ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

THE VALUE OF IMPROVED WATER SUPPLY SERVICE IN MOTTA TOWN,EAST GOJJAM,ETHIOPIA:APPLICATION OF CONTINGENT VALUATION METHOD (CVM)

BY

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List of Abbreviations

CE-Choice Experiment

CS- Compensating Surplus

CV- Compensating Variation

CVM-Contingent Valuation Method

ES-Equivalent Surplus

EV-Equivalent Variation

HPM-Hedonic Pricing Method

Km-Kilo Meter

MGD-Millennium Development Goal

MoWE- Ministry of Water and Energy

MSC-Marshalian Consumer Surplus

NGOs-Non-Governmental Organizations

NOAA-National Oceanic and Atmospheric Administration of the USA

TCM-Travel Cost Method

TEV-Total Economic Value

UN-United Nations

UNICEF-United Nations (International) Children's' Fund

WHO-World Health Organization

WSP-Water Supply Practice

WTA-Willingness to Accept

WTP-Willingness to Pay

Abstract

Adequate quality, safe and affordable supply of drinking water is a basic need for human life. However, many people in LDCs are lacking this safe and quality water. Since Ethiopia is one of these LDCs its urban and rural area population do not have access to such attributes of water. Therefore adequacy and quality are crucial for household water supply. In this study the CVM was used to analyze the determinants of households' WTP for improved water services by applying the double-bounded dichotomous choice value elicitation format. The study used cross-sectional data collected from 220 randomly selected sampled households from Motta town. The CV survey responses were analyzed through descriptive and econometric analysis using probit, bi- variate probit and Tobit as empirical models.

The CV survey results revealed that 199 (96.6%) of the respondents were willing to pay a positive amount for improved water services.

Thus if the proposed water improvement scheme is implemented, in addition to satisfying the water needs of the households, the town's 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 19.2 cents and 25.83 cents depending on the method used. The total WTP amount from the total of 10,898 households in Motta town was founded to be birr 8,198.2 per day or birr 2,992,343 per year which is much higher than the current total revenue of birr 475,325 collected by the utility management .

The results from the test statistics show that existing source of water, initial bid offered to households, age of the respondents, sex of the respondents and responsible organ for the provision of improved water services have a negative effect on the probability of households' WTP for improved water services in the probit model and at the same time they have also a negative influence on the maximum amount they are willing to pay in the tobit model. On the other hand education (both primary, secondary and tertiary), income, wealth, quality of water being used, reliability of the existing service, years of stay in the town, time taken to fetch water from the existing source and level of satisfaction with the existing service are affecting positively the probability of accepting the initial bid offered to them for improved water service and the maximum amount that they are willing to pay. Therefore the 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.

Key Words: Willingness to pay, Contingent valuation method, Improved Water Service.

CHAPTER ONE

INTRODUCTION

1.1 Statement of the Problem

Water is one of the most crucial and non substitutable environmental resources. Adequate, quality, safe and affordable supply of drinking water is a basic need for human life. However many people especially in developing countries do not have access to safe and adequate water services which affects their life in various ways. Out of 6 billion people in the world, more than one billion lack access to safe drinking water. For example, of the total urban dwellers in Asia 98 million people, in Latin America and Caribbean 29 million people, and in Africa 44 million people do not have access to clean potable water services (UN-HABITAT, 2003). In spite of all these one of the millennium development goals (MDG) is reducing the proportion of people without access to safe and adequate drinking water by half by 2015 (United Nations,2007). Thus providing safe and adequate water to the people at the right location and at the right price has become an important public policy issue.

Developing countries which depend on unsafe, expensive and inconvenient water supply and sanitation services indicates that there is a need for strategically targeted initiatives to meet the MDGs, but to address the potable water problem of these countries huge investment in water project is required. However, due to lack of finance and trained manpower, governments of these countries have limited potential to make water easily accessible to its people. Even if during 2000 to 2006 the proportion of the population with access to improved drinking water source in developing countries increased from 74 percent to 84 percent nearly one billion people were still using water from inconvenient sources such as rivers, streams, shallow wells, ponds and drainage ditches with their health and safety risks and thus these countries need

managerial and financial improvements for the provision of adequate and safe potable water services. Furthermore, those who have access to improved water supply do not necessarily get adequate services from stand pipes which are not always available 24 hours a day, which are key sources of access for the majority of the poor. In short, in these developing countries water is not supplied round the clock, pressure is insufficient to pump it to the tap and the amount of water made available to the public. Thus the population combats these problems of unreliable water supply by collecting, storing, pumping, treating and purchasing (WSP guide, 2009).

The water supply and sanitation collaborative council at the end of the last millennium revealed that there is a large service gap in low income countries. For example in Africa, a continent with an estimated population of 784 million people in the year 2002, only 62% had access to improved water supply, which has substantial health and economic benefits for households and individuals, while 60% were served by improved sanitation (WHO/UNICEF, 2000).

Like in many other developing countries, in Ethiopia there are many constraints to make potable water easily accessible such as lack of trained manpower and financial constraints. The country is not able to solve fully the potable water problem of its people. According to global water and sanitation assessment of 2000 report, only 24% of the total population, 73% of urban population and 13% of the rural population have only access to safe and clean water. As a result, in most parts of the country a considerable number of people spend a good part of their time fetching water from rivers, natural springs and other sources. Although most of the consumers in developing countries including Ethiopia have low income, research in these countries has shown that cost recovery leads to more efficiency, higher effectiveness and greater sustainability because it meets the challenges of service delivery which is greater in urban areas of low income countries, where it is projected that 88% of the increase in global population will

live by 2015. Thus to increase the level of cost recovery, there must be a deeper understanding of what factors influence consumers' willingness to pay (WTP) for water services (Boham et. al, 1994).

The Ethiopian government has prepared water and sanitation document as an integral part of the country's water management policy to improve access to safe and clean water, which clearly indicates that every Ethiopian has the right to get access to adequate and quality water to satisfy their basic needs. Improvement in financial bases needed for water development project and other public undertakings with cost recovery is indicated as the basic water law/policy of the country. In this regard two tariff structures are shown in this policy document: social tariffs and urban tariffs.

The structures of social tariffs are designed for the poor communities to cover only operation and maintenance costs, while urban tariff structures are progressive and based on the basis of full cost recovery (MoWE, 2003).

Therefore investigating the ability and willingness to pay of the users of improved water service is essential to set appropriate water pricing or tariff structures which is consistent with government policy. For those goods for which market exists, the relationship between the amount of good consumers desire and price they pay is given by down ward slopping demand curve, which is derived from the equilibrium price and quantity of the good demanded, from which consumer surplus is calculated (Freeman, 1993). But demand curve cannot be derived from the equilibrium in the market for those goods that do not come under market transactions such as water quality improvement. Thus for the improvement in quality of water two basic approaches are used to estimate households willingness to pay (WTP). The first is direct

approach which uses stated preference that is consumer's direct response to estimate WTP for better service. The second approach known as indirect approach, which uses revealed preference, includes observed behavior for averting the effects of unsafe and insufficient water services to estimate WTP (Abdalla et al. 2003).

According to the information obtained from water supply office of Motta town, the existing water source of the town is ground water and there are only two boreholes currently in use which were drilled in 1985 and 1987 for an estimated population of 26,000 during that time. But currently the estimated total population of the town is 70,739 as of 2007 (1999 E.C) and hence the existing supply is unable to meet the current demand. Even if the total number of connections increases from 922 to 1,290 between 2005 to 2010 there are problems associated with the water supply situation of the town such as the potable water coverage is only 22.6 % in 2010, quality, reliability of water service which includes interruptions of provisions due to serious water shortage and low pressure is frequently observed. Besides due to lack of adequate usage of the service there is also high leakage problem in the town.

High population growth is an additional factor which aggravated the water supply problem of the town. Therefore to improve the water supply situation of the town, in addition to the rehabilitation of the old boreholes there is a need for construction of additional boreholes, replacement and construction of pumps and all pipe lines to expand the water service to fulfill the current demand. However there is a requirement of high capital outlays to practice all these activities and thus the service beneficiaries are required to pay for the improved water services. Thus to improve the water supply situation of the town demand side information is highly required, because this demand side approach asserts that the water utility bodies need to understand actual household use behavior and observed ability and willingness to pay for

improved water services and thus enables policy makers to design appropriate water tariff that is consistent with government policy and enhance the long term viability of the service. Therefore the focus of this study is to estimate the household's willingness to pay for the improved water services by taking Motta town as a case study.

1.2 Objective of the Study

The amount of money that the users of an environmental good such as water are able and willing to pay is essential to set the correct price information for effective policy and planning by the utility management to ensure the sustainability of the service. Thus the general objective of this study is to estimate household willingness to pay (WTP) for improved water services by taking Motta town as a case study. The specific objectives of the study are:

- To elicit households' willingness to pay (WTP) for improved water services from hypothetical market scenario using the contingent valuation method (CVM).
- To examine the determinants of households' willingness to pay for improved water services in Motta town.
- To use WTP responses to calculate aggregate benefit.
- To draw policy implication

1.3 Significance of the Study

For developing countries like Ethiopia where there is a problem of safe and adequate water to fulfill the need of the population, research on variables such as consumers willingness to pay for improved water services is important. It is difficult for the government to provide safe potable water services free of charge because it requires high investment, maintenance and operation costs. Therefore there should be a requirement from the users of the service to pay for the water

service they get from the improved service. Thus, for potable water development projects, information on the amount of money that the service users are willing to pay for the improved water service is essential.

There have been few studies on willingness to pay (WTP) for improved water service in Ethiopia but none has been done in Motta town. It is therefore important for policy and/decision makers to know the amount of money the inhabitants of Motta town are willing to pay for improved water services and factors that affect their WTP. The final outcome of the study will also be an additional contribution to studies conducted in the past to evaluate improved water services. In general, this study is expected to contribute to the country's implementation of its water sector development strategies. More particularly, the results of the investigation are expected to help the town administration, town water supply office, NGOs and other interested donor agencies that work on this sector.

1.4 Scope and Limitation of the Study

Even though this study involves detailed investigation, it is limited to the analysis of the demand side about water supply service for household domestic purposes from a cross section data of households at a given point in time. Thus, while users of the improved water service also include public bodies and commercial sectors, this study deals only with improved water services of households in Motta town.

Further the sample used for this study is limited in both coverage and size. The coverage of the study is limited only to the urban part of the town administration and the sample size is limited to 220 households. This is because of time and financial constraints that prevent the possibility of wider coverage.

1.5 Organization of the Study

The remaining part of the paper is organized as follows. Chapter two focused on background of the study area. The third chapter deals with theoretical and empirical literature review followed by the fourth chapter which is devoted to the data source and research methodologies. Chapter five provides descriptive analysis, estimation results and discussions. Finally in chapter six, the study provides conclusions and policy implications.

CHAPTER TWO

WATER SUPPLY SITUATION OF THE TOWN

2.1 Description of the Study Area

During the five years occupation of Ethiopia from 1936-1941, the Italians have made Motta town as a center of administration in Ethiopia. The Italians have also constructed a modern air port, bridge and many other buildings like schools in the city enriching it with basic infrastructure in its history (Motta Town Water Service Office Document, 2010).

The town is situated in the Amhara Regional state under East Gojjam administration. The town is about 120 kilometers (Km) east of Bahir Dar, 202 km north of Debremarkos and 368 km north-west of Addis Ababa. According to the current master plan, the total area of the town is 14,728 hectares and topographically the town's areas are 68% alluvial plains, 4% gorge and 16% ups and downs at elevation of 1800-2415 meters above sea level. Ecologically the town is located in tropical rainy climate zone, "Weyna Dega", which receives moderate rain fall throughout the year, where the mean annual rain fall ranges from 1100-1189 mm which is bimodal in nature, receiving the greatest rain fall in summer and the smallest portion in spring. The mean annual daily temperature of the town lies between 14 ^{o}c and 20 ^{o}c with an approximate average of 16 ^{o}c.

Based on the 2007 (1999 E. C) national population and housing census the population of the town is 70, 739 including the additional four rural kebeles. The population of only the town administration where this research is implemented is 39,470. In terms of gender composition, the female population is slightly higher than the number of males: 52.28 % (20,635) compared with 47.72% (18.835) and most of the inhabitants are civil servants, business men, and pensioners.

The town has twenty four hour hydroelectric power supply and some small scale industries such as steel rolling and flour mills. The town also has primary schools, secondary schools, and preparatory school, technical and vocational college and health institutions (i.e. hospital and clinics), banks (government and private), government offices, shops and restaurants indicating the presence of a considerable socio- economic activity.

2.2 Water Supply Situation of the Town

According to the information obtained from the town's water service office, the main source of water for the inhabitants is ground water and the town uses pipe water starting from 1985. In 1985, the first borehole which is found at the center of the town was drilled with a production capacity of only 3.4 L/s, and after 2 years the second boreholes which was drilled from the river called 'Sedie' in 1987 and connected to the existing system with the capacity of 6 L/s. Currently, additional 8 boreholes are being drilled from the same river, 10 Km away from the town to manage the water shortage.

The water from the two boreholes is being distributed to the consumers through 1,290 connections and six public fountains. Water shortage is a major problem of the existing systems, because according to the data obtained from the town's water service office the water coverage of the town is on average 22.6 % only and particularly Kebele 3 and 4 have severe water shortage problem. In addition due to lack of preventive maintenance of pipes, there is a leakage from the water use practice. For example from the year 2004/5 to 2009/10 a total of 382,160 cubic meters of water was produced but only 309,102 cubic meters of water was used by consumers. That is 73,058 cubic meters or 19.12% of the total water produced was lost through leakage.

The total water produced, consumed and lost through leakage in the year 2004/5 to 2009/10 is shown in table 2.1.

Table 2.1 Water produced, consumed and lost through leakage in the years 2004/5 to 2009/10

Year	Water produced In M^3	Water consumed In M^3	Leakage in M^3	Leakage in %
2004/5	57,301	50,866	6,435	11.23
2005/6	77, 518	62,881	14,637	18.88
2006/7	79,673	60,417	19,256	24.17
2007/8	81,785	64,883	19,902	24.33
2009/10	85,849	70,055	15,794	18.40

Source: Motta town water service, 2010.

As shown in table 2.1, water production volume has increased from year to year in the past five years, but still the water coverage is 22.6% on average and the service has a problem of interruption, and low pressure. In addition to this the demand for water in the town is increasing due to high population growth rate and better development of the town along all sectors of the town and hence many segments of the population are complaining due to the prevailing shortage of the water supply. In general the volume of water delivered is very far from being satisfactory as compared to the current water demand.

Regarding water distribution, in 2009/10 treated water is distributed to the consumers through a total connection of 1,290 (of which 1,087 are residential consumers, 146 business organizations, and 57 government organizations), and 6 functional fountains which are out sourced to groups.

2.3 Water Tariff Structure of the Town

Before 2003/4, the tariff structure of Motta town water service office for one cubic meter was birr 0.3 and birr 0.45 at the public functional fountains and private connections respectively, but starting from January 2004, the price of one cubic meter increased to birr 0.47 and birr 0.60 respectively for public foundations and private connections. However, since the beginning of 2007, the town's water supply office applied progressive tariff

structure on private connections and the tariff structure for public fountains is birr 2.60 for one cubic meter.

As can be seen from table 2.2, customers are categorized into four groups and the tariff rate is one of the highest in the Amhara region particularly for those using private connections.

Table 2.2 Water Tariff Structure of the town's water service office at Private Connection and Public Fountains

Consumption Block (M^3/month)	**Tariff in Birr/M^3**
From 1-5 m^3	3.0
6-10m^3	3.5
11-15m^3	4.0
16-20m^3	4.5
Above 20m^3	5.0
Public fountain	2.6

Source: Motta town water service office, 2010

2.4 Revenue and Expenditure of Motta Town Water Service

The source of revenue of water utility, which is sale of water, connection fee, other miscellaneous income, and loans and subsidies from the town's administration, has grown exponentially in the last five years. The total revenue in 2008/9 (2001 E.C) was birr 475,325 while the expenditure in the same year was birr 147,980, and thus net cash flows for the year was Birr 327,345. Starting from 2006/7 the town water service has been covering its operation and maintenance costs and positive cash flows in the last three years are continuously rising despite 19.12% water leakage

CHAPTER THREE

REVIEW OF THE LITERATURE

3.1 Theoretical Literature Review

This section deals with the theoretical foundation for the techniques that economists developed for valuation of natural resources and the environment.

3.1.1 Measures of Welfare Change

There is no direct way of measuring individuals gain or loss from policy changes due to unobservable individual utility function. The changes in prices or quantities or both which causes change in utility, leads to a change in welfare of the society which is in turn measured in terms of each individual assessment of changes in well-being from policy changes. A classical tool for measuring such welfare change is consumer's surplus which can be an exact measure of welfare change in the case where consumer's preference is represented by quasi-linear utility function. In addition, even if utility is not quasi-linear it may be a reasonable approximation to more exact measures (Varian, 1992, pp.163-164). Further consumer's surplus is able to transform unobservable utility gains in to observable monetary unit (Johansson, 1991, pp.40-41).

Consumer surplus has its own shortcoming as a measure of welfare change. A basic problem is its path dependence, that is the sum of changes in consumer surplus and/or WTP depends on the order in which prices are changed.

Sir John Hicks introduced four measures of welfare change: Compensating Variation (CV), Equivalent Variation (EV), Compensating Surplus (CS) and Equivalent Surplus (ES).

The CV and EV of the utility change are associated with discrete changes in prices. The EV measure tells us how much extra money income would have to be given to an individual, willing to accept (WTA) for the person to attain the final improved utility level, where as

CV, for a proposed welfare gain it can tell us how much money income individual would be willing to pay to insure that the change occurs (Perman et al, 2003, p.405). To the contrary of Marshallian consumer surplus (MCS) the CV and EV measures do not rely on any assumption about the constancy of marginal utility of income (Freeman, 1993, pp. 55-56). If the change in price or income reduces the welfare of the consumer both EV and CV measures have negative sign, but if the change in price and /or income increases the welfare of the consumer, both the EV and CV have positive sign (Johanson, 1991, p.51).

If the utility function is quasi-linear and when the income elasticity of demand for the good is zero, the CV, EV and MCS are equal that is MCS=EV=CV but not for homotonic utility function. When utility function is homotonic and the goods are normal, for the rise in price CV>MCS>EV or WTA>MCS>WTP and for the fall in price CV<MCS<EV or WTP<MCS<WTA (Johanson, 1991, p. 41-53; Perman et al 2003, p. 407). The relationship between the CV/EV welfare measures and the WTP/WTA are shown in table 3.1.

Table 3.1: Summary of the relationship between CV/EV measure of price change and WTP/WTA compensation

	CV	**EV**
Price fall	WTP for change occurring	WTA compensation for change not occurring
Price rise	WTA compensation for change occurring	WTP for change not to occur

Source: Adapted from Perman et al, p. 407

Compensating surplus(CS) and Equivalent surplus(ES) are the other two measures of welfare changes which are not associated with price change but with quality or quantity changes of environmental goods and services. The CS can be defined as what compensating payment will make the individuals indifferent as to the original situation and the opportunity to purchase the new quantity of the good. It measures the maximum amount of money that individuals are willing to pay to secure an increased provision of the good. This measure is

clearly related to CV, but there is the restriction on adjusting the purchase of the good in response to the compensating change in income. On the other hand ES can be defined as ,what changes in income is required, given the old price and consumption level of the good ,in order to make the individual as well-off as the person would be in the new price set and consumption point . It measures the minimum amount an individual would be willing to accept before the change to make them as well-off as they would have been following an increase in provision of public good (Ng Yew-Kwng, 1985, p.87).The relationship between CS/ES welfare measures and WTP/WTA are shown in table 3.2

Table 3.2: Summary of the relationship between WTP/WTA and the CS/ES measures for changes in quality/quantity of environmental goods.

	CS	**ES**
Improvement	WTP for change occurring	WTA compensation for the change not occurring
Deterioration	WTA compensating for the change occurring	WTP for the change not to occur

Source: Adapted from Perman et al, p.409

From the above measure of welfare change, the appropriate welfare measure depends on the type of the problem. When a third party chooses the change in the environmental good, welfare change corresponds to either CS or ES rather than EV or CV (Hanley et al, 1997, p.383).For instance the government which is the third party provides the supply of improved water and hence the CS which measures the reduction in income that would maintain utility at the same level as before the improvement is used to measure welfare gains from the improved water supply project (Young, 2005, p.280).

The CS can be defined by using either the expenditure function or indirect utility function. The CS by using the expenditure function can be defined as

$$CS = e(p, r, q^o, u^o) - e(p, r, q^1, u^o) \quad \text{----------1}$$

$$= M - e(p, r, q^1, u^o) \quad \text{----------2}$$

Where p is price of the private good, q^o is environmental goods and services at the status quo level, q^1 is environmental goods and services after improvement, r is the price of environmental goods and services and M is the level of money income. In terms of the indirect utility function, CS can be defined as follows.

$V(p, M-rq^o, q^o) = v(p, M-rq^1-CS, q^1)$ ----------3

3.1.2 Theory of Environmental Resource Valuation

Economists have made considerable efforts over the past few decades for valuing an increasing number of environmental goods and services around the world for the purpose of developing better methods to estimate the value and benefits of environmental quality improvements. Increasing complexities in designing procedures and analytical structure have enhanced the optimism of economists about using non market valuation as a basic instrument to assist decision making (Hanley et al., 1997). However the term value by itself has many meanings which may be used in different senses. In economics the theory of value attempts to explain the worth of goods and services. For classical economists value of the good is the amount of labor embodied in the commodity (Srivastava, 1996, p.140), but the neoclassical economists used marginal utility gained by an individual from the last unit consumed to explain the market price of the given commodity. Further the neoclassical replaced classical notions of absolute scarcity with relative values as determined by the forces of demand and supply and since then the theory of value is developed along this neoclassical line (Perman et al, 2003, p.6)

Depending on various circumstances, economists place total economic value (TEV) on either stocks or flow of natural resources. Total economic value can be divided in to three main components namely use value, option value and non-use value. Use value arises from direct or indirect physical benefits human being obtains from environmental resources. The

option value reflects the value individuals give to the future uses of environmental resources that is it indicates individuals' willingness to preserve environmental assets for future uses even if he/she does not use the resources currently. Non-use value is obtained without actually using the resources/services, which reflects that people are willing to improve or preserve environmental resources that they do not use and will never use. Thus total willingness to pay for environmental resources is the sum of use value, option value and non-use value (Tietenberng, 2003).

3.1.3 Valuation Methods for Non- market Goods

Environmental goods are not traded, thus their value cannot be determined in the market. This is a challenge to policy makers in cost- benefit analysis of projects which involve environmental benefits and costs. We therefore require non- market valuation techniques to value improvements and/or reduction in environmental goods and services including water.

"Although water is increasingly allocated by market mechanism its attributes makes it a classic example of the markets potential failure to achieve an economically efficient allocation. Externalities, public goods decrease cost in supply and high transaction costs are among reasons why markets will not always serve society in allocating water resources .Thus we use non- market valuation techniques to provide measures of value and scarcity for economic policy making related to water"(Young, 2005, p. 22).

The relentless effort by economists has brought various methods to value non- marketed goods. In relation to this, various valuation methods are available to attach economic values to non-marketed economic resources such as water. According to Callan and Thomas (1996), the methods can be discussed in to two parts: indirect (revealed preference) method and direct (expressed, stated preference) methods.

3.1.3.1 The indirect methods of valuation

The indirect (revealed preference) methods involves inferring the unobservable demand, and hence value of environmental goods and services, based on observable demand for related marketable goods and services. That is, economists try to infer the demand for environmental goods and services by using information on market transaction for related private goods and services (Freeman, 1993 and Tietenberg, 2003). While there are many indirect estimation methods we consider two common methods on benefit valuation: the Travel Cost Method (TCM) and the Hedonic Pricing Method (HPM)

The Travel Cost Method (TCM)

This method originated with a letter sent to U.S.A national park by Harold Hotelling and it uses the complimentary relationship between the quality of natural resource and its recreational use value. The method estimates the demand function of recreational site and the site's consumer surplus, which depends on information about the amount of money and time people, spent getting in to a site to infer a value for that site. According to Callan and Thomas (1996), TCM has a primary advantage of measuring environmental benefits based on actual behavior, but the method failed to estimate non-use value. The other drawback of the method is that its application is limited only for valuation of recreational site, making it ineffective for estimating any incremental benefits that might accrue to commercial users of the resource (Seller, et al, 1985)

The Hedonic Pricing Method (HPM)

This method is based on theory that a good or service is valued for the attributes or characteristics it possesses. The method indirectly measures people's WTP for change in water attributes when housing prices can be affected by the availability of improved water supply. The main advantage of this method is that, since it is based on actual market prices,

its application is straight forward and not so controversial. According to Carson (2000), however, this method does not capture non-use value that is very important when we deal with environment and hence understate the total economic value.

3.1.3.2 The Direct Method of Valuation

The direct (stated preference) method refers to the direct expression of individuals' WTP or WTA in compensation for any change in environmental qualities, quantities or both. That is it involves direct estimation of environmental value based on the responses of individuals to the hypothetical valuation questions and hence it does not depend on market information .This approach includes Contingent Valuation Method(CVM), Contingent Ranking(CR), Choice experiment(CE) and Conjoint Analysis(CA). From all these, the most widely used stated preference method for estimating non-market values is the Contingent Valuation Method (CVM) (Freeman, 1993). Since these direct methods such as CVM rely on surveys, they 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 are good to measure people's preferences for government policies or programs to changes in the quality of environmental goods
- They can be prospective and used where no related market data are available for estimating use values.

We discus only the CVM below for it is the most widely used stated preference method and is the one used in this study.

Contingent Valuation Method (CVM):

When market data are unavailable or unreliable, economists can use alternative estimation methods that rely on hypothetical market conditions which typically use survey to inquire about individuals WTP for some environmental policy initiative.

The CVM is the earliest technique of the stated preference method of non-market valuation approaches and first came in to use in the early 1960s, by Robert K. Davis (1963) when he used questionnaire to estimate outdoor recreation benefits of Maine back woods area. Since then the method has been used by economists to measure the benefits of a variety of environmental goods (Mitchell and Carson, 1989).

The CVM involves asking people directly what they would be WTP or WTA compensation for change in preferences and the method is called contingent valuation for it is contingent on the hypothetical market. The CVM is preferred to the revealed preference methods for it includes both use and non- use values and survey responses to WTP or WTA hypothetical questions go directly to the monetary measures of utility change (Perman et al., 2003, p. 420). Further the CVM has ease of flexibility and therefore, it is the only technique theoretically capable of estimating the benefits produced by water quality improvements, including non use values. Thus based on the reasons mentioned above CVM is employed for this study. But it has its own limitation relative to the other stated preference method such as choice experiment (CE). For example CVM is not doing better than CE in measuring the marginal value of changes in the characteristics of environmental goods. Further the CE may avoid some of the response difficulties of the CV such as a Yea- saying tendency of respondents in dichotomous choice design and incentive incompatibility (Perman et al, 2003).

The major steps involved in using CVM include:

1. Designing and administering a CV survey that elicits individual's value for a good or service. According to Mitchell and Carson (1989), in this step of a CVM, the questionnaire consists of three parts. The first part of the questionnaire includes a hypothetical description of the terms under which the good or service is to be offered to the respondent. The second part tries to determine how much the respondent values a good or service (elicitation of WTP or WTA). The third part includes questions about socio-economic and demographic characteristics of the respondents including his/her family.
2. Analyzing WTP responses–this involves the calculation of frequency distribution, cross tabulation of WTP responses with socio- economic characteristics and other variables and the estimation of the bid function.
3. Estimating aggregate benefits and total revenue- calculating the total economic benefit (total WTP) which can be calculated by multiplying the population by the mean WTP.
4. Evaluating the CVM exercise (validation tests) – undertaking validity test to determine whether the CVM results are acceptable or not.

Although a number of researchers have employed the CVM, using such survey method has some basic problems in the sense that survey respondents could give biased information. The fact that the method is based on hypothetical scenario rather than actual behavior is the source of enormous controversy. Thus there will be biases which systematically understate or over state true values. There are a number of types of bias indicated in the literature, but the four major potential biases in the CV survey are strategic bias, starting point bias, hypothetical bias and information bias (Tietenberg, 2003)

The basic idea of strategic bias is that an individual may not have an incentive to reveal his/her true preference about an environmental good when responding to questions about WTP. To reduce this bias, the questionnaire for this study is designed with somehow detailed description of the proposed improvements of the scenario.

The concept of starting point bias is mostly associated with bidding games. Thus we test this in the study to check whether there is such a bias since the maximum WTP is asked in the open-ended format which involves starting points after the closed-ended questions.

As the name indicates hypothetical bias may occur because the market is hypothetical and thus the respondents may view questions as not believable or unrealistic and provide equally unrealistic responses. That is, since the respondents are not actually expected to pay the estimated values, the respondents may treat the survey by providing ill-considered answers. We tried to minimize such a bias in this study by a careful description of the good under consideration to the respondents.

The problem of information bias may arise if there is insufficient or too much information about the commodity being valued and hence the individuals' WTP response may not be equivalent to the actual WTP. Thus if the respondents have no experience about attributes of resources they are asked to value, the valuation will be based on an entirely false perception. In this study to minimize such biases the survey design was administered carefully and training was given to the interviewers.

Contingent valuation (CV) elicitation techniques

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. Mitchell and Carson (1989) further argue that the method is difficult since respondents 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

point bias and may be boring to 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, that is stated and 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 preference methods are used to estimate people's WTP for environmental public good 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 Motta town.

3.2 Empirical Literature Review

3.2.1 Water related CVM empirical studies

The Contingent Valuation Method has found extensive applications in recent years in valuing of environmental benefits, such as the benefit of reduced air pollution, valuing of water quality, valuing of improved solid waste management and the option or existence value of ecologically important species. Until 1987 the application of CVM was limited in developed countries, but little available work suggests that it can be successfully applied in developing countries as well (Whittington et al., 1990 and 1998).

In short , the above mentioned method of valuation techniques in the theoretical review part have been employed in many studies of valuing public goods like water resources both in developed and developing countries. Some of the CVM studies done on improved water supply services in developing countries in general and Ethiopia in particular are reviewed below.

Fujita et al, (2005) assessed the WTP for improved water supply and sanitation service in Iquitos city, the Republic of Peru. In this study double bounded CVM format was used and to analyze the survey responses, the survival analysis and Weibell models were employed. The findings indicate that age of respondent, household income and current water usage practices determine households' WTP for the improved water supply services. Further the results 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.

Nam and Son (2004) used CVM and Choice Modeling (CM) to assess household demand for the improved water services in Ho Chi Minch city, Vietnam. The study employed the Logarithmic Random Utility Model for the CVM and the Multinomial Logit for the choice modeling to analyze survey responses. Further the study also used Turnbull estimates for

non-piped water households to see the surveyed households WTP at various connection free levels. The findings of the CVM study indicate that the coefficient of household size, number of children in the households, water pressure and composite income (household income and bid price) were found significant for piped water and the coefficient of fridge, bottle and composite income were found statistically significant for non- piped one. The findings of the study also clearly indicate that the probability of 'yes' decreases with the increase in the availability of water and increases with the increase in composite income and increase in household size. Besides, the study result also shows that those households who own fridge and used bottled water have no WTP for the improved water services. The results of choice modeling indicate that the coefficients of monthly water bill, water quality and water pressure had expected sign and statistically significant.

Montes et al (2003) conducted a study on assessing the WTP for maintained and improved water supply in Mexico City. The result showed that the poorer households were primarily concerned with securing reliable services while wealthier households who already enjoy better services were willing to pay higher amount to avoid service deterioration than for improvements. The study demonstrates how WTP results can be used to create equity based policy of water tariffs reflecting income distribution. The aggregate WTP amounts showed that the authorities could collect sufficient resources for both service modernization and could also reduce existing subsidies by 70%.

Nallathiga and Paravatsu (2003) conducted CV survey to determine the economic value of water quality improvement for river Yamuna in India and the study employed a CVM based on double bounded format. About 125 households were randomly selected from representative clusters spread across upstream, middle stream and down-stream contiguous areas of the river and the survey was carried out only for a sample of 112. The result of the multiple linear regression analysis showed that the average WTP for current river water

quality maintenance was found to be Rs73.86 per capita per year, while maximum WTP was found to be Rs 77.86 which indicates that the WTP for river water quality improvement is small but significant. Moreover the survey results showed that the people being aware of a variety of water goods and services provided by the river water are inclined to conserve water quality by paying a premium for it and income and perception are important determinants of WTP.

Abdella (2003) attempted to establish the value of water supply services to the people of Zanzibar town by measuring their WTP for reliable water supply services. This study was conducted using CVM and 300 people in Zanzibar were interviewed and WTP responses were elicited using open-ended question. The OLS model is used to evaluate the effect of socio-economic variables by analyzing the responses to establish the value of water supply services to the town's inhabitants. The results of this study have shown that contrary to the governments' belief, the people of Zanzibar town put value in the water services that they receive. Thus they are willing to pay for improved water services but were generally reluctant to pay for the poor services that are currently being improved.

Chowdhury (1999) uses the CVM to estimate Dhaka Slum-dwellers WTP for safe drinking water and the findings of the study illustrate the Slum dwellers are willing to pay enough for water to cover the costs of providing it by suggesting that higher water charges would be financially feasible to generate funds for water system investment. The study also shows that CV is an effective tool for estimating WTP for a variety of public services.

Tapvong and 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 WTP of respondents. The data were collected from a sample of 1100 household in 20

districts in Bangkok. Of the 1100 households 1020 provided sufficiently complete responses to permit empirical analysis.

The use of logistic regression to study the WTP for the waste water treatment services indicate that education, knowledge and importance of the project, living near a river or canal and referendum fees are the factors governing the respondents' behavior to pay for the service. 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.

Day and Mourato (1998) estimated value of water quality in the Beijing Metropolitan local rivers using the CVM survey analysis. A carefully designed CV questionnaire was administered with a random sample of 999 people in the Beijing area. The study reported the annual average WTP per household to maintain water quality in all rivers in Beijing metropolitan region to be US $22.

Choe et al (1994) conducted a CVM survey based on open ended and dichotomous choice format to determine the economic value of water quality improvement for rivers and sea near Davao City, Philippines. About 777 households were randomly selected from a relevant population. The cost of clean-up estimated that ranges from $5 to $15 for each household per month and the result shows that from the CVM the estimated average WTP values of the users of Times beach for water quality ranges from $1.2 to $2.04 per month. The mean WTP of non- users of the beach for an improvement of water quality ranges from $0.04 to $14 per month. A closer investigation showed that also people are aware of the poor quality status, they do not place a high priority on it because of the existence of other environmental problem that are more urgent in the areas such as deforestation and poor management of

solid waste. The policy message of the study is to wait until incomes and WTP are higher before engaging on large investments.

Briscoe et al (1990) employed CVM to assess households' WTP for the improved water supply in three rural areas of Brazil. In this study the bidding game was administered and the Probit, Tobit and Multinomial Logit models were used to analyze the survey responses. The findings of the study indicate that the majority of the surveyed households are prepared to pay much higher tariffs than the existing once. The WTP for yard tap is positively affected by income, assets, education and formal sector occupation. Further the findings of the study also indicate that it is possible to provide free water to the public at public taps without harming the financial viability of the scheme.

Mitchell and Carson (1989) conducted a study to determine the national benefits of fresh water pollution control in America and estimating the aggregate benefits of meeting the goals of clean water act using data from a national CV survey. They regressed total WTP on water quality level, disposable income, taste; water based recreational use (dummy) and environmental attitude (dummy). The result shows that all the coefficients are reasonable in sign and all significant, confirming the importance of peoples attitude towards their WTP for improvement in the public good.

3.2.2 The Ethiopian Experience in Water Related CVM Empirical Studies

The Ethiopian experience reveals that limited CVM studies have been conducted to investigate factors that influence households' WTP for improved water supply in rural and urban areas.

Gossaye Fanta (2007) used the CVM to examine the determinants of households' WTP for improved water services in Debre-Zeit town. The elicitation method used in this study was single- bounded closed-ended followed by open–ended questions. Households' WTP for

improved water service was analyzed by estimating the Probit and the OLS methods. The coefficients of age, household size, volume of water used, reliability of existing water services, the starting bid, and household average monthly income had the expected signs and were statistically significant. The coefficients of education dummy, quality dummy, gender dummy, and satisfaction dummy variables had the expected signs but were not statistically significant.

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, where as 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 Baldi (20 liters container) from single bounded probit model estimates and 15.79 cents per Baldi from the open-ended format.

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

Alebel (2004) examined the affordability and WTP for improved water supply in the urban areas of Ethiopia taking Nazareth town as a case study. He used bidding game value elicitation format with a total number of 307 sampled households during the survey. The study used the Censored Least Absolute Deviation (CLAD) which does not need the assumption of homoscedasticity and normality assumption of the distribution of error term to get consistent estimates. The study also used the probit model to see the effect of explanatory variables on the choice of households to improve the water service. The monthly expenditure for water consumption, quality and time taken to fetch water from the existing source significantly affect the respondents' WTP from the CLAD regression results. While the Probit estimation results indicated that wealth, income, education level, quality and time taken to fetch water affect the respondents' choice of improved water services.

Terefe (2000) adopted the CVM and travel cost (TC) models to estimate benefits from establishment of park around Tis Abay waterfalls. He analyzed the responses by multiple linear regression, Tobit and Probit models and the results revealed that, for the visitors' benefits, the CV produced higher estimates than the TC estimates as the CV estimates consider the non-use value of the commodity to be valued unlike the TC estimates. The findings showed that conducting successfully the CVM and TCM surveys would give useful information on users demand for the public good.

Tsegabirhan (1999) used CVM for investigating farmers WTP for irrigation water in Tigray, Ethiopia using OLS and Orderd Probit regression models. The study estimates WTP of small holder farmers for irrigation water particularly for small scale irrigation schemes. The survey results included the main irrigation seasons and the whole year which depends on 0.25 hectares of irrigable land. The study used a sample of 82 out of 1071 household heads. The findings of the study showed that 90% of the respondents were willing to pay up to birr 600 for the main irrigation system alone. The study further indicates that credit availability,

education and fertilizer supply are major determinants of respondents' WTP. In addition, due to smaller sample size the estimated sample variance increases which could be why many of the variables were found statistically insignificant.

Using a CVM, Assefa (1998) also examined households' WTP for improved water supply in Addis Ababa by taking four kebeles as a case study. In the study Probit binomial models were estimated with LIMDEP 7.0 and the findings of the study indicate that all the coefficients of the explanatory variables had expected signs, though not all of them were significant. The coefficients of income, household size, sex of the respondent, level of education, time required to fetch water and households' attitude towards the responsibility for supplying improved water were found statistically significant. The coefficient of age of the respondent and formal sector employment had the expected signs but insignificant. According to the findings of this research female respondents had more WTP for the improved water services as compared o male respondents.

Fisseha (1997) and Duffel (1998) applied the CVM for measuring the WTP 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 WTP of the household, while education and wealth were insignificant. In Duffel's study family size and sex of the household and in Fissseha's study occupation were insignificant.

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. Besides, from the above empirical studies on CVM, it can be concluded that households' WTP for improved water services is influenced by socio-economic and

demographic characteristics such as education, income, household size, age and gender, characteristics of existing water supply situation like water pressure, water availability time, water charges or prices and satisfaction with existing water service and household water use practice and finally households attitudes towards government policy on water (World Bank, 1993).

CHAPTER FOUR

METHODOLOGY

4.1 Data Source and Type

The data used in this study are mainly primary and cross-sectional for the year 2011 obtained through a contingent valuation survey conducted in Motta town. Using simple random sampling from four kebeles of the town's administration population, 220 face-to-face personal interviews were conducted out of which 206 were found usable. The study is also supplemented by secondary data from the Ministry of Water and Energy (MoWE), Motta town's water service office and other relevant secondary sources from the kebele's administration.

4.2 Sampling Design and Procedures

There is no standard approach to the design of a contingent valuation survey although virtually all contingent valuation surveys consist of several well-defined elements. The design of the contingent valuation questionnaire used to elicit willingness to pay of respondents is done following the recommendations of NOAA panel as is found in, e.g., Portney (1994). In general the most important points considered in the design of the questionnaire include: 1) the interview should be done in person; 2) willingness to pay should be about a future event and not one that already occurred; and 3) the hypothetical facts provided to the respondents must be precise, understandable and constant across the sample and all of which are included in the contingent valuation survey.

The town of Motta was classified in to four town administrative kebeles and we used the list of households that live in each kebele obtained from the kebele's administration that enabled us to get the total number of households that live in each kebele.

The total sample was divided into the four kebeles according to the proportion of households living in each Kebele. And then using simple random sampling procedure sampled households were selected from each kebele and interviewed in person to elicit their willingness to pay for the improved water services, socio-economic and demographic characteristics, water use practice and problems with existing water service systems.

4.3 Questionnaire Development

The contingent valuation questionnaire was based on recommendations in Mitchell and Carson (1989) with some modifications to adapt it to the specific study. To identify the water supply problem of the town and to come up with a first draft of the questionnaire we did focus group discussion at the end of January 2011. After designing the draft questionnaire pre-testing was conducted in each kebele of the town by selecting a random sample of four households from each kebele and a total of 16 household heads were interviewed under this pilot survey which was done by two experienced interviewers and the researcher himself. The pre-test provided some information to make some modification in the design of the final survey questionnaire based on the responses so as to make it understandable for respondents and to enable the interviewers to meet the objective of the study. In addition this pre-testing helped us to set the starting bid for the contingent valuation elicitation part of the questionnaire, where during the pilot survey the willingness to pay part was open-ended. Therefore to consider this answer differences we took the mode, median, mean and maximum amount of the respondent's willingness to pay which are approximately 10, 15, 20 and 25 cents respectively as starting points of the willingness to pay questions. Further the pre- test also showed that respondents were mostly reluctant to answer questions regarding income, wealth and expenditure before the actual water supply problem was discussed. Therefore to address this problem the questionnaire was restructured in such a way that questions on household characteristics (especially questions on income)

appeared in the last part of the questionnaire. Moreover adjustments and corrections were made for a clear understanding of the questionnaire between interviewers and the respondents.

Thus the final version of the survey questionnaire designed for this study has three sections as indicated below.

I-the first part of the survey questionnaire considers questions related to household water usage practice, present status of water supply situation, total time required to fetch water from the existing source, volume of water used by households, status of water borne diseases, household evaluation of water supply situation such as quality and reliability.

II-The second part consists of contingent valuation questions that is double-bounded dichotomous choice questions were used in which case the respondent was asked whether he/she is willing to pay a given bid, and if the individual accepts the initial offer he/she will be asked for a higher (double) amount and if he/she refuses the first bid he/she will be offered a lower (halved) bid. This section also included a hypothetical description of circumstances under which the improved water is made available for those who have private pipe and those who are willing to have private pipe. General questions on the existing water supply situation were also included.

III- In the third part of the questionnaire, information regarding characteristics of households (for example, income, age, education, sex, wealth and so on) was collected. This section includes a series of questions about the socio-economic and demographic characteristics of households. The final version of the questionnaire was translated in to Amharic language.

A total of four enumerators and two supervisors including the researcher himself participated in the actual survey where all the enumerators were selected based on their

previous experience in house hold survey. A two-day training of enumerators and a supervisor was conducted. The field survey was implemented from February 28 to March 23, 2011. The field survey was successfully completed with a relatively small number of misused and incomplete responses of (6.36%).

4.4 EMPIRICAL MODELS

This research focuses on the double-bounded question format to elicit the WTP for the purpose of statistical efficiency and consistency (Hanemann et al. 1991; Cameron et al. 1994). The main advantage of double-bounded over single-bounded format is increasing the statistical efficiency of CV surveys in three ways. Firstly the number of responses will increase. Secondly, even if there may be cases with no clear bound on the responses (the case of Yes-Yes or No-No), it is used to constrain the distribution of WTP. Finally there will be clear bound in WTP responses in the case of Yes –No or No-Yes responses.

Given the nature of the data, the survey responses obtained from the contingent valuation study are analyzed using descriptive statistics and econometric models

From a total of 220 households 206 (93.64%) were analyzed and out of these 206 usable responses 7 (3.40%) of the respondents have zero WTP. The remaining 14 (6.36 %) households gave incomplete or misused responses. The probit model was estimated for single-bounded dichotomous choice and it is used to identify factors affecting the probability of having positive willingness to pay for improved water service and to estimate mean willingness to pay where as the bivariate-probit was estimated to see whether the double-bounded follow-up increases the statistical efficiency or not compared to that of the single-bounded format. The Tobit model was estimated for a follow-up open-ended format to estimate the mean willingness to pay and factors affecting the maximum amount of money that households are willing to pay for the proposed improved water supply scheme.

4.4.1 Model Specification

4.4.1.1 The Probit Model

According to Habb and McConnell the main objective of estimating econometric model in willingness to pay survey is to calculate mean willingness to pay and to allow inclusion of respondents' socio-economic factors in to willingness to pay functions which supports the researcher to obtain information on the validity and reliability of the contingent valuation results and hence increasing confidence in application of results obtained from the contingent valuation empirical analysis (Habb and McConnell, 2002). In the probit model used to analyze the responses to the close-ended dichotomous format, individuals are given the initial 'bid' that has 'yes' or 'no' responses. The basic model for analyzing such dichotomous contingent valuation responses is Random Utility Model (RUM) which was constructed by Hanemann (1984). This random utility model starts with utility function where by indirect utility of an individual contains deterministic and stochastic components. This is because although an individual knows his/her utility with certainty, it has some components which are not observable from the view point of the researcher and hence the researcher can only make probability statement about respondents' 'yes' or 'no' responses to the proposed scenario.

The indirect utility function for respondent 'j' can be written as follows (Habb and McConnell, 2002)

$$V_{ij} = V_i (Yj, Xj, \varepsilon_{ij}) \text{ ----------} \quad \textbf{4.1}$$

Where **Yj =jth** respondent's income

[i]= 1 denotes the final state (after improvement) and **i**=0 denotes the status quo (initial state)

X_j= is vector of household characteristics and attributes of a given choice.

ε_{ij}= is the random component of a given indirect utility that is the stochastic disturbance term assumed to be independently and identically distributed with mean 'zero and a constant variance of σ^2.

Based on this model respondent 'j' answers 'yes' or 'no' to a required payment of initial 'bid' price β_i^* for a proposed improved water service. Households are faced with two choices: either to maintain the status quo or to accept the improvement. Therefore the household will choose the improved water service, if the utility with the contingent valuation program, net of the required payment, that is the initial 'bid', exceeds utility of the status quo.

$$\mathbf{V_{1j}\,(Y_j-\beta_i^*,\, X_j,\, \varepsilon_{1j}) > V_{0j}\,(Y_j,\, Xj, \varepsilon_{0j}\,)} \text{ ----------} \mathbf{4.2}$$

By specifying the utility function as additively separable in deterministic and stochastic preferences, and by assuming linear functional forms (which is the simplest and most commonly used), it can be rewritten as:

$$\mathbf{V_{1j}\,(Y_j-\beta_i^*, X_j) + \varepsilon_{1j} > V_{0j}\,(Y_j, X_j) + \varepsilon_{0j}} \text{----------} \mathbf{4.3}$$

$$\mathbf{= \alpha_j X_j + \beta_1\,(Y_j-\beta_i^*) + \varepsilon_{1j} > \alpha_j X_j + \beta_o Y_j + \varepsilon_{0j}} \text{----------} \mathbf{4.4}$$

Where α_j is a vector of parameters and X_j is different explanatory variables excluding income. The fundamental problem that the researcher may encounter here is that the random component of preferences cannot be known; therefore he/she can only make probability statement about 'yes' or 'no' responses for the given bid which provides an intuitive basis to analyze binary responses. Thus the probability that the respondent says 'yes' is the probability that he/she thinks he/she is better-off from the improved water service program.

$$\mathbf{Pr.\,(Yes) = Pr.\,[V_{1j}\,(Y_j-\beta_i^*,\, Xj) + \varepsilon_{1j} > V_{oj}\,(Y_j,\, Xj) + \varepsilon_{0j}]} \text{ ----------} \mathbf{4.5}$$

$$\mathbf{Pr.\ (V_{1j} > V_{0j}) = Pr.\ [V_{1j}\,(Y_j - \beta_i^{*},\ Xj) + \varepsilon_{1j} > V_{0j}\,(Y_j, X_j) + \varepsilon_{0j}]} \quad \text{----------4.6}$$

$$\mathbf{= Pr.\ [V_{1j}\,(Y_j - \beta_i^{*},\ Xj) - V_{0j}\,(Y_j,\ Xj)] > \varepsilon_{0j} - \varepsilon_{1j}} \quad \text{----------4.7}$$

$$\mathbf{= Pr\ [V_{1j}\,(.) - V_{oj}\,(.) + \varepsilon_{1j} - \varepsilon_{0j} > 0]} \quad \text{----------4.8}$$

$$\mathbf{= Pr\ [\Delta V + \eta > 0]} \quad \text{----------4.9}$$

$$\mathbf{And\ Pr.\ (No_j) = 1 - Pr.\ (Yes)} \quad \text{----------4.10}$$

$$\mathbf{Pr.\ (V_{1j} \leq V_{0j}) = 1 - Pr.\ (V_{1j} > V_{0j})} \quad \text{----------4.11}$$

$$\mathbf{= 1 - Pr\ [\Delta V + \eta > 0]} \quad \text{----------4.12}$$

Where $\eta = \varepsilon_{1j} - \varepsilon_{0j}$ and letting $F_\eta\,(.)$ be a cumulative distribution function, and in the probit model it follows the normal cumulative distribution function and in the logit model $F_\eta(.)$ follows the logistic cumulative distribution function. The choice between the two models is a matter of mathematical convenience, since both the logit and probit models give similar parameter estimates (Habb and McConnell, 2002, p.28).

Assuming the normal cumulative distribution the probit model can be given by:

$$\mathbf{T_j^{*} = \beta' X_j + \varepsilon_j} \quad \text{----------4.13}$$

Where T_i^{*}= is unobservable latent variable, that is unobservable households' willingness to pay for improved water supply. What we observe is a dummy variable WTP_i which is defined as:

$$\mathbf{WTP_j = 1\ if\ T_j^{*} \geq \beta_i^{*}\ (T_j^{*} = 1,\ if\ the\ response\ is\ 'yes')}$$

$$\mathbf{WTP_j = 0\ if\ T_j^{*} < \beta_i^{*}\ (T_j^{*} = 0,\ if\ the\ response\ is\ 'No')}$$

$\mathbf{B_i^{*}}$**=**is the initial bid price offered to respondents

ε_j=is the random error term which is assumed to have random normal distribution with

mean 'zero' and common variance of σ^2.

$\mathbf{X_j}$ =is a vector of explanatory variables

It is clear that from the random utility framework that the individuals' willingness to pay is a random variable from the point of view of the researcher. Thus, while the individual knows his/her own maximum willingness to pay, T_I^*, it is a random variable to the observer with a given cumulative distribution function (cdf) denoted $F(T_i^*/X_i, \theta)$,where θ is the parameter of this distribution, which is estimated on the basis of the responses to the contingent valuation survey, T_i^* is the response of the individual and T_i^* =1, if 'Yes', T_i^*= 0, if 'No' and X_i is explanatory variables. In short in this elicitation format the respondents are asked whether they are willing to pay the initial 'bid' (β_i^*) to get the improved water services and thus they were answering by saying 'Yes' or 'No' , their actual willingness to pay for the improved water service is not observable. Thus this 'Yes' or 'No' responses obtained from the closed-ended survey is estimated by Maximum Likelihood procedures and thus the Likelihood function can be expressed as a series of Bernoulli trials

$$\mathbf{L=\sum T_j^* \ln F_j + (1-T_j^*) \ln (1-F_j)} \quad \text{----------4.14}$$

Where F_j =F (T_j^*/X_j, θ), i^{th} individual's response probability and T_j^* is the dummy variable indicating an individual choice 1 for 'Yes' and 0 for 'No' (Hanemann and Kanninen, 1998, p.23).

Based on the above justification, we specify the probit model for households' preference for the improved water services as follows:

$$WTP_i=\beta_O+\beta_1 GNDR+\beta_2 EDUR_1+\beta_3 EDUR_2+\beta_4 EDUR_3+\beta_5 AGER+\beta_6 RESP$$

$$+\beta_7 LSAT+\beta_8 FAMS+\beta_9 WLTH+\beta_{10} OCCR+\beta_{11} RLTY+\beta_{12} VOLM$$

$$+\beta_{13} QLTY+\beta_{14} TIME+\beta_{15} REYS+\beta_{16} IB+\beta_{17} INCM+\beta_{18} SORC$$

$$+\beta_{19} HHHEAD+\varepsilon i \text{----------} \quad \textbf{4.15}$$

Where WTPi = response to the 'bid' which is 1 if the response is 'Yes', 0 if the response is 'No', β_i is the regression parameter, εi is the error term and the explanatory variables are as defined in the variable description part. The regression parameters were estimated by Maximum Likelihood technique using STATA econometric software.

One of the main objectives of estimating empirical WTP model based on a CV survey response is to derive central value (or mean) of the WTP distribution (Hanemann, Loomis and Kanninen, 1991). The mean and the median measures are the most widely used measures of welfare change, where the mean measure is more sensitive to skewness or kurtosis, and the median measure has statistically a smaller sampling error than the mean estimate (Hanemann and Kanninen, 1998, pp.18-19).

The mean is an appropriate welfare measure in the cost benefit analysis as it reflects the Kaldor-Hicks compensation criterion, but not the median (Hanemann and Kanninen, p.23). Because of this the mean measure is employed to calculate the total benefit of the improved water services in this study. Since the probit model is used to calculate the mean WTP, for the closed-ended single bounded questions it can be defined as follows:

$$\textbf{Mean WTP} = \mu = -\sigma/\beta \text{----------} \quad \textbf{4.16}$$

Where **σ=**is the constant or intercept term

B= is the coefficient of the 'bid' posed to the respondent

4.4.1.2 The Bi-variate probit model

In the bi-variate probit model of double-bounded dichotomous format, individuals are asked two respective questions that has 'Yes' or 'No' responses where the second question involves another bid depending on the first answer. There is a need to derive the likelihood function of the model to get the parameter estimates of this bi-variate probit model, which takes in to consideration the follow-up questions in the double-bounded dichotomous choice. If we assume the unobserved willingness to pay of the respondent j (WTP_j^O) in the first question is between the lowest value (WTP_j^L) and the highest value (WTP_j^H) and if an individual is asked whether he/she is willing to pay β_q amount for a given environmental good or not where q=1 if β is the first bid amount and q=2 if it is the second bid. Therefore we might have four possible responses of individual j from his/her responses of 'Yes' or 'No'.

1. YES-YES, if his/her response is 'Yes' for both the first and the second bid ($\beta_1$and β_2), $WTPj>\beta_2$, that is the highest willingness to pay in the mind of the respondent will be between WTP^H and infinity.

2. YES-NO, if the individuals response is 'Yes' for the first bid (β_1) and 'No' for the second bid (β_2), ($\beta_1 \leq WTP_j < \beta_2$), that is the highest willingness to pay is between WTP_j^L and WTP_j^H.

3.NO-No,if his/her response is 'No' for the first bid (β_1) and 'No' for the second bid (β_2) ,that is the individuals highest willingness to pay is between 0 and WTP_j^L.

4.NO-YES,if the individual response is 'No' for the first bid (β_1) and 'Yes' for the second bid (β_2), that is the highest willingness to pay is between WTP_j^L and WTP_j^0.

Therefore the probability of observing one of the possible two bid responses can be given as:

$$\mathbf{Pr\ (Yes, Yes) = Pr\ (WTP_{j1} > \beta_1,\ WTP_{j2} > \beta_2)} \quad \textbf{----------4.17}$$

$$\mathbf{Pr\ (Yes, No) = Pr\ (WTP_{j1} > \beta_1,\ WTP_{j2} < \beta_2)} \quad \text{----------4.18}$$

$$\mathbf{Pr\ (No, Yes) = Pr\ (WTP_{j1} < \beta_1,\ WTP_{j2} > \beta_2)} \quad \text{----------4.19}$$

$$\mathbf{Pr\ (No, No) = Pr\ (WTP_{j1} < \beta_1,\ WTP_{j2} < \beta_2)} \quad \text{----------4.20}$$

But the j^{th} individual 'willingness to pay in double bounded data can be given as:

$$\mathbf{WTP_{jq} = \mu_q + U_{jq}} \quad \text{----------4.21}$$

Where μ_1 and μ_2 are the means for the first and the second willingness to pay answers, WTP_{jq} is the j^{th} respondent's willingness to pay and U_{jq} are error terms which are normally distributed with mean 0 and respective variances of σ_1^2 and σ_2^2

Therefore from the above equations the j likelihood function becomes:

$$\mathbf{I_{lk}(\mu/\beta) = [Pr(\mu_1 + U_{j1} > \beta_1,\ \mu_2 + U_{j2} > \beta_2)^{YY}]\ [Pr(\mu_1 + U_{j1} < \beta_1,\ \mu_2 + U_{j2} < \beta_2)^{NN}]}$$

$$\mathbf{[Pr(\mu_1 + U_{j1} > \beta_1,\ \mu_2 + U_{j2} < \beta_2)^{YN}]\ [Pr(\mu_1 + U_{j1} < \beta_1,\ \mu_2 + U_{j2} > \beta_2)^{NY}]} \quad \text{----------4.22}$$

Where YY=1 for Yes-Yes response, 0 otherwise, NY=1 for a No-Yes response, 0 otherwise, NN=1 for a No-No response, 0 otherwise and YN=1 for a Yes-No response, 0 otherwise (Hanemann et al, 2001).

In addition to estimating the parameters, one of the basic interests in such models is to calculate willingness to pay which is the amount of money that makes individual indifferent between the initial and the final state, that is:

$$\mathbf{= V_{1j}(Y_j - \beta_i^*, Xj, \varepsilon_{1j}) = V_{0j}(Y_j, Xj, \varepsilon_{0j})}$$

$$\mathbf{= \alpha_j X_j + \beta_1 (Y_j - \beta_i^*) + \varepsilon_{1j} = \alpha_j X_j + \beta_0 Y_j + \varepsilon_{0j}}$$

$$\mathbf{= \alpha_1 X_j + \beta (Y_1 - WTP_j) + \varepsilon_{1j} = \alpha_0 X_j + \beta Y_j + \varepsilon_{0j}}$$

$$= (\alpha_1 - \alpha_0) X_j - \beta WTP_j + \varepsilon_{1j} - \varepsilon_{0j} = 0$$

$$= \alpha X_j - \beta WTP_j + \eta = 0 \quad \text{where } \eta = \varepsilon_{1j} - \varepsilon_{0j} \text{ and } \alpha = \alpha_1 - \alpha_0$$

$$= WTP_j = \alpha/\beta X_j + \eta/\beta \text{----------4.23}$$

$$\sum (WTP_j) = \alpha/\beta \sum (X_j), \text{ assuming that } \sum (\eta) = 0 \text{ ----------4.24}$$

4.4.1.3 The Tobit model

The respondents' WTP survey responses from the open-ended questionnaire are estimated using a censored model such as the Tobit model if the dependent variable takes non-negative values with some 'zeros' (Siglman, Zeng, 1999, p. 5).

The Tobit model is an alternative to OLS when observations on the latent (dependent) variable are missing or censored. Thus in this study we face a problem of censoring in the open-ended questions that is some responses have zero maximum willingness to pay amount for the proposed water improvement scheme, thus Tobit model is the appropriate model.

According to Gujarati (2003), the general formula of the Tobit model is given as follows:

$$\hat{Y}_i = \alpha_o + \alpha x_i + u_i \quad , Yi = \hat{Y}_i \text{ if } \hat{Y}_i > 0$$

$$Y_i = 0 \text{ if } \hat{Y}_i \leq 0 \text{----------4.25}$$

Where Y_i=is the observed maximum willingness to pay of individual i

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

Xi=the independent variable

α=a vector of slope parameters

Ui =is the error term which is normally distributed with mean 0 and

constant variance σ^2

Following Greene (1997) the log likelihood for the censored regression model is:

$$\ln L = \sum_{yi>0} -\frac{1}{2}[\ln(2\Pi)\ln \sigma^2 + (y_i - \alpha' x_i)/\sigma^2] + \sum_{yi=0} \ln [1-\varphi(\alpha' x_i/\sigma) \quad \text{----------4.26}$$

The two parts correspond to the classical regression for the non-limit (continuous) observations and the relevant probabilities for the limit (zero) observations respectively. Then the estimable model for the censored data that is the equation in the Tobit model is:

$$MWTP^*_i = \alpha_0+\alpha_1 GNDR+\alpha_2 EDUR_1+\alpha_3 EDUR_2+\alpha_4 EDUR_3+\alpha_5 AGER+\alpha_6 RESP+$$

$$\alpha_7 LSAT+\alpha_8 FAMS+\alpha_9 WLTH+\alpha_{10} OCCR+\alpha_{11} RLTY+\alpha_{12} VOLM$$

$$+\alpha_{13} QLTY+\alpha_{14} TIME+\alpha_{15} REYS+\alpha_{16} IB+\alpha_{17} INCM+\alpha_{18} SORC$$

$$+\alpha_{19} HHHEAD+\varepsilon i \text{----------4.27}$$

Where $MWTP^*_i$ =is the maximum willingness to pay of the surveyed households in cents per Jeri can of improved water services for household i and is observed if it is greater than zero but not observed when it is less than or equal to zero.

, σ_0, σ_1-------, σ_{19} are regression parameters

εi -is the error term and the explanatory variables are as defined under the variable description section.

Since the mean measure is an appropriate method for welfare measures in cost benefit analysis, for the open-ended CV survey responses, maximum WTP reported by the respondents can be simply averaged to produce an estimate of mean WTP:

$$\textbf{Mean WTP} = \mu = \sum T_i / n \quad \text{----------} \quad \textbf{4.28}$$

Where n =is the sample size and each T is a reported WTP amount by surveyed households (FAO Corporate Document Repository, 2007, p.9)

4.4.2 Description of Explanatory Variables

GNDR:-sex of the respondent- This variable is included in the study as dummy variable with 1 for male respondents and 0 otherwise. We cannot determine the sign of gender coefficient a priori.

EDUR:-educational level of the respondent-$EDUR_1$ is a dummy variable taking 1 if the educational level of the respondents is primary (from grade1-6), 0 otherwise, $EDUR_2$ is a dummy variable taking 1 if the educational level of the respondents is secondary (from grade7-12), 0 otherwise and also $EDUR_3$ is a dummy variable taking 1 if the educational level of the respondents is tertiary (above grade 12), 0 otherwise. It is expected that households with higher educational level are more aware of the importance of improved water services and thus a positive relationship is expected between willingness to pay and education level.

AGER:-age of the respondent-the respondents' willingness to pay for water quality improvement is expected to decrease with age measured in years. A negative relationship between willingness to pay and age of the respondent is expected because older people are

expected to prefer to keep the tradition and therefore they are less likely to support the improved services. Moreover, perhaps younger people may care more about the future.

RESP:-responsible organ for the provision of improved water services-it is a dummy variable which is 1 if the respondent said that the government is responsible; 0 otherwise. Households who said that government is responsible for the provision of improved water services are expected to have less willingness to pay while those who say private sector or community is responsible have more willingness to pay for improved services. Therefore the coefficient of this variable is expected to be negative

LSAT:-respondents level of satisfaction with the existing service-it is a dummy variable which is 1 if the household is not satisfied with the existing water service; 0 otherwise. A positive relationship is expected between willingness to pay and this variable as households that are not satisfied with the existing water services are expected to have more willingness to pay for improved services.

FAMS:-respondent's family size- There are two views concerning the impact of family size on WTP. The first one indicates that when family size is higher, there will be a higher need for water in the family and hence WTP is higher. On the other hand, the preference for private connection declines for larger family size as there may be adequate labor to fetch water from outside the compound. Therefore it is difficult to determine the sign of this variable's coefficient a priori.

WLTH:-wealth of the household-ownership of house is used as a proxy for wealth. It is a dummy variable which is 1 if the house is owned by the household and 0 otherwise (that is if rented from kebeles or individuals). The coefficient is expected to have a positive sign since the richer individuals demand for improved water service is high for they have less financial

constraints. Moreover, those who own their houses may have more interest in improved water services as they have a longer term interest.

OCCR:-occupational level of the respondent-this is a dummy variable taking the value 1if the respondent is employed in formal sector salary employment such as government, private organization, NGOs, and other related areas; 0 otherwise. The expected sign of the coefficient of this variable is positive, since the employed respondents are expected to have more preference to improved water service than the unemployed one.

RLTY:-reliability of the existing source being used-this is a dummy variable taking 1 if the existing source is not reliable; 0 otherwise. The expected sign of the variable's coefficient is positive since households WTP for improved water service will be higher if the existing source is not reliable.

VOLM:-volume of water used by household-households whose water usage is high are expected to have less likelihood to support the improved water service scheme since they spend more to get water from the improved services. On the other hand households whose water usage is low would be more likely to pay for this improved water service. Therefore it is difficult to determine the coefficient's sign a priori.

QLTY: - quality of water being used-it is a dummy variable taking 1 if the existing source is not safe to drink before any purification mechanism; 0 otherwise. If the existing source is not safe, households are expected to have more WTP for improved water services. Therefore the expected sign of the coefficient of this variable is positive.

TIME:-time taken to fetch water from the existing source-households who take more time to get water from the existing source are more likely to demand the improved services. Thus there is a positive expected sign for the variable's coefficient.

REYS:-respondents years of stay in the town- it is expected to have a positive coefficient. Those households who have stayed in the town for longer period are more aware about the severity of the water supply problem and thus are willing to pay more for improved water services.

IB:-initial bid price offered to the respondents-this variable will help to see whether household's responses are affected by the initial bid. In the closed ended dichotomous choice format it has a negative expected sign since higher offers are more likely to be rejected by respondents. However the coefficient of this variable is difficult to determine a priori in the open-ended format since it is determined by respondents.

INCM:-total monthly income of the household-this continuous variable is a sum of the respondent's income and the income of other members of the family. Most micro economic theories and some other empirical results done in different areas show that income and quantity demanded are positively related in the case of normal goods. Since households with higher income have a greater ability to pay and are expected to have a greater preference for improved water services, the variable's coefficient has a positive expected sign.

SORC:-source of water being used-it is a dummy variable, taking 1 if the household has private connection; 0 otherwise. Since a household with private connection is expected to be less interested, it is expected to be less likely to pay for the improved service than others who use public taps and others. The expected sign of this variable's coefficient is, therefore, negative.

HH HEAD:-whether respondent is head of household-it is also a dummy variable, taking1 if the respondent is the head of his/her household, 0 otherwise. The coefficient has positive expected sign for the reason that if he/she is the head he/she is responsible for the

health status of his/her family and thus the demand for improved water service is high indicating higher willingness to pay for the proposed scheme.

CHAPTER FIVE

EMPIRICAL RESULTS AND DISCUSSION

In this chapter, we analyze and discuss the data from the contingent valuation survey in two ways: descriptive and econometric analysis. In the descriptive analysis the demographic and socio-economic factors that expected to influence improvement in water supply and WTP for improved services are discussed. Besides, an overview of the households' attitude towards the existing water supply in the town is discussed. In the Probit model we analyze and discuss factors that affect households' probability of accepting the initial bid posed to them and the mean WTP from the closed-ended questions were discussed while using the Tobit model we analyze and discuss the factors that influence the maximum amount of money that households are willing to pay. Furthermore, we use bivariate-probit model to examine whether the double-bounded value elicitation format increases statistical efficiency or not.

5.1 DESCRIPTIVE ANALYSIS

5.1.1 Socio-Economic and Demographic Characteristics of Households

As previously stated, for this study, a total of 220 sampled households were interviewed. However, due to incomplete and misused answers only 206 questionnaires were analyzed. A summary of surveyed households' data is given in Table 5.1. Of the surveyed households 83 (40.3%) were male respondents, while 123 (59.7%) were females. From the total of 206 sampled households 108 (52.4%) are head of their households and the rest 98 (47.6%) are not. The average family size of the household is 3.6 with a minimum of 1 household member to a maximum of 8 household members. The data about the respondents' age showed that the average is 31.9 years which ranges from 13 to 72 years of old. The education figures reveal that 185 (90%) were attending their formal education with an average years of schooling 10.58 ranged from illiterate or zero years of schooling to a

maximum of 16 years of schooling. 97 (47%) were attending their primary education(from grade1-6) which includes those who were attending informal education and can write and read,43 (21%) were attending their secondary education(from grade 7-12) and 45 (22%) have tertiary(greater than grade 12) education level, while the remaining 21 (10%) were categorized under illiterate group (0 years of schooling).Regarding the employment structure of the respondents 101 (49.02%) are employed in formal sectors for salary, from which 69 were employed in government organization and 32 were employed in private sectors which represents 33.5% and 15.5%of the total respondents respectively, while 93 (45.15%) were employed in non-salary activities ,from which 19 were housewives,43 run their own business,26 were students and 5 were retired which represent 9.2%,20.9%,12.62%,and 2.4% of the total 206 respondents respectively and the remaining 12 (5.83%) were unemployed. The survey result also shows that 93 (45.15%) households were living in their own house, and further the surveyed households were living for 14.84 years averagely in the town starting from a minimum of 6 months to a maximum of 68 years.

The surveyed households earn an average income of birr 918.89 ranging from a minimum of birr 224 to maximum of birr 5475 and spent an average income of birr 897.83 with a minimum of birr 101 and a maximum of birr 2015 for different household needs such as for food, electricity, water and so on .From such household needs the surveyed household paid an average income of birr 19.29 for their monthly consumption of water where the mean household consumption of water was 3.2 Jeri Can, or 64 liter of water per day. Based on this information the average households' water consumption per month was 1920 liter ($1.92m^3$per month).As we have seen from table 2.2 birr 3.0 is the minimum water consumption tariff for$<5m^3$ of water ,and therefore the average households' water consumption expenditure is birr 5.76.per month which is 0.63% of the household's average monthly income of birr 918.89,and thus it is far below ,the World Bank's recommendations

,which states that household should not spend more than 5% of his monthly income on water. Therefore this result suggests that the sampled households can spend more for improved and reliable water supply services of the town.

Table 5.1 Characteristics and water use profiles of surveyed households

Variable	Description	Mean	Std.Dev	Min	Max
GNDR	Gender, dummy variable 1 if male,0 other wise	0.4029	0.4917	0	1
HHHD	Household head, dummy variable 1 if head, o otherwise	0.5243	0.5006		1
AGER	Age of the respondents in years	31.9126	10.7137	13	72
$EDUR_1$	Education level of the respondent ,dummy variable 1 if primary education,0 otherwise	0.4708738	0.5423	0	1
$EDUR_2$	Education level of the respondent ,dummy variable 1 if secondaryducation,0 otherwise	0.2087379	0.4172	0	1
$EDUR_3$	Education level of the respondent ,dummy variable 1 if tertiary education,0 otherwise	0.2184466	0.4029	0	1
OCCR	Occupation of the respondent, dummy variable 1 if formal sector salary employment,0 otherwise	0.4903	0.5011	0	1
INCM	Household average monthly income in birr	918.89	682.04	224	5475
FAMS	Family size of the respondent in number	3.5874	1.5140	1	8
WLTH	House, a proxy for wealth, dummy variable 1 if the respondents have their own house,0 otherwise	0.4514563	0.4988502	0	1
REYS	Respondents years of stay in the town in years	14.8374	11.2301	0.5	68
EXPD	Household average expenditure per month in birr	847.9757	336.3565	101	2015
RESP	Responsible organ for provision of improved water, dummy variable 1 if government,0 otherwise	0.4563107	0.499301	0	1
SORC	Household main water source, dummy variable 1 if piped, 0 other wise	0.7330	0.4435	0	1
VOLM	Volume of water used by household in Jeri can (20 liter container) per day	3.2039	1.9366	0.5	12
LSAT	Level of satisfaction with the existing service dummy variable 1 if not satisfied,0 otherwise	0.7913	0.4074	0	1
QLTY	Quality of water being used, dummy variable 1 if low.0 otherwise	0.7135922	0.4531835	0	1
QTTY	Quantity of water available for households , dummy variable 1 if low.0 otherwise	0.6359	0.4823	0	1
RLTY	Reliability of the existing source, dummy variable 1if not reliable,0 otherwise	0.7135922	0.4531835	0	1
TIME	Time taken to fetch water from the existing source in minute	16.9612	7.5779	5	40
PURIF	Purification of water ,dummy variable 1 if households are purifying water before drinking, 0 otherwise	0.2767	0.4485	0	1
DISEASES	Water born diseases, dummy variable 1 if yes,0 otherwise	0.2961	0.4577	0	1
IB	Initial bid offered to the respondent	18.2524	5.5747	10	25
YES/NO_1	Household WTP for initial bid, dummy variable 1 if yes,0 otherwise	0.7961	0.4039	0	1
HB	Higher bid offered to the respondent(2X of initial bid)	34.5122	11.2039	20	50
YES/NO_2	Household WTP for this higher bid amount , dummy variable 1 if yes,0 otherwise	0.3835	0.5012	0	1
LB	Lower bid offered to the respondent(0.5X of initial bid)	12.6191	2.7582	5	15
YES/NO_3	Household WTP for this lower bid amount, dummy variable 1 if yes,0 otherwise	0.1602	0.4153	0	1
INTERST	Households interest to participate in water improvement program, dummy variable 1 if yes,0 other wise	0.9660	0.4923	0	1
MWTP	Households maximum willingness to pay	25.82524	11.0453	0	50

Source: computed from surveyed data, 2011

Note: ***The description of each variable is given in section 4.4.2***

Note that the mean estimates of dummy variables should be interpreted as percentage. For example the mean of the respondents' gender is 0.4029.This means that 40.29% of the respondents are male.

5.1.2. Households Current Water Use Patterns and Problems

The following table indicates that, from the total of 206 surveyed households more than half,151 (73.30%) of households use pipe water, of which 13 have pipe in house,49 have pipe in compound (private),16 use pipe in compound (shared) and 73 get water from public taps which represents 6.31%, 23.79%, 7.76% and 35.44% of the surveyed households respectively, while 55 (26.7%) of them use other sources of water where all of them use dug wells to get water.

Table 5.2.Households Major Sources of Water

Source of Water	Number of Households	Percentage	Cumulative Percentage
Pipe in house	13	6.31	6.31
Pipe in compound (private)	49	23.79	30.1
Pipe in compound (shared)	16	7.76	37.86
Public Taps	73	35.44	73.3
Dug Wells	55	26.7	100
Total	206	100	

Source: computed from survey data, 2011

The survey result also showed that 147 (71.36%) of the total respondents said that the water quality is low that is it is not safe to drink, and thus uses different purification mechanism, particularly boiling water, to make it clean to drink. 131 (63.6%) respondents said that the existing water quantity available is low, and from their common experience they get pipe water with an average of 2.82 hours within 24 hours, which indicates that water shortage is a serious problem in the town. Regarding the characteristics of the existing water service delivery, 163 (79.13%) surveyed households were not satisfied. Of those, who were not satisfied with this existing water services, 88 (42.72%) indicated that low water quantity available is the most serious problem to the households, 33 (16.02%) said that water quality is the most serious problem and the rest of the surveyed households gave different reason for

the town's water service problem such as 24 (11.65%), higher volume charge, 10 (4.85%), long distance to fetch water and 8 (3.88%) were indicating other reasons for their dissatisfaction. 147 (71.36%) of the surveyed household also said that unreliability problem of the existing source is the most serious problem to their household. The survey result also show that it takes an average of 16.96 minutes to fetch water from the existing source which ranges from a maximum of 5 minutes to a maximum of 40 minutes.

To know for what purposes they use water mostly in terms of priority they were required to rank different purposes in accordance to their basic usage.

Table 5.3.Households Ranking of Water Usage

Variables	Rank	Number of Households	percentage	Cumulative percentage
Drinking	1st	154	74.76	74.76
Washing	1st	34	16.50	91.26
Cleaning	1st	12	5.83	97.09
Cattle Watering	1st	6	2.91	100
Total		206	100	

Source: Computed from survey data, 2011

As we can see from the table, more than half,154 (74.76%) of the respondents used water for first priority of drinking,34 (16.50%) of them use water mostly for washing clothes,12 (5.83%) used it for house cleaning and the rest 6 (2.91%) were using water for watering of their cattle.

The other findings of the study showed that out of the total respondents, 61 (29.61%) of them indicated that the member of their households were suffered from water born diseases

such as diarrhea 24 (11.65%), typhoid 23 (11.17%) cholera 2 (0.97%), vomiting 6 (%2.91) and 6 (2.91%) of the surveyed households were suffered from other water born diseases by impure water.

Furthermore the survey result indicates that out of the total respondents, responses regarding the attitudes of the respondents towards the responsibility of the water supply service indicated that 94 (45.63%)said that the government should be responsible to administer the water supply.106 (51.46%) of the respondent think that the water supply should be under the responsibility of the community,4 (1.94%) said that both government and society should be responsible to water supply and the remaining 2 (0.97%) were indicated that water supply should be the responsibility of private sector.

5.1.3 Households Willingness to Pay for Improved Water Services

As explained in the methodology part, in the final survey, four starting prices for the corresponding valuation question were given for closed-ended dichotomous choice format together with open-ended question to ask them their possible maximum willingness to pay for one Jeri Can or 20 liter of water they get from the improved services. In the closed-ended question, from the total of 206 respondents 164 (79.61%) have said 'Yes' to pay an average initial bid amount of 18.25 cents per Jeri Can (20 liter of water) which ranges from a minimum of 10 cents to a maximum of 25 cents and the rest 42 (20.39%) have refused to pay this initial bid amount. The data also revealed that, from the total of 164 who said 'Yes' for the initial bid, 79 were also accepted higher average bid price of 34.51 cents per Jeri Can which ranges from 20 to 50 cents and the remaining 85 were refuse to pay this higher bid amount which represents 38.35% and 41.26% of the total surveyed households respectively. From 42 households who refused to pay the initial bid, 33 (16.02%) of the surveyed households have said 'Yes' to pay an average of 12.62 cents per Jeri Can, which ranges

from a minimum of 5 cents to a maximum of 15 cents which is a lower amount than the initial bid and the rest 9 (4.37%) have still refused to pay this lower amount per Jeri Can (20 liter of water).

Furthermore the surveyed result indicated that in the open-ended questions, 199 (96.60%) of them gave positive amounts as they are willing to pay for improved water services for 20 liter of water in cents and the rest 7 (3.40%) were having zero WTP.

Table.5.4 summarizes households' maximum willingness to pay for improved water services during the survey period.

Table 5.4 Summary of Maximum Willingness to Pay Reported by Surveyed Households

Maximum WTP Reported	**Number of surveyed households**	**percentage**	**Cumulative percentage**
0-10(0≤WTP≤10)	21	10.19	10.19
11-20(11≤ WTP≤20)	57	27.67	37.86
21-30(21≤ WTP≤30)	84	40.78	78.64
31-40((31≤ WTP≤40	29	14.08	92.72
41-50(41≤ WTP≤50)	15	7.28	100

Source: own survey, 2011

As we can see from the table,21 (10.19%),of households were willing to pay within the range of 0 and 10 cents which is approximately 5 cents ,57 (27.67%) said that they are willing to pay an approximate average of 15.5 cents,84 (40.78%)of them were willing to pay an average of 25.5 cents,29 (14.08%),were willing to pay an average of 35.5 cents and 15 (7.28%) expressed their willingness to pay of an average amount of 45.5 cents per 20 liter of water. In addition to this the survey result showed that the mean willingness to pay for the whole sampled households is 25.83 cents per 20 liter of water which ranges from a minimum of 0 cents to a maximum of 50 cents from the open- ended question and 19.2 cents from the closed- ended dichotomous choice format per 20 liter of water and these amounts are much higher than the current water tariff structure of the town which are 6 cents for the

consumption of 0-5m^3,7 cents for the consumption of 6-10 m^3,8 cents for the consumption of 11-15 m^3,9 cents for the consumption of 16-20 m^3 and 10 cents for the consumption of above 20 m^3 per 20 liter of water at private connection and 5.2 cents per 20 liter of water at the public taps (from table 2.2). This shows that the surveyed households were willing to pay more than the current water tariff rate for the improved water service. Therefore if the improved system is introduced in addition to addressing the water needs of the town, the town's utility management can also collect more funds from water sale which can be used for water expansion projects.

5.2 ECONOMETRIC RESULTS AND DISCUSSION

In this section results obtained from regression analyses of WTP are discussed.

But before estimation was done, data exploration is an important step. The precision 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 establishes a rule of thumb, which says that multicoliniarity is a serious problem, when a pair wise correlation coefficient between the two regressors is greater than or equal to 0.8 (Gujarati, 1998, p. 229). The correlation matrix generated using our data shows that multicolliniarity is not a serious problem (See Annex-1).

The likelihood ratio test for the probit model, which is a test against the null hypothesis that all the slope coefficients are equal to zero, is rejected at 5% level of significance. We, therefore, conclude that the model is statistically acceptable as it has some explanatory variables to explain the WTP (See Annex-2)

The likelihood ratio index (LRI) is also used to measure goodness of fit for the Probit and Tobit models which is equivalent to R^2 in a conventional OLS regression model. The computed results indicate that the models are statistically acceptable as 67% of the variation is explained in the probit model and 15% of the variation is explained in the Tobit model (See Annex-2)

In most econometric data particularly in cross-sectional data, we are more likely to encounter heteroscedasticity problem. To correct these heteroscedasticity problem robust standard errors can be estimated for the probit model. However, the log likelihood ratio test is used to test the existence of heteroscedasticity in the Tobit model and the computed result shows that heteroscedasticity is not a serious problem for this model (See Annex-2).

5.2.1 Probit Model Results and discussions

The Probit estimation results obtained using STATA version 10.0 is given in table 5.5. 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 bid due to a unit change in continuous explanatory variables and a change of dummy variables from 0 to1, for discrete variables (Greene, 1993). Both the coefficients and marginal effects of the probit model are given in table 5.5.

Table 5.5 Maximum likelihood estimates of the probit model:

Number of obs=206
Wald chi^2 (19) =62.23
Pseudo R^2=0.6656

Variables	Coefficients	Robust Std.Err	Z	Marginal Effects(dy/dx)
SORC	-1.148563	0.618151	-1.86*	-0.1231875
VOLM	-0.0888142	0.1148312	-0.77	-0.0150319
QLTY	1.040337	0.4820891	2.16**	0.1496077
RLTY	1.257786	0.3971147	3.17***	0.2654255
LSAT	0.2970285	0.4065562	0.73	0.0281062
TIME	0.0066911	0.0196441	0.34	-0.0001882
IB	-0.3152026	0.0480624	-6.56***	-0.0301105
GNDR	-0.3708064	0.3967837	-0.93	-0.0063684
HHHEAD	0.5487297	0.4066815	1.35	0.0366817
AGER	-0.0631149	0.0176301	-3.58***	-0.0052752
$EDUR_1$	1.852709	0.4858601	3.81***	0.1701481
$EDUR_2$	0.7181341	0.5343039	1.34	0.0431054
$EDUR_3$	1.862558	0.6622668	2.81**	0.1053101
OCCR	-0.3474179	0.4201076	-0.83	-0.0035494
INCM	0.0004753	0.0002638	1,80*	0.0000199
FAMS	-0.0983405	0.1335978	-0.74	0.0006972
WLTH	0.7221213	0.3868115	1.87*	0.0172226
REYS	0.0952163	0.0291338	3.27***	0.0044046
RESP	-0.3275968	0.352884	-0.93	-0.0220706
-CONS	6.051681	1.541088	3.93	
Log pseudo likelihood =-34.841248 Restricted log likelihood =-104.18227				

*** - Significant at 1% level of significance

** - Significant at 5% level of significance

* - Significant at 10% level of significance

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

Note:-the description of each variable is given in 4.4.2

The dummy variable sex of the respondent has a negative sign suggesting that female respondents are willing to pay more than males. However, the result is not statistically significant and hence the variable can be considered not statistically important.

The variable household head has positive sign suggesting that respondents that are household heads are willing to pay more than those that are not household heads. However, this variable is also not statistically significant.

The probability of a 'Yes' response (accepting the proposed bid) decreases with age and is statistically significant at 1% level of significance. The marginal effects indicate that, for every one year increase in the age of the respondent, the probability of saying 'Yes' to a given bid declines by 0.53%, ceteris paribus. This suggests that younger respondents are perhaps more concerned about water quality improvement than older ones.

The results also suggest that compared with the illiterate group, which is taken as benchmark, three other groups representing different education levels are generally more willing to pay. This is particularly true for those with primary and tertiary education while the results for those with secondary education are not significant at the 10% level. This result, tough not conclusive, suggests that more educated households are more aware about the value of improved water services.

While the sign of the coefficient for occupation level of households' is negative, it is not statistically significant.

Income of the household, which is significant at 10% level, suggests that a one birr increase in the income of the household increases the probability of accepting an offered bid by 0.002%, other things being equal.

Although no a priori expectation was made about the relation between family size of households and WTP, the result showed that the variable has a negative sign and is statistically insignificant.

As expected ownership of a house, which is a proxy for wealth, has a positive sign which is also significant at 10% level of significance. Thus, keeping all other things the same, for those living in their own house, the probability of accepting the offered bid to pay for the proposed improved water service is higher by 1.72% compared with those who do not live in their own house. This is perhaps because richer individuals demand for improved water service is high for they have no financial constraints. This may also be because those who have their own houses have a long term interest in an improvement in water supply services compared with those who, for example, live in rented houses.

The number of years of stay in the town has positive and statistically significant effect (at the 1% level) on the probability of accepting the offered bid. In particular, the results suggest that when the household's years of stay in the town is increased by one year, the probability of saying 'Yes' for any initial bid offered to them is increased by 0.44%, ceteris paribus. This is perhaps because households who stayed in the town for long years are more aware about the severity of the water supply problem and thus are willing to pay more for improved water services.

While the sign of the variable 'responsible organ for the provision of improved water service' is negative it is not statistically significant

The source of water being used by households, which is a dummy variable, has a negative and statistically significant effect (at 10% level) on the probability of accepting the offered bid. This suggests that households who have private connection are less likely to support the proposed improved water service to that of non-piped households

The volume of water used by households has a negative sign but is statistically insignificant.

The coefficient of the dummy variable representing the level of satisfaction with the existing service has the expected positive sign but is statistically insignificant.

The dummy variable quality of water being used has a positive sign as expected and is statistically significant at 5% level of significance. This suggests that households for which water quality from the existing source is low are more likely to pay for improved water services.

As expected, the dummy variable representing reliability of the existing water source has a positive sign and is significant at 1% significance level. This suggests that if households get a more reliable source of water they are more likely to pay.

The variable time taken to fetch water from the existing source has a positive sign as expected but is statistically insignificant.

Initial bid offered to the respondents has a negative effect on the probability of accepting the bid and is significant at 1% significance level. This suggests that a one percent increase in the initial bid will reduce the likelihood that respondents are paying for improved water services by 3.0%, ceteris paribus.

To see whether the follow up closed ended question that is the application of double-bounded instead of single-bounded dichotomous format improves statistical efficiency or not, we used the bi-variate probit model where the respondents were asked two consecutive questions in such a way that the second question is contingent on the response of initial bid. In particular, if a respondent accepts the initial bid, he/she would be asked about willingness to pay for twice the initial bid. If a respondent rejects the initial bid offered, half of the initial bid is proposed. Since most of the explanatory variables were insignificant this model was

estimated only for these two consecutive bids offered to households, that is initial and second bids. From the STATA version of 10.0 out put the 'rho', the coefficient of correlation of error terms of the double bounded model is positive which shows that the random components in the first and the second responses are positively correlated (See Table 5.6).

From the test statistics, the initial bid offered to the household has negative sign as in the probit model, indicating that when the bid offered increases the probability of accepting it decreases and is statistically significant at 1% level of significance. The coefficient of the second bid offered is also negative and statistically significant at 1% level of significance (See Table 5.6).

Table.5.6 Bi-variate Probit Estimation Results

			Number of obs=206 Wald chi^2(2)=60.10 Log likelihood=-75.29737
Variables	**Coef.**	**Std.Err.**	**Z-Value**
ynib (Households' WTP for initial bid,1 if 'Yes',0 otherwise)			
Initial bid(in cents) per 20 liter of water	-0.0205	0.0192	-5.47***
Constant	5.917807	1.430715	3.7
ynsb (Households' WTP for second bid,1 if 'Yes',0 otherwise)			
Second bid(in cents) per 20 liter of water	-0.1441108	0.0190195	-5.17***
Constant	1.690585	0.7311226	2.31
Athrho	6.382777	----	----
'rho'	0.764994	----	----

*** -Indicates significance level at 1%

5.2.2 Comparison of Single-Bounded and Double-Bounded Model Estimates

As described before the double bounded model was estimated using both the first and the second bids offered to the households as explanatory variables, while in the case of single-bounded format the Probit model was estimated using only the first bid offered to them. The

CV survey of this study is used to estimate two models for the purpose of comparing the statistical efficiency of these two dichotomous choice question formats. The estimation result for the two models is given in table 5.7:

Table 5.7 Probit and Bi-Variate Probit Estimates of Households' WTP for Improved Water Services

Variables	Probit Model			Bi-Probit Model		
	Coef.	**Std.Err.**	**Z**	**Coef.**	**Std.Err**	**Z**
Initial bid (in cents per 20 liter of water	-0.1231	0.0203	-4.97***	-0.0205	0.0196	-4.43***
Constant	3.2692	0.4017	6.20***	1.7237	0.3981	5.10***

***- indicates significance level at 1%

The precision of the estimates of the intercept term and coefficient of the bids offered to household which is measured using estimated standard errors is one of the mechanisms to compare the statistical efficiency of single-bounded versus double-bounded dichotomous choice question formats (Hanemann, Loomis and Kanninen, 1991). As the coefficients of the bid and the intercept terms are statistically significant at 1% level for the two types of dichotomous-choice surveys, and standard errors of these coefficients of bids and constant terms are approximately the same for both double-bounded and single-bounded models, which lead to the same t-statistics which is a measure of goodness of fit, that does not much differing in the two models (Table 5.7). This indicates that the use of double-bounded instead of single-bounded does not increase statistical efficiency as such and thus we use the single-bounded format (the Probit model) to calculate the mean WTP of households for the proposed water improvement scheme.

According to Hanemann, one of the main objectives of estimating empirical WTP based on the CV survey response is to derive the central value (mean) of WTP distribution (Hanemann, Loomis and Kanninen, 1991). As described in the methodology part, for the

Probit model the mean WTP for dichotomous choice contingent valuation survey responses can be calculated by dividing the negative of the regression constant (intercept) by the bid coefficient.

Therefore Mean WTP $=\mu=-\sigma/\beta=-6.051681/-0.3152026 =19.199337$

Thus, we conclude that the mean WTP obtained from the closed-ended format is 19.2 cents for the proposed improved water services per 20 liters of water.

5.2.3 Tobit Model: Result and Discussion

The Tobit results using STATA version of 10.0 are given in Table 5.8. The result for the variable income is consistent with a priori expectation as it has a positive influence on the amount of money that households are willing to pay and is significant at 5% level. The regression result confirms the economic theory which says that income and quantity demanded for a particular commodity are positively related for the case of normal goods.

Quality of water being used by households is positively affecting the maximum amount that households are willing to pay and significant at 1% level of significance. This suggests that households who have the perception of low water quality have more willingness to pay

The dummy variable reliability of the existing source has also the expected positive sign and is significant at 1% level. This suggests that households for whom the existing source is not reliable are willing to pay more for the proposed water improvement scheme. Its significance level indicates that it is one of the strongest factors affecting the amount of money that households are willing to pay for this improvement scheme.

The result for the initial bid shows that it has a positive sign but statistically insignificant. This initial bid is included in the estimation to test whether it creates a starting point bias on the responses of households' maximum amount of money that they are willing to pay. Even

if its positive sign indicates that the households' maximum WTP amount is upwardly biased, the coefficient is not statistically significant.

The influence of gender in this case is positive but not significant.

As expected the age of the respondent has a negative influence on the maximum WTP and is significant at 1% level. This suggests that the younger generation is more concerned about water quality improvement and thus have higher willingness to pay than the older ones.

Higher level of education leads to higher amount of money that households are willing to pay suggesting that educated people are more aware and know the value of improved water services. Thus, as expected all the three educational dummies are affecting positively the households' maximum willingness to pay and also highly significant at 1% level.

The other significant variable at 1% significance level is source of water being used by households. As expected a priori it has a negative impact on households' maximum willingness to pay for improved water services in the town suggesting that households who have private pipe water are less willing to pay than those who use other sources of water.

The variable, respondents' years of stay in the town has a positive sign as expected and significant at 5% level. The result is consistent with the idea that those households who stayed for a long period of time in the town are willing to pay a higher amount than those who lived for a shorter period perhaps because they were more aware about the severity of the water supply problem.

The coefficient of the dummy variable, responsible organ for providing improved water services has the expected negative sign and is significant at 5% level. This suggests that if government is the responsible organ households have less willingness to pay perhaps because they think not much money was expected from them to contribute..

The dummy variable called households' level of satisfaction has a positive sign as expected but insignificant. The variable volume of water consumed by households is also statistically insignificant but with a negative sign.

The mean WTP for the open-ended CV survey responses of the maximum WTP figures reported by households is simply the average of their maximum WTP amount.

Mean WTP $=\mu=\sum Ti/n$, where 'Ti' is the reported maximum WTP amount by surveyed households and 'n' is the sample size.

Mean WTP $=\mu=5320/206=25.825243$

Thus, we conclude that the mean WTP obtained from the open-ended format is 25.83 cents for the proposed improved water services per 20 liters of water.

Table 5.8 Maximum Likelihood Estimates of the Tobit model

			Number of obs=206 **LR chi^2 (19) =230.60** **Pseudo R^2=0.1485**	
Variables	**Coefficients**	**Std.Err**	**T**	**Mean**
SORC	**-4.889093**	**1.576078**	**-3.10*****	**0.733009**
VOLM	**-0.4202644**	**0.2760249**	**-1.52**	**3.203883**
QLTY	**4.423158**	**1.428981**	**3.10*****	**0.7135922**
RLTY	**8.202812**	**1.168477**	**7.02*****	**0.7135922**
LSAT	**1.406896**	**1.163205**	**1.21**	**0.7912621**
TIME	**-0.0851763**	**0.0636633**	**-1.34**	**16.96117**
IB	**0.0598642**	**0.0844047**	**0.71**	**18.25243**
GNDR	**0.5536958**	**1.01954**	**0.54**	**0.4029126**
HHHEAD	**0.7935301**	**1.050065**	**0.76**	**0.5242718**
AGER	**-0.2512297**	**0.04801**	**-5.23*****	**31.91262**
$EDUR_1$	**6.442739**	**0.9856208**	**6.54*****	**0.4708738**

$EDUR_2$	**3.994868**	**1.219136**	**3.28*****	**0.2087379**
$EDUR_3$	**5.055006**	**1.188603**	**4.28*****	**0.2184466**
OCCR	**-0.9720988**	**1.009571**	**-0.96**	**0.4902913**
INCM	**0.0012973**	**0.00054**	**2.40****	**2018.888**
FAMS	**-0.123863**	**0.3691489**	**-0.34**	**3.587379**
WLTH	**0.563965**	**1.24848**	**0.45**	**0.4514563**
REYS	**0.1401553**	**0.051258**	**2.73****	**14.83738**
RESP	**-1.988277**	**0.9237814**	**-2.15****	**0.4563107**
-CONS	**20.15904**	**3.804257**	**5.30**	
Log likelihood =-661.21282 **Restricted log likelihood=-776.5116**				

*****- Significant at 1% level of significance**

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

***- Significant at 10% level of significance**

Note: - The description of each variable is as described in 4.4.2

From the overall results of the valuation, the results indicate that the mean willingness to pay for the improved water services from the closed-ended dichotomous choice questions is 19.2 cents, while it has a value of 25.83 cents from the open-ended question surveys per Jeri Can (20 liters of water) putting the range of households' willingness to pay between 19.2 and 25.85 cents per 20 liters of water for the proposed improved water service.

5.2.4 Total Willingness to Pay and Total Revenue

Based on the willingness to pay derived from the open-ended surveys the total willingness to pay and total revenue at different prices that households are willing to pay is calculated and the demand curve for the improved water service has also been derived.

The total population of the town's administration of Motta town as explained in chapter two was 39,470 constituting 10,898 households which is approximately the same as dividing the total population by our survey results of average family size of 3.6 (National Population Census of 1991 E.C).

The class boundaries for the maximum willingness to pay amount reported by households are used to make the aggregation of total WTP, total revenue and deriving the demand curve for the proposed improved water scheme.

Table 5.9 Aggregate WTP and Aggregate Revenue (in cents) from improved water services

Class interval for WTP(in cents) per Jeri Can	Mid(class mark) for WTP	Sample Distribution of households		Total number of households	Total WTP (in cents)	Sample households willing to pay at least that amount(cumulative)		Total households willing to pay at least that amount (cumulative)	Total revenue (in cents)
(1)	(2)	(3) no	(4)%	(5)	(6)	(7) no	(8) %	(9)	(10)
0-10	5	21	10.19	1111	5,555	206	100	10,898	54,490
11-20	15.5	57	27.67	3015	46,732.5	185	89.81	9,787	151,698.5
21-30	25.5	84	40.78	4444	113,322	128	62.14	6,772	172,686
31-40	35.5	29	14.08	1534	54,457	44	21,36	2,328	82,644
41-50	45.5	15	7.28	794	36,127	15	7.28	794	36,127
Total		206	100	10,898	256,193.5				

Source: Own survey, 2011

As noted earlier, in addition to reducing the water problem of the town, the proposed water improvement scheme increases the revenue of the town's utility management. In Table 5.9 the first column shows the class-interval of willingness to pay amount while the second column shows that the midpoint of the payment which is computed from column1. Columns 3 and 4 show the number and the percentage of the sample households whose maximum

willingness to pay fall within the given boundaries respectively. In column 5, the total number of households in each boundary is shown which is computed by multiplying total number of households in the town by proportion of households falling in each interval.

Column 6 indicates total WTP in cents per 20 liter of water which is obtained by multiplying the mid WTP amount by the total number of households willing to pay that amount. The total sum of willingness to pay values in column 6 gives the grand total WTP which shows that 10,898 households are expected to pay 256,193.5 cents (birr 2,561.935), if each household uses only one Jeri can (20 liter of water) per day.

But from the descriptive analysis of the surveyed data we noted that the mean water consumption (volume of water) per household per day is 3.20 Jeri Can (64 liters of water) and therefore the 10,898 households' total willingness to pay is estimated to be birr 8,198.2 per day. This implies willingness to pay of 75.23 cents per household per day or 2,256.9 cents (birr 22.569) per month if the water improvement scheme is implemented. This result is in between the mean WTP amount of birr 19.2 in the closed-ended format and 25.83 per month in the open-ended format.

Columns 7 and 8 of Table 5.9 show the number and percentage of sample households that are willing to pay at least the amount given in each interval, and column 9 indicates the total number of households that are willing to pay at least this amount in each boundaries.

The last column, column 10 indicates total revenue of the town's utility management from the sale of water which is obtained by multiplying the mid WTP amount by the total number of households who are willing to pay at least the amount in each interval. As can be seen from Table 5.9, total revenue initially increases as payment per Jeri Can (20 liter of water) increases and reaches its maximum of 172,686 cents (birr 1,726.86) when the price of water per Jeri Can is 25.5 cents per household and then it decreases and attains its minimum of

36,127 cents (birr 361.27) per Jeri Can. Therefore, we conclude that the maximum revenue can be collected from the improved system at the average price of 25.5 cents per 20 liters of water per household and the maximum revenue is 552,595.2 cents (birr 5,525.952) per day as the average household consumption of water is 3.2 Jeri Can (64 liters of water) per day.

In terms of total number of households and their associated maximum WTP, this study also used the survey to derive the demand curve for the proposed improved water services of the town. The aggregate demand curve is derived using the mid WTP amount along the vertical axis and the number of households willing to pay at least that mid amount per Jeri Can (20 liters of water) along the horizontal axis. Therefore, the demand for the improved water service at different price level is shown graphically in figure 1.

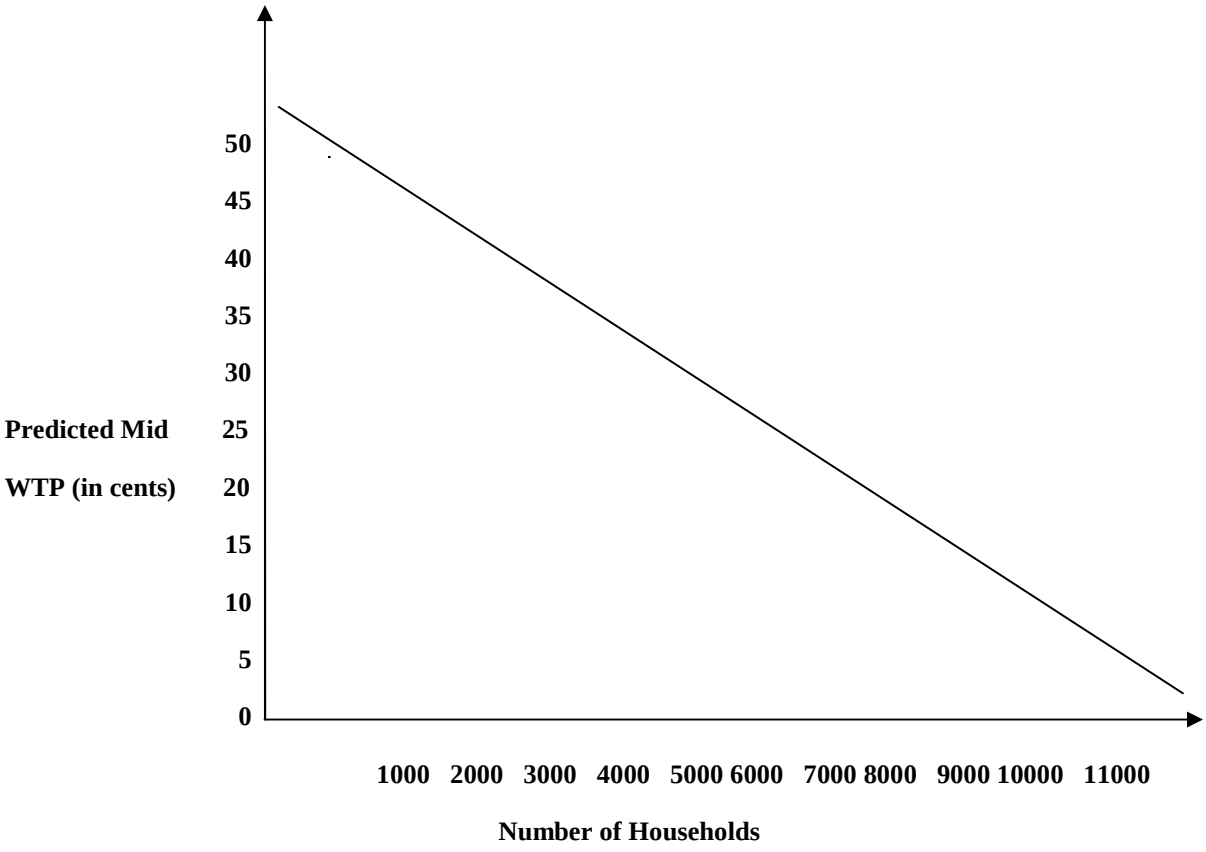

Figure 1.Households' Demand for Improved Water Services at Different Price Level

We note from figure 1 that the demand curve is negatively sloped indicating that, like most economic goods, the demand for improved water services will decrease with increasing

water use charges, keeping all other things constant. Further, from this demand curve we can calculate total consumer surplus which is the sum of the total area under the demand curve and it shows the total figures of 258,257.75 cents or birr 2,582.775 if every household uses only 20 liters of water per day from the improved water service. However from the survey data the average water consumption per household per day is 3.20 Jeri Can (64 liters of water), and therefore the gross consumer surplus has been estimated to be 826,424.8 cents (birr 8,264.248) per day.

Thus in general the result of this CVM study shows that the mean WTP amount per 20 liters of water is between 19.2 and 25.83 cents, which is much higher than the current water tariff rate of 6 cents for the consumption range of 0-5m^3 per Jeri can (20 liters of water). Therefore the town's utility management can implement the proposed water improvement scheme and in addition to solving the water problem of the town, it can increase the tariff substantially from this improved water services. This will also increase total revenue from the sale of improved water as well as households' welfare with more private pipe connection and improvement in quality of water.

CHAPTER SIX

CONCLUSION AND POLICY IMPLICATION

6.1 CONCLUSION

In most developing countries including Ethiopia, it is common to have unreliable and poor quality of drinking water which is mostly provided by public utilities. At this moment Motta town is one of the areas which face unreliable and inadequate supply of water as the existing water supply of the town's utility management. As noted above, one of the main reasons for this acute shortage of drinking water is increasing population which creates incompatibility between the supply of improved water service and the communities' demand for it.

This study attempted to analyze the demand side of improved water supply services with the aim of looking into the possibility of cost sharing by the town's residents for the improved water services by assessing their WTP. The study mainly used cross-sectional primary data while it is also supplemented by secondary data from MoWE and the town's water service office.

The Contingent Valuation Method (CVM) was used based on face-to-face interview with 220 randomly selected sampled households. The double-bounded dichotomous choice with an open-ended follow up elicitation format was used. Further 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 survey results obtained from this contingent valuation survey was analyzed by using the econometric software STATA version 10.0 using both descriptive and econometric analyses. We used the Probit model to analyze the determinants of households' WTP and to calculate the mean WTP of these sampled households for improved water services and we also employed bi-variate probit model to see whether the double bounded format increases statistical efficiency or not compared with the single-bounded format. The results suggest

that we can use only the single-bounded elicitation format to calculate the mean WTP. Further, the Tobit model was estimated to analyze the factors affecting maximum amount of money that households are willing to pay for the proposed improved water scheme.

The descriptive analysis showed that out of the total 206 usable responses, 151 (73.30%) respondents confirmed that piped water is the main source of water for their households. 163 (79.13%) of them were not satisfied with the existing water service due to factors that include poor quality, low quantity, unreliability, higher volume charge, and distance from the source. The survey result also showed that the mean consumption of water per household per day was 3.2 Jeri Can (64 liters of water). The study also revealed that from their common experience households got piped water for 2.82 hours within 24 hours (or per day). 94 (45.63%) of the sampled households indicated that the government should be responsible to provide and administer improved water supply services.

From the total of 206 usable responses, 199 (96.6%) had positive willingness to pay for improved water services with a mean WTP of 25.83 cents per Jeri Can (20 liters of water) in the open-ended and 19.2 within the closed-ended format, which are much higher than the current water tariff of the town which is 6 cents per m^3 for those who consume less than $5m^3$. This shows that if the town's 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. The total WTP for one Jeri Can of improved water (20 liters of water) from the total of 10,898 households in the study area is birr 2,561.935 per day or birr 76,858.05per month. But the average water consumption of each surveyed households per day was 3.2 (64 liter of water) which implies the total WTP of 8,198.192 per day or 245,945.76 per month for the 10,898 households. If the improved water service is

implemented, the maximum revenue collected from these 10,898 households per 20 liters of water is birr 1,726.86 when the water is sold with an average price of 25.5 cents.

The Probit model shows that there are several factors affecting households' WTP for improved water services and further the model is used to calculate the mean WTP from the closed- ended contingent valuation survey responses. 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 'Yes' to initial bid offered to them. Initial bid offered to households, age of the respondents and source of water being used by households have negative expected sign and have significant effect on the probability of saying 'Yes' to the proposed initial bid. The explanatory variables volume of water used by households, sex of the respondents, occupation dummy (formal sector salary employment =1), family size and responsible organ dummy (government=1) have negative sign but are statistically insignificant. The remaining variables including level of satisfaction dummy (not satisfied=1), time taken to fetch water from the existing source, education dummy (secondary education) and household head have positive expected sign but were statistically insignificant

The results from the Tobit model show that the following variables had a positive and statistically significant effect on on the maximum amount of money that households are willing to pay for improved water services: 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. The variables responsible organ (1 if government), source of water (piped=1) and age have the expected negative sign with a statistically significant influence on the maximum willingness to pay of households. The remaining variables, volume, level

of satisfaction (not satisfied=1), initial bid, sex of the respondent (male=1), occupation, family size, wealth and time were statistically insignificant.

The mean WTP of households from the open ended and closed ended question formats per 20 liters of water are 25.83 cents and 19.2 cents respectively which provides the range over which mean WTP lies ($19.2 \leq WTP \leq 25.83$).

6.2 POLICY IMPLICATION OF THE STUDY

From the survey responses of the sampled households, the current water supply system of the town is not reliable and cannot satisfy the existing demand and thus the town's inhabitants have a big interest to have reliable and improved water supply service. Based on the findings of this study we can draw the following policy implications.

- The results of this study show that the existing water supply system is unreliable and also the quality is poor (not safe to drink before purification) and thus policy makers should take in to consideration the quality and reliability problems in designing the water system of the town to provide good quality and reliable water supply services.
- Since the mean WTP of the sampled households is above the town'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.

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Annex.1 Correlation Matrix of Explanatory Variables

	SORC	VOLM	QLTY	RLTY	LSAT	TIME	IB	GNDR	HHHEAD	AGER	$EDUR_1$	$EDUR_2$	$EDUR_3$
SORC	1.00												
VOLM	-0.17	1.00											
QLTY	0.66	-0.11	1.00										
RLTY	-0.12	0.19	0.03	1.00									
LSAT	0.04	0.11	-0.03	-0.11	1.00								
TIME	-0.15	0.06	0.04	0.09	-0.00	1.00							
IB	0.002	-0.11	-0.03	0.04	-0.06	-0.03	1.00						
GNDR	0.05	0.20	-0.05	0.04	-0.02	-0.04	-0.01	1.00					
HHHEAD	0.06	0.21	0.02	0.13	0.01	-0.05	0.12	0.23	1.00				
AGER	-0.07	-0.03	-0.04	-0.31	0.05	-0.13	-0.07	0.00	0.01	1.00			
$EDUR_1$	-0.00	0.11	0.02	0.23	-0.04	0.01	0.03	0.02	0.16	-0.25	1.00		
$EDUR_2$	-0.12	0.14	-0.02	0.23	-0.05	0.15	0.12	0.04	0.08	-0.23	0.11	1.00	
$EDUR_3$	-0.11	0.11	-0.12	0.23	-0.05	0.01	0.10	-0.08	0.06	-0.13	0.14	0.10	1.00
OCCR	-0.02	0.06	-0.07	-0.00	-0.05	0.10	0.05	0.24	0.29	-0.08	-0.03	-0.03	-0.07
INCM	-0.31	0.24	-0.08	0.11	0.10	0.03	-0.03	0.04	0.03	0.00	0.05	0.12	0.20
FAMS	0.00	0.28	0.09	0.04	0.00	0.00	-0.11	-0.03	-0.08	-0.07	-0.03	-0.02	0.14
WLTH	0.06	-0.32	-0.01	-0.09	-0.07	0.06	0.08	0.11	-0.23	0.05	-0.15	-0.01	-0.22
REYS	0.04	0.27	0.08	0.11	-0.08	-0.01	-0.03	-0.12	0.19	0.02	0.14	0.07	0.17
RESP	0.07	-0.04	0.04	-0.00	-0.08	-0.09	-0.05	0.02	-0.01	-0.03	0.05	-0.09	0.06
SB	-0.03	0.02	0.08	0.46	-0.09	0.06	0.45	-0.01	0.16	-0.31	0.34	0.26	0.29

	OCCR	INCM	FAMS	WLTH	REYS	RESP	SB
OCCR	1.00						
INCM	0.01	1.00					
FAMS	-0.18	0.42	1.00				
WLTH	0.07	-0.38	-0.33	1.00			
REYS	-0.03	0.13	0.27	-0.55	1.00		

RESP	0.02	-0.07	-0.03	0.03	-0.04	1.00	
SB	0.01	0.10	0.02	-0.11	0.16	-0.03	1.00

Annex.2

2.1 Likelihood Ratio Test for Probit Model (LR)

The LR statistics of testing the null hypothesis of all the slope coefficients are equal to zero is given by:-

$$\lambda_{LR} = 2[L(\beta_0, \beta i) - L(\beta_0, 0)]$$
$$= 2[\text{Log } L_u - \text{Log } L_r]$$

Where Log L_u or L (β_0, β_i) is the maximized value of unrestricted log-likelihood function and Log $L_{r\ or}$ L (β_0, 0) is the maximized value of restricted log-likelihood function estimated only with constant term, β_0 is the regression constant term and β_i is the coefficients of explanatory variables.

λ_{LR} has a $X^2_{(n)}$ distribution with 'n' degrees of freedom where 'n' is the number of independent restriction. The null hypothesis of all the slopes are equal to zero will be rejected if $\lambda_{LR} \geq X^2_{(n).}$ In our model, the value of the log-likelihood with only constant term is -104.18227 and the maximized log-likelihood value is -34.841248. Therefore the result of the test for the model is shown below:

$$\lambda_{LR} = 2[-34.841248 - (-104.18227)]$$
$$= 138.68204$$

The critical value of the $X^2_{(19)}$ is 62.23 at 5 % significance level. Thus the λ_{LR} exceeds the critical value, the null hypothesis that the entire slope coefficients are equal to zero is rejected which implies that the model is statistically acceptable, since it has some explanatory variables

2.2 Measures of Goodness of Fit for the probit model

In the Probit model it is not appropriate to use the conventional R^2 to measure its goodness of fit. Instead the log-likelihood ratio index (LRI) has been suggested for models with qualitative dependent variable and can be specified as follows:

$$LRI = 1-[L(\beta_0, \beta i)/ L(\beta_0, 0)]$$
$$= 1-[\text{Log } L_{u/} \text{ Log } L_r]$$

Where Log $L_{u,}$ is the maximized value of the log-likelihood of the model being estimated and Log L_r is the value of log-likelihood estimated only with constant term. This measure has 0 values when the entire slope coefficients are zero and 1 when the model is perfect predictor. The values between 0 and 1 have no natural interpretation, but when it approaches to 1, it shows improvement in goodness of fit (Green, 1993).

Therefore the computed value of LRI is:

$$LRI = 1-[-34.841248/-104.18227]$$
$$= 0.6655741$$

The LRI =0.67 means that our Probit model explains about 67% of the variation in explained variable.

2.3 Tests for Heteroscedasticity and Goodness of Fit for the Tobit Model

The log-likelihood ratio test (LRT) is also used to test the existence of heteroscedacticity in the Tobit model.

The LRT statistics of testing the null hypothesis of homoscedasticity assumption is obtained by:

$$LRT=2[\text{Log } L_u - \text{Log } L_r]$$

Where Log L_u is the value of unrestricted log-likelihood function and Log L_r is the value of the restricted log-likelihood function.

LRT has a $X^2_{(n)}$ distribution with 'n' degrees of freedom where 'n' is the number of coefficient parameters excluding the constant term. If the calculated test statistic exceeds the critical value, the null hypothesis is rejected, that is if $LRT \geq X^2_{(n).}$

The test result for the Tobit model becomes:

$$LRT=2[-661.21282-(-776.5116)]$$

$$=230.59756$$

The critical of the $X^2_{(19)}$ is 230.60 at 5% level of significance. Therefore the calculated test statistic is found to be a bit smaller than the $X^2_{(19)}$ critical value, heteroscedasticity is not a major problem for this model.

The likelihood ratio index (LRI) is used to measure the goodness of fit to the Tobit model which is similar to R^2 in conventional OLS regression model.

Thus the measure of goodness of fit is computed using the formula of:

$$LRI=1-[\text{Log } L_{u/} \text{ Log } L_r]$$

=1-[-661.21282/-776.5116]

=0.148483

The LRI =0.15 means that our Tobit model explains about 15% of the variation in explained variable.

Annex.3 Contingent Valuation Survey-Households Questionnaires on Water Supply Service

CONTINGENT VALUATION SURVEY- HOUSEHOLD QUESTIONNAIRE ON WATER SUPPLY SERVICE

Interviewer Name_____

Place of interview_____ (write kebele №)

Date of Interview_____

Length of Interview_____ (minutes)

Household Code _____

Supervisor _____

INTRODUCTION TO THE RESPONDENT

How are you, I am _____. I am assisting an ongoing research by Yibeltal Bantie for the partial fulfillment of his MSc in economics at Addis Ababa University. The questionnaire is designed to obtain information on the current situation of water supply in Motta town, and resident's willingness to pay for improved water supply services by taking some selected households in the town. So your view could be used as an important input to officials and policy makers in their attempt to improve the water supply system of the town. Further your opinion and perception will help us to understand the attitude of the residents towards drinking water quality improvement program and their involvement. The interview will take a few minutes and the answer will be completely confidential and strictly for academic purpose only. Your name will never be associated with your answers. There are no correct or wrong answers. Thus please answer the questions honestly and as truthfully as you can

THANK YOU IN ADVANCE!

SECTION I: EXISTING WATER USE PRACTICES AND PROBLEMS

1. What is the main source of water for the members of this household?

1. Piped water 2. Other source

If piped water **GO TO Question 2**

If other source **GO TO Question29**

2. If piped, what kinds of piped do you use?

1. Tap inside the house **(GO TO Questions 4)**
2. Tap in the compound, shared with neighbors **(GO TO Question3)**
3. Tap in the compound, private **(GO TO Question 4)**
4. Public Taps **(GO TO Question 15)**

3. How many households use the shared tap in the compound? _____ Households.

4. How much water does your household consume per day? _____Jeri can (**Note that one Jeri can is assumed to be a 20 liters container).**

5. For what purpose(s) is the water from this source mainly used by your household? **IDENTIFY AND RANK STARTING BY WRITING (1) IN THE BLANK SPACE FOR THE MOST IMPORTANT PURPOSE.**

A. _____drinking B. ___ washing clothes C. ____ housekeeping (cleaning house, gardening, etc) D. ____ watering livestock E. _____others (specify)

6. How much, on average, do you pay for your water consumption per month from this source? _____ Birr per month.

7. In relation to its quality, amount and reliability, how would you rank the existing water service from this source?

A. Quality: 1-good 2-average 3-poor

B. Quantity: 1-good 2-average 3-poor

C. Reliability: 1-reliable 2-unreliable

8. During what time you often face water shortage?

1. During day time 2 .Morning 3.At Noon 4.Afternoon 5. During Night time

9. From your experience how often do you get piped water within 24 hours? _____Hours.

10. Is there any time where piped water is completely absent?

1. Yes 2. No

11. If your response to 10 is "yes" specify the time during which water is completely absent?

1. During day time 2.Morning 3.At Noon 4.Afternoon 5. During Night time

12. In general are you satisfied with the existing piped water service?

1. Yes 2. No

13. If "No" what are the main causes of your dissatisfaction? (**Multiple answers possible**)

1. Poor quality 2.Low quality 3.Unreliabilty 4. Higher volume charge

5. far away from home 6 .Other reason specifies.

14. How do you judge the existing water tariffs of the town's water service office?

1. Fair and affordable 2.Too cheap 3.Too expensive 4. It is difficult to judge

Go to Question 39

15. If public tap, how many persons from the household go at a time to fetch water from this source? _____ Persons.

16. If public taps how much time, on average, do you spend to reach from your house to these other sources to fetch water? _____ Minutes.

17. If public taps how much time, on average, do you spend for waiting to fetch water at a time? _____ Minutes.

18 if public taps how many times, on average, do you go per day for fetching water? _____times.

19. If public tap who often go to the public tap to fetch water? (**Multiple answers possible**)

1. Boys 2.Girls 3.Women 4.Men 5. Band C 6. All

20. When do you prefer the public tap to be open?

1. Early in the morning 2.Afternoon 3.Evening 4. All the day

21. What is the present status of public tap service?

A. Quality: 1. Good 2.Average 3. Poor

B. Quantity: 1. Good 2.Average 3. Poor

C. Convenience of service hours: 1. Good 2.Average 3. Poor

22. For what major purpose(s) do you use water collected from public tap? **IDENTIFY AND RANK STARTING BY WRITING (1) IN THE BLANK SPACE FOR THE MOST IMPORTPURPOSE.**

A. _____ drinking B. _____washing clothes C. _____house keeping

D. _____ watering livestock E. _____ others, specify

23. Had there been any interruption of water supply from the public tap?

1. Yes 2. No

24. If "Yes" on average how frequent was this interruption?

1. Daily 2.Weekly 3.Bi-weekly 4 .Monthly 5. If other time, specify.

25. Are you satisfied with this source of water?

1. Yes 2. No

26. If "No" why are you dissatisfied? **IDENTIFY AND RANK STARTING BY WRITING (1) IN TNE BLANK SPACE FOR THE MOST SERIOUS PROBLEM**.

A. ____ Poor quality B. _____ Low quantity C. ____ Unreliability

D. _____ higher volume charge E. _____ Far away from home F. ____ others, specify

27. Why don't you have your own or yard connection, if your current source of water is public tap?

1. The house is not mine but rented 2. High connection cost 3. Shortage of water

4. I don't want to have yard or private connection 5. Other reason, specify.

28. How do judge the existing water tariffs of the town's water service office?

1. Fair and affordable 2.Too cheap 3.Too expensive 4. It is difficult to judge

Go to Question 39

29. If “others “to Question 1, what other source do you often use for water collection?

1. River 2. Well 3.Spring 4. Others, specify

30. How much water do you collect on average in a day? _____ Jeri can.

31. How much do you pay per Jeri can? _____ Cents.

32. How many times on average per day do you go to fetch water from this other source? _____ Times.

33. How much time, on average, do you spend to reach from your house to these other sources to fetch water? _____ Minutes

34. How much time, on average, do you spend for waiting to fetch water at a time? _____ Minutes

35. How many members of the household go to fetch water at a time? _____ Person(s).

36. Who often goes to fetch water from this source? **(Multiple answers possible)**

1. Girls 2.Boys 3.Women 4.Men 5.A and C 6. All

37. Are you satisfied with this source of water? 1. Yes 2.No

38. If “No” why are you dissatisfied? **IDENTIFY AND RANK STARTING BY WRITING (1) IN THE BLANK SPACE FOR THE MOST SERIOUS PROBLEM.**

A. _____ poor quality B. _____low quantity C. _____unreliability

D. _____high volume charge E. _____ far away from home

F. _____availability problem G. _____others, specify.

39. Do you treat your piped/ public tap/other source water to make it safe to drink?

1. Yes 2. No

40. If “No” what are your reasons for not treating your piped/public tap/other source water?

1. The water is clean for drinking 2. The water is not clean but treating is costly and time consuming 3. The water is not clean but has no side effect on health.

41. If “yes” what is the mechanism used to make your pipe public tap/other source water safe to drink?

1. Boiling 2. Add chemicals 3. Use water filter 4. Other, specify.

42. If “yes” how much you pay to treat your piped/public tap/other source water to make it safe to drink? _____ Birr per month.

43. Have any of your household members suffered from diseases caused by deficient water quality?

1. Yes 2. No

44. If yes what were the diseases? **(Multiple answers possible)**

1. Diarrhea 2.Typhoid 3.Cholera 4.Vomiting 5. Other water born diseases

SECTION II: - HOUSEHOLDS WILLINGNESS TO PAY FOR IMPROVED WATER SUPPLY SERVICES

BACKGROUND INFORMATION

In the next section of the questionnaire, I would like to ask you how much value you are prepared to pay for an improved water service provision. That is it concerns on how much the provision of improved water service is worth to you in monetary terms.

INTERVIEWER: READ THE FOLLOWING INTRODUCTION

Now a day there is a big difference between the supply and the demand for clean potable drinking water in Motta town. The reason for excess demand over its supply, that is shortage of town's water supply are:-high population growth, there are low water pressure problems and limited number of boreholes which are not enough to supply the current water supply of the present population.

The provision of improved water service among other things requires the construction of additional boreholes, additional water pumps for the new water boreholes to be operational, additional water reservoirs, the construction of pipelines from the boreholes or other water sources to the public taps to have public taps at different places of the town.

Thus to practice all this, in addition to investment costs it is also necessary to pay for operational and maintenance costs and thus it is costly to implement the improvement program. Therefore, residents are requested to share the cost of the project. The proposed water improvement program goes ahead if the community agrees to share the cost and sufficient funds were generated. The provision of improved water services to the town's community means provision of good quality water which is safe for health, availability of good quality of water for 24 hours per day and 7 days a week throughout the year, and also the family need not have to spend its time and effort in fetching water from distant sources. However, all household of the town, including yours, who have an option t have private connection to such an improved piped water supply scheme, would have to pay initial investment and running costs which will be added to your water bill, but you may not be required to pay initially the costs of connection to the new scheme, instead it will be distributed for the next 20 years in your monthly bills.

QUESTIONS ON WILLINGNESS TO PAY FOR IMPROVED WATER SERVICES (Note that this part is asked to the whole respondent)

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

1. Yes 2. No

46 If "Yes" suppose that the town's water service office made the improved water service available, would you be willing to pay ____ cents per Jeri can or(for 20 liters container)?

1. Yes 2. No

47. If the answer to Q.46 is 'Yes', **ask the following question**. If the price of water per Jeri can from the improved water service is increased to (2X), _____ cents per Jeri Can (or for 20 liters container), would you be willing to pay?

1. Yes 2. No

48. If the answer to Q.46 is 'No' **ask the following question.** If the price of water per Jeri can from the improved water service is decreased to (0.5X), _____ cents per Jeri Can (or for 20 liters container), would you be w willing to pay?

1. Yes 2.No

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

50. **(To Interviewer)-**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

QUESTIONS ON WILLINGNESS TO PAY FOR IMPROVED PRIVATE PIPE CONNECTION (Note that this part is asked to respondents who use public taps and other sources)

Les us assume that you have private pipe connection together with the improved water supply scheme ,but you may not be required to pay initially the cost of connection to the new scheme for the reason that it will be distributed for the next 20 years in your monthly bills.

51. Are you willing to pay any amount to have private pipe connection with the improved water provision?

1. Yes 2. No

52. If "Yes" and if the price from the improved water service with private pipe connection is_____ cents per Jeri can, are you willing to pay?

1. Yes 2. No

53. If the answer to Q.52 is 'Yes' **ask the following question**. If the price from the improved water services with private pipe connection is increased to (2X), _____ cents per Jeri Can (or for 20 liters container), would you be willing to pay?

1. Yes 2.No

54. If the answer to Q.52 is 'No' **ask the following question**. If the price from the improved water service with private pipe connection is decreased to (0.5X), _____cents per Jeri Can (or for 20 liters container), would you be willing to pay?

1. Yes 2.No

55. What is the maximum amount you want to pay for one Jeri can of water for this improved pipe water scheme? _____ Cents per Jeri can.

56.**(To Interviewer)-**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

QUESTIONS ON WILLING NESS TO PAY FOR IMPROVED PUBLIC TAPS PROVISION (Note that this part is asked to respondents who use public taps and other sources)

If the improved water service scheme benefited households that does not have access to individual piping but using public taps and other sources of water,

57. Are you interested to participate in this improvement scheme?

1. Yes 2. No

If “Yes” and suppose that a new scheme of improved water system will be provided using a public tap as near as possible to your home and with this public taps you get quality water that does not require boiling to drink at any time of the day.

58. If the price of water from the improved service is _____ cents per Jeri can or (20 liters container), are you willing to pay?

1. Yes 2. No

59. If the answer to Q.58 is ‘Yes’ **ask the following question**. If the price of water from the improved service is increased to (2X), _____ cents per Jeri can (or for 20 liters container), would you be willing to pay?

1. Yes 2.No

60. If the answer to Q.58 is ‘No’ **ask the following question**. If the price of water from this improved service is decreased to (0.5X), _____ cents per Jeri Can (or for 20 liters container), would you be willing to pay?

1. Yes 2.No

61. What is the maximum you could pay for one Jeri can of water from this improved water scheme? _____ Cents per Jeri can

62**.(To Interviewer)-**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

SECTION III:-QUESTIONS ON DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERSTICS

To remind you, the question here is for background purposes only and thus the answers are very important. Besides your personal information is strictly for academic purposes and confidential.

63. Gender (observation):-

1. Male 2. Female

64. Are you the head of house hold?

1. Yes 2. No

65. How old are you? _____Years of old.

66. Education level _____

67. Occupation:-

1. Government employee 4.Private business 7. Self employee
2. House wife 5.Unemployed 8. Retired
3. Student 6. Other, specify

68. How much is your own gross income per (month) excluding your familys'income? _____Birr.

69. Would you please telling me your household members' income per (month) excluding your own income?

1. Person1_____ birr 3. Person 3_____ birr 5. Person 5 _____ birr
2. Person 2_____ birr 4. Person4_____ birr 6. Person 6_____ birr

70. How many are you in your house hold including yourself? _____ (No of people)

No of adults _____, ≥15 years old

No of children _____, <15 years old

71. Do you have your own house?

1. Yes 2. No

72. For how many years have you lived in the town? _____ Years.

73. Do you have_____ in your house? (Multiple answers possible)

1. Refrigerator 2.Telephone 3.Tape 4.Radio 5. Television

74. How much do you spend per month for_____ in birr?

1. Food_____ 4.Water_____ 6. Telephone_____
2. Schooling_____ 5.Electricity____ 7).Transport_____ 8. Medical_____
3. Community service (Eder, ekub, etc.)_____

75. Is your household aware about water born diseases?

1. Yes 2. No

76. If “Yes” what type of water born diseases they suffered from? (**Multiple answers possible)** 1. Cholera 2.Diarrhea 3.Typhoid 4.Vomiting 5. Other water born diseases

77. Who do you think is responsible for water supply?

1. Government 2.Community 3.Private 4. Others, specify

78. What do you recommend regarding the proposed improved water supply for the town?

1. Very good 2. Good 3.Satisfactory 4. Others, specify