	68	79.31%	79.31
Public tap	18	20.69%	100
Total	86	100%	

Source: Household survey, 2019

The above table show that sources of water supply 79.31% of households who are using Private piped water from the main source supplied to the sub city, while the remaining 20.69% of households use Public tap water supply. The Households who were not using private piped water supply were asked why there are not using the source. Based on this most of them said that water office is unable to deliver the service and they said that house has not their own.

From sample collected data households who have Private piped water supply source can consume on average 70.57 litter of water per day, which is ranging from the maximum of 100 litter to the minimum of 20 litter while who have Public tap source consume less than on average 70.57 litter of water per day as compared to who have private piped because of water problem is higher as compared to piped source. However households are not using the required quantity of water at desired time.

4.2.3. Reliability of current water supply source

Contingent valuation survey about quantity, quality and reliability of current piped water supply source indicated that, of the total surveyed households, only 31.03% of them said the existing source is reliable and available as the time it is needed. About sixty respondents (68.97%) of the total respondents said that the existing water quality is poor. But most of the respondents do not use any

kind of purification method to treat the water they use. When they asked why they don't treat before drink, 49.5of them said the water is not clean but treating is costly and time consuming, 37.15% of them answered the water is not clean but has no side effect on health and the rest reasoned out that the water is clean for drinking. Only 13.35% of them reported purification sometimes before drinking either by boiling or adding chemicals. Other findings of the study shows that out of the total respondents, 25 (29.06%) of them indicated that the member of their households were suffered from water borne diseases such as diarrhea, typhoid, cholera, and vomiting due to deficient water quality.

With Regard to availability/quantity of water, only a small proportion of respondents were said that the water availability at all time is good. While most of the respondents respondeavailability of water at all time is poor. On average water is available only for three (3) days per week.

4.2.4. Level of satisfaction with the existing source.

Data about the level of satisfaction with the existing source of piped and public tap water supply the following figure indicate that, most of the respondents are not satisfied with the existing source. As to the standards of the existing services delivery only, 23(26.74%) of the respondents satisfied with the status quo level. And 64 (74.42%) revealed their dissatisfaction with the existing systems. When these respondents asked to tell the main causes of their dissatisfaction, about 33% of them said unreliability, 13.64% of them poor quality, 37.36% of them said low quantity and the rest said far away from home.

4.3. Demand and Willingness to pay for improved water supply

In the previous two parts, data about household's attitude towards current water supply situation is presented together with their socio economic and demographic characteristics. In this section, household's willingness to pay for the improved water supply service is presented. Before doing that, it is important to see the question presented to the sample households. The provision of improved water service among other things means, good quality of water which is safe for health and an increased amount of water available for use. It also means a highly reliable source at any time (7 days a week, 24 hours a day). Now, let us assume that you have an option for a private

connection to such an improved piped water supply scheme. The improved system will provide you with as much water as you wish at any time of the day, throughout the year. Let us also assume that you will be charged a monthly water fee based on the volume of water your household consume in a month (the tariff is Progressive), the more you consume the higher will be your monthly bill. The tariff per volume will be the same for all consumers. You may not be required to pay initially the costs of connection to the new scheme. Instead, it will be distributed over several years in your monthly bill (The payment will be built-in the monthly water bill). You are required to pay a minimum of at cost recovery after the improved water supply has been come into effect.

4.3.1. Demand for improved water supply

Provision of improved water supply has much importance. Among them it is reducing the incidence of water borne diseases such as diarrhea, typhoid, cholera, and vomiting; it also improves sanitation activities, and generally contributes to the economic growth of every nation. The most of sample households responded that they need improved water supply. Their main reason for demanding improved water supply is, there is no sufficient amount of water at the required quantity in the desired time.

4.2. Empirical Analysis

4.2.1. Determinants of household's willingness to pay responses

As we have pointed out earlier, in addition to the descriptive analysis, deterministic analysis puts us in a broader framework, as to which factors are responsible for the willingness to pay for improved water services. The WTP question for private connection is presented for all respondents (for both who have a private access to the existing pipe system and those who have not). The general approach of this technique is to estimate a valuation function that relates the hypothesized determinants with the WTP responses. The variables to be included in the models were mainly based on the degree of theoretical importance and their significant impact on WTP.

Data exploration is an important preliminary step before estimation is done. The precision/accuracy of estimating the coefficients of variables is reduced by the existence of multicolliniarity between variables that is if the explanatory variables are highly correlated it is difficult to distinguish the effects of one single explanatory variable on the dependent variable

(Maddala, 1992, pp. 269-270). Gujarati has established a rule of thumb which says that multicoliniarity is a serious problem when a pair wise correlation coefficient between two regressors is greater than or equal to 0.8 (Gujarati, 1998, p. 229). Accordingly, the correlation matrix generated using the data shows that multicolliniarity is not a serious problem **(See appendix)**.

Econometric theory tells us that we are likely to encounter heteroscedastcity frequently in econometric data, particularly with cross-sectional data. Before passing in to the analysis of the result of the estimation of the models, test on the possible existence of heteroscedastcity is important for this study. The violation of the homoscedasticity assumption in the general linear model, OLS estimates are consistent but inefficient. However the problem for non-linear models such as Tobit is more sever, i.e. the resulting estimates are not even consistent (Maddala 1983). Since my data is cross sectional by its nature we are likely to encounter with the problem of heteroscedastcity **(See appendix)**. This test shows that the null hypothesis of homoscedasticity is rejected, i.e. heteroscedastcity is a problem for the model. To correct these heteroscedastcity problem robust standard errors can be estimated for the probit model.

4.2.2. Results and discussions of the Probit Model

The Probit estimation results obtained using STATA version 12.0 is given in Table 4.5. The coefficients of the probit model only give the significance and the direction of the effects of each explanatory variable on WTP. The marginal effects indicate that the probability that respondents accept or reject the offered due to a unit change in continuous explanatory variables and a change of dummy variables from 0 to1, for discrete variables (Greene, 1993). Of the total six (6)explanatory variables hypothesized to influence the probability of WTP choice decision, four(4)variables were found to have significant effect on probability of a respondent accepting the initial bid, and the remaining insignificants (2) variables were found to be insignificant. In probit regression model if Pseudo R2 is greater than 15% the model is adequate. In my model pseudo R2 81.32% .therefore my model is adequate. Both the coefficients and marginal effects of the probit model are given in

Table 4.3: Maximum likelihood estimates of the probit model

Explanatory Variable	Coef.	Std. Err.	p-value	Marginal Effects(dy/dx)
RESEX	0.2295953	0.6816244	0.736	0.0167894
REMRS	0.4107122	0.74266	0.676	0.0227211
REFS	-0.4005248	0.2093037	0.056	-0.0292887
REIN	0.0010776	0.000277	0.000	0.0000788
REEDU	0.2386914	0.0694844	0.001	0.0174545
Age of hh	0.0983902	0.0428173	0.022	0.002556

*** - *Significant at 5% evel of significance*

Significanct at 10% level of significance

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

Number of observation = 86 **significant at 1%, 5% 10%*

Goodness fit of the model: *The goodness of fit of the model has been tested in this analysis with some diagnostic tests which fulfill the following measure of respectable results.*

The pseudo R-squared: *It explains the proportion of variation in the observed values of the response (dependent) variable explained by the independent variable regression. It summarizes the proportion of variance in the dependent variable associated with the independent variables, with larger pseudo R-squared values indicating that more of the variation is explained by the model. A pseudo R-squared of 81.32% was obtained suggesting that 81.32% variation in WTP explained by the independent variables or model.*

The log-likelihood ratio statistics also computes the difference between the log-likelihood function of the full model and restricted model. The value of the log-likelihood function is -10.97962 for the WTP for improved water supply management service of households.

LRch2 (6): *It shows that the estimated regression is meaning full in the sense that the dependent variable is related to every explanatory variables. The linear relation of the model is highly significant at 1% level of significance (= 0.0000).*

Education of Respondent*: As expected education had positive significant effect on willingness to pay at 1% level of significance. Holding all other variables constant, educated people are more willing to pay for improved water supply management service than less educated people. This result seems direct and reasonable since level of education could be related to a better understanding of the problem of water supply. This means that as the education level of the households increase by one level the probability of WTP increase by1.74545% on average keeping other factor remain constant. The possible explanation might be that educated (literate) households' heads are more aware about the environment compared to those who less educated or uneducated household heads. This also in line with the expectation that hold heads with high educational level have more willingness to pay for improved water supply management.*

Sex of respondent*: As expected sex had a positive coefficient and is insignificant on willingness to pay. This indicates that male respondents are more willing to pay for improved water supply management than females. This is more likely related with the income earning difference between male and female. Marginal effect of the model show if dummy sex change from zero to one the probability of WTP taking value one increase by 1.67894% on average other factor remain constant.*

Age of respondents: *As expected age had a positive coefficient and significance at 1% level of significance. This indicates that holding all other variables constant, older people are willing to pay more than younger people. This suggests that older citizens make more mature decisions related to evaluating health and environmental issues, possibly due to their age. The marginal effect of age is 0.256% shows, when the respondent's age increases by only year the probability of WTP for improved water supply management service increase by 0.256%.*

Family size: *The negative coefficient for household size and significance at 1% level of significance. This indicates that holding all other variables constant, the number of persons in the household even though significant did not have the expected sign on WTP. The negative relationship between household size and WTP could be due to their income level, as low income household generate low volumes of water. Large household sizes are also associated with low income households. The size of the effects can be judge by analyzing the marginal effects, which are indicators of percentage change in people's willingness to pay, when all other factors are kept at their average value. As family size increase by one person the probability of willingness to pay increase by – 2.92887% on average other factors remains constant.*

Household income*: Total average income of households had positive significant effect on willingness to pay at 1% level of significance. It shows that other thing being constant, on average an increase income of respondents by one unit, increase the probability of WTP for waste*

management service by 0.00788% on average other factors remain constant. This also in line with the expectation that respondents with higher income are expected to be more willing to pay; in fact its responsiveness is very much less. Because: income is a positively related with demand in general and the same with environmental demand. This also indicates that environmental good is a normal good since its demand increases with income.

***Marital status**: Marital status had a positive coefficient and is insignificant on willingness to pay. This indicates that married respondents are less willing to pay for improved water supply management but pay more than, single, divorced, single and widow. Marginal effect show 2.27211% other variable being constant as marital status change from 0 to 1 the probability of willingness to pay for married increase by 2.27211% on average other factor remain constant.*

TEST FOR MULTICOLLINIARITY

To check the existence of multicolliniarity simple correlation matrix was conveyed. Multicolliniarity is series problem when correlation coefficient is more than 0.8 and above (vif more than 10) which based on rule of thumb (gujarati 2005). There is no problem of multicolliniarity (appendix).

TESTS OF HETROSKEDASTICITY

***LRch2 (6)** look straight to the P-value is (preferable) 0.05 or smaller, then the null hypothesis is rejected and here is significant evidence there is heteroskedasticity, but if prob-chi2 is 0.05 or greater than, or then null hypothesis is rejected, here significant, evidence there is no hetroskedasticiy problem (Gujarati, 2004). Look the following estimation result. Then by default there is problem of heteroskedasticity. Then to solve this problem robust was employed. (see appendix)*

CHAPTER FIVE

CONCLUSIONS AND RECOMNDATION

5.1. Conclusions

Harbu chulule townwater supplies provided by public services are facing serious crisis in many developing countries. As such, the urban and industrial centers of reginal are also characterized by poor water supply services. (HARBU chulule town is one of the areas faced with unreliable and inadequate supply of water. As noted above, one of the main reasons for this serious shortage of water is population increment which creates mismatch between the supply and demand of improved water services which in turn creates a greater burden on the supplier due to financial constraint.

This study, therefore, attempted to analyze the demand side of improved water supply services with the aspire of looking into the possibility of cost sharing by the residents for the improved water services by eliciting their WTP. The study mainly used cross-sectional primary data while it is also supplemented by secondary data from different relevant sources.

The Contingent Valuation Method (CVM) is used based on face-to-face interview with 8 randomly selected sampled households. The sampled households were also asked questions related to demographic and socioeconomic characteristics, problems with the existing water services, their water use practices and some other general questions.

The descriptive analysis showed that out of the total 86 usable responses, 79.31% of respondents confirmed that piped water is the main source of water for their households and 20.69% of the respondents use public tap water. 73.56% of them were not satisfied with the existing water service due to factors that include poor quality, low quantity, unreliability, and distance from the source. And only 26.44% of the respondents satisfied with the status quo level. The survey result also showed that the mean consumption of water per household per day was 3.5 jerry can (70.57 liters of water). The whole surveyed households expressed their willingness to pay for the improved services ranging from 10 cents to 50 cents for a bucket or 20 liters of water they will get from the improved sources. Above 80% of the respondents show their willingness to pay between 30-40

cent and the remaining 11.49% percent of the respondents show their willingness to pay for the improved services above 40 cent.

The researcher used the probit model to analyze the determinants of households' to accept or reject the initial bid proposed to them and to calculate the mean WTP of these sampled households. The results obtained from the CV survey were analyzed using the econometric software STATA version 12.0.

The results of Probit model shows that reliability of the existing water source dummy (reliable=1), respondents' education, income of the household, and age of households offered were significant factors that affect households' probability of The remaining variables are statistically insignificant.

95.40% of the usable responses had positive willingness to pay for improved water services with a mean WTP of 51.51 cents per jerry can in the open-ended and 31.26 cents within the closed- ended format. This shows that if the town utility management will implement the proposed water improvement scheme, in addition to solving the severe water problem of the town, the water service office can collect more revenue from the sale of improved water by charging higher price than the current tariff.

5.2. Recommendation

Harbu chulule town is suffers from increasing problems of water shortage. The of the town have high eager to have reliable and improved water services. All the surveyed households expressed their willingness to pay for the improved water services above the existing tariff structures. Thus, the expected revenue from the provision of the improved water services will be high. The findings of this study also clearly show socio-economic and demographic characteristics and water related variables that affect households' willingness to pay for the improved water services.

Based on our research findings the researcher can draw the following policy implications:

- Project planners should take in to consideration the poor quality and unreliability problems in designing the water system of the town to provide good quality and reliable water supply services since these two variables are found to be the sources of greater dissatisfaction of the existing service.

- Policy makers need to consider that supplying improved water services can further empower females because they are found more willing to pay than their male counterparts.
- Consider the effect of awareness, income and education in water development programs and design mechanisms to address them appropriately.
- Since the mean WTP of the sampled households is far above the city's current water tariff, the utility management can implement the proposed water improvement scheme to satisfy the water needs of the community while at the same time collecting more revenue from the sale of this improved water at a higher price.
- There is no faire distribution of water supply in the town therefore; we recommend that the
- Concerned office should be fairly distributing the existing water service.

BIBLIOGRAPHY/ REFERENCES

- Ahtiainen (2007) and Mehrara et al (2009).
- **Alebel Bayrou, 2004**. "Estimating households' affordability and willingness to pay for improved water supply services in urban areas".
- Cummlys, brook shire and shelze (1956) Mitchell and carsow (1959) whitingtonetals (1985) and (1950).
- **FekaduMegersa, 2011 ''**Assessing Households Willingness to Pay for Improved water service.
- Grossman (Health Economics)
- Habb, T.C., and McConnell, K.E (2002).Valuing Environmental and Natural Resource: The Econometrics of Non-Market Valuation. New Horizons in Environmental Economics, Edward Elgar
- Hanemann, M.W. (1991). Valuing the Environment through Contingent Valuation Method: Journal of Economic Perspectives, 8(4): 19-43.
- **MahirahKamaludin, Khalid Abdul Rahim** Institute Of Agricultural And Food Policy Studies, Putra Infoport, University Putra Malaysia ''Assessing consumer's willingness to pay for improved domestic water services in kelantan, malaysia"
- Maddala, G.S (2002) .Introduction to Econometrics, 3rdedition, John Wiley and Sons Ltd Singapore.
- Tietenberg, T. (2003). Environmental and Natural Resource Economics, 6th ed. International Edition, Pearson Education, Inc.
- UN (2002). Facts about Water. Fact Sheet, Johannesburg Summit 2002. Johannesburg, South Africa. Retrieved from: www.un.org /jsummit/html/media_info/
- UNICEF and WHO (2011). Drinking Water Equity, safety and sustainability.
- WHO and UNICEF (2004). Joint Monitoring Programme for water supply and sanitation; meeting the MDG drinking water and sanitation target: A mid-term assessment ofprogress. WHO, Geneva. ISBN: 92 4156278 1.
- World Bank (2007). Ethiopia urban water supply and sanitation project, Report No: 391 19Washington, D.C.: World Bank.
- **World Bank, 2004**. "Willingness to pay for water and energy" Washington DC.

❖ **World health organization, 2003.** "Domestic Water Quantity, service level and health" Geneva, Switzerland: WHO Document Production Services

❖ Yibeltal (2011). The Value of Improved Water Supply Service in Motta Town, East Gojjam, Ethiopia: Application of Contingent Valuation Method (Cvm). A thesis submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Science in Economics (Environmental and Resource Economics.

APPENDEX I: QUESTIONAIRE

CONTINGENT VALUATION SURVEY - HOUSEHOLD QUESTIONNAIRE

This survey is being undertaken by a student of Wolkite University, Collage of Business and Economics in the Department of Economics for the award of BA Degree in Economics. This questionnaire is designed to obtain information on the current situation of water supply in Harbu Chulule town and residents' willingness to pay for an improved water supply services. The information collected is for purely academic purpose and will be kept confidential.

Part I: Socio Economic Characteristics of Respondents

1. Sex: 1. Female 2. Male
2. Marital status: 1. married 2. Otherwise
3. Age of head of the household _____ Years
4. Educational level of head of the household _____ grade
5. Total income of head of household/month _____ birr
6. Occupational status of head of the household
   1. Private business 2. Government employee
   3. self-employee 4. Unemployed 5. Other, specify_____
7. Total number of people living in the house? _____people
8. List the following services in order of the most importance (Rank them)

   1. School 2. Health 3. Water 4. Sanitation 5. Road 6. Electricity 7. Telephone
9. Do you have your **own** house?
   1. Yes 2. No

Part II: Existing Water Supply Situations

1. What is your households' main source of water supply?
   1. Private piped water 2. Public tap

If the answer for Question number 1 is 1 go to Q 2 up to 11.

If the answer for Question number 1 is 2 go to Q 6 up to11 and 12

2. Does your household use any purification method to clean piped water before drinking?
   a. Yes b. no
3. If your answer for question 2 is no what is your main reason
   a. Water is clean for drinking

b. Purification is time consuming and costly

c. It is not clean but no side effect on health

4. Do you get piped water at a desired time and quantity?

1. Yes 2. No

5. If your response to above question is no how many days when water is absent? _____ Days

6. What is the present status of private pipe /Public tap water service?

i. Quantity: 1. Good 2. Average 3. Not good

ii. Quality: 1. Good 2. Average 3. Not good

iii. Reliability: 1. reliable 2. Unreliable

7. In general are you satisfied with the existing piped /tap water service?

1. Yes 2. No

8. If **Question No 7 is "No"** what are the main causes of your dissatisfaction?

1. Poor quality 2. Low quantity

3. Unreliability 4. Higher volume charge

5. far away from home 6. Other reason specifies_____

9. How much water is on average do you use daily _____ bucket (20 liters of jerry can)

10. Have any of your household members suffered from diseases caused by deficient water quality? 1. Yes 2. No

11. If **Question No 10 is yes** what were the diseases?

1. Diarrhea 2. Typhoid 3 .cholera 4. Vomiting 5. Other water borne diseases

12. Why you don't have your own connection or yard connection?

1. High connection cost 2. Water office is unable to deliver the service

3. The house is not mine, but rented 4. Scarcity of water

5. I don't want to have yard connection 6. If other (specify) _____

Part III: - Household willingness to pay for improved water supply service (for both private pipe and public tap users)

1. Are you willing to participate in this water improvement program?

1. Yes 2. No

2. If **"Yes"** supposes that the sub city water service office made the improved water service Available, would you be willing to pay ____ cents per Jerry can or (for 20 liters container)?

1. Yes 2. No

3. If the answer to **Question** No**2 is 'Yes'**, ask the following question. If the price of water per Jerry can from the improved water service is increased to (2X), _____ cents per Jerry can (or for 20 liters Container), would you be willing to pay?

1. Yes 2. No

4. If the answer to **Question** No**2 is 'No', ask the following question.** If the price of water per Jerry can from the improved water service is decreased to (0.5X), _____ cents per Jerry can (or for 20Liters container), would you be willing to pay?

1. Yes 2. No

5. What is the maximum you could pay for one Jerry can of water from this improved water scheme? _____Cents per Jerry can.

6. If the maximum amount that they would like to pay for the improved water service they will get from the improved scheme is 'zero', ask them why they do not want to pay?

1. Water should be provided free of charge 2. I satisfied with the existing source
3. I do not have enough money 4. I know that money will not be used properly
5. Other reason specify_____

Appendix

. probit Regression Result.

Variable	Obs	Mean	Std. Dev.	Min	Max
observ	86	43.5	24.96998	1	86
age	86	36.59302	7.142875	21	45
sex	86	.6395349	.4829515	0	1
man	86	.5930233	.4941518	0	1
fasi	86	3.94186	1.758038	1	8
wtp	86	.5697674	.4980125	0	1
edu	86	5.872093	5.792077	0	16
hhinc	86	3697.884	1242.952	1500	6500

probit wtp edu hhinc fasi man sex age

Iteration 0: log likelihood = -58.77071

Iteration 1: log likelihood = -12.113901

Iteration 2: log likelihood = -11.039242

Iteration 3: log likelihood = -10.979824

Iteration 4: log likelihood = -10.97962

Iteration 5: log likelihood = -10.97962

Probit regression Number of obs = 86

LR chi2(6) = 95.58

Prob > chi2 = 0.0000

Log likelihood = -10.97962 Pseudo R2 = 0.8132

---

wtp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
edu	.2386914	.0694844	3.44	0.001	.1025045	.3748782
hhinc	.0010776	.000271	3.98	0.000	.0005464	.0016088
fasi	-.4005248	.2093037	-1.91	0.056	-.8107524	.0097029
man	.3107122	.7426266	0.42	0.676	-1.144809	1.766233
sex	.2295953	.6816244	0.34	0.736	-1.106364	1.565554
age	.0983902	.0428173	2.30	0.022	.0144699	.1823104
_cons	-6.765419	1.930632	-3.50	0.000	-10.54939	-2.98145

. margins, dydx(edu hhinc fasi man sex age)

Average marginal effects Number of obs = 86

Model VCE : Robust

Expression : Pr(wtp), predict()

dy/dx w.r.t. : edu hhinc fasi man sex age

Delta-method

dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
edu	.0174545	.0030915	5.65	0.000	.0113953	.0235137
hhinc	.0000788	8.88e-06	8.88	0.000	.0000614	.0000962
fasi	-.0292887	.0113597	-2.58	0.010	-.0515534	-.0070241
man	.0227211	.0308697	0.74	0.462	-.0377825	.0832247
sex	.0167894	.0301661	0.56	0.578	-.0423352	.0759139
age	.0071949	.002556	2.81	0.005	.0021852	.0122046

Table 4.3: Maximum likelihood estimates of the probit model

. corr age sex man fasi edu hhinc

(obs=86)

	age	sex	man	fasi	edu	hhinc
age	1.0000					
sex	0.3735	1.0000				
man	0.2374	0.2161	1.0000			
fasi	-0.2087	0.0622	0.2879	1.0000		
edu	0.3483	0.2399	0.1296	-0.1183	1.0000	
hhinc	0.1370	0.3497	0.2328	0.1125	0.1182	1.0000

```
. vif, uncentered

    Variable |      VIF      1/VIF
-------------+----------------------
        hhinc |     8.81    0.113532
          age |     8.49    0.117774
         fasi |     4.47    0.223736
          sex |     3.57    0.279972
          man |     2.99    0.334667
          edu |     2.38    0.419578
-------------+----------------------
    Mean VIF |     5.12

. probit wtp edu hhinc fasi man sex age, robust

Iteration 0:   log pseudolikelihood =  -58.77071
Iteration 1:   log pseudolikelihood = -12.113901
Iteration 2:   log pseudolikelihood = -11.039242
Iteration 3:   log pseudolikelihood = -10.979824
Iteration 4:   log pseudolikelihood =  -10.97962
Iteration 5:   log pseudolikelihood =  -10.97962

Probit regression                               Number of obs   =         86
                                                Wald chi2(6)    =      55.15
```

```
                                  Prob > chi2     =     0.0000
Log pseudolikelihood =  -10.97962               Pseudo R2       =     0.8132

------------------------------------------------------------------------------
             |               Robust
         wtp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         edu |   .2386914   .0622119     3.84   0.000     .1167583    .3606245
       hhinc |   .0010776   .0002911     3.70   0.000     .0005071    .0016481
        fasi |  -.4005248   .1033801    -3.87   0.000     -.603146   -.1979035
         man |   .3107122   .4142629     0.75   0.453    -.5012282    1.122653
         sex |   .2295953   .4349448     0.53   0.598    -.6228809    1.082071
         age |   .0983902   .0205874     4.78   0.000     .0580396    .1387408
       _cons |   6.765419   1.583872    -4.27   0.000    -9.869751   -3.661088
------------------------------------------------------------------------------



. corr wtp edu hhinc fasi man sex age
(obs=86)

             |      wtp      edu    hhinc     fasi      man      sex      age
-------------+---------------------------------------------------------------
         wtp |   1.0000
         edu |   0.6210   1.0000
       hhinc |   0.6021   0.1182   1.0000
```

fasi | -0.2514 -0.1183 0.1125 1.0000

man | 0.2362 0.1296 0.2328 0.2879 1.0000

sex | 0.3748 0.2399 0.3497 0.0622 0.2161 1.0000

age | 0.5291 0.3483 0.1370 -0.2087 0.2374 0.3735 1.0000