2021-02

Determinants of Household Willingness to Pay For Improved Water Supply: The Case of Berehet Woreda

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DETERMINANTS OF HOUSEHOLD WILLINGNESS FOR IMPROVED WATER SUPPLY: THE CASE OF WOREDA

M.Sc. THESIS

BY

MARKEW WENGISTE

JUNE, 2017

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BY

MARKEM WENGISTE

A THESIS SUBMMITED TO THE DEPARTMENT OF
COLLEGE OF BUSINESS AND ECONOMICS, BAHIRDAR

INPARTIAL FULFILLMENT OF THE REQUIREMENTS FO
OF MASTER OF SCIENCE IN APPLIED DEVELOPMENT

JUNE, 2017

DECLARATION

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A Case Study on Determinants of Household Willingness to Pay for Improved Supply Bahir Dar woreda Amhara, and recommended that it be accepted as fulfilling the the of Master of Science in Applied Development Economics.

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I hereby certify that I have read this thesis prepared under my direc as fulfilling the thesis requirement.

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ACKNOWLEDGMENT

First I would like to express my appreciation to Dr. Daniel Berhanu for his
constructive comments and unlimited support for the accomplishment of
gratefully acknowledge the woreda administration for their str
collection.

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ACRONYMS AND ABBREVIATIONS

ADA	African Development Bank
BoFED	Bureau of Finance and Economic Development
CVM	Contingent Valuation Method
GTP1	Growth and Transformation Plan One
WTA	Willingness To Accept
WTP	Willingness To Pay
UNWWAP	United Nations World Water Assessment Programme

ABSTRACT

This study analyzed the determinant of household willingness
Berehet woreda, Amhara Ethiopia. In the area supply of water tariff
contributes slow coverage of clean drinking water and existing w
source. This study examines household willingness to pay for impro
the determinant factors for their decision. The simple random
sampling technique was used to select one rural kebele and the t
from the two kebeles from rural and one from urban. To analyze th
descriptive and econometric model such as Bivariate probit a
model were used. From the descriptive analysis, the major prob
in the two kebele is inadequate quality, quantity, and reliability of the sources.
problem of the water source its affects total income, on average the hous
taken 80 minutes to fetch water, the distance from home to public tap 3
public tap 46 minute. 64.5% of the household did not satisfy
survey result shows average family size in the study area is 3.88
water consumption of the household is also 5.2 jerican per ho
the household is 4.76 Birr. The estimates from Bivariate probit model indica
that determine the willingness of the household for clean drin
respondent age, level of education primary, secondary and tertiary
daily water consumption household yearly income, family size, total time
to fetch water from the source in minute, elevation of sites, existing wat
supply, reliability of existing water source, distance of the respondent to about
the existing water supply, employment status of the respondent and initia
respondent are significantly affect the respondent for clean drink
in the study area. The variable location or residence implies not s
that there is no significant difference in willingness to pay for
area between rural and urban. The other finding from the surv
the household is 0.60 Birr per jerican, this is about it might not b
for some income household in the study area. Therefore, it nee
when the lower tariff is set and the tariff for public tap user sh
and urban. Taken additional public tap should be constructed and distant so

household from the public tap to reduce the time and waiting time at the tap

CHAPTER ONE

1.0. INTRODUCTION

1.1. Background

The future of life and civilization on earth depends on water. which life and development, especially fresh water is a finite and vu essential to sustain life, development and the environment is not only limited but distributed unevenly in different part of the world scarce (Parker, 2010). The amount of water available in the world is roughly constant ove continuously growing and reached about 7.3 billion. The supply of the water is only 3% out of this two-third is locked up under deep aquifer, only one percent of the world fresh water readily available (Rogers, Bhatia, & Huber, 1998; Rogers, De Silva, & Bhatia, 2002; Young & Loomis, 2014). Water is also considered as economic good and social good. Water can be private good or pure public water is pure private good because it is excludable at low cost one individual reduces the availability for others. Water as e assigned on water is important. In the case of private ownership water would be c cover the full economic cost, but in this case it doesn't work. If the government property right, it will intervene to protect externality by subsidy the weakest user. But in this case, the price of water is not allowed to sin recovery because of setting the water tariff for domestic use and rising w economic efficiency and environmental sustainability (Rogers et al., 2002)

Water is fundamental for human-being and considered as social development is also crucial for an achievement of such objective as adequate nutrit poverty alleviation, gender equality, education. The absence of clean and source in the least developed country aggravate poverty especially on girls as they spend more time in fetching water from unsustainable sources. Unimproved water create inequality such as gap between rural and urban collection in most case woman and children walk a long dista

exclusion of the poor from water, and it affects family health and social dig
water is social goods (Rogers et al, 1998; UNICEF, 2015; UNWWAP, 2015). The other feature
of water is it becomes source of conflict around the world especially Nile basin, Middle
East and South Asia. In the study area, there is a big conflict in the use of wat
the lower stream and for irrigation in upper stream. That is why United Nations declared wh
access to safe and sufficient water as a human right and the
Government to provide a basic water supply for its people. Water for everyone
everyone accessibility (safe physically reach, affordable and a
adequate quality water for personal, or domestic use (water supply
must be sufficient and continuous for personal and domestic uses (Cassardo & Jones,
2004).

Even if inequality persists and the progress was uneven, there
world, in the improvement of the distribution of safe drinking w
due to global mobilization and commitment of the world (UN, 2015). From 1990 to
2015 the number of the world population drinking safe water increased from 76%
to 91%. During the same period of time the number of people
from 346 million to 159 million. But 663 million of the world population still have not
safe drinking water. Ethiopia, one of the countries that met the millennium development
of halving the proportion of the population without sustainable acc
1990, the clean water supply of Ethiopia was 84% in urban ar
country. In 2015, safe drinking water increased to 93% in urban and 47% in rural area
out of the total population in 1990 only 13% have had an acces
number raised to 57% in 2015. At the same period of time the number of people who use
surface water reduced from 48% to 13% (UNICEF, 2015). But the problem of safe dr
water is still a serious problem in Ethiopia, especially rural pa
the rural woredas that faces serious drinking water problem. People travel very long distance
per day to fetch water from untreated source reaching 10 to 20 km per day.

According to the woreda Finance and Economic office the woreda Government, and both the
Regional Government allocated a total budget of 100,658,017 Birr, from the ADB a total of 7
the woreda people as contributions of material and labor a total of 9,418,013 Birr.

The past eight years in the woreda a total of 223,344,874 Birr was invested in the water sec
only to improve the access, even after the effort to change the water sup
situation only 53% of the people have access to clean drinking water (woreda Finance and economics office, 2016). The contribution of the people for water project development indicate that the households are willing to contribute for the improvement of the water service. The woreda administration also subsidized up to 500,000
water to the people. Because the revenue collected from the s
cost of the service.

Regarding the theoretic willingness to pay indicates individuals has an expression of preference on the public good they are willing to pay. For example a decrease in pathogen
drinking water might reduce illness, losses in work and time spent in b
water (K. E. Haab, Timothy C & McConnell, 2002). From empirical study
people in this region are willing to pay. Especially when the drinking wa
problem of inadequate quantity of water and the quality of th
According to Bogale, Ayalneh, & Urgessa, 2013; Berhanu Mezgebo, Gidey Kidu, &
Zeleke (2015) the amount of water consumed, time spent to fetch water, househol
education, current level of satisfaction and water quality hav
willingness to pay for improved water.

1.2. Statement of the problem

A daily struggle for clean drinking water is one of the key burden of poverty,
women and girls fetching water over long distances. About 40%
the area with moderate to high water stress. Globally 663 mill
drinking water source. The majority of them live in sub-Saharan developing
Africa almost half of all people South Asia 319 million and 134 million (UNICEF, 2015; UNWWAP, 2015). Ethiopia as part of the Sub-Saharan Africa is facing seriou
water problem. According to Amhara regional state water mineral and energy bureau, the
accessibility of safe drinking water in the region is 65.8% in rural and 5
65.2% only have access to improved water (bureau, 2016). Burie woreda which
found in the Amhara region is also one of the constrain water-related challenges th

limit economic growth and threaten the livelihoods of its peo
situation of the woreda, 47.4% of the people have not got access to imp
Due to this, the residence forced to use untreated water from ponds or pay very hi
water prices to informal water vendors in order to obtain clean
water for all people time is impossible and hence they compelled to u
unprotected spring and surface water. Consequently, the commun
diarrhea and other deadly water borne diseases which lead to loss of time for
educational and employment activities.

Although the government tried to alleviate the persistent community problem, the
many problems still need the attention of the government a
integrated. The low water tariff is contributing the lion share to the
The uniform rate set is disproportionately financial burden on poor h
and hampers the expansion of pipe. This might not only the prob
water utility office used increasing block water tariff structure to
water and ensure (Tracking equity, 2012 inappropriate water tariff set by a
without any prior knowledge about the water production and
any study about the willingness of the society contributes for
water. Because the existing water project put pressure on g
government unable to expand water supply to household facing s
scarcity. Since water service office cannot fully cover the cost of
households, the woreda administration forced to subsidize the
the sale of water is too small to cover the cost. This constraints the
in new water project and expansion of the existing water servi
encourages the private vendor to accumulate the water, creates the s
distribution problem to the poor by charging higher price. Birr per
from 0.17 cent to birr paid for water service office. Because of
price and the cost of fetching individuals who have command over t
private connection (Whittington, Lauria, & Mu, 1991). The motive of the new tariff
government is to benefit the poor. Therefore, even if they paid
the individuals are willing to pay for clean drinking water high
than the price paid to private water vendors.

Although research is conducted on valuation of water there is a gap in setting previous research, they set the bid based on the other research finding case, it is difficult to set appropriate bid, because the price of water di different Geographic location and pre-testing the researcher uses a small size. For example, (Gecho, 2018) according uses 30 samples for three schemes each namely spring on spot water supply project, spring development, and wat hand pump water supply projects also pretesting (Boyle & Unger, 2012), but they didn t explain the sample used to pretest. The price of the water is engineering agre estimate, but the government wants to set tariff not based on engineering est The government also concerned about equity because consequence of rising pric people might high price or people might exclude themselves from the use of pipe water, if the price increased (Nauges & Whittington, 2010). Because water as social go willingness and affordability of the society need to be cons (Rogers et al., 1998). Therefore, in this study we use engineering estimation of the p to see the willingness of the household, based on cost recover intiial bid set based on maintenance and operation cost plus fift based on maintenance and operation cost recovery and full co recovery.

The motivation of this study is to help in solving the main problem to pricing of improved drinking water. Setting the tariff depend of the household and at the minimum with the objective of o coverage. This can help the administration with draw subsidized and operating project, for future investment in water improvement prog new project to increase the coverage.

1.3. Objectives

1.3.1. The general objective

The general objective of this study is to examine household water supply: and the determinant factors for the decision in Bore Woreda.

1.3.2. The specific objectives

The specific objectives of this study are:

- To estimate the household daily water demand function and
- To calculate the total benefit or total economic value of i WTP responses
- To assess the WTP characteristics of both rural and urban hou
- Identify the factors that determine willingness to pay for improved wa the study area.

1.4. Research question

- Is the tariff estimated consistent with the law of demand and rational water law?
- What determines willingness to pay for clean drinking water in the woreda?
- Is there any significant difference in willingness to pay for clean drinking water between the rural and urban areas of the woreda?
- Does the total benefit of the water drawn from the WTP cover t

1.5. Significance of the study

There are few studies on willingness to pay for improved water service in the r was done in the woreda. According to Ethiopia and the region water po should not be uniform throughout the country but it should be set according t of the project. This area makes the study very important for decision ma price the consumers are willing to pay affect the willingness t consumers to pay for improved water service. The study also w to raise the level of revenue collected and make the water su cost both operational and maintenance costs. In addition, the water pric the water and sewer services policy of the country, in urban determination of tariff objectives to cover 50% of investment cost and operational and maintenance and only to cover operational and The study will also contribute knowledge for further studies in thi

1.6. Scope and limitation

This study is limited to the analysis of the demand side ab
households level cross sectional data on households at a given point in
improved water service also includes public borehole and stand pipe
improved water supply services by households in the urban a
The study only focused the willingness of the household wa
production and operation cost. Because in rural area the
incur the operation cost, so in this study the household willingnes
maintenance cost only and this is not included in this study.

1.7. Organization of the paper

This proposal is organized in five chapters. Chapter one contains background
study, statement of the problem, objectives of the study, rese
study and limitation of the study. Chapter two is review of the theoretical fr
and empirical literature on CVM and willingness to pay studies. Chapter three discusses research
methods. Chapter four deals descriptive and econometric analysis and ch
conclusion and recommendation.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. THEORETICAL FRAMEWORK

2.1.1. Theory of non-market valuation

For market goods, welfare effect due to changes in price defi[ned under] Hicks compensated demand curve, while for non-market goods welfare effect due to cha defined under the area of marginal willingness to pay curve fo curve exist for non-market public goods and environmental goods (non-market goods). T cannot be directly estimated from market transaction due to non-market good th (Bishop & Freeman, 1996).

2.1.1.1. Components of value of environmental resources

Economists classify the total economic value of the environmen value and none use value. The use value of the environmental the use of environmental resource that can be further classified into indirect use value. While none use value, the value the consumer attaches to independent of his/her use of environmental resource or the intangible benefit obtained from environmental goods. None use value also divi value and existence value (Bishop & Freeman, 1996; Kriström, 1990).

2.1.1.2. Environmental valuation techniques

There are two Techniques demand and value of non-market good change in

1. Revealed preference
2. Stated preference

The stated preference and revealed preferences are the most studi valuation. Revealed preference is the approach that indirectly goods and service that people place on it, by using travel cost method and hedonic pricing. Travel cost method can help to value recreational wat on how much the visitor spent in getting to the site to cons

willingness of the visitor. Hedonic pricing is measuring the marginal willingness discrete change in an attribute such as the effect of water amenity on house price (Tietenberg & Lewis, 2016).

Stated preference the approach directly values the environme contingent valuation methods. This method use survey to ask people their prefe for hypothetical scenario regarding both the use and none use service. The most important advantage of the stated preferenc people about the non-use value of the environment. The disadvantage of stated preference approach is the validity of hypothetical estimate (Haab & Roach, 2013; Infanger, 1999).

2.1.1.3. Contingent valuation

The contingent valuation method (CVM) gets around the ab environmental goods by analyzing responses to hypothetical valuation methods can assist in the estimation of use and non-use value (Dafsbo, 2010) and

2.1.1.4. Contingent valuation analysis and related biases in CVM

The steps involved in applying the CVM can be stated as follows:

- Creating a survey instrument for the elicitation of individual WTP/WTA. This can be broken down into three distinct, but related, components: Designing the hypothetical scenario, deciding whether to ask about WTP or WTA, Creating a scenario about the means of payment or compensation.
- Using the survey instrument with a sample of the population of interest.
- Analyzing the responses to the survey. This can be seen as having two components: Using the sample data to estimate the average WTP/WTA for the Population, Assessing the survey results as to judge the accuracy of this estimate.
- Computing the total WTP/WTA for the population of interest
- Conducting sensitivity analysis (Pierman, 2003).

The major concern in the use of CV method is potential for survey respond
biased answer. There are five types of potential bias that affe

1. Strategic bias
2. Information bias
3. Starting point bias
4. Hypothetical bias
5. The observed discrepancy between willingness to pay and willingness to a

Strategic bias arises when respondents provide biased answers to influence the final
Information bias arises when respondents lack experience or k
goods valuing. Starting point bias the respondents asked to answer fro
possibilities; if the range is not properly defined it will affect
the respondents being confronted by an artificial market and unfamiliar
choice. In these cases, respondents report a much higher value for w
compensation willingness to pay for environmental improvements (Tietenberg & Lewis,
2016).

2.1.1.5. The random utility model

The basic model for analyzing dichotomous CV response, a the
utility over the option of characteristics by a systematic component
socio-economic variable and a random component the error term. The ran
from the researcher's inability to observe all elements affecting the
the assumption of the structure of the error term, the model can be used to e
preference parameters based on individual choice of the water improve
and the status quo. Utility increases if the improved source quality wa
individual will be willing to pay if the utility from improved wat
or status quo based on the price of the good, the income
socioeconomic characteristics (Qasim Grafton et al., 2008).

According to O. Haab and K. E. McConnell (2002), utility model and
willingness to pay model are the same in the case of dichotom

in the case of multiple choice conjoint analysis or choice model. random willingness to pay and linear random utility model prod and welfare estimate. It is possible to estimate non-linear willingness to pay and non-linear utility function.

2.1.1.6. Welfare measure of environmental goods

A basic choice to be made in the contingent valuation method measure between compensating variation (CV) and equivalent v variation measure-at the level of utility as a point of reference. variation measure-at the level of utility as a point of reference. project under consideration, compensating variation and equ willingness to pay and willingness to accept questions. Asking t willingness to preserve the environmental quality in its prese measure of equivalent variation. Asking the individual about environmental improvement for future use is the (Krieström, 1990).

The money welfare measure can be reported in two equally vali

1. Compensating variation vs equivalent variation
2. Willingness to pay and willingness to accept

Table 1: 2. The Relationships among CV, EV, WTP and WTA

	Compensating V	Equivalent Va
Utility Increas	WTP	WTA
Utility Decrea	WTA	WTP

Willingness to pay is the maximum amount of income a pers
improvement in environmental good such as water. Willingness
of income a person will accept to forgo an improvement (Tim C. Haab & K. E.
McConnell, 2002).

From the above literature, deciding to use compensating variation
pay to the study underway. It is possible to ask the househ
willingness to pay for the improvement of drinking water.

2.1.2. Economic theory on water pricing

The Economic theory suggested that correct pricing of private and p
efficiency. Conventional wisdom believed that the rising price
that increasing price improve equity. High water price help to extend t
currently not served and those individuals forced to purchase
price. On the other hand, it also helps to maintain the sustainability of the resource because
the price is the true cost of the resource, the resource will be put in its
(Rogers et al., 2002).

The current administration of water resource is inefficient due
to charging low price. The efficient pricing of water requires the u
marginal user cost is equal to marginal benefit, rather than a
water and marginal cost is equal to marginal benefit in the case of renewable water (Tietenberg &
Lewis, 2016).

Water as economic good two policy issue needed to be answered dep
property right assignment whether it is owned by private sector or government
the form of public goods. How to implement price policy? How
case of private ownership water price would be charged full cost, but in
our case, this doesn t work. If the government controls the proper
protect externality by imposing tax or subsidize the weakest user. But in
the price of water is not allowed to sink below full cost recove (Rogers et al., 1998).

2.1.3 Empirical evidence

2.1.3.1 Water related CVM studies

The research conducted in Nigeria state of Osun to Determine what are Willingness to Pay for Improved Water Supply by using binary the social, economic variable such as those of the household with the study. The results showed that respondents percentage of willing to pay for improved water supply and the willingness to improved source are statistically significant, age, level of education, marital status household size and household expenditure do not significantly improved water (Adesunkanmi & Titus, 2009)

The study on willingness to pay for portable water in the Accra area Ghana by using ordered probit, identified the variables that affect the household for portable drinking water. Monthly Income of respondents, Current water, Time spent in fetching water from current source, House stay in the Area, Initial Bid, Sex of respondent, Education level of current water supplied, Reliability of existing water source, Sanitation facility respondent and Marital status of respondent. Monthly Income fetching water from current source, Education level of respondent, Secondary and Education Level, Tertiary, Perceived quality water supplied, Sanitation facility of respondent and Marital significantly affect willingness to pay for portable drinking water (Tawiah, Duku, Tuffuor, Botchwa & Darkwah, 2015)

The study conducted in Ramallah Governorate, Palestine by using total economic value of domestic water service, income, the consumption and the use of water filters have significant positive Similar to other research findings positive effect significant, other research finding age has a significant positive effect on (Shaheen & Robert Holländer, 2010)

Contradicting to most research findings, the research conducted in Emmuhaya, willingness to pay for improved water supply by using logistic regre are the insignificant effect on WTP but both variables have a signific another research finding, On the other hand age has a significant negative effect is also insignificant in this research (Amimo, Wangila, & Kironchi, 2013).

In the study conducted on estimation of residential water demand water price, inc household composition are critical determinants of water demand (Arbués, García-Valiñas, & Martínez-Espiñeira, 2003). In the developing country, the main determinant of water function is water price, water collection cost, quality of water education (Nauges & Whittington, 2010).

Water as economic good two policy issue needed to be answe property right assignment whether it is owned by private sector or government the form of public goods. 1. How to implement the pricing policy? How high price should be? pr In the case of private ownership water price full cost could be charged but in this case, it doesn t work. If the government controls the prop to protect externality by imposing tax or give incentive to subsidize the weakest u case, the price of water is not allowed to set at full cost recovery (Rogers et al., 1998).

In the study conducted on estimation of residential water demand water pric household composition are critical determinants of water demand (Arbués et al., 2003).

In the developing country, the main determinant of water demand is water cost, quality of water service, income, family size and education (Nauges & Whittington, 2010).

The determinant of Water demand: Water price; income and family size (Gruenwald, Haan, Debertin, & Carey, 1976). Form all the above literature water deman water price, income, family size and composition, water collec and education are some of the most important variables.

2.1.3.2 Water related CVM studies in Ethiopia

According to the case study between Ethiopia and Nigeria the researchers iden
of the determinants of willingness to pay for improved water services such
as income, marital status, education level, household size, family size, tra
water, distance from the source of the water, daily water exp
open for customer, household tenure, year of stay in the town, affordability
source, occupation, change in water source and initial bid all
the age of the household and current level of satisfaction ha
variable identified by the researchers significantly affected the wi
for improved water services other than marital status a
household (Mezgebo & Ewnetu, 2015).

Similar to Mezgebo & Ewnetu (2015) the study conducted in E
willingness to pay for improved rural water provision by using
to fetch water, household income/family income, sex, education and w
positive effect on household willingness to pay for improved
respondent significant negative effect on willingness to pay (Bekele & Urgessa, 2012).

2.1.3.3 Empirical evidence on water pricing

Poor people in urban might pay more for water according to the study
Onitsha, Nigeria on water vending and willingness to pay the p
responsible for over 95% of the water sales in the private sector
sector covered no water tanks, only 8000 households in Onitsha
connection to the public water supply system and the majority
water vending price (White et al., 1991).

According to Ethiopian water policy, water price should not be
and it should be set according to the circumstance of the proje
precise study before the price set or any decision to be made, but in th
case, no study conducted and simply set the price without any
recommended that set the price based on users ability to pay principle t

the society. Regarding the water tariff, the rural tariff based on the be
objective of operating cost and maintenance cost coverage. In
be set based on full cost recovery (UNWATER, 2004)

2.1.4 Existing water supply of the study area

The town has water supply service office. So, the Menso town water is supp
administrated by this office. As per the information obtained from Menso town water
supply service, the town had been able to get piped water su
construction on Menso River. The source for the existing water
located about 4km from the existing service reservoir in the N direction
The currently serving system operates by pumping water from
with production capacity of about 4.88 l/s and 100m3 75m concrete service re
The existing water supply system of the town comprises River source with pumps 18 pub
fountains, 75m3 Circular sandwich Masonry & 100m3 Concrete Service Reservoir. A
the information from the town water supply service office shows scarcity
of water during dry season. As the water source for the instal
the installed pump is working for only 20 hours per day; this
reservoirs very small.

2.1.5 Existing water tariff of the study area

The water tariff currently used by the water utility office was
of the town as fixed amount. The current water tariff is set at
discussion held between the town water supply service committee and the co
data taken from the water committee indicates the current yard water
tap and 25 cents per 25 liters or one jerican for public taps.

2.1.6 Affordability of water price

The affordability index in developed country is very low because of high disposab
They spent only around 1.1% of their income. The poorest industrialized country househ
spends 3.5% of their disposable income. But in developing country the affordability range
from 3-5% of their income (Smets, 2009). The region water tariff states that the affordabilit

index would not be greater than 5% of the tariff is often assess
percentage share of monthly water expenditure (Thomas, 2012) the household

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1. Description of the Study Area

Berehet is one of the woreda, which found in North Shoa zone of Amhara regional s
Ethiopia. Berehet is bordered on the South by Kesem River which sep
Shenkora woreda, on the west by Hagere Mariam woreda, on the north by Asagirt woreda and on the east by Afar regional state. Geographically, it is located 1640m above
found at the longtiude 57^{0}97 8 and latitude 10^{0} 692 north respectively. Its major town is Metehibela. Berehet is also one of the historic place remembered by the battl
Berehet. They fought between the Shoa Nobel to resist Emperor Tewo
by General Ras Ingida on 19 November 1855.

Based on 2007 National census conducted by CSA of Ethiopia, the woreda
of 42,546 out of this 20,950 are men and 21,596 are women and 8,542 inhabitants are
With the area of 792.44 kilometers square, Berehet has a population density of 54. This is less than that of the zonal average of 115.3 persons per kilomet
inhabitants or 79.62 % practiced Ethiopia Orthodox Christianit
are Muslim

Figure 1: The map of Berehet woreda

3.2. Definition of the explanatory variable and measurement

WC: The amount of water quantity consumed. As the water consu
of the household increase, it increases the water expenditure a
to pay more. So, it has negative expected sign and measured in

SX: The sex of the household head. It is a dummy variable with
for improved water services and would be more willing to pay
women are often around the house with a higher burden of fetc
sex is specified as 0 for female and 1 for male. It has negative expected sign due to
mentioned reason.

AG: Age of the household head. It is a continuous variable with negative sign and
measured in number. This is because older people, who pay less
and lower price, might be reluctant to pay for improvement.

EDUC: The education level of the household head. EDUC1 is a dummy variable
illiterate and 0 otherwise, EDUC2 is a dummy variable take th
from 1-8 grade, 0 otherwise, EDUC3 take the value 1 if the level education is 9-12 grade, 0
otherwise and EDUC4 take the value 1 if the level education is
otherwise. It will expect a positive relationship between household with high level
improvement of the water quality and they are willing to pay.

CLFY: Children less than five years. It has the value 1, if the children less than fi
not have the children. The presences of children in the family will influ
the daily water consumption. The increase in water consumpti
household negatively. Therefore, the expected sign is negative

HFS: Family size. There are two different views regarding th
the family size on water use. Some said it has positive and anoth
this study, the expected sign would be positive. It is household with large fa
it is difficult to satisfy daily water demand from a very long dis

LSES: level of satisfaction with the existing water service, it is a dummy variable taking value 1 if the household satisfied and 0 otherwise. Willingness to pay and the level of satisfaction have a negative relationship.

RES: reliability of the existing source is the dummy variable taking value 1 if the source is reliable and 0 otherwise. If the existing water source is not reliable and if the new water source is reliable the willingness to pay will very high. There is a negative relationship between the two variables.

DSW: distance from the source of the water, it is measured in meters. The distance is expected to increase the willingness to pay as well as to increase for water. There is a positive relationship between distance and willingness to pay.

TTTFW: In the area where there is inadequate water supply, people spend more time to collect water; the opportunity cost of time is very high. Therefore, the time could be used for other productive purposes. One of the benefit of providing improved and adequate water supply is to save time. Therefore, the expected sign of time taken to fetch water is positive. The unit of measurement is minute.

INC: Monthly income of the household, it is a continuous variable. It is the total monthly income and the income of other members of the family. The a priori expectation is that there is a positive relationship between income and the demand for improved water. Economic theory supports this intuition that income and quantity demanded are directly related for normal goods. As a result a positive sign is expected on the variables of income.

RS: the residence of the household is a dummy variable it is 1 when urban and 0 otherwise. Urban due to the problem of clean drinking water may willingness to pay is assigned to be higher because of rural area more suffering from the lack of improved water.

QLTY: Respondents perception level of quality of the existing supply. We expect a priori, if households perceive a good quality then there will be a low demand for the improved system and vice versa. A dummy variable will be 1 if households perceive high quality and zero otherwise.

RYS: Respondents years of stay in the area. It is hypothesized t particular area, the more they would be willing to pay for the p will know more about the benefits. In addition, there will be sentim A positive relationship is thus expected.

MRG: Respondents Marital Status. This is a dummy variable ta married; 0 otherwise. This is expected to have a negative sign since m more water consumption than unmarried. As the consumption increases, wate affects their willingness negatively.

IB: Initial bid. This is done whether to see if household are affected by the ini bid.

Table 3.2: - Summary of variable specification

Variab	Expected s	Definition and coding of variable
WC	-	The amount of water consumed in jerrican
INC	+	Income of the household in Birr
AG	-	The age of the household
HSX	-	The sex of the respondent 1 if male and 0, f
HFS	+	The size of the family
EDUC	+	household years of schooling or the maximum household achieved
EDUC_		the maximum level of education the household achieved 1, otherwise
EDUC_	+	the maximum level of education the househo otherwise
EDUC_	+	the maximum level of education the househo otherwise
EDUC_	+	the maximum level of education the household otherwise
DFSWK	+	Distance of the household from the water source o kilometer
DFSWM	+	Distance of the household from the water source o kilometer
WTAPT	+	waiting time at public fountain or water source
RES	-	The reliability of existing water source, 1 if reliable; 0 otherwise
LSES	-	Level of satisfaction on existing water sourc
RS	+/-	Location/residence of the household 1, if urb
RLGN	+/-	the religion of the respondent, 1, if orthodox
MRG	-	the marital status of the household, 1, if ma
QLTY	-	Perception about water quality, 1, if Good, 0 otherwise
BID1	-	Higher bid affect willingness to pay negative

3.3. Survey design

3.3.1 Data source and type

A cross-sectional primary data was collected for the time period of 2016/ the necessary information on socio-economic and demographic characteristics such as income, age, sex, family size, existing education, water supply situation level of satisfa from the source, reliability of water source and willingness to structured questionnaire from a CVM survey from selected Bererhet kebele woreda. Secondary data was also used from water service office and the w economic development office reports through to support the analysis of study.

3.3.2 Sampling design and procedure

In this study, only those kebeles which have the same system of prov included both operating and maintenance cost identified or the kebele which use w hand pump and spring; the production cost of water is zero. The rural kebeles included in this study: Demeko, Gorro Solomon, Amkomi and Wosso. Only two sample kebeles one from town and one from rural are selected. Based on the above e one rural kebele by simple random sampling. As far as the urba taken, Demeko is the selected kebele by using simple random samp selected a sample by using a simple random sampling from the total population of 2232 household s i.e. 1321 from urban and 911 According to (Kothari, 2004) formula the sample size

$$n = \frac{z^2 * p * q * N}{e^2 * (N - 1) + z^2 * p}$$

$$n = \frac{1.96^2 * 0.47 * 0.53 *}{0.05^2 * (4748 - 1) \quad 1.9063}$$

$$n = \frac{4543.563275}{12.82444256}$$

$$n = 354.2893388$$

$$n \approx 355$$

$n = 355 / (1 + 355 * 0$

$n = 408$

$n_1 = 408 * 0.59 = 4$

$n_2 = 408 * 0.40 = 16$

Samples of 355 households were selected to be from the two strata i.e.
and rural. The response rate of the questionnaire was 85% and
case some of the interviewees might fail to answer the questi and some respondents
missed at the interview time. We drew a total sample of 408 households. The sample
distribution between urban and rural area was 61 percent from urban and 39 perc
depending on the proportional system based on population dist
interview was used to collect the data by using CVM questionnair
questionnaire was 94% because we use a face to face interview
to answer the question and some respondents missed at the time of interview.

3.3.3. Questionnaires design and elicitation format

Contingent valuation method studies have employed four prima
question format, simply ask the participants for his or her ma
environmental improvement being studied. Dichotomous choice method provided single val
that can either be accepted or rejected. A payment card with several values printed on
sometimes shown to participants, who are asked if any of t
maximum willingness to pay. In bidding game, participants receive values seq
either in ascending order until a value is rejected or in descending order until a value is accept
But in this study, we only use double bounded dichotomous choice method and open ended question format.
First the household was asked about his or her willingness bas
question was be asked whether a higher or lower amount depending on the first re
to double bound dichotomous format question, the individual was asked about
maximum willingness to pay by using open ended question (Damat, 2010)

The survey questionnaire was designed in three sections

1. In the first section, survey was started using the question related to household wat as the level of satisfaction of the current water supply, dis the reliability of the existing source of water and duration of wa
2. In the second section, relevant hypothetical scenario was prepar and proposed water supply in the way that it increases the bia reduce the potential bias related to bid vehicle, starting point bias, inst bias and hypothetical bias we need to take some measure s discussion on determining the initial bid price that can be u dichotomous question format is chosen over open ended format gives an advantage to g response rate and effective information provision, double b predetermined price that helps to reduce outlier and paym willingness to pay of the respondents is elicited. Open question forma single bounded dichotomous choice, and the double bounded dou dichotomous choice was used to elicit the willingness of the household. In the case of single bounded dichotomous choice was ask a quest willingness is single value that can either be accepted or rejecte case of double bounded dichotomous choice question the hou about his/her willingness if he/she will accept or reject the initial bid. accepts the initial bid he/she asked a higher amount. And if the bid he/she asked lower than the open ended question will ask about maximum willingness to pay for improved water.
3. In the third part, the socioeconomic and demographic characteristic as income, age, sex, education and the entire relevant varia

3.3.4. Bid design

In bid design we divided the household into two categories. The first category is t households used water from yard connection the bid is set ba maintenance operation cost plus some investment cost. The second catego public use in urban kebele, this bid is set based on the objec operation cost plus some investment cost less than the yard connection

those household used water from public tap, hence, their bid is based on the objective of only maintenance and operation cost coverage. The fourth catego household used water purchasing from yard connection, hence, their bid is set based on the full economic cost coverage. Because this household currently paid a higher price for clean drinking water, still, they would be willing to pay higher than other category. The last category is household who used water from neighbor user, currently they paid the same price of the yard connection user, but we set the bid in connection user and water purchaser to hold the randomization principle

3.3.5. The field procedure

The questionnaire was translated to Amharic and six enumerato data were collected between March and April 2009. Each enumerator took part of data collection.

3.4. Data analysis

This study used both descriptive statistics and econometric model for the analys Descriptive statistics such as mean, percent and median were used to analyze the willingn pay and socio-economic characteristics of the respondent.

3.4.1. Econometric model

Two econometric models which are bivariate probit and double bounded closed-ended dichotomous choice model with corresponding elicitation questionnaire. The for double bounded closed-ended dichotomous model was used to drive the mean and to set the tariff. The Bivariate probit model was used to identify dete to pay for improved water supply in Berehet woreda.

The econometric model applied to individual benefit. The process of benefit esti begins with the desired measurement for an individual: the equivalent to compensates for changes in the quantity or quality o the preference function for an individual.

Let $U_i(X_i, W_i$

$u_0 ð= V(p_i Y,$ The individual preference function

X= (x1……xn) the vector of private goods

W= (w1……wn) the vector of public goods which are not private goods

Individual chooses how much water to draw from a tap, the quantity of water

X- Available at a price p which may or may not be market determined

The individual maximizes utility subject to his income Y. The indirect V(P, W, , is given V(P, W, = Max {U(X, W) / PX ≤ Y}

The minimum expenditure function, m(P, W, u) is equal to the indirect utility fun

$m(P, W, u) = Min_x \{P X / U(X) ≥ u\}$

The derivative of an expenditure function with respect to price constant demand curve. The negative of the ratio of the derivatives of the with respect to price and income gives ordinary demand curve.

On the basis of demand function, the indirect utility function is defined

$X_i(P, W, Y) = -V_{p_i} / V_Y$ Marshallian demand curve

$v_i(P, W, Y) = U_i(x_i(P, Y))$ the indirect utility function

u(X, W) Is increasing and quasi-concave in W.

m(P, W,) Is decreasing and convex in W and

v(P, W,) is increasing and quasi-concave in W

The expenditure and the indirect utility framework for welfare estimation. Contingent valuation methods can be viewed as the

$u_j(\cdot) = u(y, z_j, \varepsilon_j)$ ..... (2) Where u indirect utility responde

error term.

Y_j the j^{th} respondent discretionary income the determinant of utility

Z_j an m dimensional vector of household characteristics

$u_{0j}(\cdot) = u(y_j, z_j, q^0, \varepsilon_{0j})$ .....

$u_{1j}(\cdot) = u(y_j - WTP_j, z_j, q^1, \varepsilon_{1j})$ .....

Quality indicator q^0 to q^1 change from q

The Utility has also changed from status quo to 1 indicate the pres

program and zero without the program.

In this case willingness to pay is the amount of income the individ

him indifferent between the original state income y and enviro

q^0, and improvement state and improve water quality.

Based on the respondent j answer yes to a required payment

the CV program, net of the required payment, exceed utility of

$u_1(y_j, z_j, q^1, \varepsilon_{1j}) \geq u_j(y_j, z_j, q^0, \varepsilon_{0j})$ ..... Improvement in quantity or quality

The measure of compensating variation is defined by

$u_1(y - WTP_j, P_j, z, q^1, \varepsilon_{1j}) = u_j(y, q^0, \varepsilon_0)$ Compensating variation, the amount o

to pay collected in order to Willingness to pay is a reduction of i

evolution of improvement in environmental goods or the price paid

improvement in environmental goods.

The probability of a yes response is the probability that the re

proposed scenario, even with error, $u_1 > u_0$. For the respondent j, the proba

$$Pr(yes_j) = Pr(u_{1j}(y_j - p_j, z_j, \varepsilon_{1j}) > u_{0j}(y_j, z_j, \varepsilon_{0j}))$$

Specify the utility function in additively separable between preferences

$$u_i(y_j, z_j, \varepsilon_{ij}) = v_i(y_j, z_j) + \varepsilon_{ij} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (7)$$

With additive specification the probability statement of respondent

$$Pr(yes_j) = Pr[v_{1j}(y_j - p_j) + \varepsilon_{1j} > v_{0j}(y_j) + \varepsilon_{0j}] \ldots\ldots\ldots\ldots\ldots.8$$

The random component in a final status can be written as a single term, so we can write

$\varepsilon_j = \varepsilon_{1j} - \varepsilon_{0j}$ as single term.

3.4.2 Conceptual framework

Depending on the framework specified by individual utility function above the functiona formula of this study is

$U = u(x, w)$ Max subject to $px + Tw \le$

Where X = private good

P = price of private goods

T = water tariff

w = water quantity consumed by households

y = income

Assume x and p does not change the demand function for w is

$w = f(T, y_i, Z)$ Z = other socio-economic variable

When we rewrite the indirect demand function in terms of tariff

$T = f^{-1}(W_i)$ ……… (21) Marginal benefit function of water

$T_i = b_0 + b_1 w + b_2 y_i + b_i$ ….. (22)

3.4.3 Closed-ended double bound dichotomous model choice

This model is closed ended double bound dichotomous eliciting question to pay for the purpose of increasing ... its close to single bound ... question format so that logit or probit. In the CVM survey involves asking the respondent if he would pay some given amount of money, t... environmental quality and obtaining yes-no response. The probability model fitted be logit or probit depending on assumption about distribution of the error term. the coefficient estimate from double bound model is asymptotically more efficient th... from single bound model. In addition, the double bound dichotomous has a narrow confidence interval as compared to single bound one. used double bound model instead of single bound (Hanemann, Loomis, & Kanninen, 1991)

Double bounded model increase efficiency in three ways: The increase in the numb... response gives the fitted function more observation and the sequence... yield a clear bound on willingness to pay. Even if the WTP is not completely... no and yes-yes pair response increase the efficiency gain, by furt... distribution where the respondent WTP lies (T. C. Haab & K. E. McConnell, 2002

This model increases the complexity of analysis, because the second que... depends on the first question and individuals are asked two consecuti... answer. In this case, with two questions possible response the outcom... yes); (yes, no), (no, yes) and (no, no) (Mamat, Yacob, Radam, Ghani, & Fui, 2013

In double bound dichotomous discrete choice format, the household was asked a follow-up question depending on his/her initial response. Suppose the ho... question given initial price p. the follow up $p_H > p$. while the household high... responds no for initial question the follow up question will be some lower $p_L < p$ pr... (Freeman III, Herriges, & Kling, 2014)

In the case of double-bounded format, the response probability model extension of the probability the WTP distribution

P ð(ð(¹Q ⁰Q ðð ðð> ð) ð=1ð-ð(ð(r ¹ C, ⁰Q, ðð ð And an equivalent representation response probability in terms of the RUM utility function is

P ð(yes ð)ð=s(ð(P¹ r, V ð-ð ð) Y ð-ð(P⁰ , ð ð).

According to Verbeek .M (2004), a person with unobserved personal latent variable, let WTP with personal characteristics X_i.

$WTP^* ð= \ _i ð b \ ð+ð e$ &&&&&&..&&&&&&&&&&&&&&&&&&.. 23

$WT_i P ð= \ If P_{jð-1} ð< WT_i^* P ð<$

Where e_i unobserved error term

Pr(yes)ð=s (Pr ðWT) P ð=1 ð-ᵘ( ) ð= p ð>w t p ð p wð=p ð-ð(pᵘ ð- ðb / ðs &&&&.&24

Pr(yes)ð=no (ᵘ ð r p ðWT) P ᵘ(p) ð-F(p) ð=F(p ð£ᵘ p ðFp) wð(p p pᵘ ð- ðb / ðs p ð- ð / ðs &.25

Pr(ð o yes (ð r p ðWT) P ð=(p) ð-F p) ð=F(p ð£ p r p ð- ðb / ðs wð=pF p ᴸp ð- ð / ðs &&&&26

Pr(ð o)ð o (P ð p)WT P)ð= p (ðp r ,p ᴸw ð<p) wð=p ð(p ᴸ ð- ðb / ðs &&&&&&&27

Given the sample of the household where

P-Initial bid price

p^L-the lower bound

p^U the upper bound

-U upper limit and L lower limit

WTP is the bid i^{th} household the likelihood function take the

$$\ln L = \sum_i \left[d_i^{YY} \ln \pi^{YY}(B_i, B_i^U) + d_i^{NN} \ln \pi^{NN}(B_i, B_i^L) + d_i^{YN} \ln \pi^{YN}(B_i, B_i^U) + d_i^{NY} \ln \pi^{NY}(B_i, B_i^L) \right] \quad \text{.............28}$$

Where d_i^{YY}, d_i^{YN}, d_i^{NY} and d_i^{NN} are binary valued indicator

Where d_i^{YY}, d_i^{YN}, d_i^{NY} and d_i^{NN} are a binary valued indicator variable. This in

d_i^{YY} :- Take the value of one if the respondent accepts the initi otherwise.

d_i^{YN} :- Take the value of one if the respondent accepts the initia and zero otherwise.

d_i^{NY} :- Take the value of one if the respondent rejects the initia and zero otherwise.

d_i^{NN} :- Take the value of one if the respondent rejects both the in otherwise.

If we assume ε_i is $N(0, \sigma^2)$, the above setting cross ponds to an orde Because the bid B_i, B_i^L and B_i^U are observed. The latent variable WTP_i^* has the clear interpretation of a person's willingness to pay, measured in Birr.

$WTP = \alpha + \beta p + \gamma z$

$$WTP = \alpha + \beta_1 p + \beta_2 w + \beta_3 AGE + \beta_4 EDU1 + \beta_5 EDU2 + \beta_6 EDU3 + \beta_7 INC + \beta_8 HHS + \beta_9 FS + \beta_{10} RES + \beta_{11} SEX \quad \text{.29}$$

-Z vector of covariate and parameter of the model (Abdu & Dambeam, 2014; Hanemann & Kanninen, 2001; Mamat et al., 2013)

3.4.4 The Bivariate dichotomous choice model

The Bivariate model is the useful point of departure because i[t allows] the estimation of two separate bounds on willingness to pay. These are the initia[l] lower bid P^L and the upper bound P^u

1. $P \le WTP < P^u$ for the yes-no response
2. $P^L \le WTP < P$ for the no-yes response
3. $WTP \ge P^u$ for yes-yes response
4. $WTP < P^L$ for no-no response

Econometric modeling of data generated by the double bounded question relies on formula given by Haab and McConnell (2002), is

$$WTP_{1j} = \mu_1 + \varepsilon_{1j} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .30$$

$$WTP_{2j} = \mu_2 + \varepsilon_{2j} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 31$$

Where WTP_{1j} represent willingness to pay for j^{th} respondent for the first response

WTP_{2j} represent willingness to pay for j^{th} respondent for the second response

μ_1 and μ_2 are the mean for the first and the second response

To construct the likelihood function, the probability of obser[ving] sequence Yes-Yes, Yes-No, No-Yes and No-No should be derived. The probability o[f] j^{th} respondent's response to first bid yes and to the second bid yes is given by

$$\Pr(yes, yes) = \Pr(WTP_{1j} \ge P, WTP_{2j} \ge P^u)$$

$$= \Pr(\mu_1 + \varepsilon_{1j} \ge P, \mu_2 + \varepsilon_{2j} \ge P^u) \quad \ldots\ldots\ldots\ldots\ldots 32$$

The probability of j^{th} respondent's response to the first bid yes and to second bid no is g[iven]

Prð(yes, no)ð = Pr(WTP$_{1j}$ ð³ ,P WTP$_{2j}$ ð<P^{u})

ð = pr(ðm$_{1}$ ð+ ðe$_{1j}$ ðP, ðm$_{2}$ ð+ ðe$_{2}$ ðP^{u}) &&&&&&&&&&&&&&.33

The probability of the jth respondent s response to first bid no and to second bid yes is given by

Prð(no, yes)ð = Pr(WTP$_{1j}$ ð< ,P WTP$_{2j}$ ð³P^{L})

ð = pr(ðm$_{1}$ ð+ ðe$_{1j}$ ðP, ðm$_{2}$ ð+ ðe$_{2}$ ðP^{L}) &&&&&&&&&&&&&&&&&&&&&&.34

The probability of the jth respondent s response to first bid no and to second bid no is g

Prð(no, no)ð = Pr(WTP$_{1j}$ ð< ,P WTP$_{2j}$ ð<P^{L})

ð = pr(ðm$_{1}$ ð+ ðe$_{1j}$ ðP, ðm$_{2}$ ð+ ðe$_{2}$ ðP^{L}) &&&&&&&&&&&&&&&&&&&&&&.35

L$_{j}$(ðm/ Pð) = pr(ðm$_{1}$ + ðe$_{1j}$ ð>P, ðm$_{2}$ + ðe$_{2}$ ðP^{u})^{YY} * p(ðm$_{1}$ ð+ ðe$_{j1}$ ðm$_{2}$ ðe$_{j2}$ ð+ &&.36

* pr(ðm$_{1}$ ð+ ðe$_{1}$ ð<P, ðm$_{2}$ + ðe$_{2}$ ðP^{L})^{NY} * p(ðm$_{1}$ ðe$_{j1}$ ðm$_{2}$ ðe$_{j2}$ ðm P)^{NN} ðe

Where YY = 1 for yes-yes response, 0 otherwise

YN = 1 for yes-no response, 0 otherwise

NY = 1 for no-yes response, 0 otherwise

NN = 1 for no-no response, 0 otherwise

This formulation is called the bivariate choice discrete model. term with mean 0 and ðs$_{1}^{2}$ variance, then WTP$_{1j}$ and WTP$_{2j}$ have a Bivariate normal distribution with ðm$_{1}$ and ðm$_{2}$, variances ðs$_{1}^{2}$ and correlation coefficient ðr.

ðrð = ðs$_{12}$ / $\sqrt{ðs_{1}^{2}}$ ð+

ðs$_{12}$ is the covariance between error of the WTP functions.

CHAPTER FOUR

4. RESULT AND DISCUSSION

In this chapter, we analyzed and discussed the data from CVM surve descriptive and econometric analysis was used. The descriptive analysis was mainly perception of the respondent on existing water-problem, de factors that expected to influence improvement in water suppl improved service. Whereas the econometric model, Bivariate pr explanatory power of the variable and dichotomous model was used to and set the tariff and to drive the household daily water deman

4.1. Descriptive analysis

4.1.1. Socio-economic characteristics of the respondent

Using CVM survey, 384 sample household are taken for this household 281(73.18%) are men and 103(26.82%) are women. Rega the household 269(70.1%) are married and the remaining 11 survey was conducted. From the total 384 respondents, 351(91.4%) household, while 33(8.6%) are female headed household. From the 70(68%) are the head of the household, but 33(32%) are not th of the respondent ranges from 18 years old to 87 years old with the average ag

The education level of the respondent shows the majority of t means they cannot read and writes it was the minimum educat respondent those who are illiterate was 125(32.55%), those who h were from 1 up to 8 grade 114(29.69%), those who achieved s up to 12 was 52(13.54%) and the remaining 93(24.22%) were a from 12+1 up to 12+5 or first degree.

Figure 2: 4 The distribution of the household family size

The family size of the household from the survey indicated
maximum of 10 with the mean family size of 3.8. As indicated in the graph above, 119 (31%)
the household family size is three, 64 (15%) of the household f
the household have the family size of four. The household family si
concentrate around the mean.

Figure 2: 5 Sex composition of the respondent

As indicated in the above pie chart, the sex composition of the respondents are men and only 103(26.82%) are women.

Figure 4: The type of disease episode in the study area

Disease episode

As far as the quality of drinking water is concerned, the study area, there was episode of water borne disease caused by low water quality the respondent was aware of diseases such as Giardia, Amoeba, Typhoid and Acute watery Diarrhea. But as the quality of the water affecting water borne disease would be getting lower. Out of most frequ born diseases of the sickness caused by Giardia is 27.8% caused by Amoeba, 11.79% caused by Typhoid and 7.1% by Acute Diarrhea and V

Figure 5.4: The picture shows water quality of the study area

Out of the 212 the total respondents who are attacked by diffe
attacked by more than one type of water borne disease. This result showed that h
quality is bad in the study area. The table above and figure 4.5 also show the water quality of the study

Table 3.4: Summary of socio-economic characteristics of the respondent

Variable	Observat	Mean	Std. Dev	Min	Max
Initial bid	384	.60533	.187616	.35	.85
Education illiterate	384	.32552	.469180	0	1
Education primary	384	.29687	.457477	0	1
Education secondary	384	.13541	.342614	0	1
Education tertiary	384	.24218	.428966	0	1
Household head sex	384	.73177	.443615	0	1
Age	384	37.859	14.1366	18	87
Ethnicity	384	.80989	.392895	0	1
Marital status	384	.66666	.472019	0	1
Household family size	384	3.8802	1.98853	1	10
Children less than five	384	.26302	.440848	0	1
Purification usage	384	.375	.484754	0	1
Water consumption	384	5.1875	3.53830	.5	24
Reliability	384	.07812	.268718	0	1
Level of satisfaction	384	.10416	.305875	0	1

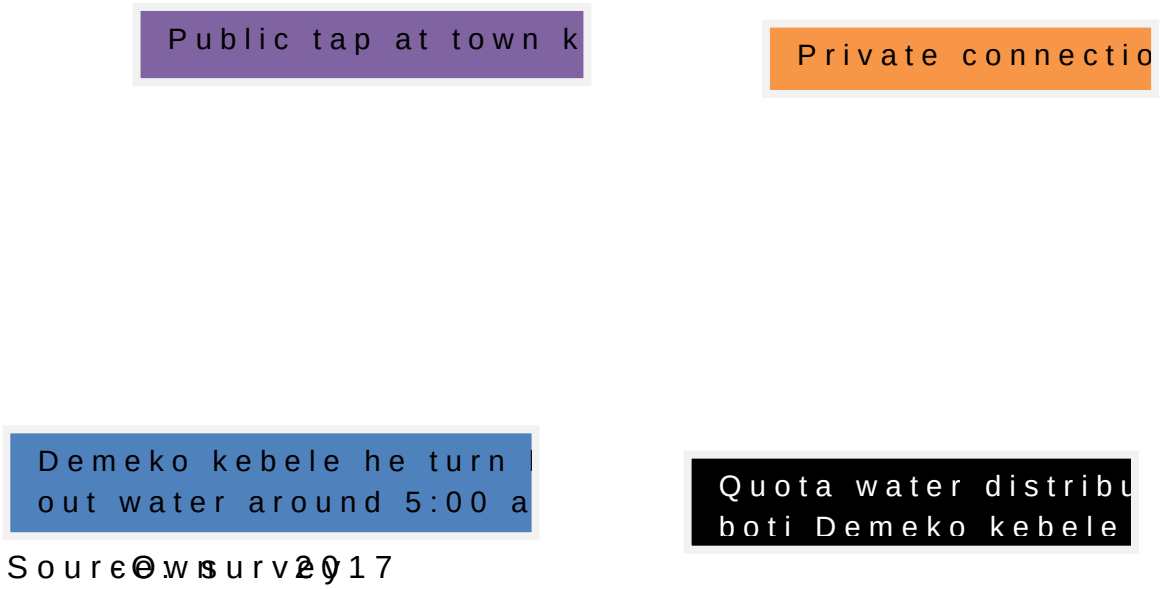
Income of the household	384	40547.	36606.6	300	36000
Residence	384	.59895	.490748	0	1
Year of stay	384	25.505	18.2579	.5	82
Perception about water	384	.11458	.318934	0	1
Total time taken to fet	384	80.475	132.063	0	723

Source: From the survey

4.1.2 Water supply situation and perception of household fo

Data from the survey about the level of satisfaction on existin of the respondent was fully satisfied, while the remaining 79 existing water source.

Figure 6: 4. Who should pay the price for water?



Source: Own survey 2017

The above figure shows the water distribution in different part of th

Table 4.4: Household attitude toward the existing water supply

Existing water c	Satisfactory			not satisfactory		
	Attribu	freque	%	Attribute	Freque	%
Quantity	Suffici	38	9.9	not suffi	346	90.1
Quality	Good	136	35.4	Bad	248	64.5
Reliability	Reliab	39	10.1	not relia	345	89.8
level of satisfac	Satisf	78	20.3	not satis	306	79.6

Source: Own survey 2017

There are some reasons for their dissatisfaction towards the existing water source such as
quality, low quantity and unreliability of the water source. In relation to reliability, 89.8%
said water sources were not reliable and only 10.2% said the source is reliable. In
water quality, only 35.42% believed that the water quality is good, w
quality of the existing water source was not good, 64.58%. Regarding quantity, 9.9% said that t
they can get the amount they want, but 90.1% said that they could not
The problem is serious especially in the dry season because of irrigation practice in upstream
kebeles, it is difficult to get enough water for drinking.

Table 4.5: -The source of the water supply

The source of water sup	Frequency	%
piped water	274	71.35
piped and river	96	25
piped and pound	2	0.52
piped, river and poun	3	.78
River	9	2.34

Source: Own survey 2017

From the total surveyed sample population 71.35% use only pi
both river and piped they use water from the river, 0.52% use both piped and p
0.78% use water from river, pond and other when piped water is not available

above table we observe that 2 out of 3 households use water only from the river

Figure 17-Affordability of existing water tariff

Affordability of the existing water tariff was another important variable dis
the respondent asked whether the tariff paid for 20 litres can be co
tariff was expensive, cheaper or reasonable. As can be seen from the t
surveyed households 48% responded that the average price is expensive, while 49
that the current price cheaper and 23.7% considered the curr
affordability calculated from the ratio of total income to water expenditur

Figure 8:-the type of the water source the household use

Source:-Own survey 2017

In the graph above out of 38.4 of the respondents 19.27 use water from
24.2% use water from connection, 4.8% use water from neighborhoods ta
water by purchasing from private water vendors and 11.2% use

4.1.3 Household Willingness to pay for improved water serv

Figure 4.9:- Household willingness to pay for improved water services

Source:-Own survey 2017

From the total 384 respondent 160(42.7%) say yes-yes to the initial and higher bi
64.2% were from urban and 35.8% from rural respondent. Out of the total respondent 63(16.4%)
accept the initial bid and reject the higher bid, say yes-no 62% from urban and 38% fro
In another hand 58(15.1%) reject the initial bid and accept the lower bid say no-yes 46.6% wer
from urban and 53.4% were from rural respondent. Finally, 103(26.8%) of the tot
respondent reject both initial and lower bid say no-no 64.1% from urban and 35.9
from the rural respondent. The total number of respondent that accepts the i
223(58.1%) and those who reject the initial bid were 161(41.9%).

Table 46: -The response of the household for proposed bid in each

	Bid1	Yes	No	BidI	Yes	No	Bidh	Yes	No	Yes-Yes	No-No	No-Yes	Yes-No
Schem	0.35	72	46	0.2	28	18	0.45	52	20	53	18	28	19
Schem	0.60	38	36	0.5	7	29	0.70	28	10	28	29	7	11
Schem	0.70	37	56	0.6	17	40	0.80	25	11	25	41	16	11
Schem	0.75	25	0	0.6	0	0	0.90	15	10	15	0	0	10
Schem	0.85	52	22	0.7	7	15	1.00	38	14	38	15	7	14
		22	160		59	10		15	65	15	103	58	65

Source: Own survey 2017

Scheme one offered for 130 respondents from the rural kebele public tap, scheme two offered for 62 respondents from urban from public tap, scheme three offered for the respondents with connection both in private and shared, fourth scheme offered for those who water from private connection or from water vendor

For the first bid 72 respondent from scheme one say yes, while, 46 respondents say no. For second scheme 38 respondent say yes but, 36 say no. in scheme while, 56 respondent say no. From scheme four 25 respondent say yes but Finally, in fifth scheme 52 respondent say yes while 22 respondents say no for the first bid. Therefore, for lower bid the numbers of respondents say yes-yes is 52 and those respondents say no-no are 18.

4.1.4. Maximum willingness to pay for clean drinking water

Table 4.7: - The distribution of the maximum willingness to pay for clean drinking water

Maximum willingness to	Frequency	%
0.0-0.24	32	8.33
0.25-0.49	116	30.21
0.50-0.74	108	28.12
0.75-0.99	38	9.90
>=1	90	23.44

Source: own survey 2017.

During the survey, the respondents asked open-ended questions by following the doub question, the household stated their maximum WTP for clean d bound dichotomous question format. The survey result shows values were reported including zero maximum WTP in the sample. 0 to respondent reported a positive maximum WTP value for 25 liter Jerican clean water from Birr to 2 Birr. Therefore, the maximum mean willingness to pay of the survey is 0.585 Bir Jerican clean water.

4.2. Econometric results and discussion

In this section before we proceed to estimate the model, the data be tested a existence of multicollinearity problem between the independent variables by using correlation matrix. According to (Gujarati & Madsen, 1998) multicollinearity is a serious problem when the pairwise correlation coefficient is greater than or equal to 0.8. From the correlation matrix, found that there is multicollinearity problem between religion and ethnicity. This is because of the reality that the majority of the people are Orthodox and Muslim. On the other hand, if the individual religion is Orthod he/she is Amhara by ethnicity. The other multicollinearity problem is between the total time taken to fetch water and distance from the existing water religion and distance from the existing water source are dropped from the regression.

4.2.1 Test for income and location or residence

From the t-test, there is a significant difference between rural and u
mean income in the rural area is 24,291 Birr per household, while in urban area 52,815
The mean difference is 28524 Birr per household. This is between
and urban not be the same.

Two sample t test with equal variances

Group	obs	Mean DFSW	Mean WTAP	Mean DFWS	Mean TTTTF
Rural	154	4.9	93.3	80.7	173.9
Urban	230	0.3	14.4	3.5	17.9
Combir	384	2.1	46	34.4	80.47
Mean d		4.6	78.9	77.2	156
t-value		12.5	11.8	11.4	13.9

Source: Own survey 2017

The distance of water source and total time water has a big differen
rural and urban. In the urban, it takes total time to fetch water f
existing source about 14.9 minutes, while time to water source take 3.5
14.4 minutes waiting at source. But the total time taken to fetch w
source in rural area is 173.9 minutes, time taken to water source is 80.47
waiting time at the source. The problem is more severe than in a
urban area.

4.2.2. Bivariate probit results using STATA version 12.

Table 8: 4 The Bivariate probit result

```
Marginal effects after biprobit
      y = Pr(answer1=1, answer2=1) (predict)
        = 0.36808927
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.      z    P>|z|     [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
    bid1 |  -0.4266274   0.23371    -1.83   0.068    -0.884685   0.03143   0.605339
 EDUC_02*|   0.1805278     0.069     2.62   0.009**   0.045285   0.315771   0.296875
 EDUC_03*|   0.4082905   0.08823     4.63   0.000***  0.235362   0.581219   0.135417
 EDUC_04*|   0.5294316    .07278     7.27   0.000***  0.386787   0.672076   0.242188
     HSX*|  -0.0430426    .06639    -0.65   0.517    -0.173155   0.08707    0.731771
      AG |  -0.0040856    .00202    -2.02   0.043**   -0.008048  -0.000123   37.8594
     MRS*|   0.0248402    .06675     0.37   0.710    -0.105997   0.155677   0.666667
     HFS |   0.0491048    .01397     3.52   0.000***  0.021724   0.076485    3.88021
     CL5*|  -0.075524    .05632    -1.34   0.180    -0.185906   0.034858   0.304688
    PURI*|  -0.0199301    .05162    -0.39   0.699    -0.121105   0.081245   0.375
      WC |  -0.0351383    0.0076    -4.62   0.000*** -0.050032  -0.020244    5.1875
     RES*|  -0.2282911    .07587    -3.01   0.003*** -0.376993  -0.07959    0.078125
    LSES*|  -0.1982902    .06177    -3.21   0.001*** -0.319359  -0.077221   0.104167
     INC |   3.00e-06    0.00000     3.79   0.000***  1.4e-06   4.5e-06    41375.8
      RS*|  -0.1098727   0.08208    -1.34   0.181    -0.270754   0.051008   .598958
     HYS |  -.0002132    .00141    -0.15   0.880    -0.002984   0.002558    25.5052
    QLTY*|  -.1173392   0.05024    -2.34   0.020**   -0.215807  -0.018872   0.114583
  TTTTFW |   .0011124   0.00031     3.55   0.000***  0.000498   0.001727    80.4753
      JB*|   .2695719   0.06949     3.88   0.000***  0.133369   0.405775   0.919271
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

The ***, **, * indicate significance level at 1%, 5% and 10%.

From the Bivariate probit model, it found that the correlation parameter rh
Wald chi2 test 0.022. This means that error term from the two
correlated and possible to use Bivariate probit. The value of the correlation coefficien
the first and the second response is statistically significant at 5% confidenc
correlation between the two responses indicates the second decision on the
system and estimating individual probit model results insufficient. This supports the
the Bivariate probit specification. When we specified the model, the goodness
Wald chi2 (40) is equal to 215.04 and the model was highly significant with a probability
of prob >chi2= 0.00, which shows that the variable included
significant in explaining the WTP decision of the household.

4.2.2.1. The determinant of household willingness to pay for improved water supply from Biv

From Bivariate probit model the variable household level of e
level, household family size, household daily water consumpti
water source, the household level of satisfaction on existing water s
of the respondent, household total income and total time take
source are statically significant at 1% significant level. The age of the Edu
respondent and the perception of the respondent about the qua
statistically significant at 5% significant level. The initial
significance level.

The survey result showed that the respondent age, level of education such
and tertiary level; household daily water consumption, total ho
family size, total time taken to fetch water from the source, the household level in
satisfaction on existing water supply, the reliability of existin
respondent about the quality of the existing water supply, emp
and initial bid offered for the respondent are significantly affecting the WTP of the re
for clean water supply in the study area. The total income of
the respondent primary, secondary and tertiary level, the fa
employment status of the respondent and total time taken to fetch water
willingness to pay, but the age, household level of satisfacti
source and the initial bid affect willingness negatively.

Table 49: -Marginal effect after Bivariate probit

Probability	Marginal effect
Yes-Yes	0.37
Yes-No	0.22
No-Yes	0.20
No-No	0.21

Source: Own survey 2017

The coefficient of age is negative and affects the WTP of the respondent fo drinking water supply negatively, the likelihood of paying for improvement water service decrease as the age of the respondent increase. age of the respondent increase by one year the likelihood of accepting both bid is reduced, on average by 0.004 percent. It is consistent with other research finding (su Awad & R Holländer, 2010; Awad & Robert Holländer, 2010; Bogale & Urgessa, 201 Mezgebo & Ewnetu, 2015).

The willingness of the respondent to pay for improvement is formal education of the respondent. From the result as the respondent increase in primary, secondary and tertiary level the likelihood of the res water supply increase. Therefore, the increase in the level of significant effect on WTP of the respondent. Being primary education level as com illiterate group the likelihood accepting both initial and higher bid increase by 0.167, keeping other variable constant. Being secondary education, le group the likelihood of accepting both initial and higher bid increased by tertiary level as compared to illiterate one the likelihood of ac increased by 0.5, and it is consistent with other research finding (Bogale & Urgessa, 2012; Mezgebo & Ewnetu, 2015; Tweneboah et al., 2015).

The respondent who perceived the existing water source has good quality have lower willingness relative to those who believed the water quality is being satisfied respondent with existing water quality declin

unsatisfied respondent. Another finding on the existing water source is about the reli
water supply. The likelihood of those households who believe
reliable has 0.21 lower willingness than, those who believed the sou
of level of satisfaction, the respondents being satisfied with the existing water source have lower
willingness relative to the unsatisfied respondent and decreased by 0.19.

Household yearly total income has also a positive and signif
drinking water service. The economic theory also stated that a
a particular commodity depends on individual /household income and quantity demand. Inc
are positively related with the expenditure (Baytriou, 2002; Ampuero et al., 2003
Nauges & Whittington, 2010) were also getting the same result income and W
having positive relation. Therefore, as the income of the respondent increases the probability of
paying for clean drinking water. As the income of the household increases by 100 Birr
the likelihood of the respondent accepting both initial and higher bid price increase

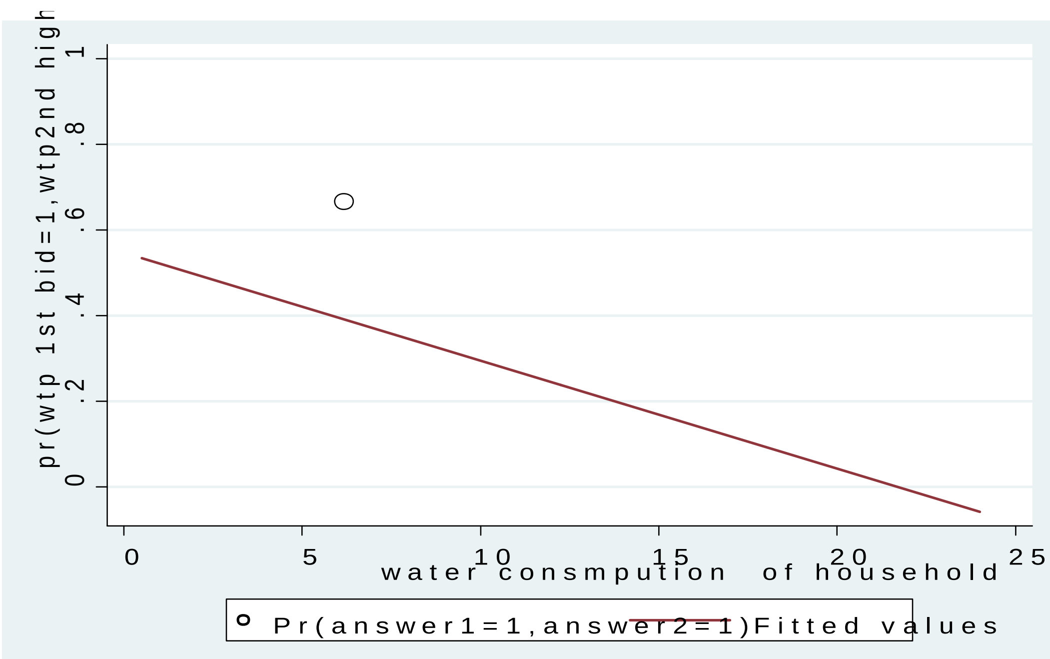
Figure 4.10- The relationship between income and willingness

The employment statuses of the respondents have a positive an
to pay of the respondent for clean drinking water. Regarding

being employed increase the likelihood of accepting both the initial and upper bids com
to those unemployed respondents. The employed respondent ha
compared to the unemployed respondent. This is because of that the empl
higher income than unemployed respondent

The family size of the household has a positive and significan
clean drinking water. Keeping other variables constant, as the size of the household in
one person the likelihood of accepting both the initial and upper bid increased by
0.052. The study conducted in Tema, Ghana on willingness to pay for the portable
same result family size (Twerefou et al., 2015)

Figure 14. The daily water demand function



The daily water consumption of the household has a negative
the respondent for improved water service. From the deman
commodity increases the demand for that commodity will decline the household
daily water consumption increase by one jerican the willingne
0.036, and it is consistent with economic theory and other research find (Bogale
& Urgessa, 2012)

The demand function of daily water consumption is 0.82-0.03price. It is consistent with the theory of demand as the price of the commod demand reduce, it is downward sloping curve. The water demand is inelasti no substitute (Arbués et al., 2003). It is also similar to research conducted on determinants of residential water consumption, they find the average 0.429 (R. Q. Grafton, M. B. Ward, H. To., and T. Kompas, 2011).

The household water demand function in developing country suggested that own estima price elasticity for water from private connection area range from 0.3 to 0.6. the find research 0.03 is much lower than the previous study because included, in addition to public tap, the study is heterogeneity in time and place (Nauges & Whittington, 2010). Therefore, the increase in the price of water, especially above initial block, can increase revenue for improvement and expansion purposes. The second important point is rise in the price might reduce the water consumption inc use of water i.e. water can be used for its maximum valuable u

In this study, one of the interest variables is residence or location and the in difference between rural and urban willingness to pay for clear shows there is no significant difference between rural and urb clean drinking water. In the case study conducted in Abbottabad district, India on house willingness to pay for safe drinking water and got the same r difference in willingness to pay for clean drinking water between rural and urban (In Awad & R Holländer, 2010).

The total time taken to fetch water from the existing source in minute has a positive relationship with the household willingness to pay for clean drinking water. T time the household to fetch the water, the dissatisfaction on increase the willingness of the household to pay for the improvement more, the reduce the time. The survey result shows that as the total time ta one minute the willingness of the household increased by 0.00 previous research finding (Tchefinge et al., 2015).

The reason for the respondent to accept and reject the propos
respondents accept the initial bid and reject the higher bid. The determinants such as ba
initial bid, household sex, level of education such as secondary, primary and tertiary
household daily water consumption. As the initial bid increase by 1 birr the likelihood of
rejecting the initial bid increase by 0.41. As the daily water
increased by one jerican, the likelihood of rejecting the higher bid increased by
the respondent being male increases the likelihood of rejec... by 0.08 as
compared to the female respondent. When we see the level of education the l
rejecting the higher bid increase as the level of education increase, being household
primary level of education increases the likelihood of rejecting the upper bid by 0.09 as compared
to the illiterate group. Being secondary education level increases the likelihood of rejecting the
upper bid by 0.18 as compared to the illiterate group. Being tertiary level education
likelihood of rejecting the upper bid by 0.19 as compared to the illiterate group. The factors th
determine the probability of saying yes-yes is only the initial bid and total tim
water. As the initial bid increases, the probability of accepting the lower bid is
As the times taken to fetch water increase the likelihood, of re
decrease by 0.0009.

On the other hand, the factors that determine the yes-yes response inversely affect th
no-no. The reason for rejecting both bids such as initial and lo
such as primary, secondary and tertiary level, household daily water cons
household yearly income, household family size, total time tak
in minute, the household level of satisfaction on existing wate
water source, perception of the respondent about the quality o
employment status of the respondent and initial bid offered fo
affect the WTP of the respondent for clean water supply. The total income of
the household, education level of the respondent primary, seco
size of the household, the employment status of the responde
water negatively affect the likelihood of saying NO-NO, but the age, household l
satisfaction, the reliability of the existing source and initial bi
no positively.

4.2.3. Result from dichotomous double bound choice model

The double bound command estimated the model ², the willingness formula is this case with no constant, variable willingness to pay is sim (Lopez-Feldman, 2012).

The price of water from doubleb only with bid and the response is about 0.69 ETB.

Table 14- Estimated price from double bound model

```
                        Number of obs   =        384
                         Wald chi2 (0)   =          .
Log likelihood = -542.8292                  Prob > chi2     =          .
-----------------------------------------------------------------------
       |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------+---------------------------------------------------------------
Beta         |
   _cons | 0.6942 .0259826  26.70 0.000 .6433907 .7457859
-------+---------------------------------------------------------------
Sigma        |
   _cons |   0.4390839   .0312263 .3177881 14.056 0.000 .5002868 .6000
-----------------------------------------------------------------------
First-Bid Variable:               bid1
Second-Bid Variable:               bid2
First-Response Dummy Variable:   answer1
Second-Response Dummy Variable: answer2
```

The price of water is the estimated explanatory variable which has a significant willingness to pay for clean drinking water. The willingness average value of explanatory variable (Lopez-Feldman, 2012).

Table 14. Estimate WTP fro double bound model with explanatory vari

```
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         WTP |    .544767   .0800378     6.30   0.000     .3476055    .6613479
------------------------------------------------------------------------------
```

The willingness to pay estimate of the explanatory variables is 0.5 with 0.5 ETB.

Table 12. cost summary of the water utility office

No.	Cost of water by item	2010
1	Salary expense	618,840
2	Operation cost	700692
3	Maintenance cost	404656
	Sub total	1,724,188
	Investment cost	38,028,384.78
	Total cost	39,752

Source: water utility office of the town 2018/2017

The daily water demand for both rural and urban is calculated regional government 40 liters for urban and 20 liters for rural population based on the CSA prediction is 6783 in rural and 84

a total of population 15235 that need clean drinking water. Th

26% loss is 434.5 m3 per day. The total amount of water produced per year is 156,420 m^3

As we see from the table 13 the maximum willingness of the ho

is 24 birr for one cubic meter water. Table 10 the actual calculation of the water

per m3 when we consider only main operation cost. From survey only 100

household or 26% use water more than 5 m^3 per month. These households would

second tariff ladder when the progressive tariff is applied. This finding indicates some low

income household did not afford the tariff set at maximum willingn

Table 14 Estimation of the tariff

Total cost year	Total amount of water produced	Total loss	Net water sold per	The ratio of cost of net water sold	Tariff m3
2,374,	156,420	40,66	115,750.	=1,724,188/1	15
950,70				=950,709/115	8

Source: water utility office of the woreda 2016/2017

The government has to goal in distribution of clean drinking water for its peopl

clean water for all at affordable price and covering the cost of production a

collecting 50% investment cost in the region. The tariff could be designed to attain this

objective. The initial tariff set, should not be equal for public tap

Sometimes the tariff rate affordable for yard connection user m

tap user setting different initial tariff. **Because** yard connection

mostly those household use water at their house and they hav

public tap users.

Table 14. Summary of water tariff from different model

Model	Mean WTP	
Double bound without explana variable	0.69	ETB
Double bound with expla	0.50	ETB

Source: Own survey result 2017

According to Amhara design, supervision works enterprise (2015), maintenance cost is estim depending on the formula below. Depending on the rate set by works enterprise the cost and revenue estimated for the project lifetime of tw years.

Pipeline&&&&&&&&&&&&&&&&&&&&&&&&&&&&& 0.2%
Reinforced service reservoir&&&&&&&&&&&&&&&&&&&&& 0.2%
Electromechanical equipment&&&&&&&&&&&&&&&..&&&& 3%
Other civil work&&&&&&&&&&&&&&&&&&&&&&&&.. 0.2%

Table 4.15-Cost Estimation

Item N	Description of worl	Investment co	Annual maintena
1	Electromechanical e	6965726	348286.3
2	Pipeline	16778955	33557.91
3	Reinforced service	8193362	16386.724
4	Other civil work	2141548	4283.096
5	Contingency	214154.8	2141.548
total		34,293,745.8	404,655.578

Source: Amhara design, supervision works enterprise 2015 document an

In the table below shows the salary and other operating cost utility office past experience and growth rate of five percent (enterprise, 2015)

Table 4.16-Summary of growth for Metehibila Demelo kokebele

Year	2015	2016	2020	2025	2030	2035
Growth rate (%) Metehibila	4.3	4.1	4.1	4	3.8	3.6
Growth rate(%) Demelo	2.1	2	2	1.7	1.5	1.5

Source: Metehibila town water supply Design Document 2015

Table 4.17-Cost coverage analysis

Year	Operang co	Maintance cost	Total cost	total popu	net water sold	Reve at ma WTP	Total cost	Profi	Tarif
201	13195	404,6	1,724,	152	1157	27786	17241	10544	15
201	13855	404,6	1,790,	157	1196	28708	17901	10806	15
201	14547	404,6	1,859,	162	1236	29673	18594	11078	15
202	15275	404,6	1,932,	168	1329	31908	19321	12586	15
202	16039	404,6	2,008,	173	1374	32978	20085	12893	15
202	16840	404,6	2,088,	179	1420	34088	20887	13201	15
202	17683	404,6	2,172,	185	1466	35186	21729	13456	15
202	18567	404,6	2,261,	191	1513	36322	22613	13708	15
202	19495	404,6	2,354,	197	1623	38960	23542	15418	15
202	20470	404,6	2,451,	203	1676	40226	24516	15710	15
202	21493	404,6	2,554,	210	1730	41538	25540	15998	15
202	22568	404,6	2,661,	217	1784	42823	26615	16208	15
202	23696	404,6	2,774,	223	1839	44152	27743	16409	15
203	24881	404,6	2,892,	230	1849	44390	28928	15462	16
203	26125	404,6	3,017,	238	1907	45779	30172	15606	16
203	27432	404,6	3,147,	245	1967	47217	31478	15738	16
203	28803	404,6	3,285,	252	2025	48611	32850	15761	16
203	30243	404,6	3,429,	260	2085	50052	34290	15762	16
203	31756	404,6	3,580,	268	2065	49560	35802	13757	17
203	33343	404,6	3,739,	276	2126	51041	37390	13650	18
								2.80E	15

Source: water utility office of the woreda 2016 2017

From the table above, we can conclude that the tariff estimated from contingent valuation method consistent with the regional water law. The maximum willingn can cover both the maintenance and operation cost in rural area and plus sevent investment cost in the urban area. Since the objective of the regional water law is to cove operation cost and maintenance and fifty percent of investment cos the tariff in rural area would be 0.30 Birr per 20 liter jerrican because this tariff can cover the ma operation cost the mean affordability index also 0.042 and below t affordability 0.05. But the tariff for urban area would recover additional fift investment cost; the result from double bounded model with explanatory variable is 0.50 Birr per 20 liter jerrican. The household can pay this tariff because the affordability inde urban area is 0.028 much lower than the rural area and the tar research, we found that the absolute amount of WTP is higher relatively household the share of the household water expenditure to t household (Tadchiiri, 2012). The water utility office can also set the tariff for ya user even higher than 0.50 Birr because the maximum willingness of the household 0.6 and there is no affordability problem for yard connection user.

4.3. Aggregation of welfare measure

The Willingness to pay estimated at the household level, since the overall objective study is to provide an estimate of the total economic value of drinking water (Aipkiang, 2010). The welfare measure could be aggregated over the number of hous about 3927 household with the mean willingness from dichotom and the average water consumption of 5.2 jerrican per household. Therefore the total economic value of drinking water is 3,675,672 Birr in the study area.

CHAPTER FIVE

5.0.CONCLUSION AND RECOMMENDATION

5.1.CONCLUSION

This paper analyzed the determinant of household willingness
Berehet woreda. The study also used both primary and secon
obtained from the contingent valuation method survey of 384 s
by using double bound dichotomous choice model through fac
data also used from water utility office. The data is used to t
from sales of water cover the recurrent cost. Fact the revenue ca
maintenance and operation cost, but it could not cover the fu
water, the water should cover maintenance cost, operation cos
cost. In the case study, this might be not the case of investment cos
due to the population of the water source and high operation co
number of customer.

The method used is bivariate probit model to see the variab
dichotomous double bound model to estimate the descriptive
statistics such as mean, percentage, table and graph used to
demographics and existing water supply service conditions. The descriptiv
out of a total of 384 usable response, 274(71.35%) of the resp
is the main source of drinking water for the household in th
indicates that the aggregate daily water consumption is 5.2 j
it is far below recommended water consumption of 8 jerican p
show that the problem of existing water source and the unreliability
amount of water, 90.1% of the respondents were not satisfied with the existing water source
because they did not get the amount of water they want. The
water source is unreliability. 89.8% of the respondent believed tha
not reliable. Regarding the quality of the water 64.6 said the
quality. Therefore, 79.7% of the respondents are not satisfied
inadequate quantity, unreliability of the source and bad quality.

The result from the econometric model showed that income, family
and tertiary level and total affected the willingness to pay positive
and significant effect on household willingness to pay for clean dr
While, age of the respondent, water consumption, the presence o
the household, perception about the quality of the existing wate
with the existing water source and initial bid have a negative and sign
the willingness to pay of the respondent.

In the study area, the maximum willingness is 24 Birr, the household
cover the cost of the 15 Birr, when we consider only operation a
and 23 Birr if 50% investment cost was added. Therefore, the
below the willingness of the people. Regarding the affordabilit
tariff rate might not be affordable to all. Affordable for yard
affordable for public tap users setting tariff could avoid this pro
the initial tariff for public tap user should be some amount les
set different initial tariff we can achieve the second objective
and distribution plus half of the investment cost.

5.2. RECOMMENDATION

From the discussion, sample respondent did not satisfy with the
and there is a high imbalance between demand and supply. The
inadequate quantity, and unreliability of the existing source. The
administration should work to change this situation.

- The tariff rate of the water should be the previous uniform t
  makes the water utility office insufficient. Those studies conducted in Banglades
  indicated that poor household are less likely to be connect
  the introduction of increasing block tariff can increase th
  (Tachiiri, 2012). Initial tariff for public tap user and yard con
  be the same price and the public tap user should pay s
  connection and during time, water utility office also should encour

with their better living condition to use yard connection to incre
increased initial tariff.

- Even there is no significant difference in willingness to pay f between rural and urban from bivariate probit model, further there is a significant difference in income between rural and urban respondents. The pay only the minimum tariff set to cover the operation and per 20 liter jerican.
- We suggested that the tariff for urban public tap user per jerican and 0.50 B 0.60 Birr for yard connection user.
- One policy implication of this study is the relationship be education. There is strong positive relationship between education and willi pay. Therefore, the Woreda government should educate th clean drinking water.
- The other variable which has strong positive effect on WTP is income. The higher the income the higher willingness of the respondent. On the other hand, low income respondent has less willingness to pay for clean drinking utility office should consider low income group when the tariff implemented.
- On average the household takes 30 minutes to fetch water from home to public tap and 46 minutes waiting at public tap. Due to this additional public tap sh constructed. It also considered distant household from the public tap time they take to head and waiting time at public tap.

References

Addai, Kwabena Nyarko, & Danso-Abbeam, Gideon. (2014). Determinants of willi improved solid waste management in Dunkwa-On-Offin, Ghana. Journal of Agriculture a Environmental Sciences, 3(1), 01-09.

Adenike, Adepoju Adebusola, & Titus, Omonona Bolarin. (2009). Det improved water supply in Osogbo Metropolis, Osun State, Nig Research Journal of Social Sciences, 4, 1-6.

Amondo, Emily, Wangia, Sabina, & Kironchi, Geoffrey. (2013). Willing supply due to spring protection in Emuhaya disrict, Kenya.

Appiah, Alfred. (2016). Estimating the Economic Value of Drinking Water Relia University of Alberta.

Arbués, Fernando, García-Valiñas, María Ángeles, & Martínez-Espiñeira, Roberto. (2003). Esti residential water demand: a state-of-the-art review. The Journal of Socio-Economics, 32(1), 81-102.

Awad, I, & Holländer, R. (2010). Towards efficient, equitable and sustainable munici domestic purposes in the west bank: a contingent valuation anal European Water

Awad, Ibrahim, & Holländer, Robert. (2010). Applying contingent val economic value of domestic water services: A case study in Ra European Journal of Economics, Finance and Administrative Sci 7-23.

Bayrou, Alebel. (2002). Analysis of Affordability and Determinants of Willingness to Pay for Improved Water Service in Urban Areas, Strategy for Cost Recovery for N Cities Rec

beurea, Amhara region water and miniral resource. (2016). First qua

Bishop, Richard C., & Freeman, A. Myrick. (1996). [The Measurement of Environmental and Resource Values: Theory and Methods, A. Myrick Freeman]. Land Economics, 72(2), 274-. doi: 10.2307/3146972

Bogale, Ayalneh, & Urgessa, Berhanu. (2012). Households' Willingne Service Provision in : Application of Contingent Valuation Method Journal of East Human Ecology, 38(2), 145-154.

David, Anderson A. (2010). environment economics and natural resou Third Edition

enterprise, Amhara Design & Supervision Works. (2015). Gore-Bella Town water supply system design final report

Freeman III, A Myrick, Herriges, Joseph A, & Kling, Catherine L. The measurement of environmental and resource values: theory and methods: Routledge.

Getachew, Zelalem. (2013). DETERMINANTS OF SUSTAINABLE RURAL WATER ETHIOPIA.

Grafton, Quentin, Adamowicz, Wiktor, Dupont, Diane, Nelson, Harry (2008). The economics of the environment and natural resources: John Wiley & Sons.

Grfaton, R. Q., M. B. Ward, H. To, and T. Kompas. (2011). Dete consumption: Evidence and analysis from a 10-country household survey. doi:10.1029/2010WR009685

Grunewald, OC, Haan, CT, Debertin, David L, & Carey, Donald I. (1976). Rural econometric and simulation analysis. JAWRA Journal of the American Water Association, 12(5), 951-962.

Gujarati, Damodar N, & Madsen, JB. (1998). Basic econometrics. Journal of Applied Econometrics, 13(2), 209-212.

Haab, Kenneth E, Timothy C, & McConnell. (2002). Valuing environmental and natural res econometrics of non-market valuation: Edward Elgar Publishing.

Haab, Timothy C, & McConnell, Kenneth E. (2002). Valuing environmental and natural resources: the econometrics of non-market valuation: Edward Elgar Publishing.

Hanemann, Michael, & Kanninen, Barbara. (2001). 11 The Statistica Response CV Data 147. Valuing environmental preferences: theory and practice o method in the US, EU, and developing countries, 302.

Hanemann, Michael, Loomis, John, & Kanninen, Barbara. (1991). Sta -bounded dichotomous choice contingent valuation. American journal of agricultural economics, 73(4), 1255-1263.

Harris, Jonathan M, & Roach, Brian. (2013). Environmental and natural resource ec contemporary approach: ME Sharpe.

Infanger, Craig L. (1999). [Environmental and Natural Resource Environmental Economics and Policy, Tom Tietenberg]. American Journal of Agricul Economics, 81(1), 255-256. doi: 10.2307/1244471

Kothari, Chakravanti Rajagopalachari. (2004). Research methodology: Methods and techn New Age International.

Kriström, Bengt. (1990). Valuing environmental benefits using the conting econometric analysis.

Lopez-Feldman, Alejandro. (2012). Introduction to contingent valuatio Munich Personal RePEc Archive, MPRA Paper No. 41018. Online at http://mpra.ub.uni-muenchen.de/41018/

Mamat, Mohd Parid, Yacob, Mohd Rusli, Radam, Alias, Ghani, Awang Willingness to pay for protecting natural environment: Langkawi Marine Park, Malay African Journal of Business Management, 7(25), 2420.

Mezgebo, Gidey Kidu, & Ewnetu, Zeleke. (2015). Households willin services in urban areas: A case study from Mekelle town, Ethio Journal of Development and Agricultural Economics, 7(1), 12-19.

Nauges, Céline, & Whittington, Dale. (2010). Estimation of water de overview. The World Bank Research Observer, 25(2), 263-294.

Parker, Ronald S. (2010). Water and development: An evaluation of World Bank supp 1997-2007 (Vol. 1 of 2).

Perman, Roger. (2003). Natural resource and environmental economics: Pearson Education.

Rogers, Peter, Bhatia, Ramesh, & Huber, Annette. (1998). Water as a social and economic go put the principle into practice: Global Water Partnership/Swedish Internatio Cooperation Agency Stockholm, Sweden.

Rogers, Peter, De Silva, Radhika, & Bhatia, Ramesh. (2002). Wate prices to promote equity, efficiency, and sustainability. Water policy, 4(1), 1-17.

Scanlon, John, Cassar, Angela, & Nemes, Noémi. (2004). Water as a human right?: IUCN.

Smets, Henri. (2009). Access to drinking water at an affordable pri Options Méditerranéennes, A nº, 88.

Tachiiri, Herath Gunatilake and Masayuki. (2012). Willingness to P Improved Water Supply Services in Khulna, Bangladesh. 9.

Tietenberg, Thomas H, & Lewis, Lynne. (2016). Environmental and natural resource economic Routledge.

Twerefou, Daniel Kwabena, Tutu, Kwadwo A, Botchway, Ebo, & Dark to-Pay for Potable Water in the Accra-Tema Metropolitan Area of Ghana. Modern Economy, 6(12), 1285.

UN-WATER. (2004). United Nations Educational, Scientific, and Cultural Org Assessment Program National Water Development Report UN-WATER/WWAP/2006/7 UNESCO.

UN. (2015). The Millennium Development Goals Report 2015. United Nations, New York, 20
UNICEF, WHO. (2015). Progress on sanitation and drinking water â Progress on sanitation and drinking water â 2015 update and MD
UNWWAP. (2015). Water for a sustainable world. United Nations Educational, Scientific and Cultural Organization. http://www.unesco.org/new/publications/un-wwap
Whittington, Dale, Lauria, Donald T, & Mu, Xinming. (1991). A study of water vending and willingness to pay for water in Onitsha, Nigeria. World development, 19(2), 179-198
woreda Finance and economics office , Berehet. (2016). five year re
Young, Robert A, & Loomis, John B. (2014). Determining economic value of water: concepts and methods. Routledge.

ANNEXES

Annex I
Test for cmoulltinearity

Contingent coefficients test

. corr EDUC_02 EDUC_03 EDUC_04 HSX ETHIC MRG CL5 PURI RES LSES RS QLTY JB rlgn
(obs=384)

	EDUC_02	EDUC_03	EDUC_04	HSX	ETHIC	MRG	CL5	PURI	RES	LSES	RS	QLTY	JB	rlgn
EDUC_02	1.0000													
EDUC_03	-0.2572	1.0000												
EDUC_04	-0.3673	-0.2237	1.0000											
HSX	0.2004	0.0335	-0.2203	1.0000										
ETHIC	0.0388	0.0754	0.1809	0.0962	1.0000									
MRG	0.1330	-0.0431	-0.1805	0.4447	0.0094	1.0000								
CL5	0.0404	-0.0140	-0.0176	0.1326	-0.0253	0.3601	1.0000							
PURI	-0.0677	0.0079	0.2025	-0.1503	0.0326	-0.0571	0.0015	1.0000						
RES	-0.0405	-0.0585	-0.1419	0.0229	-0.1310	-0.0412	-0.0240	-0.0651	1.0000					
LSES	-0.0536	-0.0353	-0.1331	0.0333	-0.1172	-0.0301	-0.0220	-0.0704	0.2502	1.0000				
RS	-0.2126	0.2151	0.4006	-0.1476	-0.0173	-0.1052	0.0106	0.0631	-0.2172	0.0007	1.0000			
QLTY	-0.0011	0.0727	-0.0698	-0.0037	0.0076	0.0809	0.0283	0.0591	-0.0133	0.1182	-0.0393	1.0000		
JB	0.0043	0.0614	0.1675	-0.0284	-0.0218	-0.0068	-0.0115	0.1111	-0.1631	-0.1806	-0.1255	0.0166	1.0000	
rlgn	0.0533	0.0754	0.1654	0.0962	0.9493	0.0235	-0.0398	0.0463	-0.1310	-0.1172	-0.0173	0.0284	-0.0218	1.0000

Multicollinarity test for continuous variable

vif

Variable	VIF	1/VIF
TTTTFW	4.01	0.249331
bid1	1.79	0.557224
HFS	1.24	0.808281
INC	1.19	0.841376
AG	1.18	0.844051
WC	1.17	0.855229
HYS	1.05	0.95377
Mean VIF	1.93	

Annex II

at-testoff income by residence

. ttest inc , by(rs)

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	154	24291.18	1924.187	23878.54	20489.77	28092.58
1	230	52815.13	2614.986	39658.22	47662.62	57967.63
combined	384	41375.83	1884.768	36933.76	37670.05	45081.62
diff		-28523.95	3563.358		-35530.2	-21517.7

diff = mean(0) - mean(1) t = -8.0048

Ho: diff = 0 degrees of freedom = 382

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0

Pr(T < t) = 0.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 1.0000

```
ttest DFSWK, by(RS)

Two-sample t test with equal variances

------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
   rural |     154    4.942208    .4503642    5.588873    4.052473    5.831943
   urban |     230    .2539565     .056634    .8588967    .1423662    .3655468
---------+--------------------------------------------------------------------
combined |     384    2.134141    .2177802    4.267603    1.705946    2.562335
---------+--------------------------------------------------------------------
    diff |           4.688251    .3747339                3.951452    5.425051
------------------------------------------------------------------------------
    diff = mean(rural) - mean(urban)                              t =  12.5109

ttest WTAPF , by(RS)

Two-sample t test with equal variances

------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
   rural |     154    93.25974    7.148894    88.71544    79.13646     107.383
   urban |     230    14.40435    2.611738    39.60897    9.258238    19.55046
---------+--------------------------------------------------------------------
combined |     384    46.02865    3.811871     74.6971    38.53383    53.52346
---------+--------------------------------------------------------------------
    diff |           78.85539    6.661181                65.75822    91.95256
------------------------------------------------------------------------------
    diff = mean(rural) - mean(urban)                              t =  11.8380
```

```
. ttest DFWSM , by(RS)

Two-sample t test with equal variances

------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
   rural |     154    80.67532    8.223766    102.0543    64.42853    96.92212
   urban |     230    3.493478    .7242608    10.98396    2.066411    4.920545
---------+--------------------------------------------------------------------
combined |     384    34.64146    3.841721    75.28204    26.89311    42.00012
---------+--------------------------------------------------------------------
    diff |            77.18185    6.782958                63.84524    90.51845
------------------------------------------------------------------------------
    diff = mean(rural) - mean(urban)                              t =  11.3788
. ttest TTTTFW , by(RS)

Two-sample t test with equal variances

------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
   rural |     154    173.9351     12.9597    160.8256     148.332    199.5381
   urban |     230    17.89783    3.008197    45.62156    11.97054    23.82511
---------+--------------------------------------------------------------------
combined |     384    80.47526    6.739312     132.063    67.22458    93.72594
---------+--------------------------------------------------------------------
    diff |            156.0372    11.21773                133.981    178.0935
------------------------------------------------------------------------------
    diff = mean(rural) - mean(urban)                              t =  13.9099
```

Annex III

stata output for the two model

```
. biprobit answer1 answer2 bd1 educ_02 educ_03 educ_04 hhsex age ethic mrg hhfs puri wc cl5 rlty ls inc residence jb live qlty_01 TTTT
> FW,r

Fitting comparison equation 1:

Iteration 0:   log pseudolikelihood = -261.14133
Iteration 1:   log pseudolikelihood =  -198.9835
Iteration 2:   log pseudolikelihood = -198.35845
Iteration 3:   log pseudolikelihood = -198.35811
Iteration 4:   log pseudolikelihood = -198.35811

Fitting comparison equation 2:

Iteration 0:   log pseudolikelihood = -262.63684
Iteration 1:   log pseudolikelihood = -188.07176
Iteration 2:   log pseudolikelihood = -187.34934
Iteration 3:   log pseudolikelihood = -187.34836
Iteration 4:   log pseudolikelihood = -187.34836

Comparison:    log pseudolikelihood = -385.70647

Fitting full model:

Iteration 0:   log pseudolikelihood = -385.70647
Iteration 1:   log pseudolikelihood =  -383.2873
Iteration 2:   log pseudolikelihood = -383.28381
Iteration 3:   log pseudolikelihood = -383.28381

Bivariate probit regression                     Number of obs   =        384
                                                Wald chi2(40)   =     215.04
Log pseudolikelihood = -383.28381               Prob > chi2     =     0.0000
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
answer1						
bd1	-.0386167	.761656	-0.05	0.960	-1.531435	1.454202
educ_02	.196572	.1958836	1.00	0.316	-.1873527	.5804968
educ_03	.5760763	.2923955	1.97	0.049	.0029917	1.149161
educ_04	.906749	.3030741	2.99	0.003	.3127346	1.500763
hhsex	.0855818	.188273	0.45	0.649	-.2834266	.4545901
age	-.0154749	.0063935	-2.42	0.016	-.0280059	-.002944
ethic	.2020164	.1971926	1.02	0.306	-.184474	.5885068
mrg	-.0276749	.1926357	-0.14	0.886	-.4052339	.349884
hhfs	.1136442	.0423631	2.68	0.007	.0306141	.1966743
puri	.0164804	.1546825	0.11	0.915	-.2866918	.3196525
wc	-.0478756	.0230281	-2.08	0.038	-.09301	-.0027413
cl5	-.3219779	.1773042	-1.82	0.069	-.6694877	.025532
rlty	-.7011056	.3187274	-2.20	0.028	-1.3258	-.0764113
ls	-.1579277	.2822806	-0.56	0.576	-.7111876	.3953321
inc	8.83e-06	2.80e-06	3.16	0.002	3.34e-06	.0000143
residence	-.1000861	.2213839	-0.45	0.651	-.5339906	.3338185
jb	.9049352	.3451449	2.62	0.009	.2284636	1.581407
live	.0016779	.0041071	0.41	0.683	-.0063718	.0097277
qlty_01	-.070073	.2467012	-0.28	0.776	-.5535984	.4134524
TTTTFW	.0032848	.0009622	3.41	0.001	.0013988	.0051707
_cons	-1.189494	.6347152	-1.87	0.061	-2.433513	.0545251
answer2						
bd1	-2.266148	.7905376	-2.87	0.004	-3.815573	-.716723
educ_02	.5611383	.2042514	2.75	0.006	.160813	.9614636
educ_03	1.280892	.3200688	4.00	0.000	.6535683	1.908215
educ_04	1.495479	.2991026	5.00	0.000	.9092481	2.081709
hhsex	-.3166551	.1993066	-1.59	0.112	-.7072888	.0739786
age	-.0043959	.0060275	-0.73	0.466	-.0162095	.0074177
ethic	.092814	.2095005	0.44	0.658	-.3177995	.5034275
mrg	.1272234	.1905504	0.67	0.504	-.2462486	.5006954
hhfs	.1226596	.0431991	2.84	0.005	.037991	.2073282
puri	-.1035772	.1618643	-0.64	0.522	-.4208253	.213671
wc	-.1104573	.0269342	-4.10	0.000	-.1632474	-.0576672
cl5	-.0212454	.1768449	-0.12	0.904	-.367855	.3253642
rlty	-.4283883	.3094088	-1.38	0.166	-1.034818	.1780419
ls	-.7492409	.2938045	-2.55	0.011	-1.325087	-.1733947
inc	5.01e-06	2.26e-06	2.22	0.027	5.78e-07	9.44e-06
residence	-.3456451	.232306	-1.49	0.137	-.8009564	.1096662
jb	.6349464	.3615202	1.76	0.079	-.0736203	1.343513
live	-.0023786	.0043612	-0.55	0.585	-.0109264	.0061692
qlty_01	-.4490487	.2261523	-1.99	0.047	-.8922991	-.0057983
TTTTFW	.0017873	.0009109	1.96	0.050	1.91e-06	.0035727
_cons	.4312982	.675162	0.64	0.523	-.891995	1.754591
/athrho	.2246355	.0980971	2.29	0.022	.0323687	.4169024
rho	.2209318	.0933089			.0323574	.3943176

Wald test of rho=0: chi2(1) = 5.24378 Prob > chi2 = 0.0220

```
mfx compute, predict(p10)
Marginal effects after biprobit
      y  = Pr(answer1=1,answer2=0) (predict, p10)
         =  0.22473166
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.      z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
   bid11 |   .0040962   .00137    2.99   0.003    .001408   .006784   60.5339
 EDUC_02*|   .0936838    .04777    1.96   0.050   -.187305   .000062    .296875
 EDUC_03*|   .1838179    .04592    4.00   0.000   -.273816   -.09382    .135417
 EDUC_04*|   .1897918    .05072    3.74   0.000   -.289203   .090381    .242188
     HSX*|   .0836113     .04586    1.82   0.068   -.006268   .173491    .731771
      AG |  -.0017321    .00172   -1.01   0.314   -.005107   .001643    37.8594
   ETHIC*|   .0161417     .05241    0.31   0.758   -.086658   .118863    .809896
     MRG*|  -.0343788    .04868   -0.71   0.480   -.129791   .061034    .666667
     HFS |  -.0079727    .01225   -0.65   0.515   -.031975    .01603    3.88021
     CL5*|  -.0523078    .04516   -1.16   0.247   -.140829   .036214    .304688
    PURI*|   .0267826     .04461    0.60   0.548   -.060658   .114223       .375
      WC |   .0168177     .00774    2.17   0.030    .001654   .031981     5.1875
     RES*|  -.0565428     .0672   -0.84   0.400   -.188256    .07517    .078125
    LSES*|   .1332304     .11096    1.20   0.230   -.084242   .350703    .104167
     INC |   4.15e-07   .00000    0.58   0.561   -9.8e-07   1.8e-06    41375.8
      RS*|   .0612252     .05118    1.20   0.232   -.039095   .161545    .598958
     HYS |   .000154    .00114    0.74   0.461   -.001398   .003081    25.5052
    QLTY*|   .0897116     .09381    0.96   0.339   -.094152   .273576    .114583
  TTTTFW |   .0001721     .00025    0.69   0.490   -.000332   .000664    80.4753
      JB*|   .0702637     .07274    0.97   0.334   -.072301   .212828    .919271
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

```
 mfx compute, predict(p01)
Marginal effects after biprobit
      y  = P(answer1=0,answer2=1) (predict, p01)
         =  0.19512201
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.      z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
   bid11 | -.0029249      .00123    -2.38   0.017  -.005337  -.000512   60.5339
 EDUC_02*|   .0439697      .05019     0.88   0.381  -.054406   .142345   .296875
 EDUC_03*|    .013289       .0736     0.18   0.857  -.131796   .158374   .135417
 EDUC_04*|  -.0231404      .06731    -0.34   0.731  -.155041    .10876   .242188
     HSX*|  -.0721958      .05021    -1.44   0.150  -.170605   .026213   .731771
      AG |   .0025414      .00162     1.57   0.117  -.000633   .005716   37.8594
   ETHIC*|  -.026428      .05151    -0.51   0.608  -.127377   .074521   .809896
     MRG*|   .0265856      .04307     0.62   0.537  -.057831   .111002   .666667
     HFS |  -.0037573      .01137    -0.33   0.741  -.026036   .018522   3.88021
     CL5*|   .0654824      .04782     1.37   0.171  -.028378   .159066   .304688
    PURI*|  -.0204705      .03943    -0.52   0.604  -.097761    .05682      .375
      WC |  -.0081124      .00691    -1.17   0.240  -.021646   .005421    5.1875
     RES*|   .0474864      .07646     0.62   0.535  -.102366   .197338   .078125
    LSES*|  -.0942196      .06286    -1.50   0.134  -.217416   .028977   .104167
     INC |  -1.04e-06      .00000    -1.53   0.125  -2.4e-06   2.9e-07   41375.8
      RS*|  -.0347423      .04862    -0.71   0.475  -.130022   .060573   .598958
     HYS |  -.0007465      .00104    -0.72   0.473  -.002786   .001293   25.5052
    QLTY*|  -.0605739      .06367    -0.95   0.341  -.185357   .064209   .114583
  TTTTFW |  -.0003986      .00023    -1.70   0.089  -.000858   .000061   80.4753
      JB*|  -.0276873      .09073    -0.31   0.760  -.20551   .150135   .919271
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

```
 mfx compute, predict(p00)
Marginal effects after biprobit
      y  = Pr(answer1=0,answer2=0) (predict, p00)
         =  0.21184146
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.      z    P>|z|     [    95% C.I.   ]       X
---------+--------------------------------------------------------------------
   bid11 |   .0030447      .00183     1.66   0.096    -.000544    .006629   60.5339
 EDUC_02*|   -.1193624      .0442    -2.70   0.007    -.205992   -.032733   .296875
 EDUC_03*|    -.219124     .03521    -6.22   0.000    -.288138    -.15011   .135417
 EDUC_04*|   -.292441     .04036    -7.25   0.000    -.371541   -.213341   .242188
     HSX*|   .0388472      .04866     0.80   0.425    -.056524    .134219   .731771
      AG |   .0034636      .00157     2.21   0.027     .000393    .006534   37.8594
   ETHIC*|  -.0528404     .05763    -0.92   0.359    -.165801     .06012   .809896
     MRG*|  -.0158586      .0529    -0.30   0.764    -.119548    .087831   .666667
     HFS |  -.0403147     .01055    -3.82   0.000    -.061029   -.019654   3.88021
     CL5*|   .0606815      .04814     1.26   0.208    -.033675    .155038   .304688
    PURI*|   .0140785      .04039     0.35   0.727    -.065084    .093241      .375
      WC |   .0266903      .00602     4.44   0.000       .0149    .03848    5.1875
     RES*|   .2261101      .11394     1.98   0.047     .002791    .449429   .078125
    LSES*|   .1562269      .07635     2.05   0.041     .006579    .305875   .104167
     INC |  -2.39e-06     .00000    -3.60   0.000    -3.7e-06   -1.1e-06   41375.8
      RS*|   .0734546      .06177     1.19   0.234    -.047605    .194514   .598958
     HYS |   .0000954       .0011     0.09   0.931    -.001055    .002246   25.5052
    QLTY*|   .0879234     .0519469    1.69   0.090    -.013868    .189715   .114583
  TTTTFW |  -.0008761     .000253    -3.57   0.000    -.001357   -.000395   80.4753
      JB*|  -.3180156     .128252    -2.48   0.013    -.569371    -.06666   .919271
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

```
. doubleb bid1 bid2 answer1 answer2 EDUC_02 EDUC_03 EDUC_04 HSX AG ETHIC MRG HFS CL5 PURI WC RES LSES INC RS HYS QLTY TTTTFW JB

initial:       log likelihood =     -<inf>  (could not be evaluated)
feasible:      log likelihood = -569.02845
rescale:       log likelihood = -569.02845
rescale eq:    log likelihood = -569.02845
Iteration 0:   log likelihood = -569.02845  (not concave)
Iteration 1:   log likelihood = -479.09877
Iteration 2:   log likelihood = -441.00462  (backed up)
Iteration 3:   log likelihood = -426.51129
Iteration 4:   log likelihood = -425.73328
Iteration 5:   log likelihood = -425.72946
Iteration 6:   log likelihood = -425.72946

                                                Number of obs   =        384
                                                Wald chi2(19)   =     212.30
Log likelihood = -425.72946                     Prob > chi2     =     0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Beta						
EDUC_02	.1157096	.0454992	2.54	0.011	.0265328	.2048864
EDUC_03	.2816336	.0655169	4.30	0.000	.1532229	.4100443
EDUC_04	.400727	.066623	6.01	0.000	.2701482	.5313058
HSX	-.0263336	.0446164	-0.59	0.555	-.1137801	.061113
AG	-.0033068	.0014585	-2.27	0.023	-.0061654	-.0004481
ETHIC	.0446876	.0470162	0.95	0.342	-.0474623	.1368376
MRG	-.0142243	.0452737	-0.31	0.753	-.1029591	.0745106
HFS	.0341391	.0104774	3.26	0.001	.0136038	.0546744
CL5	-.0807942	.0392614	-2.06	0.040	-.1577452	-.0038433
PURI	-.0125479	.0355008	-0.35	0.724	-.0821281	.0570323
WC	-.0218522	.0058386	-3.74	0.000	-.0332956	-.0104089
RES	-.1777581	.0712161	-2.50	0.013	-.3173391	-.0381771
LSES	-.0635445	.0605367	-1.05	0.294	-.1821942	.0551052
INC	2.13e-06	6.06e-07	3.51	0.000	9.42e-07	3.32e-06
RS	.0891329	.0502225	1.77	0.076	-.0093014	.1875672
HYS	-.0005712	.0009514	-0.60	0.548	-.0024359	.0012935
QLTY	-.0532733	.0462069	-1.15	0.249	-.1438371	.0372905
TTTTFW	.0004352	.0001799	2.42	0.016	.0000826	.0007879
JB	.2176181	.0839392	2.59	0.010	.0531003	.382136
_cons	.2900458	.1301234	2.23	0.026	.0350087	.545083
Sigma						
_cons	.2628576	.0186909	14.06	0.000	.2262241	.2994912

```
First-Bid Variable:               bid1
Second-Bid Variable:              bid2
First-Response Dummy Variable:    answer1
Second-Response Dummy Variable:   answer2
```

Annex IV

Demand function

```
. predict p

. reg p WC
```

Source	SS	df	MS
Model	4.61117046	1	4.61117046
Residual	29.8048757	382	.078023235
Total	34.4160461	383	.089859128

Number of obs	= 384
F(1, 382)	= 59.10
Prob > F	= 0.0000
R-squared	= 0.1340
Adj R-squared	= 0.1317
Root MSE	= .27933

p	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
WC	-.0310107	.0040338	-7.69	0.000	-.038942	-.0230794
_cons	.8279123	.0253192	32.70	0.000	.7781298	.8776947

Annex VI

survey questionnaire

I. Introducing the survey purpose

How are you? I am &&&&&&. I am assisting Mr. Markew Mengist collection of the dat partial fulfillment of Master of Science in applied developm University. He want to conduct a research on drinking water s willingness to pay for improved water in your kebele the improvement program drinking water. To recommend the woreda administration and appropriate water tariff and make the water supply sustainable opinion and perception on it. The interview may take some minute confidential your name and your answer has no connection and

SECTION I: QUESTIONS ON DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS

1. sex of the respondent 1. Male 2. Female
2. How old are you? _____ Years of old.
3. Education level _____ (specify grade achievemen
4. Religion of the respondent 1. Orthodox 2. Muslim 3. Pro
5. Ethnicity of the respondent 1. Amhara 2. Muslim 3. Other
6. Marital status 1. Married 2. Other
7. Health status of the respondent 1. Healthily 2. Sick
8. Occupation: 1. Government employee 2. Self employee 3
   Other, specify
9. How many are you in household including yourself? _____ (No of
10. No of children _____, <5 years old 1. Yes 2. No
11. For how many years have you lived in the town? _____
12. How much is the household gross income per (month)? ___
13. Would you please your household members income per (mon
    own income?

    For urban respondent

    I. By HH head_____
    II. By other Family members in the HH_____
    III. Other sources_____

    For rural respondent

Type of c	Total produc n	Bir r	Type Animals sold new bor	Sale f animal pr income new born	Other sourc	
Teff						

Sourgom						
Barly						
Wheat						
Corn						
Others						

14. What is the main source of drinking water for your family?
    1. Piped water
    2. River
    3. pound
    4. If your answer is 1 for question 14 from which water?
        1. Yard connection tap
        2. Public tap
        3. Water saler
        4. Neighborhood tap
15. When did you start to get-the water services?
16. How much Jeri can water your family use per day? &&&.

17. How much birr you pay per month for water? &&&..

18. In relation to quality, quantity and reliability how do you r

Quality	1. Good	2. Bad
Quantity	1. Good	2. Bad
Reliability	1. Reliable	2. Not reliable

19. Are you satisfied with the existing water service?

1. Yes 2. No

20. If no what is the reason for your dissatisfaction? &&&&&&&..

1. Poor quality
2. Inadequate quantity
3. Unreliability
4. all

21. How do you see the existing water tariff? 1. Expensive 2. C

22. How far the water source from your home in km? &&&&.

23. How long it take to the water point to walking minutes? &&..

24. How long you wait to get the water at the water point? &&&

25. Is your household ever suffered from water born diseases? 1. Yes 2. No

26. If Yes what type of water born diseases they suffered fro

1. Acute watery diarrhea and vomiting
2. Ameba
3. Giardia
4. trachoma
5. Typhoid

II. There is big difference in demand and supply for pure drinki of limited supply of drinking water. To solve this problem t huge resource. Now a day the government invests in the produc drinking water but also subsidized the distribution of the wa all people in the woreda who need clean drinking water. Th cover operation and maintenance cost.

Suppose the regional and woreda government work togeth
improved water in the kebele or town by set huge capital i
comes from the deep gorge of the river. Because the operation
cost of the water service high and must be covered by the s
sustainable. The money will collect about the use of the wat
is not so, the project may not be sustainable.

27. Suppose that the water service office provides a clean dri
pay ------ Birr per Jeri can?

1). yes 2

28. If your answer is yes for Q27, what about the price rise&&

1). yes 2). No

29. If your answer yes What are the reasons for yes(extra payr

1. Current tariff is minimum
2. The rise water tariff can improve water quality
3. Because there is serious water problem

30. If your answer is no what about the price fall&&&&& Birr

a). yes b). no

31. What are the reasons for no(extra payment)

1. I am happy current water service
2. It should not be paid for water above the current price
3. I have not enough money
4. I know money not used properly

According to you opinion, what should be the price of water for one Jerri can? ..... B