

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

**DETERMINANTS OF HOUSEHOLDS' WILLINGNESS TO PAY
FOR IMPROVED WATER SUPPLY SERVICES IN DILLA
TOWN, SOUTHERN ETHIOPIA: AN APPLICATION OF
CONTINGENT VALUATION METHOD.**

BY

TAMIRAT MINOTA

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Environmental Economics)**

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TAMIRAT MINOTA

Approved by the Board of Examiners

Advisor

Signature

Examiner

Signature

Examiner

Signature

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List of Acronyms

ADB	African Development Bank
CSA	Central Statistics Authority
CVM	Contingent Valuation Method
DFID	Department for International Development
FAO	Food and Agricultural Organization
GTP	Growth and Transformation Plan
HSDP	Health Sector Development Program
IWMI	International Water Management Institute
MoFED	Ministry of Finance and Economic Development
MOH	Ministry of Health
MoWE	Ministry of Water and Energy
NGO	Non Government Organization
NOAA	National Oceanic and Atmospheric Administration
PASDEP	Plan for Accelerated Sustained Development to end Poverty
SNNPRS	Southern Nations Nationalities and Peoples Regional State
UNDP	United Nation Development Program
WEDC	Water, Engineering and Development Center
WTA	Willingness to Accept
WTP	Willingness to Pay

Abstract

The supply of adequate, quality, and safe drinking water is a basic need for every human being. However, many people particularly in developing nations lack access to quality and adequate water services which affects their life in many different ways. Ethiopia, like many other developing countries, has problems such as budget constraints and trained man power in delivering safe drinking water to its people. Therefore, to satisfy the required quantity and quality of water demand as well as maintaining the sustainability of water improvement projects, the participation of the beneficiaries is found to be important. This research is designed to estimate households' WTP for improved water services and to identify the potential factors that affect their WTP. To achieve its objective the contingent valuation survey was made using 132 randomly selected households from Dilla town. The data were collected using a well designed questionnaire through single-bound dichotomous choice format followed by open-ended questions. Two econometric models, namely Probit and Tobit models were employed to analyze the data together with descriptive analysis. The result revealed that from the total sampled households 93.94% became willing to pay a positive amount for the water improvement program. The mean WTP for a jerrycan (20 liters) of improved water from both closed-ended and open-ended questions were found to be 18.96 and 21.29 cents respectively. Both values are much higher than the current water tariff of the town. Hence, the 16,501 households' total willingness to pay is estimated to be birr 10,296 per day or birr 3,758,040 per year which is quite higher than the current estimated total revenue of birr 782,485.25 collected from the water sale by the town's water supply enterprise.

The findings of this study also revealed that households' monthly income, source of water being used, occupation, and wealth of respondents positively affect households' WTP while households' family size, quality of water being used and bid value offered to the respondents negatively affect WTP for improved water services. Therefore, these variables should be given much emphasis by policy makers or other concerned bodies in the water improvement program of the town.

CHAPTER ONE

Introduction

1.1. Background to the Problem

Water is one of the essential elements of life. Humans depend not only on an intake of water to replace the continual loss of body fluids, but also for the processing of food sources those themselves need water (Tietenberg, 2003). Adequate, quality, and safe supply of drinking water is a basic need for every human being. However, many people particularly in developing nations lack access to quality and adequate water services which affects their life in many different ways. Since access to safe drinking water is a fundamental human need, it is therefore, a basic human right. Maintaining the human right to water is an end in itself and a means to give substance to the wider rights in the universal declaration of human right and other legally binding instruments. Ensuring that every person has access to at least 20 liters of clean water each day to meet basic needs is a minimum requirement for respecting the right to water (UNDP, 2006b).

According to the same source, globally, access to clean water is a growing problem. Over 600 million people lack access to clean drinking water. Lack of access to safe water is at the heart of poverty trap, especially for women and children, who suffer in terms of illness, drudgery in collection of water, and lost opportunities because of the time that water collection consumes that would be better spent in education and employment. It is believed that access to safe drinking water and basic sanitation are essential for the achievement of economic development. It is a fundamental requirement for effective primary health care, increasing enrolment of boys

and girls in schools, and a pre-condition for success in the fight against poverty, hunger, child mortality and in achieving greater gender equality.

Described as the water tower of Africa, Ethiopia has 12 river basins with an annual runoff volume of 122 billion m³ of water and an estimated 2.6 – 6.5 billion m³ of ground water potential. This corresponds to an average of 1,575 m³ of physically available water per person per year, a relatively large volume. However, only about 3% of water resources are used, of which only about 11% (0.3% of the total) is used for domestic water supply. (IWMI, 2010). Ethiopia, like many other developing countries, has problems in delivering safe drinking water to its people such as budget constraints and trained man power. Only 39.4% of the populations of Ethiopia (31.4% from rural and 83.1% from urban) have access to safe drinking water, one of the lowest coverage globally. In 1990 access to improved water supply had been estimated at only 17%. Therefore, there has been a significant increase. More than 138,000 improved community water points were constructed and rehabilitated from 2008 to 2010. (World Bank, 2011).

In 2005 the government of Ethiopia launched a program called Plan for Accelerated Sustained Development to End Poverty (PASDEP) covering the period 2005 – 2010, aimed at increasing access to improved water source to 84% and access to improved sanitation to 80% by 2010. However, in 2010, access to drinking water was estimated at 68.5%: 91.5% in urban areas (within 0.5 km) and 65.8% in rural areas (within 1.5km) (MoFED, 2010). These ambitious targets go well beyond the water and sanitation targets of the Millennium Development Goals,

which aim at halving the share of people without access by 2015. As estimated by UNDP (2006a), the financial requirements for halving the proportion of population without sustainable access to safe drinking water in 2015, is 23.3 billion Birr out of which 3.4 billion should be secured from consumers, Birr 3.7 billion from the government and Birr 16.1 billion from external partners. In 2010 the government presented the equally ambitious growth and transformation plan (GTP) 2011-2015 that aims at increasing drinking water coverage, based on the government's definition, from 68.5% to 98.5%. (MoFED, 2010).

However, to ensure the government's water supply policy, a better and much more equitable way would be to collect water charges from consumers and then improve and expand the system. According to the Ethiopian water policy, full cost recovery strategy is one of the central focuses of urban water supply. Social tariffs are designed since 2003 to establish cost recovery policy for the drinking water sector. Therefore, to maintain the sustainability of water projects as well as satisfying the required quantity and quality of water demand, establishing cost recovery tariff rate is one of the most important policy issues regarding urban water supply. To achieve the above objective, researching whether citizens are able and willing to pay for the service is very important. Hence, this study is designed to find out households willingness to pay for improved water supply using Dilla town of southern Ethiopia as a case study.

1.2. Statement of the problem

Municipal water systems provide potable water to a wide range of consumers. As indicated by Hickey (2008), the purpose of municipal water delivery systems is to transport potable water from a water treatment facility to residential consumers, for use as drinking water, water for

cooking, water for sanitary conditions and other water use in a domestic environment and business and industry. A water supply system should fulfill two primary requirements. These are adequacy and reliability. Budget constraints, low revenues and shortfalls in operation and maintenance have resulted in insufficient expansion of the system and gradual degradation of the service at the same time the water demands increased and scarcity worsened. (Hickey, 2008, Moss *et al*, 2003). Hence, based on the above justification this led to the fact that water should no longer be considered as a public good only, but also as an economic good.

According to (Edwards, 2010), major problems of water supply in urban centers of Ethiopia include low production levels, inadequate distribution systems and leakages in many areas. It is estimated that more than 30 percent of the water passing through the distribution network is lost before it reaches its delivery points. This further undermined the success and sustainability of most projects. As a result, it is now widely accepted that households should pay for improved water, and revenues should cover at least the operation and maintenance costs. According to (MoWE, 2003), rural communities should cover at least operation and maintenance costs while urban tariff structures are progressive and based on full cost recovery. A study on WTP helps to understand the fundamental value that consumers place on the improved water services; this in turn helps to establish a cost recovery strategy.

Potable water problem in Dilla town becomes a growing problem due to a big difference between the supply of and the demand for clean drinking water in the town. The reasons for the shortage of town's water supply are; high population growth, the establishment of new government and non government institutions following the growth of the town and limited

number of water treatment plants and boreholes which are not enough to meet the current demand for clean drinking water in the town. Currently, both surface and ground water are the source of drinking water for the town. However, high leakage problem coupled with the above mentioned problems aggravated the water supply situation of the town.

Therefore, to improve the current water supply situation of the town some activities such as construction of additional water treatment plants and new boreholes, additional reservoirs and replacement of some pipelines are needed. However, all these activities require high capital outlays. This requires the participation of the beneficiaries in the project. Therefore, researching whether households are willing and able to pay is very important. Furthermore, there are no empirical studies conducted on socio-economic, demographic and water use practices that determine WTP for improved water supply services in Dilla town. Hence, it is important to know for policy makers, NGOs, town's Water Supply Enterprise or other stakeholders the amount of money that inhabitants of Dilla town are able and willing to pay to improve the current water supply situation of the town. This study, therefore, aims to estimate the amount that households would be willing to pay for improved water supply services and identify the potential factors affecting their WTP in Dilla town.

1.3. Objective of the study

The general objective of the study is to assess households' WTP for improved water supply services in Dilla town of southern Ethiopia.

The specific objectives of the study are;

1. To estimate the amount that households would be willing to pay for improved water supply services in the study area.
2. To examine the determinants of households' WTP for improved water supply services in the study area.
3. To give policy implication for effective policy and planning regarding improved water supply services.

1.4. Significance of the study

The fact that drinking water problem is very serious in the town has motivated this study. Ethiopia is one of the poorest countries in the world though it is growing relatively at fastest rate. As a result, budget allocated by the government to provide free water to any group except in emergency, is always impossible. Hence, to alleviate the water supply problem of the town, a better and much more equitable way would be to collect water charges from consumers and then improve and expand the service. Charging consumers for the improved water supply service needs careful analysis of the ability and willingness of the users to pay for the improved service. Therefore, the first significance of this study is to provide basic information to policy makers, NGOs, regional government, federal government, international organizations and the town's water supply enterprise regarding the ability and willingness of consumers to pay for improved water services which the concerned bodies can use as an important input to improve and expand the service. The second significance is providing information concerning the potential factors affecting households WTP for improved water services. Finally, the findings of this study are used as an important source of information for further studies in this area.

1.5. Scope and limitation of the study

This study, which is aimed at exploring willingness of households to pay for improved water supply services and examining factors that determine their willingness to pay, is conducted in Dilla town of southern Ethiopia. Besides, it used a cross section data from the town and the sample size is also limited to 138 households because of time and budget constraints. The water use practices other than households, such as government and non government organizations and industries are beyond the scope of this study. The benefit from clean and safe water is plenty. However, this study reflects only the direct use benefits to the consumers and the external benefits to the society and the economy at large are not covered. Furthermore, this research employs contingent valuation method (CVM) so that it is subject to all the limitations associated with the method, though efforts have been made to minimize the limitations.

1.6. Structure of the Thesis

The remaining chapters of the thesis are organized as follows. In chapter two, review of relevant theoretical and empirical literatures is presented. Chapter three deals with research methodologies. In chapter four, analysis and discussion of the survey results are presented. Finally, conclusions and policy implications of the study are given in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.1. THEORETICAL LITERATURE REVIEW

This section presents theoretical foundations of valuation techniques for non-marketed goods such as water. Since water is one of non-market goods, many water quality improvements cannot be estimated through market system. The most important issue for water project designers and planners is how to ensure financial sustainability of the project. This involves predicting what users are willing and able to pay for proposed water improvement program in the future. Therefore, non-market valuation method is required to estimate users' WTP for the proposed improvement in the water supply.

2.1.1 Environmental Valuation

“Environmental valuation, not to be confused with environmental evaluation, is the process of putting monetary values on environmental goods and services, many of which have no easily observed market prices. A market is an exchange institution that serves society by organizing economic activity. Markets use prices to communicate the work and limits of a diffuse and diverse society so as to bring about coordinated economic decisions in the most efficient manner. The power of a perfectly functioning market rests in its decentralized process of decision making and exchange; no supreme central planner is needed to allocate resources. Rather prices ration resources to those who value them the most and in doing so, individuals are swept along by Adam Smith's invisible hand to achieve what in theory is best for society as

collective optimal private decisions based on mutually advantageous exchange lead to optimal social outcomes (Hanley et al., 1997). While environmental evaluation, sometimes called, environmental impact assessment is the formal process used to predict the environmental consequences (positive or negative) of a plan, policy, program, or project prior to the decision to move forward with the proposed action. Formal impact assessments may be governed by rules of administrative procedure regarding public participation and documentation of decision making, and may be subject to judicial review. An impact assessment may propose measures to adjust impacts to acceptable levels or to investigate new technological solutions (Holder, J., 2004).

However, for environmental assets markets can fail if prices do not communicate society's desires and constraints accurately. According to Hanley and Spash (1993), prices often understate the full value of environmental assets. Market failure occurs when private decisions based on these prices, or lack of them does not generate an efficient allocation of resources. A key requirement to avoid a market failure is therefore that markets are complete. This means that enough markets exist to cover each and every transaction or contingency so that resources can move in each and every transaction.

2.1.2. Valuation Methods for Non- market Goods

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

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

2.1.3. Measures of Welfare Change

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

Consumer surplus has its own shortcoming as a measure of welfare change. A basic problem is its path dependence, that is the sum of changes in consumer surplus and/or WTP depends on the order in which prices are changed. Sir John Hicks introduced four measures of welfare change: Compensating Variation (CV), Equivalent Variation (EV), Compensating Surplus (CS) and

Equivalent Surplus (ES). The CV and EV of the utility change are associated with discrete changes in prices. The EV measure tells us how much extra money income would have to be given to an individual, willing to accept (WTA) for the person to attain the final improved utility level, where as CV, for a proposed welfare gain it can tell us how much money income individual would be willing to pay to insure that the change occurs (Perman et al, 2003, p.405). To the contrary of Marshallian consumer surplus (MCS) the CV and EV measures do not rely on any assumption about the constancy of marginal utility of income (Freeman, 1993, pp. 55-56). If the change in price or income reduces the welfare of the consumer both EV and CV measures have negative sign, but if the change in price and /or income increases the welfare of the consumer, both the EV and CV have positive sign (Johanson, 1991, p.51). If the utility function is quasi-linear and when the income elasticity of demand for the good is zero, the CV, EV and MCS are equal that is $MCS=EV=CV$ but not for homotonic utility function. When utility function is monotonic and the goods are normal, for the rise in price $CV>MCS>EV$ or $WTA>MCS>WTP$ and for the fall in price $CV<MCS<EV$ or $WTP<MCS<WTA$ (Johanson, 1991, p. 41-53; Perman et al 2003, p. 407).

Table 2.1. The relationship between the CV/EV welfare measures and the WTP/WTA

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

Source, adapted from Perman et al, 1999

From the above measure of welfare change, the appropriate welfare measure depends on the type of the problem. When a third party chooses the change in the environmental good,

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

The frequent effort by economists has brought various methods to value non- marketed goods. In relation to this, various valuation methods are available to attach economic values to non-marketed economic resources such as water. However, we discuss only contingent valuation method (CVM) which is widely accepted method of economic valuation techniques for non-market goods and the one which is used in this study.

2.1.4. Theoretical Background of CVM

Contingent valuation method (CVM) is first suggested by Ciriacy-Wantrup in 1947, to interview people and elicit their monetary value. Ciriacy-Wantrup was discussing soil conservation and he noted that several of the benefits were non-market goods, such as reduced siltation of rivers or reduced impairment of scenic resources. He characterized the problem as being how to obtain a demand curve for such goods, and suggested the following solution: “[Individuals] may be asked how much money they are willing to pay for successive additional quantities of a collective extra-market good. The choices offered relate to quantities consumed by all members of a social group. If every individual of the whole social group is interrogated, all individual values (not quantities) are aggregated. The results correspond to a market-demand schedule (Hanneman, 2005). Since then, contingent valuation method (CVM)

has been applied as an effective valuation technique in many developing countries to address a wide variety of issues such as water quality improvements and sanitation. It is a direct means of estimating the economic benefits of an improved water supply. Using this method, one simply asks how much the consumer is willing to pay for a given level of service. It is a survey based method, where people are asked directly how much money they would be willing to pay or accept to maintain the existence of environmental resources such as water. CVM has been increasingly advocated by Economists and sector specialists as a useful tool for gathering reasonably accurate data about how much a household can afford and is willing to pay for particular water and sanitation options presented to them. The CVM involves asking people directly what they would be WTP or WTA compensation for change in preferences and the method is called contingent valuation for it is contingent on the hypothetical market. The CVM is preferred to the revealed preference methods for it includes both use and non-use values and survey responses to WTP or WTA hypothetical questions go directly to the monetary measures of utility change (Perman et al., 2003).

2.1.5. Applicability, Strength and Weakness of CVM

A major strength of CVM is that, because it does not rely on actual markets or observed behavior, it can in theory be applied to any situation, good or service. They remain one of the only methods that can be applied to option and existence values, and are widely used in combination with other valuation method, in order to supplement or cross-check their results (Emerton *et al.*, 2004). The same source further indicated that one of the biggest disadvantages of CVM is the large and costly surveys, complex data sets, and sophisticated analysis techniques that it requires. Another constraint arises from the fact that they rely on

hypothetical scenario which may not reflect reality or be convincing to respondents. CVM require people to state their preferences for ecosystem goods and services. They are therefore susceptible to various sources of bias, which may influence their results. The most common forms of bias are strategic, design, instrumental and starting point bias.

Strategic bias: occurs when respondents believe that they can influence a real course of events by how they answer WTP questions. Critics suggest that because there is no collection of real money, respondents who are ‘pro-environment’ will exaggerate their bids for environmental preservation so long as they believe that the survey will actually have an impact on policy or outcomes. CVM Respondents may for instance think that a survey’s hypothetical scenario of the imposition of a water charge is actually in preparation. Bennett and Carter (1993) indicated that one way of attempting to disguise the strategic bias is the use of the dichotomous choice version of the CVM. Rather than asking directly for a respondent’s WTP, in the dichotomous choice model a respondent is asked about their WTP a pre-specified amount for the good in question. It is also argued that this choice is easier for respondents to make than the conventional CVM willingness to pay decision. Mitchell and Carson (1989) suggest four steps for minimizing strategic bias. These are: remove all outliers; stress that payment by others is guaranteed; conceal other bids; make the environmental change dependent on the bid (that is, prevent the respondents from taking the change as automatically forthcoming irrespective of their bids).

Design bias: this relates to the way in which information is put across in the survey instrument. For example, a survey may provide inadequate information about the hypothetical

scenario, or respondents may be misled by its description. According to Smith (2006), careful development of survey instruments (through initial preparatory work, focus groups, cognitive interviews, and pretests); conscientious implementation of field work; and rigorous econometric analysis that link the data to underlying theoretical models (e.g., utility functions) can help reduce design bias in a CV study.

Instrument bias: arises when respondents react strongly against the proposed payment methods. Respondents may for instance resent new taxes or increased bills. Controversial payment vehicles should be avoided in favor of those most likely to be employed in real life to elicit payment for good in question (Georgiou, *et al.*, 1997).

Starting point bias: occurs when the starting point for eliciting bids skews the possible range of answers, because it is too high, too low, or varies significantly from respondents' WTP. Kartman (1997) gives three possible sources for this bias. Lack of clear understanding of the good or poorly defined good, significant difference between respondents actual willingness to pay and the starting value suggested (if used), and assumption of the respondent that the true value of the good is around the starting point. Smith (2006) suggests that the use of proper elicitation questions and proper bids with an adequate range can reduce the starting point bias. Closed-ended questions may have very small starting point bias. The iterative bidding method is especially prone to this bias. Whittington (1998) also suggests that background information and focus group discussions would help determine the appropriate range of the bid values. The rule of thumb is that the lowest bid should be low enough that most of the respondents will accept it, while the highest bid should be high enough that most respondents will reject it.

CVM method has advantages over other valuation methods, the most important advantages of this method is the one quoted by smith N. (2009) is as follows:

1. One can observe the current water situation of the households; inquire about the level of service people want and how much they are willing to pay for it.
2. The consumer can value services for which indirect approaches would be imperfect (e.g., what are the benefits of increased reliability, higher water quality).
3. The analyst can estimate the reactions of households to prices or technologies beyond the range of past experience.
4. The answers of respondents to WTP questions are easily understood by non economists and decision makers.
5. CVM can be used to easily derive estimates of economic benefits without the use of econometric techniques.
6. The CVM could also be used to assess the benefits of improved water services to industries and commercial establishments.

The major steps involved in using CVM include:

1. Designing and administering a CV survey that elicits individual's value for a good or service. According to Mitchell and Carson (1989), in this step of a CVM, the questionnaire consists of three parts. The first part of the questionnaire includes a hypothetical description of the terms under which the good or service is to be offered to the respondent. The second part tries to determine how much the respondent values a good or service (elicitation of WTP or WTA). The third part includes questions about socio-economic and demographic characteristics of the respondents including his/her family.

2. Analyzing WTP responses—this involves the calculation of frequency distribution, cross tabulation of WTP responses with socio- economic characteristics and other variables and the estimation of the bid function.

3. Estimating aggregate benefits and total revenue- calculating the total economic benefit (total WTP) which can be calculated by multiplying the population by the mean WTP.

4. Evaluating the CVM exercise (validation tests) – undertaking validity test to determine whether the CVM results are acceptable or not.

Although a number of researchers have employed the CVM, using such survey method has some basic problems in the sense that survey respondents could give biased information. The fact that the method is based on hypothetical scenario rather than actual behavior is the source of enormous controversy. Thus, the biases mentioned above systematically understate or over state true values. To reduce these biases, the questionnaire for this study is designed with somehow detailed description of the proposed improvements of the scenario.

CV Questionnaires Design

In designing CV questionnaire, initial preparatory activities should provide adequate information that will feed into designing a preliminary version of a CV survey instrument. The preliminary CV instrument should have a reasonable CV market scenario that takes into account the specific locality, various water supply sources and conditions, cultural and

socioeconomic situations of the communities, as well as payment mechanisms for the proposed service improvement. Then, it should be refined using focus group discussions and pretesting in the field (ADB, 2007).

Each component in the questionnaire fulfils an important role and taken together they introduce the respondent to the context and relevant background in progressively more detail, and also gather information about the respondent and their understanding of the scenario which is needed to report the results or to establish the validity of the response. Some questions may test whether key aspects of the scenario have been understood, while other questions about the degree of familiarity with the good in question will reveal whether the respondent is a user or a non-user. The questionnaire must ensure that three specific conditions are upheld in order to ensure validity of the results: the non-market good must be carefully defined; the scenario must provide a plausible means of payment; and there must be a plausible mechanism for making the trade-off between consumption of private goods and the good in question (Arrow *et al.*, 1993).

CV survey instruments vary from study to study depending on the specific context. According to ADB (2007) a CV survey instrument should have the following modules:

Module I: An introductory section, briefly describing background and purpose of the survey

Module II: Questions on demographic, socioeconomic profile of the households, and profile of the respondents interviewed

Module III: Questions on current condition of the good under question

Module IV: CV market scenarios followed by questions eliciting WTP values

Module V: Debriefing or follow-up questions

Contingent valuation (CV) elicitation techniques

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

- I. Open-ended format** –a CV question in which respondents are asked to provide the interviewer with a point estimate of his/her WTP; it has the advantage of relative computational easiness and counter starting point bias. But the method is associated with a large number of respondents' non-responses and protests zero bids. Mitchell and Carson (1989) further argue that the method is difficult since respondents faced to pick a value out of the air without some form of assistance.
- II. Closed-ended approaches** (dichotomous choice question)-asked respondents whether they would pay a stated amount for the good in question by providing intervals in which the respondents WTP lies. This method is advantageous over open-ended question format in eliciting WTP because of the simplicity of “yes “or “no” answers for the respondents and thus reduce incentives for strategic responses (Bateman et al., 1992). It has also advantage of being much more similar to the choice that individuals are asked to make in real markets when faced by market prices. However it suffers from starting point bias, shortage of information, reducing efficiency and requirement of large sample to estimate benefits as maximum WTP is not directly obtained from this format. This study uses both closed ended (single-bounded) and open- ended formats.

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

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

In general the stated preference methods such as CVM is used to estimate both use and non-use values and also used to estimate values of proposed new policies (Young, 2005) and this indicates that CVM can measure the total economic value of improved water projects. That is the reason why in 1979 the U.S.A. Water Resource Planning Council recommended the CVM as an acceptable method for estimating the benefits of water

resource projects (Young, 2005, p.135). Therefore CVM is the appropriate method for valuing improved water supply of Dilla town.

2.2. Empirical Literature Review

The WTP survey for safe drinking water has been conducted in many places in developing countries. Kaliba *et al.* (2002) conducted an analysis to estimate WTP to improve community water utilities in the Dodoma and Singida Regions of Central Tanzania. They used Multinomial Logit to model factors affecting households' WTP for improved water services, that is, maintain the *status quo*, increase rates of water discharge, increase the number of water distribution points/water reticulation, and other improvements. They aimed to make an analysis directed at identifying types of water services that need improvement and ascertaining the WTP for the improvement. The finding of the study showed that about 64% of respondents in Dodoma and 59% of respondents in Singida voted for an increase in improved water Supply through increased number of water distribution points.

Adebusola and Bolarin (2009) have studied WTP for improved water supply in Osogbo Metropolis, Nigeria. They employed binary Logit model to estimate the truncated mean WTP for improved water supply by regressing the responses to the WTP question on the initial bid value variable. They used the same model to identify the determinants of WTP for improved water supply by using household responses to the WTP question as a dependent variable and regressing against the prices the households WTP and other socio-economic characteristics of the household. Their results showed that the percentage of income that a household is willing to pay for improved water supply and the willingness to pay for connection charges to the improved source are significantly affect households WTP.

Similarly, several studies have been conducted in Ethiopia using CVM methods in order to elicit household's willingness to pay for water services. From studies undertaken the following are pointed out to show the empirical evidence of water related CVM studies in Ethiopia.

Gossaye Fanta (2007) conducted a study on Willingness to pay for improved water supply services using CVM method, in Debre zeit town. In his study, 234 households were randomly selected from 15 kebeles of the town. Households are asked open ended and closed ended questions to elicit households' willingness to pay. His study revealed that piped water is the main source of water for the town. On the level of satisfaction with the existing level, only 10.26% of households are satisfied with current level. Results of probit model also indicated that age, household size, water volume, reliability, and income of households are significantly determines willingness to pay. Households were willing to pay more than the existing tariff level.

The other similar WTP study was undertaken in Mekele town by Kinfe (2008). He used Heckman Two-Step Estimator to identify the socio-economic characteristics and water use practices that affect the amount of money households are willing to pay for the proposed improvement in water supply service. For this study, after analyzing the Tobit model, he found in the result that monthly income of the household, Price per bucket of water, household water purification practice, and wealth of the respondent have positive and significant effects on WTP for improved water service. He found also that respondent's marital status has a negative and significant effect on WTP for improved water supply service.

Simret (2009) studied determinants of individual WTP for quality water in Wonji Shoa Sugar Estate. She used CVM to estimate total WTP value and derive aggregate demand and aggregate benefit for quality water supply service. She used Tobit model to identify socio-economic factors that affects the WTP of households using Limdep software. As an outcome of the study, six explanatory variables were found to affect the WTP value. Income of the household, education level of the respondent, reliability on the existing water supply and respondent perception about quality of the existing water supply have positive and significant effects on willingness to pay whereas family size and age of respondent have negative and significant effect on willingness to pay.

Medhin Fisseha (2006) did a study on Households demand for improved water supply services in Addis Ababa town using contingent valuation method. The study uses both primary and secondary data by sampling 250 households. The result indicates that households are willing to pay more than the existing tariff rate. There is also a positive relationship between educational status and willingness to connect for improved water supply.

Alebel Bayrou (2004) also made a study on analysis and affordability of willingness to pay for improved water supply services in Nazret town using Contingent valuation method. Wealth of respondent, source of water the household is being used, quality of water, time taken to fetch water from the existing source and educational level of the respondents has positive effects on the respondents' choice for improved water services. The result also reveals that people are willing to pay at the price at which the revenue covers the cost: at cost recovery rate.

Genenew Bekele (1999) also conducted a study in Harar town to analyze the determinants of households' willingness to pay and demand for improved water supply services. He used ordered probit model and OLS estimation to elicit households WTP. In his study it is found that education level and sex of family head significantly affects the WTP of households. In the town, high water problem is conceived in that 97.8 percent of households who can access to direct piped water get water once in 4 days.

Generally, from researches done in different urban areas of Ethiopia it is possible to conclude that households were willing and able to pay for improved water supply services. If the town where they live provide them with the improved water, they show their willingness to pay at a cost recovery tariff level. Most of the respondents were not satisfied with the existing source of water. Socio economic characteristics of the respondents were affecting their willingness to pay. So when the tariff rate is designed, it should have to take into account the socio economic characteristics of the households.

CHAPTER THREE

METHODOLOGY OF THE RESEARCH

3.1. Description of the Study Area

Dilla town is situated in the Southern Nations Nationalities and Peoples Regional States (SNNPRS) and is about 360 km south of Addis Ababa and about 90 km south east of Hawassa, the regional capital. It is evolved from a simple custom post (kella) during Dejazmach Balcha Aba Nefso, the then governor of Sidamo in the early 20th century. Geographically Dilla town is found in 6° 14' north latitude and 38° 10' east longitudes along the Ethio-Kenyan high way. Currently, it is the administrative center of Gedeo Zone and the third largest town in Southern Nations, Nationalities and Peoples Regional State next to Hawassa and Arba Minch. According to the 2007 national population and housing census, the population of the town is 59,150 of which 31,068 (52.52%) are males and 28,082 (47.48 %) are females. The total number of households in the town is 13,256. The dominant activities in the town are commercial activities followed by government work and small scale industries such as flour mills and coffee processing industries. The fact that commercial activities are very dominant in the town is because of the location of the town. The town is found along the main road from Addis Ababa to Moyale, which is the main passage of goods from Kenya.

Water Supply Situation of the Town

Based on the information obtained from the town's Water Supply Enterprise, pipe water service in the town started in 1966 along with electric, telephone and banking services. During this early time there was only one borehole with production capacity of 5 liter per second and it was thought to supply for the estimated population of 15,000. According to the 2007 national

population and housing census, from a total of 12,315 households, largest proportion (95.5%) use pipe water as a source of drinking water. The rest (4.5%) of households use well or spring (both protected and unprotected) and rivers .However, from a total of pipe water users, (50.2%) of them use tap outside compound which shows low coverage of drinking water in the town, in that this group obtain water from water venders and public fountains. In other words, almost half of the households do not have their own private connection though they use pipe water. As indicated in table 3.1, only 2.4% use tap inside the house, 20.5% use tap in compound, private and 22.97% use tap in compound, shared with neighbors. From the total households who use non pipe sources, 2.1% use protected well or spring 1.7% use unprotected well or spring, and 0.7% use river, lake or pond as a source of drinking water.

Table 3.1: Source of drinking water of Dilla town

Source of drinking water	Number	Percent
Tap inside the house	300	2.44%
Tap in compound, private	2,523	20.49%
Tap in compound, shared	2,829	22.97%
Tap outside compound	6,186	50.23%
Protected well or spring	257	2.1%
Unprotected well or spring	213	1.73%
River/lake/pond	87	0.71%
All housing unit	12,315	100%

CSA, 2007

Regarding water production capacities of the town's water supply enterprise, currently, 1 water treatment plant, 1 reservoir and 6 boreholes are under operation in order to supply pipe water to the town. In spite of all these constructions, drinking water coverage of the town is 52%. The production capacities of the boreholes are as follows:

Table: 3.2 The Production Capacities of the Existing Boreholes

Boreholes	Production capacities (L/s)
Chichu no_1	5 L/s
Chichu no_2	6 L/s
Millennium	13.5 L/s
3 newly drilled boreholes	8 L/s each

Source: *Dilla town Water Supply Enterprise.*

Regarding water tariff structure of the town, the town's Water Supply Enterprise uses progressive tariff structure on private connections and for public fountain 2 birr per cubic meter.

Accordingly, consumers are categorized in to four groups.

Table 3.3: Water tariff structure of the town's Water Supply Enterprise at private connections and pubic fountains

Consumption (M ³ /month)	Tariff Rate (Birr/M ³)
From1- 6 m³	2.56
7 – 13 m³	3.10
14 - 20 m³	4.30
Above 20 m³	5.00
Public fountain	2.00

Source: *Dilla town Water Supply Enterprise.*

3.2. Sampling Technique and Method of Data Collection

3.2.1. Sampling Technique

For this study, a random sampling strategy has been employed in order to select a total of 138 households from the eight kebeles of Dilla town. Sample size determination is based on Cochran's population correction factors (1977), as cited in Bartlett *et al.*, (2001).

$$no = \frac{Z^2 * (P)(q)}{d^2} = \frac{((1.96)^2) * (0.1)(0.9)}{(0.05)^2} = 138$$

Where;

no = desired sample size when population greater than 10,000

Z = standard normal deviation (1.96 for 95% confidence level)

P = 0.1 (proportion of population to be included in sample i.e., 10%)

q = 1-P i.e., (0.9)

d = margin of error (0.05)

Once the sample size is determined, the next step was designing the survey questionnaire. Although there is no a standard approach in the design of a contingent valuation survey, all contingent valuation surveys consists of several well defined elements. Following the NOAA (National Oceanic and Atmospheric Administration of the USA) recommendation as cited in Portney (1994), the following three points are considered in the design of the questionnaire. These are; (1) the interview was done in person; (2) willingness to pay is about a future event and not one that already occurred, and (3) the hypothetical facts precisely provided to the respondents.

The CV questionnaire for this study is designed as follows: the questionnaire is developed to have three parts; the first part includes the socio economic as well as demographic characteristics of family members in the households. The second part of the questionnaire is designed to know about the current water supply situation of the town and, finally, the valuation scenario is presented. In this third section, attempts have been made to provide enough information for the respondent about the hypothetical market. The scenario proposes the improvement of the water supply service based on the current problems of the existing water supply situations.

Dilla town is classified in to eight kebeles and according to the new master plan the kebeles are grouped in to three sub cities. After getting the number of households living in each sub city the total sample was divided in to the three sub cities according to the proportion of households living in each sub city. And using simple random sampling procedures households were selected from each kebele and interviewed in person to elicit their willingness to pay for improved water services, socio economic and demographic characteristics and water use practices and problems with existing water supply services. In order to identify the water supply problem of the town; we did a focus group discussion with key informants and came up with the first draft questionnaire. After designing the draft questionnaire, pre-testing was conducted with 15 randomly selected households from each kebele. In addition to some modification of the draft questionnaire the pilot survey which was done by two experienced interviewers and the researcher himself helped us to set the starting bids for the contingent valuation part of the questionnaire. During the pilot survey respondents were asked to state their willingness to pay

for a jerrycan (20 liters) of improved water. Based on the responses, we selected 5 values as starting bids following their frequencies. These are 10, 15, 20, 25, and 30 cents and selected based on the number of times they appeared in the responses. In order to facilitate the random distribution of the starting bids among the respondents, we divided the total sample (138) to the number of bids (5) and obtained approximately 28. Then, each bid was appeared approximately 28 times in the total questionnaires and finally the questionnaires were distributed randomly among the total sampled households. In the actual survey, a total of three experienced enumerators were participated and the supervision was made by the researcher himself. The field survey was successfully completed with only 4.3% of misused and incomplete responses.

3.2.2. Methods of Data Collection

Data for this research were gathered both from primary and secondary sources. Interviewing the sampled households, focus group discussions, key informant interviews and direct field observation methods are primary data sources. Regarding secondary data, published and unpublished materials such as office records and reports, journals, books and files from internet/web pages have been used. Collecting and considering both primary and secondary sources through qualitative and quantitative methods of data collection have complemented the diverse data obtained from different sources, which in turn helped to make the result of the research reliable.

Contingent Valuation Method

In this study, contingent valuation method (CVM) is used to estimate households' willingness to pay for improved water supply services. The issue that is most important for project designers

and planners is how to ensure the financial sustainability of a project. This can involve predicting what users would be able and willing to pay for water in the future. Contingent valuation surveys simulate market for non-marketed goods and obtain the value for that good on the hypothetical market described during the survey. In other words, facilitators carry out house-to-house surveys and ask users a range of questions about their existing water supply system plus other socio-economic characteristics and then a hypothetical scenario, involving one or more improved water supply options which are offered to respondents at various prices (WEDC, 2003). As noted in Whittington (2001), the economic concept that CV surveys trying to capture is the maximum amount that a respondent would be willing to pay for the proposed improvement in water services in the context of the existing institutional regime with in which households are free to allocate their financial resources.

CVM has been increasingly advocated by economists and sector specialists as a useful tool for gathering reasonably accurate data about how much a household can afford and is willing to pay for particular water and sanitation options presented to them. Early research in the 1980s found that when the CV method is used to estimate the use of goods and services with which the individuals are familiar, CV surveys that are carefully designed and administered can yield accurate and useful information on households' preferences (Cummings , 1986).

Value elicitation format

As mentioned in literature review section, CV elicitation questions can be of two basic forms: open-ended or closed-ended. In an open-ended question, the respondent is asked to state the

maximum amount that he or she is willing to pay for the good that is being valued. With a closed-ended CV question (also referred to as a “dichotomous choice” or “referendum” question), the respondent is asked whether he or she is willing to pay a specified amount presented as the value of the improved service. The respondent is expected to answer “yes” or “no.” Closed-ended questions have been the preferred form of elicitation question since it was introduced by Bishop and Heberlein (1979).

On the other hand, open-ended questions provide more information than closed-ended questions; and do not require econometric modeling to analyze, as the mean WTP values of respondents can be readily estimated by simple arithmetic. However, answering an open-ended question on a new commodity requires a higher level of cognitive demand on the part of respondents, because individuals are typically not accustomed to performing such tasks in daily life decision making. Open-ended questions also lead the respondents to base their answers on their knowledge on cost of provision of improved water supply services and sometimes on their political beliefs, such as whether water should be free of charge. Such type of understanding may underestimate the true benefit of improved water supply service. Moreover, validity testing, which is vital to provide credibility to estimate WTP, still requires econometric modeling. Therefore, a closed-ended approach is preferred to elicit WTP for improved water supply services. There is a variety of elicitation questions available now, which are largely some modification of the basic two types. There are four major elicitation methods so far used in CV surveys. These are: the bidding game, payment card, take-it-or-leave it approach (single bounded dichotomous choice) and take it- or-leave- it with follow up (double-bounded dichotomous choice). This study made use of single bound close ended ‘yes’ or ‘no’ questions followed by

open-ended questions to elicit households willingness to pay for the improved water services.

3.3. Econometric Models

To analyze survey responses, two different econometric models are specified: one for single bound and the other for open ended survey responses depending on the nature of the response. The main objective of estimating econometric model in willingness to pay survey is to calculate mean willingness to pay and to allow inclusion of respondents' socio economic factors in to willingness to pay functions which supports the researcher to obtain information on the validity and reliability of contingent valuation results and hence increasing confidence in application of results obtained from the contingent valuation empirical analysis. (Haab and McConnel, 2002). There are two approaches to model the single bounded close ended survey responses. These are modeling as dichotomous variable as in random utility framework used in utility differential model constructed by Hanneman (1984) and as censored econometric model proposed by Cameron (1988). The households' willingness to pay survey responses from the open ended format are estimated as censored model such as the Tobit model if the dependent variable takes nonnegative values with some zeros. In this study we used the probit model for the single bound close ended survey responses and Tobit model for the open ended responses to analyze survey responses.

3.3.1 The Probit Model

We used the probit model to analyze the responses obtained from single bound closed-ended dichotomous format where household heads are given the initial bid that has 'yes' or 'no' responses. According to Hanneman (1984), the basic model for analyzing dichotomous CV responses is the random utility model. In utilizing the random utility framework, Hanneman

rationalized responses to dichotomous CV questions putting them in a framework that allows parameters to be estimated and interpreted. Consider that the household utility function for water service at status quo level is given by;

$$U^0 = U(W^0, Y_i, Z_i)$$

Where Y_i denotes household's income, and all other factors that influence household's WTP for the improved water services by vector Z_i , and the water services at the status quo level by W^0 and after the improvement level by W^1 . Hence, household's utility function for water service after the improvement level is given by:

$$U^1 = U(W^1, Y_i, Z_i)$$

As noted by (Hnneman and Kaninen, 1998), it is assumed that each individual know his or her utility function or preferences with certainty, and there are some components that are not observed by the researcher and treated as random variable and denoted by ε . Hence, after the incorporation of the random variable, the household indirect utility function for water service at the status quo and after the improvement level becomes $V(W^0, Y_i, Z_i)$ and $V(W^1, Y_i, Z_i)$ respectively. Therefore household utility function for water services at the status quo level can be written as:

$$U(W^0, Y_i, Z_i) = V(W^0, Y_i, Z_i) + \varepsilon_0$$

And the household utility function for water service after improvement can be written as:

$$U(W^1, Y_i, Z_i) = V(W^1, Y_i, Z_i) + \varepsilon_1$$

Let as assume that ε_0 and ε_1 are independently and identically distributed with zero means. Households are faced with two choices: either to maintain at status quo level, W^0 or after

improvement level, W^1 . Households will be asked to pay some amount of money in order to get improved water service, and assume this amount of money is denoted by T_i . Accordingly, the household will choose the improved water services if the utility with CV program exceeds utility of the status quo:

$$V(W^1, Y_i - T_i, Z_i) + \varepsilon_1 > V(W^0, Y_i, Z_i) + \varepsilon_0$$

Although households know the choice that maximize their utility, the researcher observes ‘yes’ or ‘no’ responses. Hence the responses are treated as random variable with probability distribution given by:

$$\begin{aligned} \text{Pr. (yes)} &= \text{Pr. } \{ V(W^1, Y_i - T_i, Z_i) + \varepsilon_1 > V(W^0, Y_i, Z_i) + \varepsilon_0 \} \\ &= \text{Pr. } \{ V(W^1, Y_i - T_i, Z_i) - V(W^0, Y_i, Z_i) \} > \varepsilon_0 - \varepsilon_1 \end{aligned}$$

And

$$\text{Pr. (No)} = 1 - \text{Pr. (yes)}$$

Now assume, $\Omega = \varepsilon_0 - \varepsilon_1$ and $F_\Omega(\cdot)$ be cumulative distribution function. In the probit model, $F_\Omega(\cdot)$ follows the normal cumulative distribution functions and in the logit model it follows the logistic cumulative distribution function. According to Haab et al., (2002), both the probit and the logit models give similar parameter estimates. The choice between the two is only for mathematical convenience. Assuming the normal cumulative distribution function, the probit model can be expressed as:

$$Y^L = F(X\beta + U_i)$$

Where Y^L is unobservable latent variable = 1 if the response is yes, 0 if the response is no, X is the explanatory variables, β is unknown regression parameter and U is the random error term. In the case of single bound dichotomous choice respondents indicate their willingness to pay by answering ‘yes’ or ‘no’ to a set of offered prices. These responses will be estimated by the maximum likelihood procedure.

Following Hanneman and Kanninen (1998), we can denote the response probabilities using the notation $P(Y_i/X_i, \phi)$. Where Y_i denotes the response of the individual, =1 if yes and 0 otherwise, X_i 's are explanatory variables and ϕ unknown regression parameters therefore the likelihood function can be expressed as:

$$L = \sum_{i=1}^n (Y_i \ln P_i) + (1 - Y_i) \ln (1 - P_i)$$

Where $P_i = P(Y_i/X_i, \phi)$, i^{th} individual response probability, Y_i is dummy variable indicating an individual choice 1 for yes and 0 for no.

Hence, we can specify the probit model for households' willingness to pay for the improved water services based on the above justification:

$$WTP_i = \alpha_0 + \alpha_1 \text{SEX} + \alpha_2 \text{HHSIZE} + \alpha_3 \text{AGE} + \alpha_4 \text{EDUC} + \alpha_5 \text{HHINC} + \alpha_6 \text{WLTH} + \alpha_7 \text{OCCR} + \alpha_8 \text{RELIAB} + \alpha_9 \text{SOURCE} + \alpha_{10} \text{LSAT} + \alpha_{11} \text{QLTY} + \alpha_{12} \text{TIME} + \alpha_{13} \text{NFMAF} + \alpha_{14} \text{BV} + U_i$$

Where WTP is response to the bid price = 1 if the response is yes and 0 if no, $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \dots, \alpha_{14}$ are regression parameters, U_i is the error term and the explanatory variables have been

defined in section 3.7. As we said earlier regression parameters have been estimated by maximum likelihood procedure by using STATA software version 11.

According to Haneman *et al.* (1991), one of the main objectives of estimating WTP based on the contingent valuation survey response is to find the central value (or mean) of WTP distribution. Similarly, Carlson *et al.* (2002) states that the main reason for estimating the probit model is to obtain an estimate of mean willingness to pay. Hence, the mean willingness to pay can be calculated as follows;

$$\text{Mean WTP} = \mu = -\alpha/\beta$$

Where α = is the constant term or intercept term

β = is the coefficient of the 'bid' offered to the respondents

3.3.2 The Tobit Model

For the open- ended questions, binary response models such as logit or probit is not appropriate. Therefore, the household's willingness to pay responses from the open-ended format are estimated as censored model such as the Tobit model if the dependent variable takes nonnegative values with some zeros or by using linear regression model if the dependent variable takes non zero positive numbers (Siglman, L. and L. Zeng, 1999). In this study we faced a problem of censoring in the open-ended questions, that is some responses have zero maximum willingness to

pay amount for the proposed water improvement project, thus the Tobit model is the appropriate model

As we discussed above, in the probit model what we observe is a dummy variable

$$y_i = 1 \quad \text{if } y_i^* > 0$$

$$y_i = 0 \quad \text{if } y_i^* \leq 0$$

y_i^* is observed if $y_i^* > 0$ and is not observed if $y_i^* \leq 0$. Then the observed y_i will be defined as

$$y_i = y_i^* = \beta x_i + u_i \quad \text{if } y_i^* > 0$$

$$y_i = 0 \quad \text{if } y_i^* \leq 0$$

$$u_i \sim \text{IN}(0, \delta^2)$$

Where y_i = the observed maximum willingness to pay of individual i

y_i^* = the latent variable and it is observed if it is greater than one and not

observed if it is less than or equal one.

x_i = the independent variable

β = vector of slope parameter

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

constant variance δ^2

This is the general formula for the tobit model (Madalla, 1992).

According to Green (1997), the log likelihood for the censored regression model is:

$$\ln L = \sum_{y_i > 0} -\frac{1}{2} [\ln(2\pi) \ln \delta^2 + (y_i - \alpha' x_i) / \delta^2] + \sum_{y_i = 0} \ln[1 - \varphi(\alpha' x_i / \delta)]$$

the two parts correspond to the classical regression for the non limit (continuous) observations and the relevant probabilities for the limit (zero) observations respectively. Then the estimable model for the censored data i. e, the equation in the tobit model is:

$$MWTP_i^* = \beta_0 + \beta_1 SEX + \beta_2 HHSIZE + \beta_3 AGE + \beta_4 EDUC + \beta_5 HHINC + \beta_6 WLTH + \beta_7 OCCR + \beta_8 RELIAB + \beta_9 SOURCE + \beta_{10} LSAT + \beta_{11} QLTY + \beta_{12} TIME + \beta_{13} NFMAF + \beta_{14} IBV + U_i$$

Where $MWTP_i^*$ = the maximum willingness to pay of households per jerry can of improved

water services. y_i is observed if it is greater than zero and not observed when it

is less than or equal to zero.

$\beta_0, \beta_1, \beta_2, \dots, \beta_{14}$ are regression parameters

U_i is the error term.

According to FAO (2007), an appropriate method for welfare measures in cost benefit analysis is the mean measure. For the open-ended contingent valuation survey responses maximum willingness to pay reported by the respondents can be simply averaged to produce mean WTP.

$$\text{Mean WTP} = \mu = \sum T_i / n$$

Where n = sample size

T_i = a reported maximum WTP amount by surveyed households

3.4. Description of explanatory variables and their expected signs

Household family size (HHSIZE): as the number of people living under a household increases, the need for water will be higher, this in turn increases the willingness to pay for water. But, the ability to pay is inversely related to the number of people in a household since willingness depends on the ability to pay. Hence, it is difficult to hypothesize the effect of this variable on WTP.

Gender (HHSEX): This is a dummy variable which refers to the sex of the respondent and takes value 1 if the respondent is male and 0 otherwise. Some studies such as Alebel (2003) and Aschalew (2009) investigated that male respondents are more willing to pay than female respondents for women do not have equal control over resources. On the other hand females are more willing to pay for improvement of water supply services than males (Kaliba *et al.*, 2002). The reason could be due to the fact that females are primarily responsible for water fetching activities. Therefore, it is difficult to hypothesize the effect of gender on WTP for improved water supply services a priori.

Age of the respondent (AGE): this variable, which is continuous, refers to the age of the respondent. According to Aschalew (2009), Alebel (2003) and Kaliba et al. (2002), age is negatively related to WTP. This is because older people are more likely to choose to maintain the *status quo* since they are less likely to participate in water collection activities.

Education of the respondent (EDUC): this variable is a dummy variable and takes value 1 if the respondent attended any formal education and 0 otherwise. According to Aschalew (2009) and Alebel (2003), the respondent's educational level is positively related to WTP for improved water supply services. This shows that people with formal education give more priority to improved water supply services than those without. Therefore, we can hypothesize the effect of education level of the respondent on WTP for improved water supply services to be positive.

Household's monthly income (HHINC): this is continuous variable measured in birr. According to microeconomic theory and some empirical studies, quantity demanded and income are positively related given normal goods. Hence, we expect the effect of this variable on WTP for improved water supply services to be positive.

Wealth of the respondent (WLTH): ownership of residential house is used as a proxy for wealth. It is a dummy variable takes value 1 if the respondent has residential house and 0 otherwise. Since richer individuals have more ability to pay for improved water services, the expected sign of this variable is positive.

Occupation of the respondent (OCCR): This is a dummy variable taking value 1 if the respondent is employed in formal sector salary employment such as government, private organization and NGOs; and 0 otherwise. Since the employed respondents are capable of having more preference to improved water service than the unemployed ones, the expected sign of this variable is positive.

Reliability of the existing water system (RELIAB): It is a dummy variable and takes value 1 if the water system is not reliable and 0 otherwise. This variable refers to the

functionality of the water system at any given time. It has to do with whether frequent breakages are occurring in the water system which imposes difficulties on the household's access to enough water at any given time. Simret (2009) reported that households are more willing to pay if the existing water supply service is unreliable. We expect the sign of this variable to be negative.

Source of the existing water system (SOURCE): it is a dummy variable taking value 1 if the respondent has private connection, 0 otherwise. We expect positive effect of this variable on WTP because households with private connection are expected to be more interested to pay for improvement in water service as they can get the improved water through the existing connection.

Quality of water being used (QLTY): dummy variable taking value 1 if the existing source is safe to drink before any purification technique is used, 0 otherwise. Since households with unsafe source are more willing to pay for improved water service, we expect negative effect.

Level of satisfaction with the existing water system being used (LSAT): dummy variable taking value 1 if the household is satisfied with existing water service and 0 otherwise. Since households which are not satisfied with the existing water system are more willing to pay for the improvement, we expect negative sign.

Time taken to fetch water from the existing source (TIME): households who spend more time in search of water are more likely to pay for improved water service. Hence we expect positive effect of this variable.

Number of family members affected by water born diseases in the last six months (NFMAF): dummy variable taking value 1 if one or more family members have been affected by water born diseases and 0 otherwise. If households have experienced any water borne diseases in the past it is assumed that there was a direct medical cost or indirect costs like losing productive time and labor. Then, households will need to decrease the costs through accessing reliable and quality water that will be safe for health. Therefore, this variable is expected to have a positive impact on WTP.

Bid Value (BV): this variable refers to the different BVs used to elicit willingness to pay for improved water services. The elicitation question asks whether the respondent is willing to pay the specific amount to acquire the improved service. In order to facilitate the econometric modeling of the responses, a range of values (bids) were presented to different households. This variable is included in the regression analysis to examine the existence and significance of starting point bias. According to ADB (2007), once the multivariate regression is estimated incorporating bid value in the estimation, the analyst can undertake the validity tests. Validity tests examine whether an instrument actually measures what it is designed to measure. Among others, one validity test is if the coefficient of the bid value is found to be negative and significant, then the WTP values from the CV survey can be considered valid. Therefore, the BV sign is expected to be negatively correlated with WTP.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION

This chapter presents analysis and discussion of the data obtained from contingent valuation survey. Accordingly, survey results are analyzed and discussed in two ways. These are descriptive and econometric methods. In descriptive analysis, we analyze and discuss the general characteristics of sample households including socio-economic and demographic characteristics that are expected to affect households' willingness to pay for improved water services and their attitude towards the existing water supply situation of the town. In econometric analysis, the main focus is investigating determinants that affect households' willingness to pay for improved water services. Two models were used for the econometric analysis. In the probit model, we analyze and discuss factors that affect households' probability of accepting the initial bid posed to them and the mean willingness to pay from the closed-ended questions. The Tobit model is used to analyze and discuss the determinants that affect the maximum amount of money that households are willing to pay for the improved water services.

4.1. Descriptive Analysis

4.1.1. Socio-Economic and Demographic Characteristics of Households

As we mentioned in the methodology section, a total of 138 sample households were selected and interviewed to estimate households' willingness to pay for improved water services in Dilla town. The survey questionnaires were successfully filled and analyzed with only 6 misused and incomplete questionnaires.

From the total of 132 households 44 (33.3%) are male respondents while the rest 88 (66.67%) are female respondents. The average family size of the households is 5.25 with minimum of 1 and maximum of 11 members within a single household. Regarding age of the respondents, the average year is 42.6 years which ranges from 22 to 82 years of age. The education data show that from the total of 132 respondents 101(76.5%) have attended their formal education from a minimum of 4th grade to a maximum of master's degree while the rest 31(23.5%) are illiterate.

Employment structure of the respondents indicate that of the total 132 sampled households 53(40.15%) engaged in different kinds of formal sectors for salary, of which 33(62.3%) are employed in government organization, 7(13.2%) are employed in nongovernmental organizations (NGOs) and 13(24.5%) are employed in private organizations. The rest 79 (59.85%) respondents are engaged in non salary activities. These include 12(9.1%) are students, 41(31.1%) respondents running their own businesses, 16 (12.1%) are housewives, 4(3%) are retired people and 6(4.5%) are unemployed. From the total 132 households, 90(68.2) households live in their own houses while the rest 42(31.8) households do not own houses and majority of these rented houses.

The average monthly income of the surveyed households is about 1510.22 Birr ranging from minimum income of 400 Birr to maximum income of 5500 Birr. However, monthly household expenditure of the surveyed households is 1766.25 Birr ranging from 450 Birr to 6430 Birr. This shows that households do not want to reveal their true income. In fact this is what we observed during the survey time. Hence, we took households monthly expenditure to approximate

households' average monthly income. On average the households pay 63.5 Birr for their monthly water consumption which is 3.6% of their monthly average income. The mean water consumption of the surveyed households per day is 3.4 jerrycan. Accordingly, the mean monthly water consumption of the households is about 2040 liters or 2.04m³. As indicated in table 3.2, this falls in the first category. i.e. the tariff rate is 2.56 Birr for the water consumption of 1to 6 m³ per month, and therefore, the average households' water consumption expenditure is 5.22 Birr per month which is 0.3% of households average monthly income of Birr 1766.25. Since this is a very small amount it shows that the households have big potential of paying for the proposed improved water supply in the town.

4.1.2. Households' water use practices and problems

Table 4.1 summarizes the general description of variables used in this study and households water use characteristics related to these variables.

Table 4.1: Description of variables and water use characteristics of the households

VARIABLE	DESCRIPTION	MEAN	STD.DEV	MIN	MAX
HHSIZE	Household size in number	5.25	1.9746	1	11
HHSEX	Household sex, dummy variable 1 if male and 0 otherwise	0.3333	0.4732	0	1
HHAGE	Household age, age of the respondent in years	42.5909	12.7063	22	82
EDUC	Education of the respondent, dummy variable 1if formal education and 0 otherwise	0.7652	0.4255	0	1
HHINC	Household income in Birr	1766.25	1202.452	450	6430
WLTH	House, a proxy for wealth, dummy variable 1if the respondent own a house and 0 otherwise	0.6818	0.4675	0	1
OCCR	Occupation of the respondent, dummy variable 1 if formal salary employment and 0 otherwise	0.4015	0.4921	0	1
RELIAB	Reliability of the existing source, dummy	0.9015	0.2991	0	1

	variable 1 if unreliable and 0 otherwise				
SOURCE	Household main source of water, dummy variable 1 if private connection and 0 otherwise	0.5379	0.5005	0	1
QLTY	Quality of the existing water, dummy variable 1 if high and 0 otherwise	0.6212	0.4869	0	1
LSAT	Level of satisfaction with the existing water supply, dummy variable 1 if satisfied and 0 otherwise	0.0909	0.2886	0	1
TIME	Time taken to fetch water from the existing source in minute	39.8387		10	120
NFMAF	Number of family members affected by water born diseases in the last six months, dummy variable 1 if affected and 0 otherwise	0.3864	0.4888	0	1
WTP	Households' WTP for initial bid, dummy variable 1 if yes and 0 otherwise	0.7045	0.4580	0	1
BV	Bid value offered to the respondent in cents	19.8864	7.1105	10	30
MWTP	Households' maximum willingness to pay in cents	21.2879	14.0694	0	50

Source: computed from surveyed data, 2014

N.B: the mean estimates of dummy variables should be interpreted as percentage e.g. the mean of the reliability of the existing source is 0.9015 means 90.15% of the respondents said that the existing source is unreliable.

The survey results show that from the total 132 sample households 119(90.15%) of the respondents indicated that the existing water source is unreliable while the rest 13(9.85%) responded that the water source is reliable. Regarding the main source of the water being used, almost 71(53.79%) of the respondents have their own private connection where as 61(46.21%) of the households do not have private connection. Quality of the water is perceived to be low by 50(37.88%) of the households while the rest 82(62.12%) responded that the existing water is safe to drink before any purification mechanism is used. Of the total 132 sample households, 120(90.9%) are dissatisfied with the existing source while 12(9.1%) are satisfied with the water source being used. The survey result shows that the average time taken to fetch water from the

existing source is about 39.8783 minutes which ranges from a minimum of 10 to a maximum of 120 minutes. However, the average time is computed for those households who use other sources other than pipe water and for those who use public fountain for their household consumption because the time taken to fetch water for households with their own private connection is very insignificant. The sample data indicated that 51(38.64%) of the households reported that at least one of their family members were affected by one or more of water borne diseases in the last six months, and the remaining 81(61.36%) were not affected. From the affected family members 33(25%) were affected by diarrhea and 18(13.64%) were affected by typhoid.

4.1.3. The current water supply situation and problems

As indicated in table 4.2, from the total sampled households, 121(91.67%) use piped water while the rest 11(8.33%) use non piped water source. The survey data reveal that only 8(6.1%) households have tap inside their house. The majority of the households use tap in compound both private and shared with neighbors, that is 45(34.2%) and 41(34.1%) respectively. The rest 27(20.45%) of the households use public water sources. From among the respondents who use non piped water sources, 3(2.3%) use river, 6(4.5%) use spring and only 2 (1.5%) uses well as a source of drinking water. Table 4.2 summarizes the current water supply situation of the town.

Table 4.2: Major Drinking Water Sources of the Households

Source of water	Number of households	Percentage	Cumulative percentage
Pipe inside house	8	6.1	6.1
Pipe in compound (private)	45	34.1	40.2
Pipe in compound (shared)	41	31.1	71.3
Public taps	27	20.4	91.7
Rivers	3	2.3	94.0
Spring	6	4.5	98.5
Dug wells	2	1.5	100
Total	132	100	

Source: *computed from surveyed data, 2014*

The survey result also revealed that 3.7 households on average use a single tap with neighbors for shared pipe water. Furthermore, the data indicate that 4(3.03%) households said that the current tariff rate is too expensive, 18(13.64%) said it is too cheap, 61(46.21%) said the water tariff is fair, and 16(12.12%) responded the current tariff rate charged by the town's water enterprise is difficult to judge. Of the total sampled households, 105(79.5) responded that they didn't get pipe water at desired time, and most of them, i.e., 83(79%) households get additional water from water vendors and the rest 22 get additional water from rivers, spring and dug wells and their numerical figure is 10(9.5%) ,7(6.67%) and, 5(4.8%) respectively. In addition, the price charged by the water vendors is judged as two fold by 28(26.7%), and three fold by 41 (39.04%)

households when compared with the tariff rate charged by the town's water enterprise while 10(9.5%) responded the prices are the same. The descriptive analysis of quality, quantity and reliability of the existing water services is summarized in the table 4.3.

Table 4.3: Quality and Quantity of the Existing Water Service

Quality of water being used	No of HHs	Percentage (%)	Cumulative percentage	Quantity of water being used	No of HHs	Percentage (%)	Cumulative percentage
Good	82	62.12	62.12	Good	17	12.88	12.88
Average	39	29.55	91.67	Average	51	38.64	51.52
Poor	11	8.33	100	Poor	64	48.48	100
Total	132	100		Total	132	100	

Source: *computed from survey data, 2014*

Table 4.4: Reliability of the existing Water Service

Reliability of water being used	No of HHs	Percentage (%)	Cumulative percentage
Reliable	119	90.15	90.15
Unreliable	13	9.85	100
Total	132	100	

Source: *computed from survey data, 2014*

As indicated in table 4.3, more than half that is 82 or 62.12% of the sampled households responded that the water quality is good. In other words; the water is safe to drink before any

purification mechanism. However, only 39(29.55%) and 11(8.33%) households said that the water quality is average and poor respectively. Regarding the quantity of water being used, only 17(12.88%) households responded the quantity of water is good and almost 115 (87.12%) said that the quantity of water is average and poor i.e., 51(38.64%) and 64(48.48%) respectively. Hence, the problem of quantity of water is more serious than quality. Furthermore, as shown in table 4.4, reliability problem is very critical. From the total sampled households, 119(90.15%) said that the existing water source is not reliable. In other words, only 13(9.85%) households found the existing water service reliable. The most important purpose for which the water is used by the sampled households is summarized in table 4.5. The orders are ranked from the most important to the least important purpose. The survey data revealed that more than half, or 86(65.15%) of the sampled households use water for drinking as a priority, 41(31.06%) use for washing clothes, 4(3.03%) use for housekeeping or cleaning house, gardening, etc. and the rest 1(0.76%) use for livestock watering as a first purpose.

Table 4.5: Households ranking of water usage.

VARIABLES	RANK	NO OF HOUSEHOLDS	PERCENTAGE (%)	CUMULATIVE PERCENTAGE
Drinking	1 st	86	65.15	65.15
Washing clothes	1 st	41	31.06	96.21
Housekeeping (cleaning)	1 st	4	3.03	99.24
Livestock watering	1 st	1	0.76	100
Total		132	100	

Source: *computed from survey data, 2014*

4.1.4. Analysis of Households' WTP for Improved Water Services

In the open ended questions, households are asked to state their maximum willingness to pay for the improved water services. The survey result shows that a total of 11 maximum WTP values are reported including zero maximum willingness to pay. Almost 93.9% of the sampled households reported positive maximum willingness to pay value for a jerrycan (20 liters of water) of improved water in cents. As indicated in table 4.6, different maximum willingness to pay values is reported if the proposed improved water supply service is implemented. Accordingly, 8(6.06%) of the respondents did not want to pay any amount due to different reasons. Other 8 (6.06) households are willing to pay 5 cents at maximum, 30(22.73%) of the respondents expressed their maximum willingness to pay to be 10 cents, 16(12.12%) are willing to pay 15 cents, 21(15.91%) of the respondents are willing to pay 20 cents, 6(4.55%) of the households are willing to pay 25 cents, 17(12.88%) households are willing to pay 30 cents, 15(11.36) of the respondents are willing to pay cents, and finally 11 (8.33%) of the sampled households became willing to pay 50 cents for a jerrycan (20 liters)of improved water.

Table 4.6: Summary of maximum willingness to pay reported by surveyed households

REPORTED MAXIMUM WILLINGNESS TO PAY IN CENTS/20 LITERS	NO OF HOUSEHOLDS	PERCENTAGE (%)	CUMULATIVE PERCENTAGE
0	8	6.06	6.06
5	8	6.06	12.12
10	30	22.73	34.85
15	16	12.12	46.97
20	21	15.91	62.88
25	6	4.55	67.43
30	17	12.88	80.31
40	15	11.36	91.67
50	11	8.33	100
Total	132	100	

Source: *computed from survey data, 2014*

If we multiply the reported maximum willingness to pay (column 1) by corresponding number of households (column 2) and divide the sum by total number of sample households, we get 21.29 cents. It is households' maximum willingness to pay for a jerrycan (20 liters) of improved water on average. If this value is multiplied by the current households' daily average water consumption, which is 3.4 jerrycan or 68 liters per day, we obtain 72.39 cents, and again if we

multiply this value by 30 we get the monthly average maximum willingness to pay of the respondents which is 21.72 Birr. This value is 1.2% of mean monthly income of the household that is less than households' actual pay, which is 3.6% of mean monthly income. The difference is due to the fact that water supply problem is very serious in the town. In other words, due to unreliability and other mentioned problems, water is obtained from vendors and from distant sources, which raises households' water expenditure. Furthermore, the survey result show that the mean willingness to pay for the total sampled households is 21.29 cents per 20 liters of improved water which ranges from 0 to 50 cents from the open ended question.

As indicated in table 3.3, the tariff structure of the town's water supply enterprise follows progressive rate. Accordingly, the tariff rate is 5.12 cents per 20 liters of water for the water consumption of 1-6m³, 6.2 cents from 7-13 m³, 8.6 cents from 14-20 m³, and 10 cents per 20 liters of water above 20 m³ of water consumption, and also 4.0 cents per 20 liters of water for the water consumption from the public fountain. Hence, 21.29 cents which is the mean willingness to pay of the sampled households per 20 liters of improved water is much higher than the current water tariff structure of the town. In general, the surveyed households are willing to pay more than the current water tariff of the town's water supply enterprise for improved water. Therefore, if the improved water service is provided in addition to addressing the water needs of the town; more funds can be collected from the water sale which helps the expansion of improved water projects in the town.

3.5. Results of Econometric Analysis and Discussions

In this section we present results of econometric analysis. Using regression results we discussed factors affecting households' willingness to pay for improved water supply services in Dilla town. However, before estimating the determinants of willingness to pay, what is collectively called problems of regression analysis has to be checked first. One of those problems is multicollinearity or high intercorrelation among the explanatory variables. According to (Maddala, 1992), if there is multicollinearity or high intercorrelation among the explanatory variables, it becomes difficult to know the separate effects of each explanatory variable on the explained variable. In order to know how high these intercorrelations have to be to cause problems in our inference, rule of thumb was established by Gujarati which says that multicollinearity is a serious problem when a pair wise correlation coefficient between two regressors is greater than or equal to 0.8(Gujarati, 2002,pp. 359). However multicollinearity is not a serious problem for our data.

The other problem of regression analysis is heteroscedasticity which is the case where the errors do have common variance. To correct these heteroscedasticity problem robust standard errors can be estimated for the probit model, and the log likelihood ratio test is used to test the existence of heteroscedasticity in the Tobit model. The result shows that heteroscedasticity is not a serious problem for our data. Testing whether the models are statistically significant is the other most important step we have to make before discussing the regression results. For the probit model, the likelihood ratio test which is the test against the null hypothesis that all the slope coefficients are equal to zero is rejected at 5% level of significance. For our data the model is statistically

significant since there are some explanatory variables which explain households' willingness to pay. Finally, measures of goodness of fit for both probit and Tobit models is also tested by using Likelihood Ratio Index (LRI). Measures of goodness of fit shows that both models are statistically acceptable since 62% of the variation is explained in the probit model and 13% of the variation is explained in the Tobit model.

3.5.1. Results of the Probit Model and Discussions

After data exploration has been done, the next step is estimation. As mentioned in the methodology section, the regression analysis was done by using STATA version 11. According to Green (1993), the coefficients of the probit model give only the significance and direction of the effects of each explanatory variable on willingness to pay. The marginal effects indicate that the probability that respondents accept or reject the offered bid due to a unit change in continuous explanatory variables and a change of dummy variables from 0 to 1 for discrete variables. The coefficients and marginal effects of the probit model are summarized in table 4.7.

Table 4.7: Estimated Coefficients and Marginal Effects of the Probit Model

Number of obs. = 132 Wald chi ² (14) = 59.57 Pseudo R ² = 0.619				
Variables	Coefficients	Robust Std. Err	Z	Marginal Effects (dy/dx)
HHSIZE	-0.2622584	0.122478	-2.14**	-0.0348724
HHSEX	0.7894111	0.5332838	1.48	0.0890917
HHAGE	-0.0147462	0.0247249	-0.60	-0.0019608
EDUC	0.4344444	0.5326301	0.82	0.0685307
HHINC	0.0006406	0.0002844	2.25**	0.0000851
WLTH	1.66287	0.5477278	3.04***	0.3415616
OCCR	0.0763599	0.4935717	0.15	0.100437
RELIAB	0.2176044	0.4936682	0.44	0.0328714
SOURCE	2.0454	0.6810984	3.00***	0.3435629
QLTY	-1.116741	0.4778904	-2.34**	-0.1299455
LSAT	0.129474	0.5720061	0.23	0.0159088
TIME	0.0161413	0.0130803	1.23	0.0021463
NFMAF	0.0230517	0.4072631	0.06	0.0030534
BV	-0.192576	0.0303034	-6.35***	-0.0256068
-cons	3.651726	1.479598	2.47	
Log pseudo likelihood = -30.467059				

***Significant at 1% level of significance, **Significant at 5% level of significance, *Significant at 10% level of significance. dy/dx = is for discrete change of dummy variable from 0 to 1

Note: the description of each variable is given in section 3.4

Although expectation was not made a priori about the relationship between household size and willingness to pay, the estimated result indicate that the explanatory variable household size has negative sign and is statistically significant at 5% level of significant. If the household size increases say by one person, the probability of households' willingness to pay for the improved water services decreases by 3.5%, other things remain constant. Hence, household size is one of the major determinants of households' willingness to pay for improved water services in Dilla town.

Dummy variable sex of the respondent has a positive sign though it is not expected a priori. It shows that male respondents are willing to pay more than females. However, the result is not statistically significant and therefore the variable is not statistically important. The continuous variable age of the household head has negative relationship with the willingness to pay for improved water services. However, this variable is not statistically significant. As expected initially, dummy variable education of the respondent has positive relationship with households' WTP for improved water services. It indicates that households with any kind of formal education are willing to pay more than those without formal education or illiterate groups. However, this variable again is statistically insignificant.

The households' monthly income which is approximated by households' monthly expenditure is found to be one of those influential factors which determine households' willingness to pay for improved water services. As expected earlier, it has a positive sign which means households with more monthly income are more willing to pay for improved water services. The variable is

statistically significant at 5% level of significant. It shows that if households' income increases say by 1 birr, households' willingness to pay for improved water service increases by 0.00851%. Hence, in the water improvement program of the town, the stakeholders should take the income of the households as one of the determinant factors. Ownership of house, which is a proxy for wealth in the model, is the other most important factor which determines households' WTP for improved water service in the town. As expected initially, it has a positive relationship with the probability of saying 'Yes' to the offered bid value for 20 liters of improved water and is statistically significant at 1% level of significant. In other words, other things remain constant; the probability of accepting the offered bid is higher by 34.16% compared to those who do not live in their own houses. It indicates that households living in their own houses are willing to pay for improved water more than those living in rented or other houses. Therefore, ownership of a house should be taken seriously in the water improvement program of Dilla town.

Dummy variable occupation of the respondents, as expected initially, is positively related to households' willingness to pay for improved water service. However, this variable is not statistically significant. The regression result also shows that dummy variable reliability of the existing water source is positively related to households' willingness to pay for improved water service. However, this variable is not statistically significant.

The other finding of this study is that households' source of water point positively affect the likelihood of households' WTP for improved water service and is highly significant at 1% level of significance. i.e., other things remain constant; households who have their own private

connection are willing to pay more than those without private connection by the amount of 34.34%. The reason may be due to the doubt on the side of those who do not have their own private connection about the water improvement program. The result also show that dummy variable quality of the existing water service, as expected is negatively related to households' WTP for the improved water service and is statistically significant at 5% level of significance. It means that households for which water quality of the existing source is low are more likely to pay for the proposed improvement program.

Dummy variable level of satisfaction with existing water service being used has unexpectedly positive sign and is statistically insignificant. As expected time taken to fetch water from the existing source is positively related to households' willingness to pay for improved water service. i.e., households who spend more time in search of water are more likely to pay for the proposed water improvement program. However, this variable is not statistically significant. The findings of this study also show that dummy variable number of family members affected by water born diseases in the last six months is positively related to households' WTP for improved water service as expected earlier. However, this variable again is not statistically significant.

Finally, the bid value offered to the sampled households is found to be negatively related to households' WTP for improved water service as expected initially. It is also significant at 1% level of significance. It suggests that holding all other things constant, one percent increase in the bid value reduces the likelihood of paying for the proposed water improvement program by 2.56%.

The probit model in this study is used to calculate mean willingness to pay for the closed ended format. According to Haneman *et al.* (1991), one of the main objectives of estimating WTP based on the contingent valuation survey response is to find the central value (or mean) of WTP distribution. Similarly, Carlson *et al.* (2002) states that the main reason for estimating the probit model is to obtain an estimate of mean willingness to pay. As mentioned in the methodology section, in the Probit model the mean willingness to pay can be calculated by dividing the negative of the intercept (constant) term by the coefficient of the ‘bid’ offered to the respondents.

$$i.e., Mean WTP = \mu = -\alpha/\beta = -3.651726/-0.1925767 = 18.96245$$

Therefore, it can be concluded that the mean willingness to pay for a jerrycan (20 liters) of improved water service is 18.96 cents. This value is much higher than the current tariff rate charged by the town’s water supply enterprise. Therefore, there is a greater opportunity to launch water improvement program in the town.

3.5.2. Results of Tobit Model and Discussion

As stated in the methodology section, we faced the problem of censoring in the open-ended questions. Hence, for such kind of data, Tobit model is the appropriate model. We estimated the model by using STATA version 11. The results of the Tobit model are given in table 4.8.

Table 4.8: Estimated results of the Tobit model

No of observations = 132 LR Ch ² (14) = 131.09 Pseudo R ² = 0.1261				
Variables	Coefficients	Std. Error	T	Mean
HHSIZE	-1.129092	0.4894137	-2.31**	5.25
HHSEX	2.142386	1.691009	1.27	0.3333333
HHAGE	-0.0787769	0.0980011	-0.80	42.59091
EDUC	-0.6118186	2.539044	-0.24	0.7651515
HHINC	0.0054625	0.0007985	6.84***	1766.25
WLTH	4.192323	2.5326	1.66	0.6818182
OCCR	4.352231	1.755681	2.48**	0.4015152
RELIAB	5.286883	3.357011	1.57	0.9015152
SOURCE	10.37261	2.56454	4.04***	0.5378788
QLTY	-2.046585	1.969097	-1.16	0.6212121
LSAT	4.247249	3.578617	1.19	0.0909091
TIME	0.0956979	0.0473797	2.02*	9.356061
NFMAF	0.9618248	1.83553	0.52	0.3863636
BV	0.1796168	0.1156275	1.55	19.88636
cons	1.489457	6.286469	0.24	
Log likelihood = -454.11127				

***Significant at 1% level of significance, **Significant at 5% level of significance, and *Significant at 10% level of significance. Note: the description of each variable is given in section 3.4

The regression result shows that the relationship between household size and willingness to pay is negative and is significant at 5% level of significance. In other words, as the number of family size increases by one person, households' maximum willingness to pay for improved water decreases by 112.94%. Hence, household size is one of the influential variables in this study.

Dummy variable gender of the respondent has positive influence on households' maximum willingness to pay for improved water services. However, this variable is not statistically significant. The continuous variable age of the respondent is negatively related to maximum willingness to pay for improved water. i.e. older people are less likely to pay for improved water services. But this variable is not statistically significant. Education level of the respondent has negative influence upon households' maximum willingness to pay. However, it is statistically insignificant. Dummy variable ownership of a house, which is a proxy for wealth of the household, is positively related to households' maximum willingness to pay for improved water services. However it is not statistically significant.

The other highly influential variable of the study is households' monthly income (approximated by monthly expenditure). It is positively related to households' maximum willingness to pay and is significant at 1% level of significance. In other words, if households' monthly income increases say, by one Birr, maximum willingness to pay increases by 0.55%. The regression result confirms the economic theory which says that income and quantity demanded for a particular commodity are positively related for the case of normal good. Occupation of the respondent, which a dummy variable, is positively related to households' maximum willingness

to pay for improved water services and is significant at 5% level of significance. i.e., respondents engaged in formal salary employment are more likely to pay than those engaged in self employment. Therefore, the water supply enterprise of the town should take the occupation of the respondent as one of the influential variables in the water improvement program.

Dummy variable reliability of the water being used is positively related to households' maximum willingness to pay. However, this variable is statistically insignificant. As expected earlier, the quality of water being used is negatively related to households' maximum willingness to pay. But this variable is statistically insignificant. Dummy variable level of satisfaction with the existing water source is positively related to households' maximum willingness to pay for the improved water service. However, this variable is statistically insignificant. Dummy variable number of family members affected by water borne diseases is positively related to households' maximum willingness to pay. However this variable is statistically insignificant. Finally, the bid value offered to the respondent positively affects households' maximum willingness to pay. This variable again is statistically insignificant.

Source of the water being used, which is a dummy variable, is the other highly influential variable of the study. Households' with their own private connection are more likely to pay for improved water services. i.e., the existing water source positively affects households' maximum willingness to pay and the variable is significant at 1% level of significance. The other significant variable at 5% level of significance is time taken to fetch water from the existing source. That is, as the time taken to fetch water increases by one minute, households''

willingness to pay increases by 9.57%. In other words, households who fetch water from distant sources are more likely to pay for the improved water service.

The mean willingness to pay for the open-ended contingent valuation questions is computed by taking the average of the households' maximum willingness to pay amount.

$$\text{i.e. Mean WTP} = \mu = \sum M_i/n$$

Where, M_i = the reported maximum willingness to pay amount by surveyed households

n = the sample size

$$\text{Mean WTP} = \mu = 2810/132 = 21.28788$$

Therefore, it can be concluded that the mean willingness to pay obtained from the open-ended question format is 21.29 cents per 20 liters of improved water service.

In general, the overall results of the valuation study show that the mean willingness to pay for the improved water service from the closed ended dichotomous choice questions is 18.96 cents, and 21.29 cents from the open ended questions per jerrycan (20liters) of the proposed improved water service. From this, we can conclude that households' willingness to pay lies between 18.96 and 21.29 cents per 20 liters of improved water service.

3.6. Estimated Total Willingness to Pay and Potential Revenue

The main purpose of this study is to estimate households' willingness to pay for the improved water services. As indicated in table 4.9, the total willingness to pay for the improved water services can be obtained by multiplying the mid points of willingness to pay interval (column 2) by total number of households (column 4). The implementation of the improved water system not only reduces the water problem of the town but also increases the revenue collected from the water sale. If the improved scheme is implemented by increasing water tariff, the town's water supply enterprise can collect more funds that can be used for the expansion of water development of projects. The potential revenue from the improved water system can be calculated by using the maximum willingness to pay reported by the respondents and the reported average daily water consumption of the household.

Table 4.9: Aggregate WTP and Aggregate Revenue (in cents) from improved water service.

WTP CLASS INTERVAL IN CENTS PER JERRYCAN	MID OR CLASS MARK FOR WTP	NO OF SAMPLED HHS		TOTAL NO OF HOUSEHOL DS	TOTAL WTP IN CENTS PER JERRYCAN	MINIMUM AMOUNT HHS ARE WILLING TO PAY		TOTAL WTP AT LEAST THAT AMOUNT	TOTAL REVEN UE
(1)	(2)	(3) n ₀	(4) %	(5)	(6)	(7) n ₀	(8)%	(9)	(10)
0 – 10	5	46	34.86	5,752	28,760	132	100	16,501	82,505
11 – 20	15.5	37	28.03	4,626	71,703	86	65.15	10,750	166,625
21 – 30	25.5	23	17.42	2,874	73,287	49	37.12	6,125	156187.5
31 – 40	35.5	15	11.36	1,875	66,562.5	26	19.7	3,251	115410.5
41 – 50	45.5	11	8.33	1,374	62517	11	8.33	1,375	62562.5
Total		132	100	16,501	302,829.5				

Source: own survey, 2014

As described in table 4.9, the class interval of willingness to pay is given in column 1 and the midpoints of each interval are shown in the second column. Columns 3 and 4 respectively show the number and the percentage of sampled households whose maximum willingness to pay lies within the given boundaries. Total number of households, which is obtained by multiplying total number of households in the town by the proportion of households falling in each interval, is indicated in column 5. In column 6 total willingness to pay per 20 liters of water, which is obtained by multiplying the mid WTP amount (column 2) by the total number of households willing to pay that amount(column 5), is given.

According to column 6, the grand total WTP which 16,501 (total households of the town) are expected to pay is about 302,829.5 cents (Birr 3,028.3) if each uses only one jerrycan (20 liters of water) per day. However, we investigated from the survey that the daily average water consumption of sampled households is about 3.4 jerrycan (68 liters of water). Hence, the 16,501 households' total willingness to pay is estimated to be birr 10,296 per day. This shows that willingness to pay of 62.4 cents per household per day or 1872 cents (birr 18.72) per month if the improved water service is provided. The number and percentage of sample households that are willing to pay at least the amount given in each interval are given in columns 7 and 8 respectively. Column 9 shows the total number of households that are willing to pay at least this amount in each boundary.

Finally, the total revenue obtained from water sale is indicated in column 10. This value is found by multiplying the mid WTP amount by the total number of households who are willing to pay at least the amount in each interval. The pattern of the values is increasing first, reaches its maximum of 166,625 cents (birr1,666.25) per day when the price of water per jerry can is 15.5 cents, and then decreases and attains its minimum point (i.e., 62562.5 cents or birr 625.6 per jerry can) when its price becomes 45.5 cents per jerry can average daily water consumption is 3.4 jerry can (68 liters of water).

Regarding total number of households and their respective maximum willingness to pay, we also used the survey results to derive the demand curve for the proposed improved water services of the town. Accordingly, the aggregate demand curve is drawn by putting the mid WTP amount on the vertical axis and the number of households willing to pay at least that mid amount per jerry can on the horizontal axis. Figure 1 depicts the graphical representation of the demand for the improved service at different price level. The figure further shows that like most economic good, the demand for improved water service decreases with increasing water charges, keeping all other things constant.

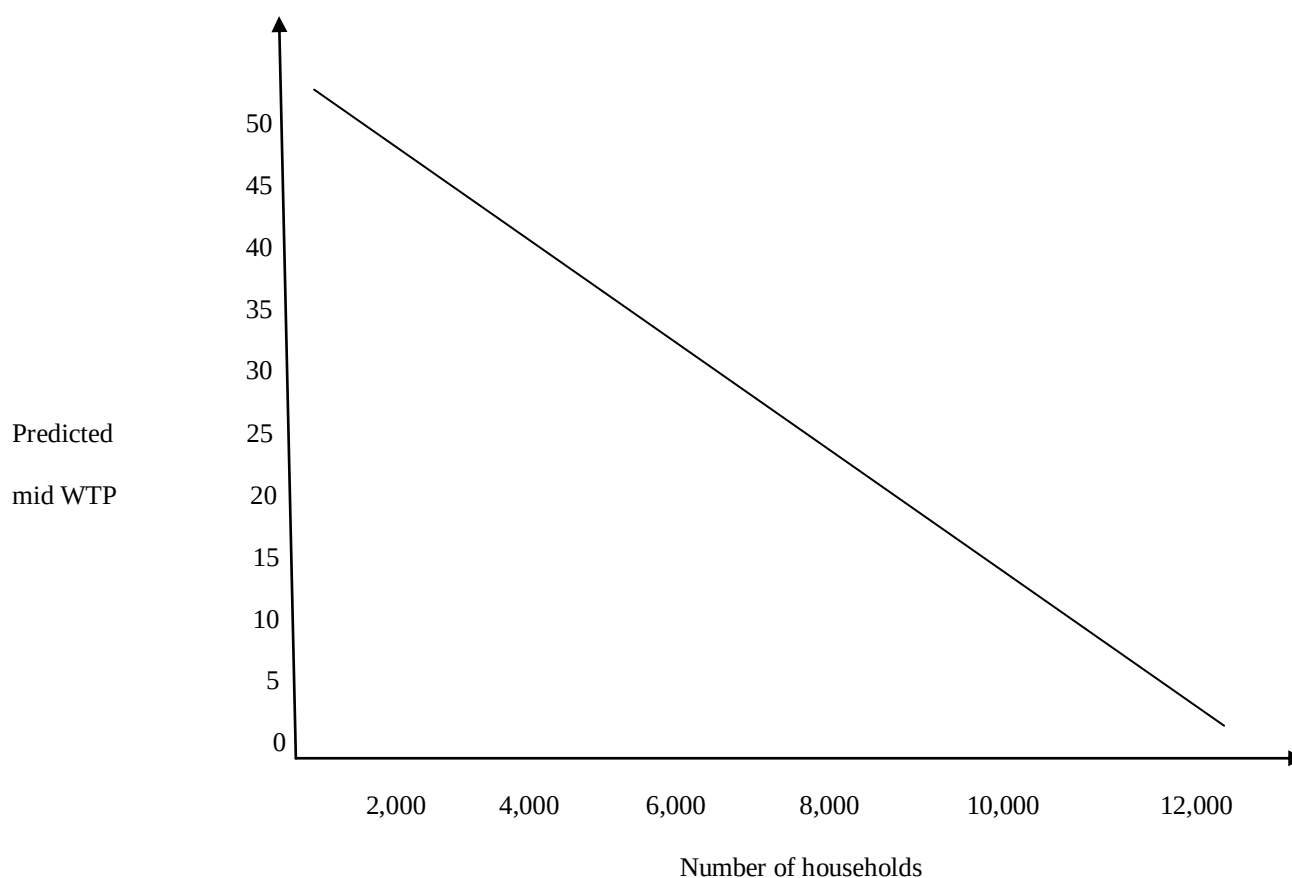


Figure 1: Graphical representation of the demand for the improved water service at different price level.

In general, this study revealed that there is a ground to implement water improvement program in the town. According to the findings of this study, the mean WTP amount per 20 liters of improved water lies between 18.96 and 21.29 cents, which is much higher than the current water tariff rate of 5.12 cents for the consumption block of 0-6m³ per jerrycan of water. Therefore, we can conclude that by implementing improved water scheme the town's water supply enterprise not only avoid the water supply problem and increase households' welfare but also increase total revenue from the sale of improved water by increasing the tariff rate.

CHAPTER FIVE

CONCLUSION AND POLICY IMPLICATION

5.1. Conclusion

The major objective of this study was to estimate the value that households would be willing to pay for improved water supply services and to find out the determinants that affect their WTP in Dilla town of southern Ethiopia. To achieve objectives of the study, contingent valuation method (CVM) was employed in order to elicit households' WTP for improved water services. More specifically, single bound dichotomous questions followed by open-ended questions were used. The data used for this study were both from primary and secondary sources. The primary data were obtained from a contingent valuation survey of 138 sampled households in Dilla town. Secondary data were obtained from both published and unpublished materials such as office records and reports, journals, research papers, books and files from internet/web pages.

The data collected from both sources were analyzed through descriptive and econometric methods. By using descriptive analysis we tried to analyze households' socio economic and demographic conditions and current water use practices. In the econometric analysis, 14 variables, 5 continuous and 9 discrete variables were hypothesized earlier to data collection.

Results of the descriptive analysis showed that out of 132 sampled households, 44(33.3%) are male respondents while the rest 88 (66.67%) are female respondents. The average family size of the households is 5.25. The average age of the respondents is 42.6 years which ranges from 22 to

82 years of age. From the total of 132 respondents 101(76.5%) have attended their formal education from a minimum of 4th grade to a maximum of master's degree level while the rest 31(23.5%) are illiterate. Employment structure of the respondents indicates that of the total 132 sampled households 53(40.15%) engaged in different kinds of formal sectors for salary. The rest 79 (59.85%) respondents are engaged in non salary activities. From the total 132 households, 90(68.2) households live in their own houses while the rest 42(31.8) households do not own houses and majority of these are rented houses.

The average monthly income of the surveyed households is about Birr 1510.22. However, monthly household expenditure of the surveyed households is 1766.25 Birr ranging from 450 Birr to 6430 Birr. This shows that households do not want to reveal their true income. In fact this is what we observed during the survey time. Hence, we took households monthly expenditure to approximate households' average monthly income. On average the households pay 63.5 Birr for their monthly water consumption which is 3.6% of their monthly average income. The mean water consumption of the surveyed households per day is 3.4 jerrykan. Accordingly, the mean monthly water consumption of the households is about 2040 liters or 2.04m³. As indicated in table, this falls in the first category. i.e. the tariff rate is 2.56 Birr for the water consumption of 1to 6 m³ per month, and therefore, the average households' water consumption expenditure is 5.22 Birr per month which is 0.3% of households average monthly income of Birr 1766.25. Since this is a very small amount it shows that the households have big potential of paying for the proposed improved water supply in the town.

The survey results also show that from the total 132 sample households 119(90.15%) of the respondents said that the existing water source is unreliable while the rest 13(9.85%) responded it is reliable. Regarding the main source of the water being used, almost 53(40.15%) of the respondents have their own private connection where as 68(51.51%) of the households do not have private connection and the rest 11(8.33%) are non pipe users. Quality of the water is perceived as low by 50(37.88%) of the households while the rest 82(62.12%) responded that the existing water is safe to drink before any purification mechanism is used. Of the total 132 sample households, 120(90.9%) are dissatisfied with the existing source while 12(9.1%) satisfied with the water source being used. The survey result revealed that the average time taken to fetch water from the existing source is about 39.8783 minutes which ranges from a minimum of 10 to a maximum of 120 minutes.

Piped water users comprise about 91.76% of the total sampled households. Furthermore, the data indicated that only 3.03% households said that the current tariff rate is too expensive, 13.6%)said it is too cheap, 46.2% said the water tariff is fair, and 12.12% responded the current tariff rate charged by the town's water supply enterprise is difficult to judge. 105(79.5%) households responded that they didn't get pipe water at desired time, and most of them, i.e., 83(79%) households get additional water from water vendors. In addition, the price charged by the water vendors is judged as two fold by 28(26.7%), and three fold by 41 (39.04%) households when compared with the tariff rate charged by the town's water supply enterprise while 10(9.5%) responded the prices are the same. Furthermore, reliability problem is very critical. From the total sampled households, 119(90.15%) said that the existing water source is not reliable and only 13(9.85%) households found the existing water service reliable.

The willingness to pay analysis revealed that out of the total 132 respondents 124(93.94%) showed positive WTP for the proposed improved water service. These households found to be willing to pay 21.29 cents on average for a jerrycan (20 liters) of improved water, which is much higher than the current water tariff rate of 5.12 cents for the consumption block of 0-6m³ per jerrycan of water.

Econometric analysis was made by using STATA software of version 11. We used the probit model to calculate the mean WTP, and the Tobit model to examine the determinants that affect households' maximum WTP for improved water services. The probit model output shows that, out of the 14 hypothesized variables, 6 of them significantly affect households' WTP for improved water services.

The estimated result indicated that the explanatory variable household size has negative sign and is statistically significant at 5% level of significant. If the household size increases say by one person, the probability of households' willingness to pay for the improved water services decreases by 3.49%, other things remain constant. The households' monthly income which is approximated by households' monthly expenditure is found to be one of those influential factors which determine households' willingness to pay for improved water services. As expected earlier, it has a positive sign which means households with more monthly income are more willing to pay for improved water services. The variable is statistically significant at 5% level of significant. It shows that if households' income increases say by 1 birr, households' willingness to pay for improved water service increases by 0.009%.

Ownership of house, which is a proxy for wealth in the model, is the other most important factor which determines households' WTP for improved water service in the town. As expected initially, it has a positive relationship with the probability of saying 'Yes' to the offered bid value for 20 liters of improved water and is statistically significant at 1% level of significance. In other words, other things remain constant; the probability of accepting the offered bid is higher by 34.16% compared to those who do not live in their own houses. It indicates that households living in their own houses are willing to pay for improved water more than those living in rented or other houses

The other finding of this study is that households' source of water point positively affect the likelihood of households' WTP for improved water service and is highly significant at 1% level of significance. i.e., other things remain constant; households who have their own private connection are willing to pay more than those without private connection by the amount of 34.36%. The result also show that dummy variable quality of the existing water service, as expected is negatively related to households' WTP for the improved water service and is statistically significant at 5% level of significance. It means that households for which water quality of the existing source is low are more likely to pay for the proposed improvement program.

Finally, the bid value offered to the sampled households is found to be negatively related to households' WTP for improved water service as expected initially. It is also significant at 1% level of significance. It suggests that holding all other things constant, one percent increase in the

bid value reduces the likelihood of paying for the proposed water improvement program by 2.56%.

The mean WTP calculated by using the results of probit model revealed that households are willing to pay 18.96 cents per jerrycan (20 liters) of improved water. This value is much higher than the current tariff rate charged by the town's water supply enterprise. Therefore, there is a greater opportunity to launch water improvement program in the town.

In the open-ended format we faced the problem of censoring as described in the methodology section. Hence, we used the Tobit model instead of simple linear regression to identify the potential factors affecting households' maximum WTP. The Tobit model results revealed that out of 14 hypothesized variables, 5 of them significantly determine households' WTP for improved water service. These are household size, household monthly income, source of water being used, occupation of the respondent, and time taken to fetch water from the current source. The average WTP is obtained simply by adding households' maximum WTP and dividing the sum by the sample size. Accordingly the mean WTP from the open-ended CV responses is estimated at 21.288 cents per jerrycan (20 liters) of improved water. Hence, we can conclude that households' WTP for improved water service lies between 18.96 and 21.288 cents per jerrycan. Therefore, by implementing improved water scheme the town's water supply enterprise not only avoid the water supply problem and increase households' welfare but also increase total revenue from the sale of improved water by increasing the tariff rate.

5.2. Policy Implications

From the CV survey, we observed that drinking water problem in Dilla town becomes a growing problem due to a big difference between the supply of and the demand for clean drinking water in the town. The reasons for the shortage of town's water supply are: -high population growth, the establishment of new government and non government institutions following the growth of the town and limited number of water treatment plants which are not enough to meet the current demand for clean drinking water in the town. The provision of improved water service requires the construction of additional water treatment plants, additional water reservoirs, the construction of pipelines from the water treatment area or other water sources to the public taps to have public taps at different places of the town. This study revealed the affordability of paying for the improved water system from the side of the beneficiaries and the possibility of implementing improved water program for the stakeholders. Accordingly, the following policy implications can be drawn base on the findings of this study.

- Both Probit and Tobit models revealed that there is strong positive relationship between households' monthly income and WTP for improved water service. Hence, much emphasis should be given to households' income structure at the time of charging water tariff.
- The other variable which has strong positive influence on households' WTP for improved water service in both models is the source of water being used. i.e., households with their own private connection are more WTP than those without. Therefore, it should be better if the towns' water supply enterprise increase the number of connections before implementing the improved water scheme.

- Households' WTP for improved water service lies between 18.96 and 21.288 cents per jerrycan from probit and Tobit models respectively, which is much higher than the current water tariff. Therefore, by implementing improved water scheme the town's water supply enterprise not only avoid the water supply problem and increase households' welfare but also increase total revenue from the sale of improved water by increasing the tariff rate.

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Declaration

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

Declared by:

Name: _____

Signature: _____

Date: _____

Place: Addis Ababa University, Addis Ababa

As thesis research advisor, I hereby certify that I have read and evaluated this thesis prepared under my guidance by Tamirat Minota entitled: “Determinants of Households’ Willingness to pay for Improved Water Supply Services in Dilla Town, Southern Ethiopia: an Application of Contingent Valuation Method”. I recommend that it be submitted for M.Sc. thesis open defense examination.

Name: _____

Signature: _____

Date: _____

Place: Addis Ababa University, Addis Ababa

Annex 1: Correlation Matrix of Explanatory Variables

. corr (obs=132)													
	hhsz	hhsex	hhage	educ	hhinc	wlth	occr	reliab	source	qlty	lsat	time	nfmaf
hhsz	1.0000												
hhsex	0.0572	1.0000											
hhage	0.5423	-0.0063	1.0000										
educ	-0.2294	0.0505	-0.4669	1.0000									
hhinc	0.0117	0.0034	0.0544	0.3085	1.0000								
wlth	0.3183	-0.1035	0.5215	-0.0715	0.2960	1.0000							
occr	-0.1198	0.0109	-0.1982	0.3444	0.1665	0.0618	1.0000						
reliab	0.1325	-0.0899	0.1801	-0.0632	-0.1085	0.1017	-0.1442	1.0000					
source	0.1796	-0.0215	0.3650	0.2034	0.4392	0.6391	0.2012	0.0506	1.0000				
qlty	0.0278	0.0552	0.0229	-0.1379	-0.3213	-0.1646	0.0343	-0.1009	-0.0973	1.0000			
lsat	-0.1206	0.0559	-0.1064	-0.0113	0.1395	0.0463	0.2248	-0.6030	0.0817	0.1383	1.0000		
time	0.0192	0.0264	0.0412	-0.3253	-0.2513	-0.0497	-0.1794	0.1021	-0.4331	0.0483	-0.1196	1.0000	
nfmaf	0.2709	0.1320	0.1891	-0.1844	-0.0457	0.1078	-0.2056	0.2100	-0.1071	-0.1502	-0.2509	0.3237	1.0000
wtp	-0.0612	0.0352	0.1207	0.2288	0.3516	0.3776	0.1578	0.0646	0.4322	-0.2661	0.0315	-0.0491	0.0705
ibv	0.0863	-0.0340	-0.0314	-0.0341	0.1713	0.0579	0.0677	-0.1309	0.1031	0.0536	0.1539	-0.1623	-0.0861
mwt	-0.0584	0.0382	0.0651	0.2549	0.6712	0.4399	0.3051	-0.0059	0.5839	-0.2570	0.1590	-0.1773	-0.0396
income	0.0026	0.0312	0.0483	0.3053	0.9606	0.2722	0.1533	-0.0953	0.4219	-0.3230	0.0882	-0.2706	-0.0234
		wtp	ibv	mwt	income								
wtp	1.0000												
ibv	-0.4206	1.0000											
mwt	0.6400	0.1941	1.0000										
income	0.3622	0.1611	0.6418	1.0000									

Annex 2: Contingent Valuation Survey – Households Questionnaire on Water Supply Service

How are you, my name is Tamirat Minota. I am conducting the research for the partial fulfillment of MSc in Economics at College of Business and Economics, Addis Ababa University. This questionnaire is designed to obtain information on the current water supply situation of Dilla town and residents' willingness to pay for improved water supply services. The data is intended to develop a mechanism to help improve the sustainability of the water supply situation of the town by creating conducive environment for community participation in the project. Therefore, your view could be used as an important input to officials and policy makers in their attempt to improve the water supply situation of the town. The interview will take a few minutes and the answer will be completely confidential and strictly for academic purpose only. Feel free to give whatever information you think is important.

Thank you in advance for your cooperation!

Section I. Questions on Socio Economic and Demographic Characteristics of the Respondents

1. Sex (observation)
A. Male B. female
2. Are you the head of this household?
A. Yes B. No
3. How many people live in this household including yourself? ____
4. Would you tell me your age, education and occupation?

Age	
Education	
Occupation	

5. Would you please tell me your family's monthly income including yours? ____ Birr

6. How much do you spend for the following items per month?

- A. Food_____ B. water_____ C. Telephone_____
- D. Schooling_____ E. Electricity_____ F. Transport_____
- G. Medical _____ H. community services (Edir, Ekub, etc)_____

7. Do you have your own house?

- A. Yes B. No

Section II Questions on Existing Water Use Practices and Problems

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

- A. Piped water B. other sources

If piped water go to question “9”

If other source go to question “29”

9. If piped water, what kind of piped water do you use?

- A. Tap inside the house
- B. Tap in the compound, shared with neighbors
- C. Tap in the compound, private
- D. Public taps

If your answer is “A” or “C” or both, go to question 4

If your answer is “D”, go to question 37

10. If your answer for question “2” is B, how many households use the shared tap in the compound? _____ Households.

11. How much water does your household consume per day? _____ jerrycan (one jerrycan is assumed to contain 20 liters of water)

12. Rank the order of water use of your household from the most important to the least important by giving number “1” for the most important purpose.

- A. _____drinking B. _____washing clothes C. _____housekeeping(cleaning house, gardening, etc) D. _____watering livestock E. _____Others(specify)

13. How much do you pay on average for your water consumption per month from this source? _____ birr per month

14. How do you judge the existing water tariff of the town’s water supply office?

- A. Too expensive B. too cheap C. fair D. difficult to judge

15. Do you get tap water at desired time?
 A. Yes B. No
16. If “No” to the above, from where do you get additional water?
 A. From vendors B. from river C. from spring D. from wells
 E. other (specify)
17. If “from vendors”, how do you judge their price as compared to the town’s water supply tariff?
 A. The same B. cheaper C. two fold D. three fold
 E. other (specify)
18. In relation to its quality, quantity and reliability how would you rank the status of the existing water service?
 A. Quality: 1. Good 2. Average 3. poor
 B. Quantity: 1. Good 2. Average 3. poor
 C. Reliability: 1. Reliable 2. Unreliable
19. Do you use any water purification mechanism before using the water?
 A. Yes B. No
20. If “Yes” to “8” what purification mechanism do you use?
 A. Boiling before drinking
 B. Using medical treatment
 C. Filtering using clothes
 D. Other (please specify)
21. In general are you satisfied with the quality of the existing piped water service
 A. Yes B. No
22. From your experience during what time you often face water shortage?
 A. Morning B. at noon C. afternoon D. during night
23. Is there any time where piped water is completely absent?
 A. Yes B. No
24. If “Yes” to “12” specify the time during which piped water is completely absent
 A. Morning B. at noon C. afternoon D. during night

25. Has any one of your house hold members suffered from waterborne diseases during the last six months?
- A. Yes B. No
26. If yes, what was the disease?
- A. Diarrhea B. typhoid C. cholera D. others(please specify)
27. In general are you satisfied with the existing piped water service?
- A. Yes B. No
28. If “No” why are you dissatisfied? Identify the reason
- A. Poor quality B. low quantity C. unreliability
- D. higher charge E. other (please specify)
29. If your answer for “8” above is other source, what other source do you use?
- A. River B. Spring C. well D. other(specify)
30. How many times on average do you go to fetch water from this other source per day? _____times.
31. How much time do you spend to fetch water from this other source at a time? _____hours
_____minutes.
32. How much do you pay per Jeri can _____cents
33. Who often goes to fetch water from this other source?
- A. Girls B. boys C. women D. men E. A & C F. All
34. Why do you prefer this source (non piped)?
- A. Access to piped water is difficult
- B. The pipe water is costly and not affordable
- C. This source is more reliable
- D. Collecting water from public tap takes more time
- E. Other (specify
35. Are you satisfied with this source?
- A. Yes B. No
36. If “No”, what is your reason?
- A. Low quality
- B. It takes more time to fetch water from this source
- C. It is too costly D. Other (specify)

37. If public tap, how much time, on average, do you spend to fetch water from this public tap per day? ____ hours____minutes.
38. Who often go to the public tap to fetch water? (multiple answer possible).
 A. Boys B. girls C. women D. men F. B & C
 G. all
39. How many persons from the household go at a time to fetch water from this source?____ persons.
40. When do you prefer the public tap to be open?
 A. Early in the morning B. afternoon C. evening
 D. all the day
41. How do you judge the present status of the public tap service in terms of quality, quantity, and convenience of service hours?
 A. Quality: 1. Good 2. Average 3. Poor
 B. Quantity: 1. Good 2. Average 3. Poor
 C. Convenience service hours: 1. Good 2. Average 3. Poor
42. In general, are you satisfied with this source of water?
 A. Yes B. No
43. If “No” for 35 what is your reason?
 A. Poor quality B. low quantity C. unreliability
 D. high volume charge E. far away from home F. others (specify)

44. Why don't you have your own private connection?
 A. High connection cost
 B. The house is not mine, but rented
 C. I don't want to have private connection
 D. Other reason (specify)

Section III Questions on Households Willingness to Pay for Improved Water Supply Services

Hypothetical Market Scenario

As you know, drinking water problem in Dilla town becomes a growing problem due to a big difference between the supply of and the demand for clean drinking water in the town. The reasons for the shortage of town's water supply are: -high population growth, the establishment of new government and non government institutions following the growth of the town and limited number of water treatment plants which are not enough to meet the current demand for clean drinking water in the town. The provision of improved water service requires the construction of additional water treatment plants, additional water reservoirs, the construction of pipelines from the water treatment area or other water sources to the public taps to have public taps at different places of the town. The provision of improved water service among other things means the service which could deliver adequate amount of good quality water to meet consumer consumption requirements and the system which is reliable, the required amounts of water needs to be available 24 hours a day, 7 days a week.

As a result, the family need not have to spend its time and effort in fetching water from distant sources. Thus to practice all this, in addition to investment costs it is also necessary to pay for operational and maintenance costs and thus it is costly to implement the improvement program. Therefore, residents are requested to share the cost of the project. The proposed water improvement program goes ahead if the community agrees to share the cost and sufficient funds were generated. Therefore, all households of the town, including yours, who have an option to have private connection to such an improved piped water supply scheme, would have to pay initial investment and running costs which will be added to your water bill, but you may not be required to pay initially the costs of connection to the new scheme, instead it will be distributed over several years in your monthly bills.

45. So, if the aforementioned improved water supply service is provided, are you willing to participate in this improvement program?

A. Yes

B. No

46. If yes to 1, would you be willing to pay _____ cents per jerrycan (20 liters of water) if the town's water supply made the improved water available?

- A. Yes B. No

If you say either "yes" or "no" go to "3"

47. What is the maximum amount you want to pay per jerrycan (20 liters of water)? _____
Cents.

➤ If "0" is recorded in "3" above go to "4"

48. If the maximum amount you would pay for the improved water supply is "0", what is your reason for you don't want to pay?

- A. Water should be provided free of charge
B. I cannot afford to pay
C. I satisfied with the existing source
D. Others (specify)