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ESTIMATION OF TOTAL ECONOMIC VALUE OF DOMESTIC WATER SUPPLY SERVICES: AN APPLICATION OF CONTINGENT VALUATION METHOD FOR HAIK TOWN

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A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT FOR THE DEGREE OF MASTER OF ARTS IN WATER AND DEVELOPMENT STUDIES (WATER RESOURCE PLANNING AND MANAGEMENT)

July 2011

Addis Ababa

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
INSTITUE OF DEVELOPMENT STUDIES (IDS)

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Water and Development

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Acknowledgment

First of all I would like to express my appreciation to my organization, Myungsung Christian Medical Center (MCM), for allowing me to pursue my study.

I would like to express my special gratitude to my university advisor, Mebruk Mohammed (PhD), whose intellectual advice, guidance and regular discussions were very valuable and inspiring in the process of the proposal writing, research undertaking and report writing.

My special appreciation goes to my brother Getachew Ahmed (Research Fellow, Ethiopian Economics Association) for his time and effort in proof reading of my work, thoughtful comments, suggestions and discussions which highly contributed to the improvement of the content of my thesis. I also extend my heartfelt thanks to my friends and those involved in data collection for their engagement and for devoting their time.

I extend my appreciation to Haik Town Administration Office for their contribution to this research work in arranging and providing information.

Finally, had it been possible, I would be more pleased listing all those who support me during my study. However, I extend my gratitude for all who were on my side.

Table of Contents

List of Tables

Acronyms

AIC	Average Incremental Cost
ADB	Asian Development Bank
CSA	Central Statistical Authority
CVM	Contingent Valuation Method
CV	Contingent Valuation
CVS	Contingent Valuation Survey
DWS	Domestic Water Supply
hh	household
HPM	Hedonic Price Method
ICWE	International Conference on Water and the Environment
INR	Indian Rupee
lpcd	litter per capita per day
MoWR	Ministry of Water Resource
NOAA	National Oceanographic and Atmospheric Administration
OLS	Ordinary Least Square
TCM	Travel Cost Method
TEV	Total Economic Value
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Education Scientific and Cultural Organization
USD	United States Dollar
WHO	World Health Organization
WTA	Willingness to Accept
WTP	Willingness to Pay
WWAP	World Water Assessment Program

Abstract

This study analyzes the willingness to pay for improved water supply services by households for Haik town. The Contingent Valuation Method (CVM) was utilized to obtain estimates of Willingness to Pay (WTP) for improved domestic water supply services to current and future generations. Analysis of bid function underlying the WTP responses was undertaken, with a range of explanatory variables being investigated. In this contingent valuation survey, we adopted a dichotomous choice with follow-up debriefing questions, as well as open-ended follow-up question to model individual's WTP. Descriptive analysis as well as two analytical models namely Tobit and Probit model and Ordinary Least Squares (OLS) were used. A sample of 145 household heads was taken. We used stratified sampling method followed by simple random sampling to select the required sample. The survey was conducted using a face- to- face interview to the selected sample of household heads. The study results show that the mean annual WTP of Total Economic Value (TEV) of improved domestic water supply services is about 239.28 Birr per annum, which seems to be a significant amount based on key socioeconomic explanatory variables suggested by economic theory. The mean WTP values are 24.75 and 27.37 cents per Baldi (a 20 liter bucket) for the improved water supply service as calculated from the Tobit and Probit models, respectively. The total WTP amount from the total of 4,590 households in the study area of Haik town is Birr 1,136.03 per Baldi or Birr 4,544.12 per a day at average service fee of 24.75 cent per Baldi. Accordingly, the mean WTP is unlikely to be a realistic value that can gauge the TEV of improved domestic water supply services. However, the study also shows that the TEV of improved domestic water supply services is likely to be difficult to estimate.

Keywords: *Contingent valuation method; Economic value; Willingness to Pay; Domestic water supply services; Haik town.*

Chapter One: Introduction

1.1. Background

In many parts of the world water is becoming a scarce good (Postel et al. 1996; Gleick 1996; United Nations 1997). And as water resources provide important benefits to humankind (both commodity benefits and environmental services), several academics hold that water will be 'the oil of the twenty-first century'.

Due to the increasing scarcity of water, competition and conflicts among uses and users of water arise. It is therefore necessary to make decisions about conservation and allocation of water that are compatible with social objectives such as economic efficiency, sustainability and equity.

Like other ecosystem services, the value of water derives from its importance and contribution to the well-being of humankind and other life on earth. Fresh water is essential to the survival (physiological need) of all living creatures including human beings (provisioning services).Water also provides indirect use benefits as an intermediate input in economic production(irrigation and industry) and in maintenance of critical ecological processes and functions (ecological production, for example, regulating and supporting services). People also use water for recreational, aesthetic, social and religious purposes (cultural services). The above economic, ecological and socio cultural values of water are conceived and measured indifferent ways, depending on disciplines of study and philosophical conceptions of enquirers.

The Dublin Statement (ICWE 1992) made in January 1992 and elaborated in Agenda 21 of the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992 (UNCED 1992), addressed the need for an integrated management of water resources. These documents stated that water should be regarded as an economic good. Later, at the Second World Water Forum held in The Hague in 2000, agreement was reached that the full resource value (economic, social, cultural and environmental) should be recognized in water management decisions, and that changes in perceptions and attitudes are required at all levels to reflect the true value of water as a resource (World Water Council 2000).

Therefore, the concept that water should be recognized and treated as an economic good has already been accepted and enshrined in official international commitments throughout the world.

Water services are often acquired (provided) free of charge or at a price that usually does not reflect its true social value. The consequence of this wedge between private and social value is typically suboptimal use of the service, including over-pollution. Valuation helps to assess magnitudes and identify causes of such divergences between private and social values, and hence generates valuable information for the appropriate policy intervention options to correct imperfections in supply and use of water services. Examples of such institutional and policy failures include open access to water, pollution externalities and the use of water as public or collective good for recreation, waste assimilation, flood mitigation, navigation, and so on. In such situations, water valuation is useful in designing water-pricing policy and selection of the appropriate economic instruments to achieve better use of water resources. Instruments for economically efficient water use include assignment of property rights, creation of water markets, taxes on water depletion and pollution, and incentives for water conservation.

To fully assess the economic desirability of environmental policies, analysts must estimate the value of non-market commodities. Overlooking or ignoring the services provided by non-market commodities in cost-benefit analyses and other empirical economic studies severely undermine the accuracy and relevance of the results. Since the 1960s, several non-market valuation techniques have been developed in recognition of the importance of these services. Of these techniques, the most commonly used is contingent valuation (CV). Its flexibility facilitates valuation of a wide variety of non-market goods, including those not currently provided. Perhaps more importantly, CV enables researchers to assess total value that include passive use value.

In many instances, the magnitude of passive use value may be substantial. However, it has often gone unmeasured. Inclusion of passive use value potentially increases the stakes in natural resource damage assessments and may tip the scales in favor of preserving natural resources over development in individual project analyses.

World Health Organization (WHO) defines domestic water as being "water used for all usual domestic purposes including consumption, bathing and food preparation". The quantity of water delivered and used for households is certainly an important aspect of domestic water supplies which influences hygiene and thus public health.

Governments in developing countries have often subsidized water supplies, typically in an attempt to achieve social and health benefits for low-income households that comprise a large majority of the rural population (Whittington et al. 1998). Furthermore, developing countries have made huge investments in their rural water supplies under the presumption that local communities will be involved in their maintenance and operation.

Many scholars claim that water-supply projects will be sustainable when consumers are willing to pay user charges that are sufficient to cover all costs in excess of grants. WTP can be taken as an indication of the demand for improved services and their potential sustainability (Kaliba et al. 2003). In contrast, other observers have concluded that rural water systems are unlikely to be sustainable unless grants are available to finance most or all initial construction costs (Bohm et al. 1993).

Water supply service in Ethiopia is far below the required level. According to Central Statistical Authority (CSA 2000) cited by Ministry of Water Resources (MoWR 2003) states that for all the water development activities achieved so far, the average access to safe water supply is 28% of the total population of Ethiopia. The average per-capita consumption in urban areas is close to 15 *lpcd* (litter per capita per day). This can be taken as an example of a very low supply and coverage level.

Lack of adequate and safe water supply and sanitation remain two of the main transmitters of disease in Ethiopia such as diarrhea, cholera and dysentery, which are potential causes of loss of life especially in the case of children. Moreover, water and sanitation inadequacies hinder economic and social development that constitutes a major impediment to poverty alleviation.

Hence, in order to assess the household willingness to pay (WTP) for improved water supply services the study employed a contingent valuation method (CVM). This method involves obtaining direct information from individual household about their WTP for improvement in water service. Thus, this study tries to estimate the total economic values for improved water service by households of the Haik town based on their WTP.

1.2. Statement of the Problem

Regarding water as an economic good can be one of the tools used to improve water resources management. Attributing economic values to water is in that case a necessary task. But estimating the value of water is complex, because, given its physical nature, the economic valuation of many of its benefits and services is a controversial issue. As a commodity, water has special features; for example, nature provides its supply partly as a store and partly as a flow, and it is available without cost in some locations but at a rather high cost (due to transportation) in others.

However, measures of economic value provide useful policy information to guide decision-making and strategic planning for development and allocation of water resources towards the goals of efficiency, equity and sustainability. Efficient and equitable allocation of water takes into account the value of water used by competing end-users in the present generation, the allocation of resources between present and future generations, and the degree of treatment of wastes discharged to water or other activities that affect water quality.

Water service providers are often under pressure to improve domestic water services, without assessing how valuable these improvements would be to consumers. In developing countries, many master plans of new treatment plants and distribution systems unquestionably take the engineer dominated supply side approach while the nature of water users' needs is neglected. Criticisms of this approach focus on the failure of such programs which ignore the demographic and financial realities (Whittington et al. 1993). From the mid 1980's, a new vision based on the demand oriented approach has emerged. This new approach asserts that water utility bodies need to understand actual household's water use behavior and the observed ability and WTP for improved water services (Whittington et al. 1990).

Similarly, in Ethiopia most previous studies made on water supply system focus on the development of supply-oriented approach to deal with the water supply service problems. But along this, to attain an improved water service to residents, an assessment on effective demands of the majority of the households need to be made.

Previous study done by Kinfe and Berhanu (2007) on Valuing Water Supply Service Improvements in Addis Ababa had applied contingent valuation method. The valuation was analyzed by using Tobit and Probit econometric models. These models were used to estimate mean and median WTP. The study had also investigated factors affecting household's WTP. However; this study failed to consider the full values, i.e. the total economic values (use and non-use values), of domestic water supply services in which the services has these attributes. Similarly Atsede (2010) made a study on domestic water demand for Mekelle City following similar methodology. This study concerned only the use values of the service improvement. These studies were not able to justify the reasons for accepting or rejection of the hypothetical scenarios developed for improvement in the service.

Since the economic value (use and non-use value) of water is the key component of an appropriate incentive for efficiency, sustainability and accountability, there is a need to research the demand. This helps to understand the fundamental economic value the consumer places on the improved water service so that the value that reflects the ability and willingness of the households to pay for the improved water services could serve as a strategy for cost recovery and resource conservation.

1.3. Research Questions

The main research question is "what are the possible factors affecting households WTP and the total economic value of domestic water supply services?"

The specific questions are:

1. What is the current status of domestic water supply services?
2. What are the main factors affecting households WTP for the improved domestic water supply services in terms of both water quality and quantity?
3. What are the reasons for accepting or rejecting of the contingent valuation scenario i.e. hypothetical improvement for domestic water supply services?
4. What is the total economic value of improved domestic water supply services in practice?

1.4. Objectives of the Study

The general objectives of the study on which this paper is based are to establish the possible factors affecting households WTP and to estimate the total economic value of domestic water supply services in Haik town.

The specific objectives of the study are designed to:-

1. Describe the status quo of domestic water supply services
2. Determine the main factor that affects the households' WTP for improved domestic water supply services in terms of both water quality and quantity for current and future generations
3. Investigate the reasons of accepting or rejecting of the contingent valuation scenario i.e. hypothetical improvement for domestic water supply services
4. Provide information on the total economic value of improved domestic water supply services in practice

1.5. Limitation of the study

Since the study use a hypothetical market to value domestic water supply service improvement, there might be difference between actual and hypothetical improvement. Moreover, respondents may not tell their true WTP. Thus, care should be taken in interpretation and in using the results. Furthermore, due to time and resource constraints the sample size is limited to 145 households.

1.6. Significance of the Study

The result of the study may provide background information for status quo of the town's domestic water supply services situation and the value household's placed for an improved domestic water supply services in terms of both its quantity and quality. The WTP values estimated provide crucial information for/on:

- Assessing economic viability of projects
- Setting affordable tariffs
- Evaluating policy alternatives
- Assessing financial sustainability
- Designing socially equitable subsidies and
- Factors that affect their WTP

Chapter Two: Literature Review

This chapter reviews the theoretical and empirical issue in the area of environmental goods, particularly domestic water supply service. First, the review focuses on theoretical issue such as economic valuation of environmental resources, the valuation technique and its underlying theoretical framework and then reviews application of the technique.

2.1. The Concept of Total Economic Value

Economic values are anthropocentric notions and are based on situations of choice. The economic definition of value is rooted in the idea that many resources are scarce. That means that the demand for those resources is great relative to their availability. There is never enough water or land or labor to do all the things that all individuals might wish. Because resources are scarce, it is necessary to make choices about how society will use what is available. These choices are often based on complex trade-offs; thus, value is revealed in how individuals and society collectively choose to allocate these resources.

The economic concept of value has its foundation in neoclassical welfare economics. Welfare economics is the science of determining how available resources may be best used to promote human welfare. It seeks to develop better procedures (without prejudice towards either the public or the private sector) for allocating the total resource base (labor, capital, land, etc.) among potential uses and users in order to meet individual and group needs. Individuals need material resources to improve their economic well-being, a healthy environment to maintain their physical well-being, and psychologically satisfying experiences to maintain their mental wellbeing (James and Lee 1971).

The basic premises of welfare economics is that the purpose of economic activity is to increase the well-being of the individuals who make up a society, and that each individual is the best judge of his/her own welfare. This welfare depends not only on the individual's consumption of private goods and of goods and services produced by the government, but also on the quantities and qualities they receive of nonmarket goods and service flows from the resource-environment system e.g. health, visual amenities and opportunities for outdoor recreation.

It follows that the basis for deriving measures of the economic value of changes in resource-environmental systems is their effect on human welfare. The anthropocentric focus of economic valuation does not preclude a concern for the survival and well-being of other species. Individuals may value the survival of other species not only because of the uses people make of them (for food or recreation, for example), but also because of an altruistic or ethical concern. The latter can give rise to non-use values (Freeman 1993a).

The term total value, synonymous with true WTP or WTA, arose in environmental economics with the awareness that substantial portions of WTP or WTA were not accounted for in the measure of economic value obtained using market prices or revealed preference techniques. In this sense, WTP and WTA estimates derived using those approaches are defective since welfare gains or losses may be overlooked if passive use value is decisive.

According to Rogers et al. (2002), Raucher et al. (2005), and Turner et al. (2004) the concept behind the Total Economic Value (TEV) is that any good or service is constituted of different attributes, some of which are concrete and easily measured, while others may be more difficult to quantify. The TEV is broken-down into two main values, those are: use-values and nonuse values (Rogers et al. 2002).

1) Use value: this value can be subdivided into direct use value or indirect use value. Direct use value is consumptive, extractive, or structural. Use value derives from goods which can be extracted, consumed, or directly enjoyed. Direct uses of water include drinking, waste disposal and industrial processing. 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 good. Other direct uses of water include recreation, sport, and fishing. In contrast, indirect use values are those in which water is indirectly used to produce a good. The indirect use values occur from the natural functioning of ecosystem. Such indirect use of water is characterized by its fewer benefits, which are not traded in any market and are sometimes referred to as un-priced benefits to water users.

2) Non-use value: this value of domestic water supply services includes intangible benefits that households derive without any direct or indirect use. The non-use values can however, be subdivided into existence, bequest, and option value. In this study, existence value reflects benefits from the improvements of domestic water supply services that can play an important

role to avoid health dangers and impacts. Many households are willing to pay for protection from such health impacts of water services, even those located in remote. Bequest value is the value a habitant places on the ability to conserve a resource so that it can be used by future generations. In other words, respondents might be willing to pay to restore water quality for the time being and in future, with the assumption that from knowledge that their heirs and future generations will have good water quality. The third part of nonuse value is option value; the concept of option value refers to the value placed on a resource's future use.

In general, the TEV of water can be defined as a combination of use and non-use values. Use value includes direct and indirect use value. Non-use value includes existence and bequest value, since option value could be classified mainly under non-use value. In other words, the TEV of water includes the full value of water at different sectors, mainly domestic, agriculture, and industrial. This study is dealing with domestic water supply services. Accordingly, in this study the household's WTP is investigated for improved domestic water supply services for current and future generations.

2.2. The Importance of a Rational Water Pricing Policy

It is quite common in many parts of the world for water to be provided to users at a price lower than the marginal or even average supply cost. In such cases there is no incentive for conservation and waste reduction. This leads to a paradoxical situation: where the water resource is already under stress, the subsidy encourages users to make additional demand upon it.

The alternative approach is to recognize that water resources are limited and new sources cannot be developed indefinitely. Users should pay a fair price for water in order to reflect its value to society as a scarce resource. With tariffs moving towards full cost recovery (average cost pricing), high-value users ought to be able to obtain the water they need at an economical price. 'Getting prices right' is seen as a reasonable way to allocate water efficiently, but how to accomplish it remains a debatable issue, since water pricing mechanisms are sensitive to the physical, social, institutional and political setting in each country.

Demand management in some form must ultimately be applied and the use of pricing is an effective instrument which can be defended by rational and objective arguments. If water is viewed simply as a commodity, forgetting for the moment its spiritual and aesthetic aspects in many cultures, it would be reasonable to expect that it should be priced to cover at least its cost of provision, and priced so that low-value uses are discouraged and supplies are available for the higher-value users who are able and willing to pay for it. However, a strict application of these principles needs to be handled with some caution, to ensure, for example, that the poorest people in the community are not disadvantaged and that the application of these economic principles does not disregard the spiritual and cultural beliefs associated with water. This is not necessarily a problem. According to Whittington et al. (1991), under water subsidy conditions it is generally the richest part of the community, which is connected by pipeline-to the supply, whether for irrigation water or domestic purposes, that receives the greatest benefits from obtaining water below the provision costs. It is the poor urban dweller who buys water by the bucket from a standpipe salesman who often pays the highest per-unit cost. Savenije (1999) refers this situation 'free water dilemma': a situation which ironically results in rich people getting water free or very cheaply and poor people buying water at excessive rates or drinking unsafe water.

The development of a pricing policy to manage water demand requires a methodology for estimating the value of water, in order to determine in a reasonable and equitable fashion what prices are to be charged. In addition, it is necessary to ensure that the impacts of the pricing policy on all the affected stakeholders are understood and considered. While the concept of realistic pricing holds the promise of a better allocation of water, it has to be introduced in a manner that will not penalize communities whose opportunities were already limited. To guarantee this, some sort of modeling or simulation study could be done before the policy is implemented.

Water pricing policies are not simply the result of certain economic theories, but are rather important instruments to achieve national and regional goals. Many advantages can be gained by ascribing a value to water and charging users a tariff related to this value (Savenije 1999 and Perry 2001):

- Recovering the cost of providing the (supply) service
- Provision of funds for water developments
- Proper allocation and resolution of water resource conflicts (reallocation) between sectors and users
- Environmental benefits, by releasing more water for environmental usage

- Demand management, reducing the demand for water
- Promotion of production of certain crops
- Promotion of development in certain regions
- Redistribution of income among economic sectors

When pricing policies are viewed as a tool to stimulate socio-economic development, prices cannot be determined by economic criteria alone. Their social, environmental and technical impacts should also be taken into account. Thus, for example, when considering water resources development for agriculture, attention should be paid to farmers' ability and willingness to pay, productivity of the land, profitability of the irrigation project, national agricultural production objectives, and social benefits from irrigation development.

It is understandable that governments in many cases hesitate to increase water prices. This is because they can foresee various hurdles, such as the inflationary effect (by charging for a commodity that is universally used). However, evidence is growing that the advantages mentioned above outweigh the potential disadvantages.

2.3. Demand Management: The Water Transition

Usually, the issue of water allocation is not tackled in a truly market-determined framework. Prices charged for irrigation water provided by public agencies are often nominal and unrelated to either the cost of supply or the benefits derived. Prices charged for domestic water supply or sewage disposal are seldom arrived at through a market-type interaction between suppliers and users of such services. The reasons for this are that: (1) in most societies the services of natural watercourses are not privately owned (they are usually considered common property); and (2) levels of water supply and water price have often been set by administrative decision.

Szesztay (1976) has depicted three distinct sequential phases. During the first (the water-abundance phase) only one direction of development exists: that of increasing the supply (water-resources engineering) in response to rising demand. The situation starts to change when the readily available local sources of water supply and development potentials begin to be exhausted. In the second stage, the emerging water-scarcity problems are tackled by carefully balanced efforts both to increase supply and to use water and water-related services more efficiently.

In this stage, the conceptual and institutional frameworks of water management and of integrated river basin development gradually gain recognition. With further increased pressures on water availability and on water-related development potentials, the rapidly rising marginal cost of supply reaches a critical level. This causes changes in the region's socio-economic goals and value systems, and pushes it toward both rational use and water conservation. Thus, in the third stage, attention is paid to the management and control of demand, via water conservation technology and the use of more effective pricing mechanisms.

Similarly, Hoekstra (1998) referred to the three phases of the changing interaction between water and development as the water transition. In simple terms it means that increasing water demand results in increasing water scarcity, which in turn causes the stabilization of water demand through increased water use efficiency and reduced pollution.

2.4. Economic Valuation of Environmental Resources

The concept of economic value is embedded in the utilitarian approach, which is based on the principles of humans' preference satisfaction. This value paradigm assumes that people have a quantitative (cardinal) utility scale against which they measure the relative degree of satisfaction (happiness or pleasure) they derive from consumption of alternative objects (goods and services) or their possible combinations. While cardinal utility (welfare) functions cannot be directly observed and measured, contemporary economics has developed theoretical and analytical frameworks through which knowledge of the structure of personal preferences can be indirectly obtained from their observed economic choices. The mechanism through which people reveal their preferences is their demand and supply decisions (the acts of buying and selling different quantities of goods at different prices), which provide information on how people hold relative values to different objects.

According to the utilitarian approach, a commodity has economic value when users are willing to pay for it rather than do without. The economic value of a commodity is the price a person would pay for it (or, on the other side of the transaction, the amount a person must be paid in compensation to part with it). Economic values can be observed when people make a choice (reveal preferences) among competing products available for barter trade and values need not be expressed only in monetary units).

In competitive markets, the process of exchange establishes a price that represents the marginal economic value, that is, the value of the last (marginal) units sold. An economically efficient allocation of water occurs when the marginal value of water is equalized across all uses because this allocation maximizes the net social benefit from water use. However, water is rarely supplied by competitive markets, and the price, if any, charged for water usually does not reflect its economic value.

According to Young (1996), water is a distinctive commodity and two factors have inhibited the development of competitive water markets for water: its necessity for human survival and its natural characteristics. In economic terms, water is an essential commodity so the value (willingness-to-pay) for a basic survival amount is infinite. Once basic needs are met, economic valuation can make an important contribution to decisions about allocating water.

Natural characteristics of water are a second factor inhibiting the emergence of competitive markets. Water supply often has the characteristics of a natural monopoly because water storage and distribution are often subject to considerable economies of scale. Property rights, which are essential for competitive markets, are often absent and not always easy to define. Exclusive property rights cannot be defined when uses of water exhibit characteristics of a public good (for example, flood mitigation) or a collective good (such as a sink for wastes, or potable water to maintain public health). Exclusive property rights are also difficult to define when water is subject to sequential use. Multiple use of water, such as a reservoir that supplies water simultaneously for recreation, hydroelectric power, irrigation and municipal use, also poses challenges for property rights. Water is a 'bulky' commodity, that is, its weight-to-value ratio is very high, inhibiting the development of markets beyond local area. There is very little international trade in water unless the water flows naturally between two countries.

In the absence of water markets or where markets function poorly, valuation techniques must be used to estimate the economic value of water, which is called a 'shadow price'. Economists have many techniques for estimating shadow prices, including shadow prices for nonmarket environmental services, and a great deal of practical experience applying these techniques. Some techniques are more widely used for water and water services than other environmental goods and services.

Treating environmental systems as economic assets that provide goods and services has become an established approach in environmental economics. When regarded as an asset, the economic value of a resource as environmental system is defined as the sum of the present values of the flows of all the goods and services provided by the system (Freeman 1993a). As many of these goods and services are not traded in markets, the economic value of a natural asset may be substantially higher than its market price. For example, the value of wetland services such as wildlife habitat, flood control and aquifer recharge could be significantly higher than the wetland's value for residential or commercial purposes on the land market.

According to Randall (1986), the valuation problem arises whenever one wants to compare the economic productivity of some existing environment entity with the productivity that could be obtained by implementing a proposal to modify it. For Young (1996) the economic value of an environmental resource is measured by the summation of many users' WTP for the goods or services in question. WTP is a monetary measure of the intensity of individual preferences. Therefore, economic valuation of natural resources is the process of expressing preferences for beneficial effects or preferences against adverse effects of policy initiatives in a monetary unit. According to Lipton et al. (1995) in estimating the economic value of a natural resource, the economist attempts to answer one of these two questions:

- How much are people willing to trade (give up) of other goods and services to have some natural resource or resource service?
- How much better off would people be if a policy or management plan actions were implemented and the amount or quality of a resource or resource service were improved?

People may react from the notion of placing a value on the natural environment. For Freeman (1993a), some people may be distrustful of economists' efforts to extend economic measurements to such things as human health and safety, the natural environment and aesthetics, and to reduce as many variables as possible to commensurate monetary measures. Although some skepticism about the economist's propensity for monetary measurements is good and necessary, it should not be overdone. It is not correct to say that there are something's, such as one human life or the preservation of a certain species, that cannot be valued in economic terms. The real world often creates situations where trade-offs between such things as deaths avoided and some other things of value cannot be avoided.

Basically two theoretical approaches (direct and indirect) are used for making reliable estimates of household's response for improvements in service and quality of water (Abdallah et al.1992).

(i) The direct approach uses stated preference in which simple direct questions like "how much an individual is willing to pay for the improved water service?" are asked. Such approach is called contingent valuation method.

(ii) The indirect approach often referred to as revealed preference that uses data on observed water use behavior. The insight behind this approach is that people cannot buy the non-market goods like clean lake water or unspoiled environment directly but sometimes there exist market goods that serve as a partial substitute for the non-market good. Economists use indirect methods to make inferences about markets that are linked to the environmental good under investigation. While there are many indirect estimation methods, the researcher consider two common on benefit valuation: the travel cost method (TCM) and the hedonic price method (HPM).

The travel cost method (TCM) is widely used to measure the demand for, or value of, water-based recreational services. It indirectly measures the value of water recreation services by estimating how much people are willing to pay to travel to that site. The TCM is used both as a benefit-based or cost based method of valuation. For instance, the cost of travel (actual travel expense) is often used to serve as a proxy for the price of enjoying this water service. On the other hand, information about travel costs and other socioeconomic characteristics of users that affect demand (for example, income, distance from site, and so on) is collected through site surveys and aggregated to estimate a demand curve, or several demand curves for different zones around the site. Most costs associated with travel can be easily measured. However, there remains controversy over whether to include the visitor's travel time as part of the cost, and, if so, how to value it.

The TCM depends on information about the amount of money and time people spent getting into a site to infer a value for that site. According to Callan and Thomas (1996), TCM has a primary advantage of measuring environmental benefits based on actual behavior, but it ignores non-use value. Furthermore, this method focuses on recreational use, making it ineffective for estimating any incremental benefits that might be accrue to commercial users of a resource.

The hedonic price method (HPM) is based on the theory that a good or service is valued for the attributes or characteristics it possesses. This perception of value suggests that implicit or hedonic price exist for individual product attributes, and these can be determined from the explicit price of the product. According to Carson (2000), however, this method does not capture non-use values that are very important when we deal with environment and hence underestimate the total economic value.

Although information may not be available for direct estimation of the demand for or marginal value of water, availability of information on a surrogate market of another good or service that is directly linked to a particular service of water will allow indirect estimation of the demand for or value of that water service. For example, the value of a piece of land or property typically reflects the value of the bundle of attributes that comes with it and cannot be sold separately. For agriculture, the bundle includes such things as soil quality, existing farm infrastructure and water resources (that is, abundance of groundwater or proximity to sources of surface water). For consumers, the purchase of a house is a bundle including characteristics of the building itself (for example, size, age), and characteristics of the surrounding area including access to water-based recreation, water quality and the aesthetic beauty of water. In such situations, the method of hedonic pricing uses land or property markets' information to derive indirectly demand for, or value of the water service directly linked to that market.

Economists are often asked to determine the value of a particular set of resources or the costs and benefits associated with changes in resource availability or quality. In such a case, the framework for valuing water should link changes in the physical characteristics (quantity and quality) of water resources to changes in the level of services or uses of the water, and to how society values these changes. A number of market and nonmarket valuation techniques have been developed. Non-market valuation, in particular, is an evolving specialty within environmental economics and is a response to policymakers' and the public's desire to consider the value of non-marketed amenities when making resource management decisions.

2.5. The Contingent Valuation Method

2.5.1. Theoretical Review of Contingent Valuation Method

Resources have economic value whenever users are willing to pay for them rather than do without. This implies that resources have economic value only if they are scarce. Economic value is a measure of the maximum amount an individual is willing to forego in other goods and services in order to obtain some commodity, service, or state of the world. The trade-offs people make when they choose less of one and more of some other commodity reveal something about the values people place on these goods. The money price of market goods is simply a particular case of a trade-off ratio, because the money given to purchase one unit of one element of the package is a proxy for the quantities of one or more of the other elements in the package that had to be reduced in order to make the purchase (Freeman 1993a).

There are cases in which it is not possible to derive value measures from observing individual choices through a market. Freeman (1993a) calls the methods developed to measure environmental values 'hypothetical methods'. Other authors use the term 'constructed markets'. In this approach, respondents (consumers) are offered a hypothetical market, in which they are asked to express their WTP for existing or potential environmental conditions not registered in any real market.

The most common form of questioning on hypothetical futures is the CVM. It involves directly asking individuals what they would be WTP for particular goods or services *contingent* on some hypothetical change in the future state of the world. The monetary values obtained in this way are said to be contingent upon the nature of the constructed (hypothetical or simulated) market and the commodity described in the survey scenario.

To fully assess the economic desirability of environmental policies, analysts must estimate the value of non-market commodities. Overlooking or ignoring the services provided by non-market commodities in cost-benefit analyses and other empirical economic studies severely undermine the accuracy and relevance of the results. Since the 1960s, several non-market valuation techniques have been developed in recognition of the importance of these services. Of these techniques, the most commonly used is contingent valuation (CV).

Its flexibility facilitates valuation of a wide variety of non-market goods, including those not currently provided. Perhaps more importantly, CV enables researchers to assess total value that include passive use value.

Contingent valuation surveys often take the form of a binary-choice instrument (open-ended surveys can be more difficult to analyse). Individuals are given a choice between two quantities of an environmental service, usually the status quo and an alternative that requires a payment. Different levels of payment are randomly assigned to different individuals in the sample and the response is analysed in the same way that behavior in actual markets is analysed. A demand curve measuring total economic value is derived by econometric analysis of the results along with other variables such as income and other factors that influence willingness-to-pay (demand). A CVM survey requires that survey respondents are well informed of an environmental good and its substitute, a large sample and face-to-face surveys.

The CVM has two variants: willingness-to-pay (WTP) and willingness to-accept (WTA); the correct measure depends on the property rights to the environmental service. Willingness-to-pay asks individuals what they would be willing to pay to acquire (or avoid loss of) an environmental good. Willingness-to-accept asks how much a consumer would have to be compensated in order to give up voluntarily some good or level of environmental service she/he already has. Boman et al. (2003) argue that WTP is more consistent with national accounts valuation than WTA. Under WTA, respondents are not constrained by their budget when giving answers, which is not consistent with the monetary measures used in standard national accounts, that is, market prices resulting from consumer demand that is restricted by income.

The choice between WTP and WTA is a question of property rights. If the individual had the right to sell the good then WTA would be the appropriate measure; whereas if the individual had to buy to enjoy with it WTP would be the correct measure (Mitchell and Carson 1989). But the problem is that in case of most public goods it is not clear what the property rights are and who hold them.

Hanemann (1991), states that large difference could be expected between WTA and WTP depending upon availability of substitutes. He states that difference between WTP and WTA not only depends upon income effects but also the ease with which other commodities could be substituted for the given public good. Holding income effects constant, the fewer the substitutes the greater the disparity. With no substitutes, the two measures could differ greatly.WTA is not constrained by one's income as is WTP. Hence WTA responses are usually higher than WTP responses for the same item.

The CVM typically measures total economic value from which an average value can be estimated, although it is possible to design the survey to obtain information about marginal values, that is, how much would you pay for a small change/improvement.

The CVM has great flexibility, allowing valuation of a wider variety of non-market goods and services than is possible with any of the indirect techniques (travel cost, hedonic pricing, etc). According to Lipton et al. (1995) it is the only method currently available for estimating non-use values, in other words it is the only method that has any hope of measuring 'existence values', the value that individuals place on simply knowing the natural resource exists in an improved state. For natural resources, contingent valuation studies generally derive values through the elicitation of respondents' WTP to prevent damage to, or to restore natural resources.

The contingent valuation methodology (CVM) differs from the revealed preference methods in that it does not rely on market data, but asks individuals about the value they place on something by asking them how much they would be willing to pay for it. This is particularly useful for eliciting the value of environmental goods and services for which there are nonmarket prices, such as recreation, water quality and aquatic biodiversity. The CVM was first used several decades ago, but became a much more popular technique after 1993 when standardized guidelines for CVM applications were set out by a prestigious panel of economists following a disastrous oil spill off the Alaskan coast (NOAA 1993). In terms of number of publications, the CVM is currently the dominant method for valuation of non-market environmental services; a recent review of the CVM found more than 2000 studies (Carson 2000).

Based on the results of contingent valuation studies, researchers have been able to predict the number of connections to water supply systems at improved conditions, and the resulting revenue for the local authority, making it possible to study the feasibility of such improvements and various financing schemes. Recent work by World Bank shows that CV correctly predicated 91 percent of the actual connections to the piped water system (Cropper and Alberini 1998).

In recent time CVM has been extensively applied in both developed and developing countries to the valuation of a wide range of environmental goods and services. CVM has been successfully applied to a variety of water related issues including sanitation, water supply (Susana 2002).

Hutton (2001) shows that most WTP studies used CVM in order to identify the potential demand curve for improved water supply and quality, and many of these identified current water markets and compared them with WTP, further to other advantages such as: (1) it can take non use values, use values, optional value, and quasi-option value into account for environmental goods; (2) it can be designed to include only the variables of the market relevant to the study objective (e.g., WTP for health effects); and (3) it also enable individuals to consider the true cost to themselves of a particular injury or illness. Moreover, Lipton et al. (1998) stated that the CV can be considered the best method to estimate the economic value of anything. Also, it is the only method that can estimate the non-use values, and it could be evaluated by the understanding of a mean or median value.

According to the above mentioned, CV technique is become widely utilized in both, policy analysis and academic research. It is utilized to elicit people's preference, expressed in terms of WTP. Using CVM for evaluating WTP for social projects is widely used not only in developed countries, but also in developing countries, especially, these countries meet difficult political and social problems, as well as water scarcity. CVM is used for this study for several reasons presented below:

- The CVM can be considered the best method to estimate the total economic value of non market goods. Moreover, it is the only method that can estimate the non-use values of a resource. It can be evaluated by the understanding of a mean or median value.
- The WTP question format utilized in the CV questionnaire (dichotomous choice question with follow-up questions and open-ended follow-up question) offers the possibility to use a variety of statistical and econometric techniques.
- According to United States National Oceanographic and Atmospheric Administration (NOAA) panel the CVM can provide useful and reliable information, but it needs to be applied carefully.

- CVM will frequently be the only technique of benefit estimation. Also, in developing countries CVM is widely used due to special circumstances, such as water scarcity, as well as political and social conditions.
- Many environmental and resource economists, and policy analysts who are working in developing countries indicated that CVM surveys are straightforward and easy to apply.
- CVM can be utilized to evaluate the value of any non-market good without need for observable behavior (data). It is the best to measure non-use values (existence and bequest values). Also, the CVM is not generally difficult to understand.
- The CV elicits information on the value of the amenity directly by using a questionnaire or interview to develop a hypothetical market in which the consumers uncover the values they place on a resource.
- Finally, the mean WTP obtained from CVM has used as a measure for cost-benefit analysis (Jones et al. 2008).

2.5.2. Limitation of Contingent Valuation Method

The representative WTP value derived from the CVM analysis cannot be used, as it is, as a basis for revising actual tariff since the WTP includes certain biases, and there is a gap between the WTP derived from the CVM and the WTP in actuality where one has to pay according to the current tariff.

CVM provides an estimate of how a certain group of respondents, living in a certain area at a given time, value their environment. It should be noted that the results of this CVM survey represent the present WTP of existing and potential improvement of water supply service in Haik town.

WTP is decided only from demand side. Therefore, it can be said that CVM is a demand oriented method. As for supply side, CVM can only assess benefits arising from the investment in services, not costs borne by the service providers. The supply side is indicated as a supply curve of the services provided and the supply cost, and the equilibrium point is derived from the demand and supply curves. In consideration of these characters and limitations of CVM, this study estimated beneficiaries' WTP which gives a basis for appropriate tariff.

2.5.3. Validity of Contingent Valuation Method

It is important to consider the following conditions for enhancing the validity of CVM studies (Bateman and Turner, 1992): (1) Willingness to Accept (WTA) scenarios should not be used; (2) Use values are likely to be more accurate than non-use values; (3) the scenario should not have a high degree of uncertainty; (4) use familiar environmental goods; and (5) respondents should have some valuation experience of the environmental change in question. Accordingly, the description of water in the scenario and the provision of information might affect the respondents, therefore should be as plausible as possible.

CVM does not produce valid measurements when it concerns goods that people are not familiar with and it does not work when people reject responsibility for the good in question. It does not provide valid estimate when people are unfamiliar and inexperienced with the good. Validity may be a problem, since it is very difficult to describe a natural good in such a way that all it attributes are accounted for. Freeman (1983) notes that CVM work best for those goods resembling ordinary commodities. This means that it is best suited for valuing consumption goods that people consumes more of as their income increases and the price decreases.

2.6. Empirical Evidence

It is widely recognized that water has traditionally been regarded as a free resource of unlimited supply with zero cost at supply point and at best, water users have been charged only a proportion of the costs of extraction, transfer, treatment and disposal. All associated externality costs of water have been ignored and users are offered very little incentive to use water efficiently and not waste it.

According to the World Water Development Report 'Water for People, Water for Life', water prices are expected to serve various and often conflicting purposes, including: cost recovery, economic efficiency and social equity. (http://www.unesco.org/water/wwap/facts_figures/).

Developed countries show a wide range of variation in water pricing: in Germany 1m costs $1.91 (USD), in Denmark it cost $1.64, in Belgium $1.54, in the Netherlands $1.25, in France $1.23, in the UK $1.18, in Italy $0.76, in Finland $0.69, in Ireland $0.63, in Sweden $0.58, in Spain $0.57, in the United States $0.51, in Australia $0.50 and in Canada $0.40. When the supply systems are deficient, the poor are the first to suffer. Water from informal vendors is more than 100 times more expensive than water supplied by house connection. In Vientiane, Laos, the cost of water through a house connection is $0.11 /m and the price charged by an informal vendor is $14.68/m, which means that there is a difference of 135.92%. In Delhi (India) the price of the water through a house connection is $0.01 /m and the price charged by an informal vendor can be as much as 4.89, i.e., 489% more. (http://www.unesco.org/water/wwap/wwdr/).

Valuing water has an important role to play in regulating the water markets of the world. In Chile, water rights can be freely traded within the irrigation subsector, like real estate property rights. About 30% of the households in Amman (Jordan) have decided to obtain additional water from the private market because accessible piped quantities are not sufficient. In France, the bill paid by domestic and industrial users connected to the water system covers the cost of distribution and collection services: water pays for water. This cost varies according to the local economic and technical configuration. (http://www.unesco.org/water/wwap/wwdr/).

In Varanasi, India, Singh et al. (2003) attempted to find the consumers' willingness to pay, and the affordability of cost of water through a bidding game. They found that about 37% of population has a willingness to pay for the sum of Indian Rupee (INR) 40 twice the existing charge of INR 20 per month for water supply.

Astana (1995) studied the economic behavior of the poor citizens through the collection of safe drinking water. The study reveals that perception of health benefits by the participants is significant, and they are prepared to spend significantly higher amount of time collecting safe water as opposed to unsafe water. In his opinion, the common assumption that people are either unwilling or unable to pay for water is incorrect. In almost all poor countries, there is need for subsidy of urban water supply that responsibility falls mainly on to the rich. Similar situations can be found in other poor countries of the world where surveys show higher willingness to pay for improved water supply. For example, Kaliba et al. (2002) presents the result of a CVM survey conducted in Tanzania where the surveyed community is willing to pay 32 shillings/20L of water, which is about twenty five percent above the existing tariff.

Nurul-Islam et al. (1994) studied the willingness to pay in Dhaka, Bangladesh. They opined that the city water supply, and sanitation system suffers from problems rooted in the lack of technology, policy, and coordination. Some of these can be explained by low willingness to pay. They found that in Dhaka, Bangladesh lower middle income people may have to pay about 10 % of the income for water and sanitation service which is more than the World Bank recommendations.

Asian Development Bank (ADB) (2003) found that official policies of the governments often support tariffs covering operation & maintenance costs, depreciation, debt servicing, and a contribution to new capital investment. ADB (2001) commented that the people in Asian cities have a willingness to pay for water but governments do not have a willingness to charge. They felt that about 5% of household income would be a realistic ceiling on affordability for water supply and sanitation services. Nearly all people in developing countries could pay this amount, they reasoned.

According to Bohm et al. (1993), WTP for improved water services increases with income and wealth, family size, education, and dissatisfaction with traditional sources. In the same vein, a study on household demand for an improved water-supply system in Kathmandu, Nepal, shows that consumers' WTP for better service is increasing (Whittington et al. 2002). A similar study in Indian cities shows contradictory results and suggests that satisfied consumers are not willing to pay more for improved domestic water supply (DWS) schemes (Raje et al. 2002).

According to Assefa (1998) cited by Alebel (2002), a study on the relationship between households' WTP for improved water services and the factors determining their WTP in Addis Ababa City using CVM & indirect approach, shows that 8.66 cents per Baldi (a bucket which can contain 20 liters) was the average WTP for private connection and 4.7 cents for public taps. Alebel (2002) made a study on the analyses of affordability and determinates of WTP for improved water service as strategy for cost recovery for Nazareth Town using CVM and estimated mean WTP as 6.8cent per Baldi (a 20 liter bucket) for improved water supply services.

Kinfe and Berhanu (2007) estimated the mean WTP values for Addis Ababa sub-cities as 15.34 and 20.20 cents per Baldi (a 20 liter bucket) for improved water supply service as calculated from the Tobit and Probit model, respectively. The total WTP amount, from the total of 126,108 households in the study area of Addis Ababa, is Birr 17,133.14 per Baldi or Birr 154,198.26 per day at different service fees.

Chapter Three: Research Methodology

3.1. Description of the Study Area

Hayq (or Haik) is a town in northern Ethiopia and 430km far from Addis Ababa. The town is named after Lake Hayq, which lies two kilometers east of the town and is the home of Istifanos Monastery, an important landmark in Ethiopian Church. Located 30 kilometers north of Dessie in the Debub Wollo Zone of the Amhara Region, it has a latitude and longitude of 11°18′N 39°41′E°N 39.683°E11.3; 39.683 and an elevation of 2030 meters above sea level.

Based on figures from the CSA in 2005, Hayq has an estimated total population of 14,319 of whom 7,226 are men and 7,093 are women within its five lower level administrative Kebeles. The 1994 census reported this town had a total population of 8,247 of whom 3,802 were males and 4,445 were females. It is the largest town in Tehuldere Woreda. The population growth and urban expansion leads to challenge the town in providing urban infrastructure service in general and water supply in particular.

The existing water supply source for the town is mainly groundwater. The groundwater is pumped, treated and distributed through pipe network to household taps and public water supply points (Bono) which is located at different location in the town are its end user accesses.

Empirical studies that used nonmarket valuation techniques including direct and indirect methods to gauge the level of changes in the commodity or service are rare in Ethiopia. Due to this reason this study which is done in Haik town may help to adapt to other towns.

3.2. Data Source

The researcher use primary data for this study collected through household survey using in-person (face-to-face) interviews.

3.3. Sample Size Determination

Determining the sample size for a study is a crucial component of study design. The purpose is to include sufficient numbers of subjects so that statistically significant results can be detected.

Using too few subjects results in wasted research resources and statistically inconclusive findings which make it difficult to determine whether a particular treatment or intervention will be effective and to identify directions for future studies. Thus, using the appropriate number of subjects optimizes the probability that a study will yield interpretable results and minimizes research waste. From a statistical perspective, studies with the optimal number of subjects have sufficient i.e. neither too much nor too little for statistical "power" to detect findings.

Here are the formulae used for sample size determination: -
(http://www.surveysystem.com/sscalc.htm)

$$SS = \frac{Z^2 * (p) * (1-p)}{C^2}$$

Correction for Finite Population

$$\text{New SS} = \frac{SS}{1 + \frac{SS-1}{pop}}$$

Where:

SS=Sample Size

Z = Z value (1.96 for 95% confidence level- tells you how sure you can be)
P = percentage picking the service improvement [the assumption is that 50% of the household's will be willing to pay for the service improvement which is expressed as decimal (0.5 used for sample size needed)]
C = confidence interval (also called margin of error) is the plus-or-minus figure usually, expressed as decimal (.08 = ±8)

Pop=Population (4590 household size is taken)

Putting all these values into the above formulae, yields a sample size of 145 and which is used for this study.

3.4. Survey Design and Sampling Techniques

Before implementing the final survey, the researcher conducted pilot survey using open-ended elicitation format to set up starting bids. The sample for the pilot study is randomly divided into five groups of equal size and each contain five households and five different starting bids assigned to households in the different groups.

The main data source is a contingent valuation survey (CVS) conducted in the town. The study employed CVM to solicit the respondents' WTP for improved water services. The CVS questionnaire used in this study is designed to include hypothetical description of the good being valued, socio-economic and demographic characteristics of household, existing water supply situation, water usage and general perception questions. The sample for the study is drawn from the five Kebeles of the town and a random sample of 145 households selected in the survey.

A two-step sample design adopted to ensure a representative sample of households in the town to identify and derive the households into five Kebeles and a representative sample from each stratum (households with individual connections) selected. In the application of the survey the interviewers tried as much as possible to take into consideration the criteria of a random sample for each Kebele that can generalize the study results on the population of the study.

The household in each Kebele selected proportionally using simple random sampling. The sample is composed of 145 household's heads from the total of 4590 household heads, 3.2 % of households for each stratum is taken. Accordingly the sample size from each Kebele 01,02,03,04 and 05 is 52, 41, 17, 13 & 22 households, respectively.

Then random sampling used to select sample household from the total household and distribute the sample size proportionally which is summarized in the table below:

Table 3.1: Sample Selection Procedure

Local Administration /Kebele	Population Size	Total no. of household	Share of households from the total households	Sample size in terms of household size
01	7074	1649	35.9	52
02	6661	1286	28.0	41
03	3275	537	11.7	17
04	4401	399	8.7	13
05	3598	719	15.7	22
Total	25009	4590	100	145

Source: Own Computation

In this study, among various elicitation formats, the dichotomous choice format with a follow- up questions format followed by an open-ended follow-up question is chosen to obtain a household's WTP for the proposed scenario. The scenario assumes that households do have private water connection together with the improved water supply service. By an improved provision of water, we mean good quality of water which is safe for health and good quantity of water which is available for 24 hours per day. Notice also that they may not be required to pay initially the costs of connection to the new scheme. Instead, the authority will cover the costs with insignificant increase in the monthly tariff rate.

3.5. Structure of the Questionnaire

In this study the contingent valuation surveys open with socioeconomic and demographic questions followed by general questions aimed at making the respondent comfortable with participating in the survey and answering questions by providing question on the existing domestic water supply provision. This is followed with a description of the scenario depicting a plan for improvement for the provision of domestic water supply services to be valued (such as a reduction in sickness associated with good quality of water and reliable provision of water supply).

This is again followed by the payment question, which queries respondents about their WTP for the proposed plan. The payment question includes households' WTP for costs incurred for the provision of improved domestic water supply service. Valuation of the questionnaire is placed in the last portion of the survey questionnaire following payment question.

3.6. Model Specification

Water is a good which is not traded in the market (non-market good); therefore, non-market valuation method is required to estimate the WTP for water. Non market valuation attempts to estimate economic value in money term society receives from uses of resources.

3.6.1. Modeling Willingness to Pay

The hypothesized WTP functions for the proposed functional forms in order to investigate the TEV: for improved water supply in terms of water quality and water quantity (use values), and insured reliable and sufficient water for future generations (non-use values). The function to be examined is:

$$WTP = f(\textit{Age, Gender, Water pressure, Time period, Water consumption, Income, Education, Employment status, Gainfully employed, Household size, Water quality} + "\varepsilon")$$

Where, WTP = WTP bid by household's head for the water quality improvements, and insured sufficient and reliable water supplies for current and future generations, which can be called the TEV of improved domestic water supply services (limited dependent variable, 1 = yes, 0 = no; and follow up question which is an open-ended dependent variable).

Age = Respondent's age in years (1= younger than 36 "the researcher combine two age categories: ≤ 28, 29-36 to facilitate statistical process and avoid the problem of multicollinearity in the regression analysis"; 2 = 37-44; 3 = 45 – 52; 4 = older than 53); Gender = Respondent's gender (dummy, 1 = male; 0 = female); Time-period = how long have you lived in the region?, (open-ended, in years); Water consumption = Consumption of water (open ended, in m^3/month/household,); Income = respondent's monthly income (open-ended, in Birr); Education = Which was the highest level of formal schooling the respondent has completed? (0 =completed primary school or less than; 1= completed secondary school; 2= completed technical school; 3= completed bachelor degree; 4 = completed graduate studies or more than that);Employment Status = employment status of the household heads (dummy, 1 = employed; 0 =otherwise); Gainfully employed = the family members who are gainfully employed (open-ended);Household size = the family includes all individuals are under the direct responsibility of the housed head (open-ended); water pressure (closed-ended);Water quality (dummy, 1 = acceptable; 0 =unacceptable); and ε variable = random error term (disturbance term) representing the unpredicted or unexplained variation in the dependent variable and assumed distributed as normal with mean and variance i.e.$(0.\sigma^2)$.

In Tobit model, the open-ended WTP variable used as a dependent variable, which includes positive and true zero responses and estimated a mean WTP (Jones et al. 2008). Also, Logistic R^2 is computed by using Tobit model. Ordinary Least Square (OLS) is also utilized to measure the value of the adjusted coefficient of determination (adjusted R^2) (Mendonca and Tilton 2000). These econometric techniques are used to estimate the coefficients of the explanatory variables of the WTP function. This analysis of household survey data administered based on expected signs of the key socioeconomic variables.

An econometric analysis was used to test the relation between WTP and socio-economic factors. Questions were in an ordered, categorical form and then were transformed into binary variables. The respondents were asked if they were WTP for a better quantity and improvement in the quality of water.

3.6.2. Tobit Model

The CVM was selected for its appropriateness when dealing with estimation of non-use values. The CVM can be used to elicit consumers' WTP for almost any environmental good or service, including more abundant and cleaner water (Mitchell and Carson 1989). Whittington et al. (1993) have carried out contingent valuation studies of households' WTP for improved sanitation services. A Tobit model was applied to household survey data, to explain household preferences for quality and quantity of domestic water supply and to derive estimates of WTP for such a service.

The study was run Tobit model while investigating the open-ended questions. This model is used as a second elicitation technique in the CV questionnaire of this study to model the actual household's WTP for improved water quality and adequate domestic water supply services to the households and future generations.

Johnston and Dinardo (1998) indicated that Tobit model is an extension of the Probit model, which is considered an important approach for dealing with the problem of censored and truncated data. Also, the model was named a Tobit model as a reference to Tobin who developed this model in 1958 (Tobin 1958).

The Tobit model, also called a censored regression model, is designed to estimate linear relationships between variables when there is either left or right censoring in the dependent variable(also known as censoring from below and above, respectively). Censoring from above takes place when cases with a value at or above some threshold, all take on the value of that threshold, so that the true value might be equal to the threshold, it might also be higher. In the case of censoring from below, values those that fall at or below some threshold are censored.

Estimating a linear regression using OLS estimates in the presence of censoring are inconsistent since OLS regression will not yield consistent parameter estimates because the censored sample is not representative of the population. Similarly, a statistical inference on the estimated parameters of the model also involves significant extensions of the standard theory.

There are dozens of published studies of CVM on household demand for improved water services around the world that applied Tobit model. Especially, Tobit model is likely to be widely used where some observations of data are truncated or censored for either dependent variable or explanatory variables (Cameron and Trivedi 2005).

Suppose that we obtain the consumer's WTP and auxiliary information about socio-economic and demographic characteristics from a survey; then the empirical WTP model that corresponds to the structural of the model to be considered is:

$$WTP_i = \alpha' X_{1i} + \beta q_i + \varepsilon_{1i} \quad \text{.....(1)}$$

Where; WTP_i is a willingness to pay question (open-ended question, a follow-up question of a binary question, "what is the maximum that you are willing to pay?") for improved water quality and water quantity of domestic water services for current and future generations, which is called the linear probability model. This model is estimated a censored model because $WTP_i \geq 0$.

X_{1i}, i=1… n is a vector of theoretically important explanatory variables including a constant, income, and all the other variables that may affect WTP. Omission of the depredated quality variable or the shortcomings of water quantity results in the model presented below:

$$WTP_i = \alpha' X_{1i} + e_{1i} \qquad (2)$$

where, $e_{1i} = \beta q_i + \varepsilon_{1i}$ is the disturbance term, it is not independent of the explanatory variables if perceived quality is correlated with any of the elements of the X_{1i} vector, violating one of the classical assumptions of regression. This will cause bias in the coefficients on the variables of X_{1i} which are correlated with perceived improvement in the quality of water use, or in a better quantity. As such, biased coefficients may result if any of the elements of X_{1i} are determinants of quality or quantity.

Including perceived quality or quantity as an autonomous variable can potentially cause other econometric problems. The degraded level of quality or the shortcomings of quantity is subjective measure in quality or quantity that varies across individuals' q_i. For instance, different individuals might consider current quality to be good or inferior, or current quantity to be sufficient or inadequate depending on the knowledge and experience they bring to the survey. Suppose that the quality or quantity perceptions are continuous, it can be presented by the model.

$$q_i = \gamma' X_{2i} + \varepsilon_{2i} \qquad (3)$$

Where, γ is a coefficient vector, X_{2i} is a vector of variables that illustrate the variation in perceived quality or quantity, is a normally distributed disturbance term.

With observed quality or quantity as the measure of quality or quantity the WTP empirical model becomes:

$$WTP_i = \alpha' X_{1i} + \beta q_i + \varepsilon_{1i}$$

$$WTP_i = \alpha' X_{1i} + \beta\,(\gamma' X_{2i} + \varepsilon_{2i}) + \varepsilon_{1i} \quad \text{..........} (4)$$

According to this information the disturbance terms may be correlated if the same unobserved elements affect both perceived quality and WTP or WTA with water quantity. Such correlation will cause the quality variable and the disturbance term to be correlated, biasing the coefficient on quality, and the same for water quantity, β. Positive correlation will bias the coefficient upwards while negative correlation will bias the coefficient downwards. However, an instrumental variable methodology can be used to avoid the endogeneity bias from including perceived quality or quantity as a regressor.

Assume that WTP variable is a continuous and censored at Zero:

$$WTP = \begin{cases} WTP^{\,Tobit} \text{ if } WTP^{\,Tobit} > 0 \\ 0 \text{ if } WTP^{\,Tobit} \le 0 \end{cases} \quad \text{..........} (5)$$

Where, $WTP^{\,Tobit} \le 0$ is unobserved continuous dependent variable, in other words, the unobserved true WTP. Based on what has been explained in this case, the Tobit model is an appropriate. In order to avoid endogeneity bias, the empirical WTP model is a simultaneous equations instrumental variables model. The model of WTP is a Tobit regression and the quality or quantity model is an OLS's regression:

$$WTP_i = \alpha' X_{1i} + \beta \widehat{q_i} + \varepsilon_{1i}$$

$$q_i = \gamma' X_{2i} + \varepsilon_{2i}$$

$$\rho = \text{correlation } [\varepsilon_{1i}, \varepsilon_{2i}]$$

Where, $\widehat{q_i}$ is the estimated variable from the used model for water quantity or water quality. The estimation method is full information maximum likelihood allowing or correlation in the normally distributed disturbance terms, ρ. The test for the exogeniety of $\widehat{q_i}$ is a t-test for $\rho = 0$

The variables in the X_{2i} vector but not in the X_{1i} vector are the identifying variables. These variables should have high explanatory power in the incrementing equation and low correlation with WTP and the disturbance term of it.

The marginal effect of an autonomous variable, say m on E(WTP) is $\frac{\partial E(WTP)}{\partial m} = \beta\Phi(Z)$, Where, Z is evaluated at the mean of all variables including quality or quantity in accord with the desired dependent variable. Since, $0 < \Phi(Z) < 1$, the marginal impact will always be smaller in absolute value than the coefficient estimate.

In CVM survey, estimation of WTP can be done through two methods: the Parametric Model in which a distribution function, such as a logarithmic function, is assumed as the decay curve i.e. acceptability curve; and the Non-Parametric Model in which no distribution is assumed. Although the parametric model has certain disadvantages such as it may be affected by the distribution curve, it has major advantages: a point estimation of WTP's median value is available, and an analysis of the reason for the WTP based on the full model is possible.

The purpose of the payment question is to obtain information about the respondents' WTP amount. WTP responses must be statistically analyzed to obtain an estimate of mean WTP, which is multiplied by N, the size of the population affected by the policy, to produce total WTP. Total WTP can be compared with of implementing the policy to determine whether the proposed policy passes a benefit-cost test.

The sample average is the best i.e. lowest variance estimator of the true population mean only if the distribution of WTP is a normal. However, it is reasonable to assume that in many CV studies the distribution of WTP is not a normal: A normal distribution allows negative values, which can be ruled out for many of the commodities under investigation in a CV survey.

If the distribution of the population is not normal, the sample average remains a valid way to estimate the true population mean, but the maximum likelihood estimate of mean WTP is more statistically efficient. Estimating the mean by the maximum likelihood requires that a distribution be specified for WTP.

Traditional techniques such as instance regression analysis may produce biased results; an alternative approach to the standard regression modeling for dealing with zero WTP values is the Tobit model. In order to test the overall goodness of fit for the model if the data distribution is logistic, logistic regression models can be used in order to calculate the value of Logistic R^2.

The Probit model is also used in this study to calculate mean willingness to pay for the closed-ended format. According to Hanemann et al.(1991) cited by Jonse (2005) states that one of the main objectives of estimating an empirical WTP model based on the CV survey responses is to derive a central value (or mean) of the WTP distribution. Similarly, Carlsson et al. (2002) cited by Mahmud (2005/06) states that the main reason for estimating the Probit model is to obtain an estimate of mean WTP.

3.6.3. Estimation Method

Stata 11 and E-views econometric software was run to estimate the WTP econometric model. E-views econometric software is used to estimate the Tobit model parameters. This model was shown and applied to household survey data, to investigate household preferences for quality and quantity of domestic water supply and for derivation of WTP estimates for such a service.

Stata is a general–purpose statistical software package created in 1983 by StataCorp, an American corporation that produces Stata. Stata's capabilities include data management, statistical analysis, graphics, simulations, and custom programming and unusual among commercial statistics packages in allowing user-written commands (http://www.stata.com). Stata 11 is the latest version handles factor (categorical) variable and does marginal analysis. It also deals with cross sectional, time-series and panel data. Predictive margins are particularly suitable for survey data and other samples that represent a population (either weighting or random sampling).

Chapter Four: Empirical Findings and Discussions

This chapter is to present the empirical results of the data obtained from the CV exercise. In the exercise, data and information collection was carried–out in-person interviews (face-to-face).

The data were entered in Microsoft Excel and Stata 11 software for ease of data screening, descriptive statistics, and frequencies, parametric and non-parametric tests. E-views econometric software was run to estimate the WTP econometric model. The data obtained from the exercise were to estimate the WTP of households' for the TEV of improved domestic water supply services.

4.1. Socio-economic Characteristics of Respondents

Table 4.1 presents the distribution of the respondents by socioeconomic characteristics. The age range of the respondents revealed that almost half of the population, that is, 49.3 percent is between 37 and 52 years, 19.9 percent are below 37 years while 30.8 percent accounted for those that are above 53 years of age. The average age is 47 years, minimum and maximum ages are 18 and 84 years respectively. The result showed that a good proportion of the sampled respondents are in their independent years (working age) hence, they are more likely to be willing to pay for improved water services. The result revealed that male and female headed households sampled are 55.5 and 44.5 percent respectively. A more proportional sample is taken and since females are responsible for household water supply, they might be willing to pay more for improved water supply services.

Findings further reveal that 95.2 percent of the respondents have no formal education and completed primary school or less, about 4.8 percent completed secondary school education. The more educated the respondents, the more likely they would be willing to adopt improved water supply provision services since they might know the outcomes of shortage in water supply or its unreliability.

The household size of the respondents as shown by the results indicated that 33.6 percent has between 1 and 3 household members, 60.3 percent has between 4 and 7 members while 6.2 percent account for those between 8 and 10 household members.

The average household size is about 4 while the minimum and maximum household sizes are 1 and 10 respectively. Large family size of households' may increase their water consumption which could discourage the family due to high bill charge services and hence may be willing to pay less for the proposed improvements than their counter parts.

The primary occupation of the respondents reveals that 37.9 and 11.7 percent are engaged in civil service and agriculture respectively while 17.9 percent are housewives. The balance, 32.4 percent, is engaged in trading and personal business.

The average monthly income of the household is 988 Birr while the lowest and highest being 60 and 5000 Birr respectively and the average monthly expenditure of the household is 749 Birr while the lowest and highest being 50 and 3000 Birr. The result reveals the level of earnings of respondents as they are not likely to spend above their income. As the level of income increases, the probability that households would adopt improved water supply services also increases.

Table 4.1: Socioeconomic Characteristics

Variables	Frequencies	%	Minimum	Maximum	Mean	Std. Dev.
Age(Years)						
18-36	29	19.9				
37-44	33	22.6	18.0	84.0	47.5	14.6
45-52	39	26.7				
53 and above	45	30.8				
Sex of the HH head						
Male	81	55.5				
Female	65	44.5				
Education						
No formal schooling & 1-6	138	95.2	0.0	12.0		
6-12	7	4.8				
Household Size						
1-3	49	33.6	1.0	10.0	4.3	1.9
4-7	88	60.3				
8-10	9	6.2				
Primary Occupation						
Agriculture	17	11.7				
Trading & per. business	47	32.4				
Civil Service	55	37.9				
Housewife	26	17.9				
Household Income			60.0	5000.0	988.0	946.9
Household Expenditure			50.0	3000.0	749.0	603.2

4.2. Existing Water supply Services: Experience and General Attitudes

Table 4.2 presents water use profile of the respondents. The data revealed that the mean monthly household water consumption is $3.4m^3$, minimum and maximum households water consumption are $0.6m^3$ and $16m^3$ respectively. The mean monthly amount that households pay for domestic water purposes is 17.4 birr, minimum and maximum households monthly water bill are 3 and 80 birr respectively. The data also revealed that households the mean daily water consumption is 3.6 baldi (a 20 liter bucket), minimum and maximum households daily water consumption are 1 and 10 baldi (a 20 liter bucket).

The data revealed that 16.9 percent of respondents indicate that water could be available only for 1-5 hours and 76 percent for 6-10 hours while 1.4 percent has access for 21-24 hours a day. The average water available time per day is 9.6 hours and the average water available day per week is 5 days. As high as 52 percent of the households have water supply at weak water pressure. On the other hand 22.6 percent of the respondents used public water supply points (Bono) and as high as 63.5 percent used other sources of water when piped water supply is not available. With regard to water quality problem, 17.9 percent of the respondents boil water and 2.1 percent boil and filter to treat water before consumption. On the other hand, 79.3 percent of the respondent don't use any form of water treatment. 9.9 percent of family member were sick for the year 2010/11 due to consumption of unsafe water and spent money ranging from 30 Birr to 300 Birr for medical fee to get treatment.

41.8 percent of the respondents are unsatisfied with the arrangement of the existing water supply services. The reason for the dissatisfaction is mostly unreliable water supply which accounted 67.7 percent of the respondents while 8 and 4.8 percent said poor water quality and higher volume charge respectively.

76 percent of the respondents are critical or very serious on the current provision of piped water as an issue worth discussion and 22.6 and 76 percent of the respondents answered community and government are responsible for the provision of water supply.

Table 4.2: Water Use Profile

Variables	Mean	Std. Dev.	Minimum	Maximum
Monthly water bill (Birr)	17.4	10.6	3.0	80
Daily volume of water consumed (a 20 liter bucket)	3.6	1.9	1.0	10
Monthly volume of water consumed (m^3)	3.4	2.5	0.6	16
Water availability time per day (hour)	9.7	7.9	1.0	24
Water availability days per week (day)	5.0	1.8	1.0	7

The data shows that households encounter problems with domestic water supply services in terms of water quality and water quantity. As shown in table 4.3, 57.5 percent of respondents revealed that they meet shortage of municipal water quantities, or poor water quality, or both, since 19.8 percent of the respondents meet either shortage of water quantity or poor water quality, 12.5 percent of the respondents face poor water quality problem, with 20.4 percent face problem of water quantity. In contrast, 47.9 percent of respondents indicated that they don't face problem with municipal water supply services. 66.6% percent of respondents stated their reason for having tap water connection as tap water has convenience while 29.4 and 3.4 percent stated for health and reliability reason respectively.

Table 1.3: The Problem of Municipal Water Supply Services

Variables	Number of Interviews	Relative Frequencies (%)
Either shortage of water quantity or poor water quality	28	19.8
Poor water quality only	18	12.5
Shortage of water quantity only	30	20.4
Neither shortage of water quantity nor poor water quality	70	47.9
Sample Size(N)	146	100

According to one sample t-test there is a significant difference between the two groups (the significance is less than 0.05). The current provision of water supply services should be an issue worth discussion, since the sample mean of 2.66 is significantly greater than the population mean of 1.5. Also, there is a significant difference between the two groups at a 5% level of significance that the respondents think the administrative body should give enough attention for improved water supply services, since the sample mean of 2.17 is significantly greater than the population mean of 1.5. There is a significant difference between the two groups at a 5% level of significance that the respondents think leaving the environment to future generation is something important, as the sample mean of 1.26 is less the population mean of 2, as shown in table 4.4 below.

Table 4.4:One Sample T-Test

Classes	N	Mean	T-test	5% conf. interval
The current provision of water supply services is an issue worth discussion	146	2.66	10.85	0. 000
The administrative body should give enough attention for improved water supply services	144	2.17	9.94	0. 000
Leaving the environment to future generation is something important	145	1.26	-19.45	0. 000

4.3. Sample WTP Estimates

Table 4.5 shows summary statistics of the data set (untrimmed case) for the TEV of improved domestic water supply services for the time being (use values) and in future (non-use values): (1) WTP for use values: The total WTP for 146 samples is 2369 Birr per month. The mean WTP of the respondents who stated a positive amount was 18.65 Birr per month (untrimmed), with standard deviation estimated by 13.96 Birr; (2) WTP for non-use values : The total WTP for 146 households participating in the survey is 690 Birr per month. The mean WTP of respondents who stated a positive amount was 4.93 Birr per month (untrimmed), with standard deviation estimated by 5.02 Birr; and (3) WTP for TEV values: The total WTP for 146 samples is 3059 Birr per month . The mean WTP of respondents who stated a positive amount was 21.38 Birr per month (untrimmed), with standard deviation estimated by 16.06 Birr.

On the other hand, the untrimmed WTP estimates are only descriptive amounts. However, it is worthy to indicate that these WTP estimate are untrimmed and unreasonable to be adopted in reality. However, the trimmed values of mean WTP estimates of regression analysis (Tobit model) are smaller than the untrimmed results, which are adopted as an indication for mean WTP. According to table 4.6, the mean WTP amounts of Tobit model (trimmed) were 19.94 Birr for the TEV of improved domestic water supply services including use and non-use values, which is the trimmed values of the mean WTP that can be taken as an indicator for WTP amounts (Jones et al. 2008).

Table 4.5: Statistical Descriptions for WTP of the Sample: TEV (untrimmed)

Statistics	WTP(use values in Birr)	WTP(non-use values in Birr)	TEV(use and non-use values in Birr)
Mean WTP	18.65	4.93	21.38
Median WTP	15. 00	4. 00	18. 00
Std. Deviation	13.96	5.02	16.06
Variance	194.81	25.23	258.07
Range	72	30	95
Minimum	3	0	3
Maximum	75	30	98
Sum	2369	690	3059
WTP(N)	127(86.9%)	140(95.9%)	140(95.9%)
No-WTP	19(13%)	6(4.1%)	6(4.1%)
Sample Size(N)	146	146	146

On the hand, according to two independent samples Mann-Whitney test, asymptotic significance (2-tailed) is 0.000 and less than 1%. However, there is a statistical significance difference at a 5% level between the WTP for use values and non-use values. According to Wilcoxon signed-rank test, the respondents who are willing to pay are higher than respondents who are not willing to pay for improved domestic water supply services.

4.4. Utilizing Regression Analysis for Derivation of WTP Estimates

The study uses CVM to gauge the TEV of improved domestic water supply services, as shown in table 4.6, Tobit model was used to investigate the open-ended WTP variables as a dependent variable, which includes positive and true zero responses (Jones et al. 2007) . Since, traditional techniques (for instance, regression analysis) may create biased results, an alternative approach to the standard regression modeling for dealing with the zero WTP values is the Tobit model (Tobin 1958). The open-ended question was used to evaluate the mean WTP in reality (Carson 2000). Although, this source of WTP could underestimate the true WTP, either for cognitive burden reasons or for anchoring bias. Nevertheless, utilizing open-ended WTP question is the only approach that can work with individual data (Santagata and Signorello 2000). Additionally, the linear regression analysis was also used (Mabta 2006). Specific econometric analysis was performed by utilizing the E-views and stata 11 software packages.

As table 4.6 indicates, the mean WTP value of Tobit model for 146 respondents in the survey was obtained as 19.94 Birr monthly. This result implies that the respondents interviewed are voluntarily willing, on average, to pay 19.94 Birr for TEV of improved domestic water supply services for current and future generations. According to the linear model the adjusted coefficient of determination (adj. R^2) is 0.224, which is an acceptable result for CVM studies (Imandoust and Gadam 2007). According to Tobit model logistic R^2 is 0.06, the result of R^2 of Tobit model is acceptable and consistent with the developing countries situation. The WTP model includes 11 explanatory variables, which comprises the variables that can be considered for WTP models based on previous studies and economic theories.

The explanatory variables were age, gender, time period "how long the respondent has lived in the town?", water consumption, income, education, employment statues, gainfully employed "the family members who are gainfully employed", household size, water pressure, and water quality. The explanatory variables were considered along with their expected signs in accord with both, economic theory and previous empirical studies as shown in table 4.6 below.

The results revealed that the variable age, water consumption, and water pressure have significant impact on WTP, since age, water pressure, water quality and water consumption have positive and significant impact on WTP (the higher age and water pressure, the greater willing to pay) and consumption has a positive and significant effect on WTP which is inconsistent with economic theory (the more I consume the less I am willing to pay).

The variable educational level, time-period "how long the respondent has lived in the town?", gainfully employed " family members who are gainfully employed" and household size have significant impact on WTP , which is consistent result with the findings in other studies (Kinfe and Berhanu 2007).

To examine the WTP amount, the signs of the estimated coefficient for the socioeconomic factors, age, gender, time period and employment status, are expected to be positive and have significant impact on WTP, which is evidence that the WTP amount is significant (Jones et al. 2008). The above mentioned interpretation showed that the variable ages, gainfully employed, water consumption and education have positive and significant impact on WTP while time period and household size have negative and significant impact on WTP. Family size of the household variable was found to be significant at 5 % with a negative parameter estimates. This suggests willingness to pay for improved water services decreases as family size of the household increases. This is due to the fact that given income of households, if family size of the household increases the per capita income of the member household decreases and hence willing to pay less to the proposed improvement services. Another reason could be large family size of households' increase their water consumption which could discourage the family due to high bill charge services and hence willing to pay less for the proposed improvements than their counter parts.

Responses for willingness to pay indicate that the average willingness to pay (WTP) for improved water service for the whole sample is 24.75 cents per bucket of water. This indicate that the residents of Haik town are willing to pay more than the existing tariff rate which is around 5 cents per bucket of water for the lowest consumption bundle (Birr $2.50/m^3$) and 12 cents per bucket for the highest consumption bundle (Birr $6.10/m^3$).

The variable gender and income have positive and insignificant impact on WTP, which is to be inconsistent result compared with the results in other studies. The mean WTP for TEV of 19.94 Birr per month or 239.28 Birr per annum is significant amount. Accordingly, the mean WTP is unlikely to be a realistic value that can gauge the TEV of improved domestic water supply services. However, the study also shows that the TEV of improved domestic water supply services is likely to be difficult to estimate.

Table 4.6: Tobit Estimates for the Determinants of WTP Model-the TEV of Improved Domestic Water Supply Services

		Linear regression model		Tobit regression model	
Variable	**Expected sign of the coefficient**	**Estimated coefficient**	**T-statistic(P-value)**	**Marginal Effect**	**Z-value(P-value)**
Constant		36.610	7.27(0.000)	21.12	7.68(0.000)
Age	+	0.004	1.15(0.256)	0.91	1.45(0.152)
Gender	+	3.170	0.85(0.397)	4.46	1.29(0.203)
Time-period	-	-0.092	-2.02(0.048**)	-0.28	-1.29(0.201**)
Water consumption	+	2.494	3.61(0.001*)	2.13	3.37(0.001*)
Income	+	2.930	0.24(0.807)	2.97	0.15(0.884)
Education	+	3.021	1.45(0.152)	5.95	1.86(0.068**)
Employment Status	+	9.885	1.23(0.222)	13.19	2.72 (0.007***)
Gainfully employed	+	20.751	2.28(0.026**)	20.94	2.43(0.018*)
Household size	-	-2.414	-2.21(0.032**)	-1.92	-2.08 (0.042**)
water quality	+	3.671	1.15(0.254)	4.21	0.89(0.377)
Water Pressure	+	3.375	2.56(0.013**)	0.03	2.72(0.018**)
Linear regression model: R-squared =0.381 Adjusted R-squared =0.224			Tobit model: Log-likelihood =-302.433 Logistic R^2 =0.06 Number of included observations =146 145 Uncensored observations 1 Left-censored observations at WTP amount ≤ 0 Mean WTP =19.94 Birr Std. deviation WTP =8.08Birr		

***, **, * indicate significance at 1%, 5%, and 10% levels respectively.

4.5. The Probit Model: Calculating Mean WTP

In this study we have already discussed the effect of socio-economic and demographic factors of the respondent on WTP using the Tobit model. Thus, the Probit model in this study is used to calculate mean willingness to pay for the closed-ended format. According to Hanemann et al.(1991) cited by Jonse (2005) states that one of the main objectives of estimating an empirical WTP model based on the CV survey responses is to derive a central value (or mean) of the WTP distribution. Similarly, Carlsson et al. (2002) cited by Mahmud (2005/06) states that the main reason for estimating the Probit model is to obtain an estimate of mean WTP.

The result is obtained by regressing the willingness to pay variable on intercept and initial bid (IB) variable. The regression result shows the following values on table 4.7.

Table 4.7: The Probit Model to Calculate Mean WTP

Variable	Coefficient	Std.Er	P-values	Mean of X
CONS	1.970	0.925	0. 000	
IB	-0.072	0.020	0. 000	17.750
Dep. Var.=yes/no(Y/N)			Mean=0.8841129	S.D.=.0893437

Mean WTP (μ) using the model for the closed-ended format is defined as follows:

$$\mu = -\frac{\alpha_0}{\alpha_1}$$

Where:

α_0 = the constant term

α_1 = the bid coefficient

$$\mu = -\frac{1.9712300}{-0.0720123}$$

$$= \mathbf{27.37}$$

Thus the mean WTP (μ) calculated from the closed-ended Probit model is **27.37**cents per a bucket of improved water services.

However, the mean WTP is 24.75 cents per a bucket of water from responses to the open-ended CV survey questions, which is a bit lower than the mean values obtained from the closed-ended Probit model estimates. Thus, the finding of the study showed the respondents willingness to pay was in the range of 24.75–27.37 cents per Baldi (a 20 liters bucket) for the proposed improvements of water supply services. The similarity of the mean WTP under the open-ended and closed-ended formats indicates the validity and reliability of the CV outcomes in the empirical analysis.

4.6. Reasons for Acceptance and Rejecting of the Scenario

The WTP questions were binary question (0, 1) and follow up question (open-ended). In addition, respondents justified their answers regardless of their acceptance or rejection of the scenario (Arrow et l., 1993). The percentage of respondents who accepted the scenario is 99.3 percent, which seems a high percentage because of reliable and sufficient water is a must for households. The main reason for being willing to pay a certain amount is the improvement of domestic water supply services in terms of both water quality and water quantity.

Reasons behind respondents who are willing to pay (accepting the scenario) are shown in table 4.8. However, 90.8 percents of respondents would like to have more sufficient and reliable water for their domestic purposes. 83.9 percents of respondents were confident for their decision while 10.4 percent were somewhat sure for their decision. 71.2 percent of respondents are interested to avoid any possible health problems due to water uses. Also, 1.4 percent of respondents are willing to pay for the service without any justification.

On other hand, the data revealed that 45.5 percent of respondents are willing to pay because of water is necessary for future generation which understands water is scarce and vulnerable resource.

Table 4.8: Reasons for Accepting the Scenario

Reasons	Sample Size(N)	Accepting the Scenario	Relative Frequencies (%)
Respondents who need more sufficient and reliable water	142	129	90.85
Respondents level of decision who are sure of their decision	143	120	83.92
Respondents level of decision who are somewhat sure for their decision	143	15	10.49
Clean tap water contribute for good health	132	94	71.21
Water is necessary for future generation	110	50	45.45
Other factor	142	2	1.40
Respondents worried about the health risks of existing water services	142	8	5.63

Reasons behind respondents who are not willing to pay (rejecting the scenario) are shown in table 4.9. 40.1 percent of respondents revealed that they receive sufficient municipal water quantities, meaning that less than half of the respondents are likely to reject the scenario because of this reason. 87.4 percent of respondents indicate that the quality of municipal water is good to use. 16.4 percent of the respondents don't worry about the health risks of existing water services. On the other hand, 26.5 percent of the respondents don't willing to pay because the government will not be able to have a concrete benefit for future generations.

Table 4.9: Reasons for Rejecting the Scenario

Reasons	Sample Size (N)	Rejecting the Scenario	Relative Frequencies (%)
Respondents who receive sufficient municipal water quantities	142	57	40.1
The quality of water is good to use	145	125	87.4
Respondents who don't worry about the health risks of existing water services	146	24	16.4
Respondents who doubt to have a concrete benefit for future generation	132	35	26.5

Chapter Five: Conclusion and Recommendation

5.1. Conclusion

Urban water supplies provided by public utilities are facing an acute crisis in many developing countries. As such, the urban centers of Ethiopia are also characterized by poor water supply services. At the moment, Haik town is facing unreliable and inadequate supply of water.

However, the existing water supplies of municipality come from two ground water sources are inadequate to meet the present and the near future water needs of the population of Haik town.

Some of the major reasons for the incompatibility between the water demand of Haik town and supplying capacity of municipality include: the rapid population growth, financial constraints, which is accompanied by administrative and technical problems.

CVM is a survey based on consumer theory, using a questionnaire to assess, in monetary terms, "charge of utilities from present time when environment has not undergone improvement, to hypothetical future when environment will have change", and to estimate WTP for environment improving services. This means that the WTP is the amount expressed by respondents on the basis of a hypothetical scenario, so that the results cannot readily be applied to the actual tariff system of environmental improvement service: but still, the WTP estimated through CVM can provide important basic information for cost benefit analysis and tariff setting. Policy makers can use this information for policy-making on water and sanitation services, thereby optimizing resource allocation among various public services.

In ensuring financial sustainability of water and sanitation sectors, it is necessary to have in place an appropriate tariff level, and to ensure a high collection ratio. In order to set appropriate tariff and user charges, sufficient justifications are needed for users and suppliers. The WTP estimated through CVM can be data of demand side (i.e. beneficiaries).

Based on the above; a CVM survey was utilized to obtain estimates of WTP for improved water quality and secured sufficient water supplies for the time being (use values), and for insured sufficient and reliable water for future generations (non-use values). Moreover, provide practical information on the TEV of improved domestic water supply services.

However, the study centered on the use of domestic water supply services in Haik town that can provide background information and suitable scenarios for planners, which are special value to improve domestic water supply services for current and future generations. A Tobit model was applied to data generated by the survey to explain the determinants of households' WTP for improved water supply services and descriptive statistics is also applied.

The principal methodological question addressed by this study was answered affirmatively. The commodity and the scenario were described clearly and accurately in the CV questionnaire that can achieve high quality for the CV survey, and WTP estimates for improved water supply services for the time being and in future (Carson 2000). CVM is employed to estimate the value that households in Haik town attach to the proposed improvement in water supply service. For this purpose, a total of one hundred forty five (145) households were interviewed after stratifying the town into five different administrative kebeles.

The study results reveal that the household mean WTP for TEV of improved domestic water supply services' including use and non use values is 19.94 Birr per month or 239.28 Birr per annum, which seems to be significant amount based on the coefficients and marginal impacts of socioeconomic factors suggested by economic theory and previous CV studies. The mean willingness to pay value is 24.75 cents per bucket for the improved water supply service as calculated from the Tobit model. The total willingness to pay amount from the total of 4,590 households in the study area of Haik town is Birr 1,136.03 per *Baldi* or Birr 4,544.12 per a day at average service fees of 24.75cent per Baldi.

The Tobit model shows that there are several factors that affect the WTP value. Age, education dummies (both primary and secondary education), employment status, water consumption, water pressure, employment status, gainfully employed, have positive and significant effects on willingness to pay. Family size and household's year of stay have negative and significant effect on willingness to pay amount. Income, water quality and gender have been found to be positive but insignificant effects on WTP amount.

The value of logistic R^2 obtained from Tobit model was relatively low, despite the model includes 11 explanatory variables, which comprise variables that can be considered for WTP models. Accordingly, the estimated amount is likely to be insignificant and insufficient to introduce a practical estimation for TEV of improved domestic water supply services in Haik town. Therefore, the policy makers should adopt proper strategies to provide background information to households about water threats in terms of both, shortage of water quantity and poor quantity that may improve water quality and secured sufficient water supplies for current and future generations.

The result also reveals the reason for accepting the scenario (hypothetical improvement for domestic water supply services) of WTP, specifically: majority of respondent's needed more sufficient and reliable water supply; respondents believed that clean tap water contribute for good health and is necessary for future generation. In other words, majority of respondents are likely to be willing to pay because they think the municipal water is not sufficient and reliable. On the other hand, the outcomes also show reasons for rejecting the scenario of WTP, specifically: respondents who doubt to have a concrete benefit for future generation and some respondents are unlikely to be cared about the reliability or stability of water supply. In other words, some respondents are unlikely to be willing to pay because they think the municipal water is sufficient and reliable.

However, this study is to be of interest since it provides background information about the economic value (both use and non-use values) of domestic water supply services and the application of CVM provides very important information on households' WTP that may be used in clarifying other essential remarks for improved water quality and insured sufficient water quantity (use values), as well as secured reliable and sufficient water supply services for future generations (non-use values).

5.2. Recommendation

Since the existing water supply system cannot satisfy the existing demand, which lead to the availability of water only for some hours per day or makes the availability unpredictable, people of the town are forced to waste their time in searching other sources of water or consume less than required. However if improved water services are supplied to the households and the water utility install meters or increase its connections, it can increase its revenue by increasing the water tariff, since households are willing to pay more than the existing tariff.

By setting the tariff equal to the average incremental cost (AIC) of providing improved water services, the water utility can recover the full cost of providing the service.

More specifically, based on our findings, we can draw the following policy implications:

- Since income and willingness to pay for the proposed improvement in water supply service are positively related, development policies should target at increasing income per household that address the low income members of the society.
- The strong positive relation between gainfully employed household members and the willingness to pay for improved water service indicate the necessity to consider households' employment status in designing and implementing the policies of water supply services.
- Another strong negative relation between the year of stay of household at a particular area and the willingness to pay for the proposed improvement in water supply service reveals inconsistent from previous studies since development policies to be focused towards the oldest quarters of the town.
- Water consumption and good water pressure positively and significantly affect households WTP this is due to the fact that when water is available in good pressure will bust demand for water.
- Family size of the household variable was found to be significant at 5 % with a negative parameter estimates. This suggests willingness to pay for improved water services decreases as family size of the household increases. This is due to the fact that given income of households, if family size of the household increases the per capita income of the member household decreases and hence willing to pay less to the proposed improvement services. Another reason could be large family size of households' increase their water consumption which could discourage the family due to high bill charge services and hence willing to pay less for the proposed improvements than their counter parts.
- Education helps increase individuals' awareness of the importance of improved water service in general, as it has been witnessed by the positive coefficient of education. It is known that more educated society have a good knowledge about the health implication of safe water and care for their family. Thus in order to have productive societies who are safe from water born disease, there should take action in educational awareness but it has influence on the growing water demand problem within the existing supply condition. Implying that water authority in particular needs to launch strong public awareness to the local community on an economical use of the available water supply.

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Annex-Contingent Valuation Survey Questionnaire

This research is conducted for academic purpose and its objective is to value the water supply service improvement in Haik town assuming as if it is going to be implemented. Your answers are completely confidential, your name is not written on this form, and never be used in connection with any of the information you told to us.

Thank you for your cooperation!

Estimation of Total Economic Value of Domestic Water Supply Services: An Application of Contingent Valuation Method for Haik Town.

By: Tekola Mekonnen

Section A: Household Characteristics

Identification:

Location: ______________________________ Date of Interview: ________________

Code: ________________________________ Length of Interview: ______________ (Minute)

Household Head

A1. Interviewee is head of the household 1. Yes 2. No

A2. Head of the household 1. Male 2. Female

A3.Age of the household head__________ (years)

A4. How long have you lived in this town ______ (years)

A5. Education of the head of the household

1. No Schooling 2. Primary Education (1-5 years)

3. Secondary Education (6-12 years) 4. Completed Diploma (2-3 years)

5. Completed Bachelor degree 6. Completed graduate studies & above

A6. Employment status of the household head 1. Employed 2. Unemployed

A7. Occupation of the head of the household

1. Agriculture 2. Own business 3. Government employee 4. Private employee

5. Housewife 6. Others

A8. Family member's gain fully employed _______

A9. Monthly income of the household (in birr) _______

A10.Monthly expenditure of the household (in birr) _______

Section B: Questions on Household's Current Status of Domestic Water Supply Services

B1. Two most important reasons for having a tap connection

1. Convenience 2. Health 3. Reliability 4. Modernization

5. Alternative source is not sufficient 6. Cheaper 7. Others

B2.How much are you charged per month, on the average, for using this sources ______ Birr/month

B3.How much water do you consume per day on average _____ Baldi (a 20 litter bucket)

B4.Consumption per month (m^3) ______

B5. Do you sell piped water to others, e.g. neighbors? 1. Yes 2. No

B6.If yes, how many Baldi per day? _______

B7.Income earned ____ (Birr/day)

B8. How many persons outside your household use water delivered through your tap connection?

__

B9. Water availability

1. Sufficient all time 2. Insufficient during dry season

3. Sometimes insufficient 4. Insufficient mostly

B10. How many hours per day do you receive water from the piped system? ___________

B11.How many days per week do you receive water from piped system?________________

B12.In winter /dry season, how many days do you receive water from piped system per week? __

B13.In summer /rainy season, how many days do you receive water from piped system per week? __

In relation to its quality, amount and reliability, how do you rank the current status of water service from this source?

B14. Quality: 1. Good 2. Satisfactory 3. Poor

B15. Quantity: 1. Good 2. Satisfactory 3. Poor

B16. Reliability: 1. Reliable 2. Unreiiable

What do you think of the quality of the water delivered?

B17. Taste 1. Good 2. Average 3. Bad

B18. Smell 1. Good 2. Average 3. Bad

B19. Color 1. Good 2. Average 3. Bad

B20. Is there any relation between the quality of water and the illnesses in your household?

1. Yes 2. No

B21. How many persons in your household were ill during last year due to the consumption of unsafe water? ______

B22.How many days of sickness per person _______

B23.If the sick person has got treatment, how much was the medical cost? _______________

B24. Water pressure: 1. Strong 2. Weak 3. Generally strong 4. Sometimes weak

B25. How do you treat water?

1. Boil and filter 2. Boil 3. Filter 4. Others 5. None

B26. Water from secondary source, if any:

1. Private 2. Dug well 3.Public stand point (Bono)

4. Water vendors 5. Others

B27.To what extent do you perceive the current provision of piped water is an issue worth discussion?

1. Critical 2. Very serious 3. Series 4. Less serious 5. Not important

B28. Who do you think is responsible for water supply?

1. Government 2. Community 3. Private 4. Others (specify)

B29. Are you satisfied with the arrangement of the existing water service?

1. Yes

2. No GO TO QB30

B30.What is (are) the cause(s) of your dissatisfaction? IDENTIFY AND RANK STARTING WITH THE MOST SERIOUS CAUSE

1. Poor quality

2. Unreliability

3. Higher connection charges

4. Higher volume charges

5. Others (specify):

B31. So far, has the administrative body done enough in solving the problems in the provision of improved piped water to household?

1. A lot attention to the problem 2. Some attention to the problem

3. Not too much attention to the problem 4. No attention at all

B32.Do you think that leaving a better environment to future generation is some thing

1. Very important 2. Important 3. Less important 4. Not important at all