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HOUSEHOLDS WILLINGNESS TO PAY FOR IMPROVED WATER SUPPLY *SERVICES IN* ADDIS ABABA CITY.

BY:

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HOUSEHOLDS WILLINGNESS TO PAY FOR IMPROVED WATER SUPPLY SERVICES IN ADDIS ABABA CITY.

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Declaration

I, Abayneh Abiyou, do hereby declare that the thesis entitled "**Households Willingness To Pay For Improved Water Supply Services in Addis Ababa city''** submitted in partial fulfillment of the requirements for the award of the degree of Masters science in Water Resource Management to College of Development studies, Addis Ababa university in the Department of Water resource, is my original work and has not been done for the award any other Degree, Diploma or other similar titles, of any other University or Institution.

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This is to certify that this thesis entitled "Households Willingness to Pay for Improved Water Supply Services in Addis Ababa city" is an authentic work of **Mr.Abayneh Abiyou Shiferaw**,Id.No.GSE 7644/09,who carried out the research under my guidance, certified further that to the best of my knowledge, the work reported here dose not form part of any project report or thesis on the basis of which a degree or award was conferred on an earlier occasion by this or any other candidate.

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Abstract

The major objective of this study is to estimate household willingness to pay for improved sustainable water supply services, and to investigate its determinants in Addis Ababa city of Ethiopia, by using contingent valuation method with a single bounded elicitation format followed by open ended questions. A total of 375 randomly selected sample households were interviewed, both probit and linear regression of ordinary list square model were used to analyze the determinants of households willingness to pay for improvement of water supply services and A mean willingness to pay is found to be 2.78 birr per one bucket or 20 liter of jerican in the probit result and mean willingness to pay 2.01 birr in the open ended format result. Household's monthly income, sex of household head, family size of household and reliability of water services have positive and significant effects on willingness to pay for improved water supply services in the probit model. On the other hand, initial bid price and age of house hold head have negative and significant effect on the probability of willingness to pay for improved water supply services. The contingent valuation survey result revealed that 323(86.1%) of household heads were found willing to pay additional fee for improved water services. This implies that if proposed water improvement scheme is implemented, in addition to satisfying the water needs of households of the city's utility management can collect more revenue from the sale of improvement water. If provision of improved water supply service will applied to the city of Addis Ababa water and sanitation authority will collect 286,693,205.50 birr additional revenue. *Therefore, the concerned body needs to take in to consideration the socio economic and demographic factors like sex, age, marital status, income, educational status and marital status in designing the improved water supply system of the city.*

Key Words: *Willingness to pay, Contingent valuation method, improved water Supply services, Household heads, Addis Ababa.*

List of Acronyms

AAWSA:	Addis Ababa Water Supply and Sewerage Authority
CSU:	Compensating Surplus and
CV:	Compensating Variation
CVM:	Contingent Valuation Method
ESU:	Equivalent Surplus
EV:	Equivalent Variation
HH:	Household
HHH:	Household head
HPM:	Hedonic pricing Method
MoWE :	Ministry of Water and Energy
MoWr:	Ministry of water resource
SPSS:	Statistical Package for Social Sciences
TCM:	Travel Cost Method
TEV:	Total Economic Value
WHO:	World Health Organization
WSSD:	World Summit on Sustainable Development
WTA:	Willingness to Accept
WTP:	Willingness to Pay

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CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

Water is one of the most valuable natural resources vital to the existence of any form of life. An adequate supply of safe and clean water is the most important precondition for sustaining human life, for maintaining ecosystems that support all life and for achieving sustainable development (Topfer, 1998). Therefore, Safe drinking water is an essential component of primary health care and has a vital role in poverty alleviation. There is a positive correlation between increased national income and the portion of population with access to improved water supply. According to World Bank (1994) as cited by Simiret .et al, 2011, an increase of 0.3% investment in household access to safe drinking water generates 1% increase in GDP. Unreliable supply and shortage of water affect life of human beings in various ways. Emphasizing the importance of water, Nielson (2004) contends that safe drinking water is not just a luxury.

Access to safe water is a human need and basic right. And yet, roughly half of urban dwellers in sub-Saharan Africa and South and South-East Asia lack access to clean, safe, affordable water (Assefa, 2012). The reasons are often financial, with poor people unable to afford connection fees. Meanwhile, utilities often lack the funds to invest in extending water networks into un-served areas, and incentives to do so. Legal barriers such as lack of land tenure, and physical barriers such as the difficulty of laying pipes in crowded urban slums, also stand in the way.

As a result, the urban poor often pay many times more for their water from alternative providers because they are excluded from the official water network.

The urban poor often pay many times more for water from alternative providers because they are excluded from the official water network by high connection costs or other barriers such as lack of land tenure (Natan, 2009). Service providers, meanwhile, are often caught in a vicious circle of poverty whereby under investment in tap water leads to poor service levels, resulting in low willingness to tolerate tariff increases among current customers, and a lack of funding available to invest in extending services to un served communities.

A well designed tariffs and subsidies regime should provide a bridge between the interests of poor and excluded people and those of the service provider. Equitable access and sustainable service should be in the interest of service providers as well as the unserved poor. The provision of equitable access would help develop a wider customer and revenue base – essential for

commercial viability, sustainable services, and capacity to extend services to the unserved clients (Natan, 2009).

Ethiopia has plenty of water resources but the available water is not distributed evenly across the country and the amount varies with seasons and years. The challenge in any situation is to maintain a year-round supply that is adequate to meet people's needs.

To ensure that supply meets demand the source of the water must be carefully chosen, taking into account present and future demand for water, and the costs. Tariff and subsidy design has a key role to play in ensuring that everyone, especially the poor or socially excluded, is able to gain and maintain access to safe and affordable water service (MoWIE, 2016).

When we see the case of Ethiopia, 86.2% of urban population and 53.9% of rural populations have access to clean potable water supply (MoWR, 2008). In urban areas of Ethiopia, the service is better when compared with rural areas. But there is the problem with the quantity, quality, sustainability as well as coverage associated with rapid urbanization in some cities like Addis Ababa city.

Most of water supply projects are by their nature requiring a huge capital. Additionally, most people see water as a free good. This has its own impact on the sustainability of the project and in many areas, the revenues gained from charging consumer is unable to cover the cost incurred. So, in order to maintain the sustainability of water projects as well as satisfying the required quantity and quality of water demand, at least there needs to be a cost recovery tariff rate. It is tariff rate at which the revenue gained from the service fully covers all expenses incurred on water supply (MoWIE, 2016).

To improve access to safe clean water, the government of Ethiopia has prepared a water and sanitation policy document as an integral part of the country's water management policy. This document clearly indicates the right of every Ethiopian to get access to adequate and quality water to satisfy their basic needs in order to achieve rapid socio economic development through better health care and productivity (MoWR, 1999).

The supply of water to such an extended area in size, altitude & variation and to a growing population and economy is an enormous challenge to Addis Ababa Water and Sewerage Authority (AAWSA). In 1944, the original Gefersa dam was constructed which is located in North West of

the city. Subsequently, the Gefersa Dam was raised and a treatment plant was built in 1960. Many of the springs were taken out of service because their quality was deteriorating.

In 1966, the raw water storage capacity in the Gefersa watershed was increased with the construction of another small dam north of the existing dam. The supply from Gefersa was transmitted through twin 400mm pipelines to a number of service reservoirs for distribution. The next major phase of expansion of the water supply facilities commenced in 1970 with the commissioning of the Legedadi Dam and treatment plant, which was located on the Dire River east of Addis Ababa.

The plant's output of 50,000m3/day was transmitted via 900 mm pipe line to the Terminal Reservoir on the city's Eastern edge and then to Meskel Square located in the center of the city Further development of the water supply facilities was pursued during the l980s under the Water Supply Project Stage II.The first phase of Stage II included expansion at the Legedadi Treatment Plant, construction of a new transmission pipeline into the city, the rehabilitation of the Gefersa Treatment plant and the construction or upgrading of several reservoirs and pumping stations throughout the city.

The second phase of Stage II included extensive primary and secondary pipeline installations and improvements to the distribution network. The capacity of the supply facilities of 150,000 and 30,000m3/day respectively for Legedadi and Gefersa Dam were projected to be adequate to serve the need of Addis Ababa up to 1992. Planning for the Stage III water supply program commenced in early 1980's, when a reconnaissance study was undertaken for all potential water supply sources located within a radius of 50km (AAWSA and CGCOC, 2014).

In this study, to improve the financial base needed for water development projects and other public undertakings, cost recovery mechanism was considered as one of the basic drinking water project financing mechanisms. As such, a thorough investigation on the extent to which households are willing to pay for improved water services and the amount they are willing to pay is of great importance. Firstly, such knowledge will enhance water managers to understand the demand side for improved water services in these areas. Secondly, this will allow water managers to know if households in the study areas are capable of paying a price of water which can ensure sustainability of the project. Lastly, this can also help policy makers in setting targeted subsidies on poor households. In order to implement cost recovery for improved water supply in urban areas researching whether the citizens are able and willing to pay for the service is very important.

1.2 Statement of the Problem

Water and urbanization are closely linked that the problem of safe and clean water inhibits further urbanization and improvement of standard of living. The situation becomes most drastic when we take urban and rural areas in the developing world where governments are the only stakeholders, with very limited financial resources, in the water supply sector. Thus, the crisis of improved water services in urban areas exacerbates the already poor living and working conditions, which in turn aggravates urban rural areas poverty. Most towns and cities in Ethiopia are good indicators of this problem. The fast growing towns and cities are not coupled with improved water and sanitation services that make an urban area decent and suitable for its residents (Challa, 2009).

As indicated by Medhin (2006) since piped water supply is not a natural system as it is a man made infrastructure, it needs huge amount of money and effort to make it quite accessible in both quantity and quality. The investments (to build, operate, sustain and maintain) turn water to an economic good and not only as a social service. Due to lack of finance and trained manpower, however, governments of poor countries have limited potential to make water easily accessible to its people. Therefore, the public utilities have to come up with a new paradigm shift from their supply-driven policy to demand-driven based on the willingness to pay of consumers.

One way of improving water quality is expanding the piped water system, i.e. water supply through a household connection. It is the final and most effective way of reducing the transmission of water borne diseases (Hutton and Haller, 2004).

Addis Ababa city is one of those cities with a lot of shortcomings in the water supply sector. Demand outstrips supply in the city; the existing supply couldn't satisfy the demand of the fast growing population in the city. Both frequency of service interruptions and the average duration of an interruption are surprisingly high. Piped water supply may be interrupted for a couple of weeks with a higher frequency throughout the year. Water loss and non-revenue water are included as key water supply problems of the city.

Even if there was a study regarding the willingness to pay of households for improved urban water services in Addis Ababa it was limited at a sub-city level and this couldn't represent willingness to pay for improved water service for the city of Addis Ababa.

The circumstance is stunning especially for Addis Ababa city, where the residents have already adapted the problem.

Because of the stated problem, the active labor force is wasting its significant time by fetching water from unimproved sources and purchasing bottled water which has a negative implication in the production sector and the quality of water as well as economic expense from those sources is also deteriorating.

In order to satisfy the rapidly growing population of the city's, water need as well as the required quantity for the existing population, new water projects must be designed and the sustainability of existing water projects must be maintained. The capital needed to supply water to the city is too high. This can make the investment on water difficult. The finance required to fill this financial problem can be filled by donors, government, and community itself, but the most sustainable way is cost recovery by consumers/community itself.

In order to implement cost recovery tariff in urban areas, researching whether the citizens/households' are willing to pay is very important. This helps to understand the fundamental value the consumer places on the improved water service so that the price that reflects the willingness to pay of the households for the improved water services, as strategy for cost recovery, can be established.

This study therefore examined factors affecting household's willingness to pay for improved drinking water services. It also aims at presenting empirical estimates (regression elasticity's) to specify and explain the impacts of some factors on the willingness to pay for improved and sustainable water supply in the city.

1.3 Objectives of the Study

The main objective of this study is to estimate household willingness to pay for improved sustainable water supply services, and to investigate its determinants in Addis Ababa city.

The specific objectives of this study were:

- To estimate households' willingness to pay for improved water services
- To examine the determinants of households' willingness to pay for improved water services
- To use the estimated WTP responses ,to calculate aggregate benefit;

1.4 Significance of the study

Due to big investment, operation and maintenance costs it is hardly possible for the Government to provide safe potable water services free of charge. The water service users are required to pay for the service they get from the improved source. Thus, information on the amount of money the service users are willing to pay for the improved service is essential for improved water development projects.

In this study, the amount of money the residents of Addis Ababa city are willing to pay for water services they get from the improved system and factors that determine their willingness to pay can be assesses. Therefore, the findings of this study will give useful information for project planners that can be use as an input for water development projects of the city. Generally, the study can be an important additional input for different stakeholders working in the water supply sectors.

1.5 Limitations of the Study

Even though users of the improved water supply services include public bodies, commercials, and industrial users, this study, however deals only with improved water supply services of households in Addis Ababa city using cross-sectional data at a point in time. The water use by public bodies, commercials, and industrial sectors in the city are not addressed in this study, therefore, it is beyond the scope of this study. Budget and time constraints will the difficulty to cover a large number of households for the survey.

1.6 Organization of the study

The remaining part of the study is organized as follow. The second chapter deals with theoretical and empirical literature review followed by the third chapter which is devoted to the data source and research methodologies. Chapter four provides descriptive analysis, estimation results and discussion. Finally in chapter five the study provides conclusion and recommendations.

1.7 Ethical Consideration

The research would be conducted upon securing ethical approval official letter from the college of development studies, center for Environmental; Addis Ababa University would be used to request permission from AWSSA office for relevant secondary data gathering. After the permission received, the study was conducted by consenting household hade's, notifying the objective of the study, data gathered from them was kept confidential and important for the study.

CHAPTER TWO

2. REVIEW RELATED LITERATURE

2.1 Theoretical Literature

In this section review of literatures on concepts of willingness to pay, households' willingness to pay for improved water supply services, contingent valuation method, and empirical literatures on WTP using CVM method would be discuses.

2.1.1 Concepts of Willingness to pay

The issue that is most important for water project designers and planners is how to ensure the financial sustainability of a project. This can involve predicting and estimating what users will be willing and able to pay for proposed water schemes in the future. That is because most water projects in developing countries are financially unsustainable leading to water supply shortages in many places (Tietenberg, 2003).

WTP is the maximum amount individual states they are willing to pay for particular goods or services based its characteristics (e.g. water supply: the difficulty of obtaining it, available sources, water quality and service level) (Douangchanh ,2004).

Another definition is one by Cardone and fonseca states that "Willingness to pay (WTP) is an expression of the demand for a service, and it is strong prerequisite for sustainable cost recovery because it is the materialization of the users' satisfaction and of their desire to contribute its functioning" (Woldemeskel, 2006).

In economics, consumer's WTP means the maximum amount that a person would be willing to pay for a service rather than do without it (Sansoon, 2003).

Generally, WTP refers to the value of a good people are willing to pay, sacrifice or exchange for it. Used in contingent valuation to estimate the value of a nonmarket good, WTP would generally be determined through questionnaires distributed to a representative population asking something like, ' How much would you be willing to pay for a certain improved water supply service' ? (Fekadu, 2011).

2.1.2 Demand for improved water service

The supply of improved water may mean the quality of water is improved, the reliability is greater, the quantity of water available may have increased and its distances from consumer location may

have been reduced. Effective demand for water signifies the level of water people demand and are prepared to pay for it at particular price level. It is determined by a complex interrelationship of a number of factors (Assefa, 1998).

Carruthers and Browne (1980) revealed that the potential benefits of safe water provision in terms of health benefit, social benefits and economic benefit which are closely related. Unsafe supply of water is certainly a hazard to health. Improving the quality of water can prevent water-born diseases. Whereas increased quantity of water can reduce water washed diseases such as skin disease, its reliability will reduce the risk of epidemics in the community. These effects also mean lower medical expenditure and an improved sense of well-being and productivity to community (health benefits).Improved water supply significantly reduces the walking distance to alternative sources which leads to saving of time and energy which may be used for productive purposes (economic benefit). It also implies more time saved to be spent with family, either looking after children or on domestic activities and leisure (social benefits) (Carruthers etal, 1980).

However, since consumers will not be willing to pay more for provision than benefits they derive, economists attempt to estimate the real benefits by asking the beneficiaries how much they are willing to pay for the good using various estimation techniques (Convery, 1995).

Water demand studies are focused on the estimation of income and price elasticity's of demand for water. All potential users are expected to connect to the system. And since the quantity of water is relatively inelastic with respect to price, future water requirements and total revenues for a given tariff can easily be estimated (Jonsen, 1989).

The number of potential users who will prefer to connect to a system is highly dependent on several factors such as household's socio-economic characteristics, the cost and perceived quality of existing water (such as tariffs, cost of connection and the level of service offered) (worldbank, 1993). .

A considerable amount of information is needed on what level of services people require and for what they are willing and able to pay, before decisions are made on water system design and tariff settings (worldbank, 1993).

2.1.3 Urbanization, water demand and supply

Population growth and rapid urbanization will create a severe scarcity of water as well as tremendous impact on the natural environment. In order to meet the future water demand, cities

will need to tap their water supply either from a deep ground or surface sources situated a far distance away from the urban area.

Moreover, rapid increase in built-up areas disturbs the local hydrological cycle and environment by reducing the natural infiltration opportunity and producing the rapid peak storm water flow.

Cities in developing countries are already faced by enormous backlogs in shelter, infrastructure and services and confronted with insufficient water supply, deteriorating sanitation and environmental pollution. The larger populations demand larger proportions of water while simultaneously decreasing the ability of ecosystems to provide more regular and cleaner supplies (Khatri. k Vairavamoorthy. k, 2007).

Water is the basis of life and is a driving force for economic, social development and for poverty reduction. For instance, in developing countries the provision of adequate potable water supply in addition to drinking and cleaning, improves health by reducing incidence of water-related illness such as diarrhoea and cholera (WHO, 2000).

The proportion of the population that uses improved drinking water sources varies significantly by country and region. It is clear that Sub-Saharan Africa is not on track to meet the target; in 2008 40% of the total population still lacked access to improved drinking water sources, as compared to 51% in 1990. In this region 20% of rural dwellers still rely on surface water sources and access to piped water supplies has decreased in urban areas. Between 1990 and 2008, the urban population in Sub-Saharan Africa more than doubled. While overall urban coverage levels have stayed just above 80%, access to piped supplies decreased by 13 percentage points from 68% in 1990 to 55% in 2008. Still, over half of the 126 million urban dwellers that gained access did so through using piped supplies on premises (42 million) and public taps (23 million) (UNICEF and WHO 2011).

Even if Ethiopia is frequently said to be the ‘water tower of North-East Africa’ there is a pervasive problem of safe and clean water. Both the urban and rural water supply and sewerage coverage in Ethiopia are low. Even though current figures show improvement in coverage of water supply, there is a great variation in official Government of Ethiopia figures and internationally accepted Joint Monitoring Program (WHO and UNICEF) figures due to lack of reliable data. Official reports show access to water supply at 68.5 % - 81.5 %for urban and 65.8% for rural. Access to sanitation facilities is reported to be 60%. The same report highlights hand washing practice at 7% and open defecation at about 15%. The JMP figures, however, show that Ethiopia has among

the lowest rates of safe water coverage in the world with only 41%. Out of this 31% of the rural and 96% of the urban population is using an improved drinking water source. The national sanitation coverage is only 11% out of which 27% urban and 8% of the rural population are using an improved sanitation facility (Water Aid, 2011-2016).

To improve access to safe clean water, the government of Ethiopia has prepared a water and sanitation policy document as an integral part of the country's water management policy. This document clearly indicates the right of every Ethiopian to get access to adequate and quality water to satisfy their basic needs in order to achieve rapid socio economic development through better health care and productivity (MoWR, 1999). In this document, to improve the financial base needed for water development projects and other public undertakings, cost recovery mechanism was considered as one of the basic drinking water project financing mechanisms.

2.1.4 Water Supply Tariff Structure of Addis Ababa City

Table 2.1.4 Tariff rate calculation for different customers

Notice	1st block	2nd block	3rd block	4th block	5th block	6th block	7th block
Blocks use in m3	0-7	08-20	21-40	41-100	101-300	301-500	>500
Payment for residential(in birr)/m^3	1.75	3.8	4.75	14.57	19.42	24.28	26.71
Payment for those **not** residential (in birr)/ m^3	1.75	3.8	9.71	14.57	19.42	24.28	26.71
Payment For Public point water	1.75 birr/ m^3						

For Solid waste /Green and beatification

No.	Customers block	For Solid waste (Green and beatification)
1.	For those residential	10%
2.	For those not residential	19%

(AAWSA, 2019)

Total operation & maintenance and depreciation costs may not be fully recovered in the first two years but gradually the WSSSs will collect more revenue which will cover the losses incurred earlier years. If the loss is high by the above method the remaining cost will be evenly distributed on all then connections and blocks up to all costs will be recovered. If investment costs are on grant only 50% of the investment costs should be considered in the tariff as depreciation and the remaining serves as a subsidy for all users. When the investment is on loan full investment and interests should be fully considered. Community contributions and regional government subsidies on investment should be deducted from investment cost to reduce depreciation costs.

If there is other subsidy (like materials, equipment etc) that amount must be reduced from the operation and maintenance costs which will reduce unit O & M tariff/M3 for all users (MoWE, 2013).

2.1.5 Approaches to improved urban water supply

Efficiency always implies some sort of process, so "water efficiency" refers not to the efficiency of the water as such but the efficiency of transformation of the use of input water to output water. Improving water efficiency requires a multi-faceted approach that considers wider social issues and values as well as physical and technical concerns (WSSD, 2002).

Improving water efficiency allows countries to reduce water scarcity and maximize the benefits provided by existing water infrastructure. It also frees up water for other uses and reduces environmental degradation. Efforts to improve water efficiency can therefore contribute directly to the development goals of many countries, especially those that are chronically short of water or the capital to invest in water development. In practice, water efficiency can be improved using many approaches, including investing in physical improvements in infrastructure and technology, fostering changes in user behavior, and developing integrated improvements in water management (WSSD, 2002).

Improving infrastructure

Regular maintenance of infrastructure also helps to maintain water efficiency levels and is more cost-effective than rehabilitation. The best ways of ensuring that structures don't fall into disrepair (which results in plummeting water efficiency levels) is to get the users involved in their management and to set water user fees which are high enough to cover the cost of operation and maintenance. It does not good to develop a lot of new water infrastructure if it is not going to be maintained (WSSD, 2002).

Enabling water users and managers to better match supply to demand is critically important when working to ensure that the type and quality of service provided fits the needs of users and their willingness and ability to pay (product-choice efficiency) (WSSD, 2002).

Impacting user behavior

Economic, social change and regulatory instruments can be used to encourage domestic, industrial and agricultural users to use water more efficiently. Charging for water can be used to affect people's behavior and so promote conservation and efficient water usage. It can also be used to ensure cost recovery and to measure consumers' willingness to pay for additional investments in water services. Full-cost pricing may be a good long-term aim from the point of view of economic efficiency and environmental sustainability; any efforts to implement it need to be accompanied

by measures to ensure that the poor can afford water especially that required for domestic uses. So, tariff and fee structures must balance the need to encourage efficient water use with the need to ensure that low-income households can afford basic levels of supply (WSSD, 2002).

2.1.6 Economic Valuation

There are many definitions of the word value, but in this study the value of a good is defined as follows: "The word Value, it is to be observed, has two different meanings, and sometimes expresses the utility of some particular object, and sometimes the power of purchasing other goods which the possession of that object conveys. The one may be called ' value in use'; the other, ' value in exchange'. The things which have the greatest value in use have frequently little or no value in exchange; and, on the contrary, those which have the greatest value in exchange have frequently little or no value in use. Nothing is more useful than water; but it will purchase scarce anything; scarce anything can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it" (Hanneman, 2005).

2.1.7 Non- Market valuation

Theory of environmental resources valuation has encouraged economists, both in intensity and scope, in valuing an increasing number of environmental goods and services around the world. Increasing complexities, in designing procedures and analytical structure, have enhanced the optimism of economists about using non-market valuation as a basic instrument to assist decision-making. Practically, non-market valuation faces a critical problem in understanding how people perceive these services and how they value changes on the genetic, species, regional and global scale (Hanley etal, 1997).

Depending on various circumstances, economists place total economic value on either stock or flow of natural resources. Total economic value (TEV) can be divided into three main components, namely, the use value, option value, and non-use value. The use value refers to the direct benefits human beings obtain from environmental resources. The option value reflects the value individuals give to the future uses of environmental resources.

That is, it indicates individual's willingness to preserve environmental assets for the future uses even if s/he does not use these resources currently. The non-use value reflects that people are willing to pay to improve or preserve environmental resources that they do not use and will never

use. Thus, total willingness to pay for environmental resources is the sum of the use value, option value and nonuse value (Tietenberg, 2003).

2.1.8 Valuation Methods

Theoretically, the total value/ benefits of some environmental improvement such as improved water can be classified into two categories. Use value comprises direct and indirect value, which is simply "value in use", option value, quasi-option value and bequest value. For example, people use a clean river for swimming, boating, drinking or bathing (Brima, 2003).

A number of valuation methods have been developed by economists to estimate the value consumers place on public goods. These include the contingent valuation method, the hedonic pricing method and the travel cost method.

According to Knees and Russell (1990), these methods can be classified into the direct and indirect methods.

2.1.9 The Indirect Methods

The most common methods which are classified under indirect methods are, the travel cost method (TCM) and the hedonic pricing methods (HPM). These are usually used in a situation where markets for environmental goods or services are absent or not well developed, under which it is hardly possible to value the environmental impacts of a particular project by using the market.

2.1.9.1 The Travel Cost Method (TCM)

The travel cost method (TCM) is the oldest of the non-market valuation techniques. The method is predominantly used in outdoor recreation modeling, with fishing, hunting, boating and forest visits among the most popular applications.

TCM seeks to place a value on nonmarket environmental goods using consumption behavior in related market. Specifically, the costs of consuming the services of the environmental asset are used as a proxy for price. The method assumes weak complementarities between the environmental asset and consumption expenditure.

In addition to valuing recreational site such as parks and beaches, TCM can also be used to value changes in the characteristics of a site, such as water and air quality, and un priced commodities such as estimating the value of fuel wood and water-studies. Studies made by Desvouges et al (1983), Faber (1988), Seller et al (1985) &Doomis (1987), (all are cited in Hanley and Clive, 1995), have used TCM approach to estimate the price of different environmental resources. Most

of these studies proved that the method is an appropriate technique for estimating recreational benefits.

Though TCM has primary advantage of measuring benefits based on actual behavior, it is restricted to use values of the resource and ignores non-use values. In addition to this, the method has got its own problems or limitations, which ban it from gaining wide acceptance. These include expensive process and time consuming nature of large data requirements, exclude time cost (though it is common in empirical work to use some proportion of average wage rates as a proxy for travel time cost) and the value non-visitors place on recreation sites, which affect regression estimates.

2.1.9.2 Hedonic Pricing Method (HPM)

Hedonic Pricing (HP) derives from the characteristics theory of value, which states that any given unit within a commodity class can be described by a vector of characteristics.

The method identifies environmental service flows as elements of a vector of characteristics describing marketed goods, typically housing. This method seeks to find a relationship between the level of environmental services (such as noise levels or total suspend or particulate levels), and the prices of the marketed goods (Hanely, 1995) .

The first step in this type of study is to decide which environmental quality variable is of interest, and then to ascertain whether sufficiently disaggregated, spatial data are available, along with data on house prices and housing characteristics. Once this has been verified, the method proceeds in two stages. The first stage is that of estimation of a hedonic price function, in which the relationship between the environmental variable of interest and a related marketed good is estimated. The second stage is estimation of a demand curve for some elements of environmental quality using the information gained from the first stage.

The main challenges of this method are the problem of correctly specifying the functional form, data constraints and the absence of competitive market for houses in developing countries.

2.1.10 The Direct Approach

Despite their use in valuing benefits associated with environmental resource improvements, the indirect methods cannot be used in some cases. They are unlikely to value non-use values that can be obtained from improving environmental resources since they rely on data from situations where consumers make actual market choices. On the other hand, the direct method draws

conclusion from responses to hypothetical questions. The most common form of the direct method is the contingent valuation method (CVM).

2.1.11 Contingent valuation method

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).

The contingent valuation method is the earliest technique of the stated preference method of non-market valuation approaches. The CVM involves asking people directly what they would be willing to pay or willing to accept compensation for change in preference. This method is called contingent valuation for it is contingent on the hypothetical market. The contingent valuation method is preferred to the revealed preference methods for it deals with both use and non-use values and survey responses to willingness to pay or willingness to accept hypothetical questions that go directly to the monetary measures of utility change (Perman et al, 2003).

Economic value is measurable in relation to utility functions through the concepts of willingness to pay (WTP) and willingness to accept (WA) compensation, as well as through the related measures of consumers' surplus, compensating variation and equivalent variation. CVM works by directly soliciting from a sample of consumers their WTP and/or WTA for a change in the level of environmental service flows, in a carefully structured hypothetical market. That is, the method is based on classical economic theory using either of Hicksian techniques i.e. either compensatory variation (WTP for improved environmental resource) or equivalent variation techniques (WTA compensation for environmental deteriorations).

The ultimate aim of CV survey is to obtain an accurate estimate of the benefits from a change in the level of provision of a public good, which can then be used in Cost-Benefit analysis. In conducting CVM, there are steps to be followed.

Designing and administering the survey.

During a face-to-face interview, the respondents are presented with a questionnaire, which consists of the following:

a) A detailed description of the good/s being valued and the hypothetical circumstances under which it is made available to the respondents. The researcher constructs a model market in considerable detail, which is communicated to the respondents in the form of a scenario that is read by the interviewer during the course of the interview. The market is designed to be as plausible as possible. It describes the good to be valued, the baseline level of provision, the structure under which the good is to be provided, the range of available substitutes, and the method of payment. In order to trace out a demand curve for the good, respondents are usually asked to value several level of provision.

b) Questions that elicit the respondents WTP for the good/s being valued. These questions are designed to facilitate the valuation process without themselves biasing the respondent's WTP amounts. The analyst can elicit the respondents 'WTP in either of the following ways: either in the form of bidding game or open-ended question form or to present the respondents with a list of values in the form of a payment card, and ask for their selection from the list or in the form of closed-ended

c) Questions about respondent's characteristics (age, income, and sex), their preferences relevant to the good (s) being valued, and their use of the good. This Information is used in regression equations to estimate a valuation function for the good.

The CVM has several advantages compared to other methods. It is inexpensive and quite fast which qualities that are beneficial, particularly in developing countries. However, there has been and still is quite a lot of skepticism concerning the actual reliability of the method. The problems associated with CVM can be classified in to biased estimates of value and choice of welfare measures. With regard to the first, Whittington et al (1987) noted that "hypothetical", "strategic", " compliance" and starting point" and other biases can influence the CVM."

Hypothetical bias" may be due to the individual who may not understand the characteristics of the good or who may not bother to answer accurately. **"Strategic bias"** is related to situations where the individual thinks that he or she may influence the investment or policy decision. The individual may overstate his or her WTP, assuming the government will provide the service with

high subsides in case he/she responds positively. On the other hand the individual may under state his/her willingness by assuming that the investment has already been decided on (Whittington et al, 1987).

With regard to problem of choice of welfare measure, the problem is which of the two measures of welfare, WTP or WTA, is most appropriate. Theoretically, these two measures are supposed to give similar estimates, deferring only in the effect on income caused by whether payment is made or received, and by the fact that WTP is constrained by income. However, empirically they give different estimates in that the estimates based on WTA are greater than the estimates based on WTP.

The reasons could be loss of aversion where individuals value a given reduction in entitlement more highly than an equivalent increase, or WTP is constrained by income where as WTA bids are not or if the consumers are risk averse that overstates WTA and understates WTP. However, Hanemann (1991) gave the following three explanations in response to the criticism that stated preference methods should not be used.

A) The difficulty of applying revealed preference methods especially to a national public good and when non-use values are expected to be significant

B) Revealed preference methods are also not foolproof

C) Observing human behavior and asking about behavioral intentions and motives should not be mutually exclusive.

The choice of which measure to use depends on the type of project in question. If the project in question has a social benefit (an improvement in environmental quality, e.g. improves water supply), then WTP is chosen whereas if the project in question has an adverse effect on the residents in the project area then WTA is an appropriate measure of welfare in which case the respondents need to be compensated for the loss of welfare.

Therefore in this study WTP is chosen of the appropriate measure of welfare, and thus the respondents will be asked the maximum amount they are willing to pay for the supply of improved water supply.

To conclude this subsection, compared to other methods, CVM is more advantageous since it captures total value of a resource. Total value of a resource consists of use value (expected

consumers' surplus) and non-use value (which include option value, existence and bequest value). Bequest value is value people give for the existence of the good for future generation. Given that the study is well designed, carried out and interpreted, then CVM is a useful technique for estimating economic values for some non-market resources (Hanely, 1995).

Contingent valuation (CV) elicitation formats

The most widely used elicitation formats in CV surveys are open-ended, bidding game, payment card and single (double) bounded dichotomous choice (Hanley et al., 1997).
I. Open-ended format –a CV question in which respondents are asked to provide the interviewer with a point estimate of his/her WTP; it has the advantage of relative computational easiness and counter starting point bias. But the method is associated with a large number of respondents' non-responses and protests zero bids. Mitchell and Carson (1989) further argue that the method is difficult since respondents face 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

14 Randall, 1987). But the method exhibits very strong starting bias and may be boring to the respondents and thus they may give answers only to avoid additional questions.

IV. Payment card-is a CV question format in which individuals are asked to choose a WTP point estimate (or an interval) from a list of values predetermined by the surveyors and shown to the respondent on the card. This method is better than open ended format as it could be simpler for the respondents and large proportion of responses could be obtained. However, the method requires the respondent to be literate that makes it of little use in developing countries where a considerable proportion of the population is illiterate. In general all methods that we have discussed, either stated or revealed preference methods for non- market valuation, that are used for measuring the benefits of water related public goods have their own strength and shortcomings.

As indicated above the revealed preferences methods are used to estimate people's WTP for environmental public goods from actual consumer behavior and hence failed to capture non-use values of environmental resources and thus are inadequate for assessing new policy initiatives (Young, 2005, p. 156). But the stated preference methods such as CVM is used to estimate both use and non-use values and also used to estimate values of proposed new policies (Young, 2005, p.152) , and this indicates that CVM can measure the total economic value of improved water projects.

That is the reason why in 1979 the U.S.A. Water Resource Planning Council recommended the CVM as an acceptable method for estimating the benefits of water resource projects (Young, 2005, p.135). Therefore CVM is the appropriate method for valuing willingness to pay for improved water supply service of Addis Ababa city.

2.1.12 Choice of Modeling

CVM is one of a stated preference technique offering hypothetical changes to respondents and using indirect choice behavior to estimate the WTP and welfare of policy changes. As indicated by (virgee, 2007) this method has developed out of conjoint analyses is indicated by Louviere (1988) and has been applied in environmental valuation exercises Blarney et al. (1999) and, in one case, water supply valuation and, (2001). A set of choices are presented to the respondent, which contains a set of alternatives and the respondent chooses one which suits him/ her.

2.2 Empirical Literature Reviews

Different studies, in the water supply sector, have been conducted in different times by different researchers using the contingent valuation methodology to elicit households' willingness to pay for improved water services. Some of them can be revised as follows.

Khuc (2013) explored consumer behavior of households for drinking water by surveying and analyzing 235 households in Hanoi and Hai Duong in the north of Vietnam and Hochi Minh in southern Vietnam. CVM and averting behavior method (ABM) were used. Binary logit regression and the linear regression results revealed that about half of the households surveyed were WTP for better drinking water, income, status of existing water source, education and awareness of the household were strong variables in determining WTP.

Mitchell and Carson (1989) conducted a study to determine the national benefits of fresh water pollution control in America and estimating the aggregate benefits of meeting the goals of clean water act using data from a national CV survey. They regressed total WTP on water quality level, disposable income, taste; water based recreational use (dummy) and environmental attitude (dummy). The result shows that all the coefficients are reasonable in sign and all significant, 17 confirming the importance of people attitude towards their WTP for improvement in the public good. His study reveals that income and time taken to fetch water are significantly determines WTP for improved water in the town. Socio demographic characteristics such as education and occupation also show significant relationship with WTP.

Samuel et al (2005) used the CVM questions where 106 households were asked using an open ended elicitation method to determine the economic value of basin protection to improve the quality and reliability of potable water supply in Equador. The empirical result from Tobit model indicated that households were WTP an average of $5.8 per month, a 25 percent increase in the monthly water bill, to preserve the basin. The main variables found to affect the WTP were existing monthly water cost, the perception about the fairness of the existing water tariff (cost of water), the number of hours that service was available and the gender of the individual interviewed.

Whittington et al (2002) examined households demand for improved water services in Kathmandu, Nepal. Data collected from 1500 randomly selected households was used. The result provided the first evidence from south Asia that households' Willingness to pay for improved water services was much higher than the existing water bills.

Yasuo et al (2004) estimated WTP for water and sanitation services through CVM in the Republic of Peru, as case of Iquitos city. The main findings of the study was that WTP was approximately twice of the existing average payment level.

Assefa Chaka (1998) using CVM and indirect approach, his did a study entitled Households Willingness to pay for improved water services and factors determining willingness to pay In selected areas of Addis Ababa City. His result like other studies reveals that households are more willing to pay than existing tariff rate.

Fisseha (1996) take a sample of 266 respondents in Meki town of Oromia regional state to point out determinants of willingness to pay for improved water services using contingent valuation method and the result shows households are willing more than the existing tariff as well positive relationship between occupational status and willingness to pay is found.

Gossaye Fanta (2007) conducting Master thesis entitled Estimating Willingness to pay for improved water supply services using CVM method, in Debrezeit town, 41 km west of Addis Ababa. In his study randomly selecting 234 households were selected from 15 kebeles of the town. Households 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 of Gossaye fanta also indicated that age, household size, water volume, reliability, income of households are significantly determines willingness to pay. Households were willing to pay more than the existing tariff level.

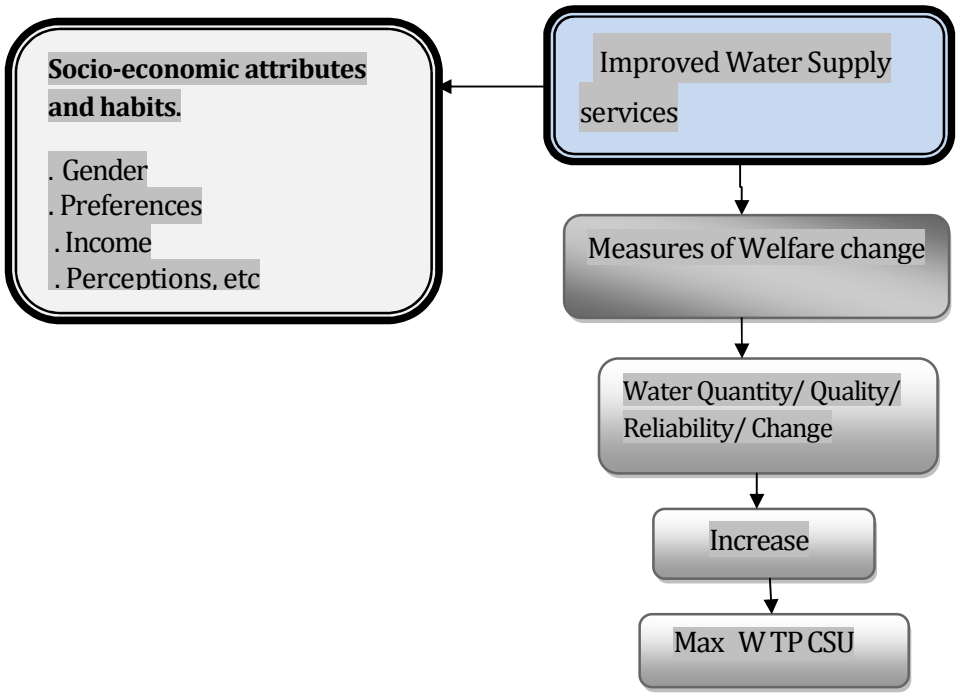
Medhin Fisseha (2006) did a study on Households demand for improved water supply services Addis Ababa city using contingent valuation method. The study uses both primary and secondary data by sampling 250 households. The result indicates that households are willing to pay more than the existing tariff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

In general these and other CVM empirical studies on water quality and quantity improvement and other non-marketable environmental goods and services in developing economies, in general and Ethiopia in particular imply that ,the CVM can be successfully applied to low income countries and indicate most of the respondents of studies is not satisfied with the current source of water.

2.3 Conceptual Frame work

The conceptual framework adopted in the study is as shown in Figure 1. As it can be shown, with the improved water project, the proper measure to assess the economic benefits depends firstly on the nature of the change we are valuing (price / quality / quantity change). The measure will also depend on the direction of the change and the concept of elicitation used (WTP or WTA). Accordingly, the decision on WTP or WTA from the household is affect by household's characteristics, perceptions and preferences (Socio economic attributes and habits).

Figure 2.1 Conceptual Frameworks for Improved Water Services



CSU = Compensating Surplus.

We measure the change in welfare as a result of the improved water services using WTP instead of WTA. According to Garrod and Willis (1999), asking WTP depends on property rights (Nqobizwe, 2015) .

CHAPTER THEREE

3. RESEARCH METHODOLOGY

This chapter deals with description of study area, the research design and the methodology that which has been used in gathering data for the study. It contains the research design; the sampling method, the sample size, source of data; data collection procedure and data analyzed techniques section.

3.1 Description of study area

Addis Ababa is the Capital city of Ethiopia. The city lies at an altitude of 2,300 meters and is a grassland biome, located at the foot of Mount Entoto. From its lowest point, around Bole International Airport, at 2,326 meters above sea level in the southern periphery, the city rises to over 3,000 meters in the Entoto Mountains to the north.

Addis Ababa is the largest city in Ethiopia, with a population of 3,007,268 according to the 2007 population census with an annual growth rate of 3.8%. This number has been increased from the originally published of 2,738,248 figure and appears to be still largely underestimated. The total area of the city is 540 square kilometers. At present, the city is divided into 10 sub-cities (kifle ketema) containing 100 kebeles/woredas in current structure/ (administrative sub-units or wards) in total (AAWSA, 2019).

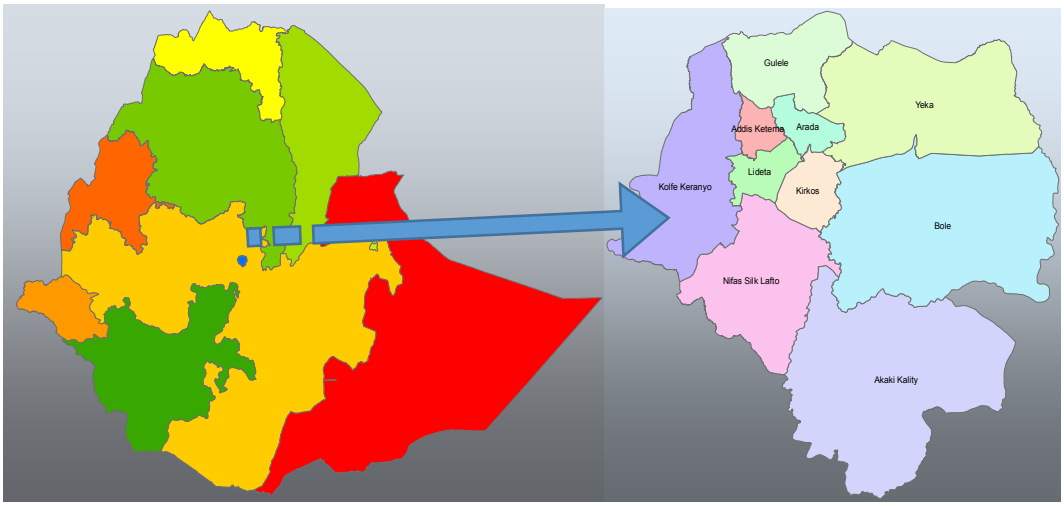


Figure 3.1 Study area map of Addis Ababa city (AAWSA, 2019).

3.2 Research Design

This study employed mixed approaches that combines quantitative and qualitative research approach .Based on its purpose descriptive research and explanatory method would use to estimating proper willingness to pay and to estimate also analyzed respectively, compare to tariff payment conditions of different water users.

The study used both primary and secondary sources of data. Primary sources were from household head residents of Addis Ababa city; whereas secondary sources were written documents and some other relevant materials. The data were collected by using questionnaire and key informant interviews.

The collected data was analyzed by using descriptive types of data analysis tools such as tables and graph as well as using the models. Finally the researcher forwarded conclusions and recommend based on the analyzed data and the results found.

3.3 Description of sampling Strategy

Addis Ababa city is classified in 10 sub city's and in survey we include all sub city's. We obtained number of population, number of household living in the city and average number of people living in the household from central statics report of 2015. Simple random sampling would use to elicit households willingness to pay for improved water supply services in the city and each household have equal chance to be select. Using simple random sampling, each household would interview personally by trained enumerators.

3.4 Determination of sample size

In planning a survey, one must decide how many people or households will to be study in order to answer the study objectives. If the study is too small, the researcher may fail to detect important effects. If the study is too large then it wastes resources. The sample size of the research is N number of households as can be calculated using the following criteria.

The minimum Sample size require for a population is N≥10,000

$$\text{Is} \quad n=Z^2\, p\,(I-p)\,/W^2$$

Where n= Sample size
Z=Confidence interval (usually set at 95% confidence level)
P = population proportion
W= margin of error
The total household of the city is N=× (until I will get the recent data of N)
Confidence interval of 95% (z) = 1. 96
Population proportion (p) = 0.5
Margin of error (W) = 0.05 therefore the sample size is calculated as
$n= (1.96)^2\, 0.5(0.5)/0.05^2$
= 3.8416 x 0 .25/0.0025
= 384
the above sample size will take, if household number is greater than 10,000. But if it is relatively smaller population, the required sample size will be obtained from the above estimate by making some adjustment and number of sample households may differ (Mjverhoet, 2004).

Since the number of house hold in Addis Ababa is more than that, the study taken a sample of 384 of households.

Table 3.4 Sample proportion of sub-city's

No.	Technique	Number of population by Cluster	Sampling proportion (%)	Cluster samples
1.	Addis Ketema	271,644	9.0	35
2.	Akaki Kaliti	195,273	6.5	25
3.	Arada	225,999	7.5	29
4.	Bole	328,900	10.9	42
5.	Gullele	284,865	9.5	36
6.	Kirkos	235,441	7.8	30
7.	Kolfe Keranio	546,219	18.2	70
8.	Lideta	214,769	7.1	27
9.	Yeka	368,418	12.3	47
10.	Nifas silk	335,740	11.2	43
	Total	3,007,268	100.0	384

Source: (MoWr, 2015).

Considering limitations in time and costs, a total of 384 household's samples would be, the true representative of the research.

3.5 Methods of data collection

The information collected for the study has primary and secondary data. Primary data would mad through the use of questioners and interviews. The secondary sources of data would be obtained using different relevant book and literature

3.5.1 Primary data collection

A. Questioner

Well organized types of questioner were used as the research instrument owing to its suitability to the level of information required. The questioner distributed to household head residents of Addis Ababa.

The questionnaires that would use to elicit households ' willingness to pay for improved water supply services can be divide to three basic parts namely :-

1. Households socio economic characteristics
2. Existing water supply situations of the city
3. Household's willingness to pay for improved water supply questions.

B. Key Informant Interview

The primary data collected mainly from interviewing the respondents and key informant interview. Semi structured interview would incorporate officials of AAWSA members, communities and experts.

3.5.2 Secondary data

Secondary data collected from Ministry of water resources, AWSSA (Addis Ababa Water Supply and Sewerage Authority), books, journals, papers, thesis, internet and other relevant sources would use.

3.6 Method of data analysis

The respondent household heads were asked Willingness to pay questions that is use to elicit their willingness to pay for improved water supply. Quantitative and qualitative data analysis is use to show their willingness to pay for the improved water supply service. Correlation coefficient result using SPSS version 24.0 and STATA version 13.0 could used in order to measure the strength of relationship between dependent variable (WTP) and independent variables of socio economic characteristics.

3.6.1 Descriptive analysis

The descriptive analysis was based on the socio-economic characteristics of the sample households, the current situation of water supply and the willingness of the households to pay to get improved water services in the city.

3.6.2 Econometric analysis

The econometric analysis was based on CVM to examine effects of factors affecting households WTP for improved water supply services in the city.

3.7 Model Specification

Given the nature of the data, two econometric models were used in the determinant of WTP, one of which was a OLS model of linear regression used, to identify factors affecting the maximum amount a household was willing to pay for the improved water supply service and for dichotomous (yes/no) responses to the initial bid (βi^*) posed to the respondent, the Probit model better fits the problem at hand.

3.7.1 The Probit Model

The Probit model is among the most widely used members of the family of generalized linear models in the case of binary dependent variables. This model specifies an indirect utility function for each respondent assuming that the representative household gains utility from improvement in water services and the two possible levels of environmental quality involved are the status quo and a specific level of improvement. Hence, the main objectives of estimating econometric (or parametric) models in WTP surveys are to calculate mean WTP for the improved environmental good and to allow insertion of respondents' socio-economic factors into WTP functions. Such incorporation of individuals' socio-economic variables into the CV model helps the researcher to gain information on validity and reliability of the CV results and increase confidence in application of results obtained from the CV empirical analysis (Habb and McConnell, 2002).

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

The indirect utility function for the jth respondent can be specified as follows: Uij=Ui (Yj, Xj, εij) Where Yj= jth respondent's income i=1 denotes the final state and i=0 the status quo (or the initial state) Xj= vector of household characteristics and attributes of a given choice εij= random component of the given indirect utility If a payment (also called the initial bid, βi*) is introduced due to changes in measurable attributes like quality or quantity of environmental goods, the consumer accepts the proposed bid only ifu1j(yj-βi*,xj,ε1j)>u0j(yj,xj,ε0j)

For the researcher, however, the random components of preferences cannot be known and s/he can only make probability statement of 'yes' or 'no' responses. Thus, the

probability that the respondent says' yes' is the probability that s/he will thinks that s/he is better off in the proposed program.

For individual j, the probability is: P(yes)=P[u1j(yj-βi*,xj,ε1j)>u0j(yj, xj, ε0j)] This probability statement provides an intuitive basis to analyze binary responses. Assuming the utility function is additively separable in deterministic and stochastic preferences: Ui(yj, xj, εij) + εij. Given the additive specification of the utility function the probability statement for respondent j becomes: P (yes) =P [u1j(yj- βi*,xj) +ε1j > Uoj (yj, xj) + ε 0j]

This probability statement is the point of departure for the linear utility function in income and covariates, which is assumed by the empirical models. The Probit model can be defined as Ti=β'Xi+ εi

Where
- β' is vector of parameters of the model
- Xi is vector of explanatory variables
- εi (the error term) and is assumed to have random normal distribution with mean zero and common variance δ2 (Greene, 1993).
- Ti=unobservable households' actual WTP for improved water supply service. Ti is simply a latent variable. What we observe is a dummy variable WTPi, which is defined as: $WTP_i=1$ if $T_i \geq \beta_i^*$

$WTP_i= 0$ if $T_i<\beta_i^*$

In the single bounded elicitation format, the jth respondent is asked if s/he would be willing to pay the initial "bid", (βi*), to get, say, a given improvement in environmental quality, quantity or both.

The probability of a "yes" response, or a "no" response, p Y or N (βi*) can be cast in terms of random utility maximization chosen by the respondent.

It is clear from the random utility framework that the individual's WTP is a random variable from the point of view of the researcher. Thus, while the individual knows his/her own maximum WTP, Ti to the observer is a random variable with a given cumulative distribution function (cdf) denoted by G (Ti;Θ) where Θ represents the

parameters of this distribution, which are to be estimated on the basis of the responses to the CV survey.

Then, following the work of Hanemann (1984), the response probabilities related to the underlying WTP distribution are: $P_Y \equiv p\{\text{yes to } \beta_{i*}\} \equiv p\{ \beta_{i*} \leq Ti\} = G(\beta_{i*};\Theta)$

$P_N \equiv p\{\text{no to } \beta_{i*}\} \equiv p\{ \beta_{i*} < Ti\} = 1\text{-}G(\beta_{i*};\Theta)$

The resulting log-likelihood function for the responses to a CV survey using the single – bounded format is $\ln L(\Theta) = \sum\{ d_{iY} \ln G(\beta_{i*};\Theta) + d_{iN} \ln [1- G(\beta_{i*};\Theta)] \}$ where $d_{iY} = 1$ if the i_{th} response is yes and 0 otherwise, while $d_{iN} = 1$ if the i_{th} response is no and 0 otherwise one of the main objectives of estimating empirical WTP model based on the CV survey response is to derive central value (or mean) of the WTP distribution (Hanemann, Loomis and Kanninen, 1991).

Therefore, the mean WTP (μ) using the model for the single –bounded probit model format can be defined as follows: $= -\beta_0/\beta$

Where,	β_0= the constant (or intercept) term β= the coefficient of the bid posed to the household heads

3.7.2 Specification of econometric Model for determinants of maximum willingness to pay:

When dichotomous choice format is followed by open-ended question format finally produces open value of the respondent. In this case the use of binary responses models such as the probit or the logit is not appropriate. The respondents' willingness to pay survey responses from the open ended are estimated as censored model such as the Tobit model if the dependant variable takes non negative values with some zero or by using linear regression model if the dependant variable takes non zero positive (Siglman, 1999).

The survey result shows that all the survey respondents expressed their willing to pay some amount of money that exceeds zero for the water they will get from the improved source. Therefore the ordinary list square (OLS) model is the appropriate model for

analyzing the determinants of household's willingness to pay for the improved water services for open-ended survey responses. Based on this theoretical background we specify the linear regression model for the improved water services empirically as follows.

$$MWTP = \theta 0 + \theta 1\ RESX + \theta 2\ REYS + \theta 3\ IB + \theta 4\ REAG + \theta 5\ REIN + \theta 6\ HOUSE + \theta 7\ REFS + \theta 8\ WBD + \theta 9\ REMS + \theta 10\ RESF + \theta 11\ REED + \theta 12\ SORC + \theta 13\ HHHD + \theta 14\ REOC + \theta 15\ LSAT + \theta 16\ VOLM + \theta 17\ QLTY + \theta 18\ RLTY + Ui \quad \text{-----(1)}$$

Where MWTP is reported maximum willingness to pay by the surveyed households in birr per bucket of improved water services, θ is regression parameters, Ui is the error term and the explanatory variables are as defined under the variable description sections (Siglman, 1999). This model is estimated by using the standard econometric soft ware such as STATA.

3.8 Description of Explanatory Variables and Hypothesis

HHHSX: **The sex of the head of household.** It is assumed that women would express more preference for improved water services and would be more willing to pay than men for the reason that women are often around the house with a higher burden of fetching water for domestic uses. A dummy variable for sex would be specified as 1 for female and 0 for male with a positive expect sign (Meron, 2014).

HHHED: **The education level of the head of household**. It is expected that, households with higher educational level are more aware of the different benefits that can be gain from improved water services thus a positive relationship is expect. A discreet variable 1 is specified for secondary education,2 is specified for college diploma, 3 is for Bachelor,4 is for Master and 5 is specified for PhD education status (Meron2014).

HHAG: **Age heads of household**. This is a continuous variable with a negative expect sign. This is because older people, who will use to live with freer water supply and less prices, may be reluctant to prefer new improved and less willing to pay for it.

HHHOC: **Occupational status heads of household**. This is a discreet variable would taking 1 if it is self employed,2 if employed in governmental sector,3 if employed in private/NGO sector,4 if it pensioned,5 if it is un employed and 6 if working in other ways(rather than above occupational status categories).There will no prior expectation in this case and it is including testing its effect (Saleamlak, 2013).

HHIN: **Monthly income of the household**s. This continuous variable is a sum of the head's income and the income of other members of the family. The available literature suggests that there is a positive relationship between income and improved water service. Theory also supports this intuition that income and quantity demanded are positively related in the case of normal goods. As a result a positive sign is expect on the variables of income (Meron, 2014).

HOUSE: Ownership of house. This variable is taking as proxy for wealth. It is a dummy variable 1 if the respondent has house, 0 otherwise. The expect sign of the coefficient of this variable will positive, since richer individuals demand for the improved water service is high because they are less resource constrain (Gossaye, 2007).
HHMS: **Marital Status head of households**. This is a discreet variable taking 1 if the head is married, 2 is for Single and 3 is specified for divorced heads. This variable is expect to have a positive sign since married people are more cautious of the health and other risk involved in poor water supply service due to family responsibility in the future than the single ones (Saleamlak, 2013).
HHFS: **Households family size**. There will be two different views concerning the impact of family size on willingness to pay. Some studies show that as the number of family size increases, willingness-to-pay for improved water services will also increase. The rationale given is that, as the number of members increases in a given household, households will be more aware of the risk involved with poor water supply provision. But in our case with limit job opportunities in Addis Ababa, increase in family size will also increase the number of un employee members in the family. Thus it will increase household's expenditure and a growing need to match with one's income. Thus a negative relationship will expect in the second case, due to these either of one will appear (Meron, 2014).

REYS: **Households years of stay in the area**. It is hypothesize that the more households stay in a particular area, the more they will be willing to pay for the proposed improvements since they will know more about the benefits. In addition, there will be sentimental attachments to that area. A positive relationship is thus will expect.
IB: **Initial bid**. This variable will help to see whether household's responses are affect by the initial bid. In the closed ended dichotomous choice format it has a negative expect sign since higher offers are more likely will be reject by respondents. However the coefficient of this variable will difficult to determine a priori in the open-ended format since it will determine by respondents (Saleamlak, 2013).

WBD: **House hold heads or members of the household who suffer from water born diseases** expect will more willing to pay in order to improve piped water service in the city. A positive relationship will thus expect (Saleamlak, 2013).
RLTY: Reliability of the existing source being used. This is discreet variable taking 1 if the existing source is excellent, 2 if it is very good, 3 if it is good and 4 if it is bad. The expect sign of the variable's coefficient will be negative since households WTP for improved water service will be lower if the existing source is reliable (Saleamlak, 2013).
QLTY: Head of household perception level of quality of the existing supply. Without any theoretical a priori, if households perceive a good quality then there will be no incentive for them to prefer the improved system and vice versa. A discreet variable 1 will be specified if existing water supply is excellent,2 if it is very good,3 if it is good and 4 if the existing water supply is bad (Saleamlak, 2013).

Table 3.8 Description of Explanatory variables and expect Sign

No.	Variables	Type	Descriptions	Expect Sign
1.	Hhh SX	Dummy	Sex of household head (1=female, 0 otherwise)	Positive(+)
2.	Hhh AG	Continues	Age of household head	Negative (-)
3.	Hhh MS	Discrete	Marital status of household head (1=married 2= single 3=Divorced)	Positive(+)
4.	Hhh ED	Discrete	Educational status of household head(1=Secondary education 2=College diploma 3=Bachelor 4=Master 5=PhD)	Positive(+)
5.	Hhh OC	Discrete	Occupational status of household head (1=Self employee 2=Employee in governmental sector 3=Employee in private sector/NGO/ 4=pensioned 5=Un employee 6=Work in other ways)	Positive(+)
6.	Hhh FS	Continues	Family size of household	Positive(+) / Negative (-)
7.	Hh IN	Continues	Income of household	Positive(+)
8.	HhhYS	Continues	Year stay of household head	Positive(+)
9.	HOUSE	Dummy	Having of house of household head (1=Yes,0 otherwise)	Positive(+)
10.	QULTY	Discrete	Quality of water households they used (1=Excellent 2=Very good 3=Good 4=Bad)	Negative (-)
11.	RLTY	Discrete	Reliability of water households they used (1=Excellent 2=Very good 3=Good 4=Bad)	Negative (-)
12.	HhWBD	Dummy	Waterborne diseases occurrence in household (1=Yes,0 otherwise)	Positive(+)
13.	IB	Dummy	Initial bid (1=Yes,0 otherwise)	Negative (-)

3.9 Testing the significance level of explanatory variables

The general approach of the contingent valuation technique is to estimate a valuation function that relates the hypothesized determinants with the WTP responses. The variables to be included in the models were mainly based on the degree of theoretical importance, and their significant impact on WTP. Before running the econometric models, it is important to check whether there is multicollinearity problem.

Test for multicollinearity.

Before estimation the independent explanatory variable in the probit and liner regression model it should start with, whether multicollinearity is present or not a simple correlation coefficient matrix was conveyed. Gujarati (1995) establishes a rule of thumb, which says that multicollinearity is a serious problem when the correlation coefficient is 0.8, or above and multicollinearity occurs when two or more predictors in the model are correlated and provide redundant information about the response. Multicollinearity was measured by variance inflation factors (VIF) and tolerance. VIF is the reciprocal of the tolerance value; small VIF values indicates low correlation among variables under ideal conditions VIF<3. However it is acceptable if it is less than 10. According to the rule thumb multicolliniarity is a serious problem if the correlation matrix is in excess of 0.8 and VIF value of stata result is more than 10 (Gujarati, 2004).

Test for goodness of fit

Equivalent to R^2 in a conventional OLS regression model the likelihood ratio index is used to measure the goodness of fit for probit model.The use of conventional R^2 for goodness of fit when the dependent variable takes either 1 or 0 is not appropriate.

A summary measure used which is similar to the conventional R^2 that have been suggested for models with qualitative dependent variable is calculated based on likelihood ratio as follows:

$$1 - \frac{L(\beta 0, \beta i)}{L(\beta 0, 0)}$$

Where $L(\beta 0, \beta i)$ is the maximized value of the log likelihood of the model being estimated, $L(\beta 0, 0)$ is the value of the likelihood estimated only with constant term. This measure has value 0, when the entire slope coefficients are zero, and value 1 when the model is perfect predictor (Gujarati, 2004)

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Descriptive Analysis

4.1.1 Socio Economic Characteristics of sample Household heads

Using a contingent valuation survey, a total of 384 sample household heads were interviewed during the survey, since 9 questioners were lost during collection, 375 samples of household heads were interviewer collected well in 10 sub city's of Addis Ababa. Based on this from the total household heads interviewed, 216(57.6%) were female household heads, while the remaining 159 (42.4) were male household heads. The mean family size of household heads is about 4 members. The data about age of household heads shows that the average is around 40 years which ranges from 24 to 75 years old. Regarding to the marital status of household heads, 41(10.9%) were single, 316(84.3%) and 18(4.8%) married and divorced respectively as shown in table 4.1.

Educational levels of heads of household shown in table 4.1 the minimum was secondary education level, while the maximum level is PhD level. Heads of house hold's educational level likes 8 (2.1%) secondary level, 39 (10.4%) college diploma, 281 (74.9%) Bachelors, 40 (10.7%) masters and 7 (1.9%) PhD level of education they attend respectively.

Concerning the occupational status of household heads, employment in governmental sector, employment in private or NGOs and self employment were took one up to three ranks orderly, these were 130 (34.7%), 121 (32.3%) and 107 (28.5%) respectively.

Table 4.1Socio economic characteristics of household heads

No.	Socio economic characteristics of hhhs	Frequency	Percent
1.	Sex of hhhs 1.Male	159	42.4%
	2.Female	216	57.6%
2.	Marital status hhhs 1. Married	316	84.3%
	2. Single	41	10.9%
	3.Divorced	18	4.8%
3.	Edu.status of hhhs		
	1.Sec.Edu	8	2.1%
	2.College Diploma	39	10.4%
	3.Bachelor	281	74.9%
	4.Masters	40	10.7%
	5.PhD	7	1.9%
4.	Occu.Status of hhhs		
	1.Selfe employee	107	28.5%
	2.Employee in G.sector	130	34.7%
	3.Employee in private sector/NGO	121	32.5%
	4.Pensioned	4	1.1%
	5.Un employed	2	0.5%
	6.Working in other ways(Those are working differ from above occu.status categories)	11	2.9%

Source: Own survey result, 2019

The unemployed number of household heads were 2(0.5%), and the remaining household heads 4 (1.1%) were pensioned, as well 11(2.9%) household heads were working in other ways of occupational structure as shown in table 4.1. The average monthly income of the sample households was Birr 17,500, further more data about the income of households reveals that, there is income disparity between one to other households.

Living conditions of households as shown in table 4.1.1 as shown below, 277 (73.8%) of households are living on their own house and 87 (23.2%) households living in rental ways, where as the remaining 11 (2.9%) households living in different ways, like living with relatives, getting house in gifts from different body's etc, more over the surveyed data shows that, the mean, maximum and minimum living years of households in that area were 28.84, 70 and 1 years respectively.

Table 4.1.1 Living condition of households

Living condition of households	Freq	% of response
Living on their own house	277	73.8%
Living in rental ways	87	23.21%
Living in other ways(Households living differ from above way of living conditions)	11	2.99%
Total	375	100%

Source: own survey result, 2019

Attempts were also made to the wealth status of the sampled household heads. Based on this, from the total sample household heads 288 (76.8%) have their own house, 87 (23.2%) had not their own house. Car ownership of sample households also shows that 141 (37.6%) have car and 234 (62.4%) do not have car.

Data about home ownership basic infrastructures shows that about 352 (93.9%) had refrigerator, 23 (6.1%) had not refrigerator, and also 376 (99.5%) had television while 2 (0.5%) had not television, 375 (100%) household heads had cell phone. Regarding to having any formal bossiness to household heads 117(31.2%) had formal businesses and 257 (68.5%) they did not have formal business.

4.1.2 Households expenditure for basic items

With regard to expenditure on selected basic items as shown in table 4.1.2 below, the mean spending for food was birr 2,331.76, the mean expenditure for water was birr 38, the mean expenditure for electric city birr was 384.1, the mean expenditure for house rent birr 722, the mean expenditure for transport birr 446.85, as well mean expenditure for education was birr 939.53 and for other items were birr 1,786.407 respectively. Based on the above survey result expenditure for food which is 2,331.76 birr, took the lion share as compared to other basic items expenditure.

Table 4.1.2Households expenditure for selected basic items

Descriptive Statistics			
Expense category	N	Mean	Std. Deviation
HHs spending for Food in birr per month	375	2331.76	1154.71
HHs spending for water in birr per month	375	38.00	30.58
HHs spending for Electricity in birr per month	375	348.10	184.31
HHs spending for house rent in birr per month	375	722.00	1359.83
HHs spending for Transport in birr per month	375	446.85	248.22
HHs spending for Education in birr per month	375	939.53	685.74
HHs spending for other items/services	375	1786.40	687.95

Source: own result, 2019

Attempts also made households their current standard of living regarding to their income, based on this 183 (48.8%) households the income they earn is less than adequate for their needs, where as the income they earn for 169 (45.1%) of households is just adequate for their needs and 16 (4.3%) of households they do not now weather the income they earn is adequate or not for their needs.

4.2 Existing Water Supply Condition of the sampled households

Most of surveyed sample households, 305 (81.3%) used private piped connection water sources. Of the total surveyed households about 291 (77.6%) of the households had private pipe water source connection, where as 84 (22.4%) they did not have private pipe connection.

Table 4.2 Types of water sources and mean amount households used, and its mean expenditure on average per month on each water sources.

Descriptive Statistics			
	N	Mean	Std. Deviation
Amount of water HHs used from private piped water connection per month in liter	375	1821.12 Littre	1245.544
HHs expenditure for private piped connection they used in birr	375	11.58 birr	11.382
Amount of water HHs used from public point water per month in liter	375	67.13 Litter	193.748
HHs expenditure for public tap water sources in birr	375	3.21birr	9.143
Amount of water HHs used from own private well water sources , per month in liter	375	25.07 Litter	117.453
HHs expenditure for own private water sources in birr	375	1.41birr	8.889
Amount of water HHs used from shared connection water sources per month in liter	375	254.48 Litter	472.847
HHs expenditure for shared connection water sources in birr	375	7.48 birr	13.592
Amount of water HHs used from protected spring water sources per month in liter	375	12.83Litter	95.381
HHs expenditure for protected spring water sources they used	375	.55 birr	3.573
Amount of water HHs used from other sources	375	7.4 Litter	12.825
HHs expenditure for other sources	375	13.7 birr	97.721
Valid N (list wise)	375		

Source: own result, 2019

Since they are living in rental ways, 73 (19.5%) households were not using private pipe water supply connection ,7 (1.9%) households they do not used private pipe connection because of unavailability of water connection,1(0.3%) households is due to high monthly charges ,1(0.3%) was said in waiting to use it. Only 1 (.0.3%) was because of other reasons, where as 291 (77.6%) of them were used private pipe water sources. The survey result also shows that sampled households on the average consumed 3.63 jerrycan or 72.6 liters of water per day.

4.2.1 Quality, quantity and reliability of current water supply source

Regarding to the quantity, quality and reliability of current piped water supply source as indicated in table 4.2.1 below, most household's response the amount of water delivered and quality is good relative to reliability

Table 4.2.1 Households attitude towards current water supply

performance	Quantity		Quality		Reliability	
	Freq	%of response	Freq	%of response	Freq	% of response
Excellent	1	0.27%	3	0.8%	3	0.80%
Very good	17	4.53%	14	3.73%	14	3.73%
Good	250	66.67%	344	91.74%	156	41.60%
Bad	107	28.53%	14	3.73%	202	54%
Total	375	100%	375	100%	375	1000%

Source: Computed own survey result, 2019

Of the total surveyed households 202 (54%) of them responces the existing water source was unreliable and they complained to its unreliability, as well they expressed the reliability in stage of bad, only 156 (41.6%) them said good regarding to reliability of the current water source. Related to the quantity and quality of current water source they used, 250 (66.67%) was expressed in good where as 107 (28.53%) expressed it the water quality in bad, but when we see the quality of the current water sources, 344 (91.7%) and 14 (3.73%) expressed in good and bad respectively. This shows the quality of current water source households are using is good, as compared to quantity and reliability.

Regarding to the quality of water, 270 (72%) of households were not using any purification method before drinking and for domestic use, where as 105(28%) households were made purification before use for drinking as well for domestic use. The reasons those households who were not using purification were, 26.4% said because of since the water is clean, 21.1% of households said lack of equipment for purification, 11.5% said since assuming no side effects on our health, 6.1% and 2.9% of household head households said since it is time consuming process and no idea about purification of water respectively.

With regard to all time availability of water in 24 hours, only a small proportion of respondents were said the water availability well, while most of household heads condemned the availability of it. When we see the time of they were facing unavailability in twenty four hours, 28.8% said in the morning time, and 48.5% said in day time, 12.5% and 9.3% of them were said in noon and night time, where as 0.8% them said none. based on this the surveyed result shows that the mean of unavailability was 19.13 hours per day and only 8.06 mean of hours they get piped water in a day.

4.2.2 Member of households who fetch water from sources

In table 4.2.2 shown below about fetching non piped water from the source indicated, 321 (85.6%) said women's, 32 (8.5%) household heads said children's, where as 21 (5.6%) of household heads said men's.

Table 4.2.2 Member of households who fetch water from the sources

Member of households	Freq	%of response
Women's	321	85.6%
Children's	33	8.5%
Men's	21	5.6%
Total	375	100%

Source: own s result, 2019

As show in table 4.2.2 women's took the lion share in fetching water for households different activities from the sources as compare to children's and men's.

4.2.3 Water born disease episodes

Water quality and related disease episodes are directly related. As the water quality becomes good the chance of getting water born disease such as typhoid, diarrhea, cholera and others. When we see the number of ill related to water borne disease during last year 84 (22.4%) them ill related to this, where as 291(77.62%) were not. Regarding to this 29 (7.73%) were with diarrhea, 46 (12.26%) of them with typhoid, as well 1 (0.26%) with cholera and 8(2.13%) of them were with others of water bore related disease in the last one year as shown in table 4.2.3 below.

Table 4.2.3 Households disease episodes in last 1 year

No.	Types of water born disease occurred in last 1 year	Frequency	percent
1.	Typhoid	29	7.73%
2.	Diarrhea	46	12.26%
3.	Cholera	1	0.26%
4.	Other water born disease	8	2.13%
5.	No disease episodes in case of water born	291	77.62%
	Total	375	100%

Source: own result, 2019

4.3 Households willingness to pay for improved water supply service

The provision of improved water service among other things means, good quality of water which is safe for health and an increased amount of water available for use. It also means a highly reliable source at any time or 7 days a week 24 hours a day, moreover households need not have to spend their time, money and efforts in fetching water.

As shown in table 4.3 below with regard to households willing to participate in water improvement program, 367 or 97.9% of them shows there willingness, whereas 8 or 2.1% of them refused their willingness in participating on it. As well, result of household's willingness to pay additional birr/cents 339 or 90.4% were shows their willing and 36 or 9.6% households refused it.

Table 4.3 Households willingness to participate, pay additional birr/cents and willingness to pay any amount for improved water services.

HHs willingness to pay additional birr/cents per jerica			
		Frequency	Percent
Valid	No	36	9.6
	Yes	339	90.4
	Total	375	100.0
HHs willing to participate in water improvement program			
		Frequency	Percent
Valid	No	8	2.1
	Yes	367	97.9
	Total	375	100.0
HHs willing to pay any amount of price if improved ppc			
		Frequency	Percent
Valid	No	185	49.3
	Yes	190	50.7
	Total	375	100.0

Source: own result, 2019.

Regarding to willing to pay any amount of price for improved water supply services, 190 (50.7%) households show their willing whereas, 185 (49.3%) were not show their willing to pay any amount as shown in table 4.3 above.

Table 4.3.1 Descriptive statistics result of household's willingness to participate, pay additional birr/cents and willingness to pay any amount for improved water services.

Descriptive Statistics				
		HHs willing to participate in water improvement program	HHs willingness to pay additional birr/cents per jerica	HHs willing to pay any amount of price if improved ppc
N	Valid	375	375	375
Mean		.98	.90	.51
Std. Deviation		.145	.295	.501

As shown the result in table 4.4, households mean willingness to participate in the water improvement program, HHs willing to pay additional birr or cent per jerican and HHs willing to pay any amount of birr or cent for improved water supply services were, 0.98, 0.90 and 0.5 respectively.

Table: 4.4 Summary of maximum willingness to pay

No.	Maximum WTP	No. of survived households	Percentage	MWTP in Birr
1.	0cents	37	9.86	0
2.	5cents	3	0.80	0.15
3.	10cents	10	2.40	1
4.	15cents	7	1.87	1.05
5.	20cents	2	0.53	0.40
6.	25cents	4	1.07	1
7.	30cents	10	2.67	3
8.	40 cents	5	1.33	2
9.	50 cent	15	4	7.5
10.	75cents	6	1.60	4.5
11.	100cents	85	22.67	85
12.	200cents	44	11.73	88
13.	300cents	64	17.07	192
14.	400cents	57	15.20	228
15.	500cents	19	5.07	95
16.	600cents	4	1.07	24
17.	700cents	3	0.80	21
	Total	375	100	755.10

Source: own result, 2019

As shown in table 4.5 above, if the improved system is implemented, for a bucket or 20 liters of water, 82 (21.8%) of household heads expressed their willingness to pay 100 cents, and 64 household heads or 17.07% of expressed their willingness to pay 300,as well 57(15.2%) heads expressed their maximum willingness to of 400cents. The maximum cents household heads willing to pay in the result was 700 cents which were 3 of them (0.8%) shows their maximum willingness for 20 liter or 1 bucket, and the remaining results are shown in the table above. If we multiply the reported maximum willingness to pay (MWTP) by corresponding number of household heads and divide the sum by total surveyed household heads of 375 we get of 2.01birr, which is the surveyed household heads are mean maximum willing to pay, on average, for a bucket or 20 liters of improved water services they can get from the improved scheme. If we multiply the average willingness to pay of surveyed households of 2.01 birr for a bucket or for 20 liters of water they will get from the improved services by households average daily consumption of 3.63 bucket or 72.6 liters of water and then if we multiply the results by

30 days we get average monthly willingness to pay of sampled households of Birr 218 birr. This average monthly maximum willingness to pay of the sampled household heads accounts for 0.0124% of average monthly income of the surveyed households of Birr 17,500, which is below 1% generally believed ceiling for the ratio of water tariffs to total household expenditures.

The tariff structures of the city water supply office at the time of survey, the price of one bucket or 20 liter of water was 0.5 cents for consumption from 0 to 7 m3, as shown in chapter two AAWSA data of 2019 in table 2.1.4.

This shows that the current water tariff structure is much more below the price customers are willing to pay. Thus if the improved system is introduced in addition to addressing the water need of the city the authorities can also collect more revenue from water sales which can be used for water expansion purposes.

Table 4.5 Mean Willingness to pay result of Sub citys

No.	Sub-city's	Observation	Mean	Std.Dev
1.	Yeka	46	1.87	1.69
2.	Bole	42	1.69	1.66
3.	Arada	29	2.2	1.33
4.	Lideta	27	1.59	1.66
5.	Addis Ketema	33	2.14	1.83
6.	Nifas silk	42	2.41	1.90
7.	Akaki	24	2.12	1.11
8.	Gullele	35	1.89	1.54
9.	Kolfe	67	2.15	1.57
10.	Kirkos	30	1.88	1.76
	Total	375		

Source: own result, 2019

As shown in the table 4.5, result of mean of maximum willingness of household heads of surveyed subcitys, maximum mean willingness to pay of Nifas silk sub city household heads was 2.41 which was higher than others maximum mean willingness results. Next to nifas silk, arada and kolfe sub city surveyed household heads takes the

2.2 and 2.15 in second and third place in result of maximum mean willingness to pay for proposed improved water supply services.

4.6 Reasons for not willingness to pay for improved water supply service

In the table 4.6 as shown below, 31 (8.3%) of household heads were not willing to pay any cents or birr for the new improvement program because of they believed that water should be provided free of charge, where as 5 (1.3%) because of the reason they are satisfying with the existing source.

Table 4.6 Reasons of households their maximum willing to pay is zero

Reasons for un willingness		Frequency	Percent
Valid	Households show their willingness to pay	323	86.1 %
	Water should be provided free of charge	30	8.0%
	I satisfied with the existing source	5	1.3%
	I do not have enough money	15	4.0%
	Other reasons	2	0.5%
	Total	375	100.0%

Source: own result, 2019

The reason of remaining 8 (2.1%) households were they do not have enough money to pay for new improved water supply service, where as 323(86.1%) households show their willingness to pay as shown in table 4.6 first column above.

4.7 Determinants of Willingness to pay

There are many factors those determines willingness to pay for improved water supply service like factors under socio economic and demography were income, gender, level of education, household size, housing or living condition, age as well level of satisfaction regarding existing water supply situation. This all are some of factors affecting on willing to pay for improved water supply service.

4.8 Estimation of mean willingness to pay.

We have discussed in the methodology section probit model is employed to analyzed factors that determine household heads willingness to pay for the improved water supply services for single bounded dichotomous choice question survey responses.

Test for multicollinearity

Not that, where the explanatory variables are highly inter-correlated it is difficult to disentangle the effects of explanatory variables on the dependant variable. And to minimize the problem we did multicollinarity test. The result indicated the correlation matrix among the explanatory variables is below 0.8(See annex I).

Multicollinearity was measured by variance inflation factors (VIF) and tolerance. VIF is the reciprocal of the tolerance value; small VIF values indicates low correlation among variables under ideal conditions VIF<3. However it is acceptable if it is less than 10.

Using command, display "tolerance"="1-e (r2) "VIF=1/ (1-e (r2)) on stata software the value of VIF = 1.0895. Since the result of correlation matrix and VIF value is less than 0.8 and10 respectively, we can say multicollinarity is not a serious problem in our data.

Test for goodness of fit A summary measure used which is similar to the conventional R^2 that have been suggested for models with qualitative dependent variable is calculated based on likelihood ratio as follows:

$$1 - \frac{L(\beta 0, \beta i)}{L(\beta 0, 0)}$$

Where $L(\beta 0, \beta i)$ is the maximized value of the log likelihood of the model being estimated, L (β0, 0) is the value of the likelihood estimated only with constant term.

In our probit model this summary measure is: $1 - \frac{(-31.88877)}{(-120.80378)} = 0.73$

This result indicates that our probit model explains about 73% of the variation.

4.8.1 Sex of household heads

The dummy variable, sex of household heads has positive sign as expected also statically significant at 10% and the marginal effect of this variable implies that female household heads have 2.45% more probability than males; this may be true because females are usually responsible for water supply and management in the house. Similar result was obtained that done by Meron (2014).

4.8.2 Age of household heads

The continuous variable age has negative sign as expects and statically significant at 1% level of significant. This result shows that other things remaining constant, when the age of household heads increase by 1 year the probability of willing to pay for improved water supply services decreases by 0.023%.Thus,as the age of household head increases their willingness to pay for the improved water supply services decreases. This may be due to as age of household heads increases, producing economy regarding to income decreases and leads to a decreases in their willingness to pay. Similar result was obtained that done by Gossay (2007).

4.8.3 Martial status of household heads

In table 4.8 as shown below, a discreet variable marital status has positive sign as expected and significant at 10% of significance, which implies married household heads are more willing than single and divorced household heads by 26.9%, for the provision of improved water supply services and this is the reason married heads have more responsibility for the family members as compared to single and divorced heads. Similar result was obtained that done by Salamlak(2013).

Table 4.8 probit model estimation results

Variables		Coefficients.	Robust Std. Err.	P-value	Marginal effects (dy/dx)
Hhh SX	Female	.3294698	.1788764	0.065*	0.0245797
Hhh AG		-0.0480593	0.0166643	0.004***	-0.0002376
Hhh MS	Married	.297125	.2608284	0.025*	0.2691932
	Single	.304266	.2860431	0.543	0.2789991
	Divorced	.0848327	.4266393	0.842	0.2674872
Hhh ED	College diploma	1.632547	.5566277	0.003***	0.0071808
	Bachelor	1.347138	.4561164	0.001 ***	0.0076463
	Masters	1.036433	.5056461	0.040 *	0.0082381
Hhh OC	Self employee	.0163321	.2475012	0.874	0.0065718
	Employee in Gov.ntal sector	-.0808634	.223791	0.718	-0.0076446
	Employee in private sector/NGO/	.0154199	.2325003	0.947	0.0070636
	pensioned	-.6452683	.7027878	0.359	-0.0091088
	Work in other ways	.0154199	.5566956	0.978	0.010003
Hhh FS		0.0704508	0.103706	0.497	0.0003483
Hh IN		0.0001339	0.0000395	0.001***	0.066207
HhhYS		0.0175785	0.0196662	0.371	0.0003869
HOUSE		0.0284162	0.384798	0.941	0.0021374
QULTY	Very good	.7954332	.834731	0.431	0.0210435
	Good	1.788869	.7556961	0.018 **	0.0268267
	Bad	.7968336	.824622	0.334	0.0382815
RLTY	Very good	1.034507	.9040114	0.252	0.0437415
	Good	-.7328281	.7619947	0.086*	-0.0313965
	Bad	.9597516	.7594723	0.206	0.0232853
HhWBD		0.5458615	0.6037644	0.366	0.0018948
_cons		2.02998	1.307942	0.423	

No. of observation = 375

LR chi2 (13) = 177.83

Prob > chi2 = 0.0000

Pseudo R2 = 0.7360

Log likelihood = -31.887715 *** Significant at 1% level of significance ** Significance at 5% level of significance, *Significant at 10% level of significance

4.8.4 Educational status of household heads

Educational status of household heads, which is discreet variable, has positive sign and heads those have status of college diploma significant at 1% level of significance and 0.71% more willing to pay than other educational status of household heads. Household heads have bachelor educational status were significant at 5% significance and 0.76% more willing than other educational status, beside this those have masters educational status were significant at 10% significance and 0.82% more willing. From this we understood that as educational status of household heads increases their willingness to pay for improved water supply services also increases other things being constant.

4.8.5 Income of households

Continuous variable income of the households which is positive sign as expected and significant at 1% level of significance, this confirms the demand theory of normal good and suggest that one birr increases in the income of households, the probability of willing to pay for improved water services is increase by 6.62%, other things being constant, Wubalem (2014) also obtained same result.

4.8.6 Quality of water supply

The discreet variable existing quality of water has a positive sign but unexpected and when the existing quality of water is good status, it is statically significant at 5% level of significance and household heads are 2.1% more willing to pay for improved water supply service, as shown in table above, Medhin(2006) also obtained the same result .

4.8.7 Reliability of water supply

The discreet variable reliability of existing water source has negative sign as expected, and when the reliability of existing water status households receive is in good condition, it is statistically significance at 10% level of significance and this shows that if the reliability of existing water source is good the probability of household's willingness to pay for the improved water services decreases by 3.1%, being other things remaining constant, Salamlak (2013) also obtained same result.

Table 4.8.1 WTP probit model estimation result

Variable	Coefficients.	Robust Std. Err.	P-value	Marginal effects (dy/dx)
IB	-1.4701517	8.212775	0.000***	-0.0232438
_cons	4.102998	1.807942	0.023	

Number of obs = 375

LR chi2 (1) = 124.68

Prob > chi2 = 0.0000

Pseudo R2 = 0.5160

Log likelihood = -58.463587

*** Significant at 1% level of significant ** Significance at 5% level of significance, *Significant at 10% level of significance

4.8.8 Initial bid

The coefficient of starting bid price as shown in table 4.8.1 has negative sign as expected and significant at 1% level of significance. The negative sign and the significance of this coefficient indicated that as the starting bid price increases by 1 cent, the probability of household heads willing to pay for the improved water services reduced by 2.3%, same result and sign in lines with salamlak (2013) and Gossaye (2007).

Discreet variable occupational status of household heads who are working in governmental sector and pensioned, they do not show their willingness to pay for improved water supply services, this may be due to the assumption of it is an obligation of government providing improved water supply services to households, but it is insignificant factor for willingness to pay for improved water supply service.

Household's ownership of house dummy variable result shown in table 4.8 has a positive sign as expected and implies those have house are more willing to pay for improved water supply services than those have not, but it is insignificant factor.

Continues variable family size of households result has positive sign and this shows as family size increases households willingness to pay for improved water supply increases but it is not significant factor as shown in table 4.8

Continuous variable household's year of stay in the area has positive sign as expected and tells as households those are living long years in the area are more willing to pay than those living few years but it is not significant factor as shown the result in the above table.

The dummy variable water born disease result has a positive sign as expected, which implies households those were suffer in water born disease are more willing to pay for the provision of improved water supply services than those households not suffer in water born diseases, because of households who suffer the disease related to water born knows the problem, but it is not significant factor as shown in table 4.8.

As described in the methodology part, for the probit model the mean WTP for dichotomous choice contingent valuation survey responses can be calculated by dividing the negative of the regression constant/intercept/ by the bid coefficient.

The mean WTP (μ) using the model results shown in table **4.8.1** for the single –bounded probit model format can be defined as follows: $=- \beta_0/\beta =$ - 4.102998/-1.4701517= 2.78 birr. Thus, we conclude that the mean WTP obtained from the closed ended format is 2.78 birr for the proposed improved water supply services per one bucket or 20 liter of water.

4.9 Results and Discussion of Linear Regression

As we have tried to explain in the methodology section, household heads willingness to pay for the improved water service in addition to the probit model, we estimated the linear regression model. The stata outputs of the linear regression model coefficients are shown in the table 4.9 below.

4.9.1 Sex of household heads

The dummy variable sex of household heads result shown in table 4.9 has positive sign as expected and female household heads is significant at 10% significance. This significant result implies that, female household heads willing to pay is increases by 5.8% for improved water supply services than male household heads, this may be due to the reason that females are usually responsible for water supply and management in the house; similar result was obtained, that done by Meron (2014).

4.9.2 Age of household head

Like in the probit model, age of household head continues variable has negative sign as expected and statistically significance at 1% level, the negative sign and significance of the age continues variable shows that as the age of households head increases by 1 year, their willingness to pay for improved water supply service decrease by 1.1%. This may be due to as age of household heads increases, producing economy regarding to income decreases and leads to a decreases in their willingness to pay other things being constant. Thus, age of household heads is one of determinant factor for willingness to pay; same result was obtained that done by Nqobizwe (2015).

4.9.3 Martial status of household heads

In table 4.9 as shown, discreet variable marital status is found to be positive sign as expected and married household heads result is significant at 1% significance .This implies, married household heads willing to pay increases by 5.7% for improved water supply services. This is the reason; married heads have more responsibility for the family members as compared to single and divorced heads.

Table 4.9 Determinants of maximum willingness to pay

Variables		Coefficients.	Robust Std. Err.	t-ratio	P-value
Hhh SX	Female	.0580014	.0323118	1.80	0.063*
Hhh AG		-.0110018	.0093088	-1.18	0.000***
Hhh MS	Married	.0577339	.0576989	1.00	0.018**
	Single	0.061411	.2015313	1.62	0.411
	Divorced	.0203252	.1041624	0.20	0.845
Hhh ED	College diploma	.4187179	.1814846	2.47	0.014**
	Bachelor	.441032	.1787866	2.30	0.022**
	Masters	.350000	.1868231	1.87	0.062*
Hhh OC	Self employee	.0934579	.028367	0.29	0.310
	Employee in Gov.ntal sector	-.0142344	.0394448	-0.36	0.718
	Employee in private sector/NGO/	0025489	.0387144	0.07	0.948
	pensioned	-.1565421	.2200952	-0.71	0.477
	Work in other ways	.0025489	0918695	0.03	0.978
Hh FS		.0117106	.0577195	0.20	0.418
Hh IN		0.05306	.000158	0.30	0.007***
HhYS		.0046133	.0074492	0.62	0.536
HOUSE		.0031682	.0412527	0.30	0.762
QULTY	Very good	.6666667	.2736288	2.44	0.015**
	Good	.5794574	.2740559	2.11	0.035**
	Bad	.3095238	.3024053	1.02	0.307
RLTY	Very good	-.2619048	.2822435	0.93	-0.054*
	Good	-.2110312	.2750515	0.77	-0.043**
	Bad	.2511416	.2742643	0.92	0.360
HhWBD		.0914459	.1509468	0.61	0.545
IB		8.039293	1.419816	4.36	0.000***
_cons		-.6687111	.8267548	-0.81	0.419

Number of obs = 375

F(13, 361) = 22.90

Prob > F = 0.0000

R-squared = 0.5889 *** *Significant at 1%, ** Significant at 5%, * Significant at 10%*

4.9.4 Educational status of household heads

The results of Educational status discreet variable as shown in table 4.10, household heads those had college diploma and bachelor status to be found significant at 5% significance, and those has masters educational status significant at 10% significance, this implies that as educational status of household heads increase willingness to pay for improved water supply services also increases keeping other things constant.

4.9.5 Monthly income of households

Household's average monthly income continues variable has positive singe as expected and significant at 1% level of significance. The positive sign and the significance of this variable shows that household heads willingness to pay for the improved water supply services increases by 5.3%, if their income increases by 1 birr, keeping other thing being constant.

4.9.6 Quality of water supply

Quality of existing water discreet variable is found to be positive sign as shown in table 4.10 but an expected and significance at 5% significant implies, when existing quality of water is very good and good status, household heads their willingness to pay for improved water supply service is increases by 66.7% and58%, in other way, if existing quality of water supply service was bad household heads willingness to pay is not such high and insignificance as shown in table above result.

4.9.7 Reliability of water supply

The reliability existing water discreet variable has negative sign as expected and when reliability of existing water supply service is very good and good status, household's willingness to pay for improved water supply service is low and statistically significance at 10% and 5% level of significance respectively. The negative sign and the significance of existing water supply discreet variable status of very good and good indicates that household's enjoying with safe existing water source their willing to pay for improvement water supply services decreases by 26% and 21%. Thus the reliable of the existing water source is one determinant factor.

4.9.8 Occupational status of household head

Occupational status of household heads discreet variable in 4.9 table shows insignificant result and those households working in governmental sector and pensioned one were negative sign result and an expected, this implies household heads pensioned and working in governmental sector are not willing to pay for improved water supply services. This is may be due to they received low income as compared to other occupational status of household heads and may assuming that it is an obligation of government body or an organization of concerned body to supply improved water services for them without any additional fee.

4.9.9 Initial bid

The bid coefficient has positive sign and is statistically significant at 1% level of significance as shown in table 4.9 above. The significance and the positive sign of the bid coefficient in this model indicate the existence of upward bias. As the initial bid increases by 1 cent WTP amount for improved water supply services also increases by 8%. This result is related to the finding of similar study done in Debre-zeit town by Gossaye Fanta (2007).

Household's ownership of house dummy variable result shown in table 4.9 has a positive sign as expected and implies those have house are more willing to pay for improved water supply services than those have not, but it is not significant determinant factor.

Continues variable family size of households result has positive sign and this shows as family size increases households willingness to pay for improved water supply increases but it is not significant factor as shown in table 4.9

Continuous variable household's year of stay in the area has positive sign as expected and tells as households those are living long years in the area are more willing to pay for improved water supply service than those living few years in the area but it is not significant factor as shown the result in the table 4.9 above.

The dummy variable water born disease result has a positive sign as expected, which implies households those were suffer in water born disease are more willing to pay for the provision of improved water supply service than those households not suffer in water born disease but it is not significant determinant factor as shown in table 4.9.

4.9.10 Measure of Goodness of fit of linear regression

The R2 value of 0.589 indicates that the linear regression model explains about 58.9% of the variation in the dependent variable.

4.10. Estimating aggregate WTP and aggregate potential Revenue

In this section, total WTP and total revenue at various prices those household heads would be willing to pay were calculated. The data obtained from contingent valuation survey (CVS) were used to derive the demand curve for improved water supply services.

According to the AAWSA 2019 report the number of households of Addis Ababa those have connection estimated to be,808,714 (AAWSA, 2019).

In order to get the aggregate WTP of the total households, first the estimated number of households in each WTP class interval would be obtained by multiplying the percent of the households in each interval by the total number of households in Addis Ababa city, then the total number of households were multiplied by the mean WTP, to estimate total willingness to pay (TWTP) by assuming the midpoint of each WTP interval as the mean of WTP (Perman et al, 2003).

Thus, the aggregate revenue that can be expected from the provision of improved water supply services, as shown in table 4.10 was calculated by multiplying the mid points of WTP interval (column d) by 375 total number of households WTP for the improved water supply services at list minimum amount (column g).The aggregate revenue expected from the provision of the improved water supply services, if each household consumes only one bucket or 20 liter jerican of water for improved water supply services is shown in the table 4.10.

Accordingly, if the price of one jerica is 0.5 birr, 808,714 households will pay for improved water supply services and the expected revenue would be 404,357 birr per

jerica of 20 liter, while if the price one jerican is 1.55 birr 411,959 households will pay and 638,536.45 birr is expected aggregate revenue. Only 6,470 households will pay if price of one jerica is 6.55 birr and the expected revenue will be 42,378.5 birr as shown in table 4.10 below.

Table 4.10 Estimating aggregate WTP

WTP interval in birr (a)	Freq. distribution (b)	Freq. distribution (%) (c)	Mid–point (d)	Total households (e)	Total WTP in Birr (f)	Minimum number of household WTP (g)	Total revenue in birr (h)
0-1	184	49.06	0.5	396,755	198,377.50	808,714	404,357
1.1-2	44	11.73	1.55	94,862	147,036.10	411,959	638,536.45
2.1-3	64	17.07	2.55	138,047	352,019.85	317,097	808,597.35
3.1-4	57	15.2	3.55	122,925	436,383.75	179,050	635,627.50
4.1-5	19	5.07	4.55	41,002	186,559.10	56,125	255,368.75
5.1-6	4	1.07	5.55	8,653	48,024.15	15,123	83,932.65
6.1-7	3	0.8	6.55	6,470	42,378.50	6,470	42,378.50
Total	375	100		808,714	**1,410,778.95**		**2,868,798.20**

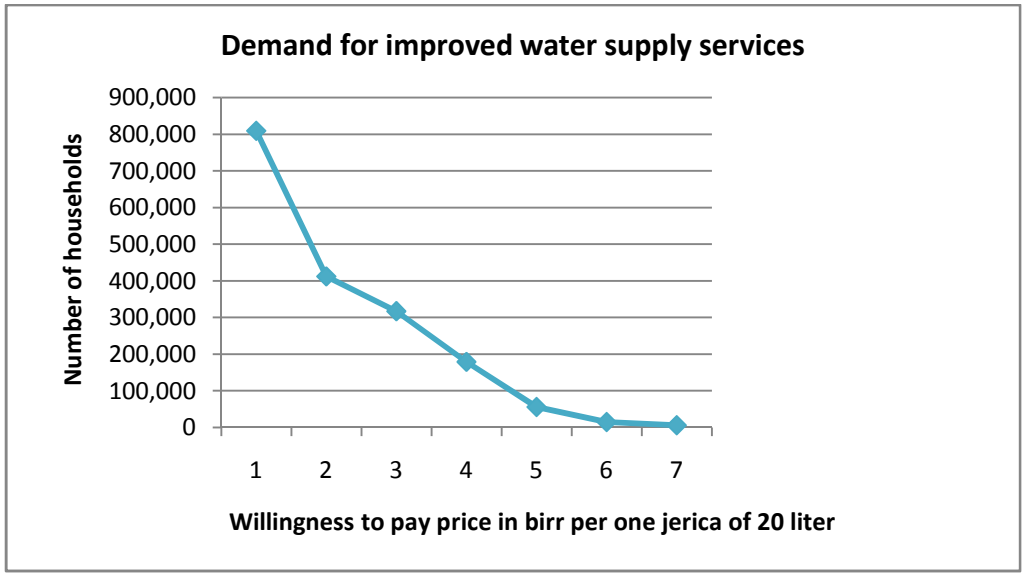
Source: own result, 2019

In the table 4.10 as shown, by summing up the total WTP amount of each class interval the total WTP (aggregate benefit) for proposed improved water supply services is found to be 1,410,778.95 birr per jerican of 20 liter. The total revenue is also estimated to be 2,868,798.20 birr per day or 1,032,767,352 birr per year if water supply service provision was implemented in the city, but in 2019 according to their data shown, AAWSA collected 746,074,146.50 birr from households of Addis Ababa in last year. If the water supply service provision will implement, AAWSA will collect additional revenue **286,693,205.50** birr.

As shown in table 4.10, the projected total number of the households is willing to pay at least the minimum amount for improved water supply services. At low price, large numbers of the total 184 households are willing to pay at least that minimum amount for the proposed scheme, while at high price small number of the total households will pay.

This reflects the inverse relationship between price and total number of the household demanding for improved water supply services. Thus, we can derive the demand curve for the proposed water supply services where WTP class interval are represented in the horizontal axis and total number of household that are willing to pay at least minimum amount is in the vertical axis, as shown in figure below.

Figure 4.10.Demand for the provision of improved water supply service.



In the figure 4.10 as shown above, demand for improved water service decreases when the price of water increases.

CHAPTER FIVE

SUMMRY, CONCLUSION AND RECOMMENDATION

5.1 Summary and Conclusion

Urban water supply provided by public utilities is facing an acute crisis in many developing countries. As such, the urban and industrial centers of Ethiopia are also characterized by poor water supply service. Addis Ababa city is one of the areas faced with unreliable and inadequate supply of water service. As noted above one of the main reason for this acute shortage of water is population increment which creates incompatibility between the supply and demand of improved water service which in turn creates greater burden on the supplier due to financial and management constraints.

This study, attempted to analyze the demand side of improved water supply services with the aspire of looking in to the possibility of cost sharing by households, for the improved water supply services by eliciting their willingness to pay. The study mainly used primary data it is also supplemented by secondary data from different relevant sources.

The contingent valuation method (CVM) is used based on face to face interview with 375 randomly sampled household heads. Further the sample household heads were also asked questions related to demography and socio economic characteristics, problems with the existing water services, their water use practices and some other general questions. The results obtained from the CV survey were analyzed using Stata version 13 and SPSS version 24 software's.

The descriptive analysis showed that out of 375 household heads 81.3% of them confirmed that piped water is the main source of water they are using. The survey result also showed that the mean consumption of water per day was 3.63 jerican (72.6liters of water). 86.1% of household heads were willing to pay additional fee for improved water service per jerican. Regarding to these the mean of willingness to pay for improved water supply service was 2.78 cents per jerican in closed ended format and 2.01 birr in

the open ended format, which is higher than the current water tariff of the city, which is 1.75birr those who consume from 0-7m^3 (0.005 cents per 20 liter jerica).

Household's monthly income, sex of household heads, marital status, educational status, quality and reliability of existing water supply have positive and significance effects on willingness to pay for improved water supply services in the probit result. On the other hand, initial bid price, age of house hold heads have negative and significant effect on the probability of willingness to pay for improved water supply services.

Since the existing water supply system cannot satisfy the existing demand, which leads to the availability of water for some hours per day or makes the availability unpredictable, and forced to buy or fetch unreliable water source as well wastes in time and money in fetching water.

5.2 Recommendation

From the surveyed, to assess their WTP for improvement in the existing water supply service, the following recommendations forwarded.

- The tariff rate household heads were willing to pay is higher than the cost of providing the service. From this, since the cost of providing improved water is less than households mean WTP, if private companies will be involved in this service delivery program they will be benefited and will benefit households as well users of the service. Further, the city water supply service sector will have to provide the service in near future, because most household heads were willing to pay additional fees for improved water service, since the cost of providing the service will be covered by monthly payment tariff in the improvement scheme.
- WTP results provide an early indication of the need for enhanced future management arrangements that are necessary to provide adequate, reliable and sustainable water service. Developing capacity to achieve this change needs to be incorporated in new plans.
- If the city water supply service body or AAWSA, implements provision of improved water supply services to households it can collect additional revenue of 286,693,205.50 birr per year.
- If the city's utility management will implement giving attention to socio economic factors (Sex, Age, Income, Marital status, Occupational status, Educational status) in design water supply service improvement, it can collect more revenue from the sales of improved water supply by charging higher price than the current water price tariff.
- To conclude the recommendation, existing past researches done on affordability and willingness to pay for improved water supply services in different urban area of the country such as Nazret, Holeta and Mekelle reveals that households who were found in urban areas of the country were willing a full cost for the improved water supply services. This helps to maintain the sustainability of the service in good manner.

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Annex I: **Correlation Matrices of Explanatory variables**

	Sex	Age	Mar_st~s	Edu_st~s	Oc_sta~s	T_neti~m	T_numb~d	Living~s	Doyouh~e	Servic~l	Servic~i
Sex	1.0000										
Age	-0.0327	1.0000									
Mar_status	0.2176	0.2771	1.0000								
Edu_status	-0.0262	0.2333	0.0199	1.0000							
Oc_status	-0.0325	-0.0434	-0.1122	0.0127	1.0000						
T_netincom	0.0395	0.5821	0.2645	0.2924	-0.2167	1.0000					
T_numberho~d	0.0225	0.5993	0.1795	0.1858	-0.0651	0.6599	1.0000				
Living_years	0.0454	0.5633	0.3361	0.0664	-0.0160	0.4744	0.4708	1.0000			
Doyouhave_~e	0.0175	0.3486	0.2585	0.0497	-0.0301	0.4718	0.3871	0.5794	1.0000		
Service_of~l	-0.0589	-0.0510	0.0350	-0.1163	-0.0740	0.0018	-0.0337	0.0251	0.0731	1.0000	
Service_of~i	0.0011	0.0333	0.0971	-0.0267	-0.0191	0.0536	0.0440	0.0914	0.1051	0.2389	1.0000
Hasanyone_~n	0.0469	-0.0142	0.0134	-0.0062	0.0089	0.0119	0.1151	-0.0530	0.0555	0.0667	-0.1050
IB	0.0104	0.6169	0.2144	0.1874	-0.0896	0.4497	0.3974	0.3627	0.2815	-0.0263	0.0231

	Hasany~n	IB
Hasanyone_~n	1.0000	
IB	0.0914	1.0000

Source: own survey result using stata version 13

APPENDICES

Annex: II

Addis Ababa University College of Development Studies Center for Environment & Development Studies

INTRODUCTION TO THE RESPONDENT

Dear respondents!

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

If you need any clarification or more information please do not hesitate to contact me through the
following addresses.

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College of Development Studies Center for Environment &Development Studies

Thank you in advance for your cooperation!

Instruction:-

- You are not supposed to write your name
- Mark symbol "**X**", "**Circle" or write** in the boxes or in front of your answer space for your response
- Please limit your answers to only one for each questions

THANK YOU IN ADVANCE!

Part I: Socio Economic Characteristics of Households (Respondents)

Location: Sub city_____ Woreda_____ Kebele_____

Interview Code: _____

1. Sex of household head Male=0 Female =1

2. Age of household head_____ years

3. Marital Status of household head 1.Marid 2.Single 3.Divorced/Separated

4. Educational status of household head: 1.No formal Education 2.Primary education 3. Secondary education 4.College diploma 5.Bachelor 6.Masters 7.Ph 8.If other specify it_____

5. Occupational Status of household head: 1.Self employee 2.Eploye in privet sector or NGO 3.Employe in governmental sector 4.Unemployed 5.Pensioned 6.Others (specify)

6. Total number of household members currently living in the house_____ in number?

7. Total income of household members per month_____ in birr?

8. Number of children, adult and elderly living in the household consequently (≤14, 15-65 and >65years old)?

≤14	15-65	>65
A. Male	A. Male	A. Male
B. Female	B. Female	B. Female

9. Do you rent or own house? 1. Rent 2.Own 3.Specify if any other way_____

10. How long have you been living in this city? _____ Years

11. Do you have_____? (Multiple answers possible)

No.	**Assets name**	**Do you have it? Yes=1, No=0**	**If 'Yes' how many in number**	**Estimated current market value in birr**
1.	Car			
2.	Telephone			
3.	Cell phone			
4.	House			
5.	Refrigerator			
6.	Tape			
7.	Television			
8.	Hotel			
9.	Restaurant			
10.	Cafe			
11.	Any formal business			

12. How much do you spend per month on each of the following items? Pleas fill in the table.

For **unit** use **C**oding **L**itter = 01, **K**g = 02, **m**3=03, **B**irr = 04

No.	Items/services	Amount	unit	Expenditure for it in birr
1.	Food			
2.	Water			
3.	Electric city			
4.	Education			
5.	Medical			
6.	House rent			
7.	Cloth			
8.	Transportation			
9.	Telephone			
10.	Vehicle fuel			
11.	Cooking fuel			
12.	Specify if any other			

13. Considering your current standard of living and income, which is true to you?

1. It is less than adequate for my need 2.It is more than adequate for my needs

3. It is just adequate for my needs 4.Don't know

Part II: Existing Water Supply Situations

Instruction:-

❖ Put symbol "**X**", "**Number" or cods** given according to the type of question in front of your answers. Please Use **coding** for Yes=1, No=0 and also Use for Litter = 01, kg = 02, M3=03, Birr = 04, Meter = 05, for drinking =01, for cooking = 02, Washing clothes = 03, Washing care and gardens = 04 others=05, as well for: - Excellent=1, Very good=2, Good=3, Bad=4 (for Q.16)

No.	1.	2.	3.	4.	5.	6.	7.
Water source	Private Piped connection	River or stream	Public point source	Owen private well	Shared connection	Protected spring	Other sources
14. Do you use the source in the last month?							
Amount							
Unit							
Expenditure for it							
purpose of use							
Distance to source in **meter**							

15. Do you sell it? 1=yes, No=0							
Amount							
Income in birr							
16.Service condition last month in Regarding to							
1. Quantity							
2. Quality							
3. Reliability							
17.Rank your Main source of water for household use							

18. Do you have privet pipe water connection? 1. Yes= 0. =No

19. If your answer is ‘’yes’’ in Q.19, is your private piped connection shared with other households? 1. Yes _____ 0.No____

20. If your answer is ‘yes’ in Q.20, how many households’ share the connection? ____in number

21. If ‘’No’’ in Q.19, reason for not having private pipe connection? 1. Connection fee is too high 2. Monthly charges too high 3. Connection is not available 4.Rented house 5.Waiting list 6. Others (Specify) _____

22. How much water on average do you use for house hold activities in 24 hours? ____ Jerican (20 litters)

23. Do you pay for the current water service? 1. Yes 0. No

24. If you say “yes” in Q. No 24 how much in average per month? _____ birr/cents

25. Do you consider this payment is too high, to afford for you? 1. Yes 0.No

26. How much do you pay for a jerican (20 litters) of water currently? _____in birr

27. How do you judge the existing water supply related to your expense for it?

1. Expensive 2.Cheep 3.Fair 4.Difficult to judge

28. Do you get tap water at desirable time and quantity? 1. Yes 0. No

29. If your answer is ‘No’ in Q.29, from where do you get additional water to satisfy your needs?

1. From river 2.From spring 3.From well 4.Specify if any other source_____

30. In your experience, how often you get piped water in 24 hours? _____hours

31. Is there any time when piped water is completely absent in 24 hours?

1. Yes 0.No

32. If your response is ‘yes’ to question no 32 for how many hours in average? _____hours

33. During at what time you face shortage of water? 1. Morning 2.Day 3.noon 4.Night

34. Do you take any of the following storage regarding the quantity of water received? 1. Store water in tanks 2.Store water in cistern 3.Bucket/vessel 4.Others 5.Non

35. Dose the household use water purification methods before drinking?

1. Yes 0.No

36. If your answer is 'yes' in Q. 36, in what way?

1. Boil and filter 2.Boil 3.Filter 4.Using chlorine/medicine for purifying water 5.Non

37. If your answer is' No' in Q. 36, what is the reason?

1. Since the water is clean 2.Since no side effect on our health

3. No idea about purification of water 4.Since it is time consuming process 5. Lack of equipments for purification

38. Has anyone in your house been ill related to water born diseases in last year?

1. Yes__ 0. No__

39. If your answer is 'yes' in Q.39, what type of water born disease is frequently occurred to your family members? (Multiple answers are possible.)

1. Diarrhea 2.Typhoid 3. Cholera 4. If any please specify it _____

40. How many persons in your household were ill during the last year due to consumption of unsafe water? 1.>1 2.Don't know 3.No sickness due to unsafe water

41. How much was the average cost, per illness spent, in the last year if any? (i.e. medication, Doctor Consultation, etc) _____birr

42. Who fetch water more from the source from your household members?

1. Women's 2.Mens 3.Childrens

Part III: Willingness to Pay Questions

The following questions are based on single bounded dichotomous.

NB: - The term **"Willingness to pay**" Is the maximum amount of individual's state they are willing to pay for particular goods or services based on its characteristics. The provision of improved water service means, good quality of water which is safe for health and an increased amount of water available for use. It is also mean a highly reliable source at any time (7 days a week and 24 hours per day).More over the household is not spend time and effort to fetch water from distance sources.

ENUMERATOR: READ THE FOLLOWING INTRODUCTION

Hypothetical Scenario

Use value of water:-use value of refers to the benefit of an individual receives from its direct use in the production of goods and services and the support of human livelihood. Direct uses of water include drinking, waste disposal industrial processes. For example**,** the use value of water to a manufacturer is closely related to the degree to which water is a necessary part of the production of a given commodity. There are also businesses that bottle and sell springs water for direct consumption. These are examples of water's direct use value.

Non-use value of water:-on the other hand, is not based on the actual use of water. Rather, it is predicted on the notation that people often appreciate water even when they are not actually using it. E.g. Swimming, Fishing, Ecological health etc.

Let us assume you have an option to a private water pipe connection with a provision of improved water supply service and you will charge as per the volume of water you use.

Now a day there is a big difference between the supply and the demand for clean potable drinking water in Addis Ababa city. The reason for excess demand over its supply and shortage of city's water supply are:-High population growth, limited water supply infrastructure, limited water provision capacity and unefficient available source in addition to others are main reasons.

The provision of improved water service among other things requires the construction of additional boreholes, additional water pumps for the new water boreholes to be operational, additional water reservoirs, the construction of pipelines from the boreholes or other water sources to the public taps, to have public taps at different place of the city. 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 request to share the cost of the project. The propose water improvement program goes ahead if the community agrees to share the cost and sufficient funds will generate. The provision of improved water services to the city's community means, provision of good quality water which is safe for health, availability of good quality of water for 24 hours per day and 7 days a week throughout the year, and also the family need not have to spend its time and effort in fetching water from distance source.

However, all households of the city, 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 for the next years in your monthly bills.

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

1. Yes 0.No

44. If ''yes'' in Q.44 suppose that the city's water service office make the improve water service available, will you be willing to pay additional birr/cents per jerican (20 litter container) from previous pay? 1. Yes 0.No

45. If the answer to Q.45 is '' Yes'' ask the following question. If the price of water per jerican from the improve water service is **5/10/15** cents per jerican (20 litters) in addition to previous payment, will you be willing to pay? 1. Yes 0.No

46. Are you willing to pay **50** cents per jerican for improved water service?

1. Yes 0. No

47. What is the maximum amount you can pay, for one jerican of water from this improve water scheme? _____ birr/cents?

48. Are you willing to pay any amount of price, if you have improved private water pipe connections? 1. Yes 0.No

49. (**To enumerator**) - If the maximum amount that they will like to pay for the improve water service they will get from the improve scheme is ‘’zero’’, ask them why do not want to pay? 1. Water should be provided free of charge 2. I satisfied with the existing source 3. I do not have enough money 4.Specfiy if any reason_____