

Addis Ababa University School of Graduate Studies

DETERMINANTS OF HOUSEHOLD'S WILLINGNESS TO PAY AND DEMAND FOR IMPROVED WATER SERVICES: A CONTINGENT VALUATION STUDY IN JIJIGA TOWN

By

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June, 2009

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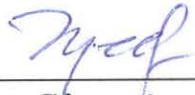
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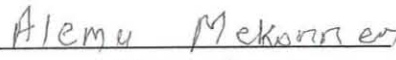
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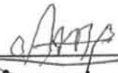
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List of Acronyms

- AAWSA: Addis Ababa Water & Sewage Authority
- BWEM: Bureau of Water Energy and Mines
- CDF: Cumulative Density Function
- CRM: Contingent Ranking method
- CSA: Central Statistics Agency
- CV: Compensating Variation
- CVM: Contingent Valuation Method
- E.C. : Ethiopian Calendar
- EV: Equivalent Variation
- HPM: Hedonic Pricing Method
- JWSO: Jijiga Water Supply Office
- Kms: Kilometers
- m.a.s.l: meter above sea level
- MDGs: Millennium Development Goals
- Mm: Millimeter
- NA: Not Available
- NGO's: Non Governmental Organizations
- OLS: Ordinary Least Square
- PFM: Production Function Method
- PLC: Private Limited Company
- SDPRP: Sustainable Development and Poverty Reduction Program
- SRS: Somali Regional State
- SRSWEMB: Somali Regional State Water, Mines and Energy Resource Development Bureau
- TCM: Travel Cost Method
- TVET: Technical & Vocational Education Training

- UN: United Nations
- WSSP: Water Supply and Sanitation Program
- WTA: Willingness To Accept
- WTP: Willingness To Pay

Abstract

As many cities in developing countries, Jijiga town faces problems in obtaining water for domestic purposes. 81.3% of the households in Jijiga town do not have private pipe connection in their houses. Although Jijiga water supply office is incurring a loss of 0.521 birr per one meter cubic of water produced, water supply is far below the existing water demand in the town.

Based on cross-sectional data collected from 251 households in Jijiga town and using contingent valuation method, this study investigates and assesses the determinants of households' willingness to pay and demand for improved water services in Jijiga city which will provide an indication of the value that consumers place on improved water services. The study will also provide guidance by enabling policy makers to design an appropriate water pricing structure.

Two empirical models adopted by this study are Probit and OLS models. The Probit model is used to analyze responses from single bounded close ended questions. The OLS model is used to analyze responses from the open ended questions by identifying factors that affect maximum WTP of the households for improved water service.

The result of the study shows that households spend 4.4% of their monthly income on water, where households consume, on average only 132 liters per day. Households do not satisfy the current water supply situation due to low quality, less quantity and unreliability of the sources. Among six main social services presented, majority of respondents give the first priority to water services. The mean WTP for improved water services is found to 0.36 Birr per Jerican (a 20 liter backed) which is about 6.5 times more than the existing authority's current tariff rate.

Both empirical models show that explanatory variables, income of the households, level of satisfaction of the household, ownership of the house, reliability of water source, primary water source and Respondents' perception about the quality of the existing water supply significantly affect the households' WTP for improved water service. Therefore, as a policy implication, the study suggests consideration to be given such variables in designing and implementing the policies of improved water supply service project.

CHAPTER ONE

Introduction

1.1. Background

Formally acknowledging access to water as a human right could be a good way of encouraging the international community and governments to enhance their efforts to satisfy the basic requirements of people to this fundamental resource without which no human being can live for more than a few days (Selim E. Guvener, 2006). Expanding access to safe drinking water is one of the Millennium Development Goals which was reaffirmed with funding commitments at the UN World Summit for Sustainable Development in September 2002.

Water is the source of life. Together with air constitutes the most basic element indispensable for any form of life. Although its scientific composition is well known as the combination of two molecules of hydrogen and one molecule of oxygen, it cannot be reproduced in a laboratory in sufficiently large quantities. For a long time water has been considered as a substance existing in unlimited amounts. However today it is widely recognized that water reserves of our planet are not infinite and their preservation and equal distribution, not only for the present but also in the future, is one of the most fundamental challenges faced by humanity (Selim E. Guvener, 2006).

Water is needed for a large array of purposes. It is used for producing food and energy, for irrigation, for making cement for construction, for combating fire and even for recreational activities such as water sports (Selim E. Guvener, 2006).

Water management is undergoing significant and important economic and financial changes. This sleepy little industry once dominated by public bureaucracies is rapidly transforming into a global business that is driven by shareholder interests and profit and loss statements. In fact, the water industry is already a booming business. Worldwide, annual industry revenues are estimated at \$300 billion, with the United States accounting for more than half that amount, and this number is expected to double as water becomes scarce and the industry matures (N. Earl Spangenberg, 2002).

New pricing policies are another key factor in the evolution of the new economy of water. As a society, we are rethinking the way we price water. For years, water has been highly subsidized and provided at little or no cost. The rationale for these policies was that water is a basic service of life and should be free to all. While a noble goal, the legacy of subsidized water has created an infrastructure crisis and has left many of the poorest society without access to good clean water. New pricing policies are moving toward real cost pricing to address water scarcity, encourage conservation, provide infrastructure funding, and most importantly, attract private sector investment. Private companies are far more interested in funding water

projects now that revenues can be generated from those investments (N. Earl Spangenberg, 2002).

The overarching objective of Ethiopia's Sustainable Development and Poverty Reduction Program (SDPRP) is to reduce poverty by enhancing rapid economic growth while at the same time improving service delivery. Water and sanitation are among the key sectoral measures and cross-cutting issues to be addressed. The SDPRP targets for the medium and long term are consistent with the Millennium Development Goals (MDGs). For water supply the MDG target is to halve, by 2015, the proportion of people without sustainable access to safe drinking water and sanitation. The baseline for water supply is 24% and the baseline for sanitation is 15% in the year 2000. Accordingly, the goal is 63% for water supply and 58% for sanitation in the year 2015 (WSSP Implementation Manual, 2004).

1.2. Statement of problem

Developing countries do not always have the resources in place to provide potable water for its population. For most households, access to a high quality, reliable source of water is one of the most important components of the bundle of goods which constitute improved housing. However, progress in improving the quality and quantity of water used by people in rural areas of the developing world has been unsatisfactory. Several reviews by the World Bank, bilateral donors, and water supply agencies in developing countries have shown that a simple model of behavioral response to

improved water supplies has usually proved incorrect (Whittington, D. et al. 1991). In rural areas many of those served by new systems have chosen to continue with their traditional water use practices.

In Ethiopia, the Ministry of Water Resources adopted its National Water Resources Management Policy in 1999. The overall goal of the Policy is to enhance and promote “efficient, equitable and optimum utilization of water resources” for sustainable socio-economic development. It recognizes water as an economic good and encompasses water supply and sanitation (WSS), irrigation and hydropower sub-sectors. One of its main objectives for the WSS sub-sector is to ensure that every Ethiopian citizen has access to water of acceptable quality to satisfy the basic human needs.

With regard to Jijiga, the water supply shortage is one of the main concerns. Excess demand as compared to water supply and insufficiency of the existing sources are considered as the actual cause of the water supply shortage in the town (Kaah Consulting Firm, 2008).

The inhabitants of the town that keep on increasing day after a day are using water by far less than they were willing to use. This is because in the town there is limited amount of water produced, which couldn't able to satisfy the ever-increasing water demand of the town. The limited water resource available together with the less coverage of the existing distribution system forced the inhabitants of the town to use other traditional sources like hand dug wells and other seasonal streams.

The distribution system is too old causing higher water loss. The existing distribution network was made in the year 1968 E.C, since then there was no any major change observed to the town's water supply system. The total length of the existing distribution system is 104 kms, which is very undersized as compared to the big size of the town and the numbers of people living in the town (BWEM, 2008).

The water supply shortage is considered as the main concern of the Jijiga Water Management Board and the Somali Regional State Water, Mines and Energy Resource Development Bureau. Accordingly, the actual cause of the water supply shortage is the insufficiency of the existing sources & the excess demand as compared to water Supply. The management explains the cause to be reduction of the yield of water at source coupled with increase of demand for water due to speedy population growth (SRSBWEM, 2008).

The price to be sold per one meter cubic of water is less than the cost of its production. For instance, an average of 2.75 birr is to be sold for one meter cubic of water while 3.021 birr of cost is incurred for the its production. The Jijiga water supply office is incurring a loss of 0.521 birr per one meter cubic of water (SRSBWEM, 2008).

If water projects are to be both sustainable and replicable, an improved planning methodology is required which includes a procedure for eliciting information on the value placed on different levels of service; and tariffs

must be designed so that at least operation and maintenance costs (and preferably capital costs) can be recovered. A key concept in such an improved planning methodology is that of 'willingness to pay'. If people are willing to pay the full costs of a particular service, then it is a clear indication that the service is valued (and therefore will most likely be used and maintained) and that it will be possible to generate the funds required sustaining and even replicating the project.

Charging consumers for water should be done carefully. Because if prices are set too low, revenues may not be sufficient to cover the full costs of supplying water. If, on the other hand, they are set too high, households may not be able to afford consuming the new improved water, and again revenues will not be sufficient to cover the full cost. Therefore, to set the required tariff, information on the ability and willingness to pay of the consumers for such services are essential.

A study on the willingness to pay provides an indication of the value that consumers place on improved water supply and an assessment of the demand for service improvement. A study of affordability provides guidance on tariff setting, helping to ascertain how far the consumers will be able to pay the cost of improved services.

This study will therefore, investigate and assess the determinants of households' willingness to pay and demand for improved water services in

Jijiga city which will provide an indication of the value that consumers place on improved water services. The study will also evaluate the consumers WTP for improve water services which provides guidance by enabling policy makers to design an appropriate water pricing structure.

1.3. Objectives of the Study

1.3.1. Main Objectives of the Study

The main objective of the study is to identify the factors that determine the households' WTP for improved water services and to evaluate how much Jijiga residents are WTP for improved water services.

1.3.2. Specific Objectives of the Study

- To identify and analyze key specific factors affecting the households' WTP for improved water services.
- To evaluate the mean WTP of Jijiga residents for improved water services.
- To estimate the demand for improved water services and revenue that can be expected from the provision of the improved services.
- To draw up appropriate policy implications and recommendations based on findings of the study.

1.4. Significance of the Study

So far, the strategies of governments and international donors for tackling the problem of water have been supply-driven; the fundamental importance of demand in the selection of appropriate policies has been virtually ignored. According to World Bank Water Demand Research Team, 1993, the realization that effective policy and planning must take into account what the rural clients want and are prepared to pay for was the impetus for the World Bank's multi-country study of households' demand for improved water services.

Addressing the service from the demand side is crucial for policy makers. In Ethiopia, for example, few studies have been attempted on the topic. Fisseha (1997), has assessed consumer' WTP for piped water supply of Meki town. Assefa (1998) has studied the determinants of household demand for improved water services in Addis Ababa. Similarly, Genanew (1999) has analyzed the determinants of households' demand for improved water services in Harar town. This study will further supplement to these past few initiations and applications to evaluate improved water services and also will contribute as a basis for empirical research.

This study which will determine and analyze factors that affect the demand for improved water services will help decision makers for their pricing and production decisions. Moreover, the study will estimate the ability and WTP of consumers for the service. Thus, the study will help decision makers compare cost of production of the service with the ability and willingness of

the people not only to pay but also to sustain their supplies which might include paying for operation, maintenance, replacement and extension costs for improved supplies.

The result of this study is expected to be beneficial to different stakeholders such as Somali Regional State authorities, Federal Ministry of Water, NGO's, World Bank and other Bilateral and Multilateral donor organizations in designing water projects and in implementing policy strategies in meeting the effective water demand of households and sustainable water use of households.

1.5. Research Questions

- What are the determinants of households' Willingness To pay for improved water services in Jijiga town?
- How much are households of Jijiga town willing to pay for improved water services?

1.6. Limitation of the Study

Due to time, financial and other constraints, the study, as far as area is concerned, is limited to only Jijiga town. For convenience, relevance and suitability purposes, Jijiga town is selected to be as the study area. Jijiga is the capital city of SRS, where there is a great concern of households' water need. Secondly, due to time and finance limit the sample size is limited to 256 households.

1.7. Organization of the Study

This paper contains six chapters and is organized in the following manner: the first chapter introduces the paper itself; the second chapter reviews the related literatures both theoretical and empirical type while the third chapter of the paper describes the study area. In the fourth chapter the methodology of the study is discussed. The fifth chapter will be empirical results and discussions of the study and the final chapter will be conclusions and recommendations.

CHAPTER TWO

Literature Review

In this section we will try to develop documented, logical rationale for the problem, research question or hypothesis to ensure that there is some flow from what is already known about the topic and what is attempted to be studied. Thus, in this section, we will have both theoretical and imperial literature.

2.1. Theoretical Literature Review

2.1.1. Measures of Welfare Change

For an individual, the change in consumer surplus can be treated as monetary measures of the individual's utility change when, for example the price of some commodity falls. However, this is a valid measure of the utility change only under some restrictive assumptions. It would be required, for example, that the marginal utility of income be constant. Hicks (1941) developed a set of monetary measures of utility change which do not require such restrictive assumptions. The "Hicksian" monetary measures of the utility change associated with a price are the compensating variation (CV) and equivalent variation (EV) (Perman et al. (2003) P.403-405).

Compensating Variation (CV) is the change in income that would 'compensate' for the price change and Equivalent Variation (EV) is the



change in income that would be 'equivalent' to the proposed price change (Perman et al. (2003) P.403-405).

The process of benefit estimation begins with the desires measurement for an individual: the net change in income that is equivalent to or compensates for changes in the quantity or quality of public goods. We begin with the preference function for an individual. Let $u(\mathbf{x}, \mathbf{q})$ be the individual preference function, where $\mathbf{x} = x_1, \dots, x_m$ and $\mathbf{q} = q_1, \dots, q_n$. The $\mathbf{x}$ are assumed available at parametric prices, $p_1, \dots, p_m = \mathbf{p}$, which may or may not be market-determined. The individual maximizes utility subject to income, y . The indirect utility function, $V(\mathbf{p}, \mathbf{q}, y)$, is given by (Haab and McConnell, 2002).

$$V(\mathbf{p}, \mathbf{q}, y) = \max_{\mathbf{x}} \{u(\mathbf{x}, \mathbf{q}) \mid \mathbf{p} \cdot \mathbf{x} \leq y\}$$

The minimum expenditure function $m(\mathbf{p}, \mathbf{q}, u)$ is dual to the indirect utility function.

$$m(\mathbf{p}, \mathbf{q}, u) = \min_{\mathbf{x}} \{\mathbf{p} \cdot \mathbf{x} \mid u(\mathbf{x}, \mathbf{q}) \geq u\}$$

The indirect utility and the expenditure function have well known properties. The derivative of the expenditure function with respect to price gives the Hicksian or utility-constant demand, where the subscript indicates the partial derivatives.

$$x_i^u(\mathbf{p}, \mathbf{q}, u) = m_{pi}(\mathbf{p}, \mathbf{q}, u)$$

The negative of the ratio of the derivatives of the indirect utility function with respect to price and income gives the Marshallian or ordinary demand curve:

$$x_i(\mathbf{p}, \mathbf{q}, y) = -V_{pi}(\mathbf{p}, \mathbf{q}, y) / V_y(\mathbf{p}, \mathbf{q}, y)$$

Further, when $u(x, \mathbf{q})$ is increasing and quasi-concave in $\mathbf{q}$, $m(\mathbf{p}, \mathbf{q}, u)$ is decreasing and convex in $\mathbf{q}$ and $V(\mathbf{p}, \mathbf{q}, y)$ is increasing and quasi-concave in $\mathbf{q}$. the indirect utility function and the expenditure function provide the theoretical structure for welfare estimation (Haab and McConnell, 2002).

Willingness To Pay (WTP) and Willingness To Accept (WTA) is a similar way or equally valid as the ideas of compensating variation and equivalent variation in describing money welfare measures. WTP is the maximum amount of income a person will pay in an exchange for an improvement in circumstance, or the maximum amount a person will pay to avoid a decline in circumstances. WTA is the minimum amount of income a person will accept for a decline in circumstances, or a minimum amount a person will accept to forgo an improvement in circumstances (Haab and McConnell, 2002).

The relationship among compensating variation (CV), equivalent variation (EV), WTP and WTA are summarized in the table below:

Table 2.1: The relationship among CV, EV, WTP and WTA

	<u>Equivalent Variation</u>	<u>Compensating Variation</u>
Utility Increases	WTA	WTP
Utility Decreases	WTP	WTA

(Adopted from Haab and McConnell, 2002. P.7)

We begin by defining these more intuitive measures. We based the definitions on changes in $\mathbf{q}$, though we could equally well change $\mathbf{p}$. For an individual, WTP is the amount of income that compensates for (or is equivalent to) an increase in the public good.

$$V(\mathbf{p}, \mathbf{q}^*, y - \text{WTP}) = V(\mathbf{p}, \mathbf{q}, y)$$

When $\mathbf{q}^* \geq \mathbf{q}$ and increases in $\mathbf{q}$ are desirable ($\partial V / \partial q_i > 0$). The changes in $\mathbf{p}$ can be valued by evaluating the indirect utility function at a new price vector $\mathbf{p}^*$. We can also define WTP with the expenditure function:

$$\text{WTP} = m(\mathbf{p}, \mathbf{q}, u) - m(\mathbf{p}, \mathbf{q}^*, u) \text{ when } u = V(\mathbf{p}, \mathbf{q}, y)$$

Assuming that we start at the same place, $y = m(\mathbf{p}, \mathbf{q}, u)$. WTP is the amount of income an individual would give up to make him indifferent between the original state: income at y and the public good at $\mathbf{q}$ at the revised state: income reduced to $y - \text{WTP}$ and the public increased to $\mathbf{q}^*$. The WTP for a price change (let the price vector decline) is defined analogously:

$$\text{WTP} = m(\mathbf{p}, \mathbf{q}, u) - m(\mathbf{p}^*, \mathbf{q}, u) \text{ when } u = V(\mathbf{p}, \mathbf{q}, y)$$

WTA is the change in income that makes an individual indifferent between two situations: the original public good $\mathbf{q}$, but income at $y + \text{WTA}$ and the new level of the public good, $\mathbf{q}^*$, but income at y . It is defined implicitly in the following equality:

$$V(\mathbf{p}, \mathbf{q}, y + \text{WTA}) = V(\mathbf{p}, \mathbf{q}^*, y)$$

It is given explicitly by the expenditure function:

$$\text{WTA} = m(\mathbf{p}, \mathbf{q}, u^*) - m(\mathbf{p}, \mathbf{q}^*, u^*)$$

Where $u = V(\mathbf{p}, \mathbf{q}^*, y)$. By this definition, $WTA \geq 0$ when $q^* \geq q$. The definition of WTP and WTA correspond to the positive parts of the Hicksian measures. As table 2.1 shows, WTP is the positive part of equivalent variation and WTA is the positive part of compensating variation (Haab and McConnell, 2002). This means in table 2.1 the case of utility decrease, equivalent variation is the maximum amount of income a person will pay to avoid a decline of the utility and compensating valuation is the minimum amount of income a person will accept for the decline of the utility.

2.1.2. Valuing the Environmental Resources

Many non-economists regard putting prices on environmental services as totally misconceived, if not wicked. Economists, however; attach values to the un-priced services provided by the natural environment (Perman et al. (2003)).

Environmental goods and services often do not have a market value and are considered as public goods with uncertainty that usually encircles their real value. Significance environmental goods have the characteristics of public goods and externalities are common that renders the markets with such goods and services to operate inefficiently in allocating environment resources. Economists have devised empirical tools to measure and estimate such benefits and costs of public action and these tools are known as valuation methods (Haab and McConnell, 2002).

Sometimes, the methods used for valuation are easy to implement and apply for certain problems and often, however, the valuation is more difficult. The reduction of human illness or death, maintaining populations of native fish or protecting visibility at national parks are not themselves goods and services bought and sold in a market, yet placing a monetary value on them can be essential for sound policy (Hanemann, 1994).

2.1.3. Valuation Methods of Environmental Resources

There are various methods available to estimate the economic value for non-market goods or environmental resources. To indicate some of these methods: i) revealed preference (indirect) method which consists of Travel Cost Method (TCM) Hedonic Pricing Method (HPM) and Production Function Method (PFM) (ii) stated preference (direct) method that includes Contingent Valuation Method (CVM), Contingent Ranking method (CRM) and others (iii) Non-preference method which includes shadow cost method (Opportunity cost) and implicit valuation (Hovenenagel, 1994).

However, the first two methods of direct and indirect are commonly used in estimating the economic value of non- market good and specifically HPM, TCM and CVM are in most researches used in assessing the value of the environment.

2.1.3.1 Indirect (Revealed) Preference Methods

This method of valuing the environmental resource is based on the preference and inferring demand for environmental goods and services by observing markets that are closely related to these goods and prices paid for other goods that are marketed. Even if there is no market for environmental goods, it is possible to estimate on implicit values for these goods and services through other well functioning markets.

2.1.3.1.1. Hedonic Pricing Method

This method attempts to estimate the price of environmental goods based on the market price of heterogeneous goods such as house, automobile and production factors (Labor, Land, etc) this assumes that the price of marketed good such as housing) is dependent on that good's characteristics (such as location, size, year of build and environmental amenities), i.e., the price of a related market good is a function of its attributes (characteristics). This means that if the quality or quantity of these goods changes, the value of environmental will also change for both consumers and producers (freeman, 1992).

The major problem of this method is the requirement that researchers be able to control for all relevant attributes or characteristics and this will likely be difficult, if not impossible. Other problems of this method includes, but not limited to the need for the individuals in question to be aware of the differences in attributes between potential housing unit insufficient market

data, and unknown functional forms of the pricing methods (Mitchell and Carson, 1989).

2.1.3.1.2 Travel Cost Method (TCM)

Travel cost method is a method in which consumers enjoy environmental goods with a market good to produce “experience” that directly provides utility and also individuals’ costly efforts to visit parks and traveling to these areas, it is possible to infer value they attach to these sites (Kolstad, 2000).

TCM, in its simplest form, estimates consumer surplus using the cost of traveling and any admission fee to a particular amenity and value benefits associated with access to recreation sites. According to Perman et al. (2003), the idea of this method is to infer values attached by visitors to environmental amenity services from the cost that they have incurred in order to experience the services.

The problems of this method include the possibility that an individual can substitute one recreation site for another, the difficulty of defining relevant costs, the difficulty in incorporating environmental quality more explicitly in to the model and the question of how to value the time one may have spent in travel and multipurpose trip. It is more difficult to use travel cost analysis to value many important classes of public goods, such as the benefits stemming from regulations directed at reducing air and water pollution (Mitchell and Corson, 1989).

2.1.3.2 Contingent Valuation Method

The contingent valuation (CV) method is a survey technique that has been used to elicit people's preferences by asking them directly to report their willingness to pay (WTP) to obtain a specified good or service or willingness to accept (WTA) to give up a good or service, rather than inferring these values from observed behaviors in regular market places. It is called "contingent" valuation because it uses information on how people say they would behave given certain hypothetical situations. It is one of a number of valuation techniques which come under the direct/hypothetical classification (Mitchell and Carson, 1989).

This method of CVM is based on the idea of compensating and equivalent surpluses that was originally developed by Hicks. In CVM, a detailed description of the good that economists seek to value is presented along with the means for provision of the good and the quality and quantity of the good. The description must satisfy the payment vehicle by which the consumers would pay for the provision of the good. People will be asked to value a hypothetical non-market good in telephone or mail survey, or personal interview or experimental setting. However, in developing countries face to face personal interview should be used to be more accurate and also reliable. A CV survey consists of three main important parts:

1. Designing and administering the contingent valuation survey.
2. empirical analysis of responses
3. estimating and aggregating benefits (WTP and /or WTA)

However, some economists have expressed skepticism of the method because contingent valuation questions are hypothetical and may therefore yield hypothetical answers. Skepticism of the method has been also generated by the implausible answers observed in some contingent valuation studies (Hausman et al. 1994). The problems with this method and these can be broadly categorized into three biases.

- Scenario misspecification:
- Implied value cue:
- Incentives to misrepresent responses:

Theoretically, WTA and WTP are supposed to provide at most the same results, but empirically the WTP measures for the same change in environmental quality (Hanley et al. 1997). (Haab and McConnell, 2002) it is common to find that for the same goods in the same setting, WTA exceeds WTP by an amount that seems intuitively far too much even for goods and services with quite small nominal values. In a summary of 45 studies, Horowitz and McConnell find the mean ratio of WTA to WTP to exceed 5. The anomaly is accentuated by the empirical results obtained from behavioral models, where one typically finds no meaningful difference between willingness to pay and willingness to accept.

Russell (1992) held the view that the differences between WTP and WTA in empirical studies is by chance and should not be taken seriously, while Knetsch (1993) took it to be significant and argued that people tend to overstate what they must receive free and understate what they must pay so

as to make gain contingent valuation methodology remains a prominent research method. While scholars of the technique have perhaps learned more about the CVM, new questions have been asked about the method and consensus regarding the technique is unlikely to be achieved in the near future if not at all. Despite these questions, CV have gained institutional acceptance and has formed the basis for policy making.

2.2. Empirical Literature Review

2.2.1. Empirical Applications of CVM

Contingent valuation survey has been widely applied to valuing public goods and environmental resources where markets for such goods or services do not exist or their transactions are not easily observable. In this section we are going to see how CVM is applied on reduced air pollution, improved water services in developed world and Ethiopia as well.

2.2.1.1. CVM Application on Reduced Air Pollution

A study by Dickie and Gerking (1991) estimated the demand for ozone pollution protection in a major metropolitan area (Los Angeles, California) using CVM. The basis of their analysis is the willingness of people to purchase health care to compensate of the health-related damage from ozone pollution.

In Morocco, Belhaj (1998) adopted CVM using iterative and dichotomous approaches in valuing WTP to reduce air pollution in Rabat city, based on a sample of 400 household. The study established WTP to reduce air pollution with a mean of 67.75 Dirhams and a median of 50 Dirhams per month for iterative approach, while for dichotomous choice mean and median were 63 and 60 Dirham per month respectively. (The exchange rate used was 1 US\$ = 8.4 Dirhams).

2.2.1.2. CVM Studies on Improved Water Services in Developing World

July 2006, first assessment of willingness to pay (WTP) for water supply change was conducted in the largest city in the developing world: Mexico City. Two large sample contingent valuation surveys are conducted to investigate WTP for two levels of water service quality: maintenance of or improvement over current provision levels. This study design permits one of the first tests of the “scope sensitivity” of WTP responses to different levels of baseline supply provision.

The findings of the study confirmed prior expectations that richer households enjoying higher baseline service levels would prefer programs to maintain the status quo, while poorer households enduring lower initial quality of service would prefer schemes which improve the quality of supplies. In fiscal terms, aggregate WTP figures show that authorities could collect the resources necessary to fund households' preferred schemes and simultaneously substantially reduce current subsidies.

The WTP survey for safe drinking water has been conducted in many places around the world including cities in India. In Calcutta, several surveys have been conducted to estimate the WTP. Roy et al. (2003) conducted a WTP survey in a ward of Calcutta Municipal Corporation for safe drinking water. A survey was conducted among 240 households selected both from residential and slum area. They start from the hypothesis that like any other market goods (food, clothing etc.) variations in WTP for drinking quality water across households may be explained by the household income. Household decision towards adoption of a purification method can be expected to largely depend on ability to pay.

Aversion behavior is also expected to vary with household perception about the likely benefits that may accrue from a new system. The researchers considered the highest educational attainment in a family an indicator of the access to relevant information. Education level was also suspected to be correlated the impact the family could have in the community in the case of adopting a new program.

Whittington et al. (1992) estimated the WTP for private connections and public taps of improved drinking water system in Edem, Umunko and Ekwegbe villages in the Nsukka district of Anambra state of Nigeria using CVM. Two different starting values, high and low, were used and each household in the sample was assigned to one of these two groups. Households' response was analyzed in three ways: interval estimate, ordering of the alternatives and as choice to a single decision about the

availability of water system. In this study it is found that coefficients of attitudes, education, storage capacity, assets, housing type and the qualitative variable for the starting point had their expected sign and statistically significant.

2.2.1.3. CVM Application on Water Services in Ethiopia

In Ethiopia, a number of CVM applications can be identified. Fissfha (1997), for example, undertook an investigation using CVM in Meki town to assess consumers' WTP for piped water supply.

Assefa Chaka (1998), using both the direct approach (revealed preference) and the contingent valuation attempted to provide empirical evidence on the relationship between household preferences and Willingness to Pay (WTP) for improved water services, and the factors determining such preferences. His survey data illustrates that the average WTP bids for private connection to be 8.66 cents per 'Baldi' (a 20 liter bucket) of improved water from private connection and 4.7 cents for public taps. The variables, household income, ownership of residing house, age and education level of household head were found to be significant determinants of households' decisions to connect to improved water scheme. Also, he suggested that the contingent valuation survey as a feasible method for estimating WTP for public utilities such as improved water services.

Genanew Bekele (1999) intended to investigate the determinants of households' WTP for improved water services in Harar town using the CVM. Accordingly, he found that all households preferred the provision of the improved piped water services, and on average, households are WTP about 15 cents per Baldi (a 20 liter bucket) of water which is about 15 times more than the existing authority tariff. His major empirical evidence of this study is that contingent valuation surveys can provide policy relevant information which is vital to judicious decisions, both technical and financial.

Haymanot Legesse (2007) made a study on the value of water quality improvement on lake Hora-Arsedi. He employed a CVM to elicit the WTP of Beshoft town residents. A single bounded dichotomous choice format with a follow up open-ended format was used and comparison of the results obtained from these elicitation formats is made. The mean WTP estimates from open-ended and closed-ended format aggregated for the total population; and the WTP of the town residents was found to be 119,893 birr per month and 254,152 birr per month respectively. In the study, it is found that homestead distance (being near the lake) and perception of the existing lake quality have impacts on the probability of WTP. Moreover, income and sex of the respondents are determinants of the WTP for water quality improvement in the lake.

Gossaye Fanta (2007) using CVM assessed and estimated the WTP for improved water services from all the 15 kebeles of Dbrezeit town. The survey response was analyzed by using STATA 9.0 econometric software. The survey

result disclosed that pipe water is the main source of water for the town. The total WTP for one backed or 20 liters of improved water service is Birr 2627.82 per day. To identify the determinants of households' WTP for improved water service both Probit and OLS econometric models were estimated.

In this study findings from the Probit model shows that age, household size, water volume, reliability dummy and the income variable determine households' WTP for the improved water service. Where as in the OLS model, age, household size, reliability dummy and the income variable determine households' WTP for the improved water service in Debrezeit town. However, in both Probit and OLS models there is strong relationships between the income of the respondents and their WTP and indicate that the water tariff should reflect the income characteristics of the households.

Kinfe G.Egziabher (2007) employed a CVM to estimate the value that households in Addis Ababa attach to the proposed improvement in water supply service. Due to censoring of WTP amount at zero, a Tobit model is employed and identified factors that affect the amount of money households are WTP for the proposed improvement in water service. Probit model is also used to calculate the mean WTP for the service. As calculated from Probit model, the mean WTP for the improved water supply service is 20.20 cents per bucket. From the Tobit model a mean WTP of 15.34 cent per bucket is found which is twice larger than the higher consumption block of the existing tariff of Addis Ababa Water & Sewage Authority (AAWSA).

In this study the Tobit model shows that income of the household, sex of the respondent, education, household year of stay, households not using tank as a storage, wealth of a household, occupation of the respondent, households satisfaction with the existing service, and location of the study site have a positive and significant effects on the WTP. However, family size is found to have a negative and significant effect on the WTP amount.

CHAPTER THREE

Water Service Situation in Jijiga

3.1. Description of Study area

3.1.1. Background of the Study area

Somali Regional State (SRS) is located in the eastern and south eastern part of Ethiopia. It is bordering with Oromia in the west and south west, Afar and Diredawa in the north east, republic of Somalia in east, Kenya in south east and Djibouti north east. The Region has 9 zones, and 53 districts of political administration, the capital city of the region is Jijiga.

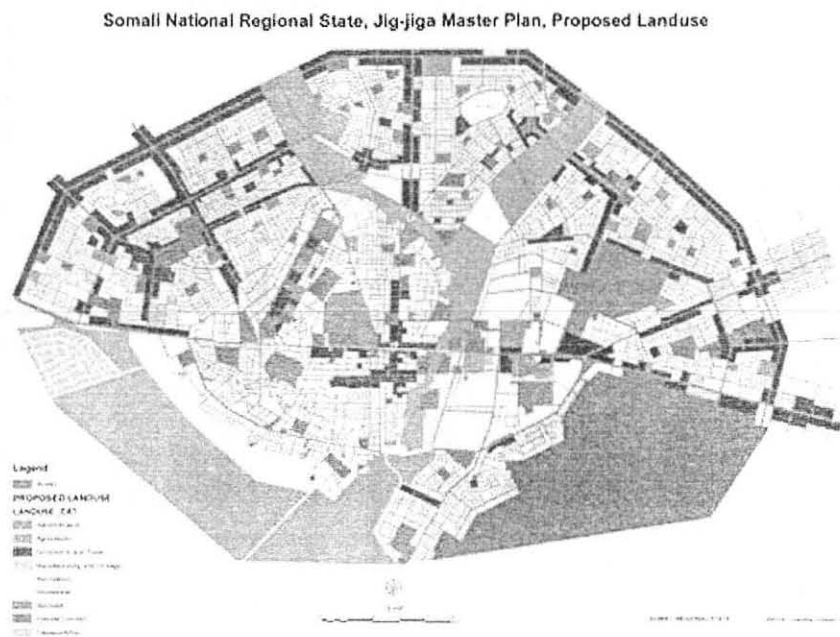
According to the 2007 population and housing census the population size of Somali region is 4,439,147 (four million four hundred thirty nine thousands one hundred forty seven).

The backbone of the economy in SRS is livestock while this remote under developed region covers a vast area of the Ethiopian territory. Its population is relatively small and predominantly nomadic with up to an estimated 90% of the population deriving their livelihood from pastoralism and animal related activities.

Jijiga town locates about 630 kilometers East of Addis Ababa, 105 kilometers east of Harar also 65 kilometers south east of commercial town Togwajale. The town also locates geographic coordinates of approximately 9⁰

20¹ North latitude and 42⁰ 56¹ East latitude (Wadani Consulting Company PLC, 2007).

Figure 3.1: Jijiga Master Plan



Source: Wadani Consulting Company PLC, 2007

Jijiga town has a total population of 102,489 in the year 2007 as per the population and housing count of the Central Statistics Agency. The population of the town is growing fast due to change of the town from district level to regional town. Accordingly it is observed that an influx of population migrating from rural townships across the region and other parts of the country.

3.1.2. Climate and Rainfall

The climate of Jijjiga town is classified under semi-arid (national atlas of Ethiopia) which is characterized by high temperature and low rainfall. Mean maximum annual average temperature of the town is 19.54⁰c, while monthly average temperature ranges between 25.24⁰c in November to 29.39⁰c in March. In contrast the minimum monthly temperature ranges between 7.21⁰c in November and to 16.13⁰c in July. As mentioned above the rainfall of Jijjiga is small (Wadani Consulting Company PLC, 2007).

The average annual rainfall is 675.77 mm. Jijjiga receives most of the rain in April and May (spring) that is 132.71(max) & 68.31mm and August and September (autumn) that is 85.47 & 80.84 mm respectively (Wadani Consulting Company PLC, 2007).

3.1.2. Economic Activities, Infrastructure and Social Services

According to the socio-economic report made by Somali Regional State Water, Energy and Mine Bureau (SRSWEMB) and Kaah Consulting Firm at May 2008 as well as data collected from municipality, the inhabitants of the town are engaged in governmental employer, private business, daily laborer, farming, etc. The result also shows that 45% of total community in the town earns life through business and only 3% of total community earns life through government employment. Regarding the income of households, rapid assessment of customer willingness and ability to pay shows that,

there is a big difference between incomes of various households. Table 3.1 below shows the range of income of households.

Table 3.1 Percentage of households' income range per month

Income Range	Percentage
< 180 Birr	3
181-500	35
501-1200	30
1201-2000	17
>2000	15
Total	100

Source: Somali Regional State Water, Energy and Mine Bureau

The socioeconomic survey showed that 64% of income is devoted to purchase food items and 13% of household monthly income is spent on water.

In the town there are 8 Kebeles. There are relatively good town levels of infrastructures as compared to other towns in the region. Jijiga town could be accessed both by air and ground receiving 24 hours electric power from national grid. In the town there is one post office, a digital communication system, a number of all weather roads with few number of asphalt roads.

There is one university, one health science college, two TVET colleges, and one teacher training college, two high schools and a number of primary schools. It is found that there are no enough water supplies to the education facilities.

There is one hospital, one health center and a number of private clinics and drug vendors. As per regional health bureau, most of water born and water related diseases are caused by lack of good quantity and quality water. The most common diseases in the town are: malaria, cholera, typhoid, scabies, amoebae, eye disease, etc. Most of the above diseases are partly the result of poor hygiene and sanitation practices and can be controlled with an integrated effort of providing improved water supply, hygiene and sanitation education.

3.2. Current Jijiga Water Service condition

The existing water supply system of the town is as old as since the year 1967 E.C. since then no marked improvement is observed to the water supply system. Initially, the water supply system of the town was designed to function by pumping with storage, i.e. during low demand period, excess water is stored in the service reservoir and during peak demand periods, and water was designed to be distributed from both the boreholes and the storage reservoir. However, due to the accidence of the demand as compared to the water produced, at present time no water is stored in the service reservoir, rather water is directly pumped to the demand center (SRSBWEM, 2008).

3.2.1. Water Treatment, Storage and Distribution System

3.2.1.1. Water treatment

In the existing water supply system, there was an injection type chlorination pant to treat the water coming from borehole. Currently, there is no water

treatment. The service has recently received donation modern water laboratory equipment and technical training from Japan government. One water laboratory technician has been hired and currently the water laboratory currently has the capacity to do bacteriological, biological and chemical tests (SRSBWEM, 2008).

3.2.1.2. Storage

There is one 350m³ capacity concrete reservoir constructed in the year 1968EC planned to serve the town by storing water during periods of low demand. The existing reservoir is located at about a ground elevation of 1728 m.a.s.l. The reservoir fails to perform its designed purpose; hence water is directly pumped to the distribution network without entering the service reservoir.

3.2.1.3. Distribution system

According to SRSBWEM, the existing distribution network was made in the year 1968 E.C, since then there is no any major change observed to the town's water supply system excepting an increase in the number of boreholes. The total length of the existing distribution system is 104kms, which is very undersized as compared to the big size of the town and the numbers of people living in the town. The existing distribution system doesn't cover the whole town and is also too old causing higher water loss.

3.2.1.3.1. Private connections

In the town there are 25,622 houses (CSA, 2007). Private water connections of the town are of two types, house connections and yard connections. In the town there are 3150 house connections, 1348 yard connections and 280 public and commercial connections. In addition to this there are 5 industrial connections and 7 cattle watering troughs (BWEM, 2008).

3.2.1.3.2. Public fountains

In the town, there are 6 public fountains all being made from concrete having shape to suit users of various types. However, at the present time majority of the public fountains are not giving service to the peoples because of various reasons: part of which are due to lack of water to be sold, due to their being damaged, and due to their being distracted if maintained by the bureau. The existing public taps do not have any fencing facility and some of which are located at improper place. In general some of the existing public taps need a sort of maintenance so as to make it serviceable in the future water supply system of the town (BWEM, 2008).

3.3. Water Supply and Demand in Jijiga Town

3.3.1. Present Water Consumption

According to Business Plan Report for Jijiga Water Supply Project (Kaah Consulting Firm, 2008), most of the inhabitants of the town are using water by far less than they were willing to use. This is because in the town there is

limited amount of water produced, which couldn't able to satisfy the ever-increasing water demand of the town. The limited water resource available together with the less coverage of the existing distribution system forced the inhabitants of the town to use other traditional sources like hand dug wells and other seasonal streams. The report indicates that, in the town, there are five modes of service; house tap users, yard tap users, neighborhood users, public tap users and traditional source users. In the year 2008 there are more than 4789 connections in the town.

Table 3.2: Water produced & consumed

Year	Water produced (m3)	Water consumed (m3)
1999(1991)	437,695	309,600
2000(1992)	606,750	430,820
2001(1993)	733,589	521,025
2002 (1994)	NA	NA
2003 (1995)	938477	656933
2004 (1996)	930800	652000
2005 (1997)	1018809	730000
2006 (1998)	1222706	870000
2007 (1999)	1323870	128000
2008 (2000)	1683390	1262542

Source: Somali Regional State Water, Energy and Mine Bureau

From the above table, the water loss is directly proportional to the water produced, averaging to 29% of the water produced. This shows that 29% of the water produced is lost within the system in the years before 2008. The

loss might be due to the oldness of the pipes, fittings and other appliances. However, the condition shows improvement in 2008 and the water lose is reduced to 25%.

3.3.2. Present water Demand

The socioeconomic survey conducted by SRSWEMB in 2008 indicated that a family consumes an average of 137 liter per day for different purposes. The survey result of the householders for modes of water utilization for different purposes is shown in the table below.

Table: 3.3: average current water consumption for a family

S/N	Type of consumption	Litter/day/family
1	Cooking & drinking	35
2	Personal & cloth washing	80
3	For toilet	22
	Average for a family	137

Source: Somali Regional State Water, Energy and Mine Bureau

A family represents an average of 8.5 people, and an average water demand of 137 litter/day/family is equivalent to 16 litter/day/person, however this does not represent the consumption by mode of service. The consumption by mode of service is estimated by using the design criteria stated below.

- Public tap = 301/c/day
- Yard connection = 401/c/day
- House connection = 701/c/day.

Hence the domestic piped water demand by mode of service is shown in the table below.

Table: 3.4: domestic piped water demands

Type of mode	Number of people*	Per-capita demand (liter/day)	Total demand (m3/day)
House connected	10,048	70	703.36
Yard connected	27,054	40	1082.16
Neighborhood users	1546	30	46.38
Public tap users	38,649	30	1159.47
Total	77,297	-	2991.37

Source: Somali Regional State Water, Energy and Mine Bureau

The existing neighborhood users are assumed to have per capita water demand of public tap users. Hence comparing the present domestic water demand to that of the actual water consumed, i.e.:

- Actual average domestic consumption = 1427.46 m3/day
- Estimated actual domestic water demand = 2991.37 m3/day

It can be seen that the existing system supply only 48% of the present domestic water demand.

3.3.3. Future Water Demand

As the living standards of the inhabitants of the town increases due to economic improvement and other various reasons, their water consumption

increases depending on the mode of service. To estimate the projected per capita water demand, and annual growth rate of 2% for house and yard connections and 1% for public fountain are assumed as explained on the design criteria report.

Table 3.5: projected per capita water demand by mode of service (1/c/d)

Mode of service	2001	2004	2009	2014	2019	2024
House connection	13	15	17	20	22	25
Yard connection	35	37	41	44	48	51
Neighborhood user	2	0	-	-	-	-
Public tap user	50	48	42	36	30	24

Source: Somali Regional State Water, Energy and Mine Bureau

3.3.4. Water Tariff

The existing tariff for all types of connection is categorized into a five progressive manner. The table below summarizes:

Table 3.6: The existing tariff for all type of connections

No	Consumption m3	Household	Commercial	Industrial	Public Tap	Others
1	0-5	2.00	2.00	2.00	2.00	2.00
2	6-10	2.50	2.50	2.50	2.50	2.50
3	11-20	2.75	2.75	2.75	2.75	2.75
4	21-30	3.00	3.00	3.00	3.00	3.00
5	> 30	3.50	3.50	3.50	3.50	3.50

Source: Somali Regional State Water, Energy and Mine Bureau

As indicated in the table above the water supply of the different client groups are charged equally.

N.B. Average tariff is 2.75 Birr/m³

3.3.5. Losses of Water

Loss of water is one factor that brings about the gap between demand and supply. According the information obtained from JWSO, from the total discharged amount of water, 25% is the lost amount; it is the maximum water loss from the Water Bureau standard. This is because as we mentioned before, the system is a dead end that does not allow free circulation of the water and the pipelines are made up galvanized iron that most of them have corroded and bring about leakage in different parts of the town (Wadani Consulting Company PLC, 2007).

CHAPTER FOUR

Methodology of the Study

4.1. Data Source and Type

The type of data used is mainly primary and cross-sectional in the year 2009. The data is obtained from the contingent valuation survey that was conducted by making a household survey in the selected areas of Jijiga town by means of questionnaire developed for the CVM. The mode of data collection used was face-to-face interview with household respondents.

The study is also supplemented by other secondary data that was gotten from relevant studies. Related documents from the Ministry of Water resources, Somali Regional State Water Energy & Mine Bureau, and other studies were used as data sources for this study.

4.2. The Sample Design

The sampling strategy was based on a stratified random sampling scheme according to primary water source for the household. To begin, a sample for the study is drawn from the all Kebeles of Jijiga town. In the town there are 102,489 persons, on average, there are 4 persons in each house (CSA,2007), hence, there are 25622.25 houses in the town. From this, 256 households that is nearly 1% of the total houses in the town were taken to be included in the sample.

Based on the primary water sources, households were divided into two, households with private piped water connection source and households with other water sources. Among the 25622.25 households in Jijiga town, only 4789 (18.7%) houses have water connection (SRSBWEM, 2008) while 20833.25 (81.3%) do not have water connection and get water from other sources. To ensure a representative sample of the total households in the town, 208 households and 48 households were randomly selected to respect the 81.3% and 18.7% ratio of the sample population over the total population from the households without piped water connection and households with piped water connection respectively.

We intend the survey to be included households from each Kebele and hence, stratified random sampling technique was used to draw samples from the entire households in the town. This technique helps to ensure a representative sample of the total households in the town.

4.3. The Questionnaire development & Design

For the development of this questionnaire, focus group discussions on water issues were organized in Jijiga during December of 2008. These discussions helped to identify household water concerns such as current water use practices and problems, sources where people receive water, water demand and factors that affect the willingness to pay for improved water services. All focus group discussions were held in Somali language. From this, a first draft of the questionnaire is developed.

This first draft was then pre-tested on about 15 households. Following the pre-test, the survey instrument was revised to avoid confusions arising in the original draft and the final version was developed. For instance, initially double bound close-ended 'Yes' or No' questions followed by open-ended questions was selected as an elicitation format but after the pre-test a single bounded closed-ended 'Yes' or No' questions followed by open-ended questions was preferred to elicit the willingness to pay of the respondents.

Also in the pre-test the initial bid was decided. Among the 15 households in pre-test, 3 of them chose a bid price of 0.10 Birr, 5 chose a bid price of 0.15 Birr, 4 chose a bid price of 0.20 Birr and 3 of them chose a bid price of 0.25 Birr for the provision of a Jerican of improved water service. From this, the respective proportions of each of these four bids are decided. Based on, the bids are randomly presented to the respondents for acceptance or rejection as an initial bid. The face-to-face survey was conducted during December 2008 by four enumerators.

The design of this contingent valuation survey questionnaire generally follows the Mitchell and Carson techniques (Mitchell and Carson, 1989) with some modifications to make it relevant to this specific study.

The survey instrument (questionnaire) consisted of three parts (see Annex 4). A first section dealt with the household's water use practices, attitudes and perceptions about water quality and services. A second section was organized around a scenario and a contingent valuation question for

improved water service. The third section asked for information on the household members & respondent's sex, age, education level, occupation, family composition and other socio-economic and demographic characteristics.

4.4. Hypothetical Scenario

In the hypothetical scenario households were proposed an option to an improved water supply scheme. The improved water supply scheme was explained as the provision of good quality of water which is safe for health inside household's house, provision of good quantity of water where an increased amount of water is available for use any time household wants throughout the year, and improved water from highly reliable source at any time.

4.5. Empirical Models

In addition to descriptive statistics, econometric models are used to analyze the data obtained from this CV survey. Here the researcher specified two models due the nature of the dependent variable and the type of the elicitation method (single bound close ended 'Yes' or No' questions followed by open-ended questions). To analyze the survey responses obtained from the single bounded and that from the open ended two different econometric models will be specified.

4.5.1. Econometric Model for the Single Bounded Questions

One of the standard approaches in the analysis of single bounded close ended survey responses is the random utility model (RUM), where it is assumed that the utility function consists of both a systematic and a stochastic part.

Hanemann (1984)¹ constructed the basic model. Utilizing the random utility framework that McFadden had developed, Hanemann rationalized responses to dichotomous CV questions, putting them in a framework that allows parameters to be estimated and interpreted.

A typical household in Jijiga proposed with a CV scenario in which a discrete change in water from W^0 to W^1 , where W^0 is the water services at the status quo level and W^1 is the water services after the improvement level confronts the following two utility functions

Utility function for water services at status quo level, U^0 is

$$U^0 = U(W^0, M_i, X_i) \text{ ----- (4.1)}$$

Utility function in the final state (after the improvement), U^1 is

$$U^1 = U(W^1, M_i, X_i) \text{ ----- (4.2)}$$

¹ Cited in Haap & McConnell, 2002

Where M_i denotes household income and X_i is an n -dimensional vector of household characteristics and attributes affecting the existing water supply preference of the households.

If we denote the stochastic disturbance term by ϵ_i and the indirect utility function for water service of the household at the two statuses, status quo and final status (after the improvement) as:

$$V(W^0, M_i, X_i) \text{ for status quo and } \text{-----} \quad (4.3)$$

$$V(W^1, M_i, X_i) \text{ for final status } \text{-----} \quad (4.4)$$

The utility functions for household of the two respective cases are therefore written as:

$$U(W^0, M_i, X_i) = V(W^0, M_i, X_i) + \epsilon_0 \text{-----} \quad (4.5)$$

$$U(W^1, M_i, X_i) = V(W^1, M_i, X_i) + \epsilon_1 \text{-----} \quad (4.6)$$

Here the researcher assumes that households are well known about their utilities and can make choice among the two alternative utilities. Further, the household understands the proposed change in the water service and is capable of evaluating the effect of this change on his/her utility, hence the household chooses the improved water services. The household considers some amount of his income (the proposed bid) for the improved service. Let us denote this amount of income allocated for the improved water services by 'Ci'.

Utility of the household from water services after the improvement level exceeds that of the status quo level.

$$V(W^1, Mi-Ci, Xi) + \epsilon_1 > V(W^0, Mi, Xi) + \epsilon_0 \text{ ----- (4.7)}$$

The researcher does not know the random part of preferences and thus can only make probability statements about yes and no. the probability of a yes response is the probability that the respondent thinks that it is better off in the proposed scenario (Haap & MacConnell, 2002). Assuming that the error term is additive, the probability can then be written as:

$$P[Yes] = P[V(W^1, Mi-Ci, Xi) - V(W^0, Mi, Xi) + \epsilon_1 - \epsilon_0 \geq 0] \text{ ----- (4.8)}$$

$$P[No] = 1 - P[Yes] \text{ ----- (4.9)}$$

If we define $\Delta U = V(W^1, Mi-Ci, Xi) - V(W^0, Mi, Xi)$ and

$$\eta = \epsilon_1 - \epsilon_0$$

Thus we can then write

$$P[Yes] = P[\eta \geq -\Delta U] = 1 - F_\eta(-\Delta U) \text{ ----- (4.10)}$$

Where F is the CDF of the error term.

For a symmetric distribution

$$P[Yes] = F_\eta(\Delta U) \text{ ----- (4.11)}$$

The dependent variable in this case is binary in nature indicating the choice of particular service level i.e. whether the household chooses the improved water services or keep its original sources. Obviously the utilities are not observable. The random utility model then will be based on an underlying latent regression model. Thus, assuming the error term, e_i has a standard distribution, with mean zero and variance one (Greene, 1995), the Probit model is expressed as:

$$Y^* = F(X\beta + U_i) \text{ ----- (4.12)}$$

Where Y^* = Unobservable latent variable = 1 if the response is Yes
= 0 if the response is No

X = Vector of explanatory variables

β = Vector of parameters

Since the variable Y^* is not observable we cannot estimate equation (4.12) directly. However, the single bounded dichotomous choice respondents indicate their WTP by answering ‘Yes’ or ‘No’ to a set of offered bids. Using Y_i as the observed indicator, where Y_i takes 1 if the respondent answers ‘Yes’ and 0 if ‘No’, we can use Y_i as a counter part of Y^* and our observation will be:

$$Y = 1 \text{ if } Y^* > 0 \text{ ----- (1.13)}$$

$$Y = 0 \text{ if } Y^* \leq 0 \text{ ----- (4.14)}$$

The model, equation (4.12), cannot be estimated directly. The responses obtained from the single bounded survey are estimated using the maximum likelihood function with the help of Stata 9 econometric software package.

Let Y_i be an indicator variable for observation i , with

$$P[\text{Yes}] = P[Y_i = 1] = P[\eta_i \leq \Delta U_i] = F_{\eta}(\Delta U_i) \text{ ----- (4.15)}$$

$$P[\text{No}] = P[Y_i = 0] = 1 - P[\eta_i \leq \Delta U_i] = 1 - F_{\eta}(\Delta U_i) \text{ ----- (4.16)}$$

So the log-likelihood function is

$$\log L = \sum_{i=1}^N y_i \ln F_{\eta}(\Delta U_i) + (1 - y_i) \ln(1 - F_{\eta}(\Delta U_i)) \text{ ----- (4.17)}$$

Where the first sum is over the observations for which $Y = 1$ and the second sum is over the observations for which $Y = 0$.

After these justifications we specify the Probit model for households' WTP for improved water services in the following manner:

$$\begin{aligned} \text{ANS} = & \beta_0 + \beta_1 \text{PWAS} + \beta_2 \text{INCHH} + \beta_3 \text{HHSIZE} + \beta_4 \text{EDUC} + \\ & \beta_5 \text{SEXR} + \beta_6 \text{AGER} + \beta_7 \text{HOUSE} + \beta_8 \text{OCCR} + \\ & \beta_9 \text{ATHRWS} + \beta_{10} \text{PRICE} + \beta_{11} \text{LSHWS} + \beta_{12} \text{RPQWS} + \\ & \beta_{13} \text{RELW} + \beta_{14} \text{MWCHH} + \beta_{15} \text{BID} + U_i \text{ ----- (4.18)} \end{aligned}$$

Where ANS is the response to the bid price = 1, if the response is Yes, and = 0 if the response is No. β_i is the regression parameters and U_i is the error

term. The description of the explanatory and their effects are explained in section (4.5) above.

4.5.1.1. Welfare Measure

The main purpose of the analysis is to estimate WTP. From the assumed utility function we can derive a WTP function. From the WTP function we can estimate the welfare change using mean and medium measure.

The literature has focused on two measures of central tendency with respect to preference uncertainty. One is the expectation of WTP with respect to preference uncertainty. The second measure of central tendency is the median of the distribution with respect to preference uncertainty. In the case of a linear utility function and a symmetric, mean zero error, the mean and medium WTP with respect to random preferences are equal (Haap & macConnell, 2002).

Having specified our Probit model above, we turn now to calculate the mean WTP which is the same as medium WTP. The Probit regression model with the dependent variable of ANS on constant and the explanatory variables including bid, the mean or medium WTP will be calculated as follows:

$$\text{Mean WTP} = \frac{\beta_0}{-\beta_{15} \text{ (Bid coefficient)}} \text{-----(4.19)}$$

Where **WTP** = willingness to pay

β_0 = the intercept

From equation (4.19) mean WTP is calculated dividing the intercept by the bid coefficient.

4.5.2. Econometric Model for Open Ended Question

For open-ended questions responses, the appropriate econometric models used to estimate is a censored model such as Tobit model or the Ordinary Least Square (OLS). For Tobit model, one of the applications is when the dependent variable is zero for some individuals in the sample (Maddala, 2002). If the dependent variable takes none zero positive number, linear regression model is used to estimate the respondents' WTP survey from open-ended questions.

In our survey a total of 256 sample households were interviewed. However, only 251 of the total sample were analyzed. The remaining 5 were removed due to incomplete or misused responses. The result of our survey indicated that all the 251 households are interested in the provision of the improved water service and are willing to pay a positive amount. The minimum price observed in the bidding was 0.05 Birr for a Jerican (a 20 liter backed) of water. Therefore, in this survey responses, the OLS model is the appropriate model for analyzing the determinants of the households' WTP for the improved water services

4.5.2.1. Ordinary Least Square (OLS) Regression Model.

Altaf et al (1992), in their study of the WTP for water in rural Punjab, Pakistan, they used this model. Similarly, Genanew Bekele (1999), in his study of the determinants of household's WTP and demand for improved water services in Hara town, Ethiopia, he used this model. Also Gossaye Fanta (2007) used this model in his assessment of estimating WTP for improved water services on Debrezeit town, Ethiopia.

In this study, using the ordinary least square (OLS) method the following econometric model is specified and regressed with the help standard econometric software Stata 9.

$$\begin{aligned} \text{MWTP} = & \beta_0 + \beta_1 \text{PWAS} + \beta_2 \text{INCHH} + \beta_3 \text{HHSIZE} + \beta_4 \text{EDUC} + \beta_5 \text{SEXR} + \\ & \beta_6 \text{AGER} + \beta_7 \text{HOUSE} + \beta_8 \text{OCCR} + \beta_9 \text{ATHRWS} + \beta_{10} \text{PRICE} + \\ & \beta_{11} \text{LSHWS} + \beta_{12} \text{RPQWS} + \beta_{13} \text{RELW} + \beta_{14} \text{MWCHH} + U_i \text{ ----(4.20)} \end{aligned}$$

Where MWTP is the maximum willingness to pay, β_i is the regression parameters and U_i is the error term. The description, specification, rationale and expected sign of the explanatory variables are well explained in the following section.

4.6. Description of Explanatory Variables and Their Expected Effect

1) Primary Water Source (PWAS)

This refers the main source of water the household using which is a dummy variable that takes 0 if the primary water source of the household is piped water and 1 if the primary water source of the household is other sources. During the pre-test it is observed that households without access to private piped water connection in their house are WTP more for improved water services and those with access to private piped water connection in their house are WTP less. Thus positive sign is expected for this variable.

2) Income of the Household (INCHH)

This includes the total monthly income from different sources of all members in the household. It is a continuous variable. Economic theory shows that there is positive relationship between quantity demanded and income in case of normal goods. Therefore it is expected that households with higher income have higher WTP for improved water services. Thus the expected sign of the variable is positive.

3) Size of the Household (HHSIZE)

This refers to number of people living under one-roof and share common resources. It is a continuous variable. It is one of the most determinant factors of households' WTP for improved water services. As family size is higher, there will be higher need for improved water in that family, hence,

that family's WTP is higher. Therefore the expected sign of the variable is positive.

4) Education Level of the Respondent (EDUC)

This refers to the years of education of the respondent. EDUC is dummy variable taking 1 if the respondent gets formal education and 0 otherwise. Its effect is expected to be positive since educated households are more aware of the health benefit of improved water service and may have higher opportunity cost of time spent for collecting time. Thus they are willing to pay more and have more preference to improved water service.

5) Sex of the Respondent (SEXR)

This is dummy variable taking 1 if female and 0 otherwise. In Somali region it is generally assumed that women are primarily responsible for arduous task of fetching water. Hence, women would attach more importance to improved water supplies than would men, and thus women would be willing to pay more for such services. Thus the expected sign is positive.

6) Age of the Respondent (AGER)

This is continuous variable in number of year. It is generally believed that older people are traditionally used to free water services so that they may be less willing to pay and may have low preference for a new source that will require fees. Thus this variable is expected to be negative.

7) Ownership of the House (HOUSE)

Ownership of the house as a proxy to household wealth is a dummy variable taking 1 if house is owned and 0 otherwise. Wealthy households are more WTP and prefer to have a private connection to the improved water services. Therefore, the expected sign of the coefficient of this variable is positive.

8) Occupation of the Respondent (OCCR)

This is dummy variable, taking 1 if the respondent is government or privately employed and 0 otherwise. Studies made on different countries show that the effect of this variable on WTP for improved water services was mixed. However, many literatures, for instance studies in Pakistan, Nigeria and Addis Ababa show that employed respondents are WTP higher for improved water services than their counterpart. Thus the expected sign for this variable is positive.

9) Attitude of the Household about the Responsibility of Water Supply (ATHRWS)

It is a dummy variable, and takes 1 if the respondent says the government should administer; 0 otherwise. If the respondent says the government should manage the water service, it might be expected that the government will provide the service at a lower price and thus less WTP. Therefore, we expect negative sign for this variable.

10) Price of Water (PRICE)

This is a continuous variable in Birr. Most of the households living in Jijiga town are buying water from private vendors, whose price is very much higher than the official tariff. However, this price is not the same for all households. Some of the households buy water from vendors with very high price while others buy water with relatively lower price. Thus the monthly expenditure for water consumption may vary among households though the volume of water consumed is the same. Therefore, households that buy water with relatively higher price might be WTP more for the provision of improved water service. Thus we expect positive sign for this variable.

11) Level of Satisfaction of Households with the Existing Water Services. (LSHWS)

It is a dummy variable, and takes 1 if the household is not satisfied with the existing water services; 0 otherwise. Households that are not satisfied with the current provision of water are in a greater need to get an improved water services and hence, are WTP more to get such service. Therefore, we expect positive sign for this variable.

12) Respondents' perception about the quality of the existing water supply (RPQWS)

Dummy variable taking 1 if the quality of the existing water supply is poor and taking 0 otherwise. The expectation is that a household would be willing to pay more for an improved source when the perceived quality of the

existing water source is poor. Thus the expected sign for the coefficient of this variable is positive.

13) Reliability of the Existing Source of Water (RELW)

Dummy variable 1 if the respondent says reliable; 0 otherwise. Since reliability refers to the availability of water at the required time and amount, people are willing to pay more for the improved water if the existing water supply is unreliable. If the household considers the existing water supply in the town is reliable, it may be willing to pay less. Thus we expect a negative relation between this variable and WTP for the improved water service.

14) Daily Water Consumption by the Household (MWCHH)

This is a continuous variable indicating the quantity of water household consumes per month. From the general belief, households that consume large quantity of water for their normal consumption suffer much during the shortage of water than those who consume less. In other words, households that consume much water spend more money for this service and hence are WTP more for improved water service. Thus, the expected sign is positive.

15) Bid

This is the bid price offered to the respondents. It is a continuous variable. The bid price influences the respondents WTP for the improved water services; therefore, it is used as one of the explanatory variable in this study. Its sign or direction of effect will be tested in the model.

CHAPTER FIVE

Empirical Results and Discussions

This chapter presents the empirical findings of the contingent valuation survey and discusses the results obtained using both descriptive analysis and multivariate regression analyses. In the descriptive analyses, an overview of the households' attitudes towards the existing water supply in the town and their preference towards improving water supply in the town are discussed. In the multivariate regression analyses, factors that affect the WTP responses of households for improved water services are discussed by applying both Probit and Ordinary Least Square models.

Regarding the organization of this chapter, the first section of this chapter will be descriptive analysis of the contingent valuation survey where characteristics of the household members, water consumption behavior, water sources, purposes, problems and socioeconomic variables of the household will be discussed. The second part of the chapter will be econometric analysis where multivariate regression analyses of the variables affecting willingness to pay of the households will be made using econometric software packages such as Stata 9.

5.1. Descriptive analysis

In this section, we summarize the results of the survey we obtained in the three sections of the questionnaire that we used in this survey. With the help of descriptive statistics, we will briefly review the result of the survey.

5.1.1. Characteristics of the Household Members

A total of 256 sample households were interviewed in the survey. However, only 251 of the total sample were analyzed. The remaining 5 were removed due to misuse of the questionnaire. From the total of 251 sample households, 97(38.6%) are female headed. 188(75%) of the respondents are the household heads themselves. Out of the total respondents 154 (61.35%) are female and the rest 97 (38.64%) are male. The average family size of the total sample household is 7.99 Ranging from 1 to 19. On average, the respondents' age is 41 which range from 19 To 76 years old.

The data about the respondents' level of education shows that the level of education ranges from none to higher degree graduates. 169 (67.3%) of the household heads have completed at least 4 years of formal education while 82 (32.7%) of the household heads do not attend any formal education. With regard to occupation, it was found in the survey that 106 (42.2%) of the household heads are government employed, while 57 (22.7%) were employed in different areas such as privately employed or self employed, and 88 (35.1%) of the household heads are unemployed.

5.1.2. Water Use Practice & Problems

This section deals with the water use practices and problems in the town. Around 85.3% of the total households have no access to direct pipe line in their houses or the existing pipe system does not work totally and are using other sources of water for domestic purposes.

5.1.2.1 Water Sources

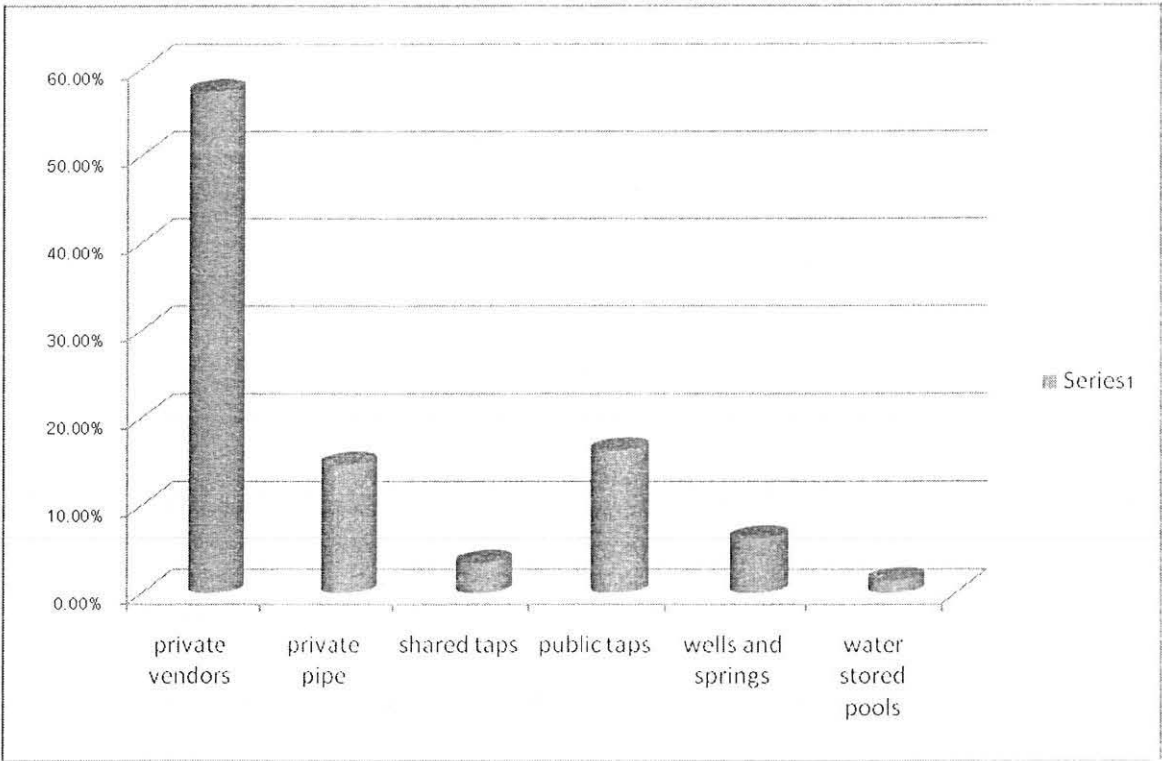
The result of the survey indicates that there are 6 different sources of water for the residents of Jijiga town. These 6 sources are piped water, public taps, private vendors (donkey driven water cars), shared taps, wells & springs, and water stored in pools.



A private vendor (donkey driven water car) in service

To begin with, data on main source of water for domestic purpose indicates that for most of households, 144 (57.3%) use private vendors (donkey driven water cars) as the main source of water, 37 (14.7%) use private piped water in their houses, 9(3.5%) use shared tap in/outside their compound, 41 (16.3%) use public taps as a main source of water for domestic purposes. 16 (6.3%) use wells and springs while only 4 (1.5%) use water stored pools as a main source of water for domestic purposes.

Figure 5.1. Source of water for domestic purposes



Source: Own survey

As the graph above indicates only 14.7% of the total households use private piped water. The rest, 85.3% use other sources as a main source of water. As to why these households (households without piped water in their houses) prefer these water sources, 24.4% of the respondents said the existing pipe system does not work totally, 25.4% said no access to the existing pipe system, 12% show that access to the existing pipe system is difficult, 22% said connection is not available due to rented house, 6.3% express that cost to the existing pipe system is not affordable, 5.3% believe that this source is reliable while 4.3% feel that this source is cheaper.

Of the shared tap, in/outside house users (4.4% of the total households) on average, there 3.5 households sharing a single shared tap. For Wells, springs and pool water users, in addition to quality problems, households are incurring additional cost in terms of time and money for fetching water in order make it available in their houses.

5.1.2.2. Water Consumption

The average daily consumption of water by households of both categories (households with piped water sources and those with other sources) is 6.6 Jericans (20 liter buckets), ranging from 1 Jerican to 20 Jericans per day. This means the average water consumption by household is 132 liters per day. This is very close to the result of the socioeconomic survey conducted by SRSWEMB in 2008 which indicated that a family consumes an average of 137 liter per day.

Based on the primary water sources, the average consumption of the households with piped water source and those with other sources are 8.2 Jericans and 6.3 Jericans per day respectively. This indicates that households with pipe line connection in their houses consume more water than households without access to the pipe line connection.

5.1.2.3. Purposes for Water Use

Almost all households in the sample use water for domestic purposes such as drinking, washing body, washing clothes, House sanitation (equipment &

house cleaning). However, some households from both categories, in addition to the above, use water housekeeping (e.g. Gardening).

According to the results of our survey, 45.7% of the households with access to piped water services use water for housekeeping in addition to all other domestic purposes. This could be due to the easy accessibility of the water. Also, this is one of the main reasons for these households with access to consume more quantity of water. However, among households without access to piped water, only 18.5% in addition to all other domestic purposes use water for housekeeping (e.g. Gardening).

Therefore, this result shows that almost half of the households with access to the pipeline connection in their houses think about the beauty of their houses, and hence the wellbeing of the environment. On the other hand, the households without access to the pipeline water in their houses, only few of them think about the beauty and the wellbeing of their houses as well as the environment. The implication of this result is that, if these households were given to improved water services, it would be good news to not only the members of the household but the environment.

In Australia the garden takes the most drinking water, typically accounting for around 35% of consumption, although in hot, dry summers, this figure can be as high as 90% in some parts of Australia (the Australian Drinking Water Guidelines, 2004).

5.1.2.4. Water Expenditure

The average household water consumption expenditure is 4.91 Birr per day (i.e. 147.4 Birr per month). However, depending on the primary water source, there is big water consumption expenditure difference. The water consumption expenditure of the households with pipe line connection in their houses and households without access to the pipe line connection are 0.83 Birr per day (i.e. 24.9 Birr per month) and 5.6 Birr per day (i.e. 168 Birr per month) respectively.

Relatively to the mean monthly income of the respondents, households spend 4.4% of their income on water. This is within the range of the World Bank's recommendation which states that maximum expenditure of water should be 5% of the household's monthly income which indicates that households can spend up-to the maximum of the WB's recommendation for improved water services if they are provided.

5.1.3. Water Quality Quantity and Reliability

Regarding to questions concerning quality, quantity and reliability asked to the respondents of different sources of water, the result shows that there are different answers for these questions depending on the primary water source. Of those households who have piped water connection in their houses, quality, quantity and reliability of the water were not seen as a serious problem. However, households with other sources of water indicate

that poor quality, low quantity and less reliability as a serious problem to them.

For quality of the existing water services, the result of the survey shows that 18.7% of the respondents ranked as poor quality, 53% ranked as satisfactory, while 28.3% of the respondents ranked as good quality for the existing water services. However, when asked whether households use purification method (such as boiling, filtering, etc), only 8.7% of the households responded that they use purification methods to clean water before drinking.

42.8% of those households who do not use purification method reasoned that the water is clean for drinking. 23.9% said the water is not clean but purification is costly and time consuming, while 33.3% believe that the water is not clean but harmless to health.

If our water becomes contaminated with microorganisms or chemical, illness can result. Disease causing microorganisms carried by water are biggest threat to health, causing gastrointestinal upset, diarrhea or even death. In some cases, people can become ill after drinking contaminated water just once (the Australian Drinking Water Guidelines, 2004).

Although the households who have the habit of purifying water before drinking are very small in number (as can be seen from the above result), only very few households, 11% of the total respondents indicates that

members of their households suffered diseases in connection to their water use practices. Diseases caused by water that are most serious include cholera, diarrhea and typhoid.

In addition to the quality, quantity and reliability of water is a serious problem in Jijiga town. As mentioned above, quantity and reliability is relatively less serious for households with access to pipe line in their houses but more serious for households with other sources of water for domestic use.

32 (15.6%), 127 (62%), and 46 (22.4%) of the households without piped water in their houses ranked as good, satisfactory and poor for the quantity of water respectively. While 30 (65.2%), 12 (26.1%) and 4 (8.7%) of the households with piped water in their houses ranked as good, satisfactory and poor for the quantity of the existing water services respectively.

Among the households without piped water in their houses, 28 (13.7%) and 177 (86.3%) ranked as reliable and unreliable respectively for the reliability of the existing water. Of the households with piped water in their houses, 24 (52.2%) and 22 (47.8) ranked as reliable and unreliable for the reliability of the existing water services.

5.1.4. Availability of Water

The survey further includes an assessment on the availability of water and requirements. The result of the survey indicates that majority, 78.3% of the households with piped water source get water all the times. 19.5% get water usually during the night time and 2.2% stated that it is unpredictable.

With regard to households with other sources of water, majority of them 84.5% usually get water during the day time, 9.4% of these households get water during the night time and the remaining 6.1% said that it is unpredictable.

For those households with access to pipe line connection uses other alternative sources of water when pipe water is not available. These households indicate that they incur additional costs of buying water from other sources.

The survey shows that 34.8% of these households use private vendors (donkey driven water suppliers) as an alternative water source with average price of 0.90 Birr per Jerican (a 20 liter backed). 28.3% use the other pipes where water is available with average price of 0.56 Birr per Jerican, while 36.9% use their own reserve with zero prices.

5.1.5. Level of Satisfaction

Households are asked whether they are satisfied with the existing water services or not. For households with piped water source, 67.3% of them are satisfied with the current water supply services and 32.7% are not satisfied with the existing water supply services. The main reasons for dissatisfaction of later respondents are due to low quantity, unreliability and the poor quality of the water.

Out of the 205 sample households without access to the piped water services, only 25 (12.2%) are satisfied with the current water supply services, while the majority 180 (87.8%) are dissatisfied with the existing water services.

Among those with dissatisfaction, the findings showed that the respondents ranked *because of poor quality* as the causes of dissatisfaction first by 39.1%, second by 15.2% third by 19.6% and fourth and above by 26.1%. *Because of low quantity* was ranked as causes of dissatisfaction first by 24% second by 34.8% third by 15.2% and fourth and above by 26%. *Because of unreliability* was ranked as causes of dissatisfaction first by 8.7% second by 10.9% third by 19.6% and fourth and above by 60.8%. Finally, *Because of high charge* was ranked as causes of dissatisfaction first by 19.6% second by 21.7% third by 11% and fourth and above by 47.7%.

5.1.6. Income, Expenditure and Housing Characteristics of the Households

Average household monthly income is 3381 Birr ranging from the minimum of 710 Birr to the maximum of Birr 10000. In addition to water expenditure, households spend their income for different other purposes. Average expenditures on food, education, transportation, electricity, Chat, water and miscellaneous expenses² are summarizes in the following table.

Table 5.1: Household Average Expenditure on Six Items

No.	Item	Expenditure Amount
1	Food	1713.5
2	Education	252.4
3	Transportation	124
4	Light	64
5	Chat	239
6	Water	147.4
7	Miscellaneous	267

Source: own survey, 2009.

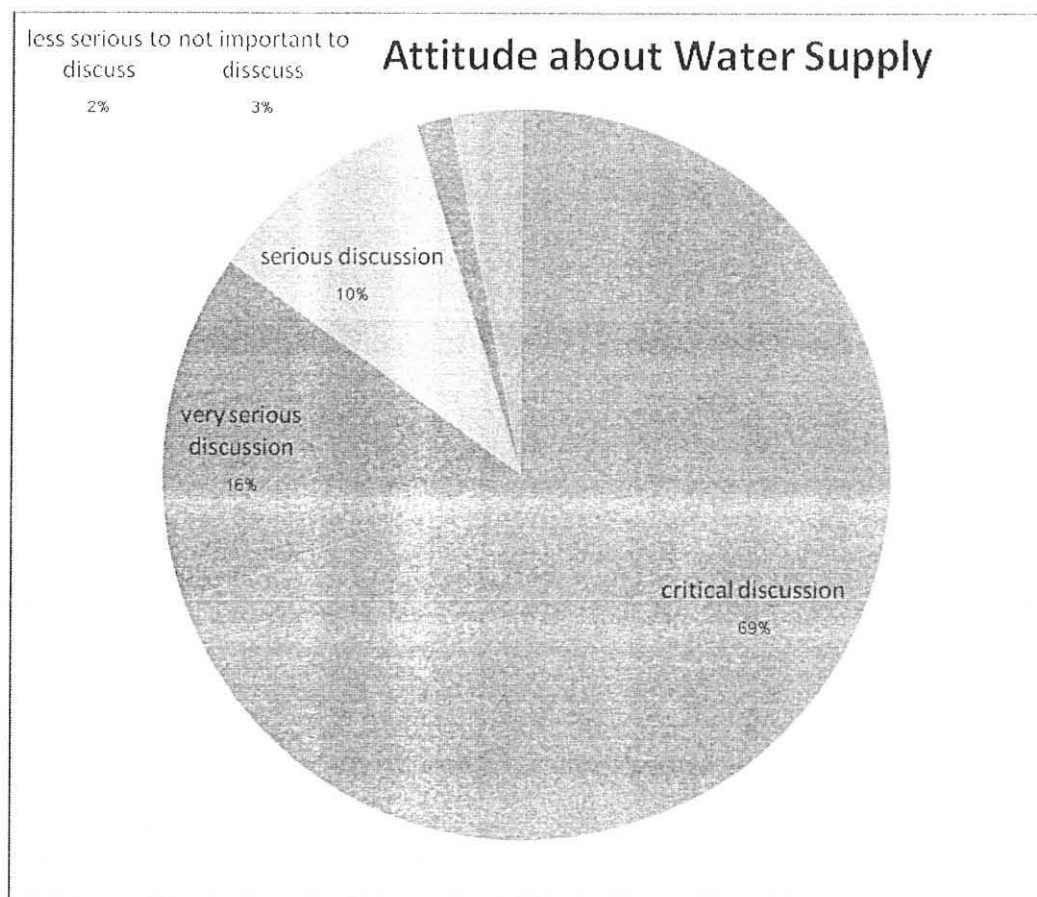
Ownership of the house in this study is assumed as a proxy to household wealth. The findings of the study shows that 53.3% of respondents own the house they are living in, 40.2% rented from private owners, 4.6% rented from Kebeles, while 1.9% of the respondents rented from the government.

² All other monthly expenditures incurred by the households

5.1.7. Respondents' Attitude about Water Supply

Regarding the extent to which respondents perceive the current provision of water is an issue worth discussion, majority of the respondents, 174 (69.3%) perceive that the current provision of water worth a critical discussion, 39 (15.6%) say it worth very serious discussion, 26 (10.3%) of the respondents believe it worth a serious discussion and only 4 (1.6%) stated that it is less serious to discuss the current provision of water, while 8 (3.2%) of the respondents expressed that it is not important to raise the current provision of water supply in Jijiga town as an issue that worth discussion.

Figure 5.2: Attitude about Water Supply (in percentage)



Source: Own survey, 2009.

For the responsibility of water supply, majority of the respondents 200 (79.7%) believe that it is the government who is responsible for the supply of water, 44 (17.5%) think that both government & private sector are responsible for water supply, only 4 (1.6%) say private sector is responsible while very view 3 (1.2%) of the respondents believe that Aid organizations are responsible for the supply of water in Jijiga town.

With regard to whether the administrative body done enough in solving the problems in the provision of piped water to households in the town, 100 (39.8%) of the total respondents believe that some attention was given to the problem, 87 (34.7%) showed that no attention was given to the problem, while the remaining 64 (25.5%) stood to the extreme that a lot attention was spent in solving the problem.

5.1.8. Household's Rank for Social Services

Six different social services, typically school, health, water, sanitation (toilet), electricity, and telephone were presented to all respondents in order to rank in their order of importance. The result of the rank findings is summarized in the table below.

Table 5.2: Household's Rank for Social Services

Item	% of the respondents and the rank given					
	First (%)	Second (%)	Third (%)	Fourth (%)	Fifth (%)	Sixth & above (%)
School	1.19	4.8	45.4	37.5	11.1	0
Health	24	50.6	23	1.6	0.4	0
Water	74	22.7	1.2	2.4	0	0
Sanitation	1.99	13	22.7	28.7	27.5	6
Electricity	0	5.6	9.2	29.5	53.8	2
Telephone	0	0	1.2	0	6	92.8

Source: Own survey, 2009.

As the table above shows, from the range of six social services, water was ranked as the most important social services, where as health, sanitation and school ranked as moderate important social services. According to the result of the 251 sample respondents, telephone³ service was ranked as the least important social services.

5.1.9. Households' WTP for Improved Water Services

From the pre-test of the survey, the initial bid decided. Based on, four different bid prices were introduced. Accordingly, for 22.3% of the total respondents an initial bid price of 0.10 Birr per Jerican (a 20 liter backed) was presented. For 28.1%, 27.7% and 21.9% of the total sample, bid prices of 0.15, 0.20, and 0.25 Birr per Jerican were prepared respectively. To see

³ Telephone here is assumed to be home based line phone but not the cell phone.

the effect of initial bid, all these four bid prices were mixed together and distributed to the respondents finally.

As justified in the preceding chapter, although 256 respondents were planned to be interviewed in the sample, a total of 251 responses were analyzed.

Out of 56 (22.3% of total) respondents, 47 (84%) gave a "Yes" response and 9 (16%) gave a "No" response for the initial bid price of 0.10 birr per Jerican. For 68 (27.1% of total) respondents, 50 (73.5%) and 18 (26.5%) answered a "Yes" and "No" response respectively for initial bid of 0.15 Birr per Jerican. Out of 71 (28.3% of total) respondents, 55 (77.5%) and 16 (22.5%) of the respondents said a "Yes" and "No" response for the initial bid of 0.20 Birr per Jerican, respectively. Finally, for the initial bid of 0.25 Birr per Jerican, for 56 (22.3% of total) respondents, 39 (69.6%) and 17 (30.4%) gave a "Yes" and "No" responses respectively.

Generally, the findings from the study show that all the households preferred the provision of improved water services. Hence despite the range of values that households whom have no pipe line connection in their houses are WTP more than households whom have pipe line connections, all of them are WTP a positive amount for improved water services.

Finally, in the open ended question respondents are asked to state their maximum WTP for a Jerican of improved water if provided. The result of

sample respondents maximum WTP obtained from our survey is summarized in the following table.

Table 5.3: Households' WTP for Improved Water Services

Range of Maximum WTP (M) in Birr per Jerican (1)	Primary Water Source		Total # of Households (4)	Percentage (5)	Mean WTP (6)
	# of households with access to pipe line (2)	# of households without access to pipe line (3)			
0.05≤ M<0.10	16	2	18	7.2	0.058
0.10≤ M<0.20	18	16	34	13.5	0.12
0.20≤ M<0.30	9	80	89	35.5	0.24
0.30≤ M<0.40	2	26	28	11.2	0.31
0.40≤ M<0.50	0	10	10	4	0.40
0.50≤ M<0.60	1	49	50	19.9	0.50
0.60≤ M<0.70	0	1	1	0.4	0.60
0.70≤ M<0.80	0	0	0	0	
0.80≤ M<0.90	0	0	0	0	
0.90≤ M≤1	0	21	21	8.3	1

Source: Own survey, 2009

From table 5.3 we can see that the least average maximum WTP is 0.058 Birr per Jerican, where 18 (7.2% of total) respondents have chose this

amount. 16 of them are from households with access to pipe line connections while only 2 of them are from the households without access to pipe line water connection. On the other hand, the highest mean of the maximum WTP is 1 Birr per Jerican. Here 21 (8.3% of total) respondents, all from households without access to pipe line water connection chose this amount as their maximum WTP for a Jerican of improved water.

The summary of descriptive statistics for the variables used in the multivariate regression analysis is shown in annex 1. The descriptive statistics of all variables in annex 1 is discussed in section 5.1 of this chapter.

5.2. Determinants of Households' WTP for Improved Water Services

In this section factors that affect the WTP responses of households for improved water services are discussed using multivariate econometric analysis. Both Probit and Ordinary Least Square models are applied to analyze the factors. The theoretical framework of these two models has already been illustrated in chapter four.

The presence of multicollinearity among variables reduces the precision of estimating the coefficients of strongly correlated variables. If the explanatory variables are highly inter-correlated it is difficult to disentangle the effects of explanatory variables on the dependent variable (Maddala, G.S, 1992). According to rule of thumb, if pair wise correlation between two explanatory

variables is high, say in excess of 0.8, then the multicollinearity is a serious problem.

To minimize the problem, a test was made to check whether the problem of existing multicollinearity is serious or not. The result indicated that the correlation matrix among the explanatory variables are less than 0.8 (see annex 2), and hence multicollinearity is not a severe problem in this study.

Based on the two models, the result obtained from the multivariate analysis of WTP for improved water services are presented in table 5.4 (for Probit) and table 5.5 (for OLS).

For the measure of model goodness of fit, the model is statistically acceptable. For example, the chi-square statistic of the Probit model ($X^2=183.91$) shows that the overall model as a good fit. Similarly, F-value for the estimates of OLS regression ($F=12.21$) shows as a good fit for the overall model.

5.2.1. Probit & OLS Regression Results and Discussion

Primary Water Source

The coefficient of this variable is found to be positive in both models as expected indicating that households without access to pipeline are willing to pay more than households with access to pipe line water connection in their

houses. In the OLS model the variable is significant at 10% level of significance, while in the Probit model it is highly significant at 1% level of significance. The variable indicating the main source of water household using is a major determinant for the probability that a respondent accepts the initial bid but relatively less determinant for maximum willingness to pay for the households of improved water services.

Price of Water

The continuous variable, price of the water has positive sign as expected in both models. This is consistent that households that currently buy water with relatively higher price might be WTP more for the provision of improved water service than households that currently buy water relatively with low price. This means the higher the current price of water the higher that household is willing to pay for improved water services if provided. However, in both models the variable is not significant and hence rejected.

Attitude of the Household about the Responsibility of Water Supply

The effect of the attitude of the household about the responsibility of water supply is proved to be negative as expected but insignificant in both empirical estimations. If the respondent says the government should manage the water service, it might be expected that the government will provide the service at a lower price and thus less WTP.

Table 5.4: Result of the Probit Regression

Probit regression with dependent variable ANS (answer of the first Bid)					
				Number of obs	= 251
				LR chi2(15)	= 183.91
				Prob > chi2	= 0.0000
Log likelihood = -46.089993					
Pseudo R2 = 0.6661					
Variable	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
PWAS	1.752657	.5954659	2.94***	0.003	.5855654 2.919749
PRICE	.2290709	.5480596	0.42	0.676	-.8451062 1.303248
LSHWS	1.06208	.4004694	2.65***	0.008	.2771746 1.846986
ATHRWS	-.7216448	.5110492	-1.41	0.158	-1.723283 .2799931
BID	-12.8033	3.663825	-3.49***	0.000	-19.98427 -5.622336
HHSIZE	.04158	.0577164	0.72	0.471	-.071542 .1547021
SEXR	.3693202	.3427059	1.08	0.281	-.3023711 1.041011
EDUC	.4570229	.4589676	1.00	0.319	-.4425371 1.356583
OCCR	-.7581676	.4836611	-1.57	0.117	-1.706126 .1897907
AGER	-.061913	.0193852	-3.19***	0.001	-.0999073 -.0239187
HOUSE	.7128079	.3404455	2.09**	0.036	.0455469 1.380069
INCHH	.000325	.0001069	3.04***	0.002	.0001155 .0005344
MWCHH	.1347034	.0543307	2.48**	0.013	.0282171 .2411896
RPQWS	.6372078	.3831509	1.66*	0.096	-.1137542 1.38817
RELW	-1.601187	.3339562	-4.79***	0.000	-2.255729 -.9466452
_CONS	1.831744	1.273227	1.44	0.150	-.6637358 4.327223

*, **, ***, indicate that coefficient is statistically significant at 10%, 5%, & 1% level of significance respectively.

Level of Satisfaction of Households with the Existing Water Services

The coefficient of this variable in both models is found to be positive as expected. This indicates that households that are not satisfied with the current provision of water are in a greater need to get an improved water services and hence, are WTP more to get such service. In both models the variable is significant. For Probit model it is significant at 1% level of significance while for OLS model it is significant at 5% level of significance. This strong relationship in both models therefore shows that the reliability of the improved water services is a major determinant of the willingness to pay as well as the probability of accepting the initial proposed bid.

Bid

We also found that coefficient of the bid is negative in our empirical analysis and statistically significant at even 1% level of significance for Probit model and insignificant in the OLS model. The negative sign and the highly significant of the Probit model shows that the probability of the respondents to accept the initial bid decreases as the bid price increases, and also this variable is a major determinant for the probability of the households to accept or reject the initial bid price for the improved water supply service.

Table 5.5: Result of the OLS Regression

OLS regression with dependent variable (Maximum WTP)					
F(15, 235) = 12.21					
Number of obs = 251					
Prob > F = 0.0000					
R-squared = 0.4381					
Adj R-squared = 0.4022					
Root MSE = .18687					
Variable	Coef.	Std. Err.	Z	P> z	[95% Conf. Interval]
PWAS	.0904623	.0513982	1.76*	0.080	-.0107977 .1917223
PRICE	.0099613	.0388171	0.26	0.798	-.0665127 .0864352
LSHWS	.0850045	.035241	2.41**	0.017	.0155759 .1544332
ATHRWS	-.0467722	.0312888	-1.49	0.136	-.1084146 .0148702
BID	-.2287807	.2301225	-0.99	0.321	-.6821474 .2245861
HHSIZE	.0059623	.0048797	1.22	0.223	-.0036513 .0155759
SEXR	.0352009	.0253537	1.39	0.166	-.0147487 .0851504
EDUC	.0408001	.033797	1.21	0.229	-.0257836 .1073839
OCCR	.0368743	.0309927	1.19	0.235	-.0241848 .0979333
AGER	-.00184	.0011702	-1.57	0.117	-.0041453 .0004654
HOUSE	.0514171	.0268742	1.91*	0.057	-.0015281 .1043623
INCHH	.0000297	7.56e-06	3.92***	0.000	.0000148 .0000445
MWCHH	.00134	.0046371	0.29	0.773	-.0077955 .0104756
RPQWS	.0684698	.0355154	1.93*	0.055	-.0014993 .138439
RELW	-.0834578	.0348152	-2.40**	0.017	-.1520475 -.0148681
_CONS	.0717995	.087969	0.82	0.415	-.101509 .2451081

*, **, ***, indicate that coefficient is statistically significant at 10%, 5%, & 1% level of significance respectively.

Size of the Household

In both models this continuous variable is found to be positive which is consistent to the expectation but not significant even at 10% level of significance. The positive coefficient suggests that as family size is wider, there will be higher need for improved water in that family, and hence, that family's WTP is higher than the family with small number of people.

Sex of the Respondent

In both estimations, the effect of gender of the respondent proved to be positive as expected. This coefficient of the sex dummy suggests that male respondent is less willing to pay than female respondent. In the Somali region of Ethiopia it is generally assumed that women are primarily responsible for arduous task of fetching water. Hence, women would attach more importance to improved water supplies than would men, and thus women would be willing to pay more for such services. To whatever degree, in both estimations, the variable is statistically insignificant and thus rejected.

Education of the Respondent

As expected the coefficient of the education dummy variable has positive sign in both models indicating that educated people are willing more to pay for improved water services. But in both models the coefficient of this variable is insignificant and rejected.

Occupation of the Respondent

In the OLS model the coefficient of the variable is found to be positively related with the maximum WTP as expected, while in the Probit model it is found to be negatively related with the probability of saying “ Yes” for the initial bid which is opposite to the expectation. This could perhaps be due to the fact that there are a lot of Jijiga residents who are engaged in informal employment such as trade and contraband trade which are not considered in this study as a formal occupation. However, in both models the coefficient of the variable, occupation of the respondent is found to be insignificant and hence rejected.

Age of the Respondent

The coefficient of this variable has negative sign as expected suggesting that as the age of the respondent increases he/she would prefer the existing water services from the improved one, and hence willing to pay less for the modern water services. In other words, it is generally believed that older people are traditionally used to free water services so that they may be less willing to pay and may have low preference for a new source that will require fees. The coefficient of this variable is insignificant in the OLS model, however highly significant in the Probit model indicating that this variable is less determinant for the maximum WTP of the households but major determinant for the probability that the respondent accepts the initial bid presented.

Ownership of the House

Ownership of the house in this study is taken as a proxy to household wealth. The coefficient of the variable is found to be positive as expected and significant at 10% and 5% level of significance in Probit and OLS models respectively. This confirms the assumption that wealthy households are more WTP and prefer to have a private connection to the improved water services. Wealthy households prefer improved water for more purposes than poor households, hence, are willing to pay more for the availability of this services than the poor.

Income of the Household

This variable is found consistent with the prior expectation in that the coefficient of income of the household is positive in both models. The variable is statistically significant at 1% level of significance in both estimations. In addition to, this result is in line with the economic theory that there is positive relationship between quantity demanded and income in case of normal goods. Therefore, income of the household is one of the major determinants of maximum WTP for improved water services by households in Jijiga town.

Daily Water Consumption by the Household

As expected the sign of the coefficient of daily water consumption by the household is positive and significant at 5% level of significance for Probit model and insignificant for the OLS model. The positive coefficient of the variable suggests that as the amount of daily water consumption by the



household increases the willingness to pay increases. The intuition behind might be that households that consume large quantity of water for their normal consumption suffer much during the shortage of water than those who consume less. In other words, households that consume much water spend more money for this service and hence are WTP more for improved water service.

Respondents' perception about the quality of the existing water supply

We also included this variable to see the effect of the respondents' perception about the quality of the water to the willingness to pay for the improved water services. The empirical result shows that the coefficient of the variable has positive sign as expected; suggesting that poor perception of the respondents about the quality of the existing water supply leads higher willingness to pay for the improved water services and vice-versa. In both models the coefficient is statistically significant at 10% level of significance.

Reliability of the Existing Source of Water

The estimated coefficient is not only negative as expected but also significant at 1% level of significance for Probit model and 5% level of significance for OLS model. Reliability refers to the availability of water at the required time and amount. If a household considers the existing water supply in the town as reliable service, then it is willing to pay less for the improved water services. The significance of the coefficient indicates that this variable is a major determinant of the willingness to pay for improved water service proposed to provide.

5.3. Estimation of Total WTP, Revenue, Mean WTP and Demand

5.3.1. Estimation of Total WTP

In this section we are going to estimate the total willingness to pay and the expected revenue from the WTP responses. To do this we use the information in column 1 and 5 in table 5.6. The total number of households in Jijiga is multiplied by the proportion of the sample households falling in each interval to obtain the total number of households whose WTP lies in that interval.

Table 5.6: Estimated Total WTP

Range of Maximum WTP (M) in Birr per Jerican (1)	Mid Point of WTP in Birr per Jerican (2)	Total Number of Households in Jijiga Town (3)	Percentage (%) (4)	Total WTP in Birr per Jerican (5)
$0.05 \leq M < 0.10$	0.075	1845	7.2	138.375
$0.10 \leq M < 0.20$	0.15	3459	13.5	518.85
$0.20 \leq M < 0.30$	0.25	9096	35.5	2274
$0.30 \leq M < 0.40$	0.35	2870	11.2	1004.5
$0.40 \leq M < 0.50$	0.45	1025	4	461.25
$0.50 \leq M < 0.60$	0.55	5099	19.9	2804.45
$0.60 \leq M < 0.70$	0.65	102	0.4	66.3
$0.70 \leq M < 0.80$	0.75	0	0	0
$0.80 \leq M < 0.90$	0.85	0	0	0
$0.90 \leq M \leq 1$	0.95	2127	8.3	2020.65
Total		25623.	100	9288.375

Source: Own survey, 2009.

From table 5.6, the total willingness to pay is calculated by multiplying the midpoint WTP amount by the total number of households whom are willing to pay that particular amount. This total WTP 9288.375⁴ shows total amount the community of Jijiga are WTP for improved water services if the households are consuming only one Jerican of improved water. However, as we have seen in section 5.1.2.2 of this chapter, on average each household consumes 6.6 Jericans of water per day. Thus, the total WTP is estimated as 61303.275 Birr per day.

5.3.2. Estimation of Total Revenue

The expected total revenue is calculated by multiplying the midpoint WTP amount by corresponding total number of households whom are willing to at least that amount (the cumulative number of households). This is shown in the following table.

⁴ Multiplying column 2 and column 3 of table 5.6 and then summing up results total WTP, 9288.375

Table 5.7: Estimated Total Revenue

Mid Point of WTP in Birr per Jerican (1)	Total Number of HHs in Jijiga Town (2)	Percentage (%) (3)	Total HHs WTP at least that amount (cumul.)		Total Revenue in Birr (6)
			% (4)	Number(5)	
0.075	1845	7.2	100	25622	1921.65
0.15	3459	13.5	92.8	23777	3566.55
0.25	9096	35.5	79.3	20318	5079.5
0.35	2870	11.2	43.8	11222	3927.7
0.45	1025	4	32.6	8352	3758.4
0.55	5099	19.9	28.6	7327	4029.85
0.65	102	0.4	8.7	2228	1448.2
0.75	0	0	8.3	2127	1595.25
0.85	0	0	8.3	2127	1807.95
0.95	2127	8.3	8.3	2127	2020.65
Total	25622	100			

Source: Own survey, 2009

In the table 5.7, last column shows the total revenue initially increases as WTP per Jerican increases, reaches maximum and then declines. In the table, each midpoint willingness to pay there is corresponding revenue. In the table the highest expected revenue is found when the households are provided with improved water services with a price of 0.25 Birr per Jerican. With a price of 0.25 Birr per Jerican, total revenue is 6405.5 Birr if the households are consuming one Jerican of improved water per day. Therefore, based on our findings the household water consumption per day is 6.6

Jericans. From this if we calculate the expected total revenue of the provision of improved water services, we get 42276.30⁵.

The expected maximum total revenue for the provision of improved water services in Jijiga town is 42276.3 Birr per day. This revenue can be founded if the price is set 0.25 Birr per Jerican. With this price almost 80% of the households are expected to subscribe to the improved water service.

5.3.3. Estimation of Mean WTP (MWTP)

One way of calculating the mean willingness to pay is using the result obtained from Probit model for the closed-ended questions format.

$$\text{Mean WTP} = \frac{\beta_0}{-\beta_{15} (\text{Bid coefficient})}$$

Where: β_0 is the constant and

: β_{15} is the bid coefficient

$$\text{Therefore, Mean WTP} = \frac{1.831744}{-(-12.8033)} = 0.14306$$

The mean willingness to pay which the same as medium willingness to pay from the closed-ended Probit model is 0.14 Birr per one Jerican of improved water services.

⁵ (0.25 X 25622) X 6.6 = 42276.30

Similarly, to estimate the mean willingness to pay of the entire households in the town using the open-ended questions format, we use the information in column 1 (midpoint of the WTP) of table 5.7 taking the mean of WTP midpoints weighted at their corresponding number of households gives us the mean WTP of the entire households.

$$MWTP = \frac{\sum_i MWTP_i n_i}{N}$$

Where: $MWTP^6$ = Mean WTP for the entire households

$MWTP_i$ = Mean WTP of interval i of column 1 of table 5.7

n_i = Number of households willing to pay the interval i .

N = Total number of households in the town.

By using the above stated formula, the MWTP is found to be 0.36 Birr per Jerican of improved water (i.e. 18 Birr per one meter cubic). This is about 6.5 times more than the existing authority's tariff rate. Compared to the mean WTP obtained from the Probit model, the mean WTP obtained from the open-ended questions is more than double of that of closed-ended questions. Therefore, the mean WTP ranges from 0.14 Birr to 0.36 Birr Jerican of improved water services.

Using the later result of the mean WTP (i.e. 0.36 Birr) the expected revenue if the households are consuming 6.6 Jericans per day (as average result of the

⁶ $MWTP = 9223.92/25622$

study) is 61303.28 Birr per day. However, this mean price is higher than the midpoint price and only 43.8% of the households are expected to subscribe to the new service. And hence the expected revenue decreases to 26664.77 Birr per day which is less than the optimal revenue.

5.3.4. Estimation of Aggregate Demand and Consumers' Surplus

The essential information in this study for policy makers is the derivation of aggregate demand and consumers' surplus. For policy makers this information helps make sensible water tariff decisions and investment. In this study, to drive the aggregate demand curve we use information in column 1, midpoint of WTP in Birr per Jerican and column 5, total number of households whom are WTP at least that amount of the table 5.7 to sketch the curve, total number of households are aligned along the horizontal axis and the midpoint of WTP are aligned along the vertical axis.

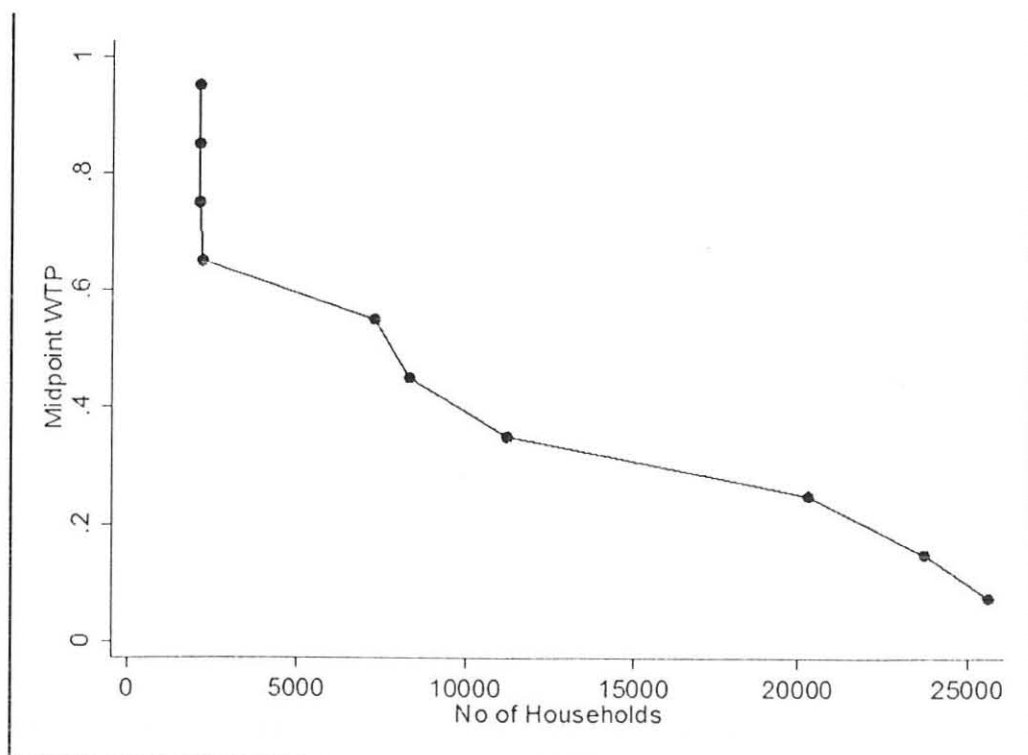


Figure 5.3: *Derived Demand Curve*

Figure 5.3 shows the aggregate demand curve for improved water services on the assumption that each household uses one Jerican per day. On the graph, any point on the curve shows all the households that prefer the improved water but do not bid more than the corresponding value of the midpoint WTP axis.

Theoretically, any economic goods there are negative relationship between the quantity demanded and its price, assuming other factors constant. Similarly, in this study as shown in figure 5.3 the demand curve is downward slopped indicating the fall of demand for improved water services as charged price rises.

The area under the demand curve represents the gross value of consumers' surplus if the improved water service is assumed to be as a free good. The sum of all the area under the demand curve is 11033.84, if the household consumes only one Jerican per day. Thus based on the study result of average daily water consumption by households, the gross value of consumer's surplus is 72823.33 Birr per day. Further, if the price of improved water is set to 0.35 Birr per Jerican (almost equal to the mean WTP by households), the expected consumer's surplus would be 19031.43 Birr per day.

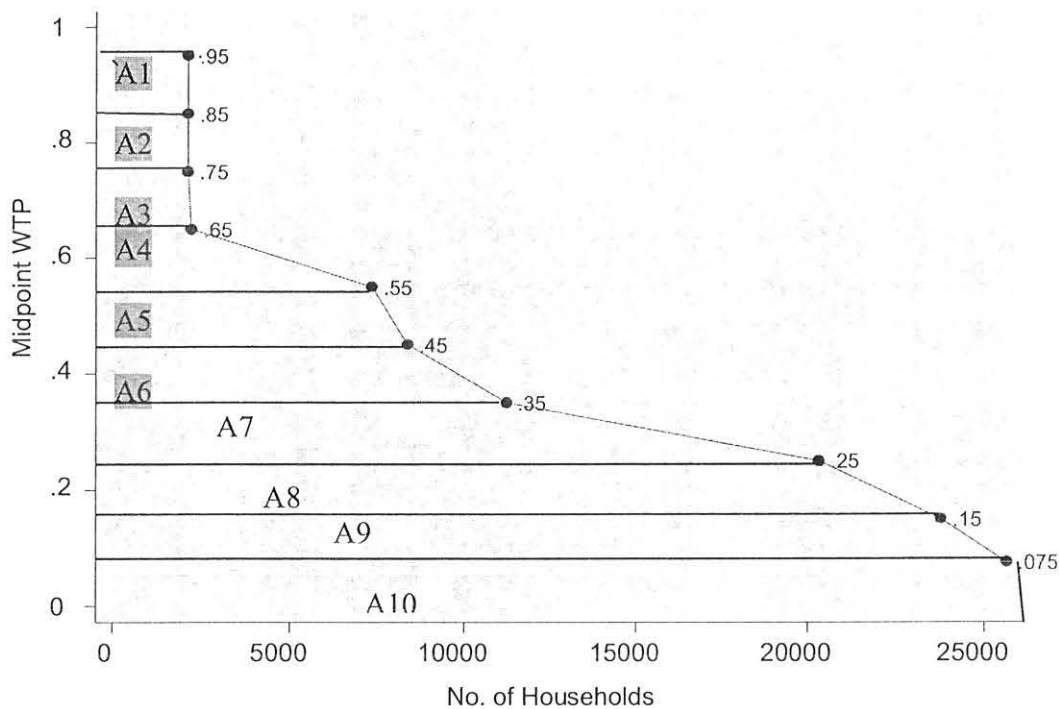


Figure 5.4: consumer's surplus.

As mentioned above the highest expected revenue is found when the midpoint WTP is 0.25 Birr per Jerican, where nearly 80% of the households are willing to pay. If price of the improved water service is set down to 0.25 Birr per Jerican, from the total benefits of the provision of this service, consumer's surplus will increase to 20608.43 Birr per day. 33524.7 Bir per day will go to the service provider as revenue. The rest 18690.2 will go to nobody and hence considered as a dead weight loss (DWL).⁷

The consumer's surplus, if price of improved water services is set respective midpoint WTP (as shown on figure 5.4) are summarized in Annex 4.

⁷ Dead weight loss measures the value to the consumer of the lost output (Varian, 1992).

CHAPTER SIX

Conclusion and Policy Implications

6.1. Conclusion

Water is the source of life, without it no human being can live for more than a few days. Water is needed for a large array of purposes. Access to safe drinking water is one of the Millennium Development Goals. However, developing countries do not always have the resources in place to provide potable water for its population. Water is among the key sectoral measures and cross-cutting issues to Sustainable Development and Poverty Reduction Program of Ethiopia.

One of main objectives for the WSS sub-sector of Ethiopia is to ensure that every Ethiopian citizen has access to water of acceptable quality to satisfy the basic human needs. However, in Jijiga, the water supply shortage is one of the main concerns. Excess demand as compared to water supply and insufficiency of the existing sources are considered as the actual cause of the water supply shortage in the town.

The Jijiga water supply office is incurring a loss of 0.521 birr per one meter cubic of water. To set the required tariff of at least covering the cost of water production, information on the ability and willingness to pay of the consumers for such services are essential. Hence, this study is trying to investigate and assess the determinants of households' willingness to pay and demand for improved water services in Jijiga town which will provide an indication of the value that consumers place on improved water services.

A contingent valuation method is applied for the assessment of the study. The type of data used is mainly primary and cross-sectional in the year 2009. The data is obtained from the contingent valuation survey on 251 households in Jijiga town by means of questionnaire developed for the CVM. The sampling strategy was based on a stratified random sampling scheme according to water source for the household.

Both descriptive statistics and econometric models are used to analyze the data obtained from this CV survey. In the descriptive analyses, the result of the survey indicates that there are 6 different sources of water for the residents of Jijiga town. These 6 sources with the respective percentage of households using the source are; piped water, 14.7%; public taps, 16.3%; private vendors (donkey driven water cars), 57.3%; wells & springs, 6.3%; and water stored in pools, 1.5%.

The average daily consumption of water by households is 132 liters per day. The average household expenditure on water is 147.4 Birr per month. That means relatively to mean household monthly income, 3381 Birr, households spend 4.4% of their income on water.

The result of the survey reveals that quality, quantity and reliability of water were not seen as a serious problem by households who have piped water connection in their houses. However, households with other sources of water indicate that poor quality, low quantity and less reliability as a serious problem to them. For later households, 18.7%, 53% & 28.3% ranked as

poor, satisfactory & good for quality of the existing water services respectively. 15.6%, 62% & 22.4% ranked as good, satisfactory and poor for the quantity of water respectively. 13.7% and 86.3% ranked as reliable and unreliable respectively for the reliability of the existing water service.

Similarly, 84.5% usually get water during the day time, 9.4% of these households get water during the night time and the remaining 6.1% said that it is unpredictable.

The information obtained with regard to the level of satisfaction of the current water supply shows that for the households with piped water source only 32.7% are not satisfied while 87.8% of the households with other sources of water are dissatisfied. The main reasons for the dissatisfaction are due to poor quantity, poor quality and unreliability of the water service. For the respondents' perception about the current provision of water, 69.3% perceive that it worth a critical discussion.

One of the most important findings of the survey is that all the households preferred the provision of improved water services and are WTP a positive amount. The MWTP⁸ is found to be 0.36 Birr per Jerican (a 20 liter backed) of improved water. This figure is about 6.5 times larger than the authority tariff.

⁸ Mean Willingness to Pay obtained from the open-ended questions format.

The total WTP is estimated as 61303.275 Birr per day. The expected maximum total revenue for the provision of improved water services in Jijiga town is 42276.3 Birr per day. This revenue can be founded if the price is set 0.25 Birr per Jerican. With this price almost 80% of the households are expected to subscribe to the improved water service. From this information the aggregate demand curve is derived.

In addition to the descriptive analysis, econometric models are used to analyze the data obtained from this CV survey. Due the nature of the dependent variable and the type of the elicitation method Probit and ordinary least square models are used. The Probit model is used for the single bounded questions where the factors affecting the response to the bid price is analyzed. The OLS model is used for open ended questions where factors affecting the maximum WTP are analyzed.

In both models, variables: primary water source, income of the household, size of the household, education level of the respondent, sex of the respondent, age of the respondent, ownership of the house, occupation of the respondent, attitude of the household about the responsibility of water supply, price of water, level of satisfaction, perception about the quality, reliability of the existing source of water, daily water consumption, and bid price offered to the respondents are included in the regression as an explanatory variables.

As a result of the OLS model, all variables have the same sign as they are expected. Among variables, primary water source, income of the household, ownership of the house, level of satisfaction, perception about the quality, and reliability of the existing source of water were found to be significant. While the rest variables were shown to be insignificantly affecting the maximum willingness to pay.

In the Probit model, all but occupation of the respondent have the same sign as expected. Variables: age of the respondent, perception about the quality, reliability of the existing source of water, primary water source, income of the household, ownership of the house, level of satisfaction, daily water consumption, bid price offered to the respondents are found to be significant, while the rest variables in the model are insignificant even at 10% level of significance.

6.2. Policy Implications

In Jijiga town, there is a serious problem of water supply service. Demand for water is very much larger than the supply of the service. The other problem is that current service providing authority is incurring a loss of 0.521 Birr per one meter cubic of water production. With this regard if the at least the distribution system is improved, the 25% of the water loss could be minimized and hence the water supply could be increased.

One of the most important findings in this study is that if an improved water service is provided, the mean maximum willingness to pay by households is 18 Birr per one meter cubic. The implication here is that if the water supply authority produces and supplies improved water it might not only solve the serious water problem but also earn profit instead.

Furthermore, based on the result of this study, we also observed the following policy implications:

- The very powerful positive relationship between the income of the household and the WTP for improved water services shows that there is a need of critical consideration for the income status of the final recipients of the service in designing and implementing the policies of improved water supply service project.
- The powerful negative relationship between the reliability of the existing source of water and the willingness to pay for improved water services indicates that the reliability of source is a major factor. Thus, the implication is, in designing and implementing the policies of improved water supply service project, sustainability of the project in providing the needed service at the required time and the required amount should be targeted.
- In addition to, the level of satisfaction by households has a strong relationship with the households' willingness to pay for improved water services. This shows that households are not satisfied with the

current provision of water services. This, therefore, suggests that as customer satisfaction plays an important role, higher consideration should be given. For policy regarding provision and supply of improved water services, user satisfaction should be addressed, and the final implementation must be customer oriented one.

- Ownership of house is positively related to willingness to pay for improved water services. Ownership of house can be considered as a proxy to household wealth. Though not as strong as household monthly income, careful thought should be given to the ownership of house (wealthy) by households in provision of private water connection of their houses.
- Two main sources of water (piped water source and other sources) are considered in this study. Positive relation between the water source and willingness to pay for improved water service is witnessed in this study. This implies that the problem of water in Jijiga town is more serious for households with other sources of water than those with piped water source. The policy implication is therefore, if improved water supply project is intended to be implemented in the town, the initial priority has to be given to those households without piped water connection in their houses.

References

- Altat A. et al (1992). Willingness to Pay for Water in Rural Punjab. UNDP-World Bank & Sanitation Program; Water & Sanitation Report-4.
- Assefa Chaka, (1998). Determinants of Household's Demand for Improved Water Services: A Case Study of the Contingent Valuation Survey in Addis Ababa, Ethiopia. M.Sc. Thesis, Department of Economics, Addis Ababa University.
- Belhaj, M. (1998). Energy, Transportation and Urban Environment in Africa: The case of Rabat Sale, Morocco. Ph.D Thesis, Department of Economics, Gothen Durg University.
- CSA. (2007). The Population and Housing Census of Ethiopia, Results at Country Level.
- Dickie, M. and S. Gerking (1991). Willingness to Pay for Ozone Control. Inferences from the Demand for Medical Care. Journal of Environmental and Management. 21:1-16
- Fisseha Aberra, (1997). Estimating WTP for Water: A Contingent Valuation Study on Meki Town. M.Sc. Thesis, Department of Economics, AAU.
- Freeman, A.M (1992). Air and Water Pollution Control. A Benefit-Cost Assessment, Wiley, New York.
- Genanew Bekele, 1999. Analysis of the Determinants of Households' WTP and Demand for Improved Water Services: A Contingent

Valuation Study in Harar Town. M.Sc. Thesis, Department of Economics, AAU.

Gloria S. M. & Ian J. B, (2006). Scope Sensitivity in Households' WTP for Maintained and Improved Water Supplies in a Developing World Urban Area: Investigating the Influence of Baseline Supply Quality and Income Distribution upon Stated Preferences in Mexico City. Research Report, Centre for Social and Economic Research on the Global Environment, School of Environmental Sciences, University of East Anglia, Norwich, UK.

Gossaye Fanta, (2007). Estimating Willingness to Pay for the Improved Water Services: An Assessment of Contingent Valuation Method on Debrezeit, Ethiopia. M.Sc. Thesis, Department of Economics, AAU.

Green, D., K.E. Jacowitz, D. Kahneman and D.McFadden. (1995). Referendum Contingent Valuation, Anchoring, and willingness to Pay for Public Goods. A Paper Presented at the August 1995 World Congress of the Econometric Society, Tokyo.

Guvener S. E. (2006). The Human Right to Water. M.A. Dissertation in Advanced European and International Studies.

- Haab, T.C and K.E. McConnell (2002). Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation. Edward Elgar, Cheltenham.
- Hanemann, M.W. (1994). Valuing the Environment Through the Contingent Valuation, Journal of Economic perspectives.
- Hanley, N., F.J. Shogren and B. white (1997). Environmental Econommics in Theory and Practice. London, Macmillan
- Hausman J., Diamond, Panel P. (1994). Contingent Valuation is Some Number Better Than No Number. Journal of Economic Perspective, 8(4) 45-64
- Haymanot Legesse, (2007). The Value of Water Quality Improvement on Lake Hora-Arsedi. M.Sc. Thesis, Department of Economics, AAU.
- Hovenenagel, R. (1994). The Contingent Valuation Method Scope and Validity. Institute of Environmental Studies, Vrije University, Ansterdam.
- Kinfe G.Egziabher, 2007. Valuing Water Supply Service Improvements in Addis Ababa. M.Sc. Thesis, Department of Economics, AAU.
- Knetsch, J. (1993). The Reference Point and Measures of Welfare Change. Paper to Caradig Conference on Environmental and the Source Economics, Ottawa.
- Kolstrad, C.D. (2000). Environmental Economics. Oxford, Oxford University press.

- Maddala, G.S. (2002). Introduction to Econometrics. Third ed., John Wiley and Sons Ltd. Singapore.
- Ministry of Water Resources, (2006). Draft Paper on Universal Access Program For Water Supply and Sanitation Services. Addis Ababa, Ethiopia.
- Mitchell, R.C. and R.T. Carson (1989). Using surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future. Washington D.C.
- Percival A., Neller A., McRae B. (2004). Water Made Clear. A Consumer Guide to Accompany the Australian Drinking Water Guidelines. Australian Government.
- Perman, R. Y. Ma, J. McGilvray and M. Common (2003). Natural Resource and Environmental Economics. 3rd Ed Edinburgh, Longman.
- Roy Joyshree et al. (2003) An Economic Analysis of Demand for Water Quality: A Case from Kolkata City. Paper Presented at the Conference on Market Development of Water & Waste Technologies Through Environmental Economics, 30th-31st October 2003, N. Delhi.
- Russell, R. (1992). Valuing Fishing Day. An Application of a Systematic Varying Parameter Model, Land Economics 58, No. 4:450-463.
- Somali Regional State Water, Energy and Mine Bureau. (2005). Business Plan for Jijiga Water Supply Project. Kaah Consulting Firm, Jijiga, Ethiopia.

- Soto Montes de Oca, G., and I. J. Bateman (2006). Scope Sensitivity in Households' Willingness to Pay for Maintained and Improved Water Supplies in a Developing World Urban Area: Investigating the Influence of Baseline Supply Quality and Income Distribution Upon Stated Preferences in Mexico City, *Water Resource. Res.*, 42, W07421, doi:10.1029/2005WR003981.
- Spangenberg N. E. (2002). The New Economy of Water. American Water Resources Association. A College of Natural Resources University of Wisconsin-Stevens Point.
- Varian Hal R. (1992). Microeconomic Analysis, Third ed. University of Michigan.
- Wadani Consulting Company PLC (2007). Population and Housing Characteristics Study: Jijiga Master Plan Expansion Project. Jijiga, Ethiopia.
- Whittington, D. et al. 1992. Giving Respondents Time to Think in Contingent Valuation Studies: A Developing Country Application, Journal of Environmental Economics and Management.
- Whittington, D., et al. (1991). A Study of Water Vending and Willingness to Pay in Ontisha, Nigeria. World Development Vol. 19, No.23
- Whittington, D. et al. 1991. In Housing the Poor in the Developing World: Methods of Analysis, Case Studies, and Policy. Edited by K. G. Willis and A. G. Tipple. Routledge.

World Bank Water Demand Research Team, (1993). The Demand for Water in Rural Areas; Determinants and Policy Implications. The World Bank Research Observer, Vol. 8, No. 1.

Annexes

Annex 1: Summary of Descriptive Statistics for the Variables Used in the Final Regression.

Variables	Mean	Std. Deviation	Minimum	maximum
MWTP	.3412749	.2416857	.05	1
ANS	7609562	.4273517	0	1
PWAS	.8167331	.3876582	1	1
PRICE	.7444622	.4452828	0	2
LSHWS	.7689243	.4223629	0	1
ATHRWS	.8047809	.4071082	0	2
BID	.1752988	.0535482	0.1	.25
HHSIZE	7.992032	3.280234	1	19
SEXR	.6135458	.4879096	0	1
EDUC	.6733068	.4699411	0	1
OCCR	.4223108	.4949144	0	1
AGER	41.02789	10.98741	19	76
HOUSE	.5338645	.4998486	0	1
INCHH	3381.024	1841.877	710	10000
MWCHH	6.641434	3.597626	1	20
RPQWS	.7171315	.451293	0	1
RELW	.2629482	.4500907	0	2

N.B. Description of all variables is available in chapter four.

Annex 2: Pair-Wise Correlation for Improved Water Supply Services

PWAS	PRICE	LSHWS	ATHRWS	BID	HHSIZE	SEXR	EDUC	OCCR	AGER	HOUSE	INCHH	MWCHH	RPQWS	RELW
1.0000														
0.6856	1.0000													
0.5465	0.5219	1.0000												
-0.1516	0.0092	-0.0773	1.0000											
0.1761	0.1612	0.1446	-0.0845	1.0000										
0.0146	0.0831	0.1372	-0.0641	-0.0786	1.0000									
0.0047	0.0299	0.0502	-0.0189	0.1001	0.0705	1.0000								
0.0213	-0.0077	-0.0594	0.1462	-0.0120	-0.0069	-0.2039	1.0000							
-0.0745	-0.1006	-0.0480	0.0932	-0.0199	0.0243	-0.1662	0.5956	1.0000						
-0.0683	-0.0273	-0.0400	0.0057	0.0015	0.0067	-0.0040	-0.3197	-0.2214	1.00					
0.1973	0.1195	0.1319	-0.1738	0.0239	0.2246	0.0621	0.0984	-0.0742	-0.125	1.000				
-0.0667	0.0241	-0.0017	0.0313	-0.0386	0.4181	0.1127	0.0634	0.0984	-0.074	0.199	1.0			
-0.2108	-0.0703	-0.0390	0.0421	-0.0669	0.6241	0.0643	0.0274	0.1123	0.026	0.166	0.47	1.000		
0.5713	0.4291	0.3482	-0.2365	0.1483	0.0876	0.0829	0.0340	-0.0182	-0.073	0.335	0.07	-0.043	1.0	
-0.5480	-0.4376	-0.3945	0.1721	-0.0199	-0.1178	-0.0636	-0.0083	0.0023	0.180	-0.253	-0.05	-0.003	-0.5	1.0

N.B. Description of all variables is available in chapter four.

Annex 3: Calculation of Consumer’s Surplus

Midpoint WTP	Area	Consumer’s Surplus Value
0.85	$A1(2127 \times 0.1) \times 6.6$	1403.82
0.75	$A2(2127 \times 0.1) \times 6.6$	1403.82
0.65	$A3(2127 \times 0.1 + 0.5 \times 10.1) \times 6.6$	1437.15
0.55	$A4(2228 \times 0.1 + 0.5 \times 509.9) \times 6.6$	3153.15
0.45	$A5(7327 \times 0.1 + 0.5 \times 102.5) \times 6.6$	5174.07
0.35	$A6(8352 \times 0.1 + 0.5 \times 287) \times 6.6$	6459.42
0.25	$A7(11222 \times 0.1 + 0.5 \times 909.6) \times 6.6$	10408.2
0.15	$A8(20318 \times 0.1 + 0.5 \times 345.9) \times 6.6$	14551.35
0.075	$A9(23777 \times 0.1 + 0.5 \times 138.376) \times 6.6$	16149.4608
0.00	$A10(25622 \times 0.075) \times 6.6$	12682.89
Total		72823.33

Annex 4: Contingent Valuation Survey Questionnaire

ADDIS ABABA UNIVERSITY

DEPARTMENT OF ECONOMICS

A CONTINGENT VALUATION SURVEY QUESTIONNAIRE

(For willingness to pay and demand for improved water services in Jijiga town, Ethiopia)

Code _____

Interviewer: _____

Date of Interview: _____ Time _____ to _____

Kebele: _____

ATTENTION: NOTICE THAT UPPER CASE LETTERS ARE REFERRED AS INSTRUCTIONS FOR INTERVIEWER WHILE lower case letters are questions & statements to be read aloud to the respondents.

INTRODUCTION TO THE RESPONDENT:

Hello, how are you? I am _____. First of all I would like to request your patience for sacrificing few minutes of having interview with you. This interview is a main body of a research Mr. Mohamed mohamoud is working with. Mr. Mohamed is currently studying at the Addis Ababa University. This research is in partial fulfillment for the award of M.Sc in Economics. We are conducting a study concerning the current situation of the drinking water of Jijiga town and reactions of the people to possible improvements in drinking water in terms of quality, quantity and reliability

Personal information of the respondent will be kept confidential and will not be associated with any responses in the survey. This interview is strictly for academic purpose and we only want your opinion so there is no right and wrong answers. Therefore, honest discussion is the best way ahead.

SECTION A: WATER USE PRACTICE & PROBLEMS

In this section I would like to ask you about your water use practices, including the quantity, quality, reliability of water supply and the cost of collecting the water.

A1. What is the main source of water for the members of this household for domestic purpose?

- a) ____ Piped water → GO TO QUESTION A2
- b) ____ Other sources (specify) → GO TO QUESTIONS (A18-A23)

IF “PIPED WATER” ASK QUESTION A2 OTHER WISE SKIP TO QUESTION A18

A2. What kind of water service is your household using?

- 1) ____ Tap inside your house → SKIP TO QUESTION A4(A4-A17)
- 2) ____ Tap in the compound, private → SKIP TO QUESTION A4(A4-A17)
- 3) ____ Tap in/outside the compound, shared → GO TO QUESTION A3
- 4) ____ Other sources → SKIP TO QUESTIONS (A18-23)

IF “TAP IS SHARED” TO QUESTION A2 ASK:

A3. How many households use the shared tap?

_____ households.

A4. How much water does your household consume per day?

_____ jerry cans (or 20 liter bucket).

A5. How is your household paying per month, on average, for this source?

_____ Birr per month.

A6. For what purpose(s) is the water use from this source mainly used by your household?

- a) _____ Drinking
- b) _____ Washing body
- c) _____ Washing clothes
- d) _____ House sanitation(equipment & house cleaning)
- e) _____ Housekeeping(eg gardening)
- f) _____ Others (specify)

A7. Regarding its quantity, quality and reliability, how would you rank the existing water services from this source?

a) Quantity

1. Good ☐ 2. Satisfactory ☐ 3. Poor ☐

b) Quality

1. Good ☐ 2. Satisfactory ☐ 3. Poor ☐

c) Reliability

1. Reliable ☐ 2. Unreliable ☐

A8. Does your household use any purification method to clean water before drinking?

(a) Yes

(b) No

A9. If "No" what is your main reasons for not using purification?

(a) The water is clean for drinking

(b) The water is not clean but purification is costly and time consuming.

(c) The water is not clean but harmless to health.

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

A10. Have any of your household suffered diseases in connection to the piped water use?

(a) Yes

(b) No

A11. If "Yes" which disease is the most serious? IDENTIFY & RANK

(a) _____ Diarrhea

(b) _____ Typhoid

(c) _____ Cholera

(d) _____ Others (specify).....

A12. How often does your household get water service?

- (a) All the time —→ SKIP TO A16
- (b) Once in ____days(on average) —→ GO TO A13

A13. During which time is water usually available?

- (a) During day time
- (b) During night time
- (c) Unpredictable

A14. When pipe water is not available, which alternative water source does your household use?

- (a) Your own reserve
- (b) Other pipes where water is available
- (c) Private water suppliers
- (d) Springs and wells
- (e) Others (specify)

A15. How much do you pay for this service?

_____Birr per

A16. Generally, are you satisfied with the existing water services?

- (a) Yes
- (b) No

A17. If “No” what are the causes of your dissatisfaction? RANK STARTING FROM THE MOST SERIOUS CAUSE.

- (a) _____Poor quality
- (b) _____Less quantity
- (c) _____Unreliable
- (d) _____Higher connection charges
- (e) _____Higher service charges
- (f) _____Others (specify)

IF “OTHERS” TO A1 & A2 ASK(A18-A23)

A18. Which source/s/ of water does your household uses for domestic purposes most oftenly?

- (a) Private water suppliers (vendors)
- (b) Public taps
- (c) Well
- (d) Spring
- (e) Others (specify)

A19. Why do you prefer this source?

- (a) The existing pipe system does not work totally.
- (b) No access to the existing pipe system
- (c) Access to the existing pipe system is difficult.
- (d) Connection is not available due to rented house.
- (e) Cost to the existing pipe system is not affordable.
- (f) This source is reliable.
- (g) This source is cheaper.
- (h) Others (specify)

A20. For what purposes is the water from this source mainly used by your household?

- a) _____ Drinking
- b) _____ Washing body
- c) _____ Washing clothes
- d) _____ House sanitation (equipment & house cleaning)
- e) _____ Housekeeping (eg gardening)
- f) _____ Others (specify)

A21. How much do you pay per jarican (a 20 liter backed)?

_____Birr.

A22. Is your household satisfied with this source of water?

- (a) Yes
- (b) No

A23. If “No” what are the causes of dissatisfaction? RANK STARTING FROM THE MOST SERIOUS CAUSE.

- (a) _____ Because of poor quality
- (b) _____ Because of Low quantity
- (c) _____ Because of Unreliability
- (d) _____ Because of High charge
- (e) _____ Others (specify)

ASK THE FOLLOWING QUESTIONS TO ALL RESPONDENTS

A24. To what extent do you perceive the current provision of piped water is an issue worth discussion?

- (a) Critical
- (b) Very serious
- (c) Serious
- (d) Less serious
- (e) Not important
- (f) Others (specify)

A25. Who do you think is responsible for water supply?

- (a) Government
- (b) Private sector
- (c) Both government & private sector.
- (d) Aid organizations
- (e) Others (specify)

A26. So far, has the administrative body done enough in solving the problems in the provision of piped water to households?

- (a) A lot attention to the problem
- (b) Some attention to the problem
- (c) No attention at all

A27. What measures do you suggest to insure safe improved and reliable water supply to the city.

A28. Please rank the following in the order of importance.

- (a) School
- (b) Health
- (c) Water
- (d) Sanitation (toilet)
- (e) Electricity
- (f) Telephone
- (g) Others (specify)

THE FOLLOWING QUESTIONS WILL BE ASKED TO ALL RESPONDENTS

SECTION B: QUESTIONS ON WILLINGNESS TO PAY (WTP)

In this section of the questionnaire, concerns on how much the provision of improved water worth to you in monetary terms.

INTERVIEWER: READ THE FOLLOWING INTRODUCTION FIRST

Provision of improved water service means:

- The provision of good quality of water which is safe for health inside your house.
- The provision of good quantity of water where an increased amount of water is available for use any time you want, throughout the year.
- Provision of improved water from highly reliable source at any time.

- Almost no need of time and effort spent (assigned) for the collection of water.

Suppose you have an option to such an improved water supply scheme. Assume also that you will be charged a monthly water fee based on the volume of water your household consumes in the month, while the tariff per volume will be the same for all consumers.

WILLINGNESS TO PAY (WTP) QUESTIONS

B1. What is the main source of water for this household for domestic purpose?

- (a) Private piped water
- (b) Shared piped water
- (c) Others.

IF "PRIVATE PIPED WATER" TO QUESTION B1, ASK QUESTION B2 OTHERWISE SKIP TO QUESTION B4

B2. Suppose the Jijiga water agency presented the improved water service, would you be willing to pay 0.____ Birr per Jerican (20 liter backed) to obtain improved from this new scheme?

- (a) Yes
- (b) No

IF THE RESPONDENT SAYS "YES/NO" TO QUESTION B2, ASK

B3. What is the maximum amount you would be willing to pay for a Jerican (20 liter backed)?
_____ Birr per

IF ZERO IS RECORDED TO QUESTION B3 SKIP TO QUESTION B6.

IF "b" OR "c" TO QUESTION C1, ASK C3

Assume also that you have private water connection together with the improved water supply scheme. Notice also that you may not be required to pay initially the costs of connection to the

new scheme. Instead the Jijiga water agency will cover the costs with insignificant increase in the tariff rate.

B4. Suppose the Jijiga water agency presented the improved water service, would you be willing to pay 0.____ Birr per Jerican (20 liter backed) to obtain improved from this new scheme?

(c) Yes

(d) No

IF THE RESPONDENT SAYS “YES/NO” TO QUESTION B4, ASK

B5. What is the maximum amount you would be willing to pay for a Jerican (20 liter backed)?
_____ Birr per

IF ZERO IS RECORDED TO QUESTION B5, ASK B6 OTHERWISE SKIP TO B7

B6. Are you totally not willing to pay because you believe that

(a) The existing system is satisfactory.

(b) You can't afford the new scheme.

(c) The government should pay.

(d) Others (specify).

B7. Are you interested in the provision of the public tap?

(a) Yes

(b) No

B8. If “Yes” suppose that a new scheme of improved water system will be provided using a public tap as near as possible to your house. With this public tap good quality water will be provided as much as you wish at any time of the day throughout the year.

Would you be willing to pay 0._____ Birr for Jerican of water from such public tap?

(a) Yes

(b) No

IF THE RESPONDENT SAYS “YES/NO” TO QUESTION B8, ASK

B9. What is the maximum amount you would be willing to pay for a Jerican (20 liter backed)?

_____ Birr per

THE FOLLOWING QUESTION WILL BE ASKED TO ALL RESPONDENTS.

SECTION C: CHARACTERISTICS OF HOUSING, INCOME & THE HOUSEHOLD MEMBERS

The next few questions concern about characteristics of housing, income & the household members' personal characteristics.

C1. Address of the respondent? Woreda _____ Kebele _____

C2. Gender of the respondent (OBSERVATION) 1= Male _____

2= Female _____

C3. Are you the head of the household? 1. Yes

2. No

If "Yes", SKIP TO QUESTION C4

IF "No" ASK QUESTIONS C3a & C3b

C3a. Who is the head of the household? Ato/ W/o _____

C3b. What is your relation with the head of the household? _____

C4. Is the house you live in is yours or rented?

(a) Mine → SKIP TO QUESTION C7

(b) Rented → GO TO C5 & C6

C5. If rented from whom do you rent?

(a) From private owners

(b) From Kebele

(c) From government

(d) Others (specify)

C6.If rented, how much is the monthly amount of rent?

_____ Birr/month.

C7. Do you have the followings in your house?

(a) Bath room ☐.

(b) Radio/tape ☐

(c) Television ☐

(d) Telephone ☐

(e) Private car ☐

C8.How much does your household spend, on average on the following items?

(a) Food. _____ Birr per Month

(b) . Education. _____ Birr per Month

INTERVIEWER: HELP THE RESPONDENT IN IDENTIFYING POSSIBLE
EXPENSES ON EDUCATION SUCH AS PAYING SCOOOL FEES,
PENCILS, EXERCISE BOOKS AND PAYING FOR EXTENSION
CLASSES.

(c) Transportation. _____ Birr per Month

(d) Electricity _____ Birr per Month

(e) Chat. _____ Birr per Month

(f) Miscellaneous expenses. _____ Birr per Month

(g) Others (specify)

C9.Please tell me how much your (respondent's) average monthly income is?

_____birr

C10. How many people, Both Adults & Children, live in the household including yourself?
_____ (Number).

C11. How much total income on average does your household (you & all other members of this household) earns per month?
_____ Birr.

INTERVIEWER:

IF THE RESPONDENT FINDS DIFFICULT TO ESTIMATE THE TOTAL INCOME OF THE HOUSEHOLD, ASK HIM/HER EACH MEMBER'S MONTHLY AVERAGE INCOME. AND ADD TO GET THE TOTAL.

INTERVIEWER:

FOR QUESTION C12 USE THE TABLE ON THE NEXT PAGE TO RECORD THE ANSWERS OF THE RESPONDENT BY STARTING THE RESPONDENT HIM/HERSELF.

C12. Would you please tell me the age, occupation & education level of every member of your household, and their relationship to you?

THE INTERVIEWER, PLEASE WRITE (X) UNDER THE COLUMN THAT MATCHES THE CHARECTRISTIC OF THE RESPONDENT, EXCEPT THE OCCUPATION COLUMN.

FOR OCCUPATION COLUMN WRITE (SE) IF SELF EMPLOYED SE = 1
 (PE) IF PRIVATELY EMPLOYED PE = 2
 (GE) IF GOVERNMENT EMPLOYED GE = 3
 (UE) IF UNEMPLOYED UE = 5
 IF ANY OTHER SPECIFY

Table 1

No	Name	Relationship to Respondent	Sex		Age	Level of Education						Occupation	Remark
			M	F		None	Primary	Jun. Sec.	Sen. Sec.	Diploma	Degree		
1	Respondent												
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													

INTERVIEWER:- PLEASE CHECK THAT THE NUMBER OF THE HOUSEHOLD MEMBERS LISTED IN THE ABOVE TABLE IS THE SAME AS THE ANSWER TO QUESTION C10.

Thank you very much for time & effort

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all source of materials used for the thesis have been duly acknowledged.

The examiners' comments have been duly incorporated.

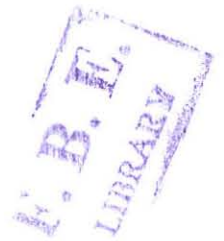
Declared by:

Name: Mohamed Mohamoud Egeh

Signature: _____



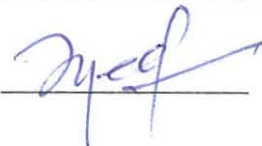
Date: June 22, 2009



Confirmed by Advisor:

Name: Dr. Syed Hasan Qayed

Signature: _____



Date: June 22, 2009

Place and date of submission: Addis Ababa University, June 22, 2009.