

**HOUSEHOLDS' DEMAND FOR IMPROVED WATER
SUPPLY SERVICE IN RURAL AREAS OF ANKASHA
WOREDA, AMHARA REGIONAL STATE IN ETHIOPIA**

By

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To

The Memory of my Mother Kassech Yalew

ABSTRACT

The major objective of this study is to assess the demand for improved water supply services in the context of rural areas of Ankasha woreda by using CVM with a single bounded elicitation format followed by open ended questions. Both Probit and Tobit models were used to analyze the determinants of households WTP for improvement of rural water supply services, and a total of 200 randomly selected rural household heads were interviewed. A mean WTP of birr is found to be 1.52 per jerican. Households monthly income, time taken to collect water from the existing source for single trip, educational level and sex of the household head have positive and significant effects on willingness to pay for improved rural water supply services. On the other hand, the initial bid price and quality of existing water source have negative and significant effects on the probability of willingness to pay for improved water provision in the probit model. In the Tobit model the variables households monthly income, time taken to collect water for single trip, educational level, marital status and age of the household head determine MWTP of respondents positively, while availability and quality of the existing water sources negatively affect MWTP. As the mean willingness to pay of the sampled households is very much higher than the amount of money households paying for existing water sources, both the rural households and service provider will be the gainers from the improved water supply service implementation. The service providers should take into consideration the quality and distance problems in designing the water system of the rural areas of Ankasha woreda.

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LIST OF ABBREVIATIONS

CSA	Central Statistical Agency
CV	Contingent Valuation
CVM	Contingent Valuation Method
HHs	Households
HPM	Hedonic Pricing Method
MDGs	Millennium Development Goals
MWTP	Maximum Willingness to Pay
NOAA	National Oceanic and Atmospheric Administration
OLS	Ordinary Least Square
TCM	Travel Cost Method
UN	United Nations
UNICEF	United Nations Children Fund
WHO	World Health Organization
WTA	Willingness to Accept
WTP	Willingness to Pay

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Water plays a critical role in welfare of societies around the world and affects the livelihood of every human and it is essential for the maintenance and survival of every human life. But according to Siedman (2005), less than 1% of the available water on the planet is fresh water that is used for drinking and other activities. In Nov 2002, the UN committee on economic, cultural and social rights declared access to clean water as human right. Adequate, quality, safe and affordable supply of drinking water is a basic need for human life (Siedman, 2005). However, many people especially in developing countries do not have access to safe and adequate water services which affects their life in various ways (Mazvimavi and Mmopelwa, 2006).

According to UNICEF/WHO, an estimated 748 million people of the total world population did not use an improved source to meet their daily drinking-water needs in 2012, of which 173 million who relied on surface water like rivers, streams or ponds and the remaining population obtained their drinking water from unprotected, open wells or poorly protected natural springs. In most developing countries provision of improved water supply is inadequate both in urban and rural areas. But lack of improved water and sanitation facilities is predominantly a rural and poverty related phenomenon. By the end of 2012, over 90% percent of the population without access to an improved drinking water source lived in rural areas. In sub Saharan Africa, 43 percent of population still did

not have access to an improved source of drinking water in 2012 (UNICEF/WHO, 2014).

According to the UN World Water Assessment Program, about 2.3 billion people suffer from diseases associated with unimproved water use, and more than 5 million people die from these illnesses each year. In spite of all these one of the millennium development goals (MDG) is reducing the proportion of people without access to safe and adequate drinking water by half by 2015 (United Nations, 2007).

Although Ethiopian government formulated the country's water resource management policy in 1999 to alleviate the problem of access to safe water supply, large number of rural communities use unprotected springs, hand-dug wells and rivers (Lema and Beyene, 2009). Thus, Water demand analysis is important at providing appropriate information and knowledge for designing an effective water demand policy in general and a policy that pursues the efficient use of water in particular (Pearce, 1999). Thus, this study intends to assess the demand side information of households in rural areas of Ankasha woreda for improved water service provision.

1.2 Statement of the Problem

Developing countries which depend on unsafe and inconvenient water supply and sanitation services indicate that there is a need for strategically targeted initiatives to meet the MDGs, but to address the access to safe and adequate drinking water problem of these countries huge investment in water project is required. However, due to lack of finance and trained manpower, governments of these countries have limited potential to make water easily accessible to its people (Ahmed, 2013). Like in many other developing

countries, in Ethiopia there are many constraints to make access to safe and adequate drinking water easily accessible such as lack of trained manpower and financial constraints. The country is not able to solve fully the access to safe and adequate drinking water problem of its people both in urban and rural areas.

Rural communities in Ethiopia mostly use unprotected springs, hand-dug wells and rivers. As a result, in rural parts of the country a considerable number of people (mostly women and children) spend a good part of their time fetching water from rivers, natural springs and other sources by moving long distances through much of the year. About 52 % of the population travelled half an hour or more to collect water every day (CSA, 2006). Like in many other rural areas in Ethiopia, people in rural areas of Ankasha woreda use water from springs, hand dug wells and rivers, even these sources are open to flood which carries open field defecations and they are highly contaminated.

To improve this extremely low level of water supply service in rural areas requires a substantial resource commitment and the primary target of government policies. Even, one of the millennium development goals (MDGs) is reducing the proportion of people without access to safe and adequate drinking water by half by 2015 (United Nations, 2007). Although improving water supply service provision is a priority for the rural and urban development, the strategies of donor organizations and the government so far, their targets have been supply driven (Medhin, 2006). The demand side of improvement in water supply service has been ignored. Hence, it is so difficult and may be impossible to provide safe, quality and enough quantity water by covering all costs for the government without adequate demand analysis from the side of the general public. To solve this

financial problem of provision of improved water supply services, the government could apply cost recovery strategy.

But to apply cost recovery strategy it is important to know the value consumers put on improvements in water supply services. However, this is difficult to quantify through simple market demand and supply analysis. Therefore, for those goods that do not come under market transactions such as water supply service improvement to set appropriate prices, it is important investigating willingness to pay of the users of improved water supply service using non market valuation techniques such as contingent valuation method (CVM).

Different contingent valuation method (CVM) studies were undertaken in line with willingness to pay for environmental quality improvements in general and water supply service improvement in particular in Ethiopia. However, the existing research effort has much focused on urban areas and this study is a contribution to an effort narrowing the existing gap in the context of rural areas of Ethiopia by taking case study of Ankasha woreda in Amhara regional state.

1.3 Objective of the Study

This study has both general and specific objectives.

1.3.1 General Objective

The general objective of this study is to assess the demand for improved water supply services in the context of rural areas of Ankasha woreda.

1.3.2 The Specific Objectives

- To examine the determinants of household's willingness to pay for improved water supply services
- To find out the factors for households unwillingness to pay for improved water supply services
- To draw out conclusions and policy implications.

1.4 Significance of the Study

This study is expected to be a pioneer work on valuation of households' willingness to pay for improved water supply services in rural areas of Ankasha woreda. Hence, it is expected to be a good reference material for further studies around the topic in the area. In general, based on the results and policy implication of the paper the government and non-government organizations could have a reliable information for their future investments on the provision of improved water supply services in the area.

1.5 Scope and Limitation of the Study

The study is limited to the analysis of the demand side about water supply services for households' domestic purpose from cross section data of households at a given point in time. Although the users of improved water supply service may include public bodies, different private organizations, households and etc., this study deals only with improved water supply services of households in rural areas of Ankasha woreda.

Further the sample used for this study is limited in both coverage and size. The coverage of the study is limited only to the three rural kebeles of Ankasha woreda and the sample

size is limited to 200 household heads. This is due to the financial constraints and especially difficulty of moving long distance among rural kebeles due to lack of transportation services. Lack of well documented data sources in the study area was the main challenge we faced during this study.

1.6 Organization of the Study

This paper is organized as follows. Chapter two reviews the theoretical and empirical literature about environmental valuation methods and water supply service improvement. The third chapter deals with survey methods, model specification, questionnaire design and methods of data analysis. Chapter four discusses analysis of empirical findings of the study. The final chapter concludes the study and provides policy implications.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Review of Literature

2.1.1 Components of Value of Environmental Resources

Loomis (1987) classified natural resource values into use values and nonuse values. The total economic benefits of environmental resources can be divided into two: use values and nonuse values.

The total use values of environmental resources can be classified into four categories: direct use value, indirect use value, optional values and quasi optional values while the nonuse values can be categorized into bequest value and existence value (Bateman et. al. 1993).

Direct use values – are contributions that the assets make to current uses or the value derived from directly consuming services provided by an environmental resource.

Indirect use values – are benefits derived basically from functional services that the environment provides to support current production/consumption or value derived from indirect consumption of an environmental good such as the aesthetic and functional services it provides.

Option value- refers values that individuals' attach to environmental resources that they may use in the future although they do not use them currently.

Quasi optional values- values related to future benefits of environmental resources that would result from future use as a result of future discoveries on new use of the resource, but do not belong to current developmental activities.

Bequest value- refers to the satisfaction that people gain from the knowledge that an environmental resource endowment is being preserved for future generations. Bequest demand exists to the extent that the present generation is willing to pay for preserving natural resources for the use of future generations.

Existence value- refers to the satisfaction that some people derive from the preservation of environmental resources so that there remains a habitat for fish, plants, wildlife, and so on. Thus the calculation of the total economic value of an environmental resource should contain all the above components of value. Since nonuse values are derived from motivations other than direct personal use, they are obviously less tangible than the use values. The estimated nonuse values can be quite large so ignoring either one or more components of the value will under estimate the total value of the resource or leads to resource misallocations (Tietenberg and Lewis, 2012, p.37 and Freeman, 1993, p. 141)

2.1.2 Environmental Valuation Techniques

There are two broad valuation techniques: direct (stated preference) valuation techniques and indirect (revealed preference) valuation techniques.

2.1.2.1 Direct Valuation Methods (Stated Preference Methods)

Two main stated preference methods are the contingent valuation method (CVM) and the choice experiment method (CEM). Both methods depend on a hypothetical market which is presented to the respondent in a questionnaire. A main advantage of stated preference

methods over the revealed preference method is that we can ask respondents for their WTP regardless of whether they make use of the hypothetical commodity or not. In other words we can obtain use and non-use values whereas the revealed preference method only addresses the use value of the resource (Hanley et al, 1997).

Contingent Valuation Method (CVM)

The contingent valuation method is the earliest technique of the stated preference method of non-market valuation approaches. The CVM involves asking people directly what they would be willing to pay or willing to accept compensation for change in preferences. This method is called contingent valuation because the valuation is contingent on the hypothetical scenario put to respondents. The contingent valuation method has two major advantages over the indirect valuation methods. First, CVM deals with both the use and nonuse values of the environmental resource while the indirect methods deal only with the use value. Second, survey responses to willingness to pay or willingness to accept hypothetical questions go directly to the monetary measures of utility change (Perman et al., 2003).

The CVM has proven the most popular of the available methods for monetary valuation of the environment. This is because of the following three main reasons. The first thing is its simplicity. Secondly the application of CVM seems unlimited in the sense that questions could apparently be asked concerning the provision of any environmental goods and services. The last and obvious reason is the CVM deals with both the use and nonuse values of these environmental goods and services (Spash, 2008).

Main steps in CVM

The major steps involved in a CVM exercise are described below.

The first step is the design of a survey instrument for the elicitation of individuals' WTP/WTA. The instrument includes a detailed description of the good being valued and the hypothetical circumstance under which the good is made available to the respondent, i.e., designing the hypothetical scenario, deciding whether to ask respondents WTP or WTA questions and creating a scenario about the means of payment or compensation.

The second step is defining the population of interest and administering the survey instrument to a sample. Different methods of survey administration can be used such as telephone, face-to-face, ordinary mail and e-mail etc.

The third step is analyzing the survey responses like estimating the average WTP/WTA for the population and assessing the survey result to ascertain the accuracy of these estimates.

The fourth step of the CVM exercise is estimating and aggregating WTP/WTA for the population. Conducting sensitivity analysis is the final step (Perman et al., 2003, p. 421 and Hanley et al., 1997, p. 384).

Elicitation Formats and Related Biases in CVM Analysis

The main value elicitation formats used in CV studies are briefly described below. Open ended format- using this format respondents are simply asked to state their maximum WTP or minimum WTA for any proposed environmental change. A major problem associated with this elicitation format is it is exposed to strategic bias and loose answers or do not know answers. To deal with such problems economists proposed the following elicitation formats even if they are not also free of bias.

Payment card approach –in this format respondents are asked to choose WTP/WTA estimate or a range of estimates from a range of values shown to respondents on a card (Mitchell and Carson, 1981).

Bidding game format- in this format respondents are asked a series of questions whether they are willing to pay a certain amount say \$X. If he/she refuses a proposed amount then another offer with lower value will be proposed for the respondent, lower than \$X amount, and the procedure continues until the respondent says yes. The last amount can be taken as his/her maximum WTP. And if he/she accepts to pay the proposed amount then he/she will be asked to pay a larger value until he/she says no to the proposed WTP amount. Likewise, the last offer will be taken as the maximum willingness to pay for the respondent (Carson and Hanemann, 2005, P. 870). In this elicitation format the starting point has a sizable influence on the final willingness to pay estimate. In this sense this format is exposed to starting point bias, i.e. if we start at inappropriate amount we will arrive at inappropriate WTP estimates.

Dichotomous or discrete choice format- respondents are asked simply whether he/she is WTP the assigned value for the environmental improvement. This format has yes or no responses. Compared to open ended this format provides limited information about the respondents WTP (Carson and Hanemann, 2005, p. 871). Even though CVM is a good method in non-market valuation for environmental goods, it suffers from potential biases. Of these biases the following can be mentioned:

A. Starting point bias - The starting point can influence the respondent's answer about WTP. For example if we start with inappropriate price (bid value) we may obtain

- inappropriate responses in the final bid. Most of the time this bias arises in the bidding game because the value selected has an impact on the final bid. (Gundimeda, 2001)
- B. Vehicle (Payment) bias– this type of bias arises if the WTP/WTA varies depending on the mode of payment. The responses of respondents on their WTP estimates may be different if the mode of payment available to them is different. For instance if an individual is asked how much he/she is willing to pay for an environmental improvement, WTP may be different depending on the mode of payment which could be in the form of tax, labor hour, user fees etc. This difference in WTP dependent on the mode of payment is called (payment) vehicle bias (Perman et al, 2003)
- C. Hypothetical bias – this bias is a potential error included by confronting the individual with all imaginary situation that is people would not behave the same way in actual market. Respondents are confronted by an artificial set of alternatives rather than actual choices. Thus, the respondents may treat the survey by providing ill-considered answers (Tietenberg and Lewis, 2012).
- D. Strategic bias – occurs in the case of public goods respondents do not reveal their true preferences or WTP of the good or service to “free ride” if they know that bids are actually going to be collected (Tietenberg and Lewis, 2012).

2.1.2.2 Indirect Valuation Methods (Revealed Preference Methods)

Travel Cost Method (TCM)

Travel cost methods have been used extensively to estimate the value of recreational sites like parks. Using these methods, researchers can calculate the economic costs necessary to reach a recreational site as an estimate of user willingness to pay for recreation. That economic cost may include entry fees, monetary costs of travel, and foregone earnings. In effect, these travel expenses represent the “price” of the recreational experience and are an indirect but observable indicator of user value. By comparing the number of visits that individuals make at different levels of travel cost, economists are able to estimate economic value for site attributes, such as improved environmental quality (Letson and Walter, 2002).

According to Freeman (1993), travel cost method is based on the following assumptions.

- I. The cost of visiting a site is a function of characteristics of the site.
- II. Individuals respond to changes in visit cost in the same way they respond to changes in admission cost.
- III. Each visit to the site is for the sole purpose of visiting the site.
- IV. All visits take same amount of time in the site.
- V. The relative opportunity cost is the wage rate.
- VI. Utility or disutility cannot be derived from time spent traveling to site.
- VII. The functional form of the trip generating function is linear
- VIII. There are no alternative recreational sites available to individuals

The main benefit of travel cost approaches is their reliance on observable market behavior and the main disadvantage of this method is it cannot be used to estimate nonuse values.

Hedonic Pricing Method (HPM)

The hedonic price approach is based on the theory that value of a commodity is a bundle of valuable characteristics, one or more of which may be environmental. The basic premise of the hedonic pricing method is that the price of a marketed good is related to its characteristics, or the services it provides (Abila et. al, no date, p. 66).

The hedonic pricing method uses the prices of traded commodities to determine the value of environmental characteristics that are thought to affect the price of the item. The main disadvantage of this valuation method (HPM) it cannot be used to estimate nonuse values of an environmental resource.

2.2 Empirical Literature Review

2.2.1 Water Related CVM Empirical Studies

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

Using CVM Tanellari (2010) examined consumers' WTP with respect to drinking water quality in the Northern Virginia and Maryland suburbs of Washington DC. Multinomial logit model was used to analyze data from 5200 urban households and both dichotomous choice and dichotomous choice with follow up formats also used. The result indicated that consumers' concerns about future system failures and income positively affected their WTP for an improved material while satisfaction with the water quality, education and the bid amount asked negatively affect their WTP for an improvement.

The CVM was utilized to obtain estimates of WTP for improved domestic water supply services from 525 urban, rural and camp refugees sample respondents for current and future generation in Ramallah governorate, Palestine. A dichotomous choice with follow up debriefing questions as well as open ended follow up question to model individual's WTP. The result from Tobit and OLS econometric models showed that the mean annual WTP of total economic value improved domestic water supply services was about 627 per annum (Ibrahim and Robert, 2009).

Farolfi et al (2007) investigated the study on the determinants of Swazi households WTP for an improvement in their water quality and quantity using CVM. A sample of 374 (127 rural and 247 urban) was surveyed and a Tobit model was applied to explain household preferences for quality and quantity of domestic water supply and derived elements of WTP for such a service. The result confirmed that household income had a positive and statistically significant impact on WTP for both quality and quantity. Distance to the water source was positively associated with WTP regardless of location (urban and rural) and of the household head's age, education, and gender. Current water consumption was also statistically significant for WTP for improved quantity, but with a negative sign,

implying that the more a household consumes water, the less that household is WTP to have improved water quantity. Rural households showed a much higher WTP for improved water services than urban households.

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

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

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

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

Using multinomial logit model Kaliba et al. (2002) estimated WTP of households' to improve community-based rural water Utilities in Dodoma and Singida regions of Central Tanzania. The study reported that households in both regions were willing to pay the fee, which was higher than the existing tariff charges. As the result of the study, WTP was affected by respondents' socio-economic factors like age, wealth and household size. WTP for improved water services was negatively affected by age and wealth, as older individuals were not directly involved in water fetching and wealthier households had their own water sources or they delegated others to collect water for them at lower costs. The family size was positively related to WTP as households with larger family need more water and hence they were willing to pay more.

2.2.2 Water Related CVM Empirical Studies in Ethiopia

A few of the studies undertaken in Ethiopia emphasized the urban water supply improvements.

Fisseha (1997) used a contingent valuation survey to estimate the WTP for better water quality, using 266 respondents, in Maki town. The questionnaire was designed to test for strategic and starting point biases, and they were not statistically significant. Half of the respondents have been satisfied by current water quality and need better water quality provision with higher charge than current price. Income and time spent to fetch water

have a significant impact on WTP. Other factors such as education, occupation and number of domestic animals owned are significant.

Dunffa (1998) adopted a contingent valuation method to estimate the willingness to pay for improvement in water quality in rural areas of Ethiopia, in Adia Liben district. WTP for improved water has a positive and significant relation with income, distance to fetch water, quality of current water source and credit.

Assefa (1998) used both the contingent valuation survey (direct method) and indirect (revealed preference) methods to estimate household's willingness to pay for improved water service in the city of Addis Ababa, Ethiopia. The research was based on primary cross-sectional data consists of 220 sampled households from different locations in the city. The CV approaches with an iterative bidding game value elicitation format were utilized to investigate the determinants of households' willingness to pay for private connection and public taps. The mean WTP bids for private connections and public taps were well above the existing tariff, 8.66 and 4.7 cents per baldi, respectively. The results of the study revealed that household income, ownership of house, age and education level are significant determinants decisions to connect to the piped schemes. The significant variables influencing the WTP responses include income, education level and sex of the household head, household size, time for fetching water and household's attitude towards the responsibility of water provision.

Alebel (2002) did a study on determinants of willingness to pay for improved water service in urban areas and to find out whether it is possible to introduce full cost recovery program. He used CVM to examine the determinants of WTP and bidding game as value

elicitation method. He also used a censored LAD estimation for the empirical analysis. He used the probit model to see the effect of the explanatory variables on the choice of the household to the improved water service. As his findings, the Censored LAD estimation result showed gender, income, monthly expenditure for improved water consumption, quality and time taken to fetch water from existing source significantly affect the respondents WTP. While the Probit estimate result showed that wealth, income, education level, source the household is being used, quality and time taken to fetch water from the existing source affect the choice of the respondents to the improved water service. And the descriptive analyses result revealed that the mean WTP for improved water service is higher than the existing tariff.

A similar study was also made by Medhin (2006) using a contingent valuation survey on households demand for improved water service in urban areas: the case of Addis Ababa. The study used cross sectional data collected from 250 sample households living in different areas of Addis Ababa. The elicitation method employed was single bounded format with an open-ended follow up question. She used Probit and Tobit model to analyze the determinants of households' willingness to pay for improved water service. The descriptive analysis showed that only 30% of the respondents reported that they did not have private connection to the existing water service. About 70% of the respondents said that the existing service were not reliable. In the Tobit model income, education, and sanitation facility were found positive sign and significant, whereas perceived water quality, age, and water related disease were negative and significant at the required level of significance. Concerning the Probit model, income, education, marital status, water related disease; years of stay in the area positively affect the probability of responding to

the initial bid. The finding further indicated, the mean WTP was found 20 cents per Baldi (20 liters container) from single-bounded probit model estimates and 15.79 cents per baldi from the open-ended format.

Gossaye (2007) employed the CVM to investigate the willingness to pay for improved water supply services in Debre Zeit town. Data from 234 randomly selected sample households were used. From the survey 99.57% of respondents used piped water. However, only 10.26% of respondents satisfied with the status quo level. The study result showed that all respondents were willing to pay above the existing tariff level, though the amount of money they are willing to pay varies from individual to individual. The survey result also showed that the mean willingness to pay for one bucket or 20 liter of improved water service was 10.2367 and 12.4786 cents according to the dichotomous choice and open ended survey responses respectively. The result of both Probit and OLS econometric models revealed that age, household size, reliability dummy and income variables influence households' willingness to pay for improved water service in Debre Zeit town.

The study by Zelalem and Fekadu (2009) employed CVM to estimate WTP for improved rural water supply in Goro Gutu district of Eastern Ethiopia. The analysis was based on data collected from 132 households using rural water utilities for at least three years. Both binary and ordered probit models were used to examine the determinants of WTP. The estimated mean and median WTP was found to be birr 6.83 and 5.87 per household per month. Results also indicated that households using water purification methods earn better annual income, participated during the early phase of project implementation and were spending more time in collecting water were more likely to pay. Whereas those

households with large family members, which used reliable water sources from convenient water points and got higher starting bid values were less likely to pay.

Bogale and Urgessa (2011) did a study on households' WTP for improved rural water service provision in Eastern Ethiopia, Haramaya district to estimate WTP of rural households for improved water service provision and identify its determinants by employing CVM. 126 sample households were interviewed and about 90 percent of the respondents expressed their WTP for improved water service provision with a mean WTP of 27.3 cents per jerican. The value elicitation format used was double bounded dichotomous method and data was analyzed using descriptive statistics and bivariate probit model. Household income, education level of the respondent, sex, and time spent to fetch water from existing source, water treatment practice, quality of water source and water expenditure of the household had positive effect on WTP for improved water provision, while age of the respondent had negative effect.

Yibeltal (2011) conducted a study using a contingent valuation survey on households demand for improved water supply service in urban areas of Ethiopia, Motta town as the case study. Double bounded dichotomous choice value elicitation format was used to analyze determinants of households' WTP for improved water service. The study used cross sectional data collected from 220 randomly selected sample households from Motta town. The CV survey responses were analyzed through descriptive and econometric analysis using Probit, bivariate Probit and Tobit as empirical models. the results from the test statistics show that the existing water source, initial bid offered to households, age of respondents, sex of respondents and responsible organ for provision of improved water services have a negative effects on the probability of households' WTP for improved

water services in probit model and at the same time they have also a negative influence on the maximum amount they were willing to pay in tobit model. On the other hand education (both primary, secondary and tertiary), income, wealth, quality of water being used, reliability of the existing service, years of stay in the town, time taken to fetch water from existing source and level of satisfaction with the existing service affected positively the probability of accepting the initial bid offered to them for improved water services and the maximum amount that they were willing to pay.

Fekadu (2011) assessed households' willingness to pay for improved water supply services in Holeta town using contingent valuation method. A total of 141 sample households were interviewed during the survey, together with group discussion and key informant interview. The survey result showed that, if the town's water supply office provide improved water supply, more than 80% of the households were willing and able to pay for the service at a price more than a cost recovery tariff rate. Correlation results showed that income of households and household size were significantly affecting households' willingness to pay.

Dessalegn (2012) conducted a study on factors determining residential water demand in north western Ethiopia- Merawi town. Data from 200 households were collected and analyzed by using SPSS. Descriptive statistics was used for descriptive results. Logistic regression and standard multiple regression analyses were also used to determine the factors explaining households water source choice decision and determinants of residential water demand of the surveyed households. The analysis point out that monthly expenditure, housing ownership, educational status of the household head were

statistically significant predictors of the households' decision to have private piped connection.

Recently, Belaynesh (2013) investigated a study on households demand for improved water service in Ethiopia in the case of Sodo town using contingent valuation method and a bidding game elicitation format with a single bound closed ended question followed by open ended follow up question. Data was collected from 160 household heads by using face to face interview. The collected data have been analyzed by using both descriptive and econometric data analysis techniques. Results of descriptive analysis revealed that of the total sample households, 47.5% have private connection. However, only 18.49% households were satisfied with the status quo. About 99.37% of sample households preferred to get the improved services and almost 94% of households expressed their willingness to pay for the proposed scheme of improved service in the town. The empirical result of probit model suggested that whether or not the household was willing to pay for improved water supply service were affected by gender of the household head, house ownership, years of stay in the area, sources of water, quantity of water used per day, time loss to fetch water and initial bid price. In the Tobit model, gender of the household head, level of education, level of satisfaction and initial bid price are found to determine the amount of money individual spends on willingness to pay.

CHAPTER THREE

DATA AND METHEDODOLOGY

3.1 Description of the Study Area

Ankasha woreda is located in Awi zone of Amhara regional state. It is bordered on the south by Mirab Gojjam zone, on the west by Guangua woreda, on the north by Banja woreda and on the east by Guagusa Shikudad woreda. Among 11 Woredas in Awi zone, Ankasha woreda is considered to be one of the most highly populated woreda. There are 3 urban and 29 rural kebeles in Ankasha woreda. In the year 2014, the total population of the woreda is estimated to be 225,733 in 42,145 households, of whom 112,227 were men and 113,506 women; 203,755 are rural inhabitants.

The dominant activity in the rural areas of Ankasha woreda is agriculture which includes activities such as farming, beekeeping and the like. One of the deepest lakes in Ethiopia known as ‘Tirba Hayik’ is also found in a rural kebele of the woreda.

According to the woreda water resource development office report of 2014, the total of 582 water sources were provided in rural areas of Ankasha woreda, by financial support of Ethiopian government, Awi Development Association, UNICEF and Finland government. This includes modified hand dug wells, protected springs, public taps and other source. For the service provided, each household is obliged to pay at least 12 birr per year for maintenance purpose.

3.2 Survey Design

3.2.1 Data Sources and Types

In order to get all the necessary information on the area where the research was conducted, both primary and secondary data sources were used. The main source of data was primarily gathered through structured questionnaire and face to face interview from the cross sectional sample survey for the year 2014. And the secondary data was also collected from documentations of Ankasha woreda, different publications, magazines, etc

3.2.2 Sampling Design and Procedures

Simple random sampling and to some extent stratified sampling procedures were employed to select 200 respondents. As there is no generally agreed formula about the sample size, we selected 200 sample household heads from the total population due to financial constraint.

Based on information obtained from Ankasha woreda water resource development office, out of 29 rural kebeles 4 (high access coverage), 10 (medium access coverage), and 15 (low access coverage), three rural kebeles; namely, Kunzena (low access coverage), Sostu Shumata (medium access coverage) and Sostu Segno (high access coverage) were purposely selected. Finally, sample households were randomly selected from the three kebeles using probability proportion population to the sample size.

3.3 Questionnaire Design and Elicitation Format

The questionnaire was designed following the recommendations of National Oceanic and Atmospheric Administration (NOAA) panel guidelines for every contingent valuation studies on Haab and McConnell (2002). So the questionnaire for this study has three main parts by borrowing the Mitchell and Carson techniques (Mitchell & Carson, 1989). The first part includes questions relating to the usage of the existing water sources of the sample respondents. The second part focuses on the valuation questions. After describing the water supply service improvement program the respondents were asked how much they were willing to pay for improved water supply. The third section includes the socio economic characteristics of the respondents like age, sex, family size, income level etc.

Based on one of the guidelines for a good CV studies of NOAA panel, ‘yes/no responses should be followed up by open ended questions’; this study employed single bounded dichotomous choice elicitation format with open ended follow up questions in the WTP section. Since it is incentive compatible, simple and cognitively manageable and it has a minimum strategic bias compared to other elicitation methods. (Haab and McConnell, 2002)

3.3.1 The Field Survey

At the first the questionnaire was translated in to local language ‘Awigna’. Four data collectors were employed based on educational level and their experience on data collection. Two of them were Msc students and others have BA degree. A one day training was given to all data collectors on how to do the survey.

To fix starting bid prices, the researcher and all data collectors conducted a pilot survey on 11 randomly selected household heads from the three kebeles. During the pilot survey the willingness to pay part was open ended questions. So, we set five starting bid prices from the pilot survey (0.25, 0.5, 0.75, 1 and 1.5 birr). In total sum 192 interviews were completed successfully and each household head being allocated at random to one of the five bid levels employed giving on average, just over 36 respondents per bid level. The actual survey was conducted from 4-20 April 2014.

3.4 Method of Data Presentation and Analysis

The study used both descriptive and quantitative techniques to analysis the data. Method of data presentation includes Table, Graphs, charts etc. For analysis; in the first part, the research used descriptive statistics (percentages, means, standard deviations and t-test). These was analyzed and described quantitatively by making use of STATA-12 version, and tables.

In the second part econometric issues, more specifically, *Tobit and probit* models are adopted. Variables, which play significant roles for the WTP for water supply services improvement in rural areas of Ankasha Woreda, are analyzed through these models by making use of econometric issues.

In this part STATA 12 software is employed to determine the coefficients of the variables which are significant to the model under consideration, marginal effects and test the statistical significance relationships between the determinants and the dependent variable.

3.5 Model Specification

One of the purposes of the study is to estimate WTP for improved rural water supply services and to suggest mechanisms for cost recovery. The econometric models for estimating WTP from dichotomous choice response data can be broadly divided into two major classes; parametric and non-parametric. This section explains the approach taken to estimation, and describes the econometric models used in estimating the WTP distribution for this thesis (i.e. parametric models).

Parametric techniques for extracting WTP estimates from dichotomous choice data are generally either binary-response models that estimate the probability of a 'yes' response as a function of bid values and selected covariates, or interval-data models which use WTP intervals defined by bid values and responses as a dependent variable (Carson and Hanemann, 2005). Contingent valuation studies employing discrete-choice models typically adopt logit, probit, or bivariate-probit specifications to extract estimates of the latent WTP from dichotomous choice response data (Abdullah, 2009). Studies employing the interval-data approach typically adopt the canonical discrete choice contingent valuation model developed by Hanemann (1984).

The model chosen for the single bounded responses was Probit model, since the researcher do not know the random preferences and can only make probability statements about the "yes" and "no" responses, a Probit model is used to estimate the probability of WTP. Since the purposes of the study is to assess WTP for improved water supply service and to suggest mechanisms for cost recovery, the main objectives of the WTP survey was to calculate mean WTP after estimated outcome of a parametric model

that includes respondents' socio-economic factors in the WTP function. Moreover, Tobit model was also used as it is most appropriate for open ended WTP questions to show the determinants of maximum willingness to pay since the household WTP variable is left censored. The details for both models are given below.

3.5.1 The Probit Model

According to Calia and Strazzera (1998) the single bound method has its own attractive features other than the double bound. For example, it requires less information, it is easier to implement at data collection and estimation stages, and can avoid systematic bias in responses that are due to the introduction of the follow-up (for example, the so called "anchoring effect"). Therefore, we have applied the single bounded probit model for comparison and to take these outweigh advantages relative to double bounded model.

The probit model specifies an indirect utility function for each respondent. Assume that the representative household gains utility from improvement in water supply services and the two possible levels of environmental quality involved are the status quo q^0 and a specific level of improvement, q^1 (Hagos et al, 2012). Hence, each household's utility function at status quo (no improvement) is:

$$U_{0i} = u(m_i, x_i, q^0, \epsilon_0) \dots \dots \dots (1)$$

And each household's utility function with improvement will be:

$$U_{1i} = u(m_i, x_i, q^1, \epsilon_1) \dots \dots \dots (2)$$

We can rewrite equations (1) and (2) into one equation as:

$$U_{ji} = u_j(m_i, x_i, q_i, \epsilon_j) \dots \dots \dots (3) \text{ (Hagos et al, 2012)}$$

where $j = 0, 1$ refers to the two different states of the water provision; $i = 1, 2, \dots, n$ refers to household i ; U_{0i} and U_{1i} represent, respectively, indirect utilities at the status quo and the hypothetical improved scenario; m_i is the i^{th} utility maximizer's discretionary income; x_i represents a vector of household socioeconomic, demographic and environmental and design variables; q_i refers to the quality of the good being valued (improved water quality); and ε_j represents other variables known to the utility maximizer, but not observed by the researcher (the error term) (Haab and McConnell, 2002).

Note that when the quality of environmental good q changes from q^0 to q^1 (as the result of a change in policy), the household's utility also changes from $U(m_i, x_i, q^0, \varepsilon_{0i})$ to $U(m_i, x_i, q^1, \varepsilon_{1i})$. Therefore, the condition that utility maximizer i answers yes to the offered price (bid) bi is given by:

$$u_1(m_i - b_i, x_i, q^1, \varepsilon_{1i}) > u_0(m_i, x_i, q^0, \varepsilon_{0i}) \dots \dots \dots (4)$$

Equation (4) states that household i answer "yes" to the question about the offered price (bid) bi if the household's utility at the improved level, net of the required payment, exceeds the utility at the status quo. However, because we typically do not know the random preferences and can only make probability statements about yes or no responses, the probability of a utility maximizer answering 'yes' to the valuation question is consequent upon $u_1 > u_0$ (i.e., the utility maximizer is better at q^1 even with the required payment bi) (Haab and McConnell, 2002). Hence, the probability of "yes" for utility maximizer i is given by:

$$\text{Pr}(\text{yes}) = \text{pr}[u_1(m_i - b_i, x_i, q^1, \varepsilon_{1i}) > u_0(m_i, x_i, q^0, \varepsilon_{0i})] \dots \dots \dots (5)$$

(Haab and McConnell, 2002)

According to Haab and McConnell (2002) for parametric estimation of the above model, the researcher need to choose a functional form for $u(m_i, x_i, q^1, \varepsilon_{1i})$ and specify the distribution of the error term ε_{ji} . Generally, most applied empirical research, whether it employs a random WTP model (Cameron and James 1987) or a utility differential model (Hanemann 1984), begins specification by assuming a utility function that is additively separable in systematic and stochastic components of preferences:

$$u_j(m_i, x_i, \varepsilon_{ji}) = v_j(m_i, x_i) + \varepsilon_{ji} \dots \dots \dots (6)$$

Given the specification in equation (6), the probability of utility maximizer i giving a positive response to the valuation question becomes:

$$Pr(\text{yes}) = pr[v_1(m_i - b_i, x_i, q^1) + \varepsilon_{1i} > v_0(m_i, x_i, q^0) + \varepsilon_{0i}] \dots \dots \dots (7)$$

$$Pr(\text{yes}) = pr[v_1(m_i - b_i, x_i, q^1) - v_0(m_i, x_i, q^0) > \varepsilon_{0i} - \varepsilon_{1i}] \dots \dots \dots$$

Note that the probability of the utility maximizer i giving a negative response is given by:

$$Pr(\text{no}) = 1 - Pr(\text{yes}) \dots \dots \dots$$

This equation is still too general for parametric estimation. However, when the systematic component of the preference function is assumed to be linear in income and other covariates (Hagos et al, 2012). The model can be simplified as:

$$v_{ij}(m_i) = \alpha x_i + \beta(m_i) \dots \dots \dots (8)$$

Where m_i represents the individual consumer's (utility maximizer i) discretionary income; x_i represents an n -vector of household socioeconomic, demographic, environmental and design variables; and α_i is an m -dimensional vector of parameters. For the new water supply improvement CVM scenario, in which the dichotomous choice

question will require a ‘yes’ or ‘no’ response to some offered price b_i , the probability that respondent i will answer yes to the valuation question is given by:

$$Pr(\text{yes}) = pr[\alpha x_i + \beta b_i + \varepsilon_i > 0] \dots \dots \dots (9)$$

To estimate equation (9), assume that the error term is normally, independently, and identically distributed with mean zero and variance 1.

Let us assume that $\eta = \varepsilon_{0i} - \varepsilon_{1i}$ and let $F_\eta ()$ be the cumulative distribution function of η then the probability that the individual is willing to pay for water supply service improvement is;

$$Pr(\text{yes}) = F_\eta(\Delta v) \dots \dots \dots (10) \text{ (Hagos et al, 2012)}$$

$$Pr(\text{no}) = 1 - F_\eta(\Delta v) \dots \dots \dots$$

$$\text{Where } \Delta v = v_1(m_i - b_i, x_i, q^1) - v_0(m_i - b_i, x_i, q^0)$$

The main purpose of the analysis is to estimate WTP and from the assumed utility function can derive a WTP function. Assume that P_i is unobservable individual household's actual WTP for improved water supply service, then

$$p_i = \alpha x_i + \beta(m_i)$$

$$\alpha_0 x_i + \beta m_i + \varepsilon_{0i} = \alpha_1 x_i + \beta(m_i - b_i) + \varepsilon_{1i}$$

$$= \alpha_1 x_1 + \beta(m_i - WTP_i) + \eta_i$$

P_i is unobservable individual household's actual WTP for improved water supply service, in our case $P_i = \text{ANS1}$, by solving this individual i 's WTP can be;

$$WTP_i = \frac{\alpha x_i + \eta_i}{\beta} \dots \dots \dots (11)$$

(Hagos, et al, 2012)

In the probit model $F_{\eta}(\dots)$ is the normal cumulative distribution function. As defined above, the unobservable individual household's actual WTP for improved water supply service is P_i , with linear relation to the initial bid bi and the covariates (Haab and McConnell, 2002). Then the actual WTP for an individual can be presented as

$$WTP_i = 1 \text{ if } P_i \geq bi \dots \dots \dots (12)$$

(Haab and McConnell, 2002)

$$WTP_i = 0 \text{ if } P_i < bi.$$

In a dichotomous choice contingent valuation method elicitation format the i^{th} respondent is asked if he/she would be willing to pay the initial bid (bi) to get a given improvement in environmental quality or both quality and quantity in this case water supply service improvement (Hagos et al, 2012).

The probability of 'yes' or 'no' can be presented as;

$$pr(\text{yes to } bi) = pr(pi \geq bi) \dots \dots \dots$$

$$pr(\text{no to } bi) = pr(pi < bi)$$

The log likelihood function of this single bounded contingent valuation survey response is;

$$\begin{aligned} \ln L(\theta) &= \sum_{i=1}^N \{d_i^Y \ln \pi^Y(bi) + d_i^N \ln \pi^N(bi)\} \\ &= \sum_{i=1}^N \{d_i^Y \ln G(bi, \theta) + d_i^N \ln [1 - G(bi, \theta)]\} \end{aligned}$$

Where $d_i^Y = 1$ if the i^{th} response is yes and 0 otherwise; $d_i^N = 1$ if the i^{th} response is no and 0 otherwise.

$G(b_i, \theta)$ and $1 - G(b_i, \theta)$ are the cumulative distribution function for the probability of yes and no responses; and θ represents the vector of parameters that index the distribution of WTP (Medhin, 2006).

According to Carlsson (no date), Mean WTP (μ) for the single-bounded probit model can be estimated as follows:

$$\text{Mean WTP}(\mu) = \frac{-(\beta_0)}{\text{Bid1 coefficient}} \dots \dots \dots$$

Where β_0 = is the intercept (constant) term

An alternative method of estimating the mean WTP (μ) where there are socio economic variables are included for close ended format is

$$\text{Mean WTP}(\mu) = \frac{-[\beta_0 + \sum_{i=1}^n \beta_i \mu_i]}{\text{Bid1 coefficient}} \dots \dots \dots$$

Where β_i -is the coefficient of the i^{th} explanatory variable

μ_i - is the mean of the i^{th} significant explanatory variable. β_0 = is the intercept (constant) term.

3.5.2 The Tobit Model

It is important to note that the dependent variable, or the WTP, is not fully observed and the dependent variable assumes zero values for a substantial part of the sample. Because an OLS (ordinary least squares) estimator cannot be applied, the study uses a Tobit model for the observed maximum willingness to pay (MWTP) which is assumed as latent

variable which is not observed when it is less than or equal to zero but observed when it is greater than zero and Tobit model is mainly used for open ended questions.

As Verbeek (2000) the Tobit model for the observed maximum willingness to pay for this particular study is given as;

$$\begin{aligned}
 MWTP_i^* &= \alpha + \beta Z_i' + \epsilon_i \dots\dots\dots \\
 MWTP &= MWTP_i^* \text{ if } MWTP_i^* > 0 \dots\dots\dots (13) \\
 MWTP &= 0 \text{ if } MWTP_i^* \leq 0 \dots\dots\dots,
 \end{aligned}$$

where $MWTP_i$ is a household's unobserved maximum willingness to pay for improved water supply services; $MWTP_i^*$ is a household's actual maximum willingness to pay for water supply service improvements; Z' is vector of independent variables; β is vector of coefficients; α is the intercept; and ϵ_i is disturbance term, which is assumed to be normally independently distributed, in other words, NID $(0, \sigma^2)$ and independent of Z_i .

Assume it is censored from zero,

$$\begin{aligned}
 MWTP &= \beta_0 + \beta_1 AGE + \beta_2 SEX + \beta_3 INCOM + \beta_4 BID1 + \beta_5 TIMMINU + \beta_6 EDU \\
 &\quad + \beta_7 FAMSIZ + \beta_8 QUAL \\
 &\quad + \beta_9 WATUSDA + \beta_{10} SATSOURCE + \beta_{11} AVALA + \beta_{12} MARI \\
 &\quad + \epsilon_i \quad \text{if } MWTP_i^* > 0 \\
 MWTP &= 0 \quad \text{if } MWTP_i^* \leq 0
 \end{aligned}$$

Where; AGE is age of the household head, SEX is respondents sex, INCOM is households income, TIMMINU is time loss to fetch water for a single trip, BID1 is initial bid price, FAMSIZ is family size, WATUSDA is water used per day, EDU is educational level of heads, QUAL is existing water quality, AVALA is availability of water, MARI is marital status of respondents, SATSOURCE is satisfaction of existing source.

3.6 Descriptions of Variables and Expected Signs

Age of the Household Head¹ (AGE): It is expected that older households are less willing to pay for improvement as they assume to live lesser years than the young individuals. However, older respondents need water improvements since older perceive the strains of moving long distance to collect water from existing sources. So it is indeterminate.

Sex of Respondents (SEX): It is expected that women could be more willing to pay than men because women are more responsible to fetch water in rural areas. The dummy variable 1 for female and 0 for male, positive relationship is expected.

Family Size (FAMSIZ): It is assumed that large family size will have less demand for improved water supply services because large family size may consume higher amount of water and expected to pay higher money. Negative sign is expected.

Households' Income (INCOM): It is expected that higher income generates higher demand for improved water services and may have positive sign.

Educational Level of Respondents (EDU): It is believed that positive relation between education levels of respondents' and willingness to pay.

Satisfaction With the Existing Water Source (SATSOURCE) – It is a dummy variable 1 if the household is satisfied with the existing water source; 0 otherwise. A negative relationship is expected between willingness to pay and this variable since households

¹Note: household head in our case is assumed to be an individual who is more responsible for activities in the house.

who are satisfied with the existing water source are expected to have less willingness to pay for the improvement.

Amount of Water Consumed by the Household per day (WATUSDA)-It is expected to have negative sign because a family whose water consumption is large will not be willing to pay more money.

Time in Minutes (TIMMINU) – Households who spend much time to get water from the existing water sources are more likely to have more willingness to pay. Thus, the coefficient of the variable is expected to have positive sign.

Quality of Existing Water Source(QUAL)- Dummy variable 1 if the existing water source is safe and 0 for it is not safe (poor and very poor) to use before any purification. Negative sign is expected as the existing water source is safe households will not be interested for water improvement.

Marital Status of the Household Head (MARI): Dummy variable 1 if the hh head is married and 0 otherwise. It is expected to have positive sign. Since married households are more careful for the health problems in poor water supply services due to family responsibilities.

Quantity and Availability of Existing Water Sources (AVALA): Dummy variable 1 if existing water source is available throughout the year and sufficient for use and 0 otherwise. Households who get enough water throughout the year may not be willing to pay for quantity improvements but they might be interested for quality improvement. So it is difficult to determine the sign of the coefficient prior to data analysis.

Initial Price (BID1) - Starting bid is expected to have a negative relationship with WTP for improved water supply services.

CHAPTER FOUR

EMPIRICAL DATA ANALYSIS

4.1 Descriptive Analysis

4.1.1 Summary Statistics for Socioeconomic Variables

A total of 200 sampled household heads were interviewed. But only 192 questionnaires were used for analytical purpose due to 5 incomplete responses and 3 protest bidders. From the total surveyed household heads 56.8% were female respondents, while 43.2% were males. As indicated in Table 4.1, the average educational level of the household heads' is 2.54 which ranges from a minimum of 0 to a maximum of grade 10 level of education. The average family size is 5.1 with a minimum of 1 household member to maximum of 11 household members. The average monthly income of sampled respondents is birr 2020.35 with minimum monthly income of birr 300.00 and maximum of birr 5100. About 81.2% of household heads are married, 8.3% are single, 6.3% are divorced and 4.2% are widowed. The average amount of water used by family members per a day is 3.6 jerican which ranges from a minimum of 1 jerican to maximum of 20 jericans. But households' level of satisfaction with the use of existing water source is only 8% on average and from sampled households 75% are affected by water supply shortage during the dry season.

Concerning the occupation of the respondents, 83.9 % are farmers and the rest 10.4% and 5.7% of them are traders and daily laborers respectively. Regarding the age of

respondents the average is 42.0 years which ranges from minimum of 18 years to a maximum of 83 years old.

Table 4.1 Characteristics and Water Use Profiles of Surveyed Respondents

Variables	Mean	Std.dev	Min	Max
AVALA	0.25	0.43	0	1
BID1	0.81	0.42	0.25	1.5
QUAL	0.31	0.46	0	1
SATSOURCE	0.08	0.28	0	1
WATUSDA	3.6	2.11	1	20
TIMMINU	34.74	15.93	3	90
INCOM	2020.35	1236.54	300	5100
FAMSIZ	5.1	2.15	1	11
MARI	0.81	0.39	0	1
EDU	2.54	3.17	0	10
SEX	0.57	0.49	0	1
AGE	42.0	12.68	18	83

Source: Result of the Survey, 2014

4.1.2 Current Water Use Patterns of the Sample Households

The figure 4.1 indicates that of the total 192 sampled respondents 41% of households use water from fully unprotected sources, of those, 16% use natural springs, 7% use unprotected hand dug wells and 18% of respondents use rivers. And the remaining 36% and 23% of surveyed households use relatively protected springs and protected hand dug wells as water sources respectively.

Figure 4.1 Respondents' Major source of Water

Source: Surveyed Data, 2014

4.1.2.1 Problems of Existing Water Sources

Figure 4.2 indicates that about 91.7% respondents are not satisfied with the existing water source. Of those 25 % households said that the reason for dissatisfaction was long distance, poor quality was also a reason for dissatisfaction for 33.5% respondents, 15.3% respondents reported that the existing water source was low in quantity and the rest 26.2% responded that long distance, poor quality and low quantity were problems of current water source in use.

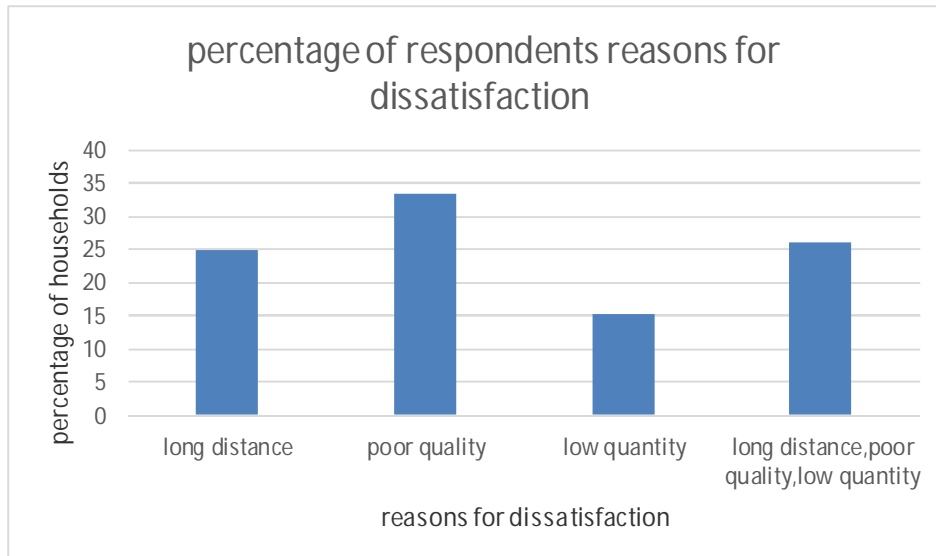


Figure 4.2 Respondents' Reasons for Dissatisfaction

Source: Survey Result, 2014

The responses from 91% of total sampled households revealed that mother and girls are more responsible for fetching water from existing water sources. The average time to fetch water from the existing source is 34.7 minutes which ranges from minimum of 3 minutes to maximum of 90 minutes for a single trip.

4.1.3 Determinants of Unwillingness to Pay

As can be seen from figure 4.3, 13.5% sampled respondents are not willing to pay for rural water supply services improvement for a given initial bid price. Out of those, 15.4% are satisfied with the existing water source, 26.9% household heads responded that water should be provided for free, 50% responded that they do not have enough money to pay for the improvement and 7.7% respondents said that they do not have trust on the project.

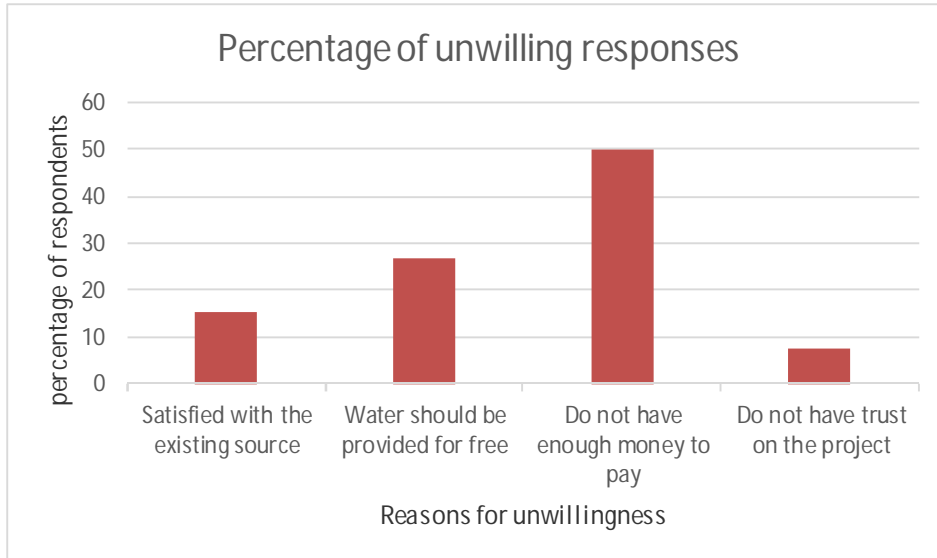


Figure 4.3 Respondents' Reasons for Unwillingness

Source: Survey Result, 2014

4.1.4 WTP and Starting Bids

Five starting bid prices were given for a single bounded dichotomous choice format questions. As stated in methodology part, these starting bid prices were set from the pilot survey from 11 randomly selected respondents of the three kebeles prior to the actual survey.

Table 4.2 Willingness to Pay and Initial Bids

Bid level in birr per jerican(20L)	0.25	0.5	0.75	1	1.5	Total
No of HHs refusing at bid level	1	1	5	16	3	26
No of HHs accepting bid level	35	36	31	32	32	166
Total	36	37	36	48	35	192

Source: Own Survey, 2014

From the Table 4.2, 26 (13.5%) respondents refused to pay for water supply service improvement for a given initial bid. Out of 36 sampled household heads who were given 0.25 birr as initial price, 35 (97.2%) responded 'Yes' and 1(2.8%) 'No' answer for the starting price. From 37 respondents, 36(97.3%) showed 'Yes' and 1(2.7%) 'No' answers to the starting bid price 0.5 birr per jerican. The initial bid price 0.75 birr was distributed to 36 respondents and 31(86.1%) gave positive answer while 5(13.9) said 'no'. From the survey, out of 48 household heads, 32 (66.7%) respondents responded 'yes' and 16(33.3%) answered 'no' for the bid price birr 1. Whereas, out of 35 respondents, 32 heads said 'yes' and 3 'no' for the bid 1.5 birr.

4.2 Econometric Results

Prior to the estimation of the probit and Tobit models the existence of heteroskedasticity is checked since it is an important statistical problem to deal within estimation. Heteroskedasticity problem is often encounter when using cross sectional data (Haab and McConnell, 2002). Since our data is cross sectional type heteroskedasticity problem faces our data. To correct this problem robust standard error was estimated. The study also tested the existence of multicollinearity among explanatory variables. But from the correlation matrix estimated using the data, multicollinearity is not a serious problem in this study.

4.2.1 Results of Probit Estimation

The main objective of estimating the probit model is to calculate the mean willingness to pay for single bounded WTP responses of improved water supply services survey. To reduce the problem of heteroskedasticity problem robust probit regression is used. The Pseudo R^2 of the data is 55.04% which indicates that the result of regression explains 55.04% of the total variation. The likelihood ratio for the model of Wald chi2 (12) is 54.28 which shows the overall significance of the model. Out of 12 variables regressed, six variables significantly affect WTP (ANS1) in probit model.

Table 4.3 Results of Probit Model for WTP (ANS1)

Variables	Coefficients	Robust Std.err	P-Value	Marginal effects(dy/dx)
AVALA	0.4675797	0.5071919	0.357	-0.0146201
BID1	-1.801481	0.5547172	0.001***	-0.0413232
QUAL	-1.090427	0.3884383	0.005***	-0.0478487
SATSOURCE	0.2326811	0.5698456	0.683	0.0042629
WATUSDA	-0.0532448	0.0801893	0.507	-0.0012214
TIMMINU	0.0534183	0.10133354	0.000 ***	0.0012253
INCOM	0.0006924	0.0002247	0.002***	0.0000159
FAMSIZ	0.1609716	0.1054634	0.127	0.0036924
MARI	0.2414424	0.3655044	0.509	0.0066839
EDU	0.1521222	0.0678064	0.025**	0.0034895
SEX	0.7907937	0.4359009	0.070*	0.0229776
AGE	0.0040553	0.0166402	0.807	0.000093
Cons	-0.8025968	0.8665357	0.354	
Number of obs = 192 Wald chi2(12) = 54.28 Pseudo R2 = 0.5504 Log pseudo likelihood = -34.230488				

***significant at 1%, **significant at 5%, *significant at 10%

The coefficient estimate of starting bid price has negative sign and highly significant at 1% level of significance. Thus, as the starting bid price increases by 1 birr the probability of household willingness to pay for improved water decreases by 4.13% holding all other things constant.

The variable quality of existing water source as expected is found to be significant at 1% level of significance and has negative sign. The negative sign indicated that households already enjoying with safe existing water source are not willing to pay for the improvement of water supply services. Medihn (2006) and Gossaye (2007) also obtained the negative effect of existing water quality on WTP. If other things being constant, the probability of willingness to pay decreases by 4.8% as a 1% increases in existing water quality.

Time variable has positive sign as expected and statistically highly significant at 1% level of significance. The result shows that households walking long distances to fetch water on a daily manner are more likely to be willing to pay for an improvement of water services at nearest places. The marginal effect indicates that, one additional minute increase in fetching water, increases the probability of willingness to pay by 0.122%, all other things held constant. The coefficient estimates of marital status of the household head and quantity of water consumed per day by households members indicating positive and negative signs as expected a priori respectively, but they are insignificant.

Households average monthly income has positive sign and statistically significant at 1% level of significance. This result confirms the demand theory of normal goods and the marginal effect shows that as average monthly income of the household increases by one

birr the probability of households' willingness to pay (ANS1) for the improved water supply services increases by 0.0016%, at citrus paribus.

The education dummy variable as expected has positive sign and significant at 5% level of significance. This indicates that more educated people have more WTP for the improvement in water supply services, since they have better awareness about health importance of rural water supply services improvement and the higher the opportunity cost of time spent in fetching water. This result is in line with results of Alebel (2002), Zelalem and Fekadu (2009) and Bogale and Urgessa (2011). As level of education increases by one additional grade the probability of willingness to pay increases by 0.35%, other things remaining constant.

Sex of the household head is significant at 10% level of significance and has positive sign. As previously expected, the positive sign implies that when the household head is female, they have more responsibilities to collect water from distant areas, are more likely to pay for the improvement of water supply services. Zelalem and Fekadu (2009) and Bogale and Urgessa (2011), who also conducted CVM survey on improved water services in rural areas of Ethiopia, found positive and significant effect of sex on household's WTP. So, the probability of willingness to pay increases by 2.3% as gender of the household head changes from being male to female, keeping all other things constant.

The mean WTP for single bounded dichotomous choice contingent valuation survey responses for probit model can be calculated as

$$\text{Mean WTP} = - \frac{-(\beta_0 + \sum_1^n \beta_i \mu_i)}{\text{BID1 coefficient}}$$

$$\text{Mean WTP} = 1.52 \text{ birr}$$

Where β_i is the coefficient of the i^{th} explanatory variable

μ_i - is the mean of the i^{th} significant explanatory variable.

β_0 = is the intercept (constant) term

This result shows the mean willingness to pay for one jerican is 1.52 birr.

4.2.2 Results of Tobit Estimation

A Tobit model was utilized to analyze the determinants of MWTP for improved water supply services from open ended questions. It was also used because 13.5% of the surveyed respondents answered they were not willing to pay anything (WTP=0) for water supply service improvement, so, the household WTP variable is left censored.

Table 4.4 Results of Tobit Model for MWTP

Variables	Coefficients	Robust Std.err	P-value	Marginal effects (dy/dx)
AVALA	-0.3851854	0.1284524	0.003***	-0.3851854
BID1	0.1134631	0.132474	0.393	0.1134631
QUAL	-0.4930778	0.136393	0.000***	-0.4930778
SATSOURCE	0.2593446	0.2541762	0.309	0.2593446
WATUSDA	-0.0317732	0.0215563	0.142	-0.0317732
TIMMINU	0.0154435	0.0032714	0.000***	0.0154435
INCOM	0.0005396	0.00006	0.000***	0.0005396
FAMSIZ	0.0187448	0.0351747	0.595	0.0187448
MARI	0.2710843	0.1562256	0.084*	0.2710843
EDU	0.0637704	0.0188581	0.001***	0.0637704
SEX	0.1355015	0.1154176	0.242	0.1355015
AGE	0.0118078	0.0049398	0.018**	0.0118078
Cons	-0.9767414	0.2781745	0.001	
Number of obs = 192 Pseudo R2 = 0.3573 Log pseudo likelihood = -194.08224				

***significant at 1%, **significant at 5%, *significant at 10%

The coefficient estimate of dummy variable availability of existing water source determines maximum willingness to pay negatively and significant at 1% level of significance. The negative sign shows that households whose water usage is not affected by seasonal shortage of the existing water source are less likely willing to pay for improvements of water supply services. Thus, keeping other things constant, the change of water availability from insufficient to sufficient reduces household heads' maximum willingness to pay by 3.9%.

The other variable statistically significant at 1% level of significance is quality of existing water source. As expected a priori it has a negative impact on households' maximum willingness to pay for improved water supply services in rural areas that households using quality water from existing source are less likely willing to pay for improvements. Thus, at *ceteris paribus*, marginal effect result revealed that as the quality of water being used changes from unsafe to safe decreases the households MWTP by 49%.

Time variable is also statistically significant at 1% level of significance and has as expected positive sign. The positive sign means that households walking long distances to fetch water on a daily manner are more likely to be willing to pay for an improvement of water services at nearest places. A 1 minute increase in time to collect water from existing water source, increases the probability of paying MWTP by 1.5%, keeping all other things constant.

The coefficient of average monthly income is highly significant at 1% level of significance with a positive sign. The result of the variable reveals that all other things

remains constant, an increase in households income by 1 birr increases the probability of household heads' maximum willingness to pay by 0.054%.

The coefficient estimate of dummy variable marital status has found to be significant at 10% level of significance and positively determines MWTP, indicating that married heads have more responsibilities for the family members as compared to single heads. The probability of maximum willingness to pay increases by 27.1% as the status of household head changes from single to married, as keeping all other things constant.

Educated household heads have better awareness and knowledge about the value and importance of improved water supply services. Thus, as expected it positively affect maximum willingness to pay of the respondent and is highly significant at 1% level of significance. As household head's level of education increases by one grade, MWTP of respondents increase by 6.4%, other things being constant.

Age of the household head is a statistically significant at 5% level of significance and positive effect on the household's maximum willingness to pay for improved water supply services. Older heads of the households have higher MWTP for improvement than younger counter parts, since older respondents most likely to perceive the pain of walking long distance to collect water from existing sources. Holding all other things constant, as the age of household head increases by 1 year, the probability of maximum willingness to pay increases by 1.2%.

Unlike the probit model, the initial bid coefficient which is used to test the existence of starting point bias, shows positive sign and insignificant in this case. Though the positive

sign implied that the existence of upward bias, its coefficient is not statistically significant.

The coefficient estimates of sex of the household head and quantity of water consumed per day by households members indicating positive and negative signs as expected a priori respectively, but they are insignificant.

4.3 Estimating Total WTP and Total Revenue for Improved Water Supply Services

According to data from Ankasha woreda water resource development office (2014), in the year 2014, the total rural kebeles population of the woreda is estimated to be 203,755 and their total household is estimated to be 38,042. To obtain the total WTP and total revenue of the total rural households, class boundaries for maximum willingness to pay was used.

Table 4.5 Total WTP and Total Revenue of Households (In Birr per Jerican)

WTP interval in birr	Mid WTP	Sample distribution of households		Total number of rural households	Total WTP of rural households in birr	Total rural households willing to pay at least that amount	Total revenue in birr
		(No)	(%)				
1	2	3	4	5	6	7	8
0-0.4	0.2	31	16.14	6,142	1,228.4	38,042	7,608.4
0.5-1.5	1	80	41.67	15,851	15,851	31,900	31,900
1.6-2.6	2.1	52	27.08	10,303	21,636.3	16,049	33,702.9
2.7- 3.7	3.2	19	9.90	3,765	12,048	5,746	18,387.2
3.8-5.0	4.4	10	5.21	1,981	8,716.4	1,981	8,716.4
Total		192	100	38,042	59,480.1		

Source: Survey Result, 2014

In the table 4.5, the total WTP of rural households for water supply service (column 6) can be calculated by multiplying the mid points of willingness to pay interval (column 2) by total number of rural households (column 5). Thus total willingness to pay of rural households for one jerican improved water supply service 59,480.1 birr per day if all households use 1 jerican. However, from the descriptive analysis the mean water consumption per rural household per day is 3.6 jerican. So the total willingness to pay of 38,042 rural households is 214,128.36 birr per day or 6,423,850.8 birr per month.

Column 8 indicates that the total expected revenue which can be collected from sales of improved water supply services is obtained by multiplying the mid WTP amount (column 2) by the total rural household willing to pay at least the amount in each interval(column 7). As can be seen in table 4.5, when price of one jerican is 0.2 birr, 38,042 rural households will pay for the improvement and the expected revenue would be 7,608.4 birr per jerican per day. When the price of one jerican is 1 birr, 31,900 rural households will pay for improved water service and the total expected revenue would be 31,900 birr per day. And if the price of one jerican increases to 2.1 birr, 16,049 rural households will pay for the improved service of expected revenue 33,702.9 birr per day. For price of one jerican is 4.4 birr, only 1,981 rural households will pay and the total expected revenue could be 8,716.4 birr per day. This implies total expected revenue increases initially and it decreases after it reaches maximum point of 33,702.9 birr per day at the price of 2.1birr.

The aggregate demand curve can be also derived from the surveyed results assigning mid WTP amount on the vertical axis and the number of rural households willing to pay at least the amount in the interval per jerican on horizontal axis. From the table 4.5, at

higher price small number of rural households are willing to pay at least the amount in the interval for the improvement while at low prices large number of rural households are willing to pay. This reveals the negative relationship between price of improved water and total rural households demand for improved water supply services. So, the aggregate demand curve for improved rural water supply service at various price levels is as follows;

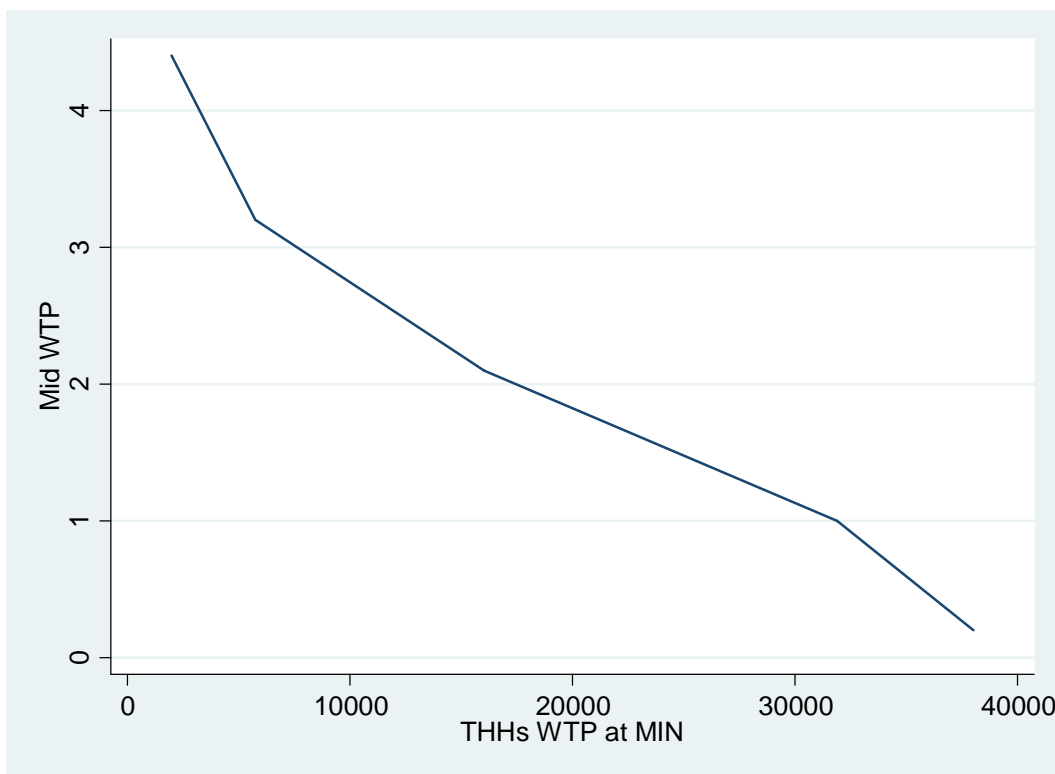


Figure: 4.4 The Expected Aggregate Demand Curve for Improve Water Service Provision

Source: Survey Result, 2014

CHAPTER FIVE

CONCLUSION AND POLICY IMPLICATIONS

5.1 Conclusion

The major objective of this study is to assess the demand for improved water supply services in the context of rural areas of Ankasha woreda. The paper uses contingent valuation method with a single bounded elicitation format followed by open ended questions to analysis the determinants of households WTP for improvement of rural water provision of Ankasha woreda, Amhara regional state. A total of 200 randomly selected household heads were interviewed, but due to incomplete answers and protest to answer, 192 household heads' survey was used. From the total surveyed households 56.8% were female respondents, while 43.2% were males.

The surveyed data revealed that about 41.2% of respondents use water from unprotected sources and the rest 58.8% households' use relatively protected water sources. Of the sampled respondents, 91.7% households are not satisfied with water sources being used because of poor quality, low quantity and long distance of existing water source. The survey also indicated that 75% of sampled households are affected by the seasonal shortage of water supply. The mean water usage per household per day is 3.6 jerican.

More than 86% of respondents expressed their willingness to pay for improved water service provision with a mean WTP of birr 1.52 per jerican. Households average monthly income, time taken to collect water from the existing source for single trip, educational level and sex of the household head have positive and significant effects on willingness to

pay for improved rural water supply services. And, the initial bid price and quality of existing water source have negative and significant effects on the probability of willingness to pay for improved water provision in the probit model. Likewise, in the Tobit model the variables households' average monthly income, time taken to collect water from the existing source for single trip, educational level, marital status and age of the household head determine MWTP of respondents positively, while availability and quality of the existing water sources negatively affect MWTP. From 26 unwillingness to pay responses, 50% households expressed that they do not have enough money to pay for improvement as the main reason for their refusal.

The total WTP of the proposed scheme is 214,128.36 birr per day or 6,423,850.8 birr per month for 3.6 jericana usage of water per day per household. Thus, both the rural households and service provider will be the gainers from the improved water supply service implementation.

Generally, the overall result of this study revealed that households are more interested for the improvement of water supply services in rural areas of Ankasha woreda. Government and nongovernmental organizations should give attention to socio economic characteristics to provide and design water service improvements.

5.2 Policy Implications

Based on the survey conducted on household's willingness to pay for improved water supply services in rural areas of Ankasha woreda, the following policy implications are forwarded.

- ❖ The results of the study show that the existing water supply service is at long distance and also the quality is poor (not safe to drink), and thus the service providers should take in to consideration the quality and distance problems in designing the water system of the rural areas of Ankasha woreda to provide improved water supply services.
- ❖ To avoid water supply shortage during the dry season the service providers should be careful at selecting the appropriate location and designing the type of improved water scheme.
- ❖ As the mean willingness to pay of the sampled households is much higher than the amount of money households paying for existing water sources, the service providers can implement the proposed water improvement scheme to satisfy the water needs of the households although at the same time collecting more revenue by selling the improved water at a higher price to recover the costs.

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ANNEX I
QUESTIONNAIRE

Addis Ababa University

Faculty of Business and Economics

Department of Economics

Survey Questionnaire for value of improved water services

Respondent's Name _____ ID _____

Date of interview _____

Name of Interviewer _____

Dear Sir/Madam,

My name is-----I am a postgraduate student in Economics at Addis Ababa University, Ethiopia. As a part of my research, I am evaluating the demand for improved water service in rural areas of Ethiopia particularly in Awi Zone (Ankasha Woreda). **I would be grateful if you would complete the following questionnaire.** The questions focus on your willingness to pay for improved water service. In addition, I need your perceptions about the improved water service and the expenses you incurred to get improved and easily available water service in this rural area. The questionnaire takes approximately 20 minutes to complete. The findings from this study may also provide information to the relevant government offices to take appropriate actions to improve and prevent the people living in this area from further damage and cost to get water. The information you provide us will be kept strictly confidential.

Thank you very much for your time and co-operation in advance.

Please circle your own choose

I. Questions on existing water service conditions

1. Where do you get water?
 - A. river
 - B. natural spring
 - C. protected spring
 - D. protected hand dug well
 - E. unprotected hand dug well

2. How much time does it take to fetch water from the source to your house at a time?
 - A. 20 min B. 40 min C. 1hr D. 1:30 E. Other (specify)

3. How many times do you go to this source per day?
 - A. One B. Two C. Three D. Four E. Other (specify)

4. How far is the water source from your house?_____kilometers

5. How many days per week do you collect water?
 - A. 3 B. 4 C. 5 D. 6 E. Every day

6. What is your perception about moving this distance to fetch water?
 - A. Unsatisfied since it is painful
 - B. Satisfied because it gives me pleasure
 - C. If other(specify)

7. Do you get enough water from this source throughout the year?
- A. yes
 - B. no
8. If your answer to the above is “No” in which season the shortage mostly occur?
- A. Summer oB. Winter C. Spring D. Autumn
- 8.1 At the time of shortage, what is your last alternative to get water?
- _____
9. Who is responsible for most of the time for fetching water from your household?
- A. Mother
 - B. father
 - C. boys
 - D. girls
 - E. other (specify)_____
10. How much water do your family use/collect per day?
- _____insira/jerican
11. Are you satisfied with this source of water?
- A. yes
 - B. no
12. If your answer to the above is “No” what is the reason behind your dissatisfaction?
- A. Poor quality
 - B. Low quantity

- C. Long distance
- D. High price
- E. Other(specify)_____

13. Have any members of your household suffered from diseases like diarrhea, typhoid, in past?

A. yes

B. no

14. How do you judge the existing status of water supply?

14.1. In its Quality? A. Very poor B. Poor C. Fair D. Good

E. Very good

14.2. In its Quantity? A. insufficient B. sufficient

15. Do you purify water through boiling or any other mechanism?

A. yes B. no

16. Who do you think is mainly responsible for improved water supply?

A. government

B. community

C. private

D. other

17. Are you currently paying any payments to use water from this source?

A. Yes

B. No

18. If “yes” how much do you pay per month/year? _____birr

II. Willingness to pay questions

Now I will ask you some questions regarding an improved water service that may be implemented in your community.

Suppose the following statement is true:

Due to high population growth, deforestation and the topography of the area, there is unequal growth of supply and demand for water for domestic consumption in Ankasha woreda. **Water aid Ethiopia** wants to provide an improved i.e. a good quality of water which is safe for health, an increased amount of water available for use and highly reliable source at any time. This project would be designed to save your time and effort by providing enough amount of quality water throughout the day, all over the year at the safest place. But the high cost of improved water service make it difficult to implement and provide a quality and improved water service without you paying for it and sufficient number of household choosing to participate in the program. You may not require to pay the cost initially. The fee is per household and paid each month by using water bill system for 20 years. Every household would pay the same fee per jerican but the amount you pay would increase as your consumption increases.

19. Are you willing to participate in this water service improvement by water aid Ethiopia?

A. Yes B. No

20. If “yes” for 18, are you willing to pay _____ birr per jerican/insra?

A. Yes B. No

30. How much is the household earning per year in cash (how much you produce per year per quintal(in kind))? _____please specify the kind of crop that you produce_____

ANNEX II

TEST FOR MULTI CO-LINEARITY

avala	bid1	qual	satsour	watusda	timminu	incom	famsiz	mari	edu	sex	age	
avala	1.0000											
bid1	-0.1803	1.0000										
qual	0.3715	-0.2405	1.0000									
satsource	-0.0000	-0.0527	0.4118	1.0000								
watusda	-0.0653	-0.0212	-0.1408	-0.0490	1.0000							
timminu	-0.1442	0.0223	-0.1830	-0.1848	0.1478	1.0000						
incom	-0.3172	0.0590	0.0648	0.1174	0.0346	0.1457	1.0000					
famsiz	-0.1404	0.1068	-0.0827	-0.0440	0.3021	0.2513		0.4989	1.0000			
mari	-0.2465	0.0500	0.0018	0.1448	-0.0360	0.0744	0.4031	0.4002	1.0000			
edu	-0.1358	-0.0568	-0.0487	-0.0571	-0.0586	-0.1080		0.0764	-0.2661	0.0646	1.0000	
sex	0.1882	0.1010	0.0343	0.0729	-0.2076	-0.0738	0.0948	0.0353	0.2273	0.1379	1.0000	
age	-0.1020	0.0194	0.0312	-0.0115	-0.0486	0.1770	0.2964	0.4794	0.1481	-0.3333	0.1285	1.0000